

IMPROVING MINE REHABILITATION DISCUSSION PAPER

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NSW MINERALS COUNCIL



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About the NSW Minerals Council

The NSW Minerals Council (NSWMC) is the peak industry organisation representing the State's \$20.6 billion minerals industry.

NSWMC provides a single, united voice on behalf of almost 100 members, ranging from junior exploration companies to international mining companies, as well as associated service providers.

Mining is and will continue to be a key economic driver for NSW. NSWMC works closely with government, industry groups, stakeholders and the community to foster a strong and sustainable minerals industry in NSW.



Executive Summary

The NSW mining industry is committed to the continuous improvement of mine site rehabilitation in NSW. NSWMC members work with the community, regulators and research bodies to improve their rehabilitation practice. While our members welcome discussions aimed at improving rehabilitation, the *Improving mine rehabilitation in NSW Discussion Paper, November 2017*, (the Discussion Paper), is a missed opportunity to properly identify the issues in relation to rehabilitation.

The Discussion Paper includes a number of proposals, but with limited discussion of the issue those proposals are aimed to resolve. There is uncertainty about the status of some of the proposals, such as the status of the proposed principles, and therefore it is difficult to assess how these will apply.

Many of the proposals duplicate existing requirements in relation to rehabilitation. The Discussion Paper identifies the interaction between the Environmental Impact Statement (EIS) and development consent for a mining project and how those requirements interact with the Mining Operations Plan (MOP) and Annual Environmental Report required under the *Mining Act 1992* (Mining Act) and regulated by the Department of Planning and Environment's (DPE's) Division of Resources and Geoscience (DRG). However, the Discussion Paper then goes on to provide a number of proposals that would move greater prescription to the EIS and consent, without identifying gaps in the current process.

The Discussion Paper does not properly acknowledge the DRG's Rehabilitation Reform Project, which is currently underway and is inconsistent with, or duplicative of those reforms.

The Discussion Paper identifies several issues that require attention, including: final voids; progressive rehabilitation; and identification of post mining land use. However, there is no interrogation of evidence in relation to these issues, whether they are widespread, or whether they apply to different types of mining or different mining regions. There is a brief discussion of Planning Assessment Commission (PAC) concerns and broader community concerns. NSWMC acknowledges that these concerns exist but expect that DPE should undertake an evidence-based consideration of these issues before proposing solutions.

With the development of the DRG GIS portal in recent years there is now a significant resource within government to map future plans for rehabilitation. This and other sources of government information, along with consultation, should be used to establish where the material issues with regard to mine rehabilitation exist and whether they can be managed through the existing framework.

DPE should take a step back from the discussion paper and consider what are the significant issues regarding rehabilitation, consider how these are being addressed and whether the regulators already have sufficient powers to resolve these issues. NSWMC believe that this is the case and that the regulators need to consistently apply the legislation, policy and guidance that already exists, and to better explain to the community how rehabilitation is undertaken and regulated.

1. Introduction

Members of the NSW Minerals Council (NSW) have a long-standing commitment to continuous improvement to rehabilitation practice. This is achieved collaboratively through NSWMC projects and research, Australian Coal Association Research Program (ACARP) grants, and individually through companies' rehabilitation practice and commitments to undertaking research projects alongside their operations. Many of these projects are highlighted in this submission and the rehabilitation case studies that are included in the submission.

DPE's approach to the Rehabilitation Improvement

The Discussion Paper does not identify the issues that need to be resolved in a methodical and evidence-based manner. It does not consider how the current regulatory regime and mine operator initiatives address the issues, where there are gaps and how these should be appropriately filled.

In addition to the overarching concern that the Discussion Paper poses solutions without proper consideration of the issues, NSWMC has the following high-level concerns:

- The proposals set out in the Discussion Paper are either duplicative of, or inconsistent with the work that is already being undertaken by government through DRG, which is the regulator of mine site rehabilitation
- Many aspects of the proposals are already dealt with through legislation, policy and guidance.
- The Discussion Paper presents a highly simplistic view of mine site rehabilitation. The Discussion Paper fails to consider the importance of the overall landform and instead focuses on voids in isolation. Further, there is no discussion of how a void is defined, what are the practical implications of backfilling a void, and whether this is desirable in all instances. These are complex issues and a project-by-project consideration is necessary.
- The Discussion Paper conflates rehabilitation and post closure land use planning.

DPE should take a step back from the Discussion Paper, and work with stakeholders and DRG to first identify:

- Supported by evidence, what are the areas where rehabilitation practice should be improved?
- What are the complexities of those areas of rehabilitation that need improvement?
- What are the current NSW Government and industry rehabilitation initiatives and how can these contribute to improved practice?
- What are the current gaps that are not being addressed in the regulatory system? What can we learn from current leading rehabilitation practice?
- How do we best encourage improved practice, and if it is a regulatory response, how is this best implemented: is it through the planning application and consent or the mining lease or a combination?

Current Initiatives of the NSW Government and industry

Despite the fact that DRG has a very significant program of rehabilitation reform underway, there is almost no mention of current initiatives in the Discussion Paper. This is a great shame as many of the proposals are either duplicative of the reforms or directly inconsistent with the reforms, which is confusing for stakeholders.



Industry and government already have significant commitments in NSW to continuous improvement of rehabilitation practice. The NSW Government already has in place a number of initiatives including:

- The update to the Rehabilitation Cost Estimate Tool and resulting increase in security bonds
- The Rehabilitation Reform Project
- The refresh of the 1999 Synoptic Plan for Integrated Mine Rehabilitation in the Upper Hunter Valley
- The inclusion of mine rehabilitation in the Biodiversity Conservation Reforms. Ecological rehabilitation of mine sites is able to generate biodiversity credit to offset disturbance.

The NSW minerals industry through the NSWMC also has a number of ongoing projects and initiatives for the continuous improvement of mine rehabilitation. These initiatives are referred to throughout the submission and include:

- The Upper Hunter Mining Dialogue¹ (UHMD) Grazing Trial
- The UHMD Beneficial Uses of Voids Project, including Voids Community Stakeholder Workshop
- The UHMD Annual Rehabilitation Reporting Initiative
- The UHMD Rehabilitation Principles and Commitments
- ACARP projects including a project which will commence looking at the optimising the effectiveness of rehabilitation of mined lands to ecological communities, as well as a project examining past and present mine rehabilitation to grazing land as a guide to future research
- Mine rehabilitation booklet which is being prepared in collaboration with the DRG
- NSWMC Rehabilitation and Mine Closure Working Group (an industry working group)
- Developing industry voids, rehabilitation and relinquishment fact sheets
- Participation in the Synoptic Plan Workshop & Refresh
- Participation in the International Council on Mining and Metals Mine Closure Workshop along with UHMD stakeholders.

In addition, NSWMC's members are undertaking progressive rehabilitation throughout their operations, continuously improving their practices and in many instances working with consultants and universities on research projects that will lead to new and innovative rehabilitation techniques. Many of these research projects are funded by ACARP. Appendix B of this submission includes case studies of rehabilitation projects undertaken by NSWMC members.

Given the intensity of mining in the Upper Hunter, many of these initiatives are focussed in the region and have been developed with local community groups, councils and State Government through the UHMD.

How should rehabilitation be defined and how is it different from post closure land use planning?

The Discussion Paper conflates post closure land use opportunities and rehabilitation. It is important to clarify what rehabilitation is, and what expectations the community should have. There is a desire in communities where mining is the overwhelmingly significant industry, to understand the final post mining landscape across the whole region. But it is important to acknowledge that this is not

¹ The Upper Hunter Mining Dialogue is a collaborative project in the Upper Hunter bringing together the mining operations, community groups, local councils and State government agencies, to work on initiatives that address the impacts of mining in the region

something that can be dealt with on a project by project basis. Regional initiatives such as the Refresh of the Upper Hunter Synoptic Plan, Upper Hunter Economic Diversification Project and the Hunter Regional Plan provide the strategic direction for post closure land uses.

At the development application stage, the Environmental Impact Statement (EIS) will commit to rehabilitate sites to land uses similar to the pre-existing land uses. In most cases this will be agricultural land or native vegetation. Given the length of the life of mining, it is difficult to identify other land use requirements that may exist in the future when the project is decommissioned. This could be considerably longer than the life of the development consent, given the possibility of further development applications and extensions.

The appropriate time to identify opportunities for other land uses is much closer to closure, or post closure. The Mine Closure Plan provides an opportunity to look to other land uses. In order to seriously consider alternative land uses (other than low intensity agriculture and native vegetation):

- There would need to be a business case and an investor for the alternative land use
- There may need to be development consent granted depending on the proposed land use.

NSWMC are concerned that the thrust of a number of the proposals is to bring a greater level of prescription to final landform post mining and to the progress of rehabilitation throughout the life of the mine through the development consent. These aims are inappropriate for a number of reasons, including:

- The development consent has limited flexibility and more onerous conditions of consent with regard to rehabilitation will fix in place rehabilitation outcomes that become inappropriate over the long life of the mining project.
- Mining communities and councils are in favour of providing greater flexibility, not less, to change rehabilitation commitments to reflect the changing land use needs of communities over the life of the project.
- These proposals are inconsistent with the approach being proposed by DRG to the sequence and progress of rehabilitation. Mining Operations Plans (MOPs) currently provide a mine's plan for rehabilitation for a period of seven years. However, in recognition that seven-year periods are too long to reliably predict the progress of rehabilitation, DRG are proposing that plans will change to have a two to three-year life span.

2. Assessment phase - Proposal 1: Adopt policy principles to guide the regulation of mine rehabilitation

The discussion paper proposes a number of policy principles for application to new State significant development (SSD) mining projects, as well as for existing projects.

Each Principle is addressed below. Many of the draft Principles are:

- Already dealt with through other obligations, including obligations under the Mining Act or the Environmental Planning and Assessment Act 1979 (EP&A Act) and are unnecessary. If the DPE are concerned that these obligations are not well understood by the community then the Government should better communicate the existing obligations.
- Unacceptable in that they impose obligations to undertake assessment which is not feasible and go beyond what a proponent should be required to undertake.
- Remove flexibility from the consent authority whose role it is to evaluate all of the social, environmental and economic impacts of a project in deciding whether to approve development.

New state significant mining projects only

Principle 1: Rehabilitation outcomes and proposed post-mining land uses must minimise the sterilisation of land and maximise beneficial social, economic and environmental outcomes for the locality and region.

These purposes may be at odds. It should be for the consent authority to weigh all of the costs and benefits of the project. This may identify for instance that the cost of backfilling a void to avoid sterilisation is prohibitive, but that the benefits of the project far outweigh the costs of the sterilisation of the land.

The consent authority already considers all of the social, environmental and economic impacts of a project in deciding whether the project is approvable. The Principle appears to be setting up a sub-assessment of rehabilitation outcomes. The project impacts should be weighed as a whole.

If the Principle is to remain, it should not deal with 'sterilisation', but instead impose a positive guideline to 'aim to maximise the opportunities for reuse of mined land'.

Principle 2: Rehabilitation and closure proposals must be feasible, based on best practice, and capable of supporting the proposed post-mining land use.

- a. Rehabilitated land must integrate and be compatible with the surrounding landscape and landforms.***
- b. Disturbed areas must be returned to conditions that are safe, stable, non-polluting, and environmentally sustainable.***

Principle 2 is unnecessarily prescriptive. While mining companies are most likely to propose to rehabilitate land to the pre-mining condition of grazing land or native vegetation, there may be a case to propose a different type of land use which might require rezoning of the land. This could be considered incompatible. This Principle is unnecessary, as the Mining Act defines rehabilitation, and the Mining Lease and the Mining Operations Plan provide objectives and criteria to achieve the rehabilitation outcomes proposed in the.

Principle 3: To provide certainty about rehabilitation and post-mining land use outcomes, development applications for new mining projects must include detailed descriptions of mine rehabilitation and closure and any associated risks. This information must:

- a. Be developed through a process of community engagement***
- b. Identify suitable post-mining land uses having regard to:***
 - Community views and any preferred use expressed in local and regional plans;***
 - Adjacent and surrounding landforms and land uses***
 - The proposed rehabilitation outcomes of any neighbouring mines***
- c. Demonstrate the feasibility of the proposed land use as related to needs, projected land use trends, and markets***
- d. Specify the rehabilitation objectives and completion criteria***
- e. Include binding milestones that ensure that rehabilitation is achieved within a reasonable timeframe***
- f. Include an assessment of costs associated with rehabilitation, closure and post-closure monitoring and management.***

This Principle is unnecessary. The Indicative Secretary's Environmental Assessment Requirements for State Significant Mining Developments, October 2015 (the Indicative SEARs) set out what is required to be addressed in a mining EIS, including rehabilitation. The Indicative SEARs with regard to rehabilitation are appended at **Appendix A** of this submission and address a number of proposals made in the Discussion Paper.

Mining proponents are already required to make significant commitments to rehabilitation in the EIS and these commitments are reflected in the consent, including:

- Commitments to the type and scale of rehabilitation
- Conceptual mine design
- Staged mine plans (these are contained in the EIS and appended to the conditions of consent)
- A condition with regard to undertaking progressive rehabilitation.

This is the appropriate level of commitment to both progressive rehabilitation and final landform design, which can be achieved at the outset of a project. The description of more detailed rehabilitation planning is appropriately provided in the MOP, which is approved by DRG and can be changed (with approval) over the life of the mine to respond to changes to the mine plan required by circumstances that are not known at the time of the assessment.

Most mining projects propose to rehabilitate mined land to a similar use that existed pre-mining, that is grazing land or native vegetation. There may be other opportunities that present in some limited cases. Proponents should not have to make the case set out in Principle 3 a.- c. in order to simply return the land to its previous use. There may be opportunities for improved land use outcomes post mining (compared to pre-mining), however deciding to pursue these opportunities should be decided on a project by project basis.

Further, the level of detail required by Principle 3 is not achievable or feasible in the development assessment. Locking proponents into this level of detail will lock the project into rehabilitation outcomes which may not prove to be achievable or desirable over the life of the project. In addition:

- The information in sub-para c. would be very high level and difficult to predict twenty years from the closure of the mine, and as noted above should not be required where the proposal is to return the land to its pre-mined state.

- Sub-para d., e. and f. should be dealt with in the MOP. It is not possible in the development consent to predict these milestones with any accuracy given that changes frequently need to be made to the MOP in response to factors unknown at the time of the assessment or outside the control of the operator, including: geology, commodity prices, changes in the operator's circumstances, and weather including rainfall and drought.
- The process for estimating the costs of rehabilitation is through the rehabilitation costs estimate tool (RCE Tool), which estimates the bond for the project. Estimates at the development assessment stage would be high level and should only be indicative (not binding) for the consent authority to weigh the costs and benefits of the project.
- There is no such thing as a 'community' view on rehabilitation. Different groups have very different views on what is the appropriate final land use. It is impossible to achieve a community consensus on this issue. As discussed later in this submission DPE are undertaking a major overhaul of the EIA process the EIA Improvement Project. One of the project's components includes a guideline with regard to community consultation. This Principle is particularly unnecessary in the light of the EIA Improvement project.

New and existing State significant mining projects

Principle 4: Mined land must be:

- a. *Progressively rehabilitated***
- b. *Subject to an agreed forward program of progressive rehabilitation unless it is being:***
 - ***Actively mined; or***
 - ***Used for operating mining infrastructure***

It is not clear how DPE is proposing to apply Principle 4. It cannot be applied through the development consent to existing operations. The EIS and development consent already provide for a commitment to progressive rehabilitation and staged plans. This process provides an appropriate balance between the prescriptive nature of the development consent and the need for operators to adapt to changing circumstances over the long life of a mining project. However as identified in the discussion of Principle 3 above, the EIS and Consent commit the development to final land forms and a staged plan for rehabilitation.

DRG currently require progressive rehabilitation through the approved MOP. The MOP sets out the plan for progressive rehabilitation, at this time over a period of seven years. DRG are proposing to reduce the timeframe of the Rehabilitation Management Plan (RMP) (which will replace MOPs) to a maximum period of three years in order to allow operations to be more responsive to the changing circumstances of the operation.

DRG's proposal makes sense as many external factors impact on the plans for mining and rehabilitation including the nature of the resource as it is uncovered, the commodity cycle, and environmental and seasonal factors such as high rainfall or drought. To require more inflexible/static commitments to a program of rehabilitation through the consent would be contrary to the needs for greater responsiveness identified by DRG.

There is a limited understanding of progressive rehabilitation outside of industry. Mining is undertaken in three stages:

- **Expansion** – during this stage of developing the mine there will be significant disturbance and limited opportunities for rehabilitation to occur. The ratio of disturbance to rehabilitation will be high.
- **Steady state** – this is the main operational phase of the mine and disturbance is still likely to outstrip rehabilitation, but the operation should be undertaking a steady rate of rehabilitation.

- **Ramp down** – this is the later phase of operations. The ratio of rehabilitation to disturbance should be in favour of rehabilitation.

In mining areas such as the Upper Hunter, where there are multiple mining operations in close proximity, and with most operations in the steady state or expansion phase, it is inevitable that there will be significant areas of land disturbed, but not yet rehabilitated. It is difficult to identify from outside of the operation where rehabilitation has been commenced.

The industry identified this gap in information for the community in the Upper Hunter, and along with stakeholders developed a reporting framework to bring together the data on total and annual disturbance and rehabilitation in the region. This information is reported annually through the Upper Hunter Mining Dialogue website.

In addition, our members agreed to a set of rehabilitation principles that were developed with stakeholders and reported on annually for each company participating in the UHMD. These Principles and Commitments have been designed specifically for coal operations in this region and keeping in mind the issues that stakeholders saw as a priority (see Box 1). Reporting against the principles is on an “if not, why not basis”, which acknowledges that rehabilitation planning needs to be responsive.

There is a great deal that DRG and DPE could do to advance the understanding of the progress of mining and rehabilitation through the GIS data project, and in the Upper Hunter particularly, the Refresh of the Synoptic Plan.

Principle 4 also presents a number of technical challenges. The Principle requires that land must be subject of an agreed forward program of rehabilitation unless it is being actively mined or used for operating mining infrastructure. This definition would require areas such as active spoil dumps to be the subject of an agreed rehabilitation plan, even though they may remain disturbed for several years while dumping continues. Such an area is not being ‘actively mined’, nor ‘used for operating mining infrastructure’. Further examples of areas that would not fall within the exemption are:

- Laydown areas used to store spare parts or a non-operating processing plant or other piece of infrastructure. These areas cannot be rehabilitated as they are actively used and contain valuable infrastructure.
- Future resource areas that will be subject to further development but will have a period where there is no active mining.
- Dumps that are going to be relocated (or partially relocated) at a later stage of mining to create the final landform (for example, to reduce a final void).
- In the case of deep mines, particularly gold mining operations, out of pit spoil dumps that remain active for the life of the mine.
- Block cave mines. Following completion of block cave mining, the remaining surface void is unable to be accessed and rehabilitated due to safety issues in working near the void.
- Underground coal mines, mine subsidence may or may not manifest as surface disturbance requiring rehabilitation. The majority of mine subsidence does not require any treatment or rehabilitation. It is impossible to predict exactly how this will develop and as such it would be impossible for such areas to be the subject of an agreed forward program of rehabilitation.

Accordingly, it is difficult to see how the Principle 4 will improve on the process that DRG already have in place and are in the process of improving to be more responsive.

If DPE pursue this Principle, the areas exempted in (b) will need to be expanded. Where disturbed land creates immediate impacts, such as dust, then temporary rehabilitation can reduce those impacts, and this should also be acknowledged in the Principles.



Box 1: Upper Hunter Mining Dialogue Rehabilitation Principles and Commitments²

UHMD Rehabilitation Principles and Commitments

1. **Include rehabilitation planning in mine planning** - Planning for rehabilitation should be integrated into the mine planning process and should include allocating adequate and dedicated resources to achieve the planned rehabilitation outcomes.
2. **Undertake progressive rehabilitation** - Companies should undertake rehabilitation progressively, with the objective of ensuring that rehabilitation is as close as possible to active mining.
3. **Minimise time that disturbed areas are left without vegetation** - Companies should actively seek to minimise the time that land is left without cover during mining. This should include:
 - Taking steps to ensure that rehabilitation is commenced within 12 months of land becoming available for rehabilitation.
 - Utilising methods of temporary rehabilitation, such as aerial seeding of overburden and other disturbed areas where permanent rehabilitation has not commenced.
4. **Prioritise areas of rehabilitation and temporary cover to reduce impacts** - Companies should prioritise rehabilitation and temporary cover in those areas where leaving land exposed will have the most impact. The following areas should be considered to have priority:
 - Areas that have the greatest impact on visual amenity, such as areas that face townships, residences, or the highway
 - Areas that have the potential to generate dust leaving the site.
 - Areas that are important for biodiversity, such as rehabilitation adjoining or providing connectivity to remnant vegetation.
5. **Meet target for rehabilitation progress identified in the Mining Operations Plan** - Each company should meet the annual target for rehabilitation quantity (area) set in the Mining Operations Plans for each of its mines.
6. **Set quality targets for rehabilitation in the Mining Operations Plan and implement a monitoring program to measure performance** - Each company should include quality targets for the various types of rehabilitation in the Mining Operations Plan for each of its mines. A monitoring program to measure the performance of rehabilitation areas against the quality targets should be implemented at each of its mines.

Principle 5: Information on mine rehabilitation and associated activities must be made publicly available.

The MOP is currently publicly available on each company's website. Mining companies report annually on their rehabilitation through the Annual Environmental Report. This includes data on progressive rehabilitation.

In addition, in the Upper Hunter, through the UHMD, NSWMC collects and aggregates information on rehabilitation progress for the region and publishes this on the UHMD website. See Table 1 below that sets out the reporting figures since 2012.

² Upper Hunter Mining Dialogue, <http://www.nswmining.com.au/dialogue/latest-projects/land-management/rehabilitation-principles-and-commitments>

Table 1 – Upper Hunter Mining Dialogue Rehabilitation Reporting Data (2012 to 2016)³

UHMD Rehabilitation Reporting Project (2012 to 2016)						
	Rehabilitation	2012 (ha)	2013 (ha)	2014 (ha)	2015 (ha)	2016 (ha)
A	Total land area disturbed and not yet rehabilitated at the beginning of the reporting period	17,830	18,098	18,479	20,171	21,180
B	Total amount of land newly disturbed within the reporting period	1,163	1,148	1,057	1,424	1,270
C	Total amount of land newly rehabilitated within the reporting period (rehabilitation commenced in this period)	895	962	801	856	907
D	Total land area disturbed and not yet rehabilitated at the end of the reporting period ($D = A + B - C$)	18,098	18,283	18,736	21,008	21,304
E	Total area of rehabilitation at all operations at the end of the reporting period	8,791	9,145	10,023	10,783	11,653
F	Annual rehabilitation to disturbance ratio ($C : B$)	0.77	0.84	0.76	0.60	0.71
G	Overall proportion of disturbed land rehabilitated ($E/(D+E)$)	32.7%	33.3%	34.9%	33.9%	35.4%
Other Managed Land						
	Estimate of the total land held as biodiversity offsets	10,973	13,164	22,607	22,773	25,466
	Estimate of the total area of land managed for agricultural use (e.g. grazing, cropping, viticulture)	57,533	60,174	44,252	44,632	40,146

DRG are also moving to make rehabilitation progress more visible to the public through the GIS portal that is being established.

It is unclear what additional information DPE believe should be made available and what outcome this would achieve. Mining operations are already subject to a very significant reporting and compliance regime in NSW. The Government should make a clear and compelling case that additional reporting is required, including an analysis of the cost and benefits of any additional reporting.

Again, we are uncertain how Principle 5 provides any additional benefit given the requirements that are already in place with the MOP, the Annual Report and industry-based initiatives.

Principle 6: The proponent is responsible for meeting all costs associated with their rehabilitation obligations.

The mine operator (it appears that ‘proponent’ has been used incorrectly in place of ‘mine operator’ or ‘owner’) is currently responsible for meeting all costs associated with rehabilitation.

The NSW Government, through the DPE’s Division of Resources and Geoscience (DRG) holds rehabilitation security bonds in the event of a default. The total value of security deposits held in NSW has increased from \$500 million in 2005 to around \$2.2 billion in 2016, with a further increase of 20% currently being implemented.⁴ The security bond is required by the Mining Act. Principle 6 is unnecessary given the statutory obligation.

³ *ibid*

⁴ Audit Office of NSW (2017), *Mine rehabilitation security deposits report*, <https://www.audit.nsw.gov.au/news/mine-rehabilitation-security-deposits>

Principle 7: Mined land will be considered to be rehabilitated when it is demonstrated to be safe, stable, non-polluting and able to sustain the approved post-mining land use.

The Mining Act contains the definition of rehabilitation as ‘the treatment or management of disturbed land or water for the purpose of establishing a safe and stable environment’. The Mining Act makes no reference to approved post-mining land use.

Principle 7 is inconsistent with the definition under statutory obligation.

Recommendations

- DPE should not pursue Proposal 1. Instead DPE and DRG should work together to pursue their objectives through the DRG Rehabilitation Reform process and other current initiatives.
- DPE should go through the proposed Principles and where these are already required through legislation, policy or guidelines identify this, and undertake better communication of these requirements to stakeholders.
- DRG and DPE should work together to provide a greater level of understanding of the approved mining and post mining landscapes in mining regions using the data from the GIS portal developed by DRG.
- In the event that DPE develops the proposed Principles, the following amendments should be made:
 - Principle 4. The list of types of areas that should be subject to a ‘forward program of progressive rehabilitation’ should be expanded to include other areas where it is unreasonable to expect progressive rehabilitation. The Principle should acknowledge the role of temporary rehabilitation in reducing short-term impacts of disturbed areas that are not being mined, but not available for rehabilitation.

3. Assessment Phase - Proposal 2: Develop a policy framework for the assessment of final voids

While the title of this proposal indicates that it is meant to be a policy framework for the assessment of voids, it is in fact a decision tool for the approval of voids. The Discussion Paper does not include any discussion of the complexities of backfilling voids, the limitations on beneficial reuse, or any assessment of the scale of this issue.

By providing a decision-making tool for voids, the proposal requires assessment of this one impact alone, rather than in the context of all of the social, environmental and economic impacts of a project. This is contrary to the approach to assessing developments provided by section 75C of the EP&A Act, which provides for the consent authority to evaluate all of the impacts, both positive and negative of a project, in making a decision.

It assumes that beneficial uses for voids will be commonplace, but in fact they will most likely be rare. It assumes that beneficial uses for voids will be able to be identified decades from the closure of the mine, which will not be possible given the changing environmental, social and economic circumstances surrounding the mine. It assumes that having filled a void there will not continue to be environmental and social costs, as if this area is returned to its pre-mining state.

It should be noted that NSWMC does not support any proposal to apply a policy to backfill voids retrospectively to existing operations or those seeking a modification to the DA. Investment decisions for such operations are founded on the basis that voids will remain and such changes would threaten their economic viability.

It is appropriate for DPE to provide a framework for the assessment of voids and this is already provided through the Indicative SEARs. In addition, there is scope for both government and industry to continue to work to provide better information with regard to voids.

NSWMC response to the options in Proposal 2

Allow final voids to be included in a State significant mining proposal only if the proponent can demonstrate:

- ***It is not feasible to remove the final void,***
- ***The proposed design and associated rehabilitation will minimise short-term and long-term impacts on the environment, the community and visual amenity,***
- ***The mine site can accommodate retention of the final void as part of an identified post-mining beneficial land use, and/or***
- ***The void could be beneficially reused in the future.***

Unfortunately, the discussion paper makes a number of high-level assumptions in relation to mine voids. It is suggested that DPE need to better consider all of the evidence in relation to voids, including:

- In which mining regions are voids an issue?
- What is the scale and possible environmental, economic and social impact of voids, in regions where mining is intense?
- What are the impacts of backfilling from an economic, social and environmental point of view (the paper assumes that there are no negative impacts)?
- How likely is it that a beneficial re-use will be available?

The decision-making framework means only those voids that are not 'feasible' to backfill can remain. Leaving aside the difficulty and subjectivity of assessing 'feasibility', this framework would prevent a void being left in circumstances where the void may be compatible with the surrounding environment, and where there is a valuable beneficial re-use of the void, but it is feasible to backfill. Example 1 below sets out a possible scenario where a void, which is feasible to backfill, would have greater value as a void.

Example 1 – Pumped Hydro Storage

Technology associated with pumped hydro storage is being developed at a rapid rate. This form of energy generation can involve pumping water from mine voids during the day using solar to store energy. There are examples of these integrated renewable energy projects being developed¹, and the technology is being investigated in the Hunter Valley¹. However, under the assessment framework proposed by DPE, if it is feasible to backfill a void, even if that void is well situated to be a pumped hydro project, the beneficial reuse would not result. Instead the void would be backfilled and at best be available for low value land uses such as low intensity grazing or native vegetation.

The framework begins from a premise that final voids are always unacceptable, without any consideration of the complexities of backfilling voids. The assumption that should be made instead is that a project should aim to maximise the economic benefits of a project as this is in the public interest. In most cases, this could be achieved and satisfy the Mining Act by leaving a void. In the event that the social and environmental impacts of a void compared to backfilling a void are relatively minor, then it will be in the public interest to leave a void, rather than reduce the economic benefits of the project. In considering the impacts, the consent authority needs to consider that backfilling does not avoid future environmental impacts, and that the land uses for a backfilled void will be low value. As a result, if the proposed void is relatively inert, there is unlikely to be a good case to backfill.

Example 2 – Westside Mine

Glencore's Westside Mine (Case Study C) is a good example. This mine near Newcastle has ceased operation and is in the process of closing. It has a final void. It is safe, and stable. The area around it has been rehabilitated to native vegetation. It adjoins bushland and is a short distance from a residential area. The void has partially filled with water. In short, the void can be accommodated by the land uses that surround it. However, if this project was assessed under Proposal 2, the void may have been required to be backfilled and the project would have lost significant value, with no additional benefit.

NSWMC's position is that a state-wide policy with regard to voids, including the framework proposed is unnecessary and that the current regulatory regime, including the Indicative SEARs and the evaluation criteria provided in section 79C of the EP&A Act provide the framework for assessment and determination of projects which propose a void.

In the event that DPE persist with the framework it should be amended to:

- Remove dot point 1 of the voids framework.
- Remove the final void pit lake framework and move dot point 3 to the voids framework.

Alternatively, the policy framework should be consistent with the Indicative SEARs in relation to mine voids, which provide that the EIS should include the following assessment:

Where a void is proposed to remain as part of the final landform, include:

- (i) a constraints and opportunities analysis of final void options, including backfilling, to justify that the proposed design is the most feasible and environmentally sustainable option to minimise the sterilisation of land post-mining;*
- (ii) a preliminary geotechnical assessment to identify the likely long-term stability risks associated with the proposed remaining high wall(s) and low wall(s) along with associated measures that will be required to minimise potential risks to public safety; and*
- (iii) outcomes of the surface and groundwater assessments in relation to the likely final water level in the void. This should include an assessment of the potential for fill and spill along with measures required be implemented to minimise associated impacts to the environment and downstream water users.⁵*

It is not always possible to identify a suitable post-mining beneficial land use during the assessment phase, or even post mining. Given the dynamic nature of mining, even if a suitable post-mining land use was identified in the assessment period, a number of external factors may prevent this outcome from eventuating, at which point an operator will be locked into a particular landform.

A requirement that all voids be put to a beneficial use post mining may commit industry to unrealistic and unachievable goals, which may ultimately prove far costlier to both operators and the community in the long term. Further, it may result in a perverse outcome where a number of unsuitable voids may be forced to provide some beneficial use, placing the community at an elevated risk than if they were to remain as they were.

It is unrealistic for the Government to expect that all voids will provide a beneficial use post-mining. Voids have unique characteristics which may limit their suitability for beneficial end uses and will require individual assessment to determine any risks to water sources, or geotechnical risks from high walls or subsidence. Any opportunities are dependent on various environmental, safety, economic, and social factors, and must be considered in the context of the community in which the void is located.

Allow final void pit lakes to be included in a State significant mining proposal only if the proponent can demonstrate:

- The water quality is compatible with the post-mining land use***
- There is sufficient licensed water available for that use***
- Designs are of the highest standard for public safety***
- The lake will not result in the diminution of the quality and quantity of water by adjacent surrounding landowners.***

The framework with regard to 'mine pit lakes' is largely redundant. It is unlikely that a mine void will be developed that will not attract water. In addition, if DPE pursue the overall framework for voids:

- Dot point 1 is dealt with by dot point 3 of the framework for voids:
- Dot point 2 is already dealt with by the requirement for the mine to purchase and retire water licenses through the existing water licensing regime
- Dot point 3 would cover all types of voids
- Dot point 4 should not be included as the NSW Aquifer Interference policy deals with the complex issue water impacts from mining projects.

⁵ DPE, Indicative Secretary's Environmental Assessment Requirements, October 2015

This proposal is premised upon a notion that pit lakes are a negative outcome and should not be permitted except in certain circumstances. This view is unwarranted and ill informed. There are examples in Australia where the community has called for final void pit lakes to remain and is currently seeking access for recreational and other purposes.

Instead of the decision-making framework proposed, the Government should provide a guideline with regard to the rehabilitation of mine pit lakes, which would provide guidance to proponents and the community about how a mine pit lake can meet the Mining Act definition of rehabilitation, which is defined as “the treatment or management of disturbed land or water for the purpose of establishing a safe and stable environment”.

Some elements of the above proposal could form the basis of a guideline and the following should be considered:

- Mines are required to hold sufficient water licenses for water take during the life of the project. Any residual impacts are dealt with by way of surrender of water licence allocation. If a void is to become a pit lake and this was decided early in the assessment phase, this will have been factored in to impacts on the local water use. However, if accelerated filling is proposed, this will require additional consideration, and may not be an appropriate course of action.
- Industry generally seeks to design voids such that they will pose a minimal safety risk to those who seek to gain authorised access and egress into pits. Where voids are used for water recreation, primary consideration will be paid to the safe access to and use of that water in the pit void.
- Industry generally seeks to design voids such that they minimise water quality impacts to nearby surrounding aquifers, creeks or ecosystems. Any residual impacts of a pit lake are considered and assessed in the EIS for the project and assessed as part of the overall project costs and benefits. If these impacts are deemed acceptable then the project is approved. By requiring a pit lake to ‘not result in the diminution of the quality and quantity of water by adjacent surrounding landowners’ you are circumventing the entire EIS process which considers each project in its entirety.

Government and industry initiatives

Better understanding of the long-term nature of voids and the possible beneficial uses of voids in a NSW context is important to inform mining operation, the community and decision makers. The NSW Government and industry have a number of initiatives that could assist in this area.

Lack of information about number and size of voids

There is a lack of proper information about the number and type of mine voids that are approved in NSW. While this does not appear to be an issue for the vast majority of the state where voids are isolated, it is a concern in the Upper Hunter Valley given the intensity of mining. Recent attempts by non-government groups to provide a picture of the post mining landscape have shown a need for accurate information.

DRG’s GIS portal project which aims to produce maps of approved future land use in mining regions could provide the rich data that is necessary to begin a discussion about this issue, including whether voids are acceptable, and how they should be dealt with.

Viable beneficial uses for voids

Stakeholders in the Upper Hunter Mining Dialogue have identified what beneficial re-uses of voids would be viable in the Upper Hunter as a useful project. This project has commenced and currently has a focus on obtaining a better understanding of the long-term water quality of voids, by evaluating water quality trends over time for a number of pit lakes across Upper Hunter Valley sites.

Preliminary analysis found that long term water quality is a key factor in determining sustainable, practical and beneficial end uses for pit lakes, as water quality monitoring data is important for making water quality predictions and explaining trends. There may be long-term issues with salinity at sites depending on the concentration of any groundwater inflows, and ongoing water quality monitoring of pit lakes may be required.

To help industry with the ongoing water quality monitoring that may need to be undertaken, a pit lake monitoring guidance note was developed to help guide industry on how to conduct pit water sampling programs, having regard to relevant health and safety matters, sampling time and locations, a variety of sample parameters, and analysis and reporting requirements. The guidance note was developed to complement other relevant environmental sampling and industry practices.

Some common misconceptions that the government should address before considering appropriate proposals with regard to voids

Backfilling a void removes any future environmental issues associated with the former void

It should be noted that the backfilling of final voids may not improve environmental, social or economic conditions, and may in fact be deleterious.

By filling a void with waste rock or overburden, the residual environmental impacts that may accompany a final void or pit lake are not prevented. A backfilled void will continue to act as a sink for groundwater and surface water as an open void. An unfilled void offers greater storage of water and therefore may actually provide a better environmental outcome. A backfilled void may also introduce materials that negatively impact the stored water quality which may have otherwise been useful.

Final voids have the potential to offer better social outcomes for the local community through the provision of recreational facilities or other uses such as a water storage or aquaculture opportunity. Further, a backfilled void is unlikely to offer sufficient foundational stability to construct any significant infrastructure such as housing or roads. If a void is left open, the solid ground can be used for construction purposes, potentially alongside a pit lake.

The act of filling a void is a significant cost and may make many operations economically unviable. Backfilling of voids would sterilise many resources that could only later be extracted with the existing void. Dewatering a pit lake is a significantly more economically manageable proposition than excavating a backfilled void.

Additionally, the economic value delivered by backfilling a void is unlikely to justify the costs. For example, a recreational lake may deliver greater value than grazing land. Grazing land would also be highly unlikely to ever generate revenue close to the cost of backfilling a void and therefore the best economic solution may be to leave a void and pit lake.

The USA requires all coal mine voids to be backfilled so why can't this be done in NSW

The concept of backfilling voids is not a reality for many Australian voids. Not every void can be backfilled, nor is backfilling necessarily the most appropriate or safe option for each void.

Industry opponents have consistently claimed that the United States has a policy in operation since the 1970's, which requires coal mine final voids to be filled. However, this statement is an over-

simplification of the complicated legal requirements for mine approval and closure in the USA, and relates to vastly different mining conditions, including shallower reserves.

The primary federal law that regulates the environmental effects of coal mining in the United States is the *Surface Mining Control and Reclamation Act of 1977*. However, in the USA, state legislation generally has primacy. The main requirements in the US are same as here: for larger projects, an environmental impact statement is typically required to assess impacts and propose management or mitigation measures. From that, a reclamation (mine closure plan) can be prepared which relevant authorities need to approve. A bond is required to be paid to guarantee that rehabilitation works can be completed.

Coal mines can be required to rehabilitate to approximate original contour (AOC), however the requirement can be waived if land can be used for higher purposes, or if the implementation of AOC is not deemed to be technically viable. The requirements for AOC are based on aesthetics rather than on technical necessity and may in fact make final landscapes less stable.

The costs associated with a requirement for industry to backfill voids will be extremely high. It would likely render many projects uneconomic, as well as potentially sterilise the resource and inhibit future use. Moreover, in many cases, it may not be technically feasible due to a lack of materials to use for the backfilling. While it may be possible for some shallower mines in the USA, it is unlikely to be an achievable goal for many of the expected voids in NSW.

Recommendations:

- DPE should not pursue the decision-making framework for voids set out in Proposal 2.
- DPE should provide:
 - Guidance on the information that proponents should provide in the environmental impact statement to assist the consent authority to evaluate all of the social, environmental and economic impacts of a project (including whether a void is proposed). This should be consistent with Indicative SEARs.
 - Provide guidance (through DRG) as to when a mine pit lake is considered to meet the Mining Act definition of rehabilitated.
- DRG should provide a greater level of information about the scale of voids in key mining regions and address issues on a regional basis where necessary, such as through the Upper Hunter Synoptic Plan refresh project.

4. Assessment Phase - Proposal 3: Improve consideration of rehabilitation and closure in the early stages of mine planning

The discussion paper notes this proposal aims to ensure:

- Adequate consideration of rehabilitation and closure in the early stages of mine planning, consistent with best practice.
- Recognition of the benefits of earlier community engagement in understanding local values and informing the design of appropriate rehabilitation outcomes.

To achieve these aims, the following suggested improvements were included for consideration in the Discussion Paper:

- Development of guidance for industry on how to incorporate mine rehabilitation and closure into project design to facilitate sustainable post-mining land use outcomes;
- Requirements to provide information on preferred and alternative mine design options as part of the Scoping Report submitted to the Department with the request for SEARs; and
- Requirements for proponents to consult with the community on the proposed post-mining landform/land use as part of the preparation of the Scoping Report.

The paper notes that “Any proposed changes to rehabilitation and closure activities or outcomes over the life of the mine which could result in inconsistencies with the development consent would continue to be managed by the modification process under the EP&A Act”.

Any moves to lock in rehabilitation and closure activities in the development consent are premature, inflexible and inconsistent with reforms proposed by the DRG. Mining projects take place, in many cases, over several decades and are highly dynamic.

Unlike other projects, many external factors impact on the plans for mining and rehabilitation, including the nature of the resource as it is uncovered, the commodity cycle, environmental and seasonal factors such as high rainfall or drought. By locking in rehabilitation and closure activities and outcomes in the development consent, industry will be forever preparing and undertaking modifications.

This process is best managed through the regularly reviewed, yet strategic process administered by DRG. This process allows the rehabilitation and closure activities and outcomes to evolve over time in response to variables yet maintaining high standards.

Development of guidance for industry on how to incorporate mine rehabilitation and closure into project design to facilitate sustainable post-mining land use outcomes

Industry currently conducts detailed rehabilitation and mine closure planning. It is unclear what issues exist with current processes that would require guidance material. Any guidance material developed would necessarily be very high level and unlikely to be of much assistance to proponents.

As previously discussed, mine operators have a responsibility for rehabilitation and mine closure and are not always involved in the active management of the post mining land use.

This proposal is not required.

Requirements to provide information on preferred and alternative mine design options as part of the Scoping Report (formerly the Preliminary Environmental Assessment) submitted to DPE with the request for SEARS

The intent of this proposal is not clear. Industry currently provides this information as a requirement of the Preliminary Environmental Assessment Report and this requirement will be strengthened through the proposed Scoping Report and Environmental Impact Statement Guideline, which DPE are proposing through the EIA Improvement Project. Significant time and resources are invested in developing feasible mine designs and refining these to determine the outcome that best balances environment, community, financial and operational outcomes.

This proposal is redundant and NSWMC does not support requirements to provide further alternative mine design options.

Requirement for proponents to consult with the community on proposed post-mining landform or land use as part of the preparation of the Scoping Report

The purpose of the Scoping Report is to identify the issues that need to be assessed as part of the Environmental Impact Assessment. It is not an assessment of the project. In many cases it will be too early in the design of the project to undertake meaningful consultation of post-mining landform. Consultation at this stage should be directed to understanding what the community thinks are the issues for assessment.

Recommendations:

- The 'potential improvements' outlined in Proposal 3 are already addressed sufficiently through the existing development application process. DPE should not further burden industry with duplicative or additional requirements.

5. Assessment Phase - Proposal 4: Ensure rehabilitation requirements are clear and enforceable

The discussion paper lists several potential improvements, as outlined below:

- Development of a high-level standard landform and land use rehabilitation and closure objective and criteria for consideration in development applications.
- Defining binding, measurable and enforceable rehabilitation outcomes (including progressive rehabilitation milestones) in the conditions of the development consent.
- Guidance on the development of more detailed rehabilitation and closure objectives and criteria in management plans required under the mining lease to assist in tracking progress and measuring success.
- Clarification of roles and responsibilities in the development and implementation of rehabilitation and closure objectives and criteria.

Development of high-level standard landform and land use rehabilitation and closure objectives and criteria for consideration in development applications

It is unclear if this 'potential improvement' is referring to standard criteria for consideration in the preparation of an EIS or if these would be included in the conditions of consents. Most development consents include Rehabilitation Objectives as part of the Performance Criteria. Further, most EIS's include a rehabilitation strategy which forms part of the legal compliance requirements for the project.

It is not necessary to develop further high level standard landform and land use rehabilitation and closure objectives and criteria. Such criteria may not be appropriate for all sites and may be inconsistent with those already contained within development consents.

Defining binding, measurable and enforceable rehabilitation outcomes (including progressive rehabilitation milestones) in the conditions of the development consent

This is inconsistent with the current direction of DRG's reforms, which is to encourage more flexibility in progressive rehabilitation. As outlined earlier, it is inappropriate to incorporate inflexible rehabilitation outcomes into the development consent.

Given the dynamic nature and duration of many mining projects, NSWMC recommends a flexible approach that monitors and ensures progressive rehabilitation is more suitable than setting defined outcomes in a development consent. This is being dealt with in the DRG Rehabilitation Reform Project and should not be duplicated by DPE.

Guidance on more detailed rehabilitation and closure objectives and criteria in management plans required under the mining lease to assist in tracking progress and measuring success

There may be some value in providing guidance and certainty for industry around the development of detailed rehabilitation and closure objectives. However, as outlined in the section of the Discussion Paper titled Post Closure Phase, DRG's Rehabilitation Reform Project has addressed this potential improvement through the action titled 'Improving the quality of rehabilitation and closure plans to reduce uncertainty about outcomes, ensure consistency with the rehabilitation and closure requirements of the development consent and more accurately inform the costing of security deposits'.



This potential improvement is redundant and should not be duplicated.

Clarification of roles and responsibilities in the development and implementation of rehabilitation and closure objectives and criteria

The motivation for this proposal is unclear. Mine operators are required to comply with their rehabilitation and closure requirements regardless of roles and responsibilities. Most operations already have clearly defined roles and responsibilities for rehabilitation and mine closure. Further, the roles and responsibilities for the development and implementation of rehab and closure objectives and criteria is ultimately a matter for each individual business considering its particular structure and scale.

The Discussion Paper does not give any explanation or reasoning for this proposal and it appears completely unnecessary.

Other considerations

Relinquishment process needs to be clearly defined

A clear pathway is needed on the process for relinquishment of tenements through DRG. Currently, this is not a clear or transparent process and for the most part, remains untested. Industry requires greater certainty that rehabilitated land is able to be relinquished at some point by complying with the requirements of the development consent and leases.

NSWMC recommends the Department develop guidance material for industry on the process by which rehabilitation is assessed, certified as completed and facilitates the return of security deposits.

Recommendations:

- The potential improvements outlined in Proposal 4 are largely addressed by the existing DRG Rehabilitation Reforms Project or are not necessary.
- NSWMC does not support the inclusion of inflexible and binding conditions in the development consent relating to rehabilitation and mine closure outcomes.
- NSWMC recommends that the potential improvements outlined in Proposal 4 are not pursued.

6. Operational phase - Proposal 5: Ensure that regulatory processes that occur once a mine has been approved are transparent and deliver consistent rehabilitation outcomes.

The discussion paper lists a number of potential improvements that could be made to the regulatory process during the operational phase of mining to increase accountability, access and information to stakeholders, with regards to various aspects of mine rehabilitation. The proposed improvements include:

- Greater accountability by improving public access to information on rehabilitation performance.
- Strengthening the Department's assessment and decision-making processes relating to rehabilitation management plans and strategies required by the development consent and mining lease.
- Better communication between government agencies, proponents and the community on assessment and decision-making relating to rehabilitation management plans and strategies required by the development consent and mining lease.
- Greater accountability by improving public access to rehabilitation management plans and strategies required by the development consent and mining lease.

DPE is proposing to drive greater accountability from industry and improve transparency of the mining process with respect to rehabilitation. To increase community awareness and education of the various mine rehabilitation efforts being undertaken by industry, a number of communications tools and initiatives are being developed that highlight best practice case studies and industry's commitment to achieving excellent rehabilitation outcomes.

One such project is the Mine Rehabilitation Booklet, a collaboration between the NSWMC and the NSW Government, using research from The University of Newcastle. The booklet aims to provide a brief overview of the life cycle of a mine, the various components of the NSW rehabilitation regulatory framework, and highlights a number of NSW rehabilitation case studies, and future considerations. Unfortunately, this valuable project has stalled following ministerial reshuffles, and remains unpublished. NSWMC encourages DRG to recommence their involvement in this initiative, as it highlights both the government's key role in the regulatory oversight of the rehabilitation process, as well as demonstrating industry's obligations, accountability and transparency as to what rehabilitation is being undertaken.

Greater accountability by improving public access to information on rehabilitation performance

Industry provides all relevant required information regarding their rehabilitation performance to the NSW government through the annual reporting requirements of the Annual Review or Annual Environmental Management Review (AEMR). The data is freely available to be viewed by the public on each company's website.

The Discussion Paper does not provide any detail of the alleged information gap that is sought to be filled by this proposal. Any requirement to provide additional information is a further impost on industry's considerable reporting requirements, and as such a strong case should be made to justify additional reporting.

Further, the DRG's GIS rehabilitation data project is building upon work that the industry has already undertaken through the Upper Hunter Mining Dialogue Rehabilitation Reporting and Principles project,

as referred to earlier in the submission, which provides an annual rehabilitation update to the community.

Strengthening the Department's assessment and decision-making processes relating to rehabilitation management plans and strategies required by the development consent and mining lease

Again, this proposal raises the issue of incompatibility between the DRG and DPE approaches to mine rehabilitation regulation. DRG's Rehabilitation Reform Program is already increasing their regulatory oversight of industry.

DPE is seeking to regulate through development consents, rather than the Mining Act, which already allows for far greater flexibility for industry to achieve their rehabilitation goals, and realistically shape these as they work through the rehabilitation process, which includes being responsive to changes throughout the life of the project.

Improving communication between government agencies, proponents and the community on assessment and decision-making relating to rehabilitation management plans and strategies required by the development consent and mining lease

It is not clear what is being proposed here. Significant consultation occurs during the development of the EIS with a broad cross section of the community on issues including rehabilitation. Mining operations are required to have a Community Consultative Committee (CCC). The CCC Guidelines require companies to consult the CCC on management plans. In addition, the consent may require specific stakeholders, such as the local council to be consulted with regard to a management plan.

Greater accountability by improving public access to rehabilitation management plans and strategies required by the development consent and mining lease

Again, it is difficult to understand where DPE believes there is a gap in the publicly available information. All sites currently operating in NSW are required to publicly display all necessary approvals and licences; environmental monitoring reports; management plans; and other key regulatory information on their company websites. These are freely available and easy to locate by the public with minimal searching required.

Further, any proposed modifications for sites are publicly exhibited on the Department of Planning website along with other major development projects for community consultation, with the results communicated by the government.

Again, the government needs to advise what gaps they see in relation to public access to rehabilitation management plans, as these are clearly provided by industry.

Recommendations:

- DPE should not seek to acquire additional information from industry, as industry already provides all relevant information regarding rehabilitation performance.
- DPE should identify any gaps in information and justify why this is needed, with an appropriate cost/benefit analysis.
- DPE/DRG should seek to promote the successful rehabilitation work being undertaken under their regulatory oversight, highlighting a number of the key features such as the security deposit scheme, and case studies in the mine rehabilitation booklet.

7. Post closure phase

The discussion paper lists a number of actions being undertaken as part of the DRG Rehabilitation Reform Project related to releasing rehabilitation responsibilities for mining lease holders, including:

- a. Developing new requirements for mines in care and maintenance;
- b. Improving the quality of rehabilitation and closure plans to reduce uncertainty about outcomes, ensure consistency with the rehabilitation and closure requirements of the development consent and more accurately inform the costing of security deposits;
- c. Enhancing regulatory tracking of mine rehabilitation;
- d. Reviewing mechanisms to address residual risk and potential long term environmental degradation post-mining, in collaboration with other relevant agencies; and
- e. Documenting and publishing the mine closure and relinquishment process.

A number of the actions already underway and outlined here, including the improved quality of rehabilitation and closure plans, regulatory tracking of mine rehabilitation, and documenting the closure and relinquishment process appear to address perceived issues or concerns raised in earlier sections of this discussion paper.

For example, Proposal 5 of the Discussion Paper seeks to ensure that regulatory processes that occur once a mine has been approved are transparent and deliver consistent rehabilitation outcomes including greater public access to information on rehabilitation performance and greater public access to rehabilitation management plans and strategies required by the development consent and mining lease. Beyond the existing development consent requirement to publish management plans required by the consent and mining leases, the second and last dot points of the Rehabilitation Reforms Project above address this perceived concern.

New requirements for mines in care and maintenance

There seems to be concern from industry opponents regarding sites in care and maintenance and behaviour they perceive as ‘set and forget’ to enable industry to avoid their rehabilitation obligations. This is not the case. Mines under care and maintenance still have the same compliance and rehabilitation reporting obligations as those which are operating. Additionally, the rehabilitation security deposit scheme applies to all sites in care and maintenance preventing exposure to Government and community for rehabilitation liability.

NSWMC understands that new requirements are being developed for mines in care and maintenance. NSWMC is unaware of systemic issues relating to mines in care and maintenance. Government has not raised issues relating to mines in care and maintenance with NSWMC. Given that this is not a high profile, nor significant issue, it begs the question why further requirements are proposed for mines in care and maintenance.

NSWMC seeks justification for any further requirements and, if warranted, thorough industry consultation on any proposal. It is important that consideration be given to the variety of care and maintenance sites. Care and maintenance requirements should not be a one size fits all approach.

Residual risk

With regard to residual risk, given the rigorous regulatory processes that are in place and the rehabilitation bond framework which acts as a safety net, industry does not support any further requirements for bonds or additional requirements around rehabilitation and mine closure.

Recommendation:

- NSWMC does not support further requirements for mines in care and maintenance or measures to reduce residual risk

Appendix A: Indicative Secretary's Environmental Assessment Requirements – Rehabilitation

E. Rehabilitation

- (1) The EIS must include a detailed description of progressive rehabilitation timeframes and commitments for each rehabilitation domain, having regard to the following:

Post-mining land use

- (a) Identification and assessment of post-mining land use options;
- (b) Identification and justification of the preferred post-mining land use outcome(s), including a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives;
- (c) Identification of how the rehabilitation of the project will relate to the rehabilitation strategies of neighbouring mines within the region, with a particular emphasis on the coordination of rehabilitation activities along common boundary areas;

Rehabilitation objectives and domains

- (d) Inclusion of a set of project rehabilitation objectives and completion criteria that clearly define the outcomes required to achieve the post-mining land use for each domain. Completion criteria should be specific, measurable, achievable, realistic and time-bound. If necessary, objective criteria may be presented as ranges;

Rehabilitation Methodology

- (e) Details regarding the rehabilitation methods for disturbed areas and expected time frames for each stage of the rehabilitation process;
- (f) Mine layout and scheduling, including maximising opportunities for progressive final rehabilitation. The final rehabilitation schedule should be mapped against key production milestones (i.e. ROM tonnes) of the mine layout sequence before being translated to indicative timeframes throughout the mine life. The mine plan should maximise opportunities for progressive rehabilitation;

Conceptual Final Landform Design

- (g) Inclusion of a drawing at an appropriate scale identifying key attributes of the final landform, including final landform contours and the location of the proposed final land use(s);

Monitoring and Research

- (h) Outlining the monitoring programs that will be implemented to assess how rehabilitation is trending towards the nominated land use objectives and completion criteria;
- (i) Details of the process for triggering intervention and adaptive management measures to address potential adverse results as well as continuously improve rehabilitation practices;
- (j) Outlining any proposed rehabilitation research programs and trials, including their objectives. This should include details of how the outcomes of research are considered as part of the ongoing review and improvement of rehabilitation practices;

Post-closure maintenance

- (k) Description of how post-rehabilitation areas will be actively managed and maintained in accordance with the intended land use(s) in order to demonstrate progress towards meeting the rehabilitation objectives and completion criteria in a timely manner;

Barriers or limitations to effective rehabilitation

- (l) Identification and description of those aspects of the site or operations that may present barriers or limitations to effective rehabilitation, including:
 - (i) evaluation of the likely effectiveness of the proposed rehabilitation techniques against the rehabilitation objectives and completion criteria;
 - (ii) an assessment and life of mine management strategy of the potential for geochemical constraints to rehabilitation (e.g. acid rock drainage, spontaneous combustion etc.), particularly associated with the management of overburden/interburden and reject material;
 - (iii) the processes that will be implemented throughout the mine life to identify and appropriately manage geochemical risks that may affect the ability to achieve sustainable rehabilitation outcomes;
 - (iv) a life of mine tailings management strategy, which details measures to be implemented to avoid the exposure of tailings material that may cause environmental risk, as well as promote geotechnical stability of the rehabilitated landform; and
 - (v) existing and surrounding landforms (showing contours and slopes) and how similar characteristics can be incorporated into the post-mining final landform design. This should include an evaluation of how key geomorphological characteristics evident in stable landforms within the natural landscape can be adapted to the materials and other constraints associated with the site.
- (m) Where a void is proposed to remain as part of the final landform, include:
 - (i) a constraints and opportunities analysis of final void options, including backfilling, to justify that the proposed design is the most feasible and environmentally sustainable option to minimise the sterilisation of land post-mining;
 - (ii) a preliminary geotechnical assessment to identify the likely long term stability risks associated with the proposed remaining high wall(s) and low wall(s) along with associated measures that will be required to minimise potential risks to public safety; and
 - (iii) outcomes of the surface and groundwater assessments in relation to the likely final water level in the void. This should include an assessment of the potential for fill and spill along with measures required be implemented to minimise associated impacts to the environment and downstream water users.
- (n) Where the mine includes underground workings:
 - (i) determine (with reference to the groundwater assessment) the likelihood and associated impacts of groundwater accumulating and subsequently discharging (e.g. acid or neutral mine drainage) from the underground workings post cessation of mining; and
 - (ii) consideration of the likely controls required to either prevent or mitigate against these risks as part of the closure plan for the site.
- (o) Consideration of the controls likely to be required to either prevent or mitigate against rehabilitation risks as part of the closure plan for the site;
- (p) Where an ecological land use is proposed, demonstrate how the revegetation strategy (e.g. seed mix, habitat features, corridor width etc.) has been developed in consideration of the target vegetation community(s);
- (q) Where the intended land use is agriculture, demonstrate that the landscape, vegetation and soil will be returned to a condition capable of supporting this; and
- (r) Consider any relevant government policies⁹.

⁹ The following government policies should be considered when addressing rehabilitation issues:

- Mine Rehabilitation (Leading Practice Sustainable Development Program for the Mining Industry, 2006)
- Mine Closure and Completion (Leading Practice Sustainable Development Program for the Mining Industry, 2006)
- Strategic Framework for Mine Closure (ANZMEC-MCA, 2000)

Appendix B: Best practice rehabilitation case studies from the NSW mining industry

The NSW mining industry has not only met its regulatory commitments but has pursued innovative approaches to restoring land disturbed in mining. A number of case studies have been included highlighting a variety of rehabilitation projects undertaken in NSW:

- a. Mining's contribution to tourism in regional NSW (Peak Hill Gold Mine, Alkane Resources Ltd, Peak Hill, NSW)
- b. Progressive rehabilitation success in the Gunnedah Basin (Boggabri Coal Mine, Idemitsu Australia Resources, Gunnedah, NSW)
- c. Successful rehabilitation in a highly-urbanised environment (Westside Open Cut Coal Mine, Glencore, Lake Macquarie, NSW)
- d. Successful emplacement rehabilitation in the Illawarra by South32 (South32 Illawarra Coal, Illawarra, NSW)
- e. The benefits of using organic waste by-products in rehabilitation (Rix's Creek Mine, The Bloomfield Group, Hunter Valley, NSW)
- f. Cropping as a post-mining land use (CMOC Northparkes Mine, Parkes, NSW)
- g. Reducing off-site disposal through an underground backfill emplacement project (Metropolitan Underground Colliery, Peabody Energy, Helensburgh NSW)
- h. Rehabilitation of alluvial lands suitable for irrigated agriculture (Hunter Valley Mine, Yancoal, Hunter Valley, NSW)
- i. Study of Sustainability and Profitability of Grazing on Mine Rehabilitated Land in the Upper Hunter (Hunter Valley Mine, Yancoal, Hunter Valley, NSW)
- j. Natural landform rehabilitation at Mangoola (Mangoola Open Cut, Glencore, Hunter Valley, NSW)

a. Mining's contribution to tourism in regional NSW (Peak Hill Gold Mine, Alkane Resources Ltd – Peak Hill, NSW)

Peak Hill Gold Mine was a drill and blast gold mining operation which was owned and operated by Alkane Resources Ltd from 1996-2005 just 200m from the residential edge of Peak Hill. Peak Hill is an historic gold mining town where gold mining operated from 1889 to 1917. During Alkane's tenure over the mining leases, historic mining legacies were preserved where appropriate, removed, rehabilitated and made safe. The final landform has been rehabilitated for continuing use as a tourist mine, a haven for biodiversity and part of the mine has been turned into state of the art solid waste transfer station.

This site is 95% rehabilitated to a stable final landform with multiple uses. The Mining Leases are still in place as potential to mine gold one day in the future still exists. The Open Cut Experience is a tourist mine just a few hundred metres east of the Newell Highway. Interpretive signs explain historic and modern mining techniques to visitors in a pleasant bushland setting.



Figure 1: Peak Hill Open Cut Gold Mine Experience

Sediment ponds are effectively ephemeral wetlands. Thousands of planted trees and shrubs provide valuable woodland habitat on what was previously cultivated farmland. In 2016, Alkane gifted four hectares of land (Contractor's area) to Parkes Shire Council (PSC) to establish a waste transfer station. PSC were able to take advantage of the infrastructure (power, water and shed) made available by the mine.

b. Progressive rehabilitation success in the Gunnedah Basin (Boggabri Coal Mine, Idemitsu Australia Resources - Gunnedah, NSW)

Boggabri is an open cut coal mine located approximately 15 km north-east of the township of Boggabri, in north-western NSW. Mining operations commenced in 2006, with approval to produce up to 8.6 million tonnes per annum (Mtpa) of saleable coal.

Progressive rehabilitation of disturbed areas has been undertaken throughout the life of the mine toward the objective to return the site to a condition where its landforms, soils, hydrology, flora and fauna are self-sustaining, and compatible with the surrounding land, being Leard Forest.

Progressive rehabilitation focuses on overburden emplacement areas, with biodiversity the focus of the final land use.

Revegetation of the post mine landscape is focused on the establishment of the threatened Box-Gum Woodland community, using native species common to the region. The appropriate management of topsoil resources is a fundamental component of rehabilitation success.

Four rehabilitation plots (4, 5 and 7 years old) were surveyed for birds, invertebrates, bats and vegetation. A BioBanking survey was also conducted at each site. Biobanking is a framework established by NSW government assessment for management of biodiversity offsets.



Figure 2: Rehabilitation progress at 2 years (left) and 7 years (right) at Boggabri Coal Mine.

Approximately 111 ha of overburden emplacement area has been rehabilitated to date. The final landform includes proposed rehabilitation of:

- 858 ha of shrubby woodland on the steep slope,
- 500ha of grassy woodland on the lower slopes and flat top areas, and
- 150ha of riverine woodland on the existing and proposed drainage lines.

Biodiversity is being monitored in comparison with analogous state forest area. The results of surveys show that native species diversity and structure of the vegetation are progressing over time within the rehabilitation areas.

c. Successful rehabilitation in a highly-urbanised environment (Westside Open Cut Coal Mine, Glencore - Lake Macquarie NSW)

Rehabilitation of the Westside open cut coal mine near Lake Macquarie in New South Wales was completed in April 2012, just two months after mining operations ceased. Monitoring has recorded around seventy different fauna species in rehabilitation areas, including eleven threatened species. These include the grey-headed flying fox, masked owl, greater broad-nosed bat, little bentwing bat, powerful owl and squirrel glider.

Extensive surface preparation activities for rehabilitated areas commenced following the completion of mining. This followed a program of progressive rehabilitation across the life of the mine. These included the following:

- Spoils and topsoils were characterised to determine the need for soil ameliorants (e.g. gypsum, lime, fertiliser etc).
- Topsoils or suitable alternatives were spread across areas to be rehabilitated
- Structures such as tree hollows, logs and other woody debris were incorporated into the final landform to improve the habitat value of rehabilitated areas
- Habitat structures including nest boxes, were installed where practical.

The mine closure plan included retaining the void associated with the open cut mine. The void will fill with water fed by rainfall runoff and groundwater. Modelling has indicated it will take 17 years to fill the void (2029) at which time flows will be returned into an adjacent creek with water quality similar to background levels. A long-term monitoring program has been designed to confirm modelling results.



Figure 3: Before (left) and after (right) closure of the Westside open cut coal mine.

The rehabilitated areas have been assessed annually to develop detailed records of the progress of the rehabilitation works. These records include revegetation germination rates, the presence of second generation seedlings, plant health and the success or failure of rehabilitation management. In sufficiently mature areas (three or more years) monitoring of the floristic and structural composition of rehabilitated land has been undertaken using standard methods employed by New South Wales government agencies.

Three natural reference sites are simultaneously assessed to provide baseline information regarding regional vegetation structure and floristics. Monitoring of reference sites allows for a comparison of flora species, abundance and structure. Post mining, this land was successfully returned to high quality native vegetation and is home to a diverse range of flora and fauna.

d. Successful emplacement rehabilitation in the Illawarra by South 32 (South 32 Illawarra Coal - Illawarra, NSW)

Coal wash generated from Illawarra Metallurgical Coal's Coal Preparation Plants is being emplaced at West Cliff and progressively rehabilitated, resulting in successful regeneration of Threatened species; high native species richness and diversity; and cultivation of 'difficult to grow' species.

The waste areas undergo specific surface reshaping, in order to mimic micro-topographic features. Stripped soil layers are immediately redistributed to donor sites to allow maintenance of the inherent nutrient value and soil seed bank to the soil. Native seeds are collected locally and are spread over completed emplacement areas to supplement the seed bank.



Figure 4: Examples of rehabilitation after 2 years (left) and 8 years, showing dense cover of canopy species at South 32 Illawarra.

Habitat reinstatement undertaken includes: transplanting dead stag trees; habitat logs and woody debris; nest box use; and reconstruction of rock outcrops and waterholes.

Methods for measuring the success of the rehabilitation include: Biometric plots and transects; using the BioBanking Assessment Methodology. Some of the indicators that the methodology has been successful are:

- scores of between 50 and 70 species have been recorded (well above benchmarks for the local vegetation types).
- rehabilitation methodology has resulted in a good cover of difficult to grow species such as: heaths; some sedges; rushes, and also *Persoonia* spp. Two threatened plant species, *Pultenaea aristata* and *Persoonia hirsuta*, have been recorded in the rehabilitation area.



Figure 5: Waterhole constructed in 2007 to provide fauna habitat at South 32 Illawarra.

Many species have seeded multiple times and young germinates are evident. This indicates that the stand will be self-sustaining over time and seed fall will provide insurance if the area is inadvertently burnt in a wildfire.

e. The benefits of using organic waste by-products in rehabilitation (Rix's Creek Mine, The Bloomfield Group - Upper Hunter Valley NSW)

Rix's Creek is an open-cut coal mine located five kilometres northwest of Singleton, New South Wales. Mining commenced in 1990 and the mine continues to produce both thermal coal and high quality, semi-soft coking coal. The Bloomfield Group trialled improving rehabilitation outcomes through the reuse of potentially beneficial waste materials. This included the use of biosolid and composted garden wastes.

Biosolids, a solid by-product of domestic wastewater treatment, provides medium to long term benefits to the physical and chemical characteristics of land. Amendment of plots with biosolids at 23, 000 kilograms per hectare provided increased productivity over two years.

The Bloomfield Group commenced the trial of at Rix's Creek in September 2013. The trial involved four treatments, which consisted of three different soil amendments plus a control. The control involved a base inorganic fertilizer. The three treatments involved biosolids, a solid by-product of domestic wastewater treatment process (23, 000 kilograms per hectare) and two amendment rates of composted garden waste (80, 000 and 140, 000 kilograms per hectare). Additionally, an undisturbed pasture was also included in the trial.

Plant species seed included common pasture species, including Rhodes grass, Green panic and couch grass, among others. Pasture samples were taken after 12, 18 and 24 months from sowing. Total dry matter production, amount green leaf mass, crude protein and metabolisable energy were measured.

Total mass of plant matter produced was highest in the biosolid treatment over the 24-month period. In contrast to the mineral fertilizer and compost plots, the biosolid amended plot increased up to 24 months to more than twice that in the undisturbed pasture.

The biosolid amended plot also produced the comparable green leaf production and more than 4 times greater metabolisable energy after 24 months. Indicative pasture productivity and stocking rates are approximately two to three times higher than native pasture. The trial demonstrates the benefits of biosolid amendment to low-fertility soils.



Figure 6: Rehabilitation trials involving organic waste by-products at Rix's Creek.

f. Cropping as a post-mining land use (CMOC Northparkes Mine - Parkes NSW)

Northparkes Mines (Northparkes) is a copper-gold mine located in central western New South Wales, approximately 27 kilometres north north-west of the town of Parkes. Northparkes produces around 6 million tonnes of ore from its underground block-cave mine.

Northparkes operates a series of Tailings Storage Facilities, also known as tailings dams, to manage the waste products (Tailings) resulting from copper-gold concentrate production. In 2015, the Parkes area experienced a number of dry, hot and windy periods, which resulted in increased dust lift-off from the tailings dams. These dust lift-off events raised community concerns and resulted in number of events where Northparkes self-reported dust to the regulatory authorities.

Consequently, in 2015, Northparkes commenced a small-scale trial to grow crops directly into one of the tailing dams, without topsoil. This small-scale trial was successful and proved that crops could be grown in tailings to provide an effective windbreak. Based on the success of the small-scale trial, Northparkes undertook a large-scale cropping trial in 2016, which involved sowing 130 ha of barley, in combination with varying levels of compost, directly on two of the tailings dams. These large-scale cropping trials have been highly successful and have drastically reduced the potential of dust lift-off from the tailings dams.

Northparkes has trialled a number of innovative strategies to minimise dust lift-off from the tailings dams over recent years. As tailings are a waste product from the processing plant, they are extremely fine particles that create a very smooth surface on the crust of the tailings dam. In addition, the tailings dams are elevated, contributing to the increased wind speeds across their surface. These factors all culminate in the ideal conditions for dust lift-off, particularly during periods of dry, windy conditions.

Previous long-term measures implemented by Northparkes to mitigate dust lift-off have been only moderately effective, costly and permanent. As such, Northparkes has been searching for a semi-permanent, but highly effective, solution to manage dust lift-off from the tailings dams until more permanent decommissioning, rehabilitation and closure activities can commence.

Northparkes has a long history of mineral and agricultural production, so to tackle the dust lift-off from the tailings dams, Northparkes looked for a solution from outside of the mining industry. Northparkes has access to an existing successful commercial farming operation, farming equipment and in-house knowledge of farming practices and utilised this experience to address the issue of dust lift-off from the tailings dams.

In November 2014, Northparkes commenced a pot trial, using reeds, to see if plants grown directly into tailings could thrive. Unfortunately, these trials were unsuccessful. In April 2015, the same pots were used to trial growing barley, with the addition of fertiliser. This time, the pot trials were successful, as the barley germinated and grew in the pots. However, Northparkes still had to determine if the barley would grow in-situ on the tailings dams.

In May 2015, the Environment team conducted a small trial on a section of one of the tailings dams, using a mix of left-over grains from the farming operations. These seeds germinated and gave Northparkes confidence to invest in a large-scale trial.

In 2016, the barley cropping program covers an area of approximately 130 ha and includes various trial conditions such as the addition of different level of compost and different pasture seeding varieties. Since commencing the large-scale trial in April 2016, there has been no incidences of dust lift-off from the tailings dams.



Figure 7: Barley cropping trials on tailings at Northparkes.

Planting a crop directly on tailings dams to manage dust is an industry first, and consequently, the outcomes were unknown. However, the results of the barley crop and other dust management techniques speak for themselves. There has been no dust lift-off from the areas of the tailings dams included in the trials since sowing in April 2016. Today, barley covers 65 per cent of the tailings dams and Northparkes has significantly reduced the chance of future dust lift off for the community.

g. Reducing off-site disposal through an underground backfill emplacement project (Metropolitan Underground Colliery, Peabody Energy - Helensburgh NSW)

Peabody, Underground Coal Mine, Metropolitan Colliery Pty Ltd, Helensburgh NSW has implemented a project to backfill emplacement of coal waste rejects underground to replace offsite disposal. This will allow 60% of the material generated to be emplaced underground instead of being disposed offsite. Ultimately the project will remove dependence on offsite disposal by 2021.

The Metropolitan Colliery is located 34 kilometres north of Wollongong near the township of Helensburgh and is one of Australia's oldest continually-operating coal mines, with history dating back to the 1880s. The mine produces approximately 2 million tonnes per annum of coal extracted from underground longwall mining operations.

Coal washery reject (CWR) from the surface coal handling preparation plant had been transported by truck to an off-site approved disposal facility 65km away. The mine recognised the need to develop a sustainable, environmentally friendly, and lower cost option for CWR disposal than trucking waste off-site. Given the restricted footprint of the mine, the proximity of community and strict environmental management requirements, an option for underground disposal was identified.

The project has proceeded in a staged approach through concept, pilot scale operation, feasibility study, detailed engineering and now the construction phase. The backfill emplacement plant will take CWR from the thickener underflow, teeter bed separator and screened coarse reject stream, mix them in appropriate ratios with water then utilise a high pressure positive displacement pump to pump the CWR slurry underground where it is emplaced behind high pressure concrete seals into the goaf behind the active longwall operations.

A successful pilot plant emplaced 80,000 tonnes of CWR underground between 2010 and 2013, reducing approximately 5,600 CWR trucking movements through the township of Helensburgh. Once complete and operational in December 2016 this project will allow 60% of CWR to be disposed of by underground emplacement into an operating goaf via a main gate pipeline – something that has not previously been done at a coal mine.

Following emplacement of CWR and optimisation of systems performance, work is scheduled for upgrades to the plant in 2018 to allow the disposal of 100% of CWR underground by 2021.



Figure 8: Surface UG Emplacement Backfill Plant Construction Complete July 2016 at Peabody Energy.

h. Rehabilitation of alluvial lands suitable for irrigated agriculture (Hunter Valley Mine, Yancoal, Hunter Valley, NSW)

The Hunter Valley Mine located in the Upper Hunter Valley Region, is partially situated on alluvial land with rich fertile soils. As such, a condition of development consent for the mine was a requirement to reinstate 65 hectares of the land to Class 1 and 2 lands suitable for irrigated agriculture.

In order to demonstrate that the land had been restored as required, Yancoal was required to produce Lucerne hay with a productivity yield equivalent to the average crop productivity yields for the Upper Hunter Region for three consecutive years.

Yancoal's rehabilitation of alluvial lands in the Hunter Valley is the first trial of its kind in New South Wales to demonstrate that alluvial land used for mining can be rehabilitated to match the crop production levels of nearby farms. The land has since been tendered out for commercial cropping and is being used for Lucerne and Triticale.

Planning for rehabilitation began before commencement of mining. The soil profile was mapped, and topsoil and subsoil stockpiled. Backfilling of the eastern section was completed in 2003, allowing rehabilitation to commence. Soils were replaced to a depth of 1.5m to accommodate deep rooted crops, such as Lucerne.

Cropping trials demonstrated hay production yields above the district average for three consecutive years by 2007 (Table 3), as required for development consent.

Table 2: Two Stage Cropping Trial at Yancoal's Hunter Valley mine

Year	Stage 1	Stage 2	District Average
2003-04	11.7*	Not sown	Not available
2004-05	15.9	18.4	14.8
2005-05	14.8	15.6	14.9
2006-07	Compliant	8.72	7.6

* Shortened harvest season due to crop establishment

In 2010, Yancoal conducted competitive tender for commercial cropping of the land, attracting five submissions.

In June 2013 preparation commenced for the first commercial crop. Triticale is a hybrid of wheat and rye was planted. Due to late frost in October 2013, the crop was baled and used for fodder instead of being harvested. Another crop of Triticale was planted in 2014 and subsequent crops are likely to include Lucerne.

The ability to attract graziers to compete for the right to commercially crop the land highlighted community confidence in the results of the trial and will ultimately be a valuable asset at the end of the mine life.



Figure 9: Post rehabilitation, during the lucerne cropping trial at Yancoal's Hunter Valley mine

i. Study of Sustainability and Profitability of Grazing on Mine Rehabilitated Land in the Upper Hunter (Hunter Valley Mine, Yancoal, Hunter Valley, NSW)

At the Hunter Valley mine near Singleton, Yancoal in collaboration with the NSW Department of Primary Industries, assessed grazing on rehabilitated mine land. Angus steers were found to be 150 kilograms heavier on average than cattle grazed on farming land that had not been previously mined. These results show potential for rehabilitated land to be used for grazing.

This rehabilitation program used best practice techniques from the agriculture sector including the establishment of exotic grasses and legumes as part of the rehabilitation. As a result, the HVO rehabilitated land had greater productivity and diversity than the suite of mainly native grasses existing on the unmined land used as a control for the study.

The trial also monitored the health of the cattle through blood tests, with results indicating the steers were within normal health range.

There is potential to improve the grazing productivity of the rehabilitated land even further through management practices aimed at increasing the growth of plant species active in winter such as clovers and medics.

In addition to the grazing trials at Mt Arthur Coal (BHP Billiton), these projects have provided industry with an indication that with high quality rehabilitation practices the grazing of cattle on rehabilitated mined land could be commercially viable and may provide superior pasture compared to surrounding unmined paddocks.



Figure 10: Grazing trial steers yarded for regular weighing (left) and rehabilitated mine land at Hunter Valley Operations used for grazing trials.

j. Natural landform rehabilitation at Mangoola (Mangoola Open Cut, Glencore - Hunter Valley, NSW)

Glencore's Mangoola open cut coal mine includes the largest area of rehabilitation in NSW constructed using natural landform design principles. Mined land has been successfully returned to natural hills and valleys and vegetated with native plants found in the surrounding areas. The objective is to recreate the natural ecosystems and supporting habitats of the region.

Mangoola open cut coal mine is located near Wybong in the Muswellbrook Local Government Area. The mine has operated since 2011, with approval to produce 13.5 million tonnes of Run of Mine (ROM) coal per annum for export and domestic markets.

Mangoola mine is located in an area characterised by undulating hills and heavily vegetated sandstone escarpments. This created a major challenge, to manage and reshape excavated rock and earth to produce a natural looking landform that would blend in with the surrounding topography.

A number of preliminary steps guided the development of natural landform rehabilitation planning. These included:

- testing of overburden and topsoil;
- evaluation of existing creek and drainage lines; and
- the use of hydrological modelling.

Mine planners and managers worked with external specialists to develop a mine plan using landform design computer software. The software can be used to design landforms similar to surrounding areas that can convey runoff water in a similar way that a natural landform would.

Following a successful trial in December 2012, the mine revised final landform plans for the entire footprint of the mine. To date, the natural landform rehabilitation covers over 250 hectares, and this will continue to grow.



Figure 11: Natural landform rehabilitation at Mangoola Coal