

# Guideline

## Resource Activities

### Rehabilitation requirements for mining resource activities

This guideline provides information on both progressive and final rehabilitation requirements for site specific resource projects operating in Queensland under the *Environmental Protection Act 1994*.

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### Version History

Version	Effective date	Description of changes
1.00	14 January 2014	Amended to reflect amendments to the <i>Environmental Protection Act 1994</i> .
2.00	23 May 2014	Wording added section 1.2 – scope clarifying how uranium mining relates to rehabilitation.
2.01	18 June 2018	The document template, header and footer have been updated to reflect current Queensland Government corporate identity requirements and comply with the Policy Register.

## 1. Introduction

### 1.1. Purpose

This guideline is to assist mining companies to propose acceptable rehabilitation outcomes and strategies during the planning stages of a mine or when changes to the proposed rehabilitation outcomes and strategies become necessary during the operational stages of a mine.

The guideline also explains how the administering authority<sup>1</sup> will assess whether progressive or final rehabilitation for either new or established mining projects is satisfactory. Assessment will be based on the accepted rehabilitation objectives for each domain within the mine site and monitoring of indicators to demonstrate that the completion criteria have been met and are likely to be sustained for an acceptable period. Establishment of early contact with the administering authority through pre-design conferencing is recommended to ensure there are “no surprises” in the later stages of the assessment process. Similar contact during any proposal to change rehabilitation outcomes or to obtain progressive certification or final sign-off is also recommended.

### 1.2. Scope

This guideline applies to resource projects for a mining activity that is a site specific mining project and to both progressive and final rehabilitation.

The scope and content of this guideline extends to and is useful for determining the rehabilitation requirements for uranium mines. Setting site specific goals, strategies, objectives, indicators and completion criteria for the rehabilitation of uranium mines will however require specialist input from persons or organisations with relevant knowledge and experience.

The guideline does not apply to standard or variation mining projects, which have simplified rehabilitation requirements listed in relevant codes of environmental compliance. This guideline is not to be used to interpret the standard environmental conditions in those codes.

### 1.3. Structure of the guideline

Section 1 provides an introduction to the guideline. Section 2 describes the policy and legislative frameworks that provide direction for mine rehabilitation outcomes. Section 3 lists the goals that the Government expects rehabilitation to achieve. Sections 4, 5 and 6 describe how a mining company should develop site-specific rehabilitation strategies comprising:

- rehabilitation objectives for each domain in a mining project;
- indicators that can measure progress towards the objectives;
- completion criteria that are consistent with the rehabilitation goals set by Government and with the rehabilitation objectives established in the environmental authority for each domain in a mining project.

Section 7 describes the assessment process that will provide transparent and consistent decisions for progressive and final rehabilitation based on the rehabilitation goals, objectives, indicators and completion criteria for the mining project. Section 8 describes how existing mining projects with inadequate rehabilitation objectives, indicators or completion criteria will be assessed.

### 1.4. Other relevant guidelines

The following guidelines should also be consulted:

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<sup>1</sup> The Department of Environment and Science is the administering authority under the *Environmental Protection Act 1994*.

- Triggers for environmental impact statements under the Environmental Protection Act 1994 for mining, petroleum and gas activities.<sup>2</sup>
- Financial assurance under the Environmental Protection Act 1994 (ESR/2015/1758<sup>3</sup>).

## 2. Policy and legislative framework

### 2.1. Policy framework

Unlike most other industrial activities, each mining operation is expected to cease in the foreseeable future. This generally occurs when its finite resources are depleted. However, like other industries, a mining operation may also cease when production costs exceed returns or as a result of an unrelated management decision. The closure of a mine provides opportunities for land disturbed by mining to be rehabilitated to one or more sustainable post-mining land uses. Technological advances and changing market conditions in recent decades have facilitated the development of many new mines and increased production at existing mines. There have also been changes in community expectations about the management of the impacts of mining. These factors have focused the attention of regulatory authorities on mine rehabilitation.

National Strategy for Ecologically Sustainable Development (COA 1992) (NSESD) promotes economic growth that safeguards the welfare of future generations, provides equity within and between generations, protects biological diversity and maintains essential ecological processes and life support systems. The ecologically sustainable development (ESD) framework includes the “polluter pays” principle, i.e. those who generate pollution and waste should bear the cost of containment, avoidance or abatement. To ensure sound environmental practices throughout the industry, NSESD also sets several objectives for mining including development of rehabilitation policies based on:

- repairing the land so its ongoing maintenance needs are consistent with those of equivalent unmined land under equivalent land use;
- rehabilitation requirements that are open to public scrutiny;
- treating rehabilitation and mine closure as integral components of the planning and operation of mines.

The Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) jointly published the *Strategic Framework for Mine Closure (ANZMEC 2000)*. The framework recognised that the mining industry is responsible for rehabilitation of mine disturbance in an environmentally and socially acceptable way. It considered mine planning, stakeholder involvement, financial provisioning for rehabilitation, implementation, standards and relinquishment; and developed the following key principles:

- legislation should provide a broad regulatory framework for the mine closure process;
- standards of rehabilitation should be acceptable and achievable;
- completion criteria are specific to each mine and should reflect its unique set of environmental, social and economic circumstances;
- an agreed set of indicators should be developed to demonstrate that successful rehabilitation has been achieved;
- targeted research will assist both government and industry in making better decisions about rehabilitation.

In 2003, the International Council on Mining and Metals (ICMM) adopted 10 principles for sustainable development for mining. Specific elements of Principles 4 and 6 included:

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<sup>2</sup> This guideline can be found at [www.des.qld.gov.au](http://www.des.qld.gov.au), using the ‘triggers for environmental impact statements’ as the search term.

<sup>3</sup> This is the publication number, which can be used as a search term to find the latest version of the publication at [www.des.qld.gov.au](http://www.des.qld.gov.au).

- consulting interested and affected parties<sup>4</sup> on all significant impacts;
- regularly updating risk management systems;
- providing safe disposal of waste and process residues;
- rehabilitating land in accordance with appropriate post-mining land use.

The MCA sought government input when it developed *Enduring Value (MCA 2004)*. That publication provides a framework for implementing the ICMM principles in an Australian context and indicates that effective rehabilitation planning and implementation are intimately linked to the “social licence to operate”. The ICMM has stated that the mining industry’s contribution to sustainable development is dependent on ensuring acceptable long-term environmental performance of mine rehabilitation (ICMM, 2005).

The mining industry has been working with Australian governments to improve the mutual understanding of how rehabilitation can minimise the future impacts of mining activities. During the 1990s, the Commonwealth Government supported the development of a series of booklets on *Best Practice Environmental Management in Mining*. The Commonwealth Department of Resources, Energy and Tourism are currently replacing this series with booklets in the series *Leading Practice Sustainable Development Program for the Mining Industry*.

## 2.2. Rehabilitation hierarchy

In assessing the acceptability of rehabilitation objectives, indicators and completion criteria that may be proposed for a mining project, the administering authority will have regard to a hierarchy for mine rehabilitation that is similar to the waste hierarchy. The strategies listed higher in the hierarchy should be adopted in preference to those listed lower, unless there are significant environmental, economic or social issues that override such a selection. The rehabilitation hierarchy, in order of decreasing capacity to prevent or minimise environmental harm, is:

1. avoid disturbance that will require rehabilitation
2. reinstate a “natural” ecosystem as similar as possible to the original ecosystem
3. develop an alternative outcome with a higher economic value than the previous land use
4. reinstate previous land use (e.g. grazing or cropping)
5. develop lower value land use
6. leave the site in an unusable condition or with a potential to generate future pollution or adversely affect environmental values.

In determining whether it is feasible to achieve levels in the top half of the hierarchy, the applicant and the administering authority should consider the pre-mining land use, any compensation or other agreements regarding the land, the potential uses of likely rehabilitated landforms and existing use or environmental values of surrounding land.

Developing a lower value use may be acceptable if that use is acceptable to the relevant stakeholders and all higher strategies are impractical. Leaving the site in an unstable condition or with potential to cause environmental harm will rarely be acceptable.

In general there is a higher risk of future environmental harm after the mine closes if the strategies listed lower in the hierarchy are adopted. However a “lower value” land use may be more sustainable in terms of preventing off-site impacts, especially if the post-mining land use makes an economic return that is sufficient to maintain the rehabilitation. To manage a site so that the potential for on-going environmental harm is kept to acceptable levels, future monitoring and maintenance may be required. For this reason, the acceptance of a rehabilitation

<sup>4</sup> Similar consultation requirements are included in ss. 38 and 39 of the *Environmental Protection Act 1994* in regard to environmental impact statements.

strategy involving outcomes lower in the hierarchy may mean that, when progressive or final rehabilitation is assessed, the company may have to make larger payments to cover the remaining residual risk.

### 2.3. Legislative framework

In Queensland, rehabilitation is required under the *Environmental Protection Act 1994* (EP Act)<sup>5</sup>, which has as its object the attainment of ecologically sustainable development (ESD). The principles in the National strategy for ecologically sustainable development (NSES) must be considered in decision-making under the EP Act. Section 4(6) of the EP Act requires that all reasonable and practicable measures are taken to protect environmental values from all sources of environmental harm and requires persons who cause environmental harm to pay costs and penalties for the harm. The fundamental reasons for rehabilitation are to reduce the apparent disturbance caused by authorised mining activities and to minimise the potential for future environmental harm.

Section 9 of the EP Act defines environmental values as characteristics of the environment that are conducive to environmental health or public amenity or safety, as well as qualities of the environment declared to be environmental values by an environmental protection policy (EPP) or a regulation. The environmental values listed in the EPP for water are the suitability of water for recreation, drinking, agriculture, industrial use and maintaining biological integrity; the environmental values listed in the EPP for air are qualities that are conducive to suitability for life, health and human wellbeing; and the environmental values listed in the EPP for waste management are life, health, human wellbeing, diversity of ecological processes and ecosystems, and land use capability (having regard to economic considerations).

Sections 125 (1) (l) (i) (E) of the EP Act describes the requirements of applications for site specific or variation environmental authority which includes details for how the land the subject of the application will be rehabilitated after each relevant activity ceases. The application information is used to help the administering authority prepare the draft environmental authority for a resource project. The administering authority must be satisfied with the rehabilitation before it can certify progressive rehabilitation for part of a mining project or accept the surrender of an environmental authority for the whole or part of a project.

The administering authority decision is based on an assessment of either a progressive rehabilitation report for part of the project (section 318Z) or a final rehabilitation report (section 264) for the whole project or a part being surrendered. The holder of the environmental authority for mining activities must prepare a progressive / final rehabilitation report and submit it to the administering authority for assessment. The administering authority must consider the relevant completion criteria (section 318ZI or section 268) when deciding whether to certify progressive rehabilitation or whether to approve a surrender application.

Under the current legislation it is difficult to enforce future land use constraints for rehabilitated land after the mining tenement has been relinquished. Appropriate post-mining land use may require some form of statutory constraint to future land use in order to prevent or limit the extent of "inappropriate post-mining land use". The options currently available include:

- specific land tenure (protected estate, reserve, etc.);
- lease conditions (e.g. term lease under *Land Act 1994*);
- covenant (freehold, perpetual lease); or
- site management plan (for contaminated land).

The various legislative / administrative steps and their associated timeframes relating to rehabilitation during the life of a mine are shown schematically in Figure 1.

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<sup>5</sup> A small number of mines operating under Special Agreement Acts have their rehabilitation requirements set under the *Mineral Resources Act 1989* and/or the relevant Special Agreement Act.

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Figure 1 - Elements of the rehabilitation process for a mine

	Regulatory elements	Company-controlled elements
Pre-mining		Exploration and feasibility studies –including baseline studies and planning possible rehabilitation objectives
		Pre-design conference
		Apply for an Environmental Authority
	EIS requirement decision (the Administering authority (AA)).	Prepare EIS, if required, and/or requirements for applications under section 125 EP Act
	Public Notification	
		Submit requirements for applications under section 125 EP Act
	Assess the requirements for applications under section 125 EP Act (AA)	
	Prepare a draft EA (the AA)	
	Objection hearing if required	
	Issue final EA (the AA) – including conditions defining rehabilitation objectives	
	Progressive rehabilitation and monitoring	
During mining		Apply for progressive certification
	Assess progressive rehabilitation report (the AA)	
	Decide the application (the AA)	
		Adjust financial assurance
		Apply for surrender of EA –including final rehabilitation report and residual risk calculation
Post-mining	Assess final rehabilitation report (the administering authority refers to PRAC)	
	Decide application and advise holder of decision the AA)	
		Lodge any residual risk payment
		Post closure management (if required)
		Exploration and feasibility studies –including baseline studies and planning possible rehabilitation objectives

### 3. General and specific rehabilitation goals

#### 3.1. General rehabilitation goals

In this guideline, the Government's policy objectives for rehabilitation are called rehabilitation goals to distinguish them from the rehabilitation objectives selected by mining companies in their rehabilitation strategies for a particular mine. The rehabilitation goals have been developed from the ESD policy framework, especially in relation to intergenerational equity; polluter pays principle, protection of biodiversity and maintenance of essential ecological processes.

The four general rehabilitation goals require rehabilitation of areas disturbed by mining to result in sites that are:

- safe to humans and wildlife<sup>6</sup>;
- non-polluting;
- stable;
- able to sustain an agreed post-mining land use.

#### 3.2. Site specific goals

There may be specific additional goals that are relevant at some mine sites. These may be indirectly identified by Government through requirements under other legislation dealing with matters such as endangered species, water, registered heritage places or regional or local planning. For example, there may be requirements to:

- establish vegetation communities that are demonstrably similar to a pre-existing ecosystem (especially where native vegetation is the proposed land use);
- establish or enhance the habitat of an endangered species (especially where the mining has affected such habitat);
- restore stream patterns where there has been a temporary stream diversion;
- achieve water quality that meets some specific beneficial use;
- maintain or restore some specific aesthetic values;
- preserve specific European and indigenous heritage that has been registered for the site (note that these values are managed under other legislation); or
- achieve specific socio-economic outcomes (e.g. restore high value agricultural land necessary to maintain a viable rural industry).

### 4. Rehabilitation objectives for a mine

#### 4.1. Setting rehabilitation objectives

Rehabilitation objectives must provide a clear description of proposed rehabilitation outcomes within the individual domains<sup>7</sup> in the mine site. One domain may contain elements that require different rehabilitation. If the elements are essential components of a single land management unit, e.g. a waste rock dump with battered slopes and a flat top, it is preferable for the elements to be included in the same domain (with different rehabilitation objectives) rather than to be treated as separate domains.

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<sup>6</sup> Human safety at mine sites is largely managed under the *Mining and Quarrying Safety and Health Act 1999* and the *Coal Mining Safety and Health Act 1999* but fauna safety is not covered in those Acts. It will generally be appropriate to consider both human and fauna safety when designing rehabilitation under environmental legislation.

<sup>7</sup> Domains are defined in Appendix C.

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The rehabilitation program for a mine site must address the general rehabilitation goals listed in Section 3 and any relevant site-specific goals. To ensure that the mine fulfils its environmental, economic and social responsibilities within the ESD principles, the rehabilitation objectives must:

- address potential environmental impacts;
- achieve the highest practicable level in the rehabilitation hierarchy;
- identify post-mining land uses that are acceptable to the community, local government and any other relevant stakeholders.

The first steps in identifying the potential environmental impacts for a mining resource activity that is an ineligible ERA mining project will generally be baseline environmental investigations and consultation with local residents and other interested parties to identify the environmental values in the proposed mining lease and adjoining areas. Economic or social studies may also be undertaken. The mining company is advised to seek a pre-design conference with the administering authority at this stage in the planning of the mining project. While the main purpose of a pre-design conference is to assist the applicant to identify potential environmental issues at the site, it also allows the applicant to propose a stakeholder consultation program for discussion. The administering authority may give an indication that a stakeholder consultation program proposed by the applicant is satisfactory for the development of rehabilitation conditions that will be used for assessment of progressive and final rehabilitation. Any agreements between the applicant and stakeholders should be committed to writing and, where it is relevant to the rehabilitation requirement, should be forwarded to the administering authority with the relevant application.

The second step is to develop ways to prevent or minimise the potential environmental impacts from mining and mineral processing activities that may occur on the site. Both the design of the mine and the rehabilitation strategies will be influenced by the spatial distribution of the various environmental values, the potential impacts and the costs associated with the various options for preventing or minimising the impacts. An environmental impact statement (EIS) will be required if the project exceeds the triggers in the guideline Triggers for environmental impact statements under the *Environmental Protection Act 1994* for mining, petroleum and gas activities<sup>8</sup>. Another consideration is how to minimise the residual risk associated with the rehabilitation. If that risk is too high (i.e. issues are identified that have the potential to result in significant failure of the rehabilitation in the future, say within 30 years), the administering authority may not accept the rehabilitation. In some cases, a high risk may be accepted if the residual risk payment was sufficient to cover the expected maintenance of the rehabilitation. However, the Government is unlikely to accept the role of long-term involvement with a large number of mine sites.

Other matters that may influence decisions about selecting a rehabilitation strategy include:

- the conservation value of a proposed environmental outcome;
- the importance to the local community of the economic productivity of the proposed future land use;
- the consistency of the proposed land use with local and regional plans;
- the long-term ownership of the affected land.

Mine rehabilitation provides opportunities to restore ecosystems or create wildlife corridors which may produce major environmental benefits in all or part of the mining lease. There will also be cases where rehabilitation of a mine site may not be able to achieve future economic productivity that is comparable to the pre-mining situation. Irrespective of the rehabilitation outcome, the environmental authority holder must ensure that the rehabilitation will endure normal climatic variations and the agreed post-mining land will be sustained so that future generations are not paying maintenance costs that are higher than those normally incurred for the same land

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<sup>8</sup> This guideline can be found at [www.des.qld.gov.au](http://www.des.qld.gov.au), using the 'triggers for environmental impact statements' as the search term.

use on unmined land. To achieve this, the rehabilitated land may need to have constraints placed on its future use (e.g. a site management plan for contaminated land or a nature refuge) making any future land owner responsible for meeting those constraints<sup>9</sup>.

The final step in setting the objectives is to include them in them in the application documents required under section 124 of the EP Act. This makes them publicly accessible and provides guidance to management and workers on the need to conduct activities on the site in a way that is consistent with the future use. They must also be stated in a way that allows the development of measurable indicators that can be audited against the completion criteria. Table 1 gives examples of strategies that contain a range of objectives for different mine domains. It does not attempt to identify all possible domains, nor does it list all possible strategies for any domain. The EA holder proposes both the domains and the strategies.

#### **4.2. Combining the rehabilitation hierarchy with the rehabilitation goals**

For each of the goals there may be many rehabilitation strategies that can be developed and applied to a mine. It is possible that the rehabilitation requirements for different domains at a mine may be significantly different. For example, a waste rock dump domain will require a different rehabilitation approach than a tailings storage facility. Rehabilitation strategies for each domain should be developed and documented in the application documents required under section 124 of the EP Act.

Table 1 provides some examples of how the hierarchy described in Section 2.2 might be applied to establish the possible rehabilitation strategies that would achieve the main rehabilitation goals for particular mine domains. The table has not covered all the possible strategies or all potential post-mining land uses, which can be widely divergent (e.g. nature conservation, grazing, cropping, waste disposal, water supply, etc). Nor does Table 1 specify which strategy will be acceptable in a particular locality for a specific mine.

It is probable that strategies in the top row of Table 1 would be considered to produce satisfactory rehabilitation if the strategies are implemented effectively. Strategies in the middle row of Table 1 may be accepted in some circumstances but will generally have a higher residual risk payment associated with them. Strategies in the bottom row will rarely be acceptable.

#### **4.3. Describing how land will be rehabilitated**

As part of the progressive rehabilitation certification process and final surrender application, the environmental authority holder will be required to submit a risk assessment that documents the probability and consequence of future environmental harm across each of the rehabilitated domains. Where there is potential for future environmental harm, the cost to remediate this harm must be calculated in order to decide whether a residual risk payment is required.

During mine planning, the post-mining land use must be identified, as this is a controlling factor in setting rehabilitation objectives that are consistent with the goals described in Section 3.1 and in defining how rehabilitation success will be measured.

Definition of the final land use is essential for the assessment of the long-term environmental impacts of the project by the administering authority and is typically required for the development of realistic life-of-mine costs in feasibility studies that will be assessed by the project financiers. It is also necessary for calculating financial assurance as that is based on the third party costs of rehabilitation, which cannot be calculated if the final land

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<sup>9</sup> The administering authority is considering extending the concept of a site management plan to ensure appropriate post-surrender land management where contamination is not an issue. The intent is to require a third party to implement a management plan prepared by the mine operator to minimise future risk. Funding (if not covered by the compensation agreement) and the third party's level of responsibility for the management plan will require further consultation.

use is not specified. Consultation with the landowner, the local community and other stakeholders is essential when considering the future land use.

Other rehabilitation objectives may be determined through a risk assessment of the proposed mining operation and mine closure where that process identifies hazards likely to prevent the achievement of the rehabilitation goals. The objectives will focus on the end result of the rehabilitation and will not normally describe in detail how the hazards can be avoided or managed to achieve the agreed future land use. The end result must, to the maximum extent possible, be maintenance free and require no future management intervention beyond the normal land management practices for the post mining land use. The future landholder will be responsible for the management and maintenance requirements when undertaking any post mining land use at the site. A regular review of the objectives is desirable as mine plans and technology change frequently.

Achievement of short term objectives may not deliver rehabilitation outcomes that are considered sustainable in the long term i.e. centuries. Decision-making should involve stakeholders who have been provided relevant information about possible future impacts developed through a thoroughly documented risk assessment process which considers the likelihood and consequence of hazards being realised.

During the environmental impact assessment of a project, several rehabilitation options may be proposed. However, the application documents for the mining project must clearly identify the intended land use and other rehabilitation objectives for the mine at the domain level and cover the relevant rehabilitation goals listed in the previous section for each domain within the whole site. The objectives must be specified in sufficient detail to allow the administering authority to assess long-term impacts and for the community to understand the postmining condition of the site. For a mining lease, this information is made public and objections may be lodged. Objections are considered by the Land Court and the recommendations that come from the objections hearing may result in changes to the proposed land use or other objectives before the lease is granted. The objectives must be clearly reflected in the environmental conditions for the project.

The typical details required in the application documents for each domain within the mine site include:

- **Safety measures** – If safety hazards remain at mine closure or inevitably will develop after closure, solely as a result of the mining activities (e.g. steep slopes, exposure of hazardous materials, subsidence or potentially unstable structures), the application documents must indicate what management controls will be implemented to reduce risks to humans or animals. These may include exclusion of access to unstable areas, waste rock characterisation and segregation or selective management of hazardous wastes. These measures complement any requirements under the *Mining and Quarrying Safety and Health Act 1999* or *Coal Mining Safety and Health Act 1999*.
- **Water management and water quality** – Details of any reconstructed water courses or proposals to contain surface water on the site must be provided. The risk of any significant environmental harm resulting from potentially contaminated water entering surface waters or groundwater must be considered. An assessment of the possible quality of water impounded in a final void or surface dam must be provided. This is likely to be based on a model and will require an ongoing monitoring program to verify the predicted water quality and hydrology so that modifications can be made to the rehabilitation plans if water quality trends or flow rates are found to vary from the predicted values in a way that is likely to cause a significant increase in the resultant environmental harm.
- **Landforms** – There must be a clear indication of the post-mining topography of the site. The final shape of waste rock heaps, tailings dams and voids must be indicated on a contoured plan at a suitable scale. The choice of landforms must be supported by an assessment of the factors that will affect long-term stability with particular reference to hazardous materials, protective capping, geotechnical stability, and surface stability under the proposed post mining land use.

- **Land use** – The proposed post mining land use must be clearly specified using terms such as grazing (up to a particular intensity), cropping (including type of crop), forestry plantation (for a specified type of wood), habitat (for a nominated species), or return to native vegetation (see next dot point). Indicating that the land will achieve a specific land capability class (DME 1995) will generally not be sufficient description of the proposed land use. The prior land capability and use of the site, the existing uses of adjacent land and the views of landholders when selecting the future land use should be considered.
- **Vegetation** – When establishing native vegetation is one of the rehabilitation objectives for the mine site, the application documents must specify the ecosystem(s) or habitats that are intended to be developed on the rehabilitated domains. The plan may also nominate reference / analogue sites that will be used for comparison.
- **Socio-economic objectives** – An example of when such objectives might be considered is where mining occurs on good quality agricultural land and there is an agreement that the land is to be returned to a similar productive use so that it will support a viable community similar to what was there before mining.

#### 4.4. Changing or amending objectives

Should circumstances or knowledge change during the life of the mine, rehabilitation objectives and completion criteria may need to be reviewed. If substantial changes to the rehabilitation objectives are involved, there must be a transparent amendment process that gives the public an opportunity to comment on significant changes. The current process allows the environmental authority holder to apply for a change to the objectives through an amendment of the environmental authority. In such cases the rehabilitation goals applying at the time of the application will be taken into account. It is considered good practice for the mining company to consult community members who are likely to be affected by the changes before the amendment application is lodged.

### 5. Rehabilitation indicators

#### 5.1. Defining good indicators

Rehabilitation indicators provide defensible measurements of progress towards the rehabilitation objectives. Environmental indicators may involve the measurement of a single parameter or they may involve the amalgamation of measurements of several parameters into an index or model. There could be several indicators for one objective and one indicator may have relevance to more than one objective. Some may be important over a wide area while others may have a local significance or relate to how a particular objective is to be achieved for a particular mine. Although there will be site-to-site variations in the indicators, some regional groupings are expected to emerge as knowledge improves and is shared among companies and consultants.

The properties of a good indicator (CSIRO 1998) are that it:

- has an agreed, scientifically sound meaning;
- represents an environmental aspect of importance to society;
- tells us something important and its meaning is readily understood;
- has a practical measurement process;
- helps focus information to answer important questions;
- assists decision making by being effective and cost-efficient.

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**Table 1 - Possible strategies to achieve rehabilitation goals for various domains<sup>10</sup>**

**PART A – Domains involving surface features including final voids, shafts, audits, subsidence**

OUTCOMES	GOALS			
	SAFE	NON-POLLUTING	STABLE LANDFORM	SUSTAINS AGREED LAND USE
<b>Generally acceptable</b>	<ul style="list-style-type: none"> <li>• Backfill to original ground level (or higher to allow for settlement).</li> <li>• Seal or install bat gates for shafts and audits</li> <li>• Structurally sound; safe to people and animals;</li> <li>• No hazardous materials</li> <li>• Treat hazardous material</li> <li>• Remove hazardous material</li> </ul>	<ul style="list-style-type: none"> <li>• Contains good quality water</li> <li>• Moderate quality but no connectivity</li> <li>• Low risk of groundwater contamination or overflow but monitoring and management in place</li> </ul>	<ul style="list-style-type: none"> <li>• Backfill voids and shallow shafts</li> <li>• Stable collar and capping or cover for shafts</li> <li>• Battered slopes with vegetative cover</li> </ul>	<ul style="list-style-type: none"> <li>• Natural ecosystem restored</li> <li>• Alternative high value use, e.g. water reservoir, good quality agricultural land, recreational use</li> </ul>
<b>May be acceptable</b>	<ul style="list-style-type: none"> <li>• Cover hazardous material with benign material or water</li> <li>• Build safety barriers</li> </ul>	<ul style="list-style-type: none"> <li>• Void acts as a sink or reservoir for contaminated water with minor risk to stock or wildlife</li> </ul>	<ul style="list-style-type: none"> <li>• Battered moderate slopes with little vegetation</li> <li>• Steep slopes in competent rock</li> </ul>	<ul style="list-style-type: none"> <li>• Waste disposal (if site approved under Sustainable Planning Act 2009)</li> <li>• Industrial or commercial land use</li> <li>• Unused void with low risk</li> </ul>
<b>Rarely acceptable</b>	<ul style="list-style-type: none"> <li>• Contains exposed hazardous materials (e.g. potentially acid forming or containing heavy metals)</li> </ul>	<ul style="list-style-type: none"> <li>• Poor water quality that poses a high risk to stock or wildlife</li> </ul>	<ul style="list-style-type: none"> <li>• No action but site is structurally unsound, geotechnical instable, a threat to nearby sensitive places and infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• Battered moderate slopes with little vegetation</li> <li>• Steep slopes in competent rock</li> </ul>

<sup>10</sup> Not all of these structures may be grouped in the same domain. However, similar matters will have to be considered in developing the rehabilitation outcomes for areas that have been used for these activities. There may be more than one domain of any particular type of activity within a single mine if the rehabilitation outcomes are going to be different because of variations in the topography, adjoining land use, scale of activity or other considerations.

## Rehabilitation requirements for mining resource activities

Table 1: Continued

PART B - Domains involving solid waste disposal<sup>11</sup>

OUTCOMES	GOALS			
	SAFE	NON-POLLUTING	STABLE LANDFORM	SUSTAINS AGREED LAND USE
<b>Generally acceptable</b>	<ul style="list-style-type: none"> <li>Structurally safe, no hazardous materials</li> <li>Structurally safe, treated hazardous material</li> </ul>	<ul style="list-style-type: none"> <li>Runoff and seepage will be good quality water that is unlikely to affect known environmental values</li> </ul>	<ul style="list-style-type: none"> <li>Place wastes below natural land surface (i.e. below grade)</li> <li>Place wastes above natural surface with minimal slopes (e.g. less than 5°)</li> </ul>	<ul style="list-style-type: none"> <li>Reinstate original ecosystem</li> <li>Create different use with enhanced environmental, economic or social values acceptable to stakeholders</li> <li>Return to previous use/condition</li> </ul>
<b>May be acceptable</b>	<ul style="list-style-type: none"> <li>Structurally safe, hazardous material adequately contained</li> </ul>	<ul style="list-style-type: none"> <li>Potential for pollution of water that is managed by: <ul style="list-style-type: none"> <li>Natural low groundwater connectivity (demonstrated by hydrological studies)</li> <li>Impervious capping or lining</li> <li>Store and release capping</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Place wastes above ground with moderate slopes</li> </ul>	<ul style="list-style-type: none"> <li>Return to previous use, or a different use with reduced environmental, economic or social values (evidence that use is acceptable to stakeholders would be essential)</li> <li>Managed constrained use</li> </ul>
<b>Rarely acceptable</b>	<ul style="list-style-type: none"> <li>Uncontained or inadequately contained hazardous materials</li> </ul>	<ul style="list-style-type: none"> <li>Waste disposal facility contains inadequately managed severely contaminated water or water requiring continuing treatment</li> </ul>	<ul style="list-style-type: none"> <li>Place above ground with angle of repose slopes</li> </ul>	<ul style="list-style-type: none"> <li>Unusable contaminated site that is not adequately managed</li> </ul>

<sup>11</sup> Solid wastes include rejects, waste rock dumps, heap leach pads and general refuse disposal facilities.

Rehabilitation requirements for mining resource activities

Table 1: Continued

PART C - Domains involving tailings dams

OUTCOMES	GOALS			
	SAFE	NON-POLLUTING	STABLE LANDFORM	SUSTAINS AGREED LAND USE
<b>Generally acceptable</b>	<ul style="list-style-type: none"> <li>Structurally safe (appropriate certification against relevant code) - no hazardous materials</li> <li>Structurally safe - treated hazardous material</li> </ul>	<ul style="list-style-type: none"> <li>Runoff and seepage will be good quality water that is unlikely to affect known environmental values</li> </ul>	<ul style="list-style-type: none"> <li>Stored in redundant pit below natural surface level with appropriate erosion control</li> <li>Outer walls designed for long term stability</li> <li>Vegetation cover established and preventing erosion</li> </ul>	<ul style="list-style-type: none"> <li>Reinstate original ecosystem</li> <li>Create a different use with enhanced environmental, economic or social values acceptable to stakeholders</li> <li>Return to previous use/ condition</li> <li>Site management plan in place and effective</li> </ul>
<b>May be acceptable</b>	<ul style="list-style-type: none"> <li>Containment of hazardous material but limited strengthening of walls or capping</li> </ul>	<ul style="list-style-type: none"> <li>Eliminate inflow</li> <li>Breach wall to prevent ponding</li> <li>Armoured impervious capping with capillary break if needed</li> <li>Store and release capping</li> <li>Collect and treat seepage</li> </ul>	<ul style="list-style-type: none"> <li>Appropriate maintenance program proposed</li> </ul>	<ul style="list-style-type: none"> <li>Return to previous use, or a different use with reduced environmental, economic or social values (evidence that use is acceptable to stakeholders would be essential).</li> <li>Manage constrained use</li> </ul>
<b>Rarely acceptable</b>	<ul style="list-style-type: none"> <li>Unstable poorly designed structure</li> </ul>	<ul style="list-style-type: none"> <li>Seeping contaminated water to surface or ground water</li> </ul>	<ul style="list-style-type: none"> <li>High risk of instability and structural failure</li> </ul>	<ul style="list-style-type: none"> <li>Unusable contaminated site that is not adequately managed</li> </ul>

Rehabilitation requirements for mining resource activities

Table 1: Continued

PART D – Infrastructure

OUTCOMES	GOALS			
	SAFE	NON-POLLUTING	STABLE LANDFORM	SUSTAINS AGREED LAND USE
<b>Generally acceptable</b>	<ul style="list-style-type: none"> <li>No hazardous structures or chemicals used in mine</li> <li>Avoid effects of hazardous materials on site by restricting use to fully contained facilities which are cleaned and removed from site</li> <li>Treat hazardous materials</li> <li>Remove hazardous materials</li> </ul>	<ul style="list-style-type: none"> <li>After removal of infrastructure - runoff and seepage will be good quality water that is unlikely to affect known environmental values</li> <li>Remediate contamination so that runoff and seepage will not have unacceptable effects on known environmental values</li> </ul>	<ul style="list-style-type: none"> <li>Allow continued use of permanent infrastructure that is stable or is managed under a maintenance program</li> <li>Remove infrastructure, re-shape disturbed areas to resemble surrounding landscape and establish adequate vegetation cover</li> </ul>	<ul style="list-style-type: none"> <li>Avoid areas of remnant vegetation by locating infrastructure on previously cleared areas</li> <li>Reinstate original ecosystem</li> <li>Create a different use with enhanced environmental, economic or social values acceptable to stakeholders</li> <li>Return to previous use/ condition</li> </ul>
<b>May be acceptable</b>	<ul style="list-style-type: none"> <li>Containment of hazardous materials</li> </ul>	<ul style="list-style-type: none"> <li>Minimise runoff or seepage that is likely to have unacceptable effects on known environmental values e.g. by eliminating inflow through impervious capping</li> <li>Collect and treat seepage</li> </ul>	<ul style="list-style-type: none"> <li>Erosion rates higher than surrounding areas but an appropriate maintenance program proposed</li> </ul>	<ul style="list-style-type: none"> <li>Return to previous use, or a different use with reduced environmental, economic or social values (evidence that use is acceptable to stakeholders would be essential).</li> <li>Manage constrained use</li> </ul>
<b>Rarely acceptable</b>	<ul style="list-style-type: none"> <li>Unstable poorly designed structure</li> </ul>	<ul style="list-style-type: none"> <li>Seeping contaminated water to surface or ground water</li> </ul>	<ul style="list-style-type: none"> <li>Landform has doubtful stability</li> </ul>	<ul style="list-style-type: none"> <li>Unusable contaminated site that is not adequately managed</li> </ul>

## 5.2. EA holder to nominate indicators

The EA holder is responsible for nominating the indicators for the mining project and should consider the properties of good indicators when doing so.

As rehabilitation deals with complex systems, and the relationships between indicators and objectives may not be well understood at the mine planning stage, there needs to be appropriate mechanisms for reviewing the indicators if improved information or more cost effective rehabilitation techniques become available during the life of the mine. If the proposed change to an indicator is to be accompanied by a change in the rehabilitation objectives for a particular domain, an amendment of the environmental authority will be required. If there is likely to be a significant change to the level of environmental impact, the administering authority must require the amendment to be publicly notified.

For all indicators that are selected, the environmental authority holder will:

- state what objective(s) the indicator relates to;
- justify the selection of the indicator, including how the relationship between the indicator and the objective has been established (supported by references to authoritative sources or relevant monitoring data);
- state how the indicator is to be measured;
- state how the results will be reported and interpreted.

## 5.3. How the administering authority will consider the indicators

A major area of concern for government is the relevance of the indicators to the specific rehabilitation objectives for the mining project, and ultimately to the long term sustainability of the rehabilitation. To ensure that the indicators are relevant, it is recommended that monitoring of the indicators start as soon as possible and continue until the application to surrender the area has been approved by the administering authority (or beyond that time if a site management plan or transitional environmental program is in place). Presentation of a long time series of monitoring data is potentially the most credible way to demonstrate that the risk of rehabilitation failure is low and/or quantifiable. The monitoring will also assist in improving the validity of the completion criteria. Despite the monitoring, there may be some remaining risk that the rehabilitation was inappropriate or will fail and serious environmental harm will occur.

Examples of possible indicators for a selection of rehabilitation objectives are presented in Appendix A. For land use objectives, the indicators may range from simple quantitative measures of grazing capacity or crop yields to a complex array of indicators that might be needed to establish the viability of a native species ecosystem or its similarity to some analogue / reference site or baseline study. Two recent reviews of the use of indicators show the complexity of this issue at a regional scale and the need to establish the validity of a set of indicators for each specific site (Nichols, 2004; Tongway et al 2003).

## 6. Completion criteria

### 6.1. Setting completion criteria

The completion criteria must provide a clear definition of successful rehabilitation for each domain at the mine site in the form of a set of measurable benchmarks against which the rehabilitation indicators can be compared to determine whether the objectives are being met. At least one completion criterion must be developed for each indicator. Completion criteria should specifically relate to the environmental, social and economic context of the mine site. However, it is possible that some completion criteria may be applied uniformly across a region if supported by technical evidence.

## Rehabilitation requirements for mining resource activities

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The criteria should be developed in consultation with stakeholders (e.g. the landowner, local government, indigenous groups, community groups and various State departments). The criteria are of importance to landowners because they may set limitations on the agreed future land use and expose the landholder to risks and potential costs associated with maintaining the former mine site in a safe and productive condition.

The applicant is required to propose completion criteria in their application documents during the application process. If these are based on relevant regional or local studies of successful mine rehabilitation, then the administering authority will include these criteria or modified versions of the proposed criteria in the environmental authority as rehabilitation conditions. The administering authority will require a risk assessment of possible failure modes for the rehabilitation, based on their consequences and probabilities of occurrence. The option to require a cash residual risk payment may defuse some potential debates about what is achievable by making the justification of rehabilitation costs a commercial decision. However, the administering authority may refuse to accept rehabilitation that is clearly not sustainable. Some examples of the type of completion criteria that might be developed are provided in Appendix A.

Note that not all of the indicators and criteria listed in the Appendix would be required for all of the goals at all mines and that specific percentages and other numbers are indicative only.

The quantitative value of a particular criterion may vary significantly from mine to mine or even between domains within a single mine depending on the nature of the disturbance, climate, topography, soil characteristics and other factors. The rehabilitation objectives will guide the selection of the indicators and the specific completion criteria. For example, stability could be reflected in criteria that do not allow erosion of materials from the disturbed areas at rates that exceed natural rates for the locality (and that may range from 1 t/ha/yr in western Queensland to more than 100 t/ha/yr in wet coastal areas). The criterion would be set at an appropriate rate, and in some cases a maintenance program may need to be developed to repair eroded areas, especially if the eroding material is contaminated or the erosion is likely to expose contaminated material.

As another example, if the outcome is to re-establish (as closely as possible) the native ecosystem that was on the mine site there may be an array of vegetation-related criteria. These may emphasise specific species, species diversity, wildlife corridors or fauna re-population. The criteria may require high levels of similarity with baseline studies or reference sites. If the vegetation is of greatest relevance as erosion control, the criteria may focus on canopy foliage cover; ground cover or the biomass developed per unit area. Comparisons with reference sites may be used as an indirect indicator of how sustainable the rehabilitated ecosystem is likely to be. If the vegetation is for aesthetic purposes, a criterion may be the abundance of a nominated species.

If the desired outcome is not related to native vegetation (e.g. the future land use is to be agriculture, grazing, urban development, waste disposal or recreation), native vegetation criteria are likely to have limited, if any, application within the site. Other criteria such as agricultural productivity, chemical and geotechnical stability, and water runoff quality/quantity may become relatively more significant. In some cases certification that a structure is meeting engineering specifications may be appropriate criteria (e.g. for tailings dam walls, waste rock dump slopes, erosion rates or void slope stability).

In areas where suitable rehabilitation information is not available, the applicant may be required to establish a research program. It may benefit the potential applicant to commence this research before an application is made for a mining lease (i.e. while the applicant holds a mineral development licence). As a fallback, this research may occur after an application is made during the preparation of an environmental impact statement. Where neither of these options is possible, the environmental authority must contain criteria based on similar mines or general research and should contain a condition requiring the commencement of on-site trials to verify or modify these criteria within a relatively short timeframe (e.g. less than two years). The absence of field trials to verify the criteria is not justification for omitting completion criteria from the application documents.

## 6.2. Monitoring and changing completion criteria

Once the criteria are established, the environmental authority holder will be expected to collect relevant information to assist the administering authority to make decisions about the adequacy and sustainability of the rehabilitation. Progressive certification of rehabilitation requires the administering authority to make the decision on whether rehabilitation is satisfactory possibly several years before the final rehabilitation application is made. In that time monitoring of the rehabilitation will continue and may disclose inadequacies in the earlier rehabilitation.

The later information does not invalidate the earlier certification unless the rehabilitation ceases to meet the original completion criteria. However, it may be used to reassess the residual risk. If the residual risk payment is likely to increase substantially or there are technical or social reasons for change, the holder may apply to amend the rehabilitation objectives and/or change the indicators or completion criteria.

A similar consultation process should be undertaken if there is a need to change the criteria because of subsequent rehabilitation research, strong community concerns or improved technology. The environmental authority must be amended and the amendment must be publicly notified if it is likely to increase the level of significant environmental harm or a significant change in the impacts on environmental values, including land use capability. If the amendment is granted, the new requirements will be taken into account at final surrender to assess the rehabilitation and to calculate the residual risk.

Monitoring of the indicators for an area of progressive rehabilitation should result in a clarification of issues, minimisation of risks and an increasing certainty in the sustainability of the rehabilitation. Where there is evidence of decreasing potential environmental harm, the monitoring of low risk matters may become unnecessary. However, unless the environmental authority is amended, evidence that the low risk matters are continuing to meet the relevant completion criteria will still be required at the time of surrender.

## 7. Certification or surrender

### 7.1. The assessment process

The certification or final sign-off of rehabilitation requires the appropriate application form to be completed and adequate information to be provided by the applicant in a rehabilitation report. This includes evidence that the rehabilitation meets the completion criteria and a risk assessment. The benefits of providing high quality information include expediting the assessment by the administering authority, improving the likelihood of a positive outcome, and minimising any necessary residual risk payment. The administering authority regards the surrender as a very significant decision as it effectively transfers future liabilities at the site from the mining company to the State and in some cases to the landowner. The administering authority will establish a Progressive Rehabilitation Advisory Committee (PRAC) consisting of senior staff members with a range of technical skills relevant to rehabilitation. The PRAC will consider any rehabilitation application for a mining resource activity that is an ineligible ERA mining project, and will be available to discuss critical issues with the applicant. The PRAC will have an advisory role and provide recommendations to the decision-making delegate, based on the wide experience of its members and external advisors, if necessary.

The completion criteria are an important component of the certification process and need to be agreed before the application can proceed. The other necessary component is clear and comprehensive information on the performance of the rehabilitation from when it was undertaken until when the application for certification or surrender is made. This information is required in the progressive or final rehabilitation report that must accompany the application for certification or surrender. The administering authority may seek advice from landholders, other government departments or technical experts when deciding the application.

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To minimise delays in the assessment process, the mining tenement holder should provide this information together with an interpretation of its significance by an appropriately qualified person. The number of measurement sites and the monitoring period will vary due to differences in the size of mines, climate and the complexity of ecosystems being established. Most mine sites are listed on the Environmental Management Register and to be removed from the register they require a site investigation and suitability report. If they remain on the register a site management plan (under s. 401 of the EP Act) must be lodged before or with the final surrender application. It must include the landowners' agreement to the proposed management arrangements for the contamination and be approved by the administering authority. A compliance statement will also be required from an appropriately qualified person on behalf of the holder of the environmental authority.

Before the administering authority issues a certificate for progressive rehabilitation, it will require any residual risk payment to be made. This can be in a bank guarantee with the financial assurance for the mining project. This may be paid in cash or bank guarantee. If the application is for the final surrender of a tenement, the administering authority will require the total residual risk payment to be made in cash, even if it includes amounts that were covered by a bank guarantee when progressive certification was granted for all or part of the area. The administering authority must decide whether the rehabilitation is satisfactory or meets other requirements such as an approved transitional environmental program or site management plan. The administering authority will consider whether the conditions of the environmental authority and any environmental protection policy (EPP) requirements have been met, the final or progressive rehabilitation report, any assessment report on the rehabilitation report, the risk assessment report, the compliance statement, any site investigation conducted with regard to the contaminated land provisions of the EP Act and the standard criteria in Schedule 4 of the EP Act.

The rehabilitation will be accepted if the procedures outlined in this guideline demonstrate that it meets the specific objectives set for the mine site in its environmental authority.

### **7.2. Relationship between completion criteria and residual risk**

The completion criteria must be met in order to obtain either certification of progressive rehabilitation or approval of a surrender application (involving final rehabilitation). Some of the criteria may require achieving a nominated value for an indicator for a specified time period. Others may require evidence that the nominated value has been achieved, or is expected to be achieved, on the basis of current trends. The latter is potentially a higher risk option and that would be reflected in the residual risk calculation described below.

Because natural processes and human activities may have adverse effects on rehabilitation, it is possible that a site that meets a criterion at one time may fail to meet the same criterion at some future time. Even if all criteria are met for several years, there is no guarantee that the rehabilitation will not fail in the future. The risk of failure is called the residual risk. A risk assessment that considers the following should be used to determine how to calculate residual risk:

- what components of the rehabilitation are most likely to fail (hazards)
- the likelihood of failure
- the consequences of failure.

For any given set of completion criteria, the cost of rehabilitation will depend to some extent on the length of time that the rehabilitation is designed to meet the criteria. If more costly rehabilitation were undertaken, the risk of failure within a specified time period would generally decrease. This would be reflected in a requirement for a lower residual risk payment. It is a commercial decision for the mining company whether it should design its rehabilitation to a standard that goes beyond compliance with the environmental authority and be rewarded by a lower residual risk payment.

### 7.3. Use of the risk assessment in decision making

Risk assessment involves measures of likelihood and consequence of a potentially hazardous event. In order to quantify the risk, both likelihood and consequence need to be estimated quantitatively. That means likelihood will be identified as the probability of rehabilitation failing to meet completion criteria within specific timeframes after certification or approval and consequence will be estimated as the cost of managing the hazardous event.

The probability of rehabilitation failure will usually be established from estimates of the minimum time before the rehabilitation has a 50 percent probability of failure and the variance of that estimate. In some cases it will be possible to model when a particular structure may fail, or to predict when a final void is likely to overflow on the basis of empirical measurements at the mine. In other cases there may be empirical data from nearby mines or theoretical calculations based on general scientific principles. If relevant scientific data is not available, anecdotal evidence from this or nearby mines may be of some use. However, there will be cases where the only source of information will be the best estimate of people with extensive experience in particular aspects of rehabilitation. A risk assessment based on poor data will have relatively high levels of uncertainty that would be factored into the administering authority decision on whether or not to accept the application.

While estimates of probability of failure would normally assume that the proposed land use will occur, the estimates may not be relevant if the rehabilitated land is used for a purpose other than the specified/agreed use. This needs to be considered where an alternative/more intensive use may occur without constraint. As indicated in Section 2.3, there are few legislative constraints on future land use and most of these (except site management plans and nature refuges) depend on voluntary actions by the land owner.

The consequence of a hazardous event will be estimated as the cost of management if the event happened at the present time. A consequence that does not reach the threshold of material environmental harm, i.e. an actual or potential loss to property or rehabilitation costs of at least \$5000 within the first year period, will not be considered in calculations. Because risk is defined as the product of likelihood and consequence, the threshold for consideration will be set at a risk-cost of \$5000 per year to provide consistency with material environmental harm.

The first decision the administering authority must make is whether to accept the rehabilitation for certification or approval of surrender. Certification or approval is unlikely to occur unless the likelihood of failure of the rehabilitation to meet the required outcomes over the medium term (e.g. at least 30 years) is expected to have a low probability (e.g. less than 0.01). If there is a higher probability of failure that would exceed the risk-cost threshold in the medium term, the administering authority would generally determine that the risk of failure is unacceptable. However, in some cases the failure would be accepted because the company has proposed a financial scheme to cover ongoing costs, such as a sinking fund. This type of arrangement is only likely to be an appropriate solution if maintenance is required for a short period. An alternative rehabilitation strategy would be needed if perpetual maintenance (in excess of the maintenance that would normally be required to undertake the proposed land use on un-mined land) is considered necessary to deliver a sustainable outcome.

The second application of the risk assessment is to assist the administering authority in determining whether any residual risk payment will be required and if so, how much will be required. Because these costs are likely to occur at some future time, standard accounting procedures should be used to establish the net present value (NPV) of the consequences. Note that the NPV is not used in calculating the risk-cost of the incident.

## 8. Dealing with existing mines

### 8.1. Mines with clear rehabilitation objectives

Historic rehabilitation must be evaluated against the rehabilitation requirements that were in place for the mining project at the time the rehabilitation was completed. This could lead to a matrix of different rehabilitation

## Rehabilitation requirements for mining resource activities

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outcomes within a single domain. For example, over a period of time the species mix may have been changed in response to earlier experience or changing community expectations. The following does not deal with mines operating under Special Agreement Acts (see section 614 of EP Act).

Mines operating prior to September 1990 may have had special lease conditions relating to rehabilitation. Many would have had no specific rehabilitation requirements. Otherwise they may have been subject to rehabilitation conditions applied under section 60(2) of the *Mining Act 1968* or under section of the *Mining Act 1968*, which gave the Minister discretion to require the tenement holder to:

- undertake certain activities if directed by the Minister;
- level the surface and otherwise restore the land to its original condition (as nearly as may be);
- reinstate (as nearly as may be) the natural contours and channel of every watercourse.
- The standard wording used typically was even more stringent and required:
- shaping the area so that it conforms as far as reasonably practicable with the surrounding topography;
- reforming all drainage lines, waterways and creek beds to stable contours and as near as reasonably practicable to the situation existing prior to mining;
- achieving a post mining land use capability across the lease area equal with that pre-existing the Lease, where this is technically feasible.

Between 1 September 1990 and 1 May 1995, all mining leases that were current under the *Mineral Resources Act 1989* (MR Act) had a condition that the holder shall undertake rehabilitation to the satisfaction of the Minister for Mines (section 7.33(1)(d)). From June 1992 until 1 January 2001 a Department of Mineral Resources policy, *Environmental Management for Mining in Queensland 1992*, explained how those requirements were to be defined in an *Environmental Management Overview Strategy (EMOS)*. An amendment to section 276 of the MR Act in May 1995 made the preparation of an EMOS a statutory requirement. Every EMOS that had been accepted or approved (except for mines operating under Special Agreement Acts) were validated by section 585 of the EP Act. Also in 1995, the Minister for Mines and Energy was prevented from accepting the surrender of a mining lease, unless the Minister was satisfied that the holder had satisfactorily rehabilitated the land (section 309(5) of MR Act).

Rehabilitation completed prior to 2001 would generally not be assessed against the current legislation or the policy position proposed in this guideline. Where rehabilitation was completed prior to the preparation of an accepted EMOS, the rehabilitation requirements may have been in:

- the instrument of lease;
- special conditions imposed by the minister at grant, renewal or assignment;
- a direction by the Minister for Mines under section 309(3) of the MR Act; or
- a decision of the Mining Warden.

Between 1992 and 1996, almost every mining project prepared an EMOS. Most will have identified at least one rehabilitation objective (typically low intensity grazing), but few will have established indicators that can be used to measure the success of the rehabilitation and even fewer will have any specific completion criteria.

Where there is a clear intention for the rehabilitation to achieve a specified objective, the administering authority will consider applications for surrender or progressive certification from the environmental authority holder on the basis of that objective. The application must show how the holder has rehabilitated the site to achieve the objective, and provide evidence to support the success of the rehabilitation. This success must be demonstrated for the four rehabilitation goals described in Section 3.1 above (and any other site specific goals that are appropriate).

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As the overall rehabilitation objective for these mining projects is likely to be some form of agreed post-mining land use, the environmental authority holder will be expected to demonstrate that the land use has been established and is sustainable. If on-going maintenance needs are likely (above the level that would typically be required for the specified land use in that locality), an explanation of how the holder intends to fund those costs is required.

A site that is unsafe (or is likely to become unsafe because of stability issues) would not be accepted as adequately rehabilitated. Similarly a site that is causing, or likely to cause, material or serious environmental harm (e.g. water pollution) would not be accepted as being successfully rehabilitated. If an environmental risk assessment shows that the risk cost of the rehabilitation failure exceeds the threshold set by the administering authority (currently \$5000), the applicant will be required to nominate an appropriate amount as the residual risk payment. A site that is likely to require on-going maintenance would not normally be accepted without a fully funded maintenance program.

### 8.2. Mines without clear rehabilitation objectives

The rehabilitation requirements that applied at the time the rehabilitation was completed will be considered. However, if those requirements do not clearly define rehabilitation objectives, the environmental authority holder should apply to amend the environmental authority to define rehabilitation objectives, indicators and completion criteria for the site that are consistent with the four rehabilitation goals described in Section 3.1 above. Public notice of this application will be required and public objection rights will apply to any new rehabilitation objectives and any associated amendments that are likely to cause a significant increase in environmental harm. Approval of any amendment application will be required before an application for surrender or progressive certification of rehabilitated areas can be decided. An application that provides a strategy to ensure that the proposed future land use will be adopted would reduce some of the uncertainty that may delay decision making.

An environmental risk assessment and residual risk calculations must also be included with the application. If the rehabilitation meets the rehabilitation requirements that were in place at the time the rehabilitation was completed and there is an acceptably low risk of environmental harm occurring from the site, a certification application should be accepted. Acceptance of a surrender application may require lodgement of an appropriate residual risk payment.

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## 10. Further information

The latest version of this publication can be found at [www.des.qld.gov.au](http://www.des.qld.gov.au) using the publication number ESR/2016/1875 as a search term.

### Disclaimer

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## Appendix A – Examples of possible rehabilitation objectives, indicators and completion criteria

REHABILITATION GOAL	POSSIBLE REHABILITATION OBJECTIVES	POSSIBLE INDICATORS	NATURE OF COMPLETION CRITERIA
Long-term safety	Site is safe for humans and animals now and in the foreseeable future	<ul style="list-style-type: none"> <li>• Safety assessment of openings</li> </ul>	<ul style="list-style-type: none"> <li>• Certification in rehabilitation report that openings are now safe and will remain so</li> </ul>
		<ul style="list-style-type: none"> <li>• Safety assessment of slopes that are &gt;30° and &gt;5m in height</li> </ul>	<ul style="list-style-type: none"> <li>• Certification in rehabilitation report that slopes are safe and predictions about future safety</li> </ul>
		<ul style="list-style-type: none"> <li>• Exposure to and availability of heavy metals and other toxic materials (selected because of relevance to site)</li> </ul>	<ul style="list-style-type: none"> <li>• Certification in rehabilitation report that specified cover thickness (and/or other specific criteria) is in place and predictions about future changes</li> <li>• Evidence in rehabilitation report that dust monitoring results have complied, and will continue to comply, with limits (derived from EPP Air or other agreed reference source)</li> </ul>
			<ul style="list-style-type: none"> <li>• Evidence in rehabilitation report that measures required in site investigation report have been implemented</li> <li>• Leaching tests of exposed material meet specified guideline values (using standard protocols such as US EPA Toxic Characteristic Leaching Procedure)</li> <li>• Evidence that monitoring surface water quality for [X] years has complied with specified guideline values (derived from ANZECC 2000 or agreed reference source)</li> <li>• Site management plan to include measures for fire reduction and to control woody weeds</li> </ul>
		<ul style="list-style-type: none"> <li>• Adequacy and predicted long-term performance of safety barriers</li> </ul>	<ul style="list-style-type: none"> <li>• Evidence in rehabilitation report that adequate safety plan has been implemented</li> </ul>
Non-polluting	Hazardous material adequately managed	<ul style="list-style-type: none"> <li>• Technical design of capping</li> </ul>	<ul style="list-style-type: none"> <li>• Engineers certification of construction and maintenance to design performance stated in environmental authority or application documents</li> </ul>

Rehabilitation requirements for mining resource activities

REHABILITATION GOAL	POSSIBLE REHABILITATION OBJECTIVES	POSSIBLE INDICATORS	NATURE OF COMPLETION CRITERIA
			<ul style="list-style-type: none"> <li>Evidence that X years monitoring data demonstrates that capping is functioning according to environmental authority</li> </ul>
		<ul style="list-style-type: none"> <li>Results of site investigation report</li> </ul>	<ul style="list-style-type: none"> <li>Removed from Environmental Management Register or Adequate funds to implement approved site management plan</li> </ul>
	Acid mine drainage will not cause serious environmental harm	<ul style="list-style-type: none"> <li>Technical design of barriers</li> </ul>	<ul style="list-style-type: none"> <li>Engineers certification of construction and maintenance to specified design performance</li> </ul>
	(a) by excluding water and/or air from sulphides		
	Or	<ul style="list-style-type: none"> <li>Hydrostatic head / temperature in waste rock piles</li> </ul>	<ul style="list-style-type: none"> <li>Certification that monitoring data show no unexpected rise of water levels or temperature</li> </ul>
	( b) by implementing a treatment system to remove acidity	<ul style="list-style-type: none"> <li>Downstream surface/groundwater monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Certification in rehabilitation report that water neutralisation system is meeting and will continue to meet design requirements</li> </ul>
	Polluted water contained on site	<ul style="list-style-type: none"> <li>Downstream surface/groundwater monitoring</li> </ul>	<ul style="list-style-type: none"> <li>Certification that water diversion/containment structures to minimise quantities of polluted water and containing it on site are effective</li> <li>Certification that monitoring data meet specified criteria relevant to potential contaminants</li> </ul>
Stable	Very low probability of subsidence or rock falls with serious consequences (link to environmental harm?)	<ul style="list-style-type: none"> <li>Geotechnical studies of existing structures, underground workings, high walls or voids</li> </ul>	<ul style="list-style-type: none"> <li>Evidence in rehabilitation report that appropriate risk assessment has been undertaken and control measures are in place</li> </ul>
		<ul style="list-style-type: none"> <li>Past record of subsidence or rock falls in this mine</li> </ul>	<ul style="list-style-type: none"> <li>Evidence in rehabilitation report that appropriate control measures are in place to prevent recurrence</li> </ul>

## Rehabilitation requirements for mining resource activities

REHABILITATION GOAL	POSSIBLE REHABILITATION OBJECTIVES	POSSIBLE INDICATORS	NATURE OF COMPLETION CRITERIA
	Very low probability of slope slippage with serious consequences (link to environmental harm?)	<ul style="list-style-type: none"> <li>Geotechnical, geochemical and hydrological studies of existing structures (outer batter slopes of waste rock dumps &amp; tailings storage facilities)</li> </ul>	<ul style="list-style-type: none"> <li>Evidence in rehabilitation report that appropriate risk assessment has been undertaken and control measures are in place that will continue to meet agreed requirements</li> </ul>
		<ul style="list-style-type: none"> <li>Past record of slope failure in this mine</li> </ul>	<ul style="list-style-type: none"> <li>Evidence in rehabilitation report that appropriate control measures are in place to prevent recurrence</li> </ul>
	Landform design achieves appropriate erosion rates	<ul style="list-style-type: none"> <li>Slope angle and length</li> </ul>	<ul style="list-style-type: none"> <li>Slopes <math>&lt;12\alpha</math> (or other value determined for particular waste material and climate)</li> </ul>
		<ul style="list-style-type: none"> <li>Engineered structures to control water flow</li> </ul>	<ul style="list-style-type: none"> <li>Evidence in rehabilitation report that required contour banks, channel linings, surface armour, engineered drop structures, etc are in place and functioning</li> </ul>
		<ul style="list-style-type: none"> <li>Rate of "soil" loss</li> </ul>	<ul style="list-style-type: none"> <li>Evidence in rehabilitation report that measured erosion rates meet limits set from reference sites, regional studies or by agreement (e.g. derived from in situ trials or calculated from Universal Soil Loss Equation or similar agreed method)</li> </ul>
	Vegetation cover to minimise erosion	<ul style="list-style-type: none"> <li>Vegetation type and density</li> </ul>	<ul style="list-style-type: none"> <li>Evidence that the vegetation type and density are of species suited to the spoil/waste composition, slope, aspect, climate and other factors, and that the measured erosion rates meet the limits set (only relevant to stability where root systems are a major control of erosion).</li> </ul>
		<ul style="list-style-type: none"> <li>Foliage cover</li> </ul>	<ul style="list-style-type: none"> <li>Evidence that the percent cover meets the set values based on the regional assessment of cover requirements (Note: Values in excess of 70% are typically needed to protect surface soils from rain-induced erosion. In arid areas achievable values are likely to be much lower (perhaps less than 50%) and in high rainfall areas the values may be higher).</li> </ul>
		<ul style="list-style-type: none"> <li>Leaf litter, humus, depth of growing medium</li> </ul>	<ul style="list-style-type: none"> <li>Evidence that nutrient cycling is occurring and the presence of leaf litter is assisting in limiting erosion of the soil/spoil surface.</li> </ul>

## Rehabilitation requirements for mining resource activities

REHABILITATION GOAL	POSSIBLE REHABILITATION OBJECTIVES	POSSIBLE INDICATORS	NATURE OF COMPLETION CRITERIA
Sustainable land use	Soil properties that support and will continue to support desired land use (The soil indicators are less likely to be used for completion criteria than as planning tools to improve chances of other outcomes being achieved)	<ul style="list-style-type: none"> <li>Chemical properties (e.g. pH, salinity, nutrients, trace elements) of topsoil and in soil profiles that are within range of roots of proposed vegetation</li> </ul>	<ul style="list-style-type: none"> <li>pH in range 5.0 to 8.5 (narrower range if necessary to achieve specific outcomes or broader range depending on local conditions)</li> <li>Salinity &lt; 0.2% chloride (lower levels if necessary to achieve particular outcome or broader range depending on local conditions).</li> <li>Evidence that highly saline material should not be used as surface cover or potential growth medium</li> </ul>
		<ul style="list-style-type: none"> <li>Physical properties (e.g. depth of top soil, water infiltration, crusting, slope)</li> </ul>	<ul style="list-style-type: none"> <li>Limits set from reference sites, regional studies or agreed conditions (e.g. derived from trials)</li> </ul>
		<ul style="list-style-type: none"> <li>Biological properties (e.g. nutrient cycling, microbial biomass, invertebrates)</li> </ul>	<ul style="list-style-type: none"> <li>(Completion criteria for such indicators may require site trials because they will be specific to the site)</li> </ul>
	Establish specified self-sustaining natural vegetation or habitat	<ul style="list-style-type: none"> <li>Presence of key species</li> <li>Species type and diversity</li> <li>Abundance of weeds</li> </ul>	<ul style="list-style-type: none"> <li>Certification that key species are present</li> <li>Certification that species diversity achieved</li> <li>Certification that weed management successful</li> </ul>
	Establish specified water body with low risk of environmental harm	<ul style="list-style-type: none"> <li>Hydrological studies to establish water levels and connectivity</li> <li>Water quality established by monitoring or modelling validated by monitoring</li> <li>Structural report on integrity of structure</li> </ul>	<ul style="list-style-type: none"> <li>Certification that water body will not overflow in 1:100 ARI event (or less frequent event if containing hazardous material)</li> <li>Monitoring specified contaminants (e.g. pH, As, cyanide) for X years</li> <li>Meets specified water quality guidelines</li> <li>Hydrologists report</li> <li>Engineers certification of structure</li> </ul>
	Establish land use with comparable management requirements to similarly used non-mined land.	<ul style="list-style-type: none"> <li>Crop productivity</li> <li>Achieve agreed capability distribution</li> </ul>	<ul style="list-style-type: none"> <li>Meets specified yield (e.g 90% of unmined land or 20% of unmined land)</li> </ul>

## Appendix B – Definitions

Term	Definition
Appropriately qualified person	The person or persons should have qualifications and/or experience that are relevant to aspects of the rehabilitation so they can give an authoritative assessment of the performance of that aspect of the rehabilitation, especially in relation to the completion criteria.
Completion criteria	These are the standards that are to be met by successful rehabilitation. They will generally be in the form of numerical values that can be verified by measurement of the indicators selected for the rehabilitation objectives. They may include an element based on time, e.g. the criterion has been achieved for 7 consecutive years for 95 percent of the area.
Consultation	The act of providing information or advice for, and seeking responses to, an actual or proposed event, activity or process.
Domain	<p>Land management units within a mine site, usually with similar geophysical characteristics.</p> <p>Some examples of typical domains include:</p> <ul style="list-style-type: none"> <li>• Mine pit</li> <li>• Waste rock piles</li> <li>• Tailings dam</li> <li>• Infrastructure area</li> </ul> <p>Within domains, elements may be designated where different rehabilitation techniques and/or timing of work is required, e.g. an access road</p>
EA	Environmental authority
Environmental hazards	These are chemical, physical or biological changes that may cause environmental harm to one or more environmental values.
Goals	These are the policy objectives for rehabilitation that are set (often informally) by Government.
Indicator	An indicator is something that can be measured and audited according to an established protocol and used to evaluate changes in a system.
Land capability class	Classification of the capacity of land to achieve and sustain specified land uses. Class I land is capable of supporting most agricultural and grazing activities whilst class VIII land imposes severe limitations on agricultural or grazing uses. "Average" management inputs are assumed.

## Rehabilitation requirements for mining resource activities

Term	Definition
Objectives	The end points that rehabilitation aims to achieve. They may be described in terms of future land use, biodiversity values, conservation values, health and safety outcomes, aesthetics or social outcomes or combinations of these.
Rehabilitation	<p>Rehabilitation is the process of making a former mine site safe, stable and self-sustaining.</p> <p>Note: This usage is far broader than rehabilitation's literal meaning of re-establishing former condition or effectiveness. While it may be appropriate to attempt to restore the pre-mining conditions after mining has ceased for some smaller mines and mines in areas with special values, this may not be possible or an optimum result across mine sites particularly in specific domains.</p>
Residual risk	<p>Residual risk is defined in schedule 4 of the EP Act to include the risk that:</p> <ul style="list-style-type: none"> <li>• apparently satisfactory rehabilitation will fail in the foreseeable future and require repair, replacement or maintenance;</li> <li>• the area will need ongoing management; or</li> <li>• contaminants will be released and potentially cause environmental harm that requires monitoring or management.</li> </ul>
Stable	Resistant to change in landform, pollution generation or land use potential to an extent that is similar to unmined land in the locality. The acceptable rates of change of specified parameters or the maximum risk of specified environmental harm may be set in an environmental authority.
Stakeholder	A person or organisation that is potentially affected by a decision, such as a resident, land owner, community group, government agency, company, traditional owner, or environmental group.
Suitably qualified person	A person whose professional training or experience is relevant to the matter being considered.