



**NSW
Resources
Regulator**

GUIDELINE

REHABILITATION RISK ASSESSMENT



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Contents

Purpose of this guideline 3

Our role..... 3

Role of the lease holder..... 4

Glossary..... 11

Department guidance 16

Purpose of this guideline

Conditions of a mining lease granted under the *Mining Act 1992* require the lease holder to conduct a rehabilitation risk assessment and implement measures to eliminate, minimise or mitigate the risks.

The purpose of this guideline is to assist lease holders to identify and evaluate the potential risks to achieving the final land use and identify the specific measures to be implemented to mitigate those risks by undertaking a rehabilitation risk assessment.

Our role

The rehabilitation risk assessment is not required to be submitted to us for approval. However, in accordance with mining lease conditions, lease holders must keep appropriate records documenting the rehabilitation risk assessment, including how it has been evaluated over the term of a mining lease.

The rehabilitation risk assessment is to be made available to us upon request. We have the regulatory power to direct a lease holder to implement further measures if it is considered that a risk assessment and associated controls are unlikely to result in acceptable rehabilitation outcomes in a satisfactory timeframe.

To assist industry, we have conducted a risk assessment focusing on rehabilitation. This was conducted in consultation with industry stakeholders and other government agencies. The bowtie risk assessment method was used to clearly display the links between the potential causes, the preventative and mitigative controls and the consequences of the material unwanted event - being where the post-mining conditions and environment are unsuitable to support the final land uses. The bowtie assessment addressed the rehabilitation risks during the operational mining phase and the rehabilitation phase. This risk assessment can be accessed on our [website](#).

The outcomes of our risk assessment have been incorporated into this document to provide guidance to industry on the range of risks associated with the establishment of sustainable mine rehabilitation, which can be considered in site-specific rehabilitation risk assessments when developing and implementing rehabilitation management plans. The range of risks presented in this guideline should not be considered as an exhaustive list but should be considered as a minimum by lease holders when conducting site specific risk assessments.

As part of our compliance and enforcement approach, we have implemented a targeted assessment program (TAP) focusing on the industry's implementation of critical risk controls. The TAPs comprise inspections across mine sites in NSW to ensure measures have been identified and implemented to facilitate sustainable rehabilitation outcomes. The bowtie rehabilitation risk assessments have been

used by us to identify critical risk controls. Further information on critical controls for rehabilitation and the TAPs program can be accessed on our website.

Role of the lease holder

This section sets out the requirements for conducting a rehabilitation risk assessment to identify and evaluate all potential risks to achieving the final land use and the specific measures to be implemented to mitigate those risks. To comply with the requirements of Schedule 8A of the Mining Regulation 2016, the lease holder is required to:

1. conduct a rehabilitation risk assessment that:
 - identifies, assesses and evaluates the potential risks to achieving the rehabilitation objectives, rehabilitation completion criteria and (for large mines) the final land use as spatially depicted in the final landform and rehabilitation plan
 - identifies the specific risk control measures that need to be implemented to eliminate, minimise or mitigate the risks¹
 - identifies how the effectiveness of the risk control measures will be assessed.
2. conduct the rehabilitation risk assessment:
 - before preparing a rehabilitation management plan (for large mines only)
 - before preparing the rehabilitation outcome documents for the mine
 - whenever a hazard is identified that presents a risk of rehabilitation not achieving the final land use
 - whenever directed to do so by the Secretary.
3. implement the measures identified to eliminate, minimise or mitigate the risks.
4. prepare a rehabilitation management plan (for large mines only) which:
 - provides an overview of the key risks to achieving the rehabilitation objectives, rehabilitation completion criteria and the final land use
 - incorporates the risk control measures identified in the rehabilitation risk assessment

¹ The rehabilitation risk assessment needs to be specific to the actual causes and risk controls and not default to merely referencing ancillary management plans.

- identifies triggers and controls/actions to manage/respond to risks to rehabilitation performance and outcomes.
5. keep and maintain risk assessment records, trigger action response plans, and records on the effectiveness of mitigations and management controls (refer to *Guideline: Rehabilitation records*).
 6. ensure that the effectiveness of the rehabilitation risk assessment and controls adopted in the life of mine progressive rehabilitation schedule and rehabilitation phases are routinely evaluated throughout the life cycle of a project. An updated/new rehabilitation risk assessment will be required whenever:
 - any risk control measures are updated (e.g. in circumstances where revised controls are required to replace those that have been assessed as not being effective)
 - any foreseeable hazard is identified that presents a risk to achieving the rehabilitation objectives, the rehabilitation completion criteria and, for large mines, the final landform and rehabilitation plan.

Mandatory requirements associated with managing risks to rehabilitation are detailed in the *Form and way: Rehabilitation management plans for large mines*.

To satisfy mining lease conditions, it is recommended that lease holders:

- refer to *AS NZS ISO 31000:2018 Risk Management – Guidelines* to support any rehabilitation risk assessment
- refer to the bowtie risk assessment conducted by us which addresses the rehabilitation risks during the operational and rehabilitation phases and can be used to inform site specific rehabilitation risk assessment. This can be accessed on our website
- undertake the rehabilitation risk assessment as a component of a broader risk assessment conducted for the broader mining project
- ensure the rehabilitation risk assessment is undertaken by appropriately skilled people representing a cross section of the workforce
- ensure the level of detail in the rehabilitation risk assessment is proportionate to the type and scale of activities likely to cause disturbance, as well as the sensitivities of the surrounding environment
- ensure the rehabilitation risk assessment remains current and relevant to the mining operations.

Table 1 sets out a non-exhaustive list of potential risks that a lease holder may consider as part of a rehabilitation risk assessment throughout all phases of mining operations.

The relevance of controls to achieve effective rehabilitation should be determined based on the site-specific risk assessments conducted by a lease holder. A rehabilitation risk assessment can be brief or very detailed. The length and complexity of a rehabilitation risk assessment will depend upon the scale of activities likely to cause disturbance and the potential risks to effective rehabilitation.

The rehabilitation risk assessment should be used not only to establish a basis for managing a risk when planning an activity, but also used and updated (as required) to continuously evaluate risk and the effectiveness of controls used to prevent or minimise impacts (refer to *Guideline: Rehabilitation controls*).

Table 1: Rehabilitation risk assessment – potential risks**POTENTIAL RISKS****1. General**

- Insufficient skills and experience of rehabilitation personnel.
- Lack of clearly defined responsibilities.
- Insufficient funding for or prioritisation of rehabilitation activities.

2. Active mining phase of rehabilitation

- Biological resource salvage and maintenance (e.g. subsoil, topsoil, vegetative material, seedbank, rocks, habitat resources) through clearing, salvage and handling practices.
- Limited pre-existing biological resources for salvage (e.g. topsoil, weeds)
- Clearing in adverse seasonal and weather conditions when salvaging biological resources.
- Adverse geochemical/chemical composition of materials such as overburden, interburden, processing wastes, subsoils and topsoils and imported cover materials.
- Handling and containment of geochemical and geotechnically unsuitable tailings and reject materials.
- Adverse surface and groundwater quality and quantity (underground and surface operations).

3. Decommissioning phase of rehabilitation

- Impacts on heritage items.
- Hazards associated with retained infrastructure.
- Contamination resulting from associated activities (e.g. storage and use of hydrocarbons/chemicals, drilling fluids, spillage of dirty or produced saline water, brine, sewage).
- Generation of material and waste products from the demolition process.
- Groundwater accumulation in former underground workings (e.g. potential for fill and spill or impacts on regional ground water users).

POTENTIAL RISKS

- Exposure or access to underground workings.
- Habitation of structures and/or underground workings by native fauna (e.g. bats).

4. Landform establishment phase of rehabilitation

- Unstable landform due to erosion and/or mass movement issues associated with inappropriate design and/or quality assurance during landform construction.
- Exposure or release of geochemical and/or geotechnically adverse material (typically tailings or waste rock) associated with containment design and construction, including capping/cover system, drainage and liner (if required).
- Lack of availability of suitable materials for encapsulation or capping of adverse materials.
- Borehole or gas well seals failure.
- Final landform unsuitable for final land use (e.g. large rocks present affecting cultivation, settlement and surface subsidence leading to extended ponding).
- Landform aspect not suitable for intended target plant species.

5. Growth medium development phase of rehabilitation

- Physical and structural properties of substrate.
- Subsoil and topsoil deficit for rehabilitation activities.
- Substrate inadequate to support revegetation or agricultural land capability (e.g. lack of organic matter, nutrient deficiency, lack of soil biota, adverse soil chemical properties, exposed hostile geochemical materials, and any other factors impeding the effective rooting depth).

6. Ecosystem and land use establishment phase of rehabilitation

- Lack of availability and quality of target seed resources, including genetic integrity.
- Poor seed viability, seed dormancy.
- Ant and insect predation of seed.
- Damage to seed through revegetation process.
- Poor quality tubestock.

POTENTIAL RISKS

- Weed infestation associated with both introduction and control (or lack thereof).
- Adopting inappropriate or inadequate rehabilitation techniques, including equipment fleet.
- Inappropriate revegetation species mix for targeted final land use.
- Weather and climatic influences (e.g. drought; intense rainfall events; bushfire and climate change).
- Availability of areas for revegetation in optimal seasonal conditions.
- Habitat structures for colonisation or use.

7. Ecosystem and land use development of rehabilitation

- Weather and climatic influences (e.g. drought; intense rainfall events; bushfire and climate change).
- Long term water quality and quantity issues (e.g. acid-drainage, high salinity).
- Damage to rehabilitation (e.g. fauna, domestic stock, vandalism, vehicular interactions, bushfire, insects and plant disease).
- Re-disturbance of established rehabilitation areas.
- Insufficient establishment of target species and limited species diversity.
- Limited vegetation structural development and habitat for targeted fauna species.
- Erosion and failure of landform, drainage and water management/storage structures.
- Lack of infrastructure to support intended final land use (e.g. dams, fences, watering facilities).

8. Mine subsidence affected areas

- Extended water ponding.
- Redirection of creek and river flows.
- Subsidence cracking.
- Interconnective cracking with underground workings.

POTENTIAL RISKS

- Interference with tree roots.
- Sink holes.
- Impacts to aquifers and groundwater loss of water to water users including the environment.

Glossary

TERM	DEFINITION
Active	In the context of rehabilitation, land associated with mining domains is considered active for the period following disturbance until the commencement of rehabilitation.
Active mining phase of rehabilitation	In the context of rehabilitation, the active mining phase of rehabilitation constitutes the rehabilitation activities undertaken during mining operations such as salvaging and managing soil resources, salvaging habitat resources, and native seed collection. This phase also includes management actions taken during operations to manage risks to rehabilitation and enhance rehabilitation outcomes such as selective handling of waste rock and management of tailings emplacements.
Annual rehabilitation report	As outlined in the Mining Regulation 2016.
Biological resources	<p>In biology and ecology, a substance that is required by an organism for normal growth, maintenance or reproduction.</p> <p>In the context of rehabilitation, biological resources are those materials salvaged from the land, or sourced externally, that are used to enhance the biological and ecological functioning of a rehabilitated site. This includes topsoil and subsoils, woody or vegetative materials, rocks and nesting structures.</p>
Decommissioning	The process of removing mining infrastructure and removing contaminants and hazardous materials.
Decommissioning phase of rehabilitation	Activities associated with the removal of mining infrastructure and removal and/or remediation of contaminants and hazardous materials. In the context of the rehabilitation management plan (for large mines only) this phase of rehabilitation may also include studies and assessments associated with decommissioning and demolition of infrastructure or works carried out to make safe or fit for purpose built infrastructure to be retained for future use(s) following lease relinquishment.
Department	Department of Regional NSW.

TERM	DEFINITION
Ecosystem and land use development	<p>This phase of rehabilitation consists of the activities to manage maturing rehabilitation areas on a trajectory to achieving the approved or, if not yet approved, the proposed:</p> <ul style="list-style-type: none"> ■ rehabilitation objectives, and ■ rehabilitation completion criteria, and ■ for large mines – final landform and rehabilitation plan. <p>For vegetated land uses this phase may include processes to develop characteristics of functional self-sustaining ecosystems, such as nutrient recycling, vegetation flowering and reproduction, and increasing habitat complexity, and development of a productive, self-sustaining soil profile. This phase of rehabilitation may include specific vegetation management strategies and maintenance such as tree thinning, supplementary plantings and weed management.</p>
Ecosystem and land use establishment	<p>This phase of rehabilitation consists of the processes to establish the approved final land use following construction of the final landform (as per the approved final landform and rehabilitation plan for large mines). For vegetated land uses this rehabilitation phase includes establishing the desired vegetation community and implementing land management activities such as weed control. This phase of rehabilitation may also include habitat augmentation such as installation of nest boxes.</p>
Final landform and rehabilitation plan	As defined in the Mining Regulation 2016.
Final land use	As defined in the Mining Regulation 2016.
Form and way	Means the form and way approved by the Secretary. Approved form and way documents are available on the Department's website.
Forward program	As defined in the Mining Regulation 2016.
Growth medium development	<p>This phase of rehabilitation consists of activities required to establish the physical, chemical and biological components of the substrate required to establish the desired vegetation community (including short-lived pioneer species) to ensure achievement of the approved or, if not yet approved, the proposed:</p> <ul style="list-style-type: none"> ■ rehabilitation objectives, and

TERM	DEFINITION
	<ul style="list-style-type: none"> ■ rehabilitation completion criteria, and ■ for large mines – final landform and rehabilitation plan. <p>This phase may include spreading the prepared landform with topsoil and/or subsoil and/or soil substitutes, applying soil ameliorants to enhance the physical, chemical and biological characteristics of the growth media, and actions to minimise loss of growth media due to erosion.</p>
Habitat	Has the same meaning as that term under the <i>Biodiversity Conservation Act 2016</i> and the <i>Fisheries Management Act 1994</i> (as relevant).
Land	As defined in the <i>Mining Act 1992</i> .
Landform establishment	<p>This phase of rehabilitation consists of the processes and activities required to construct the approved final landform (as per the development consent and, for large mines, the approved final landform and rehabilitation plan).</p> <p>In addition to profiling the surface of rehabilitation areas to the approved final landform profile this phase may include works to construct surface water drainage features, encapsulate problematic materials such as tailings, and prepare a substrate with the desired physical and chemical characteristics (that is, rock raking or ameliorating sodic materials).</p>
Large mine	As defined in the <i>Mining Regulation 2016</i> .
Lease holder	The holder of a mining lease.
Life of mine	The timeframe of how long a mine is approved to mine, from commencement to closure.
Mining area	As defined in the <i>Mining Act 1992</i> .
Mining lease	As defined in the <i>Mining Act 1992</i> .
Phases of rehabilitation	<p>The stages and sequences of actions required to rehabilitate disturbed land to achieve the final land use. The phases of rehabilitation are:</p> <ul style="list-style-type: none"> ■ active mining ■ decommissioning ■ landform establishment ■ growth medium development

TERM	DEFINITION
	<ul style="list-style-type: none"> ■ ecosystem and land use establishment ■ ecosystem and land use development ■ rehabilitation completion (sign-off).
<p>Progressive rehabilitation</p>	<p>The progress of rehabilitation towards achieving the approved or, if not yet approved, the proposed:</p> <ul style="list-style-type: none"> ■ rehabilitation objectives, and ■ rehabilitation completion criteria, and ■ for large mines – final landform and rehabilitation plan. <p>This may be described in terms of domains, phases, performance indicators and rehabilitation completion criteria.</p>
<p>Rehabilitation</p>	<p>As defined in the <i>Mining Act 1992</i>.</p>
<p>Rehabilitation completion</p>	<p>The final phase of rehabilitation when a rehabilitation area has achieved the final land use for the mining area:</p> <ul style="list-style-type: none"> ■ as stated in the approved rehabilitation objectives and the approved rehabilitation completion criteria, and ■ for large mines – as spatially depicted in the approved final landform and rehabilitation plan. <p>Rehabilitation areas may be classified as complete when the NSW Resources Regulator has determined in writing that rehabilitation has achieved the final land use following submission of the relevant application by the lease holder.</p>
<p>Rehabilitation completion criteria</p>	<p>Rehabilitation completion criteria set out the criteria the achievement of which will demonstrate the achievement of the rehabilitation objectives.</p>
<p>Rehabilitation management plan</p>	<p>As defined in the <i>Mining Regulation 2016</i>.</p>
<p>Rehabilitation objectives</p>	<p>Means the rehabilitation objectives required to achieve the final land use for the mining area.</p>
<p>Rehabilitation outcomes</p>	<p>Means the final land use for the mining area as stated in the approved rehabilitation objectives, the approved rehabilitation completion criteria</p>

TERM	DEFINITION
	and (for large mines only) the approved final landform and rehabilitation plan.
Rehabilitation outcome documents	As defined in the Mining Regulation 2016.
Rehabilitation risk assessment	As defined in the Mining Regulation 2016.
Rehabilitation schedule	The defined timeframes for progressive rehabilitation set out in the forward program.
Risk	The effect of uncertainty on objectives. It is measured in terms of consequences and likelihood (AS/NZS ISO 31000:2018).
Risk control	A measure (process, device practice or action) that modifies (eliminates, minimises or mitigates) a risk.
Secretary	The Secretary of the Department.
Small mine	As defined in the Mining Regulation 2016.
State significant development (SSD)	<p>Has the same meaning as that term under the <i>Environmental Planning and Assessment Act 1979</i>.</p> <p>Note: Schedules 1 and 2 of <i>State Environmental Planning Policy (State and Regional Development) 2011</i> provide a full list of SSD types and identified sites. Large mining and extraction operations (including all coal mines) are identified as SSD.</p>

Department guidance

- Form and way: Rehabilitation objectives and rehabilitation completion criteria for small mines
- Form and way: Rehabilitation objectives, rehabilitation completion criteria and final landform and rehabilitation plan for large mines
- Form and way: Rehabilitation management plan for large mines
- Form and way: Annual rehabilitation report and forward program for small mines
- Form and way: Annual rehabilitation report and forward program for large mines
- Guideline: Rehabilitation risk assessment
- Guideline: Rehabilitation records
- Guideline: Rehabilitation controls
- Guideline: Mine rehabilitation portal
- Guideline: Rehabilitation objectives and rehabilitation completion criteria
- Guideline: Achieving rehabilitation completion (sign-off).

The above resources are located on our [website](#).