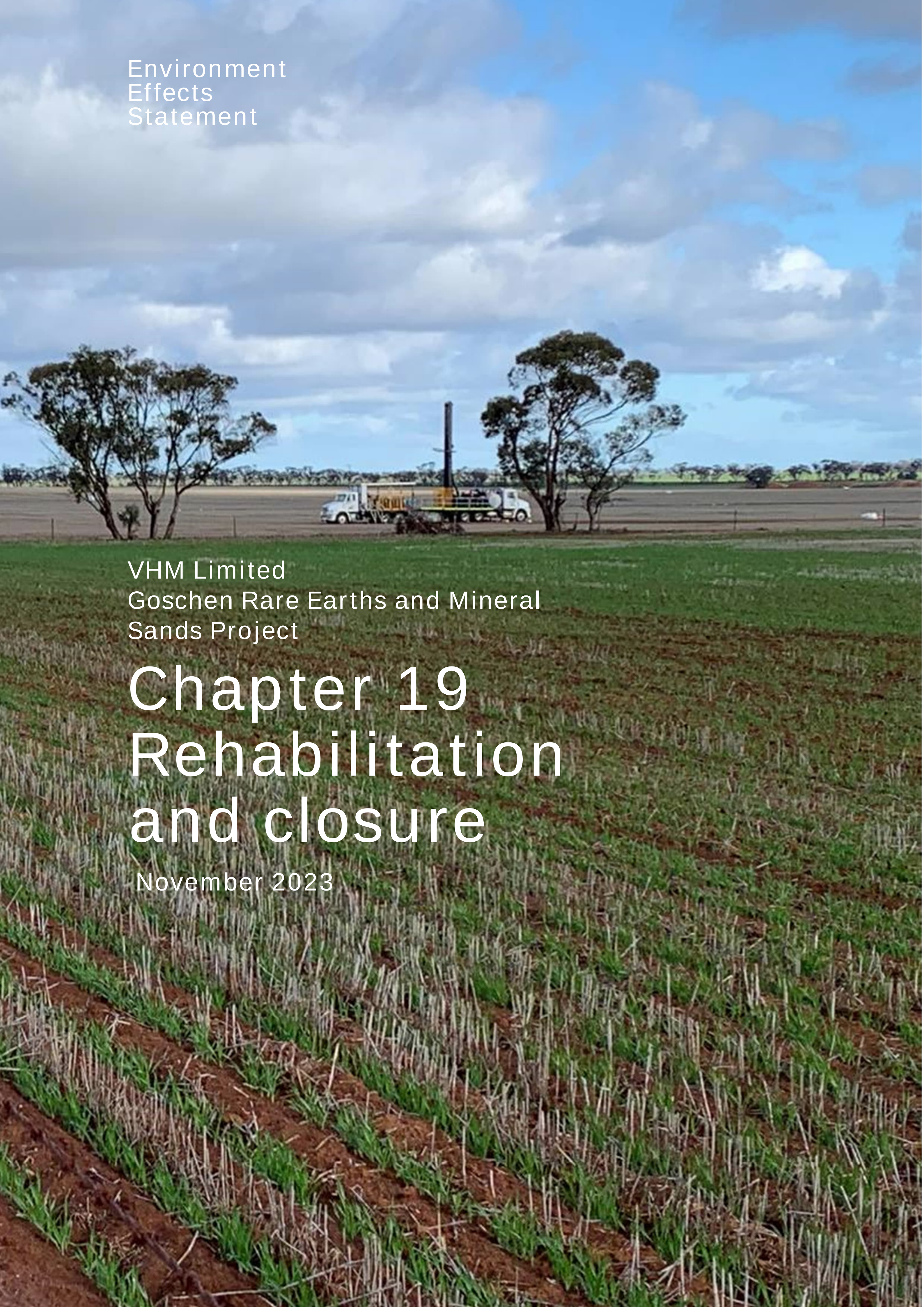

Environment
Effects
Statement

VHM Limited
Goschen Rare Earths and Mineral Sands Project

Chapter 19 Rehabilitation and closure

November 2023

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19. Rehabilitation and closure

Overview

VHM Limited (VHM) is proposing to develop the Goschen Rare Earths and Mineral Sands Project (the Project) in the Loddon Mallee Region of Victoria, approximately 35 kilometres (km) south of Swan Hill in the Gannawarra Shire. Part of the Project is the rehabilitation of the mine site to an equivalent, or better, agricultural land capability that enables a broad range of future agricultural uses. The post-mining landform would be a gently undulating plain which is consistent with the existing landform and will avoid sharp relief between the existing and rehabilitated landscapes. All roads closed as part of the Project will be reinstated and ancillary infrastructure such as the public road upgrades retained. In the context of this Chapter, rehabilitation and closure refers to the point in time when rehabilitation has been completed and deemed successful, the rehabilitation bond has been returned and the mining licence has been relinquished.

Progressive mine rehabilitation will be a key component of the Project and will commence as soon as the first mining cells are mined, tailings deposited and overburden/topsoil is placed. This first rehabilitation stage is anticipated to be within two to three years of mining operations commencing.

In order to achieve the desired outcomes, the approach to rehabilitation includes measures undertaken during soil stripping and handling, erosion control, revegetation, weed and pest management and decommissioning, and includes record keeping and quality assurance. Additionally, by implementing a formalised rehabilitation monitoring and review process to monitor progressive rehabilitation performance during mining, it is anticipated that any emerging risks can be identified, and early intervention enabled, where appropriate and well before end of mining.

With consideration to the objectives of rehabilitation, the proposed methodology and the completion criteria, a post-mining land use suitable for agriculture is considered readily achievable.

19.1 Introduction

This chapter describes the legislation, guidelines and strategies relevant to closure of the Project and provides an overview of the characteristics of the existing environment that can affect closure activities and outcomes. The strategy for closure of the Project is outlined, including the decommissioning and rehabilitation activities and proposed post-mining land use and landforms. The chapter also presents criteria that have been developed to measure closure success.

The key potential risks, issues, and impacts associated with closure activities are outlined, together with proposed measures to avoid, mitigate and manage these risks and impacts.

Proposed inspections and monitoring activities to measure progress towards achieving closure criteria are specified, along with current knowledge gaps that affect closure activities, and the activities proposed to address these gaps.

This chapter draws on information in the draft Rehabilitation Plan (Technical Report P) for the mine site and several specialist studies including Technical Report J: Geotechnical impact assessment.

19.2 Scoping requirements

The EES scoping requirements set out the following draft evaluation objective for closure:

- Rehabilitation: To establish safe progressive rehabilitation and post-closure stable rehabilitated landforms capable of supporting native ecosystems and/or productive agriculture that will enable long-term sustainable use of the Project area.

The EES scoping requirements also set out other draft evaluation objectives relevant to closure:

- Biodiversity: to avoid or minimise potential adverse effects on native vegetation, listed threatened and migratory species and ecological communities, and habitat for these species, as well as address offset requirements for residual environmental effects consistent with state and Commonwealth policies.
- Water, catchment values and hydrology: to minimise effects on water resources and on beneficial and licensed uses of surface water, groundwater and related catchment values over the short and long-term.

- Amenity and environmental quality: to protect the health and wellbeing of residents and local communities, and minimise effects on air quality, noise and the social amenity of the area, having regard to relevant limits, targets or standards.
- Social, land use and infrastructure: to minimise potential adverse social and land use effects, including on, agriculture (such as dairy irrigated horticulture and grazing), forestry, tourism industries and transport infrastructure.
- Landscape and visual: to avoid adverse effects on the landscape and recreational values and minimise visual effects on the open space areas.

Rehabilitation is not proposed to be undertaken to groundwater. Any potential impacts to groundwater, including mitigation and monitoring associated with groundwater, is covered in EES Chapter 14: Groundwater.

19.3 Legislative context

This section describes the primary and secondary legislation, guidelines and strategies relevant to closure of the Project, including decommissioning and rehabilitation activities. Key legislation, policies, standards and guidelines relevant to all aspects of the Project are detailed in Chapter 5: Regulatory framework.

19.3.1 Legislation

The legislation relevant to closure of the Project is presented in Table 19-1.

Table 19-1 Relevant closure legislation

Name	Relevance
Mineral Resources (Sustainable Development) Act 1990 (Vic) and associated Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019	The principal legislation governing the mining industry in Victoria. The act encourages the exploration and development of minerals in a manner that is compatible with the economic, social and environmental objectives of the State. The act establishes a legal framework to ensure mined land is rehabilitated and requires: • A rehabilitation plan to be prepared that considers any special characteristics of the land, the surrounding environment, land stability, agreed end uses, and the potential for long-term degradation of the environment. The plan must include proposals for the progressive rehabilitation, stabilisation and revegetation of extraction areas, waste disposal areas, stockpiles areas, dams and other land affected by the operation. Landscaping to minimise visual impacts and details of final rehabilitation and closure of the site must also be included in the plan. • A rehabilitation bond to be lodged by the proponent to cover rehabilitation costs should the operator default on its obligations to complete rehabilitation. The bond amount is determined by the Victorian Minister for Resources and may in consultation with the licensee require the licensee to enter into a further bond amount at any time. Compensation agreements with landholders, severance or redundancy payments to employees or contractors, and shire rates, royalties or taxes do not form part of the bond.
Environment Protection Act 2017 (Vic)	The *Environment Protection Act 2017* (EP Act) establishes the framework for environmental protection, underpinned by the general environmental duty (GED) and duties for waste, contaminated land and incident notification and management. The closure of the Project would be required to operate in accordance with these duties, to manage and respond to risks of harm and notify the Authority in the event of a notifiable incident or contamination. The EP Act is designed with a different mix of subordinate instruments and regulatory tools (including Environment Reference Standards (ERS)) to support and work with the Act. This framework focuses on the prevention of waste and the impacts of pollution, rather than managing those impacts after they have occurred. The EP Act regulates waste and pollution discharges to the environment including, but not limited to, emissions to surface water and groundwater by a system of permissions. Any discharge to the environment during the construction or operation of the Project must be in accordance with the requirements of the EP Act. Schedule 1 of the Environment Protection Regulations 2021 sets out prescribed permission activities. The Project falls under prescribed development activity and a prescribed operating activity as described in the C: Extractive industry and mining category. The prescribed permission activity in the C01 (Extractive industry and mining) is described as: Extractive industry and mining, but excluding any of the following activities: (a) Educator dredging; (b) Activities discharging or deposition mining or extractive industry wastes solely to land, and that are in accordance with the Mineral Resources (Sustainable Development) Act 1990; I activities that involve discharges or emissions solely to the atmosphere in accordance with the Mineral Resources (Sustainable Development) Act 1990.

19.3.2 Policy and guidelines

The main national policy and guideline documents relevant to closure include:

Preparation of Rehabilitation Plans: Guideline for Mining and Prospecting Projects (Earth Resources Regulation, 2020):

This guideline provides information to assist licensees for mining and prospecting licences to develop rehabilitation plans that meet regulatory requirements in Victoria and achieve sustainable rehabilitation outcomes. It sets out what the regulator, Earth Resources Regulation, expects to be included in a rehabilitation plan, and how the safe, stable and sustainable requirement in the Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019 (Regulations) is interpreted.

This guideline aims to enhance regulatory certainty and minimise regulatory burden through its adoption of an outcomes-based and proportionate approach.

ANZMEC/MCA Strategic Framework for Mine Closure (2000):

The framework aims to provide a consistent approach for mine closure across all Australian jurisdictions (although does not provide a detailed set of guidelines for mine closure). The development of comprehensive closure plans that are adequately financed, resourced, implemented and monitored, return mine sites to viable, and wherever practicable, self-sustaining ecosystems is encouraged. The framework also promotes involvement of stakeholders in the mine closure process, and seeks to ensure that processes and indicators are in place to demonstrate the successful completion of the closure process.

Mine Rehabilitation: Leading Practice Sustainable Development Program for the Mining Industry (2016):

This practice manual is one of 17 handbooks addressing key issues of sustainable mining development, developed by the Australian Government in consultation with the mining industry and other stakeholders. The document is aimed at operational management and outlines the key principles and procedures of leading practice for planning, implementing and monitoring mine rehabilitation.

Environment Reference Standard

Under the EP Act, the Environment Reference Standard (ERS) provides the indicators and objectives needed to support environmental values. The ERS is a reference tool and does not set compliance limits or specific obligations that must be followed.

The ERS is a tool that can be used to assess the impacts on human health and the environment that may result from a proposal or activity. This application of the ERS must be seen within the context of the GED and preventing harm from pollution and waste as part of the broader environment protection framework under the EP Act. Because it is preventative in nature, this framework seeks to maintain environmental values and minimise risks of harm to human health and the environment, rather than setting and authorising acceptable levels of pollution and waste. The focus on prevention allows for continual improvement in managing these risks as knowledge expands and more effective risk- reduction techniques and technologies emerge.

Other:

Several other guidelines and non-statutory instruments developed by the Commonwealth and Victorian Governments, industry organisations and independent bodies, have guided the rehabilitation, decommissioning and closure strategy for the Project, and include:

- Guidelines for the Assessment of Geotechnical Risks in Open Pit Mines (ERR, 2021)
- The Victorian Environment Protection Authority's Industrial Waste Resource Guidelines for wastes and resources regulated under the Environment Protection (Industrial Waste Resource) Regulations 2009
- Guidelines on Tailings Dams: Planning, Design, Construction, Operation and Closure, Rev 1 (ANCOLD, 2019).

19.4 Rehabilitation obligations and commitments

The overall objectives of rehabilitation are to ensure that the final landform and land use is safe, stable and non-polluting, and capable of supporting the final land use which is broadacre agriculture.

With reference to Earth Resources Regulation's (ERR) *Preparation of Rehabilitation Plans* guideline, the specific whole-of-site rehabilitation objective is:

"*To restore land disturbed by mining to an equivalent (or better) agricultural land capability to enable a variety of productive agricultural uses*."

The following aspects of the Project mine site closure and rehabilitation strategy will help to achieve this objective:

- Pits would be backfilled to reinstate levels and gradients similar to pre-mining conditions
- No stockpiles would remain at surface following closure
- Land area would be graded to achieve gradients and topography similar to pre-mining conditions
- Soil profile would be re-established to a minimum depth of 1 metre (m) including topsoil and subsoil
- Topsoil would be rehabilitated to pre-mining fertility or better
- Crop yields will be returned to pre-mining levels of production or better
- Crops and soils will not contain any pollution or increase in elements associated with mining above pre-mining levels
- Where desirable, infrastructure utilised during mining will remain for use of landholders: such as upgraded roads, water storage ponds, upgraded electricity connections, water pipeline, fences, etc. This will be determined in conjunction with the local government authority and landholders. If infrastructure is not required, it will be decommissioned and rehabilitated as per the previous commitments
- Public roads disturbed or removed by mining would be reinstated to the satisfaction of the roads authority
- Roadside native vegetation would be restored consistent with the EVC present and boundary fencing replaced.

Section 19.8 presents the rehabilitation methodology and Section 19.9 outlines the specific rehabilitation objectives and completion criteria.

19.5 Study area

The study area for the Project's draft Rehabilitation Plan is the proposed mining licence area (refer to MIN Boundary in Figure 19-1).

It is assumed that the road upgrades to Ultima, the Kangaroo Lake pump station and the pipeline that form part of the Project (and aspects outside the MIN) will be retained for ongoing use post mining. Refer to EES Chapter 03 – Project Description and EES Chapter 10 – Traffic and transport for further information. Thus, closure and rehabilitation of these Project components are not considered herein.

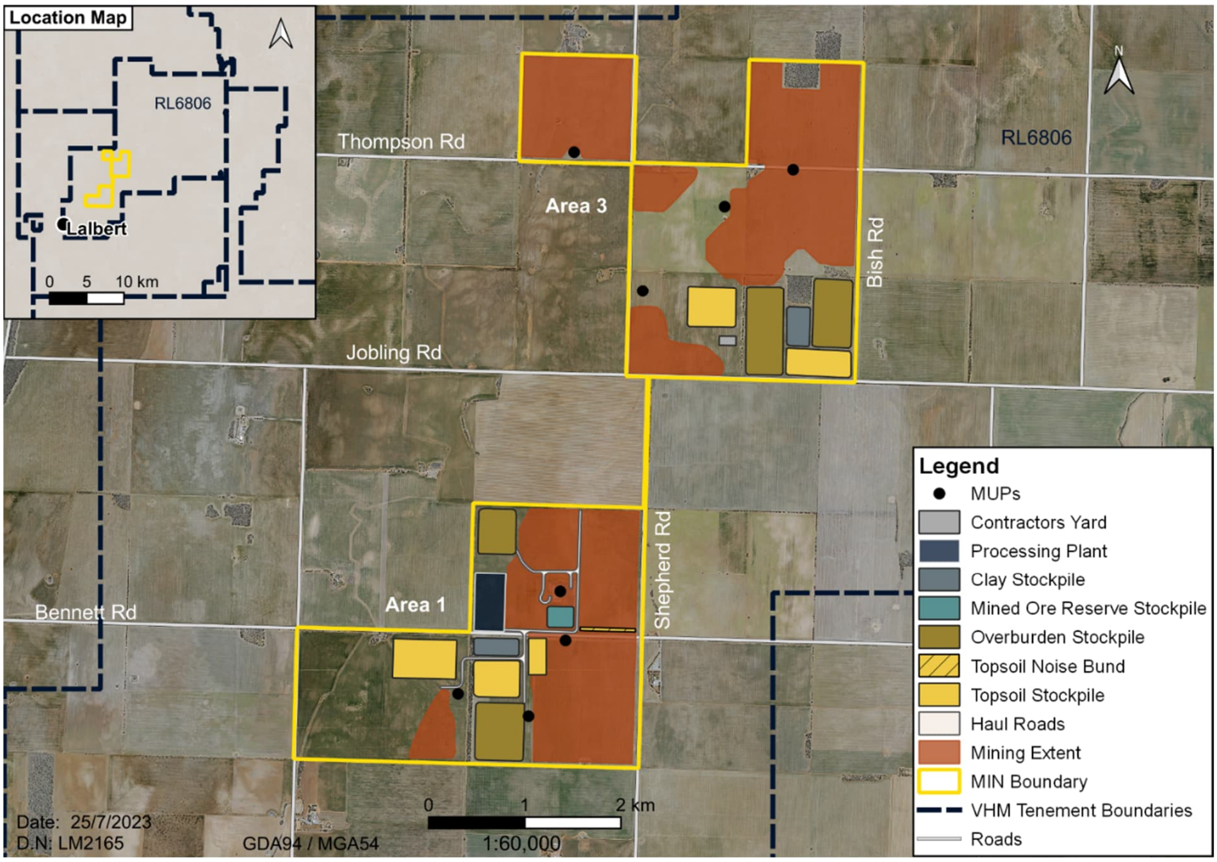

Figure 19-1 Study area for the Project's closure and rehabilitation plan

19.6 Existing environment

A range of interrelated factors can affect the strategy developed for closure, including the characteristics of the existing physical and social environment. This section summaries the key features of the physical and social setting for the Project relevant to rehabilitation, decommissioning and closure, and any potential implications for closure activities.

19.6.1 Climate

The study area experiences a relatively dry climate where average monthly rates of rainfall are exceeded by evaporation in all months of the year. Climate data was obtained from the Bureau of Meteorology Station at Lake Boga (Kunat), ID 77021, located approximately 10 kilometres north-east of the study area. Mean annual minimum and maximum temperatures range between 9.4 and 24.0°C. Average annual rainfall is 327 mm and evaporation 1,620 mm.

The area is classed as a low rainfall cropping zone according to the 2022 Farm Gross Margin and Enterprise Planning Guide (GRDC), with an average annual rainfall less than 350 mm. The growing season rainfall for winter cropping falls between April and October, with rainfall spread reasonably evenly across all months. There is a net moisture deficit annually and the moisture deficit is most significant over the warmer summer months. This moisture deficit presents a risk for rehabilitation during vegetation establishment. Monthly rainfall averages are presented in Table 19-2 below.

Table 19-2 Monthly rainfall averages (1933 – 2021), Lake Boga (Kunat) (ID 77021)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
23.9	21.0	20.4	21.4	31.3	26.9	33.8	33.2	31.0	34.9	27.8	20.7	**327.3**

19.6.2 Landform and topography

The region within which the mine site is located is characterised by a gently undulating topography, with small depressions in the landscape.

The topography of Area 1 ranges from approximately 105 metres Australian height datum (m AHD) to 115 m AHD and the topography of Area 3 ranges from approximately 110 m AHD to 120 m AHD.

The Cannie Ridge is located on the east side of the mine site, trending from north to south, and represents a peak in the regional topography at 125 metres AHD. The lowest point in the region topographically is 53 metres AHD, which is characterised by Lake Lalbert, located 4 kilometres west from the Project area.

Surrounding the mine site area, the main landform is a wide flat alluvial plain with minor features such swamps, shallow lakes, lunettes, sand sheets and minor drainage features. The main water features near the Project area are Lake Boga to the northeast and the Kerang wetlands 25 kilometres to the east.

The gentle landform gradients with limited relief and absence of natural watercourses, suggest the landform poses minimal constraints to the proposed mining and rehabilitation operations.

19.6.3 Regional land use

Agriculture is the main employer and economic driver within the Gannawarra Shire (the Shire) with a value of around $284 million per annum, employing around 1,058 people. The Shire has a diverse agricultural economy comprised of dairy, cereal and legume cropping, livestock including beef, lamb and pork, viticulture and horticulture comprising walnuts, olives, tomatoes, apples, peaches and citrus along with small plantings of vegetables and herbs (Gannawarra Shire Council, 2022).

A variety of soil types combined with a suitable climate can support a range of enterprises across both irrigated and dryland properties. The Shire is split distinctively between the riverine plain to the east and the Mallee to the west. Soils in the Mallee are dominated by Calcarosols, Chromosols and Sodosols, which are suited to dryland winter cropping. Cropping comprises approximately 30% of agricultural land use in the Shire.

Irrigation plays an important role in agricultural production within the Shire. Water is supplied from the Murray River and Goulburn River systems via a network of automated channels and natural lakes and creeks. Lake Charm, Kangaroo Lake and the Gunbower Creek are natural assets that play a key role in the distribution of irrigation water from the Murray River.

Irrigation farmland have undergone an efficiency transformation with laser grading and re use systems developed for flood irrigation farms. The implementation of subsurface irrigation, centre pivot irrigators, pipes and risers and automation has assisted in further efficiency gains for irrigation farmers.

Crops grown with irrigation include:

- Wheat, barley, canola, cotton, corn, peas, beans, sorghum, vetch and oats.
- Tree crops including walnuts, olives, stone-fruit, citrus and apples.
- Tomatoes, onions, broccoli and pumpkin.
- Wine grapes.
- Hay including oaten, vetch, lucerne, clover and pasture.

The majority of the study area has been cleared of native vegetation, with only remnant areas left along road reserves and isolated patches within paddocks.

The predominant land use within and surrounding the Project area is dryland winter cereal cropping, with wheat, barley, oats and canola the most commonly sown crops. Crops are sown using minimum or zero tillage techniques with an emphasis on minimal ground disturbance and stubble retention to protect the topsoil from wind and water erosion. Grazing of sheep and cattle is undertaken opportunistically, however dryland winter cereal cropping is the predominant land use. There is no irrigation within or in the vicinity of the mine site area.

The proposed final land use has been developed to be consistent with the existing and surrounding agricultural land uses and there is some opportunity to improve productivity and diversity of agricultural pursuits on the land if the water supply pipeline infrastructure to be constructed to support the Project is retained following closure.

19.6.4 People and communities

Settlements and towns close to the Project area are diverse in size and character. The majority of residents adjacent to the mine site live in owner occupied households on rural residential living and farming properties. One such dwelling is located within Area 3 of the mine site area and has been purchased by VHM and will be uninhabited during the Project.

Rehabilitation, decommissioning and closure activities were included as part of the engagement for the Project. Comments were provided by potentially affected landowners and residents adjacent to and near the Project area, local communities, special interest groups, and business and interest groups. Forums for engagement included meetings with landholders, government agencies and the community.

Potential issues raised from these stakeholders related to the proposed rehabilitation approach, land stability and erosion, the final landform, post mining land use (specifically, return to productive land), and risks to achieving effective rehabilitation.

The key concern from community members was that rehabilitation of the Project area will be unsuccessful and previous land uses of agriculture will not be possible.

Information sheets outlining key aspects of the Project and the EES process were made available on the Project website throughout the engagement process. The information sheets provided comprehensive information on key environmental and social aspects in response to specific issues raised by the community including rehabilitation and closure. The sheets and material on the website have been updated throughout the preparation of the EES.

Further information on people and communities is provided in Chapter 18 Socio-economics.

19.6.5 Geology

The surface geology of the Project area comprises of a thin quaternary cover of sandy clay, which ranges in thickness from approximately five to 10 m below ground surface. This Quaternary aged sediment overlies the Loxton Parilla Sands, which hosts the target mineralisation zone.

The site stratigraphy is summarised as follows:

- Topsoil/Quaternary – Loam and sandy clay, five to 10 m thick
- Loxton-Parilla Sands – Coarse-grained to gravelly quarts-rich sand, 35 to 55 m thick
- Geera Clay – Dark grey/black clay of low plasticity, 32 to 46 m thick
- Olney Formation – Dark grey/black silty clay of low plasticity, 13 to 25 m thick; and
- Warina Sand – Coarse-grained sand with clayey interbeds, minor shale.

19.6.6 Radiation

The radionuclide content of surface soils in the Project area are consistent with worldwide soil radionuclide concentrations. On this basis, the soils do not have elevated levels of these radionuclides.

The background gamma radiation dose rate vary, as they depend primarily on the natural levels of radionuclides in soil. A portion of the background gamma dose rate also comes from cosmic radiation. The results of monitoring show an average similar to the gamma dose rates in other areas of Australia.

Groundwater contains naturally occurring radionuclides, which are present due to a combination of locational geology, hydrogeology and land-use practices (past and present). Both U and Th were below detection limits of 0.01 mg/L which equated to 0.1 Bq/L U-238 and 0.041 Bq/L Th-232. Pb-210 was detected in only one sample with an activity concentration of 0.15 Bq/L. The radium concentrations in the study area groundwater are elevated, and the groundwater exceeds Australian Drinking Water guidelines. However due to its high salinity, this groundwater is not used for human consumption, stock watering or irrigation.

These baseline (naturally occurring) levels of radiation provide the basis for setting appropriate closure targets, i.e., less than or equal to baseline levels found within the Project area.

Further information on radiation is provided in Chapter 17: Radiation.

19.6.7 Hydrogeology

Groundwater beneath and surrounding the mine site area can be defined by the following hydrogeological units:

- Loxton Parilla Sands Aquifer:
  - forms the upper most aquifer beneath the mine site
  - consists of sands, silts and silty clays and a generally low permeability/yielding aquifer
  - salinity of between 13,000 to 30,000 mg/L making the groundwater unsuitable for any agricultural or domestic use
  - the inferred depth to groundwater at the proposed mining locations is approximately 48 metres below ground level
- Geera Clay Aquitard:
  - forms an aquitard (zone that restricts the flow of groundwater) between the Parilla Sands and Renmark aquifers
  - consists of up to 20m of dark grey to black clay of low plasticity
- Renmark Group Aquifer:
  - forms a sand/gravel aquifer underlying the Geera Clay

There are no licenced or stock and domestic bores in any of the aquifers and no groundwater dependent ecosystems within 10 kilometres of the mine site.

These groundwater characteristics are unlikely to limit rehabilitation activities, as groundwater will not be a water source during closure, and interactions between groundwater and surface water in the Project area do not occur.

Further information on the Project's existing hydrogeological conditions, including impacts and relevant mitigation measures, is provided in Chapter 14: Groundwater.

19.6.8 Surface water

The mine site is located in area that experiences relatively low rainfall and is not in direct proximity to any designated waterways.

Surface water runoff within the project area flows predominantly to the west. While there are more defined flow paths across Area 1 than Area 3, the runoff from both areas largely forms isolated pools in depressions and quickly infiltrates or evaporates.

The closets waterways include:

- Murray River – 30 km north at its closest point to the mine site, the Murray River forms part of the Murray–Darling basin river system which drains most of the inland waterways in Victoria and New South Wales
- Avoca River – 18 km southeast and east of the mine site, the Avoca River has a history of flooding, with significant events in September 2010 and January 2011 and October/November 2022 which filled the Avoca Marshes and flowed through to Lake Boga. The river is an anabranching system, with the majority of floodwater leaving the river downstream of Charlton and spreading across the floodplain and through various anabranching waterways
- Back Creek – 14km to the east, Back Creek is part of the Avoca floodplain and is one of its anabranching waterways. It also drains a large local catchment to the west of the Avoca River and flows back into the Avoca River system at the Avoca Marshes; and
- Lalbert Creek – 10km to the southwest Lalbert Creek is an ephemeral stream of the Avoca River, carrying flood flows to the terminal lake systems of Lake Lalbert and Lake Timboram.

These characteristics of the surface water environment in the Project area have implications for rehabilitation including the need to manage the quality of runoff water post mining and until, for example, vegetation has stabilised the landform.

Further information on the Project's surface water impacts is provided in Chapter 13: Surface water.

19.6.9 Biodiversity

The existing vegetation across the project area is dominated by pasture supporting introduced grasses and weeds. Areas of native vegetation (less than 10% of the project area) represent mostly disturbed habitat and are concentrated along public roads, as well as farm lanes and fences separating farm properties. A few large remnants of native mallee vegetation occurred in private land, ranging in size from 5 and 20 hectares. Numerous scattered trees occurred in farmed paddocks, most of which were old multi-stemmed mallee eucalypts, although Buloke and Slender Cypress Pine were occasionally recorded

Where farmhouses and outbuildings occur in private property, planted trees are common. Planted tree species include Pepper Tree and Sugar Gum, both introduced species.

Across the broader study area Mallee woodland comprises the vast majority of the native vegetation recorded, occurring on red sands throughout the central and east. The western portion of the study area is on the edge of a floodplain and portions support a healthy canopy of large Black Box trees over a chenopod dominated understorey. Small, scattered occurrences of Buloke Woodlands existed in the western and northern parts of the study area.

Remnant mallee vegetation was distinguished by an open canopy of typical mallee eucalypts. The four most common canopy trees recorded were Dumosa Mallee, Oil Mallee, Red Mallee and Bull Mallee, many of which were old growth multi-stemmed trees. The understorey often comprised a mid-layer of shrubs (including Cattle Bush, Weeping Pittosporum, Sugarwood and Umbrella Wattle) as well a diverse ground layer of saltbushes, with Hedge Saltbush, Prickly Saltwort, Ruby Saltbush, Grey Copperburr and Black Cotton-bush commonly recorded. Native grasses and herbs were present but generally sparse. Common herbs included Pale Twin-leaf and Variable Sida. Introduced flora varied in cover across the study area and survey period, with the vast majority being annual grasses, which had died off by the time of the summer and autumn surveys. Other common weed species included African Box-thorn and Common Heliotrope

An understanding of the types and distribution of existing vegetation (and the fauna species that use different habitats) helps to inform the selection of flora species to revegetate the different land use zones in the final post-mining landform. For example, native species currently occurring in the project area, could be selected for revegetation of mined areas that provide habitat for listed threatened species known to occur or that have the potential to occur within the project area.

Further information on biodiversity is provided in Chapter 07 Ecology.

19.6.10 Soils

Soil properties and types, and their distribution, will be a key influence on closure activities in the mine site area.

The soil in and surrounding the mine site can be defined by one soil map unit (SMU), a calcic red-brown calcarosol. SMUs refer to a soil landscape and usually comprise a number of soil types. The following table, Table 19-3, summarises the Australian soil classification (ASC) soil types within the study area as informed by Chapter 16: Agriculture and soils.

Table 19-3 ASC soil types

ASC soil type	Soil type group	Hectares
Calcic red calcarosol	Dominant	1,479
Calcic brown calcarosol		
Eutrophic red chromosol	Sub-dominant	
Subnatric brown sodosol		

According to the ASC, a solum refers to surface and subsoil layers which have undergone the same soil forming conditions. A solum includes soil layers known as the A horizon and B horizon. The A horizon generally refers to topsoil and the underlying B horizon generally refers to subsoil.

The characteristics of the three different soil types, calcarosol, chromosol and sodosol are as follows:

- Calcarosols are soils which are calcareous throughout the solum, or calcareous at least directly below the A1 horizon, or within a depth of 0.2 metres. Calcareous soils contain carbonate segregations. Carbonate accumulations within calcareous soils must be judged to be pedogenic, referring to the process of soil formation. Calcarosols do not have a clear or abrupt texture contrast between the A horizon and the B horizon.

- Sodosols are soils with strong texture contrasts between A horizons and sodic B horizons, which are not strongly acidic. Sodic soils are classified as soils with an exchangeable sodium percentage (ESP) greater than 6.
- Chromosols are soils with strong texture contrast between A horizons and B horizons, which are not strongly acidic and are not sodic, unlike sodosols.

The existing surface soils in the mine site area display several inherent limitations to plant growth which need to be considered in the rehabilitation process, including the final composition of topsoils and their ability to support plant growth under different land uses. These limitations include:

- acidity
- sodicity
- low water-holding capacity
- deficiencies in phosphorus and potassium and any other trace element

Further information is provided in Chapter 16: Agriculture and soils.

19.7 Proposed post-mining land use and landform

Agriculture is the proposed post mining land use with the restoration of land disturbed by mining returned to an equivalent (or better) agricultural land capability to enable a broad range of future agricultural uses.

As described in Section 19.6, the study area landform, soils and hydrology present relatively limited constraints to achievement of this final land use. Due to the current flat typography of the site, the final landform at closure is relatively simple to recreate. The site contains no watercourses and the proposed mining and final landform present minimal drainage and water quality impacts. Soils have been thoroughly investigated and though soils constraints do exist with respect to alkalinity, structure, sodicity and salinity, mitigation methodologies are available and are readily implementable. Specific topsoil and subsoil handling procedures have been developed to ensure preservation of the site’s valuable soils resources.

The key design criteria for the final landform are:

- Final levels within +/- 0.5 m of existing levels when averaged across the mining blocks
- Landform gradients typically less than 3% across agricultural areas and avoidance of sharp relief between rehabilitated landscapes and surrounding land
- Drainage predominantly as sheet flow mirroring present conditions; and
- Topsoil and subsoil profiles restored to minimum 1m deep comprising at least 20cm of topsoil and 80cm of clayey subsoil material.

This final landform was assessed as part of EES Technical report J: Geotechnical impact assessment. The final landform would present a very low relief environment with no steep gradients or unstable slopes, no watercourses and no complex landforms to reinstate. The very low site gradients and low erosion hazard of the region indicates a very low risk of instability of the final reconstructed landscape. The final landform would support a range of potential agricultural uses consistent with the agricultural activities that occur throughout the region.

Achieving final landform

As identified by Technical report J: Geotechnical impact assessment, the main challenges to achieving the final landform relate to settlement and deformation during tailings and overburden emplacement within mine cells. Differential settlement in the backfilled mining cells could result in a landscape with hummocky or irregular topographic features including poorly drained or closed depressions, or deformation features such as tension cracks.

The geotechnical modelling and analysis included an assessment of potential impacts due to deformation and settlement, with mitigation measures to reduce the risk to as low as practicable. A summary of the geotechnical approach and findings is as follows:

- The assumption is that rehabilitated areas would be returned to the original landform as broad acre farming. Ground movement of the rehabilitated area may result in harm of the landform through settlement of the underlying replaced material.
- The Project has adopted a cyclic approach to mining. As mining advances and an area of the pit is excavated, it is then prepared as a tailing containment cell. Each tailings containment cell would be filled with tailings over a period of months until it reaches its design capacity. During filling, the tailings settle. As more tailings

are deposited, they continue to settle as the water content is either decanted for reuse or seeps into the pit floor. Once the tailings reach sufficient strength, overburden would be placed on the tailings as part of the rehabilitation process. The load of the overburden on the tailings continues to compress the tailings.

- The risk of soil /ore extraction and loss impacting the proposed final landform was considered from a mass balance perspective and determined to be negligible. As a rough estimate, approximately 3% of the ore zone would be taken through ore processing to produce the mineral concentrate. This is a very small proportion (<1.5%) of the overall profile depth and this loss would be offset by bulking of the tailings and overburden during backfilling. The likelihood is there will be an excess of material resulting in a slightly elevated landscape relative to present.
- This compression and the resulting vertical movement of tailings and overburden in the containment cell is known as settlement. The settlement of the tailings and overburden reduces over time and would be negligible after approximately one year following initial placement in the containment cell.
- The tailings would be more compressible than the material used to construct the tailings bund. Where the overburden crosses from the tailings to the tailings bund, there is a risk of differential settlement. Analysis of the settlement over time in the zone of tailings and overburden indicate that differential settlement would be low, less than 100 mm and that the transition would have a gradient of 1 in 500. This would be less of a gradient change than is currently observed in the pre mining landscape.
- The severity of the differential settlement is assessed as minor. Normal soil cultivation for cropping is likely to obscure the actual affect. There is not expected to be any risk of harm to people or environmental harm. Land use harm is expected to be minor and manageable.
- Possible impacts could be minor impact on overland flow paths leading to minor impacts of the broad acre farming. The large scale cell size and existing site cross fall will assist in mitigation.
- The mine life is in the order of 20-25 years. During this time for most cells, the majority of the consolidation cycle would have occurred, and the mine would review the final landform as part of its rehabilitation plan.
- For limited areas where settlement is likely to continue post cessation of mining, a monitoring program would be implemented by VHM in accordance with the rehabilitation plan. Any regrading would need to be carefully planned and implemented to avoid loss of topsoil.

Further information, including proposed mitigation measures, are presented in Technical report J: Geotechnical impact assessment.

19.8 Rehabilitation

This section provides an overview of the approach to rehabilitation including the sequence and methodology for key processes. Key impacts identified through the environmental impact assessment process are addressed, in particular those related to geotechnical aspects, soils and weeds.

Four rehabilitation domains were identified based on rehabilitation requirements: 1) processing and infrastructure areas; 2) active mining areas; 3) stockpiles; and 4) services and transport corridors. Each has different rehabilitation requirements based on the nature of mining activities and disturbance, with a final land use for agricultural purposes except for those areas that would be reinstated as public roads.

The draft rehabilitation domains are presented in Table 19-4 below.

Table 19-4 Rehabilitation domains

Domain	Coverage	Key rehabilitation activities
1	Processing and Infrastructure Areas: • Process plant • Run of mine stockpile • Workshop/admin buildings/laboratory • Water treatment plant • Haul roads • Hardstands • Water storage dams	• Decommissioning and removal of infrastructure and utilities • Waste removal, contamination assessment and remediation • Backfill excavation (e.g. dams) and rip hardstands • Removal of temporary environmental and drainage controls • Soil replacement and revegetation • Reinstatement of public roads and other infrastructure (e.g. fences) • Retention of infrastructure (e.g. roads, dams, hardstands, water supply infrastructure, electrical / telecommunication services) where agreed for the final land use
2	Active mining areas: • All mine cells which also service as tailing storage/disposal	• Removal of infrastructure and services • Controlled backfill with overburden, subsoil and topsoil following tailings dewatering • Soil preparation and revegetation • Reinstatement of public roads and other infrastructure (e.g. fences) • Removal of temporary environmental and drainage controls

Domain	Coverage	Key rehabilitation activities
3	Stockpiles: • Overburden • Subsoil • Topsoil	• Stockpile removal • Soil replacement and revegetation • Reinstatement of public roads and other infrastructure (e.g. fences) • Removal of temporary environmental and drainage controls
4	Services and Transport Corridors: • External water supply pipeline from Kangaroo Lake • Public roads	• Rehabilitation of areas disturbed during installation of water supply pipeline (construction stage) • Removal of underground water supply pipeline except where agreed to be retained (decommissioning stage) • Soil preparation and revegetation as appropriate • Reinstatement of public roads and other infrastructure (e.g. fences) subject to any required further design and local authority approval • Reinstate roadside native vegetation in accordance with relevant Ecological Vegetation Class (EVC) • Replace boundary fencing

19.8.1 Mining sequence and tailings disposal

The mining sequence would be a conventional open cut operation comprising removal of topsoil and overburden to expose the ore which extends from a depth of approximately 20m to 50m below present ground. Mined out voids would be used to dispose tailings from processing operations and would therefore avoid the need for construction of a dedicated above-ground tailings storage facility. Tailings would be deposited in voids to backfill to about the depth of the top of the orebody, allowing space for subsequent replacement of overburden, subsoil and topsoil to restore the landscape to as close as possible to the original landform and levels.

The time for the full mining sequence within each mine cell, from initial excavation of overburden, extraction of ore and replacement of tailings and subsequent progressive rehabilitation is expected to be approximately two years.

A set of conceptual staged tailings disposal and backfill plans are provided in Figure 19-2 to Figure 19-5. These describe the core features of the backfill operations and use of major and minor tailings bunds to assist in tailings containment and consolidation.

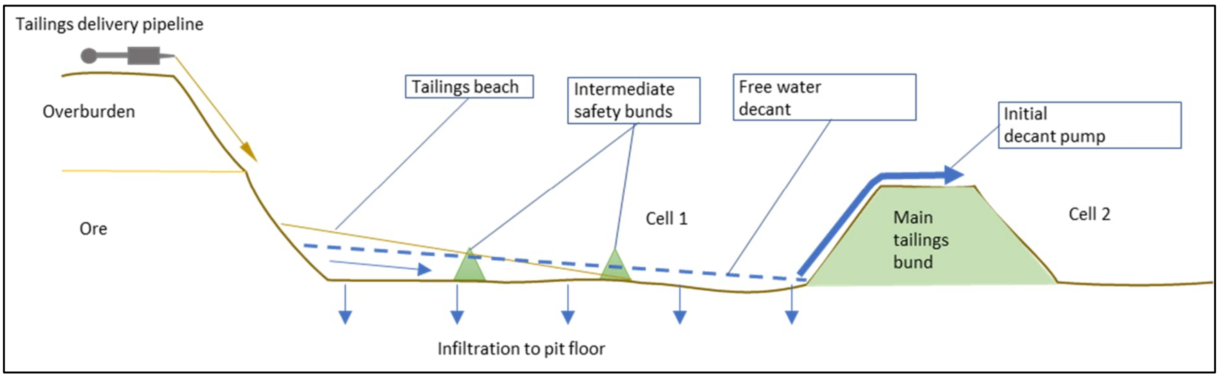

Figure 19-2 Tailings disposal

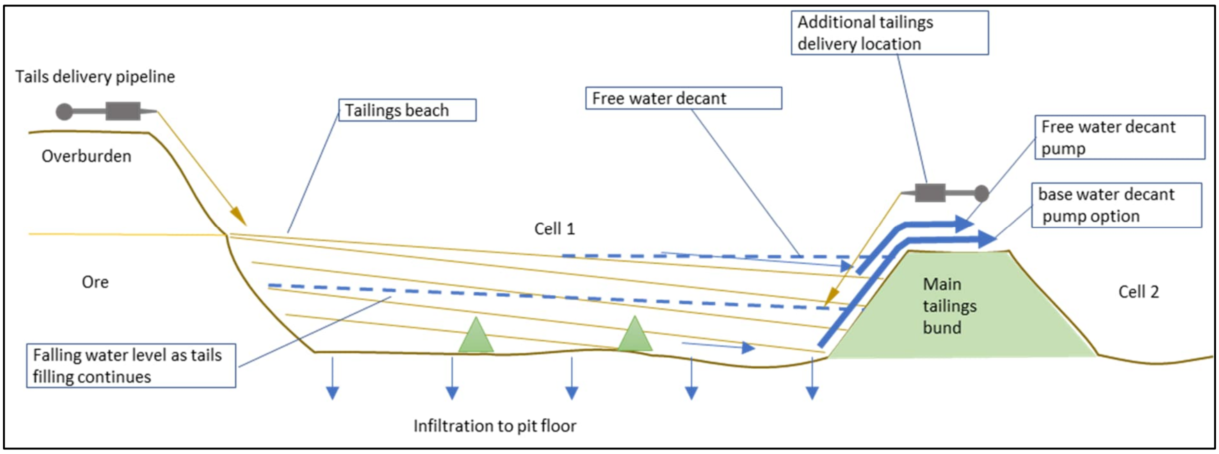

Figure 19-3 Tailings fill complete and in process of consolidation

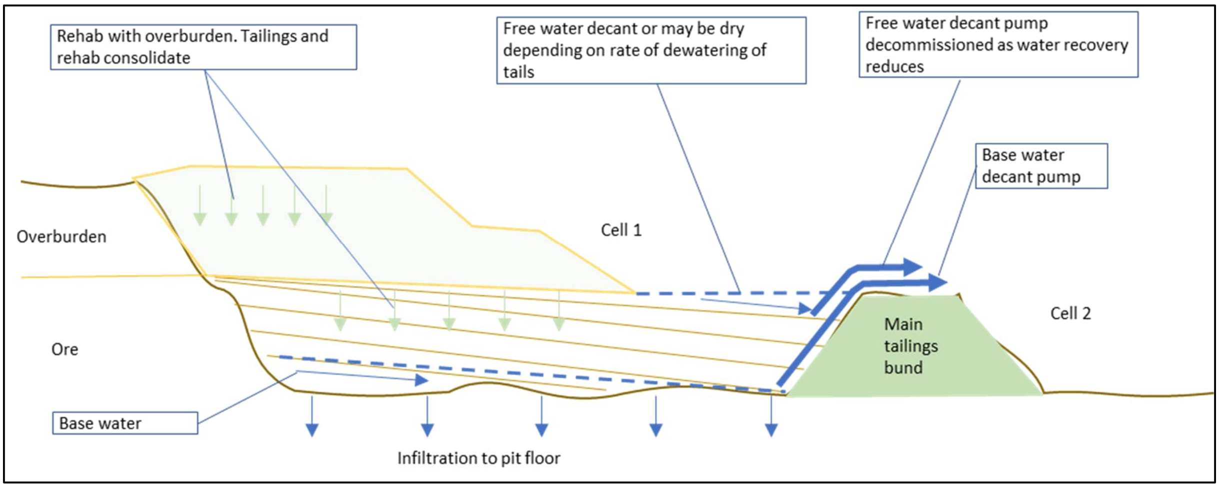

Figure 19-4 Overburden backfill and further tailings consolidation

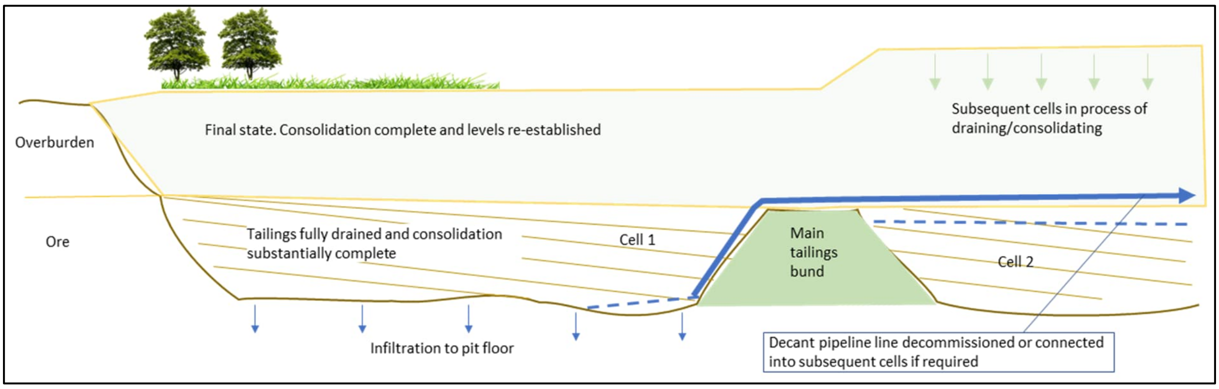

Figure 19-5 Final levels established for rehabilitation

Tailings streams from metallurgical testing conducted on ore from Areas 1 and 3 were assessed for acid generating, salinity and metal leaching potential.

The investigation found that:

- Tailings streams are slightly acidic with no significant or long-term acid drainage likely to occur from tailings material.
- Salinity in various ratios of solid to water leachates were relatively low, particularly when compared to groundwater. Tailings is not considered to be a potential source of saline drainage.
- The tailings material tested show the potential to be a source of dissolved metals including aluminium, arsenic, cerium, chromium, hexavalent chromium, fluoride, phosphorus, nickel, titanium and vanadium.

- There appears to be a marked difference in total elements between the two mining Areas, with Area 3 containing considerably higher total concentrations than the tailings from Area 1. This difference however, does not appear to be reflected as a significant difference in the leachability of the tailings.

The full suite of dissolved metals which have the potential to be present in the tailings is covered in Appendix C of Technical Report I – Groundwater Impact Assessment.

19.8.2 Decommissioning

Decommissioning phase to the Project would at the end of mining and include activities associated with removing mining infrastructure and the removal and/or remediation of contaminants and hazardous materials if required. It is assumed that all fixed plant, buildings, mine roads and water storage infrastructure will be completely decommissioned and removed prior to, or during the mine closure process. If desired certain infrastructure such as water supply pipelines and electrical infrastructure may be retained to assist the future land use agreed with future landowners.

It is proposed that a *Decommissioning and Closure Management Plan* would be developed prior to end of mining to guide activities at the end of the mine operations and detail the resources needed to undertake those activities. The plan would aim to address the following:

- Before demolition, all infrastructure to be evaluated in terms of the presence of hazardous substances and land contamination, and appropriate management strategies developed to protect employees and the public to minimise potential environmental harm. This includes the identification of the various waste streams and development of management strategies in accordance with the appropriate waste legislation.
- Decommissioning risk assessment.
- Inventory of all salvageable equipment and resources.
- Waste management strategy identifying waste types, indicative quantities, disposal and recycling practices for all materials, and suitable disposal locations.
- Decommissioning and demolition plans.
- Telecommunications, water supply and other services to be disconnected and removed unless agreed to remain. Services removal to adopt techniques that minimise additional land disturbance and ensure prompt stabilisation and restoration of final landforms to support the desired land use.
- A plan for reconstruction of local roads closed by mining. This would address matters such as collecting and storing materials useful in future rehabilitation (e.g. pavement material, roadside habitat such as logs, stumps and vegetation, collection of local seeds and raising of tubestock for native vegetation replanting), and replacement of fencing. Detailed design of roadways and approvals required from local roads authority.
- Where services are buried (e.g. pipelines, cables) and their retrieval may lead to further unacceptable disturbance, the infrastructure may be left in situ if agreed with the relevant authority (subject to any necessary approvals or agreements) if they don't pose constraints to the final land use. In this situation, the location of the services would be surveyed and marked on the site plan and a suitable caveat developed to provide that they are readily identifiable for future land holders.
- Fuel and other hazardous materials stores to be decommissioned and removed, and contamination assessments undertaken to identify remediation requirements for any contaminated soil or water resources.
- All buildings, fixed plant and other infrastructure that are not required as part of the final land use would be demolished and removed. Demolition would be carried out in accordance with the AS 2601—2001, *The demolition of structures*.

A Radiation Management Plan (RMP), Radioactive Waste Management Plan (RWMP) and Radiation Environmental Plan (REP) would be developed to ensure that radiation related impacts and risks remain well controlled during, and at the end of mining operations. Potential radiological risks due to the Project would be avoided or minimised and managed to required standards through the Radiation Management Plans and by routine monitoring to identify any exceedances with procedures to minimise impact.

19.8.3 Soil stripping and handling

Development of the mine cells would involve stripping of nominally 20m depth of overburden including an upper soil profile comprising clay subsoils and topsoil. Overburden, clay subsoil and topsoil would be directly emplaced in rehabilitation cells as a general rule to minimise double handling and minimise potential for material decline during extended stockpiling. When stockpiling is required, materials would be separated into their respective layers and stockpiled in dedicated areas with a focus on preserving quality of the clay subsoil and topsoil material for future rehabilitation.

As described in Chapter 16: Agriculture and soils, the following process would be applied to topsoil and subsoil stripping and handling. Soil should be stripped in a slightly moist to moist condition, whereby soil is pliable when hand texturing (15-30% soil moisture) wherever possible. Stripping operations should not be undertaken during excessive dry periods to prevent pulverisation of the natural soil aggregates. Similarly, stripping during wet periods should not be undertaken to prevent damage of the resource through compaction by equipment. Given the normally dry climate, consideration should be given to stripping and stockpiling large areas of topsoil when soil moisture conditions are favourable. This is primarily applicable to the upper 1 m or so of the profile that will be utilised for future soil restoration.

To reduce soil degradation during stripping operations preference should be given to using equipment which can grade or push soil into windrows such as graders or dozers for later collection by open bowl scrapers or for loading into rear dump trucks by front-end loaders or excavators. This would minimise compaction impacts of heavy equipment that is often necessary for economical transport of soil material. These techniques are examples of preferential, less aggressive soil handling systems which may be adopted.

All soils removed should be placed in designated stockpile areas if they cannot be directly applied to rehabilitation areas. Freshly stripped and placed topsoil retains seed that is more viable and a greater number of micro-organisms and nutrients, than does stockpiled soil. Vegetation establishment is generally improved by the direct return of topsoil and is considered 'best practice' topsoil management. Should long term storage stockpiles be proposed accurate records are required, indicating stockpile volumes and areas to be covered by each stockpile upon rehabilitation and final decommissioning. Where possible soil stockpiles could be utilised as long-term batters or bunds to facilitate noise, visual screening and surface water diversion where required. If sodic soils are used for this purpose they would be first ameliorated (with gypsum) and vegetated to minimise the risk of dispersion, erosion and turbid stormwater runoff.

The following stripping depths are recommended (refer to Chapter 16: Agriculture and soils):

- Strip topsoil to a depth of 20 cm. Topsoil would be stripped from all disturbance areas, including haul roads, infrastructure areas and subsoil stockpile locations. Stripping to 20 cm is deeper than some of the existing topsoils and will collect some of the heavier (clay textured) and more sodic subsoils. The benefit is an increase in clay content and water and nutrient holding capacity of the existing lighter sandy loams and loam topsoils. Although there will be a slight increase in sodicity this can be mitigated by the application of gypsum prior to stripping works being undertaken.
- Strip subsoil from mining areas only to a depth of 1.0 m (80 cm thick layer). Subsoil clay would be stockpiled separately to topsoil and used to restore a rehabilitated soil profile depth at least 1.0 m thick.

Management and mitigation strategies recommended for implementation as appropriate to reduce degradation during stripping and stockpiling operations include:

- Prior to stripping topsoils should be treated with gypsum as described in Table 19-5.
- Where possible, freshly stripped subsoil and topsoil should be re-spread directly onto rehabilitation areas. Topsoil to be spread, treated with fertiliser and seeded using equipment that will minimise the potential for compaction and also topsoil loss to wind and water erosion.
- Locations and nature of material in stockpiles recorded using GPS along with data relating to the soil type and volume and any soil treatment/amelioration. An inventory of available soil maintained and updated regularly to ensure adequate topsoil and subsoil materials are available for planned rehabilitation activities.
- Develop a soil model that can be used with GPS guided stripping equipment (e.g. grader/dozer) to accurately strip the precious resource and assist with recording soil volumes and storage locations.
- The surface of soil stockpiles should be left in as coarsely structured condition as possible to promote rainfall infiltration and minimise erosion prior to cover vegetation becoming established. The coarse structure will also prevent anaerobic zones forming.
- Maintain a maximum stockpile height for subsoil and topsoils of two metres with shallow batter angle (<1:5) for ease of access and management.
- Topsoil and subsoil stockpiles are to be stored separately.
- Storage time should be minimised, where possible. If long-term stockpiling is planned (greater than 12 months), stockpiles should be seeded with an annual cover crop species. A rapid growing and healthy annual pasture sward provides sufficient competition to minimise the emergence of undesirable weed species. The annual pasture species will not persist in the rehabilitation areas but will provide sufficient competition for emerging weed species, enhance the desirable micro-organism activity in the soil and minimise the erosivity potential of the stockpile.
- Subsoil and topsoil are spread to depths according to target requirements.
- Stockpiles should not be disturbed until required for rehabilitation, weed management, erosion control or for seeding and fertilising purposes.

- The surface of all stockpiles should be treated with the ameliorants shown in Table 19-5, which will create the most suitable growth medium for the chosen rehabilitation pasture species. Topsoil that is treated with gypsum prior to stripping will not require additional treatment of stockpile surfaces.
- Gypsum rates of 10 tonnes per hectare are recommended where ESP is greater than 14 (i.e. strongly sodic) which will apply to the majority of stripped and stockpiled subsoil. The gypsum sourced should have a minimum 19% calcium and 15% sulfur.

19.8.4 Soil amelioration

To maximise soil fertility and address sodicity constraints, it is recommended that soil amelioration be undertaken during stripping, stockpiling and material spreading as detailed in Table 19-5.

Table 19-5 Soil amelioration by rehabilitation phase

Ameliorant	Topsoil	Subsoil
Soil stripping		
Gypsum	5 T/ha (10 T/ha if ESP>14)	NA
Stockpile surface		
Gypsum	NA	10 T/ha
Granulock 15 (or similar)	80 kg/ha	80 kg/ha
Re-spread materials:		
Gypsum	NA	5 T/ha
Granulock 15 (or similar)	120 kg/ha	120 kg/ha

19.8.5 Soil replacement

In infrastructure areas affected by the creation of hardstands (processing plant area, roads, building pads etc), it is recommended that hardstand material be deep ripped and ameliorated prior to topsoil placement to a minimum depth of 20cm. Hardstands would consist of onsite material, from cemented layers in the overburden, or offsite rock aggregate. Mining areas would be finished with a reinstated soil profile comprising 80 cm of subsoil and 20 cm of topsoil as described previously. Soils would be ameliorated during re-spread in accordance with the guidance provided in Table 19-5.

Subsoils may need to be ripped or scarified during amelioration and prior to topsoil replacement to key the topsoil in and prevent a hardpan developing at the topsoil/subsoil interface. This would be assessed in practice and if necessary incorporated into the rehabilitation methodology.

Contour scarification of topsoil is suggested to incorporate soil ameliorants into the plant rooting zone (to a depth of 100 mm) and to provide a suitable seedbed for direct seeding. A roughened soil surface also increases rainfall infiltration, reduces run-off and provides a micro-habitat allowing plants to germinate and establish. Where possible ripping and scarification would be undertaken when the soil is moist to minimise structural decline and immediately prior to sowing.

Soils would be tested, and additional fertilisers or ameliorants added as necessary to address any deficiencies.

19.8.6 Erosion control

The water erosion hazard in rehabilitation areas is expected to be very low due to the low rainfall conditions and flat site gradients. Implementation of conventional erosion control techniques would be appropriate and include:

- Amelioration of dispersive soil with gypsum as outlined earlier to minimise the risk of dispersion and hardpan creation, and so maximise opportunity for surface infiltration of rainfall. This in turn would reduce the amount and velocity of surface water runoff.
- Leaving the topsoil surface in a loose, roughened condition (e.g. by scarification) to increase infiltration and reduce runoff.
- Establishing ground cover vegetation promptly following completion of rehabilitation works to prevent raindrop and sheet erosion of the overburden emplacements. This would include a sterile cover crop for temporary stabilisation, even if that species will not form part of the final, permanent vegetation. Cover crops may need to be resown where there is a delay in handing areas back for farming.

19.8.7 Revegetation in agricultural areas

Revegetation for the purpose of rehabilitation and closure prior to hand-back would be aimed at achieving a desirable surface cover of annual and perennial grasses to protect the soil surface and restore the land to productive agriculture. Revegetation methodologies would be developed and would include revegetation trials undertaken within the earliest mining rehabilitation areas. The trials would test different revegetation species, seeding times and rates, and application methods. Success and failure factors would be investigated and fed into an adaptive management program to develop preferred revegetation methodologies.

Revegetation methods would be developed based on first-hand knowledge of local landholders and agronomists. The methodology would need to address the significant revegetation challenges posed by the site's dry climate with a short growing season during autumn and winter. Revegetation during summer would generally not be prudent except during unseasonal wet conditions or where supplemental watering can be provided. Watering may be required at any time of year.

Initial advice suggests that revegetation of rehabilitated landforms and temporary stockpiles could be achieved using a suitable winter active cover crop such as ryegrass sown in autumn. Sterile cover crops may be needed to avoid seed set where the cover crop species is not desirable in the final vegetation mix. Within final rehabilitation areas legumes would also be sown to provide nitrogen fixing to improve the health of pasture. Perennial pastures may be provided to provide longer term stability. Once rehabilitated, VHM would seek to restore active agriculture over former mining areas through appropriate arrangements and would ensure the revegetation program is targeted to achieving this end.

19.8.8 Roadside restoration and revegetation

Although relatively small in area, mining would impact some existing public roads and adjacent roadside native vegetation. VHM commits to reinstating public roads post mine closure to the satisfaction of the local roads authority. This would include replacing boundary fencing. A Decommissioning and Closure Management Plan will be developed to guide activities at the end of the mine operations and detail the resources needed to undertake those activities. This plan would detail the activities required to reinstate the public roads.

Revegetation to restore native vegetation disturbed by the Project, will be limited in extent mainly to the woodland and grassland communities adjacent public roads closed by mining, and along the corridor disturbed by water pipeline installation. In these areas VHM commits to restoring native vegetation consistent with the representative ecological vegetation classes (EVC) as agreed through the EES process.

During removal of the roads in preparation for mining it is important to preserve materials that will be useful in future rehabilitation. This could include pavement material, roadside habitat such as logs, stumps and brush, collection of local seeds and raising of tubestock for native vegetation replanting, and even fencing materials for reuse. Where appropriate, weed free topsoil from the roadway reserves should be stored separately for reuse in rehabilitation of these areas. Weed infested topsoil may not be appropriate for reuse and should be segregated.

19.8.9 Weed and pest management

Weeds present a risk to rehabilitation through competition with target species. A targeted weed control program would reduce the long term cost of weed control and help ensure successful rehabilitation. The *Invasive Plants and Animals Policy Framework* is the Victorian Government's approach to the management of existing and potential invasive species and would be incorporated into the Project's relevant weed and pest management plan.

Weed control is necessary at various stages of mining and rehabilitation:

- Prior to topsoil stripping. Weed control would occur in areas that are yet to be mined if they are not under agricultural production to prevent seed set prior to topsoil stripping
- On stockpiles. Weed control on stockpiles should occur biannually as required, during autumn/winter and spring/summer. Sowing of suitable pasture species or cover crop on stockpiles will provide competition for weed species and help minimise weed invasion. Develop a revegetation plan that allows for weed management. For example, sow only grass species (monocotyledons) or legumes (dicots) on stockpiles to allow use of selective herbicides.
- Rehabilitation establishment. Weed control to be undertaken as required during rehabilitation including soil replacement and revegetation.

Herbicide use for weed control would be in accordance with a weed management plan and agronomist advice, which would be reviewed and adapted as necessary during operations.

Weed surveys would be undertaken at least annually. An inventory should be maintained of weed inspections, target weed species and weed control actions.

Weed management should be addressed within a broader Vegetation Management Plan prepared as part of the operational management plans for the site post approval. The Vegetation Management Plan would address protection of remnant native vegetation, weed management and revegetation with pasture and/or crop species.

All equipment or machinery particularly from interstate or overseas will follow the standard procurement safeguards and quarantine procedures as per Victorian and Australian requirements from the *Biosecurity Act 2015*. Once on site the equipment to be used for the Project will be site-dedicated and pose no biosecurity risk.

Pest animals such as kangaroos and rabbits can have a significant determinantal impact on revegetation areas. There may be a need to manage birds such as cockatoos and corellas, that can predate seed and impact on revegetation performance. Permits may be required if native animals are being managed as pests. Pest control should be addressed in a Pest Animal Management Plan prepared as part of the project Work Plan.

19.8.10 Rehabilitation monitoring

VHM would implement a formalised rehabilitation monitoring and review process to monitor rehabilitation performance, identify emerging risks and enable early intervention. Rehabilitation monitoring would include surveys to be undertaken routinely within each discrete rehabilitation area. The recommended frequency of survey would vary depending on the stage of rehabilitation and progress towards completion, but also depending on the presence or otherwise of active rehabilitation threats. A typical monitoring frequency might include:

- Monthly for the first three months during initial vegetation establishment, then
- Quarterly for the first year following commencement of rehabilitation, then
- Annually until completion and achievement of closure criteria.

Rehabilitation monitoring will continue for at least 2 years post meeting closure criteria to ensure rehabilitation progress remains acceptable with a positive trend towards achieving the final land use, and no longer requires active intervention. This would be when:

- The final landform is achieved
- Drainage is stable and in accordance with final landform design
- Soil fertility and erosion hazard are equivalent or better than pre-existing conditions
- Vegetation and weed cover are acceptable.

Rehabilitation surveys would record key details of rehabilitation progress, including identification of any emerging risks, activation of triggers for mitigation controls, and noting any corrective actions that may be required. Any identified deficiencies or failures shall be noted, and follow-up actions identified. Success factors would be noted for future reference and to assist in continuing improvement.

Monitoring of settlement and final landform topography would be undertaken by Drone / LiDAR and compared against the design final landform plan. Any irregularities would be reviewed and actioned.

19.8.11 Record keeping

Good record keeping will assist VHM track rehabilitation planning and progress and improve success. Important rehabilitation records include:

- Mine Rehabilitation Plan. The plan would be reviewed and updated as necessary throughout the course of mine operations and closure planning.
- Rehabilitation Risk Assessment. Maintain and update a risk assessment.
- Register of soil materials for use in rehabilitation. The register would identify material type, locations, quantity and treatment/amelioration history.
- Rehabilitation Register to record rehabilitation activity and monitoring. This would detail the current rehabilitation status and outline in detail the rehabilitation methodologies undertaken (including landform preparation, drainage goals, growth media development, surface preparation techniques, and revegetation processes, and any follow up corrective actions). The register would highlight success factors and lessons learned from previous reviews to assist future rehabilitation planning and improve outcomes. The register would include quality assurance records such as as-built drawings. A photographic log would be kept as part of the rehabilitation register; and
- Rehabilitation Survey results, included as part of a Rehabilitation Register.
- Additional quality assurance documentation (refer to Section 19.8.12).

19.8.12 Rehabilitation quality assurance

A Rehabilitation Quality Assurance Process (RQAP) would be implemented throughout the life of the mine and each phase of rehabilitation. The RQAP would ensure that:

- Persons responsible for rehabilitation implementation are identified.
- Rehabilitation is being implemented consistent with the nominated methodologies.
- Rehabilitation records are updated.
- Identified rehabilitation risks are adequately addressed at each phase of rehabilitation.

The RQAP would include inspections, monitoring and documentation to ensure that each phase of decommissioning and rehabilitation has been completed according to the nominated methodologies before proceeding to the next rehabilitation phase. The rehabilitation risk assessment is part of the quality assurance process and a live document that would be updated to address any emerging risks.

As part of the RQAP, a rehabilitation register would be developed and maintained. The register aims to record success factors and lessons learned from previous reviews to assist future rehabilitation planning and improve outcomes. This register would detail the current rehabilitation status within each mining domain and outline the rehabilitation works undertaken.

Key elements of the rehabilitation quality assurance process and how they would be applied at each rehabilitation phase are summarised in Table 19-6.

Table 19-6 Quality assurance elements

Mining / rehabilitation phase	Quality assurance elements
Active mining	• Mine and rehabilitation plans, updated to reflect current status and future planning • Topsoil and subsoil inventory to document stripped, stockpiled and re-spread resources and soil amelioration • Scheduled rehabilitation surveys to identify soil and land erosion and adequacy of soil, erosion and drainage controls • Weed inspections and maintenance.
Decommissioning	• Inspections and demolition reports to confirm all infrastructure has been removed • Contamination assessment, remedial action plans and validation reports post site clean-up • Waste tracking documentation to demonstrate that all wastes are disposed legally.
Landform establishment / post-mine backfill	• Survey and preparation of as constructed drawings of final constructed landforms and water drainage structures • Inspection to record the progression of the intended landform.
Soil preparation	• Registers of topsoil and subsoil stockpiles including management records (such as stripping/stockpiling dates, weed control, amelioration) • Records of soil replacement including source and destination of soil resources, soil replacement depths and methodologies, and soil amelioration (e.g. gypsum application fertilisers) • Soil testing results to confirm appropriate soil physical and chemical parameters for plant establishment • Soil surface preparation (e.g. ripping, scarification) • Implementation of any necessary erosion and sediment controls.
Vegetation establishment	Records of revegetation activities including: • Date/season of revegetation actions • Weather conditions • Seed mix and seeding rate (kg/ha) and/or planting rate (tubestock/ha) • Scheduled rehabilitation surveys to allow early identification of any emerging threats to rehabilitation, assess stability and revegetation success • Regular inspections to identify weed and feral animal impacts and controls.

19.9 Rehabilitation objectives and closure criteria

The mine site objective for rehabilitation is to restore land disturbed by mining to an equivalent (or better) agricultural land capability to enable a variety of productive agricultural uses.

This overall objective is supported by a set of specific objectives as described in Table 19-7. It is noted that as required under Section 82(2) of the MRSDA 1990, landowner engagement and ultimate agreement that land has been rehabilitated to their satisfaction is required.

Table 19-7 Rehabilitation and objectives and completion criteria

Mining domain	Rehabilitation objective	Completion criteria
Processing and infrastructure	Infrastructure decommissioning: All infrastructure that is not to be used as part of the final land use will be decommissioned and removed to ensure the site is safe, stable and free of hazardous materials. Infrastructure to be removed within two years of operations completion.	All infrastructure and underground services removed in accordance with a Decommissioning and Closure Plan, including: • Fuel and chemical tanks and drums are removed in accordance with relevant guidelines. • Mining roads are removed and revegetated. • Water pumps and pipelines are removed (unless post mining users are identified, and the assets repurposed and relicensed for agricultural or other uses). • Ground water piezometers and any temporary supply bores are sealed, except as required for long term monitoring post closure • Hazardous and contaminated materials are removed • Offices/ laboratory, stores and workshops are dismantled, demolished and removed; • Processing plant and MUPs are dismantled and materials salvaged and recycled where possible, but otherwise removed; and • Waste tracking documentation verifies legal disposal of all wastes.
	Water storage removal: Water storages that are not retained as part of the final land use, are to be drained and backfilled.	• Water quality in storages is tested prior to dewatering. • Dewatering avoids release of contaminants to land or waters. • Sediments accumulated in sediment dams are tested, removed and emplaced in the final landform if suitable. • Contaminated sediments deemed unsuitable for emplacement in the voids are disposed offsite at a facility licensed to accept contaminated waste, or emplaced onsite subject to further assessment. • All ancillary equipment including pumps and pipelines are removed and services terminated. • Dams are backfilled in a controlled way consistent with geotechnical advice to minimise post closure settling. • Water storages are removed and land regraded so final land surface is contiguous with surrounding landscape in preparation for return to agricultural practices.
	Water storage retained: Water storages to be retained as part of the final landform will be for a clear and agreed purpose, and be safe, stable and sustainable.	• Sediments tested and any contaminated materials removed from water storages ensuring no residual contaminants exist that would compromise future water use goals. • Retained dams will be assessed and verified as structurally sound by a suitably qualified person. • Water quality is tested and fit for the final use (e.g. agriculture, stock and domestic) consistent with relevant water quality guidelines. • Dams are licenced (if required) in accordance with relevant state legislation.
	Retained infrastructure: Infrastructure is only to be retained where it is sympathetic to and supports the final land use, has a clear purpose and is in a condition that does not present undue risk to safety or the environment.	• Any retained infrastructure is to have a clear purpose and agreement from relevant stakeholders that the purpose is supported and the retained infrastructure is safe, stable and sustainable. • Condition assessments and certification are completed as required. • Hardstands and tracks retained in a fit for purpose condition that is safe and stable and supports the final land use.
	Land free of contamination: Land, water and soils are free from contamination, safe, compatible with the final land use and pose no unacceptable threat of ongoing environmental harm or risk to people.	• Hazardous materials are removed from site and any wastes and visible indicators of contamination are cleaned up. • Soils (and where required water) tested and site validated as fit for final land use in accordance with applicable guidelines including the National Environment Protection (Assessment of Site Contamination) Measure (1999).

Mining domain	Rehabilitation objective	Completion criteria
		• Water quality monitored with respect to the relevant Environment Reference Standard and fit for final land use. • Water quality and quantity are not impacted at any sensitive receptors/beneficial uses/environmental values.
Active mining areas	Infrastructure decommissioning: All mobile and fixed plant and infrastructure from mining areas is to be decommissioned and removed.	• All temporary infrastructure is removed. • Mining roads ripped and revegetated
	Mine backfill and landform establishment: Mine cells are backfilled and rehabilitated progressively on completion of resource extraction to reinstate a final landform that is contiguous with the surrounding natural landscape and is fit for future agricultural land use.	• Mine cells are backfilled to design levels allowing for any final consolidation. Confirmed through geotechnical inspection and testing. • Final levels are within +/- 0.5 m of existing (pre-disturbance) levels when averaged across the mining blocks. • Landform gradients will be typically less than 3% across agricultural areas and avoid sharp relief between rehabilitated landscapes and surrounding lands. Verified through survey. • Landforms are shaped to blend with the natural environment and maximise sheet flow drainage.
	Landform drainage: Rehabilitated landform is to be free draining with sheet flow conditions and avoiding poorly drained depressions and flow concentration.	• Drainage conditions are stable with no active gully heads or tunnel erosion. Verified through rehabilitation inspections. • Drainage is predominantly as sheet flow mirroring present conditions. • Site topography is a gently undulating and free draining plain, verified through topographic survey as within acceptable tolerances.
	Soil preparation: Soils reinstated to create a productive soil profile with topsoil and subsoil depths, physical and chemical characteristics in line with agronomist's advice and similar to pre-mining conditions.	• Topsoil and subsoil profile restored to minimum 1m deep comprising at least 20 cm of topsoil and 80 cm of clayey subsoil material. • Restored soil profile contains similar physical, chemical and fertility characteristics to surrounding natural soils and is suitable for agricultural land use. Verified through soil survey and testing. • Soil surfaces do not possess problematic dispersive or hard setting surfaces.
	Vegetation cover: Establish a vegetation cover crop across rehabilitation areas to stabilise the soil, restore soil health and minimise sediment loss subject to agronomist's advice.	• A vegetative surface cover is established for long term erosion control and consistent with achieving the final agricultural land use. Target 70% groundcover. Erosion control and cover verified through rehabilitation inspections. • Weeds managed to ensure weed types and density within rehabilitation areas are no worse than on surrounding agricultural lands, Verified through weed survey.
	Hazards including bushfire: Management measures are implemented to minimise bushfire risks in rehabilitation areas.	• Bushfire risk managed to the satisfaction of local rural fire service and consistent with management approaches on adjoining agricultural land.
Stockpiles	Stockpiles removal and landform establishment: Stockpiles are removed and surface revegetated consistent with objectives for mining domains.	• Stockpiles removed and surface rehabilitated to design levels • Subsoil ripped and topsoil replaced • A vegetative surface cover is established for long term erosion control and consistent with achieving the final agricultural land use. Target 70% groundcover. Erosion control and cover verified through rehabilitation inspections • Weeds managed to ensure weed types and density within rehabilitation areas are no worse than on surrounding agricultural lands.

Mining domain	Rehabilitation objective	Completion criteria
Services and Transport Corridors	Telecommunications, water supply and other services to be disconnected and removed unless agreed to be retained.	• Telecommunications, water supply and other services are disconnected and removed unless agreement is reached with relevant stakeholders to retain services infrastructure to benefit future land use. • Services removal to adopt techniques that minimise additional land disturbance and ensure prompt stabilisation and restoration of final landforms to support the desired land use
	Public roads: Public roads reinstated to the satisfaction of local roads authority.	• A plan is prepared and implemented for reconstruction of local roads closed by mining, to the satisfaction of the relevant roads' authority. • Roadside revegetation is undertaken to restore representative ecological vegetation classes (EVC) as agreed through the EES process. • Roadside boundary fencing is replaced in a condition acceptable to the landowners.

19.10 Rehabilitation Bond

The Earth Resources Regulation (ERR) bond calculator will be used as the basis for preparing an estimate for rehabilitation, decommissioning and closure as part of the final Work Plan submission. The estimate will consider the extent of proposed disturbance for Area 1 and Area 3, but also processing plant, and includes:

- Demolition or removal of industrial infrastructure, including associated hardstand areas and services.
- General site clean-up to remove demolition debris and other rubbish.
- Completion of a contaminated site assessment (including radiation monitoring) over the whole of the industrial infrastructure area and over any area in which mining products or residues (tailings) have been stored (either permanently or on a temporary basis).
- Backfilling, capping and recontouring of pit voids.
- Removal or recontouring of onsite access and haul roads.
- Removal or reshaping of bunds (if required).
- Topsoil replacement over all disturbed areas.
- Revegetation of all disturbed areas to agreed post-mining vegetation types, using a combination of direct seeding and planting of tubestock.
- Fencing of revegetated areas which require protection from grazing and post-closure maintenance of fences
- Post-closure monitoring, maintenance and reporting for 10 years, or until closure criteria have been achieved.
- A 10% contingency sum, as recommended in the bond calculator.

During operations, costs and unit rates for rehabilitation, decommissioning and closure activities will be developed at a site level and used as the basis for annual review of rehabilitation, decommissioning and closure cost provisioning. In the event of sudden (unplanned) permanent cessation of operations, a final closure report would be prepared immediately. A review of the closure cost liability would be carried out and funds for closure sourced from VHM closure provision accounts.

19.11 Summary of mitigation measures

The mitigation measures to manage rehabilitation and closure are presented in Table 19-8.

Table 19-8 Rehabilitation and closure mitigation measures

Mitigation measure ID	Mitigation measure	Project phase implementation
MM-RH01	Project to be rehabilitated and closed in accordance with the finalised Rehabilitation Plan and in accordance with the provisions of the MRSD Regulations, including likely conditions such as compliance with the specific provisions of the Radiation Regulations that might apply to the Project. The Rehabilitation Plan must include a monitoring and review process to monitor rehabilitation performance, identify emerging risks and enable early intervention in accordance with monitoring and contingency measures outlined in Table 21-7 of the Environmental Management Framework.	Closure

Mitigation measure ID	Mitigation measure	Project phase implementation
MM-RH02	Unplanned closure – Staged and progressive rehabilitation and backfilling of pits to be undertaken, which limits the amount of land needing rehabilitation at any given time and will limit any legacy rehabilitation issues in the event of unplanned closure.	Operation Closure
MM-RH03	Unplanned closure – Rehabilitation bond to be adequate to address safety risks and site restoration in the event of default by miner.	Closure

19.12 Conclusion

The closure and rehabilitation aim is a post-mining land use suitable for future ongoing agriculture. It is proposed that the ancillary components outside the mine site, such as public road upgrades, will be retained for ongoing community and/or landowner use.

Four rehabilitation domains were identified to assist with the rehabilitation methodology and based on similar mine-related impacts and subsequent rehabilitation requirements: 1) processing and infrastructure areas, 2) active mining areas, 3) stockpiles and 4) services, and transport corridors.

Progressive rehabilitation would be undertaken throughout the life of the Project, occurring as soon as the first pit cells have been mined and tailings deposition completed, approximately two to three years from the commencement of mining.

The goal of rehabilitation would be to restore land disturbed by mining to an equivalent, or better, agricultural land capability to enable a broad range of future agricultural uses. The final landform would include levels and local relief similar to current conditions, avoiding sharp relief between the existing and rehabilitated landscapes. To achieve these desired outcomes, the approach to rehabilitation includes measures undertaken during decommissioning, soil stripping and handling, erosion control, revegetation and weed and pest management, and includes monitoring, record keeping and quality assurance.

Rehabilitation objectives and completion criteria were also developed to ensure that the overall objective for rehabilitation, *to restore land disturbed by mining to an equivalent (or better) agricultural land capability to enable a variety of productive agricultural uses,* is achieved.

The closure criteria include the removal of all infrastructure and underground services, the backfilling of mine cells to final levels within +/- 0.5 m of existing (pre-disturbance) levels when averaged across the mining blocks and the restoration of the topsoil and subsoil profile, comprising at least 20cm of topsoil and 80 cm of clayey subsoil material.

In response to the EES evaluation objective described at the beginning of this chapter, rehabilitation of the Project has considered changes in topography, groundwater conditions, drainage and vegetation cover during mining operations and at the end of the mine life, and the mine rehabilitation plan has been informed by and has adopted recommendations from specialist studies within the EES.