Prepared for
VHM Limited
Co No.: 601004102

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Draft Work Plan- Goschen Rare Earths and Minerals Sands Project

22-Aug-2023

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Client: VHM Limited

Co No.: 601004102

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1.0Introduction

1.1 Project Overview

VHM Limited (VHM) proposes to develop one of the world's largest, highest-grade zircon, rutile and rare earth mineral deposits. The project includes mining of heavy mineral sands and rare earths in two stages over an approximate mine life of 20-25 years:

Goschen (Area 1) at an approximate 5 million tonnes per annum (Mtpa) (±10 %) Run of Mine (ROM) throughput capacity. The processing facility for ore extracted from Area 1 and Area 3 is also to be located in Area 1, north of Bennett Road, and

Goschen (Area 3) at 5 Mtpa (±10 %) ROM throughput capacity once mining of ore within Area 1 has been exhausted.

1.2 Objectives and Legislative Requirements

The *Environment Effects Act 1978* (EE Act) establishes a legislative framework to assess the environmental effects of proposed works that are capable of having a significant effect on the environment. The EE Act also enables the Minister for Planning (the Minister) to decide that a proponent of works should prepare an Environment Effects Statement (EES).

In light of the potential for significant environmental effects, on 10 October 2018 the Minister for Planning (the Minister) determined under the EE Act that an EES is required for the Project. The Minister's reasons for making this decision included 'the potential for a range of significant environmental effects'. In particular, the Project could potentially have significant effects on:

1. Native vegetation and associated biodiversity values, including listed threatened species and communities
2. Surface water and groundwater and protected environmental values
3. Existing land uses, amenity and landscape values
4. Aboriginal cultural heritage values.

This Draft Work Plan is the preliminary work plan and has been developed for exhibition with the EES.

It has been prepared in consideration of the EES project scoping requirements and is not intended to fully meet the obligations of a work plan under the *Mineral Resources (Sustainable Development) Act 1990 (MRSD Act 1990),* but rather to be an illustration of a work plan and provide an indication of the detail of the project description for mining activities that will fall within the Mining Licence.

Following the determination by the Victorian Minister for Planning on the outcome of the EES, if the Project is successful, the Work Plan will be fully formed in consideration of the outcomes of the Ministers Assessment, updated to reflect any additional requirements/ assessments arising from the Minister's Statement and include all the requirements under the *MRSD Act 1990.* The Work Plan would then be submitted for formal consideration under section 40A of the MRSD *Act 1990* for assessment by the Earth Resources Regulation (ERR) branch of Department of Energy, Environment and Climate Action (DEECA), under a non-statutory approvals pathway. It is noted that as part of the ERR assessment process, the final work plan approval may require further changes to meet the requirements of the MRSD Act, and would also be subject to comment by relevant Agencies as part of that work plan approval process.

1.3 Work Plan Requirements

The Draft Work Plan has been prepared in consideration of the requirements set out section 40(3) of *Mineral Resources (Sustainable Development) MRSD Act 1990* (MRSDA) and regulation 42, regulation 43(2), regulation 44 and regulation 45 and regulation 46 *Mineral Resources (Sustainable Development)*

(Mineral Industries) Regulations 2019 (MRSD(MI)R, noting however this work plan is a preliminary version only and is not intended to fully comply with the MRSD Act requirements at this stage of work plan development.

To meet these requirements, a Work Plan is to comprise of the following information/ documents;

- Description of the proposed work as per Regulation 42, which is documented in this **Work Plan** document, and includes the description of surrounding sensitive receptors, description of geological setting, proposed mining operations and supporting site locality and site layout plans;
- Identification of hazards and risks including details of mining hazards from the set- up or construction of the work, operations and production and hazards arising from rehabilitation activities as per Regulation 44. A list of hazards has been provided, however a full risk register detailing risk events has not been provided with this draft work plan. However, an outline of the hazard identification and risk register process and format is provided in Section 7.
- Preparation of a **Risk Management Plan** (RMP) as per Regulation 45 which sets out the control measures to be applied to eliminate or minimise the risks as far as reasonably practicable, the performance standards, systems to be applied to monitor and manage the risks and the roles and responsibilities for the risk management plan. For this draft work plan a standalone RMP has not been prepared, however will form part of a formal work plan submission package. The development of the RMP will rely on the technical impacts assessment outcomes and recommendations which have been prepared to support the EES, including namely the commitments listed in the EMF. Further detail on the RMP which will be prepared is detailed in Section 6.9 below;
- Preparation of a **Rehabilitation Plan** as per Regulation 43 which requires details for the final end use to be safe, stable and sustainable, objectives for rehabilitation domains and criteria for measurements, schedule of rehabilitation and assessment of the risk that the rehabilitated land may pose. A standalone Rehabilitation Plan will form part of a formal work plan submission to address Regulation 45 requirements. A draft Rehabilitation Plan has been provided as part of the draft work plan package.
- Preparation of a **Community Engagement Plan** as per Regulation 46 which sets out how the mining licence holder will identify community attitudes, share information, receive and analyse feedback and register, document and respond to community complaints. A draft CEP is provided.

In preparing this document set, consideration has been given to the supporting guidelines prepared by ERR which outlines further details on the requirements of the work plan documents: *Preparation of Work Plans and Work Plan Variations - Guideline for Mineral Industry Projects, 2020,* and full consideration of this guidance will be made when preparing the final work plan for submission to ERR post EES.

1.4 Project background

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 km south of Swan Hill in the Gannawarra Shire.

VHM is an Australian owned and operated listed public company established in 2014 that is developing an integrated business comprising of heavy mineral sands projects located in Victoria, providing feedstock to downstream customers.

VHM initially held over 7,000 km^2 of near-contiguous tenements in Victoria, which provided the Company with access to significant historical exploration data. This data formed the basis of VHM's exploration program to generate its own data for estimating mineral resources and ore reserves within its tenements. The exploration undertaken to date has discovered one of the world's largest, highest-grade zircon, rutile and rare earth mineral deposits, located near Lalbert in the Murray Basin, Victoria. The Project will involve the mining and processing of these deposits within the area within RL6806.

Details of the activities and development of operations for both Phase 1 and Phase 2 for the full life of the mine, are included in this work plan.

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1.5 Supporting technical assessments

A number of supporting technical assessments have been prepared to support the project and have been referred to in developing this Work Plan, including;

1. CDM Smith, 19 December 2022. *Goschen Project EES- Groundwater, rev 3.* Prepared for VHM Limited.
2. Eco Aerial Environmental Services, 15 September 2022. *Technical Report: Fauna Ecology- Goschen Mineral Sands and Rare Earth Project*. Prepared for VHM Limited.
3. Eco Logical Australia, version 4, 21 September 2022. Cultural Heritage Impact Assessment. Prepared for VHM Limited.
4. JRHC Enterprises Pty Ltd, 29 November 2022. *Radiation Impact Assessment.* Prepared for VHM Limited.
5. Moir Landscape & Architecture, 23 September 2022. *Landscape & Visual Impact Assessment- Goschen Mineral Sands and Rare Earths Project.* Prepared for VHM Limited.
6. Nature Advisory, September 2022. *Goschen Mineral Sands and Rare Earth Project- Native Vegetation and Flora Assessment.* Prepared for VHM Limited.
7. Pitt & Sherry, 17 November 2022. *Goschen Mineral Sands and Rare Earth Project- Geotechnical Impact Assessment, rev 01.* Prepared for VHM Limited.
8. Pitt & Sherry, 5 August 2022. *Goshen Mineral Sands and Rare Earths Project- Mine Site Surface Water Impact Assessment, rev B.* Prepared for VHM Limited.
9. SLR, November 2022. *Air Quality Impact Assessment- Goschen Mineral Sands and Rare Earth Project.* Prepared for VHM Limited.
10. SLR, September 2022. *Noise Impact Assessment- Goschen Mineral Sands and Rare Earth Project.* Prepared for VHM Limited.
11. Water Technology, 12 December 2022. *Technical report: surface water impact assessment- Goshen Mineral Sands and Rare Earths Project.* Prepared for VHM Limited.

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2.0Plan Description

2.1 Area Details

SUMMARY	
Project Name	Goschen Rare Earths and Mineral Sands Project
Address:	Bennet Road, Lalbert
Proposed MIN Area Size:	1,500 hectares
Licensee:	VHM Limited
Land Tenure:	Freehold

The MIN is located near Lalbert, in the Murray Basin, Victoria, approximately 35 kilometres south of Swan Hill. The proposed MIN tenement boundary is shown on **Figure 1- Regional Plan (Appendix A)** and is within land within the Retention Licence held by VHM (RL6806) as shown on Figure 1-1 below. .

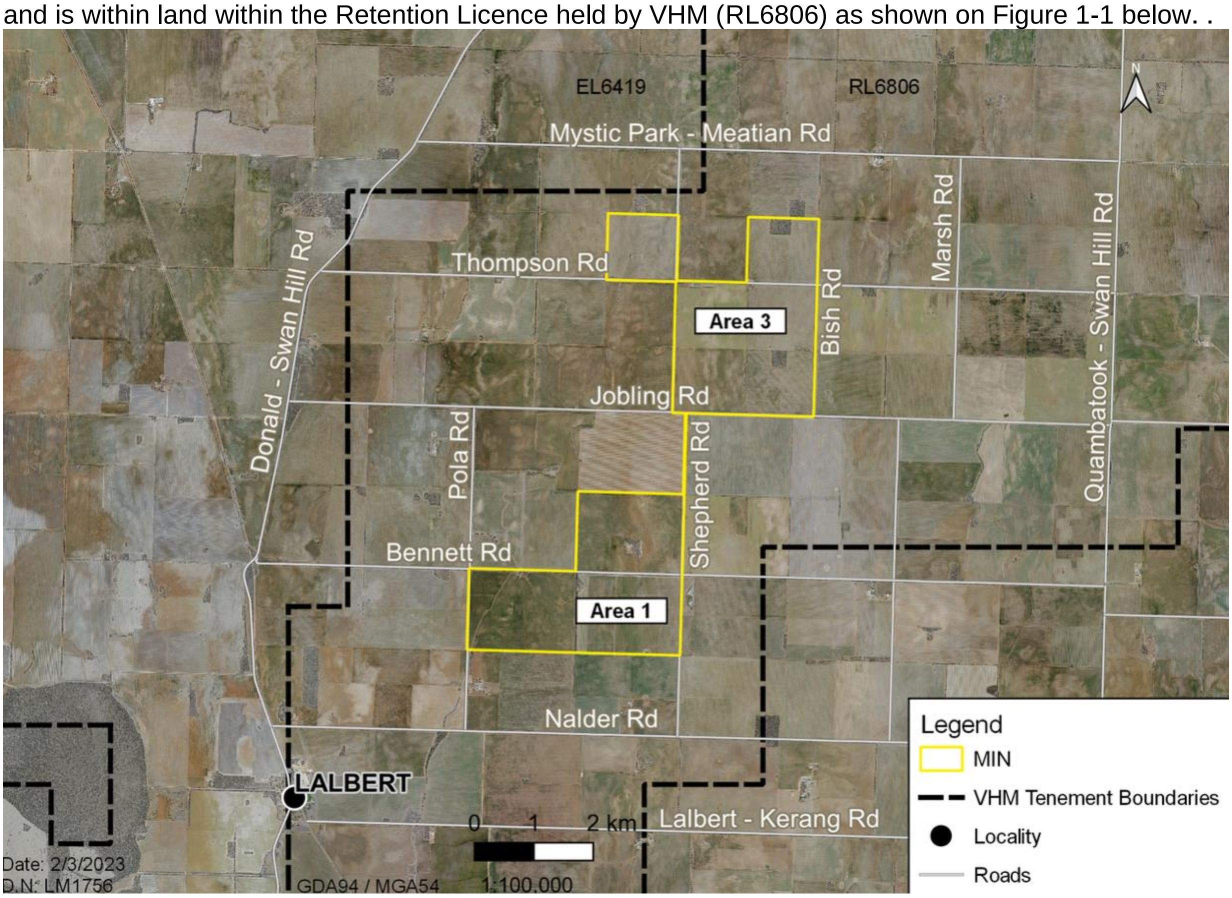

Figure 1- Project footprint

2.2 Site history

The landscape typical of the region and of the Work Plan area is predominantly cleared for croplands, consistent to its historical land use as broadacre dryland cropping for production of wheat, barley, pulses, legumes and livestock grazing.

There is no history of mining on the land, however there are two former Council borrow pits within the MIN. They are understood to be less than 5m in depth and have not been backfilled. These former borrow pits are within the Area 1 mining area.

3.0Sensitive Receptors

3.1 General surrounding landuse and site setting

The mining site is located within an agricultural setting, approximately 35 km southwest of Swan Hill. The rural town of Lalbert is approximately 3.8 km southwest.

The landscape typical of the region is predominantly cleared for croplands, consistent to its historical land use as broadacre wheat growing.

3.2 Sensitive receptors

SUMMARY
Communities and residences
Public infrastructure and facilities
Crown land and reserves
Waterways
Groundwater
Aboriginal cultural heritage and European historic heritage
Biodiversity (native flora and fauna)

A summary of identified sensitive receptors is provided below and further assessment and discussion of the impacts on sensitive receptors is included within the technical reports and in Section 6.2 below.

3.2.1 Communities and residences

The rural town of Lalbert is approximately 3.8 km southwest of the mine operations. As shown on **Figure 1- Regional Site Plan (Appendix A)**, there are scattered rural residential properties within the vicinity of the MIN, including seven existing dwellings within 2km of the MIN.

It is noted that the occupants of those dwellings identified as R0009 and R0014 will not be present during the mining operations- the house at R009 will not be occupied as a residential house by agreement, and there is a legal agreement in place whereby the house at R0014 will not be occupied during the entirely of mine operations.

The closest dwellings to the MIN (within 2km) are presented below.

Table 1 Residential Dwellings

ID	Description	UTM Coordinates (Zone 54)		Distance and Direction from Project Boundary
		(m East)	(m South)	
R0003	Residence	720,945	6,050,305	2.0 km S (Area 1)
R0007	Residence	724,968	6,060,540	1.6 km NE (Area 3)
R0012	Residence	720,623	6,051,214	1.0 km S
R0013	Residence	718,485	6,054,126	0.6 km NW (Area 1)
R0015	Residence	718,344	6,051,555	1.0 km SW (Area 1)

3.2.2 Public infrastructure and facilities

There are a number of public roads adjacent to the mine operations, including Bennett Road, Sheppard Road, Jobling Road and Thompson Road as shown on **Figure 2- Appendix A**.

Bennett Road where it intersects with the MIN, will be closed to the public by agreement with the local road authority until a point that mining activity south of Bennett Road ceases. Thompson Road, where it intersects with the MIN, will be closed to the public by agreement with the local road authority for when the mine activities progress to the north-east corner of Area 3 (as the road is within the planned pit shell).

A pumping station for GWMWater is located to the north of Thompson Road and is within the MIN. In consultation and in agreement with GWMWater, this pumping station is to be removed and relocated prior to mine operations.

A number of GWMWater decommissioned channels and branches run through the MIN. These will be removed and relocated prior to mine operations by agreement and in consultation with GWMWater.

Historically, there were many stock and domestic channels that bisected the area delivering water to the region. The larger of them included the Wychitella, Harpers, Nullawil, Kings and Kalpienung channels, all with small spur channels which were used to connect to farm dams. Most of these have been decommissioned, with water presently supplied to the area via pipelines (as part of the Northern Mallee Pipeline). The channels have mostly been decommissioned via infill.

> GWMWater pumping station and associated infrastructure within the MIN are to be removed prior to mine operations.
>
> All stock and water channels in the mining area are not in use and have been decommissioned.
>
> Bennett and Thompson Road will be temporarily closed during mining of the north-east of Area 3 where it intersects the MIN.

3.2.3 Crown land and reserves

There are crown land parcels in the vicinity of the site which are considered a receptor. The closest is a parcel of Crown Land (parks and reserves) approximately 2 km southeast of the MIN boundary.

3.2.4 Commercial and Industrial developments

Aside from the agricultural land surrounding the MIN, there are no commercial or industrial sites within 2 km of the MIN.

3.2.5 Waterways

As shown on Figure 2- Appendix A, there are no designated waterways with the MIN, with the closest being Lalbert Creek, Back Creek and the Avoca River, located some distance away (>2km).

One farm dam exists within the MIN and will be removed as part of the mining process.

3.2.6 Groundwater

Drilling and groundwater investigations have been completed by CDM Smith (2022) and have identified the following hydrogeological units:

Table 2 Hydrogeological Units (from CDM Smith, 2022)

Stratigraphic Unit	Description
Loxton-Parilla Sands	The Loxton-Parilla Sands forms the main aquifer under the MIN. It is unconfined and hosts the regional aquifer. Loxton Parilla Sands consists of a coarse grained to gravelly, well sorted, quartz rich sand with interbeds of finer sand and clay. Interbedded high strength, iron-stained sand (ironstone) is prominent near the base of the aquifer across the project area. The Loxton-Parilla Sands aquifer thickness ranges from 35 to 55 m.
Geera Clay	The Geera Clay forms a significant aquitard and consists of a dark grey to black clay of low plasticity with a sticky/slimy texture. The unit serves as an aquitard in the region, separating the Loxton-Parilla Sands and the underlying Renmark Group aquifer. Regional mapping may indicate there is no Geera Clay in the region however investigations have identified the Geera Clay to be prominent across the site. The Geera Clay aquitard thickness ranges from 32 to 46 m.

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Stratigraphic Unit	Description
Olney Formation (Renmark Group)	The Olney Formation forms an aquifer underlying the Geera Clay and consists of a dark grey to black silty clay of medium to low plasticity with a slimy/sticky texture. The unit becomes increasingly coarser grained/gravelly with depth and the thickness ranges from 13 to 25 m.
Warina Sand (Renmark Group)	The Warina Sand forms an aquifer underlying the Olney Formation and consists of a poorly consolidated coarse-grained sand, with clayey interbeds, minor quartz and laminated shale. The unit is encountered at depths of approximately 105 metres below ground level (mbgl).

A search of the Water Measurement Information System (WMIS) identified 18 monitoring bores within 10 kilometres of the MIN (CDM Smith, 2022). The existing groundwater bores have a listed use of monitoring / observation purposes or non-groundwater / unknown. No bores are listed with the use of domestic / stock bores or licensed bores and therefore there are no registered groundwater users in the vicinity of the site.

Eight groundwater monitoring bores were installed in July 2021 and were screened across the Loxton-Parilla Sands aquifer or the Renmark Group. Monitoring for groundwater levels was completed in August 2021 and April 2022. A summary is provided below.

Table 3 VHM Groundwater Bore Monitoring Network and groundwater levels

Bore ID	Aquifer	Screened interval (mbgl)	Standing water level (mbgl) - April 2022	Standing water level (mAHD)
MW001S	Loxton Parilla Sands	35-41	29.20	62.5
MW001D	Renmark Group	105-117	30.45	63.8
MW002	Loxton Parilla Sands	47-53	47.04	64.6
MW005	Loxton Parilla Sands	42-54	18.81	67.1
MW006S	Loxton Parilla Sands	40-46	24.93	63.1
MW006D	Renmark Group	107-119	25.72	63.9
MW007	Loxton Parilla Sands	38-44	Bore dry*	Bore dry*
MW008	Loxton Parilla Sands	48-54	39.89	63.2

**The depth of the base of screen at MW007 is 44 mbgl and therefore the depth to groundwater is >44 mbgl (<64 mAHD).*

Based on the groundwater monitoring network on site, the groundwater salinity in the local area ranges from approximately 15,440 mg/L to 29,565 mg/L total dissolved solids (TDS) in the Loxton Parilla Sands Aquifer.

3.2.7 Groundwater Dependent Ecosystems

A search of the Bureau of Meteorology Groundwater Dependent Ecosystems (GDE) Atlas shows no GDE types within 10 km of the mine. The Atlas indicates there are no baseflow dependent surface water features in the area. There are known features existing between the site and Lake Lalbert but it is unlikely that they receive groundwater from the Loxton Parilla Sands aquifer or that groundwater would provide any ecological benefit to the wetlands (CDM Smith, 2022).

3.2.8 Heritage

Cultural heritage

There is no cultural heritage sensitivity layer overlying the MIN or adjacent areas.

A review for historical heritage was completed by Eco Logical Australia (Eco Logical Australia, 2022). The desktop assessment and subsequent standard assessment (survey) for cultural heritage, did not identify any cultural heritage evidence within the MIN.

Historic heritage

A review for historical heritage was completed by Eco Logical Australia (Eco Logical Australia, 2022). The desktop review did not identify any historical heritages sites or sites of archaeological potential within the MIN or in the local vicinity (2 km) of the mining area.

3.2.9 Biodiversity

The area spans the Murray Mallee and Victorian Riverina bioregions of north-western Victoria. Bioregions are a landscape-scale approach to classifying the environment using a range of attributes, including vegetation, climate and geomorphology. Vegetation is largely characterised by mallee trees and shrubs.

Detailed fauna and flora surveys have been completed across the MIN area (Eco Logical, 2022 and Nature Advisory, 2022) which identified the presence of native vegetation, including large trees, within the mining areas.

Based on the studies, Mallee trees were found on red sands throughout the central and eastern parts of the study area.

Flora species listed as threatened under the state *Flora and Fauna Guarantee Act 1988* (FFG Act), including the Umbrella Wattle, were recorded in the study area during the native vegetation and flora impact assessment. The Plains Mallee Box Woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregion, listed as a threatened ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), is also present within the project footprint.

4.0Geological Information

SUMMARY	
Resource to which this work plan pertains:	Mineral sands, rare earth elements
Total estimated mineral resource:	198Mt

4.1 Geology and stratigraphy

The geological setting was reviewed in detail by Pit and Sherry for the geotechnical design and impact assessment for the project. An extract of the report is provided below (Pit& Sherry, 17 November 2022).

The outcropping geology at the Project site is comprised of a thin quaternary cover of sandy clay and ranges from approximately 5–10 m. The quaternary material overlays the Loxton Sand (formerly 'Loxton–Parilla Sand/s'), which hosts the target mineralisation zone. This unit consists of a typically well sorted, fine to medium grained, quartzrich sand) and has an average thickness of 50 m across the basin.

In the broader, general study area, the Loxton Sand overlays the Geera Clay, which separates the Loxton Sand from the Renmark Group. The Geera Clay is comprised of massive clays of low plasticity with minor sand and silt horizons. Drilling investigations undertaken by CDM Smith (2021) identified the Geera Clay to be prominent across the site with a thickness ranging from 32–46 m. Field observations are typically consistent with VHM drill hole data with encountered depths ranging from 43–56 m below ground level (BGL). This suggests that the Loxton Sand is thinner in the vicinity of the Project site than regional mapping indicates and that the Geera Clay is more extensive than regional mapping shows.

The Renmark Group consists of fluvio-lacustrine sediments comprising gravels, sand, silt and clay and is divided into the upper Olney Formation and the lower Warina Sand.

1. The Olney Formation is typically poorly consolidated and comprises carbonaceous clay, with minor silts and sands, as well as beds of brown coal and peat (GeoScience, Australia, 2017). No brown coal or peat beds were identified during drilling investigations completed by CDM Smith.
2. The Warina Sand is also typically poorly consolidated and comprises carbonaceous sand, clay and silt sequences. CDM Smith drilling investigations identified several bands of green laminated shale at depths of 110–120 m BGL.

The Victorian Aquifer Framework (VAF) indicates that the Renmark Group is 33 m thick at the site. In the general study area, the Renmark Group rests unconformably on pre-Tertiary sedimentary basement rocks and granitic plutons. The Project site is on a basement high, with the VAF indicating a basement elevation of 6 m AHD. The basement high is likely due to a granitic intrusion in the basement rocks (Lake Boga granite). The site stratigraphy is summarised below.

1. Topsoil/Quaternary - Loam and sandy clay – 5-10m thick
2. Loxton-Parilla Sand - Coarse-grained to gravelly quarts-rich sand – 35-55m thick
3. Geera Clay - Dark grey/black clay of low plasticity – 32-46m thick
4. Olney Formation - Dark grey/black silty clay of low plasticity – 13-25m thick
5. Warina Sand - Coarse-grained sand with clayey interbeds, minor shale

4.2 Adverse geological structures and conditions

VHM geologists have interpreted a basement fault which has experienced movement during and after deposition of the Geera Clay and Loxton Sand, resulting in a step change in thickness and elevation of these units. The fault forms the western edge of the Cannie Ridge and coincides with the interpreted edge of the Lake Boga granite pluton. The elevation of the top of the Geera Clay is 10–15 m lower on the western side of the fault.

Extensive investigations have been undertaken of the geology, lithology and geotechnical parameters for the proposed mine. The basement fault is not expected to impact on the mining operations.

Full detail on the investigations completed to date are provided in Pitt & Sherry, 2022.

4.3 Mineral resource description and reserves

Geochemical characterisation of the ore and subsurface have been assessed by Right Solutions Australia (2018).

Key extracts of their assessment are provided below (from Right Solution Australia, 2018):

Mineral sands are deposits of materials that have a specific gravity that is greater than that of quartz (SiO_2 - 2.65 g/cm^3). These heavy minerals are eroded from sources such as granites and metamorphic rocks. The sediments are deposited, where they are then concentrated in place usually by fluvial or marine action, which, over time, washes out the lighter silica minerals and serves to concentrate the heavy minerals where they would otherwise be at low concentrations.

Mineral sands are chiefly mined to obtain a source of titanium from the minerals: **rutile**, **anatase** (TiO_2) and their alteration product **leucoxene**, **ilmenite** ($FeTiO_3$) or **sphene** ($CaTiSiO_5$); and **zircon** ($ZrSiO_4$), but can be a valuable source of rare earth elements such as yttrium in the mineral **xenotime** (YPO_4), and cerium, lanthanum, neodymium, thorium, samarium, europium, gadolinium and uranium in the mineral **monazite** (Ce, La, Nd, Th, Sm, Eu, Gd, U-PO_4).

Deposits of mineral sands can contain levels of Naturally Occurring Radioactive Material (NORM) and their decay products and, as a result of radioactivity, must be assessed for human and environmental safety.

Goschen has a current Proved and Probable Ore Reserve of 198.7Mt, which includes the area underlying the MIN.

5.0Mine Operations

5.1 Overview

The work plan area contains ore which is to produce a range of products including mixed heavy mineral concentrate (HMC), zircon concentrate, rutile product, leucoxene products, ilmenite product, rare earth mineral products. The mine operations will include mining within two defined mining areas and processing of heavy mineral sands at a throughput of approximately 5 Mtpa (±10 %) over an estimated 25-year mine life. Mine products are to be transported via a combination of road and rail networks to port facilities for export overseas.

The mining operations includes the following two key areas:

1. Area 1- approximately 722 hectares in size;
2. Area 3- approximately 754 hectares in size.

In Area 1, the mineral processing plant is centrally located to the west of the site, north of Bennett Road. The mineral process plant includes the feed preparation plant (FPP), wet concentrate plant (WCP), rare earth mineral concentrate (REMC) flotation plant, mineral separation plant (MSP) and re-agent storage, tailings thickener, process water storage, workshop administration and ancillary buildings and HMC and p-flotation stockpiles. The hydrometallurgical plant (HMP) will also be located within the processing infrastructure area.

The raw water storage, power station and fuel storage are to be located across from the process plant itself to separate it from high traffic areas. The plant workshop is to be split into two, with a smaller workshop located near the plant entrance. This would service small scale works and storage of components for the WCP. A larger workshop is to be located near the MSP and would service larger deliveries, such as equipment and bulk re-agents.

The noise impact assessment (refer to Section 6.5) assessed the mining unit plants (MUP) running on surface, however where possible, an excavation is to be undertaken for each MUP location so that the MUP and loading equipment would be approximately 12 m bgl as part of reducing amenity impacts. The pumping distances between the MUP and the FPP/WCP would typically be 1 to 1.5 km in Area 1 and upto 5 km in Area3.

A service corridor between Area 1 and Area 3 is to be established parallel to Sheppard Road which will also provide access between Area 1 and Area 3. The service corridor will include a water pipeline and power under the roadway. Above ground pipes will be used to transport ore slurry and tailings from Area 3 to the processing plant in Area 1 and will be established in readiness for the commencement of mining in Area 3.

The site layout of Area 1 and Area 3 are provided as **Figure 3 and Figure 4- Appendix A** respectively.

5.2 Method and scale of extraction

SUMMARY	
Operation type:	Dry open pit
Principal mining methods:	Strip mining
Estimated maximum terminal depth:	47metres below ground level
Batter slope	Maximum 31 degrees (unless further design analysis permits steeper angles)

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5.2.1 Construction and Commissioning

The following key elements will form part of the construction phase.

Table 4 Mine construction

Phase	Activities
Site establishment	Establishment of site access to Area 1 Establishment of temporary construction services such as demountable site offices, site ablutions, and lay down areas. All farm dams will be decommissioned or removed and any GWMWater assets, such as pump stations or pipelines, will be moved in consultation with GWMWater.
Earthworks and civil works	Clearing and stripping of topsoil layers and bulk filling of the site (from on-site material) to design level for site infrastructure and plant in Area 1. Construction of concrete pads under the key processing infrastructure areas. Construction of mine water storage and stormwater dams, roads (imported material), carparks and ancillary areas.
Structural, mechanical and piping construction	Installation of mining unit plant (MUP). Installation of overland piping. Mechanical installation of key process plant components. Installation of high voltage cabling to mining area.
Electrical and instrumental construction	Electrical and instrumental construction to allow for plant commissioning.

The commissioning phase will commence following the handover of the construction verified processing plant. Power to the plant and process water supply will be in place prior to commencing commissioning.

Sufficient feed material is required for continuous operation during commissioning, which would require the commencement of the first mining cell within Area 1.

The plant will be energised first and then dry commissioned. Dry commissioning is a subsequent phase of pre-commissioning and includes the loading of the control system, first fill lubrication, “bump testing” of drives, initial instrument calibration, testing of critical safety systems and the running of rotating machinery without water and without feed.

Subsequent phases consist of:

1. A water run to initially flush out construction debris followed by the circulation of water through identified systems on a system-by-system basis. These water runs prove the integrity of the plant under water; and
2. The dry run of those items that do not carry fluids such as conveyors, feeders, and screens with the purpose of tracking, aligning, and adjusting these items of plant.

5.2.2 Mining description

The mining method will be strip-mining. Each mined segment, or block, will be approximately 200 m along-strike and will be variable in width to suit prevailing ground conditions. Mining operations will take place at least 1 metre above the regional groundwater water table, with mining generally to be 2-3 m above the groundwater table. In Area 1 the depth of mining will be between 25- 30 metres below ground level (m bgl) and due to increased overburden in Area 3, pit depths will be generally between 35-43 m bgl. In proximity to Jobling Road, mining will reach a maximum depth of 47 m bgl.

Ground conditions do not indicate that drilling and/or blasting would be required as part of mine operations.

Mining will occur in blocks, with excavation, tailings deposition and rehabilitation being undertaken in a progressive sequence. It is expected that each block would only be open for approximately 24 to 36 months. The mining sequence has been optimised to allow for the co deposition of tailings into each block without the need for an aboveground tailings storage facility. The mineral processing description is further discussed in Section 5.3.2 below.

At the beginning of mining operations, overburden and ore extracted from the first mining block will be stored at the surface in stockpiles. Once the first block has been mined, overburden stockpiled at the surface will be used to make tailings bunds within the void of mined blocks. Ore processing would then begin, and tailings will be deposited into the contained cells located within the mined block. The deposited tails will then be covered by more overburden as mining progresses to the next block, allowing for co-disposal to occur. This sequence is presented in Figure 2 below.

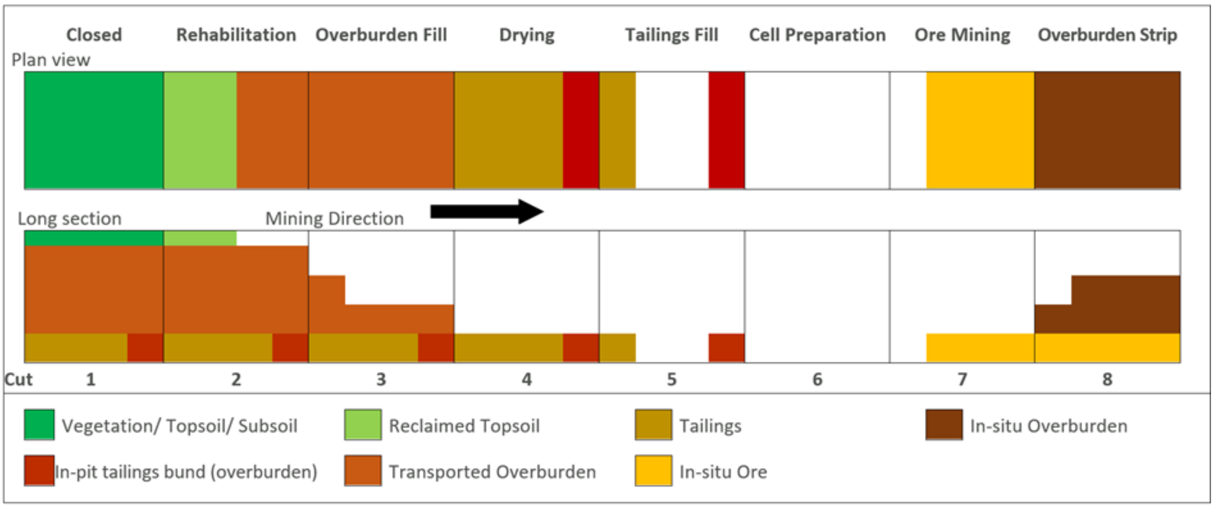

Figure 2 Co-deposition mining sequence

Once buried within the void of a mined block, the deposited tailings would continue to dewater. Under Schedule 1 of the *Environment Protection Regulations 2021*, this triggers an A18 permission for the discharge or deposit of waste to aquifer.

A18 permissions from EPA will be in place prior to any disposal of tailings to mine voids.

5.2.3 Stockpiling- Topsoil, Overburden and Ore

Location for the stockpiles of topsoil, clay and overburden area are shown on **Figure 3 and Figure 4- Site Layout** respectively.

Topsoil and subsoil stockpiles will be created by material removed from stockpile areas, infrastructure footprints and from the surface of mining blocks. Topsoil will be deposited with overburden upon rehabilitation of mined blocks or would be used as needed at the surface. Topsoil stockpiles will not exceed a height of 2 m and will be carefully managed to ensure soil biota and nutrients are maintained.

A clay stockpile will be created from subsoil material to ensure the availability of clay for rehabilitation activities and for construction around the site throughout the life of the Project. This material, with its expected lower permeability, may be used in the construction of water storage dams or tailings cells within mined blocks.

Overburden will also be used to make tailings bunds and barriers as close to the mining location as possible. Overburden will then be used to cover deposited tails as the mining sequence progresses, with any excess overburden stockpiled on the surface. Overburden waste dumps have been designed to a height of 30m above the highest point of the surrounding topography, with the capacity to hold the majority of waste mined in the initial 12 months of production and approximately 50% of the waste mined in the subsequent 12 months, up to a total of approximately 9 million bank cubic metres (Mbcm).

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A bank cubic metre is a cubic metre of material *in-situ* before it is extracted. Over the life of the mine, waste movement to backfill mined voids will be prioritised whenever possible, with surface stockpiling occurring when there is insufficient capacity in the mined voids.

The geotechnical assessment assessed the stockpile geometry for stability and assessed that clay and sand stockpiles up to 30m in height with a 4m berm, 6m lift and 1V:2.5H batter meet minimal factor of safety requirements.

In order to capture surface water runoff from stockpiles and prevent it from entering bunded area, catch drains with bunds, formed by using clay overburden to prevent erosion and scour, will be constructed where required. The catch drains will be about 600 mm deep, with 2m high bunds with grassed batters. The crest will be nominally 1 m wide and all batters will be 1V:2H where practicable. A typical cross section is below (Figure 56 from Pitt & Sherry, 2022).

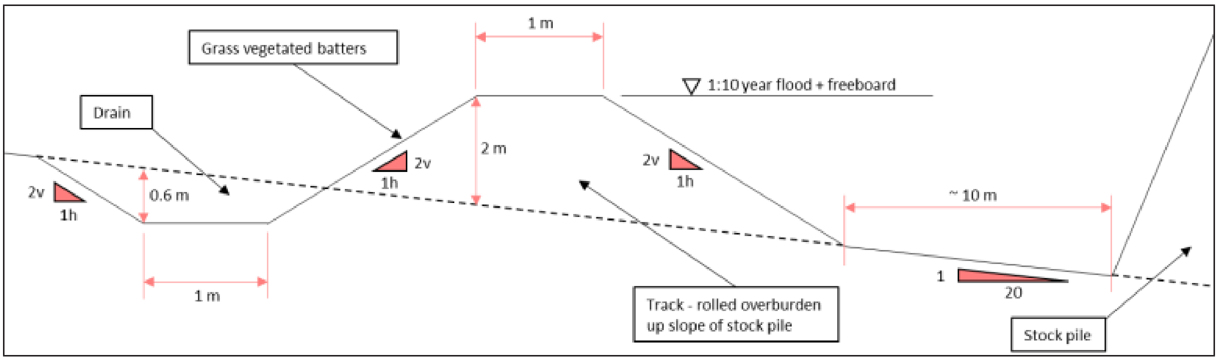

Figure 3 Cross-section of typical design for bunded surface water catch drains

An ore stockpile will be positioned adjacent to the initial MUP location. This stockpile will contain all ore material from the first mining block. This location is a short distance from the mining area and will be dozed into the sub-surface MUP run of mine (ROM) during day shifts to allow for night loading of the MUP. It is expected that the ore mining rate for the first 12 months of processing would be below the 5 Mtpa capacity, with the balance being sourced from this initial ore stockpile, which would be depleted within 12 months of mining operations. During operations, this stockpile could be used to balance overall production rates, if required.

5.2.4 Pit design

Geotechnical assessment and design for the pit has been completed by Pit & Sherry (2022). To inform the pit design, visual inspections, chip tray samples and preliminary laboratory analysis has been completed. A program of further geotechnical investigation is in place to further inform and refine the pit design once the pits have been opened.

Soil investigations to date, have identified the following general profile across the area:

Table 5 Generalised subsurface profile

Description	Typical depth range (m)	Typical layer thickness (m)	Thickness for design (m)
Topsoil, silty clay	0	1.0 to 1.5	1.5
Silty clay, becoming clayey sand with depth	1 to 6; locally up to 10 m in Area 3	4.5 to 8.6	4.5
Cemented silty sand, varying from lightly to moderately cemented	6 to 20	10 to 16	14
Silty sand	16 to 20	20	18
Geera Clay	40 to 50	Not determined	Not determined

Based on the geotechnical assessment, the follow pit slope and design parameters have been set:

Table 6 Pit Geometry

Geometry	Design Limits	
Pit depth	Up to 42 m	47 m
Bench heights	First bench at 10 m Second bench at 25 m	First bench at 10 m Second bench at 25 m Third bench at 40 m
Minimum berm width	6 m	6 m
Overall slope angle	Maximum 32˚ degrees	Maximum 31˚ degrees
Buffer zone	22m	22m

5.3 Processing methods and facilities

5.3.1 Mobile plant

Excavators and trucks will be the primary equipment used for mining, stockpiling materials and hauling the ore and materials within the mine area.

Alternative equipment such as articulated dump trucks, or a heavier reliance on track mounted equipment, would be utilised if required due to site trafficability conditions.

Primary mining operations would be supported by dozers and front-end loaders (FELs) which would be used for activities such as cross-ripping, pushing up bunds and contouring waste dumps. Dozers may also be used to accurately remove overburden immediately above ore zones in order to minimise dilution. FELs and dozers may also be used for feeding the MUP and to assist in cleaning the pit floor to improve mining recovery.

Other mobile plant utilised may include (but is not limited to) scrapers, water truck for dust suppression.

5.3.2 Mineral processing description

The mine development is to occur phases, with the key mine processing units and products from each phase summarised in the table below.

Table 7 Summary of development phases and mineral products

Phase	Processing circuit development	Mineral products
Phase 1	Mining unit plant (MUP) Wet concentrator plant (WCP) Rare earth mineral concentrate (REMC) flotation plant	Zircon/titania HMC
Phase 1A	MUP WCP REMC flotation plant Hydrometallurgical plant (HMP)	Zircon/titania HMC Mixed rare earth carbonate
Phase 2	MUP WCP REMC flotation plant HMP Mineral Separation plant (MSP) Hot acid leach (HAL) and chromium removal circuit	Zircon/titania HMC Mixed rare earth carbonate Premium zircon Zircon concentrate HiTi/rutile HiTi leucoxene

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Phase	Processing circuit development	Mineral products
		Low chromium ilmenite

An overview of the process circuit for Phase 1, Phase 1A and Phase 2 is provided below.

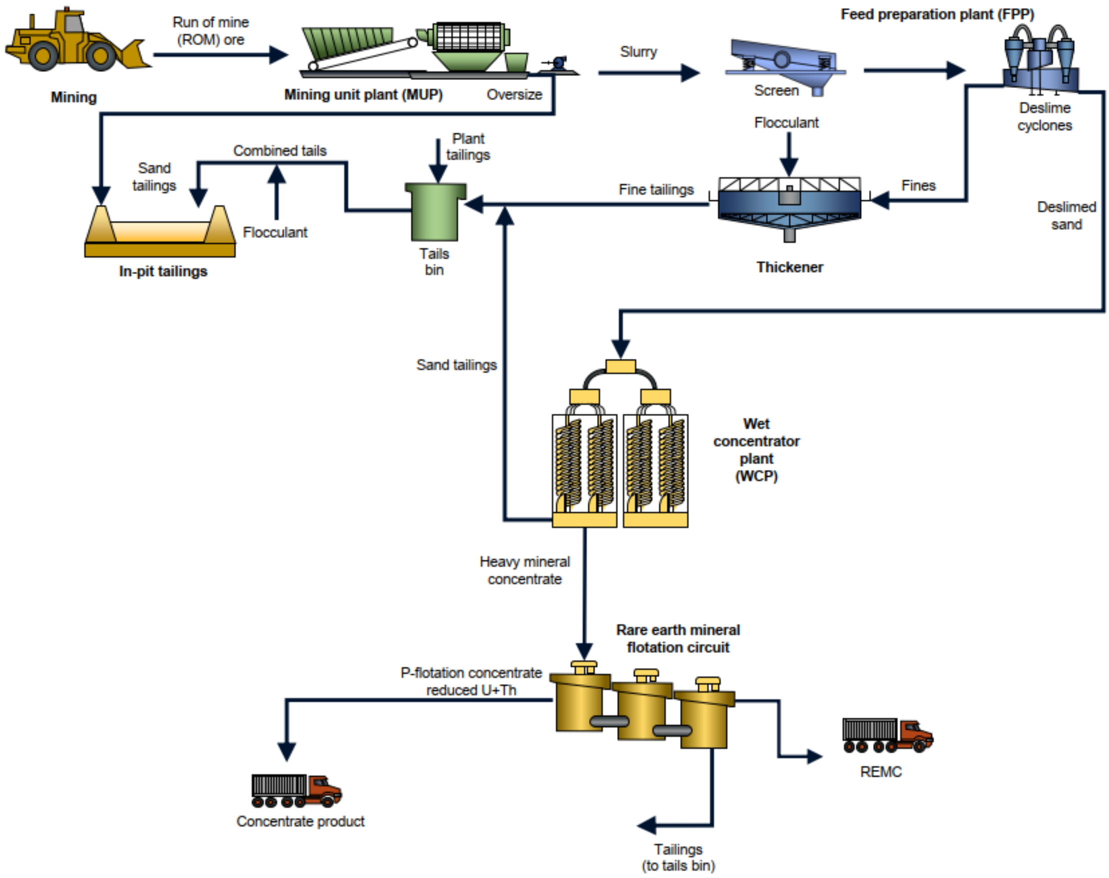

Figure 4 Phase 1mining process circuit

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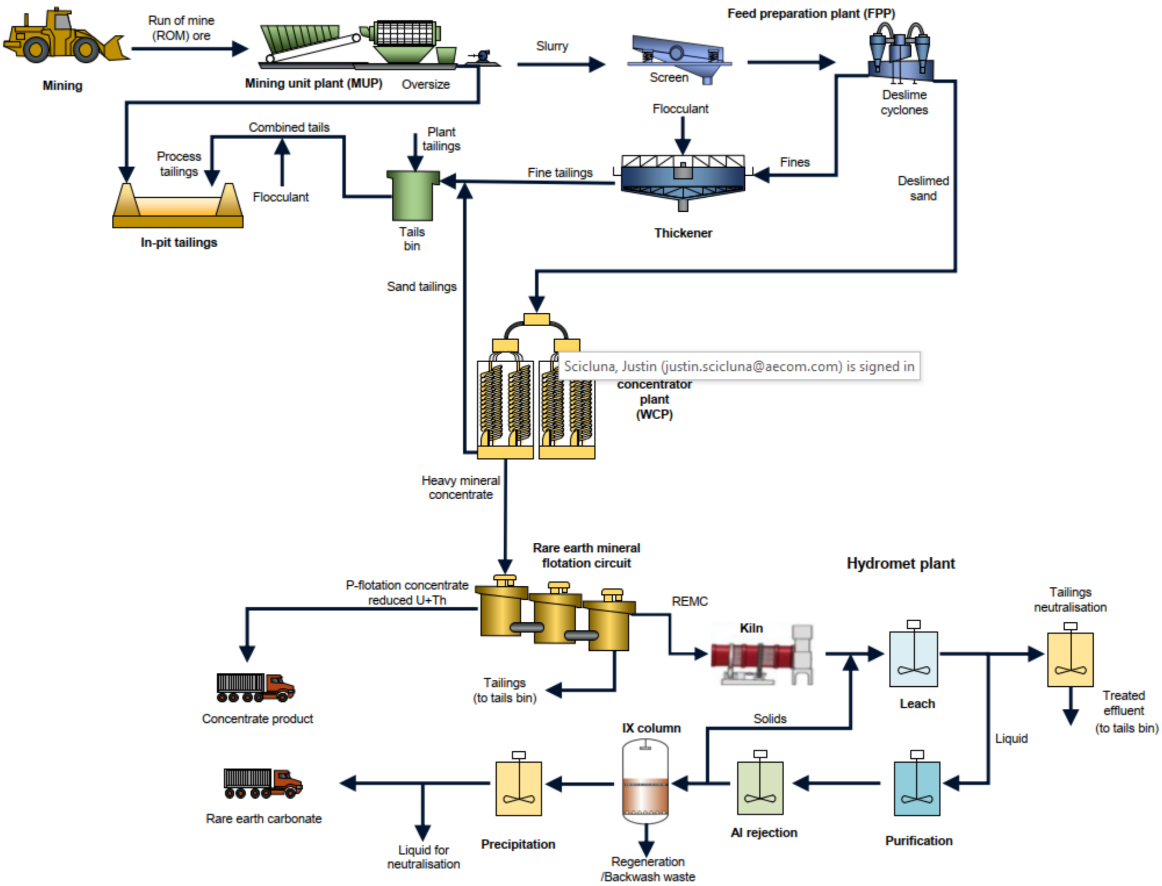

Figure 5 Phase 1A mining process circuit

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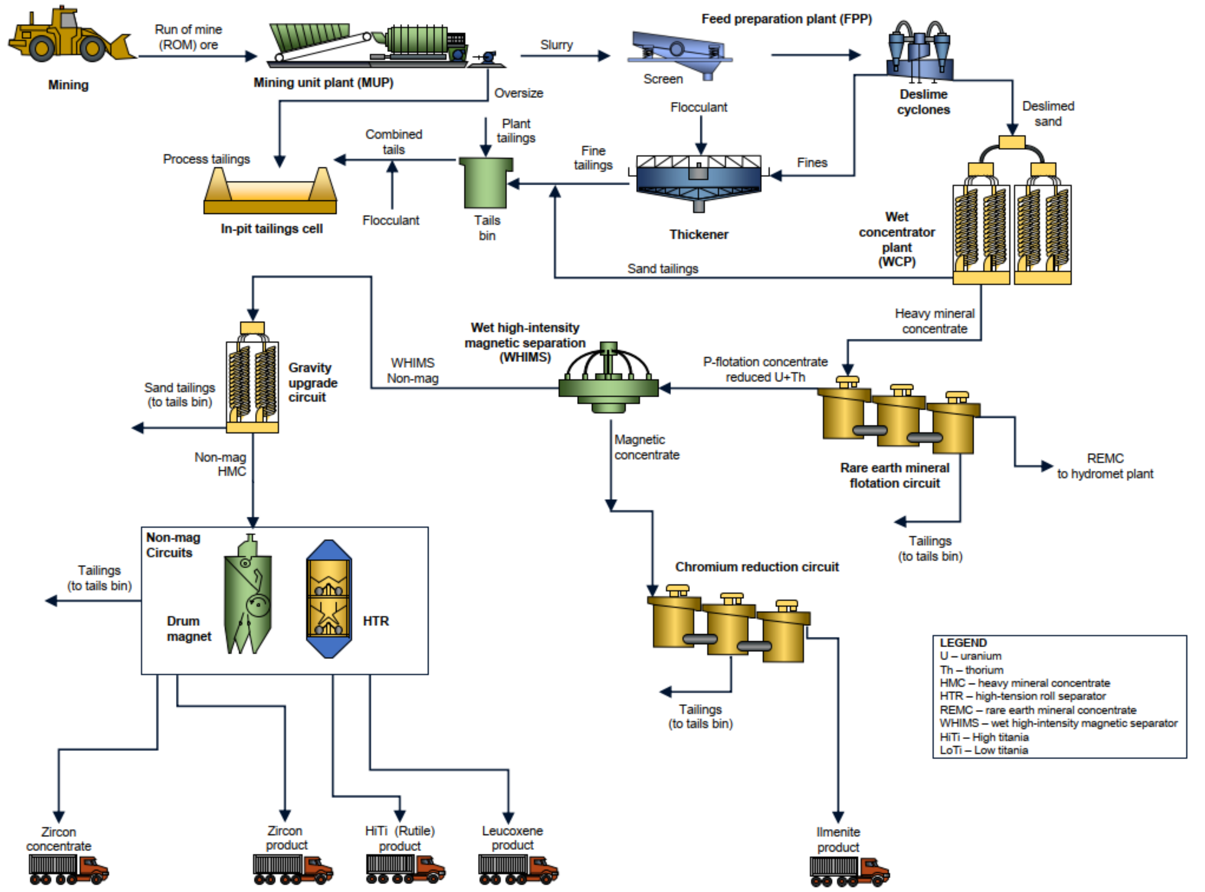

Figure 6 Phase 2 mining process circuit

5.3.3 Mining Unit Plant

Mineral processing would begin with the mining unit plant (MUP). The MUP has a processing capacity of 5 Mtpa ((±10 %). It may sit at surface, however, where possible, it will be situated at a bench level of 12 m bgl to minimise noise and light emissions at ground level. The MUP will move to different locations as mining operations progress, so that it is always proximate to the active mine face, as per the nominal locations on **Figure 3** and **Figure 4- Appendix A**.

5.3.4 Feed preparation plant and wet concentrator plant

The FPP will be located at the main processing plant and consists of coarse screening, fine screening, desliming cyclones and scavenging cyclones.

Material removed from the ore by the initial coarse screen will be stockpiled for use as fill on-site, or deposited within the void of a mined block. The finer cyclone overflow will be pumped to a thickener for further treatment, while underflow, coarser material, will be pumped to the surge bin.

Material will be pumped from the surge bin to the wet concentrator plant (WCP), which contains spirals and a further screening stage. The spirals separate heavy minerals from light minerals based on their specific gravity. The screen removes recirculating larger gangue material, otherwise known as valueless ore, and prevents it from building up in the process.

Material removed from the WCP is combined with the thickened overflow from the FPP and is deposited as tailings within a mined block.

5.3.5 Rare earth mineral concentrate plant

Heavy mineral concentrate (HMC) is to be collected from the WCP and pumped to the rare earth mineral concentrate (REMC) flotation plant, or stockpiled as a buffer between each of the plants. Throughout mining operations, the utilisation of the WCP and REMC may differ and stockpiling HMC material would allow for throughput to be maximised.

Rare earth mineral (REM) present in the HMC will be separated from other heavy minerals by flotation and gravity separation. Attritioning and conditioning cells would scrub the surface of HMC particles in preparation for flotation. A multi-stage float circuit maximises REM recovery, floating off a monazite and xenotime stream which undergoes gravity separation to remove residual heavy minerals.

The REMC plant produces a REMC that is further processed at the hydrometallurgical plant (HMP) and a 'P-flotation' concentrate will be dewatered and processed at a mineral separation plant (MSP) as part of Phase 2 mining operations.

5.3.6 Hydrometallurgical plant

The hydrometallurgical plant (HMP) is made of a number of processes and includes a sulphation bake, water leach tanks, purification, aluminium rejection, ion exchange and uranium processing and rare earth carbonate precipitation.

REMC will be dewatered in an indirectly heated electric dryer and will then discharge to a paddle mixer where concentrated sulphuric acid is added to make a paste in preparation for baking in a gas-fired kiln. The sulphation process involves the conversion of the monazite and xenotime rare earth phosphate species into water soluble sulphate species.

Product from the sulphation bake kiln then discharges into a water leach tank where it is contacted with recycled process water. The water leach process involves the solubilisation of the rare earth sulphate species generated in the sulphation bake.

The slurry leaving the water leach tanks is then sent to a thickener, where the solid residue is diverted to a higher density underflow stream. This underflow is then sent to a filter for further dewatering and washing, with the aim to produce a high-density cake with minimal rare earth species for disposal.

The thickener overflow is primarily a liquor stream containing most of the dissolved rare earth elements. This stream will then be sent to purification for further refinement.

The primary goal of the purification stage is to separate soluble phosphate from the rare earth liquor stream. In addition to phosphate removal, co-precipitation of other species also occurs. The slurry leaving the purification tanks is sent to a thickener. The thickener overflow is primarily a liquor stream and is sent to aluminium rejection for further refinement.

The aluminium rejection circuit involves the addition of magnesium oxide to achieve a target pH of 5. Under these conditions, the majority of any aluminium, iron and thorium metals would precipitate as hydroxides. Uranium is removed from the liquor via ion exchange and the rare earth elements are precipitated using sodium carbonate. This creates a high grade, high purity rare earth carbonate precipitate. This precipitate is dewatered in a thickener, with a portion of the underflow directed to a final product filter, where the rare earth carbonate product is washed and dewatered prior to being dried.

All chemicals and reagents will be stored according to applicable standards and spill response procedures will be in place. All management measures will be detailed in Risk Management Plan.

5.3.7 Wet high intensity magnetic separation circuit

Phase 2 processing operations will use a mineral separation circuit to separate p-float concentrate into a magnetic ilmenite (TiO_2) HMC product and a non-magnetic HMC product consisting mostly of zircon and various titania minerals. Separation occurs through a wet high intensity magnetic separation (WHIMS) and gravity clean up.

The non-magnetic stream largely rejects quartz to a tails stream during gravity separation, resulting in a zircon rich non-magnetic HMC with high TiO_2 minerals leucoxene and rutile.

The magnetic HMC product is then further processed by flotation to produce a low chrome ilmenite.

5.3.8 Non-magnetic HMC upgrade circuit

The resultant non-magnetic HMC is processed through several circuits including dry magnetic separators and high tension (electrostatic) rolls to create high quality products of zircon. These include HiTi rutile, HiTi leucoxene and LowTi leucoxene.

Rejected materials are collected and combined to produce a zircon/rutile rich HMC.

5.4 Production

The throughput is expected to be 5 Mtpa (±10 %) for the approximate 20-25-year life of the mine. As the ratio of overburden removed to mineralised ore mined varies across the mine extent, annualised production rates would vary accordingly between 10 Mtpa and 27.5 Mtpa total material movement, to maintain a throughput of 5 Mtpa.

5.5 Tailings

5.5.1 Tailings Composition

As a results of the nature of the minerals sands deposit, the majority of the material is separated on site via mainly physical concentration processes. The mineral processing involves various separation processes including particle size screening, gravity spirals for density fractionation, floatation, electrostatic and magnetic separation to recover the valuable heavy minerals.

Through the processing circuit, 10 tailings streams are generated with variable composition, with the tails also varying in size- fine tails (<20 µm), coarse tails (20µm-2 mm) and oversize (>2mm). The majority (approximately 80%) of the mass of the tailings is expected to be coarse tails, generated through gravity separation.

Table 8 Tailings streams and mass flow rates

Stream	Process	Size	Mass (ktpa)	%
T1	Feed Process Plant (FPP) - Oversize Tails	>2mm	90	2
T2	Feed Process Plant (FPP) - Fines Tails	< 20 µm	800	16
T3	Wet Concentrator Plant (WCP) – Coarse Tails	20 µm – 2mm	3,900	80
T4	Rare Earth Mineral Concentrate (REMC) Tails		1.1	<0.05
T5	Non-magnetic Gravity Upgrade (N/M-GT) Tails		40	0.8
T6	Magnetic Separation Plant (MSP) – "Mags" Tails		-	-
T7	Cr_2O_3 Removal (CrFloat) Tails		15	0.3
T8	Non-Magnetic Zr/HiTi (N/M-MSP) Tails		<5	<0.5
T9	Hot acid leach (HAL) Tails		<1	<0.05
T10	Mixed Rare Earth Carbonate (MREC) Tails		40	0.8

The tails will be homogenised and pumped as a slurry to be co-disposed to the mine void as a combined, homogenised stream.

A geochemical assessment has been undertaken to characterise the tailings waste material that will be generated from processing based on samples collected from Area 1 and Area 3 within the area to be mined. Analytical testing of the generated tailings was completed on between 1-8 samples of each tailings stream for the following suite:

- Acid-base accounting
- Total element analysis (whole rock) by acid digestion used to determine a geochemical abundance index
- Dissolved parameters by leach testing
- Mineralogy by x-ray diffraction (XRD).
- Calculated radioactives of the tailings and combined tailings waste streams.

A summary of the key test results is as follows:

- All tailings material is classified as Non-Acid Forming;

- There is a significant difference in total element concentrations between the Feed Process Plant (FPP) oversize (OS) and fine tails (FT). The higher aluminium concentrations in the Fine Tails indicates that the majority of clay minerals have been separated into this fraction which is the goal of this process. Similarly the major soluble ions are also highest in the fines tails as they are associated with clay minerals.
- The Wet Concentrator Plant (WCP) Coarse Tails (CT), which comprises the largest volume generally has the lowest concentrations of all metals.
- The Rare Earth Mineral Concentrate (REMC) Gravity Tails (GT) have elevated concentrations of minor metals such as barium, cerium, gallium, lanthanum, selenium, and yttrium. The flotation process is designed to separate the rare earth heavy minerals and so minor concentrations of the heavy minerals are expected in the gravity upgrade tails.
- In general, tailings appear to show no potential for acid or saline drainage and a slight to moderate potential for metalliferous drainage. There is a moderate to high risk that tailings may constitute a source of aluminium, arsenic, hexavalent chromium and vanadium. It is well-known that ilmenite concentrates produced from Murray Basin deposits contain high levels of chromium due to the presence of chrome spinel minerals.
- Based on the available testing data, the majority of the waste streams generated by the project will not be considered to be radioactive materials, with the exception of two waste streams (T5 and T7) which appear to contain sufficient activity which will need specific measures and handling applied individually. Testing to date shows that the combined tails have a lower leachable content and radioactivity that than the individual waste stream data may predict and ongoing testing will form part of the tailings testing and management program.

An ongoing testing program to evaluate the tails will form part of the detailed design and operations. Tailings management, including (but not limited to) management and handling of waste streams, slurry and decant water return lines management and monitoring and spills response will be further detailed within a Tailings Management Plan.

A Groundwater Management and Monitoring Program will be in place to assess any groundwater quality changes and will be based on the compilation of all available tailings and groundwater quality data at the time of preparation. Baseline groundwater testing has commenced in advance of any mining operations to assist with informing the monitoring program.

A Radiation Management Plan (RMP), Radioactive Waste Management Plan (RWMP) and Radiation Environmental Plan (REP) are to be developed and approved as per the *Radiation Act 2005* to ensure that radiation related impacts and risks remain well controlled.

5.5.2 Tailings Management

Tailings from the minerals processing are managed by confinement to minimise potential impacts to human health and the environment. Once a block has been mined, overburden will be used to create an in-pit bund approximately 2 m high. This would allow for tailings to be deposited in-pit and without the need of a temporary above ground tailings storage facility.

All tailings and solid waste streams from the processing of ore will be homogenised into a single tailings slurry at the process plant. The tailings slurry will be delivered in-pit via a delivery pipeline and spigots spaced approximately 100 m apart along the perimeter of the pit. The homogenised tailings will be placed above the pre-mining groundwater elevation and across the same interval as the extracted ore zone. During later stages of filling, a second tailings feed pipeline is to be installed along the crest of the tailings bund to optimise fill volumes (Figure 7).

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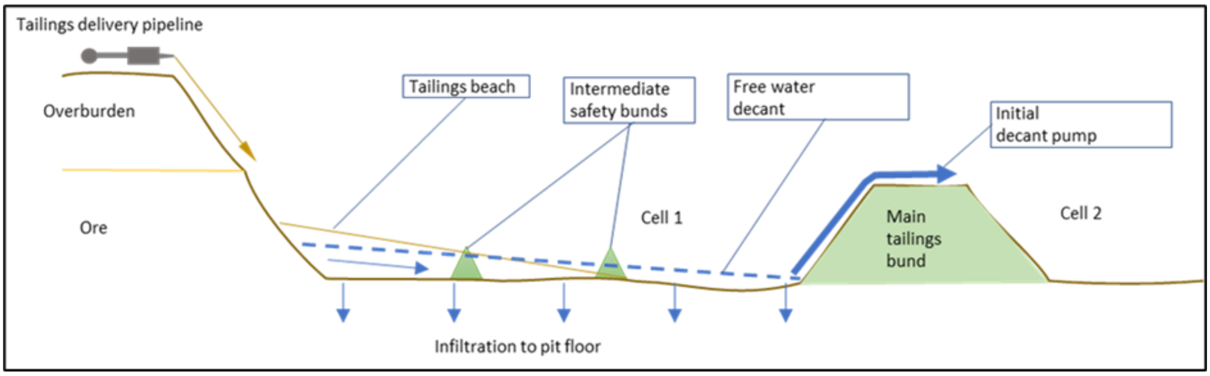

Figure 7 Tailings management - the in-pit tailings bund

Within each tailings cell, lower intermediate safety bunds is to be constructed with overburden to provide separation, risk management in the event of a storm, and access as required. These will be up to 5m high, and two to three bunds may be constructed in each tailings cell.

Water will be recovered from the tailings slurry via submersible pump lines located down the face of the block wall or down the face of the main tailings bund. Maximising decant water from the tails placed in-pit forms a key management measure to minimise infiltration to groundwater. The pump lines are oversized ducts which allow for optimal water recovery, and the pump can be raised or lowered as required. Tailings will also dewater under gravity and some seepage would occur into the base of the pit (Figure 8).

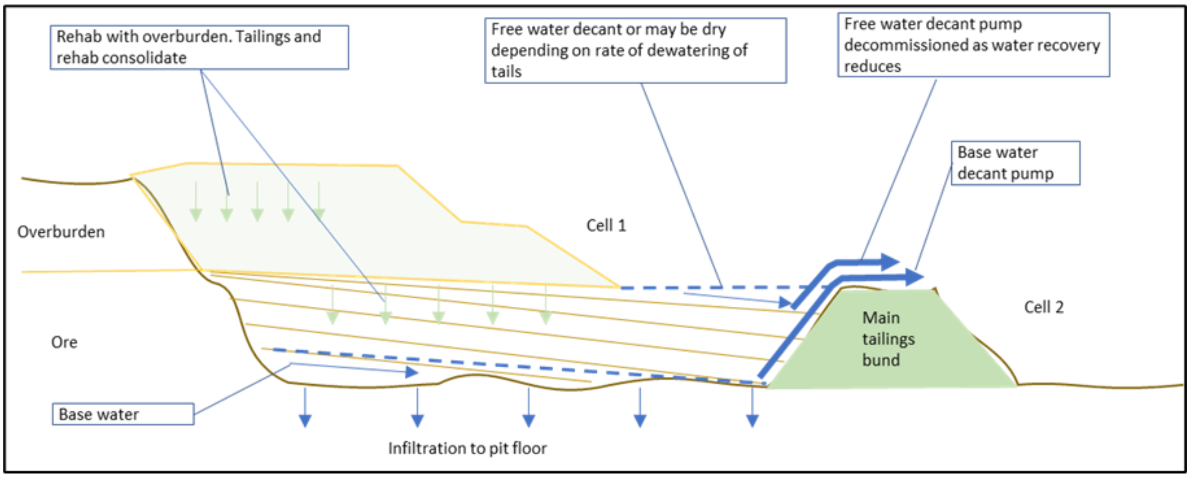

Figure 8 Tailings management - water recovery

Once tailings are fully drained, the decant pipeline will be connected to subsequent pits or decommissioned. Water recovered from the tailings slurry will be pumped to the above ground (lined) process water storage (Figure 9) and the water will remain with the closed process water circuit (see Section 5.6).

Once buried within the void of a mined block, the deposited tailings would continue to dewater. Under Schedule 1 of the *Environment Protection Regulations 2021*, this triggers an A18 permission for the discharge or deposit of waste to aquifer.

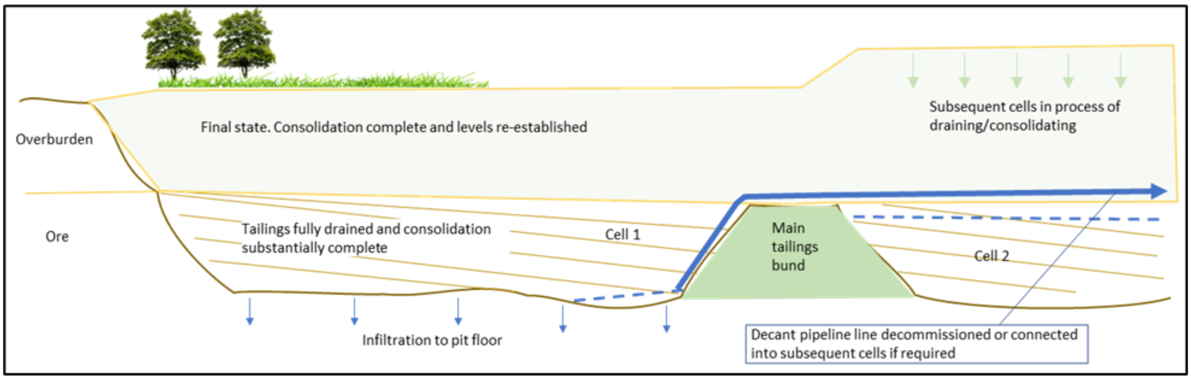

Figure 9 Tailings management - tailings drained

A18 permissions from EPA will be in place prior to any disposal of tailings within the mine voids. Inherent design features form part of the tailings management to minimise infiltration to groundwater, including:

- thickening of the tails slurry
- addition of flocculant at the spigots to enhance water and solid separation
- decant collection from the in-pit tails ponds, with targeted dewatering of the mound;
- Construction of an underdrain along the embankment toe to collect seepage.

Tailings management will be further detailed within a Tailings Management Plan.
A Groundwater Management and Monitoring Program will be in place to assess any groundwater quality changes.

5.6 Water Use and Management

5.6.1 Raw Water and Process Water Storage

A raw water storage is to be constructed on-site adjacent to the processing area in Area 1 shown on **Figure 3- Appendix A**. The raw water will be fed from the pipeline from Kangaroo Lake. Water from the raw storage water will be reticulated to various areas for dust suppression and storage for use in the various mineral processes. Water demand would peak at 4.5 Gigalitres per year (GL/y) during start-up and would reduce to 3.1 GL/year for operations.

Process water is a closed circuit and water on this circuit will only be used within the processing plant and mining areas, with evaporation being the only discharge from site. Process water circuits are designed to optimise the re-use of water recovered from the various process circuits, which will draw water from the raw water storage as required. A small process water storage will be located in the processing area. The process water storage will be lined to minimise losses from the process water circuit. The final design will be part of the detailed design phase. Decant water from the tails placed in mined voids will be returned to the process water storage.

Permits for pipeline and the design, construction and use of the raw water storage from GWMWater will be in place prior to pipeline and water storage construction.

5.6.2 Stormwater

Given the potential for contamination of surface water due to mining and construction activities, the need for substantial quantities of water within the operational process and the site's semi-arid climatic conditions, it is intended that surface water from disturbed catchments (mine affected water) be contained within the mine site and harvested for use in process. Stormwater storage dams will be strategically located in the disturbance footprint.

Modelling of internal surface water flows was completed by allows for storage of surface water flows up to the 5% AEP (1 in 20-year Average Recurrence Interval) design storm event, with further allowance for surface water from more extreme events to be directed to the active pit, ensuring that surface water that has reasonable risk of not achieving required water quality objectives cannot leave site (Pitt & Sherry, 2022).

The following other considerations form part of the project design to manage stormwater run-off on-site:

1. Progressive rehabilitation;
2. Stockpiles and processing infrastructure located outside of key drainage areas
3. Erosion control
4. Use of existing drainage features to reduce internal surface water catchments
5. Surface water management plan development and implementation to detail surface water management and structures, including bunding around stockpiles and also to assess water efficiency/ recovery opportunities.

Any stormwater which comes into contact with disturbed or processing areas will be contained on-site and no turbid or contaminated water will leave the site. The design of the stormwater drainage and containment system will for part of the mine detailed design, with all surface water design and management detailed with a Stormwater Management Plan.

5.7 Ancillary utilities-water, power and fuel supply

Mine water will be supplied to the processing plant through a pipeline from Kangaroo Lake, approximately 30km to the east of Areas 1, and will be pumped into the raw water storage on site. The water will be treated using Reverse Osmosis to supply site potable water. The brine from the reverse osmosis plant will be placed within the process water storage as part of the closed process water circuit. If needed, the salt accumulating within the storage, will be periodically cleaned out and removed off-site and disposed of by an appropriately licenced contractor.

Water recycling systems will be used as far as is practicable. A packaged wastewater treatment system will be installed to collect and homogenise wastewater from showers, toilets and sinks. The system will contain the waste water which will then be removed periodically by vacuum truck for off-site disposal at a licenced facility.

Power to the operations will be supplied via a 12 megawatt power station to be located within the processing plant in Area 1 (refer **to Figure 3- Appendix A** for the location of the power plant).

Fuel storage for diesel, LPG and liquefied natural gas (LNG) each with capacity for 10 days operation will be stored on site to operate the power plant. Hydrocarbons will be stored in bunded and double skinned storage vessels as required.

Fuel and LPG/ LNG will be stored in the processing area.

The following table provides a summary of the expected dangerous goods inventory associated with the storage of dangerous goods at the Project:

Material	DG Class	HAZCHEM Code	Location	Quantity
Diesel	C1	-	Processing facility, Project Area 1	880 kL
LNG (Liquefied Natural Gas)	2.1	2WE	Processing facility, Project Area 1	160 kL
LPG (Liquifiedd Petroleum Gas)	2.1	2YE	Processing facility, Project Area 1	160 kL

It is expected that the fuel storage facility would comprise above ground self-bunded diesel tanks and LNG or LPG bullets. To ensure the proper handling and storage of fuel as part of the Project, the dangerous goods would be managed in accordance with the following:

- Dangerous Goods Act 1985 (Vic).

- Dangerous Goods (Storage and Handling) Regulations 2012.
- Code of Practice for the Storage and Handling of Dangerous Goods 2013.
- Relevant guidelines, including EPA Publication 1698: Liquid storage and handling guidelines.

As required under the *Environment Protection Act 2017*, the following permits will be in place for the following activities:

- A03 (sewage treatment) – prescribed development and operating activity.
- K01 (Power generation) – prescribed development and operating activity

5.8 Waste disposal methods and facilities

5.8.1 Hazardous materials- including fuel storage

All petrochemical and chemical waste, including from the on-site laboratory and process area, would be stored to the appropriate regulatory requirements and be removed by a contracted licenced waste management service.

Process building areas will be constructed of reinforced concrete-bunded aprons allowing for the containment of spills and all processing areas would have bunded concrete floors with appropriate design controls to capture hydrocarbon waste.

Hydrocarbon waste will be collected using appropriate equipment and specialised storage vessels local to potential discharge points. Hydrocarbon waste will be collected, transported, treated and/or disposed by appropriately licenced contractors.

5.8.2 Non-Hazardous materials

Waste will be minimised where practicable on-site, and recyclable material will be separated from landfill waste.

Non-hazardous waste generated from mining operations will be stored in dedicated areas, with landfill and recyclable materials sorted and separated in dedicated areas. All waste, including recyclables will be removed by an appropriately licenced waste management contractor for offsite disposal or recycling.

5.9 Offices and amenities

Site buildings will be prefabricated and modular. The stores warehouse includes a large laydown area for heavy equipment. Other buildings include an on-site laboratory, a maintenance workshop, and a security guardhouse with boom gates for access to the process plant.

Site buildings are shown on **Figure 3** and **Figure 4- Appendix A.**

5.10 Internal roads and vehicle washdown

Internal haul roads are shown on **Figure 3** and **Figure 4- Appendix A**. The plant access road is to be a one-way ring road around the process plant. A separate mine access road is to be provided for off-road vehicles for haulage from the mining void.

A vehicle washdown and weighbridge will be installed at the entrance to the process area. Washdown is required for all vehicles which have been in the mining and processing plant areas before exiting operations areas back onto the public road system.

5.11 Site access and security

Perimeter security fencing will be installed around Area 1 from time of site construction to secure areas, such as the on-site fuel depot which would be regularly supplied by fuel tankers. The security fencing will be minimum 1.8m high chain mesh fencing. A secure minimum 1.8m high chain mesh fence will also be in place around the processing plant for additional security, with additional clearance and signage stating that this is a restricted area (chemical and radiation hazards) in accordance with an approved Radiation Management Plan.

Perimeter fencing will be installed around Area 3 and will consist of four strands of galvanised barbed-wire and steel star pickets. The perimeter fencing is to discourage unwanted intrusions to the mine and process plant site, including people, cattle, horses and wild fauna and will be replaced with security fencing closer to the time of operations.

Site lighting includes floodlights to provide external area lighting for visibility and security.

5.12 Operating Hours

The mine will operate under the following hours:

Table 9 Operating Hours

Activity	Hours
Construction phase	Daytime hours only (7am-6pm), Monday to Saturday No Sundays or public holidays
Process plant	24hrs/day, 7 days per week
Mining	24 hrs/ day, 7 days per week Restricted areas: day time hours only (7am- 6pm) as required under Noise Management Plan.
Loadout and haulage	Daytime hours only (7am-6pm), Monday to Saturday No Sundays or public holidays

6.0Assessment of Impact of Operations

A summary of relevant technical impact assessments is provided below. These assessments were used to inform and refine the project design as presented in the EES, and will informed the risk mitigation and monitoring documented in the Risk Management Plan which will be prepared for the final work plan.

6.1 Heritage

A heritage impact assessment was completed by Eco Logical Australia (2022) which includes assessment for both historical heritage and cultural heritage.

A summary of the assessment and findings by Eco Logical is below.

Historical Heritage

The historical heritage assessment (desktop and survey) did not identify any known historical cultural heritage values that have the potential to be impacted by the mining operations.

Mitigation measures including the requirement for an appropriate contractor induction to communicate the protections, requirements and the Unexpected Finds Protocol are to be implemented prior to construction commencing.

Cultural Heritage

The desktop assessment and subsequent standard assessment (survey) for cultural heritage, identified that there is a very low likelihood of subsurface Aboriginal cultural heritage. Geomorphological analysis of the study area has also demonstrated that the most common sediments (Loxton – Parilla sands) often contain a carbonate or limestone horizon at shallow depths below the surface. This layer of carbonate is of age that pre-dates human habitation.

As observed during the standard assessment, the entirety of the study area has undergone continuous ploughing activities, including the removal of the lower calcareous layer which has revealed the limestone/ironstone nodules to the surface. This has been demonstrated throughout the study area, it is therefore likely the archaeological deposits have been disrupted and would have been visible on the surface especially in consideration of the excellent visibility. At the conclusion of the assessment, no Aboriginal cultural heritage places were identified, and the study was rated as having a low archaeological potential.

During construction, there is the potential that ground disturbance works would result in partial or complete disturbance of previously unidentified and unregistered Aboriginal cultural heritage, resulting in loss of heritage values.

Mitigation measures such as the preparation of an Aboriginal Cultural Heritage Management Plan (CHMP) would reduce potential impacts to Cultural Heritage.

A CHMP will be prepared and in pace prior to commencement of site disturbance.

6.2 Native Vegetation and Fauna

6.2.1 Native Vegetation

To assess the impacts of the mine on native vegetation, the following technical study has been completed:

Nature Advisory, September 2022. *Goschen Mineral Sands and Rare Earth Project- Native Vegetation and Flora Assessment.*

A detailed desktop and field surveys program was completed. A summary of the key outcomes is provided. An avoidance and minimisation approach was undertaken within mine site Area 1 and Area 3.

Opportunities to avoid and minimise impacts to native vegetation within mine site Area 1 have been adopted where possible and have resulted in the retention of a total extent of 23.868 hectares of native vegetation, including 22.445 hectares in patches and 22 scattered trees. At mine site Area 3, a similar approach has resulted in the retention of a total extent of 41.375 hectares of native vegetation, including 40.497 hectares in patches and 17 scattered trees.

Some native vegetation patches and scattered trees in Area 1 and Area 3 is required to be removed for operations. The total extent of native vegetation in patches, trees in patches, large scattered trees and small scattered trees to be removed in Area 1 and Area is summarised in the table below.

Table 10 Native vegetation removal extent

Project area	Native vegetation in patches (ha)	Number of patches	Trees in patches	Large scattered trees	Small scattered trees
Mining Area 1	4.095	13	253	6	5
Mining Area 3	2.699	17	187	31	9

This 'worst-case' scenario total extent is based on the removal of all native understorey vegetation within mine site Area 1 and Area 3. It is anticipated that the extent of native vegetation removed during construction activities would be reduced by the implementation of mitigation measures. These would include engaging an arborist to assist with micro-siting the underground water supply pipeline and to identify additional measures to avoid adverse impacts to structural root zones and safeguard trees at the mine site and along the pipeline alignment located within the MIN. In addition, provision of no-go fencing may enable protection of some understorey vegetation along the pipeline alignment located within the MIN.

Vegetation and tree protection zones are to be established around native vegetation and all relevant personnel are to be appropriately briefed prior to any works being undertaken.

Mine operation and vehicle activity within and beyond the mine site would potentially introduce weed seeds and cuttings. This could lead to an increase in the number and extent of weed species in areas adjacent to retained native vegetation. Observations during the native vegetation and flora assessment indicated that the following high threat weeds are potentially of concern:

- African Box-thorn.
- Bridal Creeper.
- Field Dodder.
- Horehound.
- Onion Weed.
- Paterson's Curse.
- Soursob.
- Sticky Ground-cherry.

Mitigation measures such as clean down bays and controlling of high threat weeds will reduce potential impacts from introduced weeds.

All native vegetation permits and offsets will be in place prior to the disturbance of any ground.

6.2.2 Fauna

To assess the impacts of the mine on fauna, the following technical study has been completed:

Eco Aerial Environmental Services, 15 September 2022. *Technical Report: Fauna Ecology- Goschen Mineral Sands and Rare Earth Project*.

A summary of the key finds of the report is provided. The removal of native vegetation would result in the direct loss or degradation of fauna habitat and could disrupt the movement of fauna species between areas of habitat. Furthermore, construction activities may result in indirect impacts to fauna species.

Minimising impacts to native vegetation during the construction of the underground pipeline (where situated on MIN), will ensure potential impacts to listed fauna species are minimised. Strategies such as marking areas where removal has been approved and, restricting vehicle and equipment movement into areas where vegetation is to be retained should be implemented. Where habitat is to be removed, fauna salvage would be undertaken by a suitably qualified specialist. Areas suitable to relocate fauna would be identified prior to fauna habitat removal.

Further measures, such as engaging an arborist to assist with micro-siting the underground water supply pipeline, will also minimise potential impacts to native vegetation and fauna habitat and as stated in Section 5.11, perimeter security fencing would be installed around Area 1 and Area 3 and would discourage unwanted intrusions by wild fauna.

6.2.3 Threatened Species and Threatened Ecological Communities

No EPBC Act-listed threatened flora species were recorded in the study area as part of the native vegetation and flora impact assessments and none are considered to have the potential to occur based on habitat records and a lack of regional records. Therefore, no EPBC Act-listed species are expected to be impacted by the construction of the project.

FFG Act-listed threatened flora species, including Umbrella Wattle, were recorded in the study area during the native vegetation and flora impact assessment and are considered likely to be impacted by the construction of the project.

The construction of the project is not anticipated to impact any FFG Act-listed threatened communities, however the Plains Mallee Box Woodlands, listed as a threatened ecological community under the EPBC Act, would be impacted.

A number of mitigation measures were recommended as part of the technical studies which are to be implemented, including (but not limited to), tree protection zone establishment, briefing of construction personnel various weed spread and management measures.

All mitigation measures recommended by the technical reports will be included in the Risk Management Plan. Prior to any removal of protected flora, which includes threatened flora species and the plants that make up threatened communities, listed under the FFG Act, a Protected Flora Licence or Permit under the FFG Act 1988, will be obtained from DELWP.

6.3 Visual Amenity

A visual impact assessment was completed to assess the likely impact of the mining activities on the existing landscape character and visual amenity. The visual impact assessment, documented in Moir Landscape & Architecture, 2022. *Landscape & Visual Impact Assessment- Goschen Mineral Sands and Rare Earths Project*, included a viewpoint analysis, photomontage assessment and an assessment of the impacts of night lighting sources on surrounding dwellings.

Key outcomes included:

- Publicly accessible viewing locations are generally limited to roads adjacent to the site. Local roads such as Pola Road, Bennett Road, Shepherd Road, Old School Road and Nalder Road have a low frequency of use and they are generally used to provide access to dwellings or farm lots along these roads. Moderate impact is likely to be experienced along Bennett Road since it would be used to access the mine. This road also has a slightly higher road usability.
- The surrounding land has been extensively cleared and modified to support agricultural activities. Apart from the removal of some trees at the proposed driveway entry/exit locations along Bennett Road, it is expected that roadside vegetation would largely remain intact. Existing vegetation patches in Area 3 are to be retained and the mine footprints have been planned to avoid intersection with significant areas of remnant native vegetation. As a result, the mine would have minimal impact on the existing vegetation character.
- A total of six dwelling were identified within 2km of the mine. Due to the large scale of the operations and the relatively flat topography surrounding it, there is potential for visual impact to

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occur at any of the nearby dwellings. An assessment of visual impact at the dwellings involved 3D modelling, review of aerial imagery and consideration of mitigation measures. It was identified that the majority of the dwellings would have limited or no views to the site, due to screening factors such as vegetation and/or exiting structures in the dwelling's foreground;

- From most dwellings within the study area, direct views would be screened by existing vegetation surrounding the dwelling and the site. This is also the case for dwellings R0013, R0014, R0015 and R0012 as they are surrounded by vegetation in their foreground or along the lot boundary. It is noted that R0014 will be vacated as per legal agreement through life of operations.
- Views to light sources would also be obscured and therefore the impacts of lighting sources on residences would be considered low. There is the potential for lighting sources to be visible to motorists travelling along adjacent roads through the vegetation. The impacts of such lighting would likely be limited to glow effect when the night sky is unclear with fog or haze.
- Provision of planting along the perimeter of the processing facility will be effective in integrating the development into the surrounding landscape. Additionally, it is recommended that all structures as part of the processing facility should be built with non-reflective and earthy-toned material. Additional screening could be provided in the foreground at dwelling R0012 where visual impacts would likely be moderate, however consultation with the landowner should be undertaken prior to recommending any additional screening. With the implementation of the recommended mitigation measures, the project would have a minimal visual impact on the surrounding visual landscape.

Existing vegetation along roadsides in proximity to the processing facility should be maintained. Vegetation screening will be planted and maintained as visual buffers to the mine operations.

6.4 Air Quality

An air quality impact assessment has been completed to assess the air quality impacts from the construction, operation and rehabilitation phase of the mining operations:

SLR, September 2022. *Air Quality Impact Assessment- Goschen Mineral Sands and Rare Earth Project.*

A summary of the assessment and outcomes is provided below.

The Project is located within flat farmland, with several rural residences surrounding the MIN. Winds from the south and southwest are predominant, with few winds from the east.

Ambient air quality monitoring undertaken between January 2019 and September 2020 indicates that like any Victorian rural area with little anthropogenic activity, the area may be subject to periods of elevated concentrations of particulate with equivalent aerodynamic diameters of less than 10 microns (PM_{10}) and less than 2.5 microns ($PM_{2.5}$) due to regional bushfire and backburning impacts, and dust storms. Bushfires across Victoria in January 2020 were clearly evident in the data with elevated $PM_{2.5}$, and to a lesser extent PM_{10}, concentrations. However, the non-bushfire impacted year 2019 demonstrates elevated concentrations in the summer months such that the distinction between the years representing normal and bushfire conditions is not significant. Both years include periods of elevated background PM_{10} and $PM_{2.5}$ concentrations which exceed the relevant 24-hour average criteria. Monitored concentrations of respirable crystalline silica (RCS) were well below the annual average criterion. In the absence of NO_x monitoring on-site, with little anthropogenic activity, the background concentrations of NOx are likely to be low, approaching zero.

Results of the assessment indicate that in general, exceedances of the PM_{10} criterion are predicted at all sensitive receptors due to the maximum background concentration exceeding the criterion before the Project contribution is added. The mining activities are not predicted to contribute significantly to existing conditions and with a few exceptions (between 0 and 3 depending on the receptor and stage of mining), the contributions are a small fraction of the criterion. Note that R14 is no considered as a receptor in the assessment given this receptor will be removed during mining.

Worst-case power station and pumping station dual-fuel generator emissions are predicted to result in exceedances of the 1-hour average NO_2 concentration beyond the MIN when using diesel fuel. However, due to the rural and relatively remote nature of these locations, the likelihood of a third party occupying these impacted areas for more than a few minutes at a time is low. While impacts of NO_2 from the power station are predicted to exceed the annual average criterion relating to terrestrial vegetation beyond the MIN boundary, the extent to which the exceedance is predicted is limited to approximately 50 m from the boundary, covering and an area of approximately 2.5 hectares. $PM_{2.5}$ ground level concentrations resulting from pumping station emissions to air are predicted to be negligible at sensitive receptors such that cumulative concentrations are unlikely to be increased by a measurable amount. These findings indicate that the risk of impacts from other products of diesel combustion (e.g. sulphur dioxide, volatile organic compounds, PAHs etc) would also be low. Use of liquified petroleum gas (LPG) instead of diesel would result in significantly lower emissions of NO_X (and $PM_{2.5}$), likely negating impacts predicted for diesel in these areas.

To reduce NO_x emissions from power station and pumping station, select diesel generators employing emission reduction technology such as catalytic reduction (SCR; e.g. *AdBlue*) will form part of the key mitigation to reduce NOx emissions. VHM have a process of periodic re-evaluation of the power supply during operations to look for opportunities for an alternative energy supply as part of reducing their GHG emissions and meeting the obligations of the EPA General Environment Duty.

The risks of impacts to surrounding agricultural industry and local water supplies (rainwater tanks) were assessed to be low.

This assessment informed the development of mitigation measures to avoid, minimise and manage potential impacts on air quality. Best practice dust emission mitigation measures will be employed for all aspects of the operations including, but not limited to, use of water sprays, misting systems and water trucks.

Air quality monitoring would be captured as part of a site-specific air quality management plan and would include continuous PM10 and PM2.5 monitoring, monthly monitoring of respirable crystalline silica and continuous PM10 monitoring at the site boundaries. The visual assessment of both fugitive dust generation, especially that leaving the site boundary, and dust deposition on the vegetation surrounding the site would be captured as part of a Dust Environmental Management and Monitoring Plan. These plans would be prepared with reference to EPA Publication 1961 Guideline for assessing and minimising air pollution.

Wheel generated dust from haul roads has been identified as the primary potential source of dust emissions, therefore preparing and maintaining level and well finished haul road surfaces is a priority. Contingency measures may include reducing the site speed limit for haul trucks during periods of hot and dry weather coupled with increased water truck application.

The mining schedule, will generally include only six active blocks at any one time which will limit exposed areas subject to wind erosion, with surface consolidation and ongoing progressive rehabilitation planned.

Risk mitigation measures for dust and air quality will be detailed in the Risk Management Plan.

6.5 Noise

A noise impact assessment has been completed to assess the noise impacts from the construction, operation and rehabilitation phase of the mining operations:

SLR, September 2022. *Noise Impact Assessment- Goschen Mineral Sands and Rare Earth Project.*

A summary of the assessment and outcomes is provided below.

- Existing conditions were evaluated through a four-week noise monitoring programme completed in in October 2018. Ambient background noise levels were found to be generally low
- Construction phase noise emissions comply with the requirements of the *Civil construction, building and demolition guide*, (EPA Publication 1834). Construction activities would be limited to standard EPA ‘normal’ day-time hours, with the provision that some unavoidable works (such as extended concrete pours if necessary) or low noise impact works (such as finishing works) may occur during the evening or night periods.

- Only a single receptor (R13) is anticipated to receive construction noise at an elevated level, however, is similar to ambient noise levels and it is unlikely to result in adverse impact.
- During Area 1 mining operations (Year 1 to Year 8) a significant exceedance (7-10 dBA) of the day-time noise limit was predicted for a single receptor (R14). However, an agreement has been reached between VHM and R14 for the duration of works in Area 1 and this dwelling will be vacated for the duration of the works in Area 1- and therefore will not be a receptor.
- During Area 1 mining operations a moderate exceedance (4-5 dBA) for night-time are predicted at receptor R12 and R13. it is anticipated that compliance would be achieved by a combination of applying:
  - Addition of specialist engineered noise suppression kits to haul fleet vehicles
  - Higher levels of noise suppression on the processing plant building
  - Restricting mining activities to below ground pits only during the night.
- During Area 3 mining operations the house denoted as R9 would be used as a mine operations office and therefore not considered a sensitive receptor. Mining in the northernmost cells of Area 3 (Year 11) is closest to receptor R7 which is predicted to comply with day-time noise limits. Subsequent mining in Area 3 (Year 15) is sequenced for cells further from R7 and it is anticipated to comply with day, evening and night-time noise limits with the inclusion of modest levels of noise mitigation and management controls.

This assessment informed the development of mitigation measures to avoid, minimise and manage potential impacts related to noise.

Construction activities will be limited to daytime only, with the provision that some unavoidable works (such as extended concrete pours if necessary) or low noise impact works (such as finishing works) may occur during the evening or night periods, and some restrictions on mining during the night-time will be applied to reduce noise emissions.

For R14, which is in close proximity to Area 1, an agreement has been reached between VHM and R14 for the duration of works in Area 1 and this dwelling will be vacated for the duration of the works in Area 1- and therefore will not be a receptor during mining.

Best practice noise emission mitigation measures will be employed for all aspects of the operations including maintenance of roads, vehicles, ensuring noise attenuation on plant and equipment and use of stockpiles as acoustic bunds to provide additional noise screening. Risk mitigation measures for noise will be detailed in the Risk Management Plan.

6.6 Geotechnical

Geotechnical investigations and a Geotechnical Impact Assessment has been completed by Pitt & Sherry to evaluate the potential impacts from ground movement from the construction, operational and decommissioning activities. Pit geometry and buffers were determined as part of an assessment of the factor of safety (FoS) of the pits and overburden stockpiles which have been used to inform the project design. All pit slopes have been assessed and designed to meet a FoS of 1.6 and a probability of failure (PoF) at 5%.

Based on the Geotechnical Impact Assessment (Pitt & Sherry, 2022), the following was recommended:

Mine operation initially construct infrastructure and above ground stockpiles for topsoil, overburden and extracted ore material. Processing of ore and generation of a tailing slurry is recommended to commence when suitable empty pit volume is available sub surface to receive the treated material. Rehabilitation and remediation are recommended as soon as feasible during ongoing operations with overburden returned subsurface to cover tailings with subsequent topsoil redistribution.

Recommended mitigation and contingency measures include:

- Comprehensive geotechnical design methodology and review using conservative elastic parameters and incorporate sensitivity assessments

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- Ensure mine pit floor is above groundwater table
- Consideration of forces due to earthquake loading in slope/batter design where design life > 2 year. in the event of a low probability earthquake occurring any tailing breach is contained subsurface
- Recommendation that Ground Control Management Plan (GCMP) and a Storm Water Management Plan (SWMP) are established and implemented
- Management of mine extraction and ore process timing to return tailings below ground level to progressive in pit storage system eliminates above ground storage of tailings and avoids or substantially reduces the risk to sensitive receptors with no risks or consequences outside of the pit
- In pit void tailings storage to avoid the risk of a tailing breach reaching a sensitive receptor with suitable bunds to separate returned tailings from open pit working
- The pit floor and base of mining operations to terminate above the groundwater table with any intersected mounding managed with local dewatering to avoid the risk of liquefaction.Pit slopes and stockpile locations to be separated by suitable buffer distance from vulnerable receptors; and
- Management of rehabilitation and long term stockpiles and basins to be incorporated in the ongoing mine operation to minimise open exposures and potential dispersive soil impacts and return affected mine areas to a safe, stable, and sustainable landform capable of supporting land uses currently operating on adjacent lands.

6.7 Surface water

A comprehensive assessment was undertaken to understand the existing environment of the study area to inform the surface water impact assessment and mine site surface water impact assessment:

- Pitt & Sherry, 5 August 2022. Goshen Mineral Sands and Rare Earths Project- Mine Site Surface Water Impact Assessment, rev B.

Water Technology, 12 December 2022. Technical report: surface water impact assessment- Goshen Mineral Sands and Rare Earths Project. Based on the surface water impact assessment no significant waterways are located in proximity to the mine area, therefore construction activities are not expected to impact riverbeds, riverbanks and existing drainage paths and impacts as a result of erosion and sediment runoff are considered to be unlikely. Mine site water management basins are to be designed to capture surface water runoff from 5% AEP events. Any runoff generated in rainfall events greater than 5% AEP would be directed to the active mine pits ensuring that that stormwater runoff could not leave the site- i.e. there will be no off-site discharge from disturbed areas.

While Area 1 would be located within an overland flow path and the mining activities have the potential to reduce runoff, only one sensitive receptor is located downstream of Area 1, a residential building. A reduction in surface water discharge would not adversely impact the residential building.

Measures to mitigate potential impacts associated with the discharge of stormwater include the development of a water quality program, construction environmental management plan (CEMP) and a sediment erosion and water quality management plan.

While there is no risk of riverine inundation of the project area in a 1% AEP flood event, inundation of the site could be caused by surface water runoff within the local catchment. This could be mitigated by designing access routes to maintain access to mine sites and associated infrastructure with flood depths below 300 mm and designing any infrastructure within the 1% AEP storm extent to withstand potential flooding.

A surface water management plan and a trigger action response plan (TARP) will be developed and in place prior to construction.

6.8 Groundwater

A groundwater study has been completed by CDM Smith (2022), which broadly included:

- Development of a conceptual hydrogeological model for the site based on desktop and field data;
- Prepare a numerical model domain and flow model;
- Consider Contaminants of Concern (COC) that have been linked to the project in relation to the groundwater at the site and the pathways and mechanisms for potential CoC release from the mine pits into local groundwater systems;
- Develop a particle tracking model to assess the fate of potential CoCs in groundwater.
- Identify and assess potential impacts from the development to the surrounding environment, groundwater users and groundwater dependent ecosystems; and
- Evaluation of potential impacts to groundwater resources based on conceptual and model outcomes via a preliminary risk assessment approach.

Based on the desktop and field investigations completed to support the groundwater study, the following key points of the hydrogeological site model were summarised (CDM Smith, 2022):

- Drilling and groundwater investigations in the region have identified the four main hydrogeological units. The Loxton-Parilla Sands forms the main aquifer in the study area.
- The water table contours indicate that groundwater in the Loxton Parilla Sands aquifer flows to the northwest.
- The results of the groundwater level data indicate an upward vertical pressure gradient between the Renmark Group and the Loxton Parilla Sands. The upward gradient identified indicates a low potential of leakage to the underlying Renmark Group aquifer from the Loxton-Parilla Sands in the area. No other nested data is available within 10 km of the Project area.
- Geochemistry indicates that groundwater with sodium is the dominant cation and chloride the dominant anion is typically consistent across the site. The salinity of the groundwater is high and pH indicates a neutral to slightly acidic groundwater. There is no consistent distinction between the Loxton-Parilla Sands and the Renmark Group groundwater in relation to water quality.

Following the development of the conceptual hydrogeological model, a numerical model was developed to assess the potential impact of the mining operations on groundwater. The regional groundwater table is at least 1m below the maximum base of the pits, with the separation distance greater than 3m in some mining areas. Due to the placement of tailings as backfill in mined voids during operations, there is the potential for localised groundwater mounding. The outcomes of the numerical model indicate that groundwater mounding would reach a maximum of over 20 m at year eight of mining operations and would remain high for the following three years (until the end of the backfilling period at year 20). From year 20, groundwater mounding declines as the mounding spreads and dissipates within the aquifer. The numerical model demonstrates that by the end of operations, a 0.1 m increase to groundwater levels would extend no further than 2 km from the mined areas. The maximum groundwater mounding shows that there is no potential expression of groundwater to ground surface.

Localised groundwater mounding may lead to groundwater levels intersecting mine pits during mining operations. Any groundwater entering the mine pits through the sides or base of the pit would be managed by a collection of sumps. This water would be recovered from the sumps and returned to the process water circuit along with any recovered tailings water. The potential for a decline in groundwater levels due to groundwater recovery from mine pits would be minimal. Mine dewatering systems, such as groundwater dewatering bores, are not planned to be used and no system to reduce groundwater levels beyond the depth of mine pits floors is currently proposed. At the cessation of mine operations, in-pit groundwater recovery would cease.

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There results of the numerical modelling were then used to inform the impact assessment. Key findings are summarised below:

- The potential for a decline in local groundwater levels due to in-pit groundwater recovery would be minimal. Mine dewatering systems, such as groundwater dewatering bores, are not planned to be used and no system to reduce groundwater levels beyond the depth of mine pits floors is planned.

At the cessation of mine operations, in-pit groundwater recovery would cease. As such, the potential impacts to groundwater levels from dewatering activities are considered negligible.

- Groundwater impacts to surface water are considered negligible regarding the proposed mining method.
- Potential impacts to sensitive groundwater receptors are considered unlikely to occur- there are no registered stock or domestic groundwater users within 10km of the operations.
- The conservative modelling approach overestimates the potential extent of mounding and demonstrates that any actual groundwater mounding from the deposition of tailings would be localised to the immediate Project area. Mounding would be spatially limited beyond the Project area, with increases to groundwater levels considered negligible. Therefore, the potential impacts to groundwater from mounding would be insignificant.
- The contaminants of concern (CoC) associated with the tailings leachate and which may infiltrate the groundwater at elevated concentrations compared to existing conditions includes aluminium, arsenic, cerium, chromium, hexavalent chromium, fluoride, phosphorus (as reactive phosphorus), nickel, titanium and vanadium.
- The groundwater impact assessment determined that geochemical processes in the Loxton Parilla Sands aquifer would potentially mitigate any long-term impacts to groundwater quality from tailings leachate. The dissolved phase aluminium in the leachate may precipitate in the alkaline reducing waters of the Loxton Parilla Sands aquifer and any hexavalent chromium would likely reduce to the less toxic trivalent chromium. The presence of vanadium in the leachate may lead to the precipitation of uranium. Rare earth elements in the tailings, such as cerium, lanthanum and yttrium may sorb onto the in-situ clays. The element most likely to attenuate onto iron oxide phases is nickel, while arsenic and selenium may also sorb onto iron oxides.
- Therefore, it is considered that CoC introduced to the Loxton Parilla Sands aquifer through leachate would only persist at dissolved phase concentrations above existing groundwater conditions for a short period of time and there is unlikely to be any long-term measurable change to groundwater quality surrounding the Project area from the deposition of tailings.
- As part of the numerical model, particle tracking was used to show the likely long-term pathway of possible CoC. Particle tracking demonstrated that for a pre-defined period of 10,000 years, potential CoC would travel 2 km northwest of the Project area. This would not impact any groundwater sensitive receptors, such as stock and domestic groundwater users or GDEs which have not been identified within 10 km of the Project. While unlikely, any future users of groundwater surrounding the Project area may be managed via administrative controls.
- Nonetheless, measures to minimise the infiltration of groundwater would be implemented to minimise impacts to the groundwater environment. During operation of the Project, tailings water recovery would be optimised as much as practicable to minimise seepage to the underlying aquifer. Measures to optimise tailings water recovery would include, but would not be limited to, the design of in-pit spigots and use of flocculant to maximise water recovery. These measures would be captured in a tailings management plan.
- A groundwater quality and monitoring program was recommended to establish baseline conditions pre-mining, assess impacts and changes during mining and at closure.

Due to the groundwater mounding which will intersect the pits, a licence to recover groundwater in-pit is required to allow for ongoing mining operations. A Take and Use Licence from GWMWater will be applied for and obtained prior to any removal of water from within the working pit areas.

Deposition of tailings into the pits requires an A18 permit to be obtained from EPA Victoria for placing waste into an aquifer. An approved A18 permit will be in place prior to any placement of tailings in-pit.

A groundwater level and quality monitoring program will be implemented during construction, operations and closure phases. All groundwater monitoring would be undertaken in accordance with

EPA Publication 669.1: Groundwater sampling guidelines and EPA Publication 668.1 Hydrogeological assessment (groundwater quality) guidelines.

6.9 Radiation

As the material to be mined and processed contains elevated concentrations of natural occurring radioactive elements of uranium and thorium, a radiological risk assessment has been completed by: JRHC Enterprises Pty Ltd, 2022.

Quantification of the existing radiological environment commenced in April 2018 with a gamma survey. In February 2019 a continuous routine monitoring program commenced with the establishment of five Environmental Radiation Monitoring Locations (ERMLs) within a 5km radius of the MIN.

Radiological modelling was also completed as part of the impact assessment.

The Radiation Impact Assessment (JRHC, 2022) found the following key impacts:

- The conservative maximum dose to humans as a results of the Project is 0.19 mSv/y which is below the dose limit of 1 mSv/y
- The radiological impact to flora and fauna, as assessed using the ERICA Tool is considerably below the screening level of 10 µGy/h with the highest being 0.47 µGy/h for lichens and bryophytes
- The radiological impact to grain crops is considered to be minimal as the project originated soil radionuclide increments are within the analysis error bands for existing soil radionuclide levels, and for crop activity concentrations, the calculated project increment radionuclide activity concentration is one to two orders of magnitude less than current calculate crop radionuclide activity concentrations
- The radiological impact to groundwater is considered to be low due to the inert nature of the tailings and also because the radionuclide concentration of tailing will be less than that of the ore.
- The activity concentration of the ore and tailings is less than 1 Bq/s. Some products with activity concentrations exceeding 1 Bq/g will be stored at the processing facility, however these products will be encapsulated and the impact to the environment is assessed to be not significant.

The overall radiological impacts of the operations are expected to be low, and various controls will be implemented, consistent with the magnitude of the radiological risks to the public and to the environment.

A Radiation Management Plan (RMP), Radioactive Waste Management Plan (RWMP) and Radiation Environmental Plan (REP) are to be developed and approved as per the *Radiation Act 2005* to ensure that radiation related impacts and risks remain well controlled.

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7.0 Risk Management

7.1 Objectives

A Risk Management Plan (RMP) aims to detail and assess the risk of the mining hazards[1] that may arise from work documented in the work plan as required by Regulation 43 of MRSDA(MI)R and includes mining hazards arising from:

- set up or construction;
- operations and production; and
- details of rehabilitation hazards arising from rehabilitation work under the work plan.

Where mining hazards associated with the project construction/ project operations and/or closure are identified, associated controls will be implemented **to reduce the risk of harm or damage to the environment, any member of the public, to land, property or infrastructure** in the vicinity of project works.

The RMP includes the following key components:

a) Summary of risk assessment process;

b) Risk register; and

c) Risk treatment plans.

A RMP will be prepared for the final Work Plan submission. The RMP will based on the technical impact assessment outcomes and will collate the recommendations from the supporting Technical Assessments, Environmental Management Framework (EMF) in the EES and various management plans that have been prepared to support the Goschen mine development for implementation at the site.

The RMP will be approved by ERR as part of the work plan package and will form the key document where all the management, mitigation and monitoring commitments made as part of the EES are held and must be followed by the Mining Licence Holder throughout the phases of mine development.

7.2 Risk assessment methodology

The methodology used in the risk assessment is consistent with the methodology described in the *Preparation of Work Plans and Work Plan Variations Guideline for Mineral Industry Industry Projects*- (DJPR, 2020).

The risk assessment process included the following steps:

- Identify all assumptions and sensitive receptors associated with the work plan;
- List all possible mining hazards associated with the proposed changes, with definition of *risk events* associated with those hazards (generation of risk register);
- In conjunction with relevant site personnel and relevant specialists, assign a likelihood and consequence rating for each *risk event* based on the project description to determine an inherent risk rating;
- identification of controls to eliminate or reduce each risk event; and
- For each risk event with additional controls, re-assign the likelihood and consequence rating to determine the residual risk rating.

[1] As defined in the Regulations

7.3 Risk assessment

A risk register prepared using the risk assessment methodology provided above is to be included and is based on the technical impact assessments prepared for the EES.

The risk assessment includes the identification of hazards during construction, operations and rehabilitation phase and includes details of sensitive receptors which may be impacted by the identified hazards.

A list of the hazards associated with the project include:

- Altered visual amenity ((including night light emissions);
- Dust/ air quality
- Erosion and sedimentation
- Fire
- Greenhouse gas emissions
- Ground disturbance- cultural heritage, historical heritage, native vegetation, biodiversity and flora
- Ground instability
- Hazardous materials- tailings, radiation and radioactive waste, fuels, lubricants and chemicals
- Imported materials
- Noise
- Security (unauthorised access)
- Water- surface water, groundwater, process water
- Waste management (non-hazardous)
- Weeds, pests and disease.

The likelihood and consequence ratings for each risk event associated with each hazard are used to determine the inherent and residual ratings as per the ERR guidance (DJPR, 2020).

The risk matrix used to determine risk ratings is shown in Table 11.

Table 11 Risk Rating Matrix

Likelihood	**Almost Certain**	Medium	High	Very High	Very High	Very High
	Likely	Medium	Medium	High	Very High	Very High
	Possible	Low	Medium	Medium	High	Very High
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Medium	Medium	High
		Insignificant	**Minor**	**Moderate**	**Major**	**Critical**
		Consequence				

The risk register includes key design elements which have been used to inform the inherent risk rating, along with the mitigations to be implemented.

An example of the risk register template is provided below.

Hazard	Risk Event	Causes/ Background	Project Design	Receptors	Phase of Project			Initial Risk Assessment prior to additional risk controls - project inherent risk			Summary of Key Mitigation	Risk Assessment after including risk controls - project residual risk		
					Construction	Operation	Rehabilitation	Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Altered Visual Amenity														

D R A F T

7.4 Risk treatment plans

Following the development of the risk register, as per the Work Plan guidelines, a Risk Treatment Plan must be developed for any risks that have a residual risk of high to very high.

As stated above, the risk register includes key mitigation to be implemented at a minimum for all the identified risk events.

For Goschen, the additional Risk Treatment Plan component will either be:

1. Standard RTPs (using standard ERR guidance as the format) for more low/ moderate or simple risks; or
2. Tailored RTPs, which will be standalone management plans for complex risks or high to very high risks which will be referred to and attached as part of the RMP.

For Goschen, it is planned that the following tailored RTPs will be developed and submitted as part of the formal work plan RMP based on the outcomes of the technical assessments and the commitments made in the EMF:

- Cultural Heritage Management Plan
- Biodiversity Management Plan (including weed management) and Offset Management Plan
- Ground Control Management Plan (incorporating ground instability and erosion)
- Air Quality Management Plan
- Noise Management Plan
- Stockpile Management Plan
- Tailings Management Plan
- Sediment and Erosion Control Plan
- Mine Surface Water Management plan
- Emergency Management Plan
- Radiation management plan, radioactive waste management plan and radiation environment plan
- Construction EMP for activities within the MIN (for access road/ utility corridor and pipeline construction)
- Management plans for groundwater as required under the Take and Use Licence
- Any additional management plans as required under the Development Licence.

All RTPs (standard or tailored) will include the following detail at a minimum:

- details of the sensitive receptors, their location and proximity to the site
- how the hazard may harm or damage the sensitive receptor and evidence to support this assessment
- control and mitigation measures
- performance standards (these need to measure the effectiveness of the control measures, not the implementation of the control measures).
- monitoring program and ongoing management (the management systems, practices and procedures that are to be applied to monitor and manage risks and compliance with performance standards).
- Roles and responsibilities for the implementation and maintenance of the Risk Management Plan.

8.0Rehabilitation

A draft Rehabilitation Plan that supports the draft Work Plan and has been prepared in consideration of the items prescribed under the *MRSD Act 1990* and regulation 43 of *Mineral Resources (Sustainable Development) (Mineral Industries) Regulations 2019.*

Refer to Goschen *Mineral Sands and Rare Earth Project- Environment Effects Statement – DRAFT Mine Rehabilitation Plan*, prepared by Pitt & Sherry, dated 7 December 2022 for full details of the mine rehabilitation.

Appendix A

Figures

D R A F T

Appendix A Figures

Figure List:

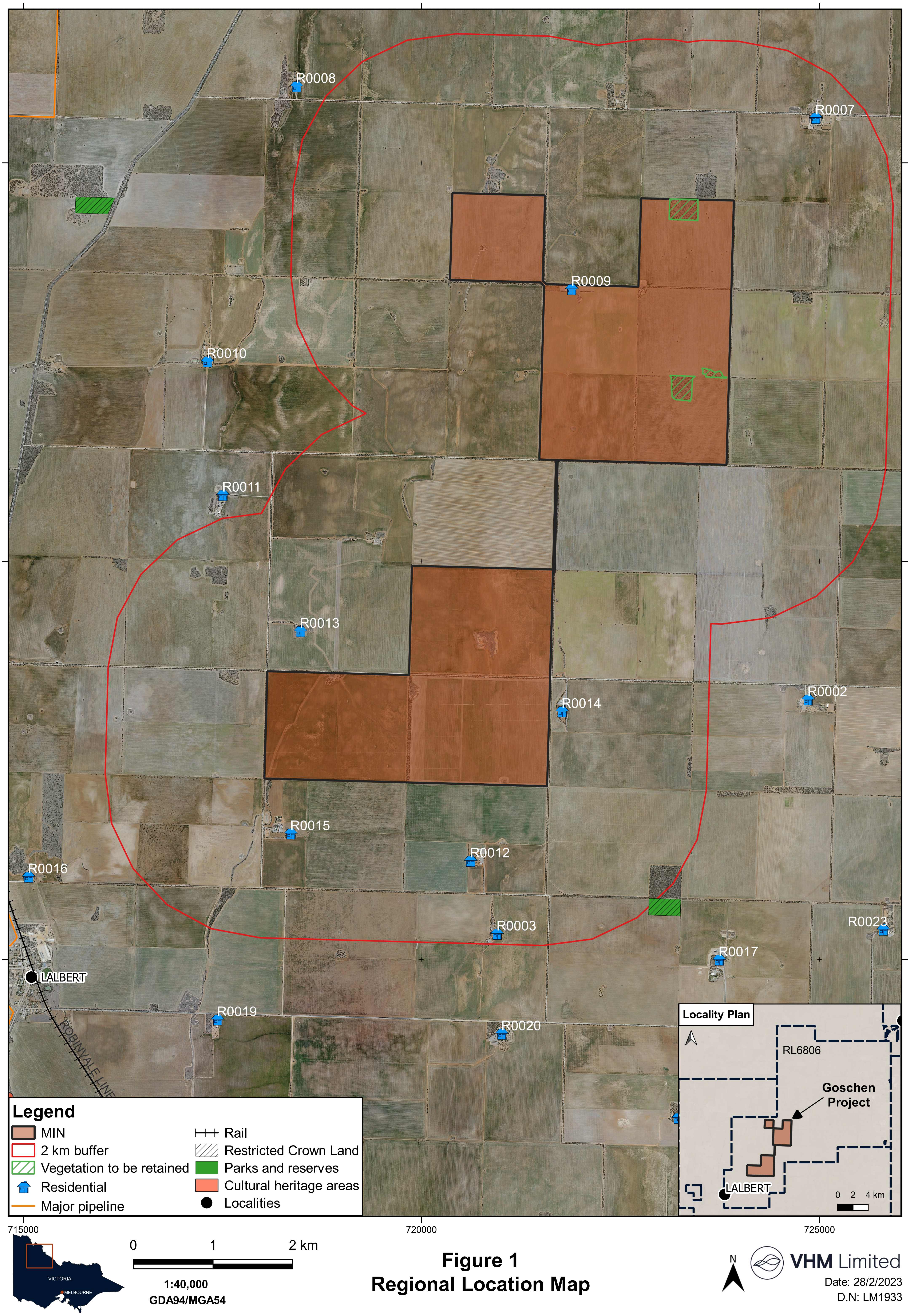
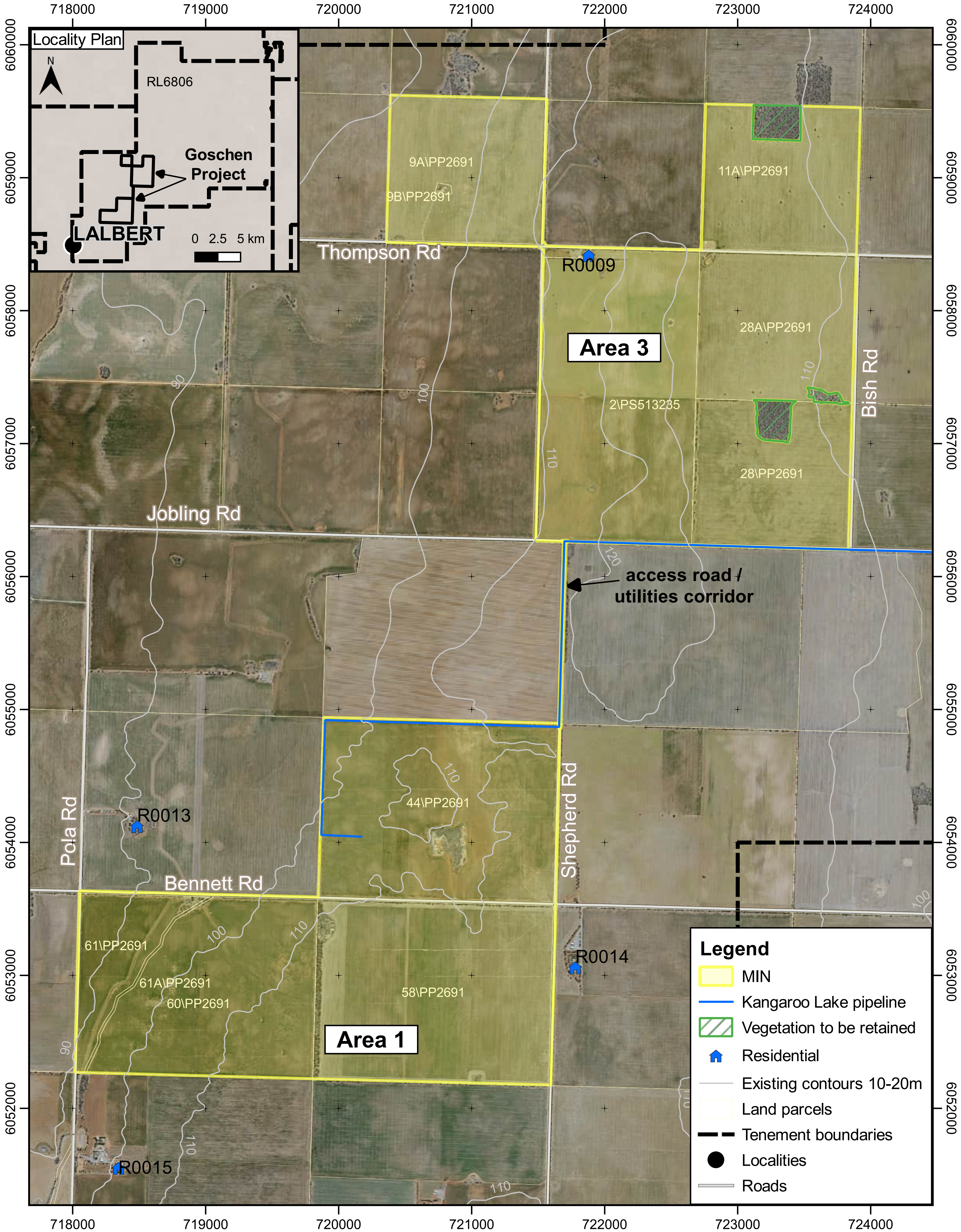


Figure 1
Regional Location Map

VHM Limited
Date: 28/2/2023
D.N: LM1933



0 0.5 1 km

1:35,000

GDA94/MGA54

Figure 2
Site Plan

VHM Limited

N

Date: 2/2/2023

D.N: LM1935

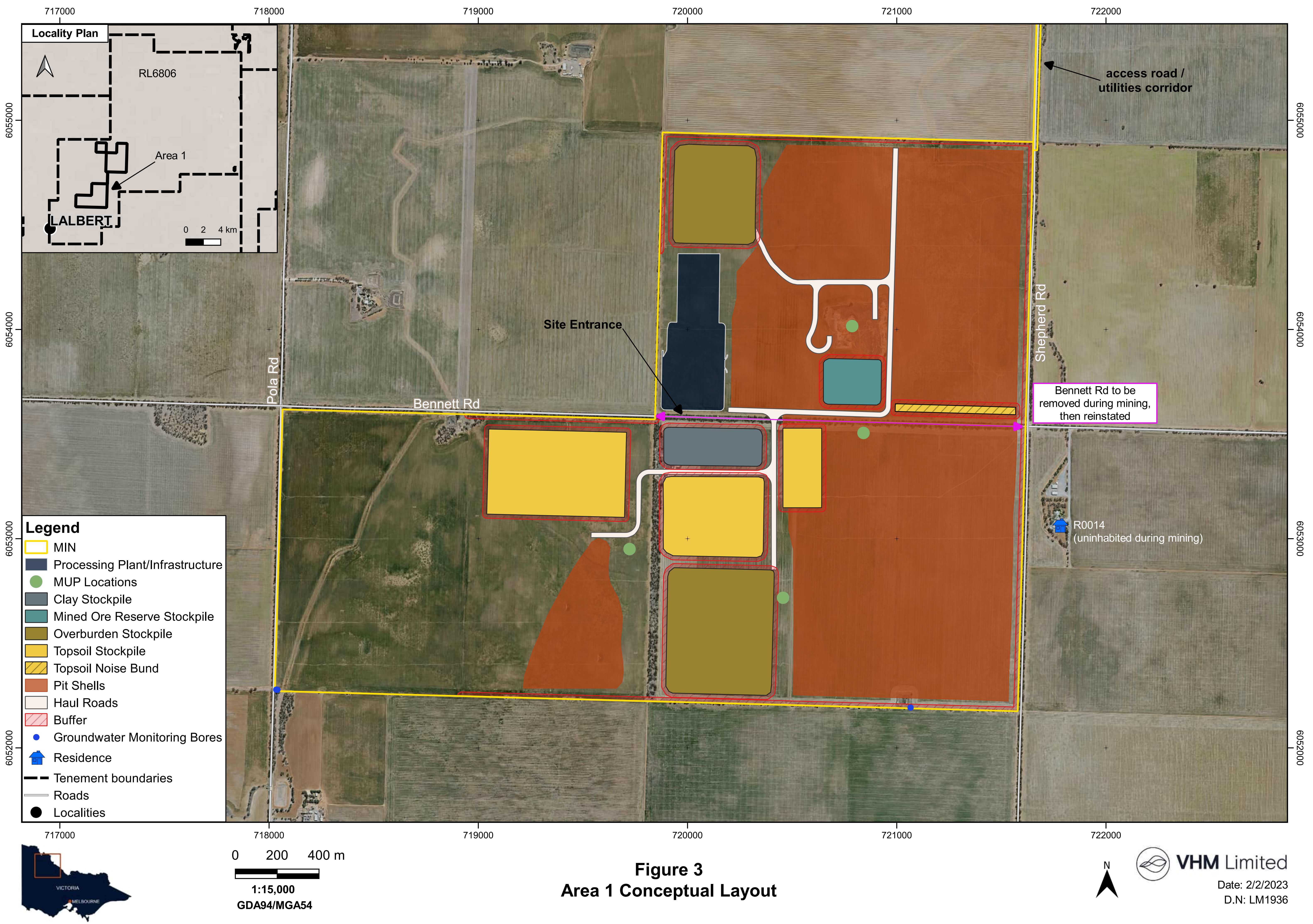


Figure 3
Area 1 Conceptual Layout

VHM Limited
Date: 2/2/2023
D.N: LM1936

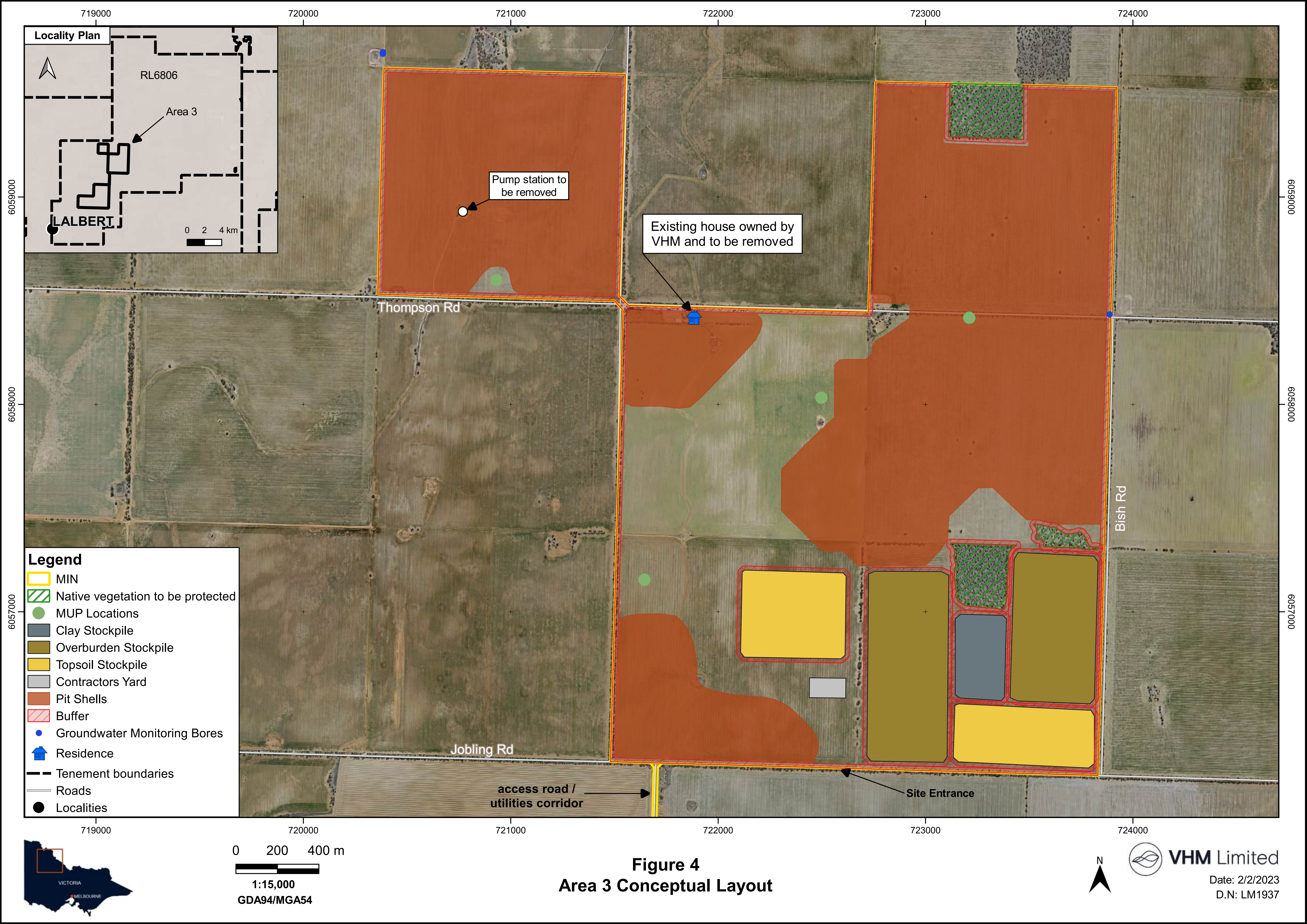


Figure 4
Area 3 Conceptual Layout