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Environmental & Social Consultants

MANUKA RESOURCES

REHABILITATION MANAGEMENT PLAN

Manuka Mine

FINAL

December 2022

REHABILITATION MANAGEMENT PLAN

Manuka Mine

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Manuka Resources

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Report No.	MRL-ENV-PLN-007
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Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
1	Alex Irwin	28 October 2022	Alex Irwin	28 October 2022
Final	Luke Bettridge	14 December 2022	Luke Bettridge	14 December 2022

Summary Table

Manuka Mine Rehabilitation Management Plan	
Name of Mine:	Manuka Mine
Rehabilitation Management Plan Commencement Date	14 December 2022
Rehabilitation Management Plan Revision Dates and Version Numbers	Version 1: 14 December 2022
Mining Leases	ML1659
Name of Lease Holder:	Manuka Resources Ltd
Date of Submission:	15 December 2022

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1.0 Introduction to Mining Project

This Rehabilitation Management Plan (RMP) for the Manuka Silver Mine has been prepared by Manuka Resources Limited (Manuka Resources / "the Company") as required by condition 17 of Development Consent DA 2010/LD00074 REV03 and the amendment to the Regulation under the Mining Act 1992.

This RMP follows the new format and content requirements identified in the *Form and Way: Rehabilitation Management Plan for Large Mines* (Form & Way RMP) first published on 2 July 2021 (Version 1) by the NSW Resources Regulator.

1.1 History of Operations

The Wonawinta Silver Project ("the Mine") is operated by Manuka Resources and is located within ML 1659 on the "Manuka" property, approximately 80km south of Cobar. Principal access to the "Manuka" property and ML1659 is governed by a defined transport route from the Barrier Highway (State Highway [SH] 8) at Cobar and includes the Kidman Way (Main Road [MR] 410), Manuka-Yarranvale Road (Shire Road [SR] 14) and via Cobar-Bedooba Road (SR 13). The Company acquired the Mine on 31 August 2016 after the former operator and holder of ML1659, Black Oak Minerals Limited (BOML), entered administration. **Figure 1.1** provides a Locality Plan of the Mine within the Western NSW Region.

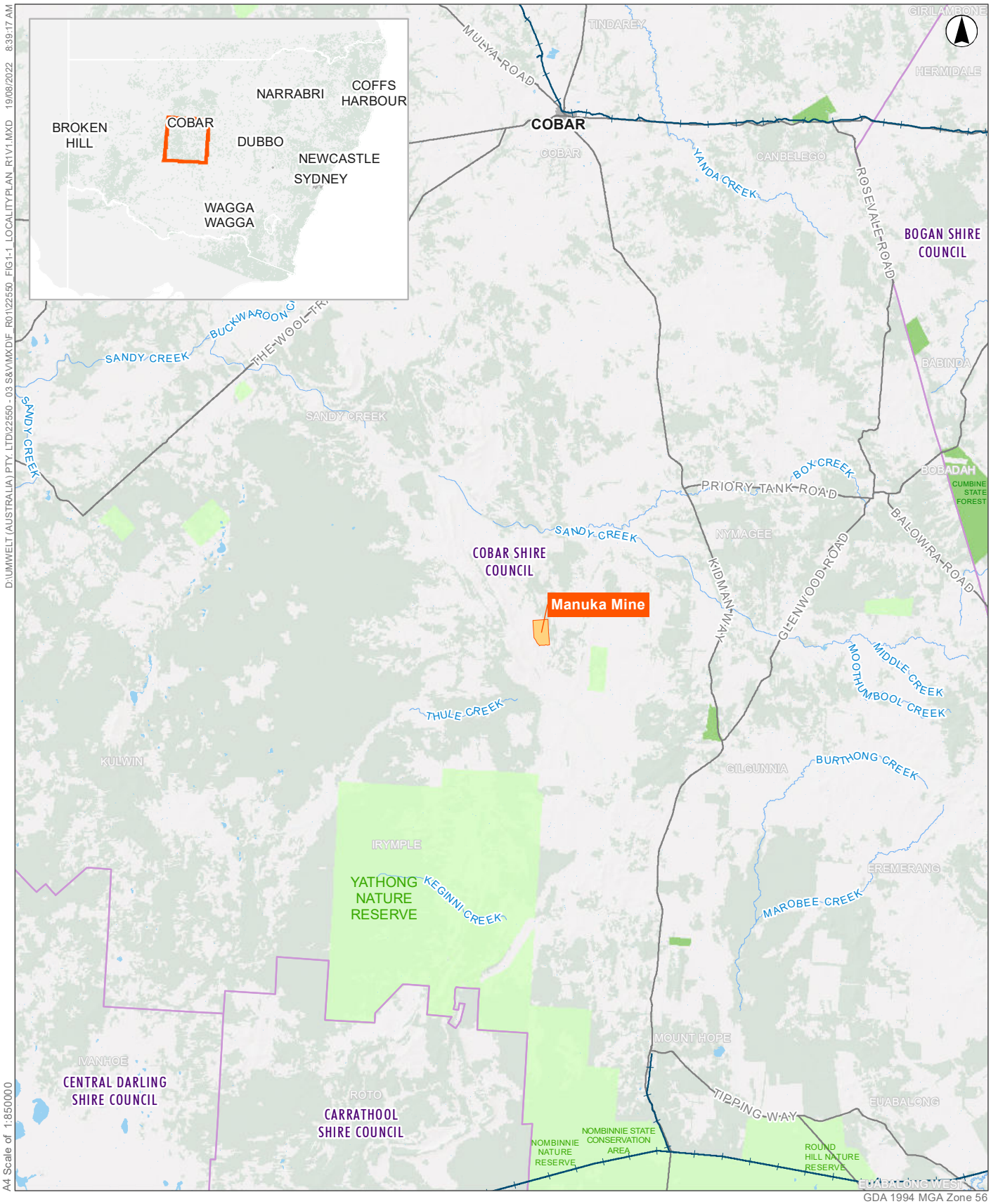
During the previous MOP/RMP Term (October 2019 to July 2022) operational activities included:

- The processing of 350,000 t of ore mined / stockpiled at the Mt Boppy Mine and imported to the Mine in accordance with the Mine's Development Consent, and for the Mt Boppy Mine development consent DA 2010/LD-00070 (as modified) issued by Cobar Shire Council; and
- Up to 4,000 m of exploration drilling activities have been undertaken targeting the base metal sulphide mineralisation within the footwall of the Manuka thrust fault zone, as well as infill drilling of the current inferred oxide silver resource to measured and indicated status.

1.1.1 Cobar Consolidated Resources (CCR)

An Environmental Impact Statement (EIS) was completed in support of an application to develop a minimum of four open pits, associated waste dumps, processing operations and a tailings storage facility in December 2010 (RWC, 2010). The application resulted in the determination of DA 2010/LD-00074 on 1 June 2011, Environmental Protection Licence (EPL) 20020 was granted on 14 November 2011 and ML 1659 on 23 November 2011. Prior to the issuing of the Development Consent, there was no history of mining or extractive industry on ML 1659 or surrounding land.

Exploration activity within tenements held by the former operator of the Mine had been carried out over a number of years in the early to mid-2000's. Once indications of a substantial ore reserve had been identified within an economically mineable area, the focus of the exploration activities was progressed to assessing and proving the reserves on which development of a mining and minerals processing operation would be based. The maiden inferred resource estimate on which the application for the Mine had been based was made public during June in 2008, and a feasibility study for the establishment of the Mine was completed in June 2010.



Legend

- Roads
- Railway
- Watercourses
- Local Government Area
- Built Up Areas
- Waterbodies
- State Forest
- NPWS Estate
- Native Vegetation Areas
- Manuka Mine

FIGURE 1.1

MANUKA MINE
Local Setting and Locality Pan

Data source: New South Wales State Government, SEED

Between 2012 and 2014 two of the four approved pits had commenced construction and their associated waste dumps constructed. A Processing Plant and associated Run-of-Mine (ROM) Pad, stockpile areas, offices, workshops and water management structures have also been constructed along with the initial lifts of a TSF. Soil and other miscellaneous material stockpiles are maintained ahead of future use in Mine rehabilitation. As has been previously reported, some minor modifications to the layout of the developed pits and associated waste dumps were made to reflect resource definition and exploration / sterilisation drilling results, which identified a potential resource in the general vicinity of the ROM Pad, Processing Plant and Office Area. The final shape and layout of the TSF has also been modified to better account for local ground and topographic conditions, as well as the modified location of the ROM Pad and Processing Plant and Office Area. These modifications, along with those associated with temporary stockpiles of hard rock, mineralised waste, clay and sulphidic ore and a realigned Mine Access Road, were essentially regularised as part of the September 2015 modification to DA 2010/LD-00074.

Mining and processing operations had been undertaken on ML 1659 until March 2014 when CCR was placed into administration. At this time, the Mine had been placed under care and maintenance with mining and processing operations suspended. Following a period of assessment where prospective options for continued trading of CCR were reviewed, the Mine was purchased by Southern Cross Goldfields Limited (which was later renamed Black Oak Minerals Ltd) as a liquidated asset with all leases and licences transferred by November 2014.

1.1.2 Black Oak Minerals Limited (BOML)

In November and December 2014, BOML completed surface water management works required by a Pollution Reduction Program of EPL 20020 which were left outstanding by CCR. On completion of these works, a mining fleet and workforce was mobilised with mining and processing operations recommencing in February 2015. Ore from the Boundary and Manuka Pits was mined and stockpiled, along with ore transported from the Mt Boppy Gold Mine, for processing. Tailings generated by the processing operations have been discharged to the TSF. Operations at the Mine continued as noted above until BOML entered administration with no activities other than monitoring and maintenance since December 2015.

1.1.3 Manuka Resources

Manuka Resources Limited subsequently acquired the site on 31 August 2016 and initiated a thorough review of operational history and identified various improvements which could be introduced at the site leading to a proposed restart of operations towards the end of 2019. During the non-operational review period Manuka Resources completed engineering reviews to allow for certification of the last TSF wall lift completed in 2013 by CCR (project developer) and conducted a number of site audits for the NSW EPA and Resources Regulator. These audits included a number of recommendations relating to mine operations and management. Where relevant these recommendations are reflected within this RMP.

1.1.4 Existing Disturbance and Rehabilitation

The status of existing disturbance and rehabilitation at the Mine is described as follows:

Manuka and Boundary Pits

Both pits have been extracted of ore from previous mining operations within the Mine, with Boundary Pit ore exhausted. Partial backfilling to the north of the Boundary Pit has been undertaken. Final benching and pit stabilisation activities completed. Perimeter bunds are in place.

Boundary Waste Dump

Rehabilitation Phase 2 has been partially completed with sections of the waste dump shaped to a final landform with 18° slopes. Finalisation of batter shaping and application of growth medium and revegetation remains to be completed.

Manuka Waste Dump

While no further waste rock is to be placed within the approved footprint, final landform creation remains to be completed while the exact volume of material to be used in the construction of the TSF embankment lift and capping material is confirmed.

Tailings Storage Facility

The outer walls of the Stage 1B lift have been formed, spread with soil and revegetated. Erosion on the outer walls was remediated during the previous MOP/RMP Term. The TSF remains active and therefore uncapped. Surface drainage is prevented from inflowing by constructed water diversion drains up-slope of the TSF.

ROM pad and stockpiles

Previously extracted ore from Boundary and Manuka Pits is currently stockpiled with appropriate drainage controls installed. Some maintenance and upgrade works were undertaken during the period October 2019 to December 2021.

Mine Infrastructure Area / Processing Plant

No specific rehabilitation to date.

Soil stockpiles

All soil stockpiles have been shaped with covering vegetation. Some stockpiles were removed and spread over areas to be rehabilitated during the October 2019 to December 2021 period.

Hard rock stockpiles

Material will be used for off-lease road upgrade and maintenance works or in the construction of the TSF embankment lift.

Low Grade Ore and Mineralised Waste Stockpiles

Materials not processed through the on-site processing plant will be placed within the TSF.

During the previous MOP/RMP, rehabilitation of the following components of the Mine were completed and either under maintenance or suitable for relinquishment and an update of the rehabilitation security bond:

- exploration drill sites; and
- consolidation of surface storage areas for plant and equipment and removal of redundant equipment from site.

1.1.5 Approved Life of Mine

Development Consent 2010/LD-00074 does not specify an approved life of mine.

1.2 Current Development Consents, Leases and Licences

The tables below show the date or grant and duration of the following with respect to the Mine:

- **Table 1.1** - Development consents granted under the Environmental Planning and Assessment Act 1979 (EP&A Act)
- **Table 1.2** - Authorisations covering the mining area (including exploration licences, assessment leases and mining leases) granted under the Mining Act 1992, and
- **Table 1.3** - Any other approvals, licenses or authorisations issued by the Government agencies that are relevant to the progress of mining operation and rehabilitation activities.

Table 1.1 List of Development Approvals

Development Approvals	Date Granted	Expiry Date	Details/Comments
Development Consent 2010/LD-00074	1 June 2011	Not Applicable	Determined by JRPP on 24 May 2011 and issued by Cobar Shire Council on 1 June 2011. DA 2010/LD- 00074 has been subsequently modified on the following occasions: • 29 February 2012; • 6 November 2012; and • 9 September 2015.

Table 1.2 List of Current Mine Authorisation

Lease	Date Issued	Expiry Date	Details/Comments
ML 1659	23 Nov 2011	23 Nov 2032	Granted by the (then) Minister for Resources and Energy for recovery of Copper, Gold, Lead, Silver, Zinc. ML 1659 incorporates an area of 923.8ha.
EL 6155	17 Nov 2003	17 Nov 2021	Incorporating a combined 314 units authorising exploration for Group 1 minerals.
EL 6302	23 Sep 2004	23 Sep 2021	
EL 6482	18 Nov 2005	18 Nov 2021	
EL 6623	31 Aug 2006	31 Aug 2023	

Lease	Date Issued	Expiry Date	Details/Comments
EL 7345	25 May 2009	25 May 2022	
EL 7515	7 Apr 2010	7 Apr 2022	
EL 8498	10 Jan 2017	10 Jan 2024	

Table 1.3 Other Approvals, Leases and Licences

Other Approvals, Leases and Licences	Date Issued	Expiry Date	Details/Comments
Environment Protection Licence No. 20020	14 November 2011	Not Applicable	Originally issued by the EPA to CCR on 14 November 2011 and transferred to BOML 14 October 2014. Following acquisition by the Company and completion of the requirements of special conditions, the licence was subsequently transferred to Manuka Resources Ltd effective 1 October 2018. The current licence version date is 31 July 2019.
Water Supply Works Approval 85WA752614	16 January 2012	15 January 2027	Issued to Manuka Resources Ltd Limited for four bores within the Kanmantoo Fold Belt MDB Groundwater Source of the NSW Murray Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan.
Water Access Licence 36531	20 December 2016	Not Applicable	Issued by NOW providing entitlement to 300ML from the Lachlan Fold Belt MDB Groundwater Source.
Water Access Licence 30322	20 December 2016	Not Applicable	Issued by NOW providing entitlement to 750ML from the Kanmantoo Fold Belt MDB Groundwater Source. The nominated works specify Water Supply Works Approval 85WA752614.
AHIP 1131690 Impact to Aboriginal objects from construction of Mine	13 May 2012		Aboriginal Heritage Impact Permits (AHIP) issued under this Part 6 of the NPW Act 1974 provide permissions and prohibitions for harming aboriginal objects, places or human remains through the proposed works onsite. AHIPs also lists long term management directives, care agreements and temporary storage instructions, and notification and reporting requirements to be followed by the AHIP Holder
AHIP 1131993 Removal of two scar trees	12 November 2012		

1.3 Land Ownership and Land Use

Table 1.4 provides an overview of the land tenure of the general area (i.e., land tenure of lots within and adjacent to mining leases), including land ownership, occupancy and leases over the mining lease area.

Table 1.4 Land tenure of lots within and adjacent to the Mine

Lot and DP Address	Land Ownership	Occupancy	Lease
Lot 4225, DP 766852 8110 Bedooba Rd, Sandy Creek NSW 2835	Crown Land	Residential, Inhabited	Exploration Lease (EL) 7345
Lot 1, DP1164142 860 Manuka Rd, Nymagee NSW 2831	Crown Land	Western lands lease	ML1659, Exploration Lease (EL) 7345, EL6155
Lot 885, DP762088 1156 Wallace Vale Rd, Nymagee NSW 2831	Crown Land	N/A	Exploration Lease (EL) 7345
Kidman Highway Cobar, NSW 2835	Private	Residential, Inhabited	N/A
Lot 3633, DP766015 9870 Bedoota Rd, Nymagee NSW 2831	Private	Residential, Inhabited	Exploration Lease (EL) 7345
Lot 872, DP761941 33221 Kidman Way, Cobar NSW 2835	Crown Land	Residential, Inhabited	N/A

Figure 1.2 presents the land ownership of and surrounding the Mine.

Land use on and surrounding the mining lease is as follows:

Agriculture

Agricultural land use is principally grazing of sheep and goats. The “Manuka” property, which is owned by the Company, is managed in accordance with the terms of a Property Vegetation Plan (PVP) over the property. Agricultural activities on other properties are principally undertaken in more cleared areas in between the more densely vegetated hill and ridge tops.

Mining

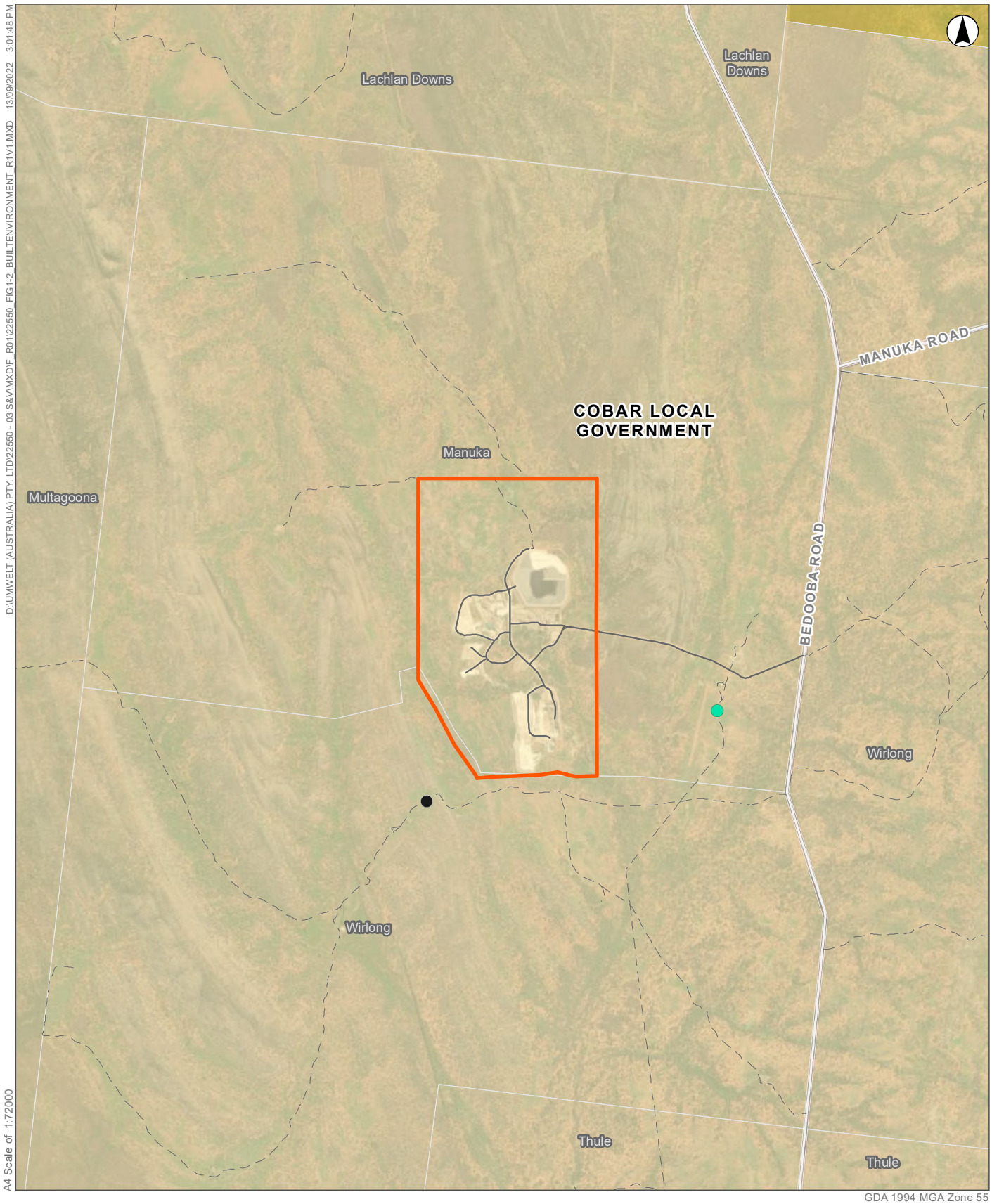
Mining has been an ongoing feature of the Cobar local government area (LGA) since the 1870s. The McKinnon’s Mine is located approximately 50km to the north of the mining lease.

Mineral Exploration

Mineral Exploration for precious and base metals is a feature throughout the Cobar LGA.

1.3.1 Land Ownership and Land Use Figure

Figure 1.2 to **Figure 1.3** show the following land ownership, land use, and environmental features of the Local setting



Legend

- Residence (Non Project-related)
- Residence (Project-related)
- Sub Arterial Road
- Local Road
- Track-Vehicular
- Local Government Area
- Manuka Mine

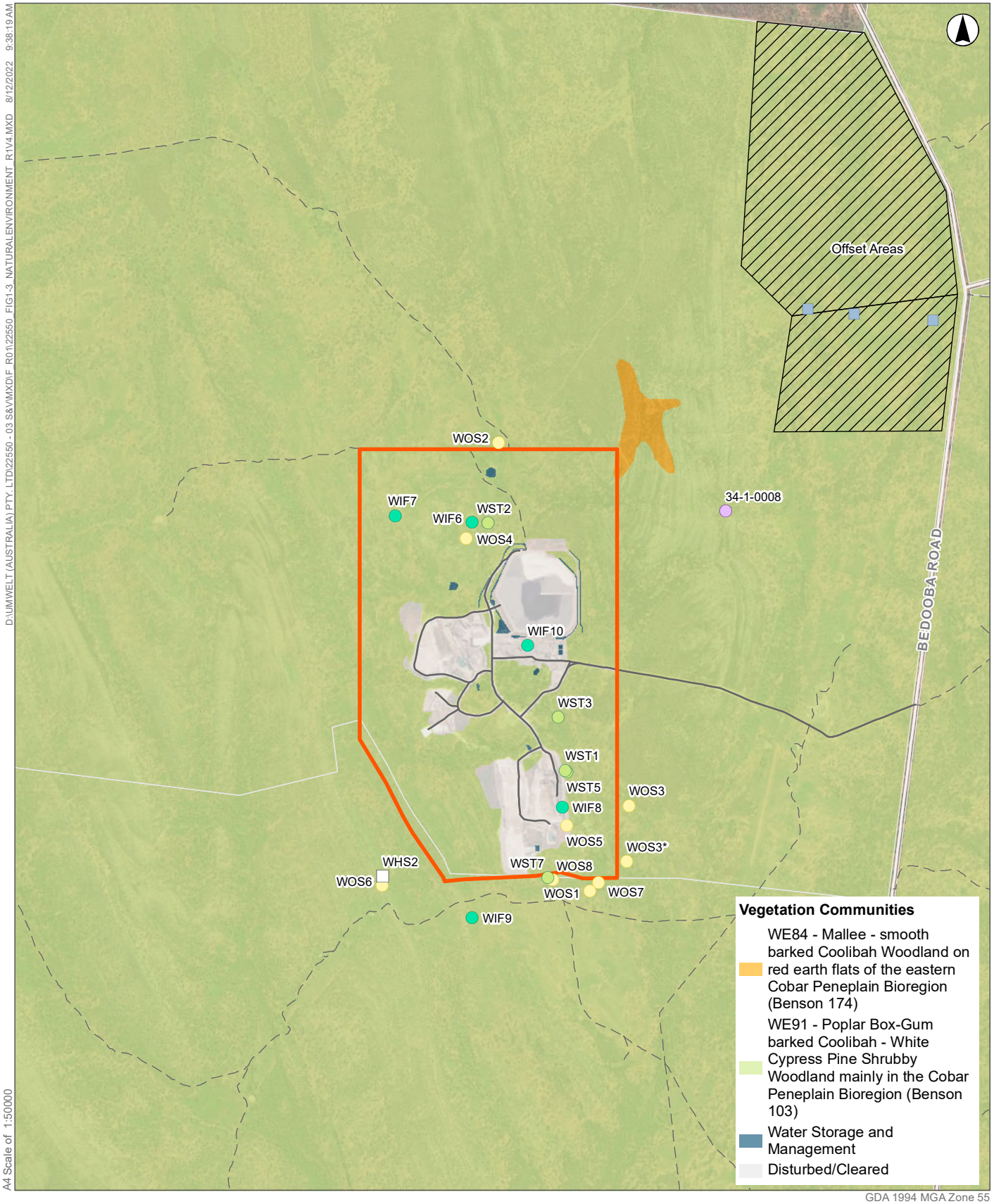
Land Use

- Crown Land
- Crown Land - Privately Leased

FIGURE 1.2

MANUKA MINE
Land Ownership and Land Use

Data source: New South Wales State Government, SEED



Legend

- Rehabilitation Analogue Monitoring Sites
- Art Site
- Isolated Find
- Open Scatter
- Scarred Tree
- European Heritage Site
- Sub Arterial Road
- Local Road
- Track-Vehicular
- Cadastre
- Manuka Mine
- Biodiversity Offset Area

FIGURE 1.3

MANUKA MINE
Environmental Features

Data source: New South Wales State Government, SEED

2.0 Final Land Use

2.1 Regulatory Requirements for Rehabilitation

The following **Table 2.1** lists all of the regulatory requirements for rehabilitation that apply to the Mine, including Conditions of Development Consent DA 2010/LD-00074 REV03 (granted under the EP&A Act 1979 and commitments in the associated environmental assessments.

- Mining Lease Conditions
- other relevant legislation (for example Biodiversity Conservation Act 2016, Heritage Act 1977), and
- any other relevant government approvals, permits, policies and guidelines.

At the time of developing this RMP, the Mine was in discussions with relevant stakeholders regarding the development of a Biodiversity Offset Management Plan. The RMP will be updated once this agreement is finalised.

Table 2.1 Regulatory requirements for rehabilitation - Development Consent 2011/LD- 00070REV01

Requirement	Source	Land to which it applies	Timing	Section
Rehabilitation to occur as soon as reasonably practicable after disturbance The holder of a mining lease must rehabilitate land and water in the mining area that is disturbed by activities under the mining lease as soon as reasonably practicable after the disturbance occurs.	Mining Amendment Regulation 2021 Schedule 1, Part 2, Division 1, Clause 5	Entire Site	Ongoing	6.0
Rehabilitation must achieve final land use 1. The holder of a mining lease must ensure that rehabilitation of the mining area achieves the final land use for the mining area. 2. The holder of the mining lease must ensure any planning approval has been obtained that is necessary to enable the holder to comply with subclause (1). 3. The holder of the mining lease must identify and record any reasonably foreseeable hazard that presents a risk to the holder's ability to comply with subclause (1).	Mining Amendment Regulation 2021 Schedule 1, Part 2, Division 1, Clause 6	Entire Site	Ongoing	5.0 – 10.0
Rehabilitation risk assessment 1. The holder of a mining lease must conduct a risk assessment (a rehabilitation risk assessment) that— a. identifies, assesses and evaluates the risks that need to be addressed to achieve the following in relation to the mining lease— i. the rehabilitation objectives, ii. the rehabilitation completion criteria,	Mining Amendment Regulation 2021 Schedule 1, Part 2, Division 2, Clause 7	Entire Site	Completed	3.0

Requirement	Source	Land to which it applies	Timing	Section
iii. for large mines—the final land use as spatially depicted in the final landform and rehabilitation plan, and b. identifies the measures that need to be implemented to eliminate, minimise or mitigate the risks. 2. The holder of the mining lease must implement the measures identified 3. The holder of a mining lease must conduct a rehabilitation risk assessment— a. for a large mine—before preparing a rehabilitation management plan, and b. for a small mine—before preparing the rehabilitation outcome documents for the mine, and c. whenever a hazard is identified under clause 6(3)—as soon as reasonably practicable after it is identified, and d. whenever given a written direction to do so by the Secretary				
Rehabilitation management plans for large mines • The holder of a mining lease relating to a large mine must prepare a plan (a rehabilitation management plan) for the mining lease … • If a rehabilitation outcome document has not been approved by the Secretary, the holder of the mining lease must include a proposed version of the document. • A rehabilitation management plan is not required to be given to the Secretary for approval. • The holder of the mining lease— ○ must implement the matters set out in the rehabilitation management plan, and ○ if the forward program specifies timeframes for the implementation of the matters—must implement the matters within those timeframes.	Mining Amendment Regulation 2021 Schedule 1, Part 2, Division 3, Clause 10	Entire Site	Completed	Whole Document
Amendment of rehabilitation management plans • The holder of a mining lease must amend the rehabilitation management plan for the mining lease as follows—	Mining Amendment Regulation 2021	Entire Site	As required	11.0

Requirement	Source	Land to which it applies	Timing	Section
• to substitute the proposed version of a rehabilitation outcome document with the version approved by the Secretary—within 30 days after the document is approved, • as a consequence of an amendment made under clause 14 to a rehabilitation outcome document—within 30 days after the amendment is made, • o reflect any changes to the risk control measures in the prepared plan that are identified in a rehabilitation risk assessment—as soon as practicable after the rehabilitation risk assessment is conducted, • whenever given a written direction to do so by the Secretary—in accordance with the direction.	Schedule 1, Part 2, Division 3, Clause 11			
Rehabilitation outcome documents • The holder of a mining lease must prepare the following documents (the rehabilitation outcome documents) for the mining lease and give them to the Secretary for approval— ○ the rehabilitation objectives statement, which sets out the rehabilitation objectives required to achieve the final land use for the mining area, ○ the rehabilitation completion criteria statement, which sets out criteria, the completion of which will demonstrate the achievement of the rehabilitation objectives, ○ for a large mine, the final landform and rehabilitation plan, showing aspatial depiction of the final land use. • If the final land use for the mining area is required by a condition of development consent for activities under the mining lease, the holder of the mining lease must ensure the rehabilitation outcome documents are consistent with that condition.	Mining Amendment Regulation 2021 Schedule 1, Part 2, Division 3, Clause 12	Entire Site	1 August 2022	4.0
Forward program and annual rehabilitation report • The holder of a mining lease must prepare a program (a forward program) for the mining lease that includes the following—	Mining Amendment Regulation 2021	Entire Site	Required 1 August 2022 (then within 60 days of end reporting period)	N/A

Requirement	Source	Land to which it applies	Timing	Section
○ a schedule of mining activities for the mining area for the next 3 years, ○ a summary of the spatial progression of rehabilitation through its various phases for the next 3 years, ○ a requirement that the rehabilitation of land and water disturbed by mining activities under the mining lease must occur as soon as reasonably practicable after the disturbance occurs. • The holder of a mining lease must prepare a report (an annual rehabilitation report) for the mining lease that includes— ○ a description of the rehabilitation undertaken over the annual reporting period, ○ a report demonstrating the progress made through the phases of rehabilitation provided for in the forward program applying to the reporting period, ○ a report demonstrating progress made towards the achievement of the following— ▪ the objectives set out in the rehabilitation objectives statement, ▪ the criteria set out in the rehabilitation completion criteria statement, ▪ for large mines—the final land use as spatially depicted in the final landform and rehabilitation plan. …	Schedule 1, Part 2, Division 3, Clause 13			
Certain documents to be publicly available • This clause applies to the following documents— ○ a rehabilitation management plan, ○ a forward program, ○ an annual rehabilitation report …	Mining Amendment Regulation 2021 Schedule 1, Part 2, Division 3, Clause 16	Entire Site	Ongoing	11.0
The person(s) having benefit of the development consent shall rehabilitate the site to the satisfaction of the Director, Environmental	DA 2011/LD-00074 REV03	Entire Site	Mine Closure	4.0, 5.0

Requirement	Source	Land to which it applies	Timing	Section
Sustainability in the Division of Resources and Energy.				
Rehabilitation must be substantially consistent with the Rehabilitation Objectives described in the SOEE, and the following objectives in the following table:	DA 2011/LD-00074 REV03			
Mine Site Safe, stable and non-polluting, fit for the purpose of the intended post-mining land use(s).		Entire site	Mine closure	4.0, 5.0
Rehabilitation materials Materials (including topsoil, substrates and seeds of the disturbed areas) are recovered, appropriately managed, and used effectively as resources in the rehabilitation.		Entire site	Ongoing	6.2.1, 9.0, 10.0
Landforms Final landforms sustain the intended land use for the post-mining domain(s). Final landforms are consistent with and complement the topography of the surrounding region to minimise the visual prominence of the final landforms in the post mining landscape. Final landforms incorporate design relief patterns and principals for consistent with natural drainage.		Entire Site	Mine Closure	4.0, 5.0
Water Quality Water retained on site is fit for the intended land use(s) for the post-mining domain(s). Water discharged from site is consistent with the baseline ecological, hydrological, and geomorphic conditions of the creeks prior to mining disturbance. Water management is consistent with the regional catchment management strategy.		Open Cut Void	Mine Closure	4.0, 5.0
Native flora and fauna Size, locations and species of native tree lots and corridors are established to sustain biodiversity habitats. Species are selected that re-establishes and complements regional and local biodiversity.		Entire Site	Mine Closure Ongoing	4.0, 5.0
Post-mining agricultural pursuits The land capability classification for the relevant nominated agricultural pursuit for each domain is established and self-sustaining within 5 years of land use establishment (first planting of vegetation).		Entire Site	Mine closure	4.0, 5.0

Requirement	Source	Land to which it applies	Timing	Section
The proponent must prepare and implement a Rehabilitation Plan to the satisfaction of the Director Environmental Sustainability of the DRE.	DA 2011/LD-00074 REV03	Entire Site	Refer to document footer	Whole Document

The Mining Amendment (Standard Conditions of Mining Leases—Rehabilitation) Regulation 2021 no 360 ("Mining Amendment Regulation"), made under the Mining Act 1992, amends the current Mining Regulation 2016 to prescribe new mining lease conditions. These new conditions set clear, achievable, and enforceable requirements for the environmental management, protection and rehabilitation of land that is or may be affected by activities under mining leases.

While the Mining Amendment Regulation commenced on 2 July 2021, the new conditions will only take effect for pre-existing mining leases in July 2022. As ML 1659 was issued prior to this date, the new standard rehabilitation conditions apply to the Manuka Silver Mine on 2 July 2022. These new conditions replace existing rehabilitation and environmental management conditions, hence only the new conditions have been addressed in this RMP.

2.2 Final Land Use Options Assessment

An additional final land use options assessment is not required as a detailed final land use options assessment has previously been undertaken as part of the development application process (as outlined in Section 2.15.2.2 of the 2010 EIS). DA 2010/LD-00074 for the Mine requires the development be undertaken in accordance with this (and additional) documentation.

Land use on properties surrounding the Mine includes limited agricultural (very low-quality grazing), or essentially vacant Crown Land. Final land uses considered for the Mine include the following:

1. Return to agriculture (grazing of sheep and goats)
2. Development of other industry
3. Conservation of biodiversity; and/or
4. Development as a tourist site.

Return to agriculture (grazing of sheep and goats)

The Mine is subject to intermittent grazing, controlled by fencing established on the "Manuka" property. Reinstatement of vegetation types that are compatible with rural uses (native grasses, saltbush) remains an aim of the project rehabilitation. In line with current stocking levels of "Manuka" and surrounding properties, grazing pressure should be restricted once a suitable cover had been established. Grazing by native fauna (i.e., macropods) and feral vertebrate pests (i.e., rabbits, goats) which are a regional land management issue also requires control.

The management of feral pest species (and native species) requires management as part of the broader "Manuka" property. Ultimately, the management of sustainable grasslands across the property, in accordance with the "Manuka" property vegetation plan (PVP), will be the most effective strategy for managing grazing pressure. By establishing sustainable grasslands, the requirement for competing species to enter the Mine and graze on establishing vegetation will be diminished. Animal numbers can then be controlled over the "Manuka" property in accordance with the PVP.

During the establishment phase of vegetation on the final landform, regular inspections will be required to assess what impact feral and native animal grazing is having. Strategies such as the installation of temporary fencing, use of tree guards, physical movement of animals would be undertaken in collaboration with the Lessee and manager of the "Manuka" property.

Development of other industry

Given the establishment of infrastructure at the Mine, industrial development could be an option. However, the site is too isolated and services too poor to enable a viable concern to become established. This use has thus been removed from further consideration.

Conservation of biodiversity

There are no areas within or in close proximity to the Mine that are considered suitable for conservation protection in their current condition. While rehabilitation will aim to re-establish a viable native ecosystem, the outcome is unlikely to be of significant conservation value.

Development as a tourist site

Upon closure, the Mine may be of some interest to tourists travelling in the general Cobar region. However, the constraints of isolation of the site from other support services, general security issues and the availability of other examples of mining in closer proximity to Cobar which are more suited for tourism activity preclude this option.

2.2.1 Stakeholder Consultation

A summary of the stakeholder consultation undertaken for the final land use options assessment is provided in **Table 2.2** below.

Table 2.2 Summary of Stakeholder Consultation

Stakeholder	Consultation Activities Methods	Consultation Matters	Outcomes
Cobar Shire Council	Correspondence prior to development application	Information contained within SoEE supporting the development application. Response to Submission of DRE Recommencement and modifications to operations at the Mine, primarily around compliance issues associated with the conditions of DA 2010/LD-00074; Terms of agreement between BOML and Council over road works and maintenance on SR13 and 14.	Rehabilitation as presented in the SoEE.
Division of Resources and Energy		2015 Modification application of the Development Consent DA 2010/LD-00074	Response received 25/03/15 Provided feedback on the proposed rehabilitation and final land use outcomes for the Mine requesting that the MOP: • provide a final landform plan that identifies vegetation types, habitat features, Aboriginal heritage features and fencing design; and • address mine closure planning. Also required that rehabilitation be undertaken progressively and as soon as reasonably practicable. DRE noted the standard Secretary's Environmental Assessment Requirements (SEARs) would apply with respect to DRE expectations, i.e., information on proposed rehabilitation, final landform and land use.
Environmental Protection Authority	Correspondence	Consultation sought for requirements regarding the 2015 Modification application of the Development Consent DA 2010/LD-00074.	Response received 16/03/15, however did not provide specific comments on rehabilitation.
Office of Environment and Heritage	Correspondence	Consultation sought for requirements regarding the 2015 Modification application of the Development Consent DA 2010/LD-00074.	Response received 24/03/15, however did not provide specific comments on rehabilitation.

Stakeholder	Consultation Activities Methods	Consultation Matters	Outcomes
NSW Office of Water	Correspondence	Consultation sought for requirements regarding the 2015 Modification application of the Development Consent DA 2010/LD-00074.	Response received 13/03/15, however did not provide specific comments on rehabilitation.
Roads and Maritime Service	Correspondence	Consultation sought for requirements regarding the 2015 Modification application of the Development Consent DA 2010/LD-00074.	Response received 24/03/15, however did not provide specific comments on rehabilitation.
Community – Mr Andrew Moseley (who holds an option to buy back the 'Manuka' property)		Planned rehabilitation of the Mine Form and implementation of a Biodiversity Offset Strategy to compensate for disturbance to native vegetation on the Mine.	Mr Moseley has indicated no objections to the proposed final landform with his expectation being that the final pits are safe and stable landforms, and the waste rock dumps, TSF, other stockpiles and hardstands are stabilised and revegetated to allow for pastoral activities. Manuka and the Mosely family had proposed to join their respective landholdings to meet the minimum critical size to advance a Carbon Sequestration Project.
DPI-Lands	Prior to development application Advertisements in the Cobar news press.		Implementation of land management practices such as weed and pest control. Rehabilitation as nominated in original development application.

2.3 Final Land Use Statement

Consistent with the final land use options assessment approved by DA 2010/LD-00074 in **Section 2.2** , the final land use would consist of a combination of agricultural land and for the conservation of biodiversity (i.e., return to native ecosystems).

This option was presented as part of the original EIS for the Mine (RWC, 2010), and confirmed in the more recent SoEE prepared to support the most recent modification to DA 2010/LD- 00074 (RWC, 2015a).

The final land use is depicted spatially on the Final Landform and Rehabilitation Plan (**Section 5.0**).

2.3.1 Final Land Use Domains

The final land use domains for the Mine are detailed in **Table 2.2**.

Table 2.3 Manuka Silver Mine Final Land Use Domains

Final Land Use Domain	Description
Infrastructure	The domain includes built infrastructure proposed to be retained for future use e.g., a long-term access road to be retained through the Mine Site.
Native Ecosystem	Self-sustaining native ecosystems.
Agricultural – Grazing	This domain includes the rehabilitation of area covering the existing TSF and the miscellaneous disturbance adjacent to other Mining Domains.
Water Management Areas	This domain includes surface water diversion structures to be retained for long term water management with native seed spread to assist in the regeneration of trees and grasses that are naturally found along drainage lines. Decommissioned sediment basins are to be in-filled and profiled as an extension to these drainage features and retained as part of the final landform.
Water Storage (Excluding Final Void)	This domain includes sediment basins to be retained for long term water management.
Final Void	Final remaining void area/s from mining extraction areas that form part of the final landform design.

2.3.2 Mining Domains

The current mining domains described in **Table 2.3** below are categorised on the basis of mine-related activities occurring within each domain.

Table 2.4 Mining Domains

Mining Domain	Description
Infrastructure Area	Demountable Site Office Heavy Vehicle Workshop Amenities Hardstand Areas (including the ROM Pad Rural Fencing
Tailings Storage Facility	TSF TSF Batters
Water Management Area	Existing Dirty and Clean Diversion Drains Process Water Pond Raw Water Pond Five Sediment Basins Water Pipeline Bore Field and Associated Bores
Overburden Emplacement Area	Manuka and Boundary Waste Dumps Proposed Future Bimble and Belah Pit Waste Dumps
Active Mining Area (Open Cut Void)	Boundary and Manuka Pit Voids Void Safety Bund Proposed Future Bimble and Belah Voids and Associated Safety Bunds

Mining Domain	Description
Other: Stockpile Area	Existing Soil and Vegetation Stockpiles Hard Rock Stockpiles Low Grade Ore and Clay Stockpiles
Other: Heritage Area	Aboriginal Sites

3.0 Rehabilitation Risk Assessment

The rehabilitation risk assessment was undertaken generally in accordance with:

- Australian Standards HB 203:2006, AS/NZS 4360:2004 and AS/NZS ISO 31000:2018 Risk Management – Principles & Guidelines; and
- NSW Resources Regulator's Rehabilitation Risk Assessment Guideline dated 2 July 2021.

This risk assessment has been prepared in consideration of the Rehabilitation Management Plan for the Manuka Silver Mine and relevant background documentation, including previous Mining Operation Plans. Risks to achieving the rehabilitation objectives and rehabilitation completion criteria outlined in **Section 4.0** of the Rehabilitation Management Plan, as well as the final landform outlined in **Section 5.0** of the Rehabilitation Management Plan, were identified, and assessed jointly by Manuka Resources Limited (Manuka) and R.W. Corkery & Co. Pty Limited (RWC).

Site specific threats to rehabilitation were assessed based upon previous risk assessments undertaken as part of the Mining Operations Plans, observations of site-specific conditions and threats to rehabilitation observed during site operations. This risk assessment was completed with consideration of existing controls as well as those risk controls outlined in the Rehabilitation Management Plan.

For each identified risk to rehabilitation, potential adverse outcomes were identified and allocated a risk rating based on the potential consequences and likelihood of occurrence. Where risk ratings were determined to be "Moderate" or above, a Trigger Action Response Plan has been developed and is presented in **Section 10.0**.

Table 3.1 summarises the risks to rehabilitation identified in the risk analysis assuming the mitigation measures that have previously been proposed are implemented. The risk consequence has been determined largely upon the outcomes of the assessments completed for the EIS (RWC, 2010) and other documentation submitted to obtain approval.

Table 3.1 Key Rehabilitation Risks identified

Consolidated Risk	Risk Reference	Ranking	Addressed in Section
Rehabilitation Phase - General			
Insufficient skills and experience of rehabilitation personnel.	R1	Low	**7.0**
Lack of clearly defined responsibilities.	R2	Low	**7.0**
Insufficient funding for or prioritisation of rehabilitation activities.	R3	Low	**7.0**
Rehabilitation Phase – Active Mining			
Inappropriate biological resource (e.g., subsoil, topsoil, vegetative material, seedbank, rocks, habitat resources) through clearing, salvage, and handling practices.	R4	Med	**6.2.1**
Limited pre-existing biological resources for use (e.g., topsoil, woody debris).	R5	Med	**6.2.1**
Adverse meteorological conditions during salvage of biological resources.	R6	Med	**6.2.1**

Consolidated Risk	Risk Reference	Ranking	Addressed in Section
Adverse geochemical/chemical composition of materials such as overburden, processing wastes, topsoils and subsoils.	R7	Low	**6.2.1**
Handling and containment of geochemical and geotechnically unsuitable process residue and reject materials.	R8	Low	**6.2.1**
Adverse surface and/or groundwater quality and quantity.	R9	Low	**6.2.1**
Rehabilitation Phase - Decommissioning			
Impacts on heritage items.	R10	Low	**6.2.2**
Hazards associated with retained infrastructure.	R11	Low	**6.2.2**
Contamination resulting from associated activities (e.g. storage and use of hydrocarbons/chemicals, drilling fluid, spillage of dirty water, brine, sewage).	R12	Low	**6.2.2**
Generation of material and waste products from the demolition process.	R13	Low	**6.2.2**
Groundwater accumulation in former underground workings (e.g. potential for fill and spill or impacts on regional ground water users.	R14	N/A	**N/A**
Exposure or access to underground workings.	R15	N/A	**N/A**
Habitation of structures and/or underground workings by native fauna (e.g. bats).	R16	N/A	**N/A**
Adverse surface water quality and quantity	R17	Med	**6.2.2**
Rehabilitation Phase – Landform Establishment			
Unstable landform due to erosion and/or mass movement issues associated with inappropriate design and/or quality assurance during landform construction.	R18	Low	**6.2.3**
Exposure or release of geochemical and/or geotechnically adverse material associated with containment design and construction, including capping/cover system.	R19	Med	**6.2.3**
Lack of availability of suitable materials for encapsulation or capping of adverse materials.	R20	Med	**6.2.3**
Borehole or gas well seals failure.	R21	N/A	**6.2.3**
Final landform unsuitable for final land use (e.g. large rocks present affecting cultivation, unsuitable surface cover and landform settlement).	R22	Low	**6.2.3**
Landform aspect not suitable for intended plant species.	R23	Low	**6.2.3**
Rehabilitation Phase – Growth Medium Development			
Inappropriate physical and structural properties of substrate.	R24	Med	**6.2.4**
Subsoil and topsoil deficit for rehabilitation activities.	R25	Low	**6.2.4**
Substrate inadequate to support revegetation or agricultural land capability (e.g. lack of organic matter, nutrient deficiency, lack of soil biota, adverse soil chemical properties, exposed hostile geochemical materials, and any other factors impeding the effective rooting depth).	R26	Med	**6.2.4**
Rehabilitation Phase – Landform Ecosystem and Land Use Establishment			

Consolidated Risk	Risk Reference	Ranking	Addressed in Section
Lack of availability and quality of target seed resources, including genetic integrity.	R27	Low	**6.2.5**
Poor seed viability or seed dormancy.	R28	Low	**6.2.5**
Seed predation.	R29	Low	**6.2.5**
Damage to seed through revegetation process.	R30	Low	**6.2.5**
Poor quality tubestock.	R31	Low	**6.2.5**
Weed infestation associated with both introduction and control (or lack thereof).	R32	Med	**6.2.6**
Adopting inappropriate or inadequate rehabilitation techniques, including equipment fleet.	R33	Low	**6.2.6**
Inappropriate revegetation species mix for targeted final land use.	R34	Low	**6.2.6**
Adverse weather and climatic influences (e.g. drought; intense rainfall events; bushfire and climate change).	R35	Med	**6.2.6**
Areas not available for revegetation during optimal seasonal conditions.	R36	Low	**6.2.6**
Lack of habitat structures for colonisation or use.	R37	Low	**6.2.6**
Rehabilitation Phase - Landform Ecosystem and Land Use Development			
Hazards associated with retained infrastructure.	R38	Low	**6.2.6**
Adverse weather and climatic influences (e.g. drought; intense rainfall events; bushfire and climate change).	R39	Med	**6.2.6**
Substrate inadequate to support revegetation or agricultural land capacity.	R40	Med	**6.2.6**
Post-closure water quality and quantity issues.	R41	Low	**6.2.6**
Damage to rehabilitation (e.g. fauna, domestic stock, vandalism, vehicular interactions, bushfire).	R42	Med	**6.2.6**
Re-disturbance of established rehabilitation areas.	R43	Low	**6.2.6**
Insufficient establishment of target species and limited species diversity.	R44	Med	**6.2.6**
Erosion and failure of landform, drainage and water management/storage structures.	R45	Low	**6.2.6**
Lack of infrastructure to support intended final land use (e.g. bunding, fences).	R46	Low	**6.2.6**
Lack of resources for rehabilitation maintenance.	R47	Low	**6.2.6**

4.0 Rehabilitation Objectives and Rehabilitation Completion Criteria

4.1 Rehabilitation Objectives and Rehabilitation Completion Criteria

To achieve progressive rehabilitation of the Mine, the short-term rehabilitation objectives are to:

- control and minimise erosion and the generation of sediment-laden water by stabilising all earthworks, drainage lines and disturbed areas no longer required for mine-related activities; and
- establishment of ground cover on disturbed land areas that are no longer required for mining activities in the future.

To achieve the nominated post mining land use goals in the longer term the objectives are to:

- decommission and remove all mining-related infrastructure not required for the agreed end land use
- create a low maintenance, geotechnically stable and safe landform that is secure and non-polluting
- construct above ground landforms which are commensurate with the surrounding land fabric as far as practicable
- provide a sustainable growth medium suitable for the establishment and retention of the nominated vegetation communities, and
- revegetate with native tree, shrub, and grass species comparable with, and with maintenance requirements no greater than, the surrounding vegetation communities.

In order to achieve the nominated post mining land use goals, the rehabilitation objectives are discussed and presented in detail in **Table 4.1**.

The rehabilitation objectives demonstrate that each final land use domain will be returned to a condition capable of achieving the final land use. These objectives have been developed on the basis of the public and government agency consultation, review of the original EIS (RWC, 2010) for the approved operations, and current leading practice in rehabilitation of mine sites. The EIS documents confirm that comprehensive consultation has been, and continues to be, undertaken with local residents. This consultation includes consideration of Mine rehabilitation and future land use.

Rehabilitation objectives, performance indicators, completion criteria, monitoring/measurement methods and justification for each phase of rehabilitation are further discussed in **Section 6.0**.

Table 4.1 Proposed Performance Indicators and Rehabilitation Completion Criteria

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
Mining Domain: 1 – Infrastructure Area **Final Land Use Domain**: I – Infrastructure **Spatial Reference**: I1	All sections of road to be retained for a lawful final land use reduced in width / size suitable for final land use.	Roads not required for final land use are removed.	Unless specified to be retained, all internal roads, carparks and hardstands not required for the end of land use are decommissioned, ripped and profiled.	Single occurrence relinquishment inspection and report, including photographs.
		Roads required for final land use are reduced in width (if required).	Road reduced in width to that suitable for final land use.	
	All infrastructure to be retained as part of the final land use is safe, free from any hazardous materials and contaminants, and does not pose any hazard to the community.	Visible assessment of presence / absence of contamination and/or measured contamination levels (concentration of key parameters)	Contaminated land assessment confirms land is free of contaminants or within acceptable limits for final land use.	Single occurrence contamination assessment report prepared by a suitably qualified person with follow up validation testing to be undertaken if required.
		Presence/absence of hazardous materials.	All hazardous materials removed from site and transported to an acceptable waste management facility.	Single occurrence hazardous materials audit undertaken with follow up inspections to be undertaken if required.
		Potential hazards have been identified, isolated and secured / removed from site.	All potential hazards isolated and secured or removed	Single occurrence relinquishment inspection and report, including photographs, with follow up inspections to be undertaken if required.
	Established final landform is non-polluting, free draining, geotechnically stable and permanent.	Retained access road is in suitable condition.	The retained access road surface provides access suitable for four-wheel drive vehicles and road batters do not present an erosion hazard.	Single occurrence relinquishment inspection and report, including photographs, following decommissioning.
	The final landform integrates with and complements the surrounding topography.			
	Established final landform is free draining with erosion hazard consistent with the surrounding landforms and drainage features.			
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators and criteria.		Relinquishment report prepared by suitably qualified or experienced person(s).
Mining Domain: 1 – Infrastructure Area 3 – Water Management Area **Final Land Use Domain**: B – Agricultural - Grazing **Spatial Reference**: B1 and B3	All infrastructure and services not suitable for a lawful final land use will be removed.	Disconnection and removal of connected services (power, water, communications) not required for the final land use.	Relevant services are isolated, disconnected, and/or removed.	Work statement provided / utility service disconnection record / notification. Single occurrence relinquishment inspection & report prepared by a suitably qualified person, including photographs with follow up inspections to be undertaken if required.
		Decommissioning and removal of all surface infrastructure not required for final land use.	All infrastructure and associated buildings which are not to be retained are decommissioned and removed from site.	
		Removal of haul roads not required for the final land use.	Roads no longer required are removed and land rehabilitated.	
	Domain is safe, free from any hazardous materials and contaminants, and does not pose any hazard to the community.	Visible assessment of presence / absence of contamination and/or measured contamination levels (concentration of key parameters)	Contaminated land assessment confirms land is free of contaminants or within acceptable for limits for final land use.	Single occurrence contamination assessment report prepared by a suitably qualified person with follow up validation testing to be undertaken if required.
		Presence/absence of hazardous materials.	All hazardous materials removed from site and transported to an acceptable waste management facility.	Single occurrence hazardous materials audit undertaken with follow up inspections to be undertaken if required.
	Established final landform is non-polluting, free draining, geotechnically stable and permanent.	Free draining landform.	Mapping confirms that the final landform is free draining. No visible pooling water	Final survey plans. Photographic records.

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
	Established final landform is free draining with erosion hazard consistent with the surrounding landforms and drainage features.	Runoff water quality.	Water quality meets the objective of Section 120 of the POEO Act. Water quality criteria identified by EPL 20020, and Water Management Plan.	Sampling and analyses of runoff – with continued compliance with criteria 5 years following completion of final landform works. Water quality and visible monitoring reported through ARRFPs.
	The final landform integrates with and complements the surrounding topography.	Visual indicators of erosion and land instability.	No 'active' erosion or sedimentation visible.	
	Establish soil / growing medium suitable for establishment of grassland vegetation community.	Presence of surface compaction.	Compacted areas are deep ripped cross slope.	Single occurrence inspection and records including photographs.
		Appropriate depth of growth medium.	Where required, growth medium applied to a minimum depth of 150mm, unless rehabilitation trials indicate that an alternative thickness is acceptable	Single occurrence testing using small 'test pits' (5 per ha) and report, including photographs, following final placement/shaping of growth medium.
		Soil appropriately prepared prior to seeding.	Growth medium is pre-treated with gypsum (2t/ha topsoil stockpiles and 5t/ha for stockpiled clay and waste rock to be utilised as growth medium) prior to seed and fertiliser application (per Section 7 of Landloch Report Aug 2021, Rev1).	Single occurrence report including pre-treatment analysis results and records of ameliorant applied.
		Appropriate soil chemistry for vegetation establishment and sustainability.	Analysis of soil samples record parameters as follows. • pH – 5.5 to 8.5. • Electrical conductivity (EC) – less than 0.6 dS/m. • Cation Exchange Capacity (CEC) – 5 to 30 meq/100g. • Exchangeable Sodium Percentage (ESP) - 0.6 to 5.0% • Dispersion index – below 6 • or within 20% of analogue sites after 5 years.	Soil samples taken (1 bulk sample per ha), analysed, and reported in ARRFP and relinquishment report. Samples taken annually for 5 years.
	Establishment of vegetation communities with a similar species composition to the surrounding native vegetation communities complementing regional and local biodiversity.	Establishment of target species as outlined in Rehabilitation Management Plan.	Revegetation monitoring confirms that, within 2 years following planting, >70% of the total number of species established are either in accordance with the applied species mix or local native species and represent >50% to 70% of the total projected foliage cover.	Establish a minimum of two monitoring points within final land use domain area (i.e. at least 1 per 20ha) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Annual survey and analysis reports (or as otherwise advised) by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs. Annual revegetation monitoring for a minimum of 5 years.
		The rehabilitated area does not constitute an erosion hazard.	Total projected foliage cover exceeds 70% or bare ground and litter coverage is equivalent to analogue sites.	
		Weeds are not competing or impacting on the rehabilitated area.	Revegetation monitoring confirms that, after 2 years, the non-native / non-target species (weeds) represent <30% of projected foliage cover or equivalent to analogue sites not disturbed by mining activities.	
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and the trends at relevant analogue sites.	
	Maintenance of self-sustaining vegetation communities capable of light intensity grazing.	Key soil characteristics remain within acceptable range.	Analysis of soil samples record parameters after 5 years from growth medium establishment are as follows. • pH – 5.5 to 8.5. • EC – less than 0.6dS/m. • CEC – 5 to 30 meq/100g. • ESP – 0.6 to 5.0%. • Erodibility (K) Factor – less than 0.05. or within 20% of analogue sites.	Soil samples taken (1 bulk sample per ha) at least 5 years following establishment of growth medium, analysed and reported within relinquishment report. Single occurrence unless parameters non-compliant with criteria.

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
		Native species diversity and coverage consistent with local benchmark / analogue sites.	Revegetation monitoring reports confirm that, after 5 years from planting >80% of the total number of species established are either in accordance with the applied species mix or local native species and represent >60% to 80% of the total projected foliage cover.	Establish a minimum of two monitoring points within final land use domain area (i.e., at least 1 per 20ha) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Ongoing survey and analysis reports at frequency advised by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs.
		Weeds are appropriately controlled, do not compete with established vegetation, and do not impact on rehabilitated area.	Revegetation monitoring confirms that, after 5 years from planting, the non-native / non-target species (weeds) represent less than 20% of projected foliage cover, or equivalent to analogue sites not disturbed by mining activities.	
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and relevant analogue sites.	
		Light intensity grazing is sustainable with evidence of a self-sustaining vegetation community	Monitoring confirms: • evidence of new growth of endemic species. • evidence of successive generations of endemic species. • weed control requirements no greater than analogue sites.	
			Total projected foliage cover remains >70% or equivalent to analogue sites not disturbed by mining activities.	
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators.	Demonstrated compliance with all completion criteria.	Relinquishment report prepared by suitably qualified or experienced person(s).
	Establishment of a sustainable land capability for grazing land use within 5 years of rehabilitation.	Successful land relinquishment and turnover of responsibilities to the new land managers.	Consultation meeting with future land managers and other relevant stakeholders with the Mine in preparation for the land relinquishment and turnover of management and monitoring responsibilities.	Following land relinquishment, future land managers will be responsible for monitoring grazing pressures to ensure that overgrazing does not occur (i.e., in accordance with the Manuka PVP).
Mining Domain: 2 – Tailings Storage Facility **Final Land Use Domain:** B – Agricultural – Grazing **Spatial Reference:** B2	Removal of all TSF management infrastructure	Unless specified to be retained, all associated TSF management infrastructure not required for the final land use are decommissioned, dismantled, removed and appropriately disposed.	Dismantling and removal of pumps and pipelines connected to the TSF.	Removal of all TSF management infrastructure
	The final landform integrates with and complements the surrounding topography.	TSF is properly capped.	Construction of a capping cover using a combination of a 2m (total) coarse waste rock to form a capillary break, and a minimum 600 mm clay to form an impermeable barrier.	Engineered capping design specifications. Report, including photographs, prepared by qualified person confirming construction undertaken in accordance with design specifications.
	Established final landform is free draining with erosion hazard consistent with the surrounding landforms and drainage features.	Results of surface water and groundwater monitoring.	Water quality meets the objective of Section 120 of the *Protection of the Environment Operations Act 1997*, Water quality consistent with criteria identified by EPL 20020, and Water Management Plan.	Sampling and analyses of runoff and leachate in accordance with the Water Management Plan. Monitoring reported through ARRFP.
	Established final landform is non-polluting, free draining, geotechnically stable and permanent.	Free draining landform.	Mapping confirms that the landform is free draining. No pooling of water on upper surface of the facility is observed.	As constructed survey plan. Visual inspection and photographs.
		Landform suitable for growth media establishment (grass cover only).	Maximum slope profiling of TSF batters is no more than 18º (~3H:1V).	Engineered design specifications and as constructed survey plans.
		Rehabilitated area does not represent as an erosion hazard.	No 'active' erosion or sedimentation visible.	Regular monitoring and reporting in accordance with an inspection test plan.

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
		Stable and permanent landform is established.	Landform is geotechnically stable.	Geotechnical report confirms no evidence of instability, weak points that pose as potential risk of cracking and leakage.
	Establish soil / growing medium suitable for establishment of grassland vegetation community	Soil appropriately prepared prior to seeding.	Growth medium is pre-treated with gypsum (2t/ha topsoil stockpiles and 5t/ha for stockpiled clay and waste rock to be utilised as growth medium) prior to seed and fertiliser application (per Section 7 of Landloch Report Aug 2021, Rev1). *Note: pre-treatment rates will depend on the results of the 5-year rehabilitation treatment trials currently being undertaken along the TSF batter.	Single occurrence report including pre-treatment analysis results and records of ameliorant applied. Recommended soil treatment rates from the 5-yr Rehabilitation Trial Treatment Study.
		Landform suitably stable to be traversed by equipment to be utilised for spreading of growth medium.	Implementation of mechanical broadcasting of ameliorant and spreading of soil following report that heavy machinery can move on consolidated tailings.	Geotechnical report confirming heavy machinery can move on consolidated tailings.
		Appropriate depth and type of growth medium spread following consolidation and capping of the Facility.	Minimum growth medium depth of 150 mm spread over TSF area (note: clay or waste rock-based growth medium restricted to gradients below 6%).	Single occurrence testing using small 'test pits' (5 per ha) and report, including photographs, following final placement/shaping of growth medium.
		Key soil characteristics generally within the range of pre-disturbance soil characteristics.	Analysis of soil samples record parameters as follows. • pH – 5.5 to 8.5. • Electrical conductivity (EC) – less than 0.6 dS/m. • Cation Exchange Capacity (CEC) – 5 to 30 meq/100g. • Exchangeable Sodium Percentage (ESP) - 0.6 to 5.0% • Dispersion index – below 6 or within 20% of analogue sites after 5 years.	Soil samples taken (1 bulk sample per ha), analysed, and reported in ARRFP and relinquishment report. Samples taken annually for 5 years.
	Establishment of vegetation communities with a similar species composition to the surrounding native vegetation communities complementing regional and local biodiversity.	Establishment of target species as outlined in Rehabilitation Management Plan.	Revegetation monitoring confirms that, within 2 years following planting, >70% of the total number of species established are either in accordance with the applied species mix or local native species and represent >50% to 70% of the total projected foliage cover.	Establish a minimum of three monitoring points within final land use domain area (i.e. at least 1 per 20ha) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Annual survey and analysis reports (or as otherwise advised) by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs. Annual revegetation monitoring for a minimum of 5 years.
		The rehabilitated area does not constitute an erosion hazard.	Total projected foliage cover exceeds 70% or bare ground and litter coverage is equivalent to analogue sites.	
		Weeds are not competing or impacting on the rehabilitated area.	Revegetation monitoring confirms that, after 2 years, the non-native / non-target species (weeds) represent <30% of projected foliage cover or equivalent to analogue sites not disturbed by mining activities.	
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and the trends at relevant analogue sites.	
	Maintenance of self-sustaining vegetation communities capable of light intensity grazing.	Key soil characteristics remain within acceptable range.	Analysis of soil samples record parameters after 5 years from growth medium establishment are as follows. • pH – 5.5 to 8.5. • EC – less than 0.6dS/m. • CEC – 5 to 30 meq/100g. • ESP – 0.6 to 5.0%. • Erodibility (K) Factor – less than 0.05. or within 20% of analogue sites.	Soil samples taken (1 bulk sample per ha) at least 5 years following establishment of growth medium, analysed and reported within relinquishment report. Single occurrence unless parameters non-compliant with criteria.

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
		Native species diversity and coverage consistent with local benchmark / analogue sites.	Revegetation monitoring reports confirm that, after 5 years from planting >80% of the total number of species established are either in accordance with the applied species mix or local native species and represent >60% to 80% of the total projected foliage cover.	Establish a minimum of two monitoring points within final land use domain area (i.e., at least 1 per 20ha) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Ongoing survey and analysis reports at frequency advised by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs.
		Weeds are appropriately controlled, do not compete with established vegetation, and do not impact on rehabilitated area.	Revegetation monitoring confirms that, after 5 years from planting, the non-native / non-target species (weeds) represent less than 20% of projected foliage cover, or equivalent to analogue sites not disturbed by mining activities.	
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and relevant analogue sites.	
		Light intensity grazing is sustainable with evidence of a self-sustaining vegetation community.	Monitoring confirms: • evidence of new growth of endemic species. • evidence of successive generations of endemic species. • weed control requirements no greater than analogue sites.	
			Total projected foliage cover remains >70% or equivalent to analogue sites not disturbed by mining activities.	
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators.		Demonstrated compliance with all completion criteria.
	Establishment of a sustainable land capability for grazing land use within 5 years of rehabilitation.	Successful land relinquishment and turnover of responsibilities to the new land managers.	Consultation meeting with future land managers and other relevant stakeholders with the Mine in preparation for the land relinquishment and turnover of management and monitoring responsibilities. Documented evidence of future land managers' acceptance of responsibilities.	Documentation of consultation process with future land managers and other key stakeholders
Mining Domain: 4 – Overburden Emplacement Areas **Final Land Use Domain:** A - Native Ecosystem **Spatial Reference:** A4	All infrastructure and services not suitable for a lawful final land use will be removed.	Decommissioning and removal of all surface infrastructure not required for final land use.	All infrastructure (pipelines, dirty water drainage systems, sediment fencing etc) no longer required have been decommissioned and removed from the site.	Single occurrence relinquishment inspection & report prepared by a suitably qualified person, including photographs with follow up inspections to be undertaken if required.
		Removal of access and haul roads not required for the final land use.	Unless specified to be retained, internal roads and access tracks no longer required are for the final land use are decommissioned, ripped and profiled.	
		Roads required for final land use are reduced in width (if required).	Road reduced in width to that suitable for final land use.	
	Domain safe and free from hazardous materials and contaminants.	Visible assessment of presence / absence of contamination and, if required, measured contamination levels (concentration of key parameters)	Contaminated land assessment confirms land is free of contaminants or within acceptable for limits for final land use.	Single occurrence contamination assessment report prepared by a suitably qualified person with follow up validation testing to be undertaken if required.
		Visible presence/absence of hazardous materials.	All hazardous materials removed from site and transported to an acceptable waste management facility.	Single occurrence hazardous materials audit undertaken with follow up inspections to be undertaken if required.
	The final landform integrates with and complements the surrounding topography.	Final landform is geotechnically stable.	PAF encapsulation area is stable with a permanent capping shaped and contoured according to design specifications.	Geotechnical assessment confirm encapsulation area is structurally stable, will not leak and no further earthworks / profiling will be required. indicating no evidence of instability of emplacements.

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
		Final landform does not represent as an erosion hazard.	No observable 'active' erosion and sedimentation.	Ongoing photographic monitoring at fixed points of the rehabilitated area Validation through constructed survey plans.
		Final landform is suitable for growth media establishment.	Maximum outer slope profile does not exceed 18º (~33%).	
	Established final landform is free draining with erosion hazard consistent with the surrounding landforms and drainage features.	Suitable water management structures installed.	Water management structures to include suitable drop-down structures.	Visual inspection and photographs included in AEMR/ARRFP reports.
		Results of surface water and groundwater monitoring.	Water quality meets the objective of Section 120 of the *Protection of the Environment Operations Act 1997*. Water quality criteria identified by EPL 20020 or Water Management Plan.	Groundwater quality monitored quarterly during operations and for 5 years following completion of final landform works. Surface water sampling and analyses of runoff quarterly (when runoff present at discharge points) during operations and for 5 years following completion of final landform works.
		Free draining landform.	Mapping confirms that the landform is free draining. No pooling of water on upper surface of the emplacement is observed.	As constructed survey plans. Visual Inspection and Photographs reported in ARRFP.
	Establish soil / growing medium suitable for establishment of grassland or woodland vegetation community.	Presence of surface compaction.	Gypsum applied at a rate of 5 to10t/ha to final landform surface and then ripped to a depth of 300mm.	Single occurrence report including pre-treatment analysis results and records of ameliorant applied.
		Appropriate depth of growth medium.	Area capped with secondary growth medium (low to moderate saline clay) to a depth of 150mm, followed by primary growth medium (topsoil) to a depth of 150mm.	Single occurrence testing using small 'test pits' (5 per ha) and report, including photographs, following final placement/shaping of growth medium.
		Soil appropriately prepared prior to seeding.	Growth medium is pre-treated with gypsum (2t/ha topsoil stockpiles and 5t/ha for stockpiled clay and waste rock to be utilised as growth medium) prior to seed and fertiliser application (per Section 7 of Landloch Report Aug 2021, Rev1).	Single occurrence report including pre-treatment analysis results and records of ameliorant applied.
		Appropriate soil chemistry for vegetation establishment and sustainability.	Analysis of soil samples record parameters as follows. • pH – 5.5 to 8.5. • Electrical conductivity (EC) – less than 0.6 dS/m. • Cation Exchange Capacity (CEC) – 5 to 30 meq/100g. • Exchangeable Sodium Percentage (ESP) - 0.6 to 5.0% • Dispersion index – below 6 or within 20% of analogue sites after 5 years.	Soil samples taken (1 bulk sample per ha), analysed, and reported in ARRFP and relinquishment report. Samples taken annually for 5 years.
	Establishment of vegetation communities with a similar species composition to the surrounding native vegetation communities complementing regional and local biodiversity.	Establishment of target species as outlined in Rehabilitation Management Plan.	Revegetation monitoring confirms that, within 2 years following planting, >70% of the total number of species established are either in accordance with the applied species mix or local native species and represent >50% to 70% of the total projected foliage cover.	Establish a minimum of two monitoring points within final land use domain area (i.e., at least 1 per 20ha) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Annual survey and analysis reports (or as otherwise advised) by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs. Annual revegetation monitoring for a minimum of 5 years.
		The rehabilitated area does not constitute an erosion hazard.	Total projected foliage cover exceeds 70% or bare ground and litter coverage is equivalent to analogue sites.	
		Weeds are not competing or impacting on the rehabilitated area.	Revegetation monitoring confirms that, after 2 years, the non-native / non-target species (weeds) represent <30% of projected foliage cover or equivalent to analogue sites not disturbed by mining activities.	

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and the trends at relevant analogue sites.	
	Maintenance of self-sustaining vegetation communities with a similar species composition to the surrounding native vegetation communities complementing regional and local biodiversity	Key soil characteristics remain within acceptable range.	Analysis of soil samples record parameters after 5 years from growth medium establishment are as follows. • pH – 5.5 to 8.5. • EC – less than 0.6dS/m. • CEC – 5 to 30 meq/100g. • ESP – 0.6 to 5.0%. • Erodibility (K) Factor – less than 0.05. or within 20% of analogue sites.	Soil samples taken (1 bulk sample per ha) at least 5 years following establishment of growth medium, analysed and reported within relinquishment report. Single occurrence unless parameters non-compliant with criteria.
		Native species diversity and coverage consistent with local benchmark / analogue sites.	Revegetation monitoring reports confirm that, after 5 years from planting >80% of the total number of species established are either in accordance with the applied species mix or local native species and represent >60% to 80% of the total projected foliage cover.	Establish at least 1 monitoring point per 20ha within final land use domain area (i.e.) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Ongoing survey and analysis reports at frequency advised by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs
		Weeds are appropriately controlled, do not compete with established vegetation, and do not impact on rehabilitated area. .	Revegetation monitoring confirms that, after 5 years from planting, the non-native / non-target species (weeds) represent less than 20% of projected foliage cover, or equivalent to analogue sites not disturbed by mining activities.	
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and relevant analogue sites.	
		Grazing pressure from domestic and/or native animals does not adversely affect vegetation development.	Monitoring confirms: • evidence of new growth of endemic species. • evidence of successive generations of endemic species. • weed control requirements no greater than analogue sites.	
			Total projected foliage cover remains >70% or equivalent to analogue sites not disturbed by mining activities.	
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators.	Demonstrated compliance with all completion criteria.	Relinquishment report prepared by suitably qualified or experienced person(s).
	Establishment of a sustainable land capability for grazing land use within 5 years of rehabilitation.	Successful land relinquishment and turnover of responsibilities to the new land managers.	Consultation meeting with future land managers and other relevant stakeholders with the Mine in preparation for the land relinquishment and turnover of management and monitoring responsibilities. Documented evidence of future land managers' acceptance of responsibilities.	Documentation of consultation process with future land managers and other key stakeholders
Mining Domain: 8 – Other (Stockpiled Material Areas) **Final Land Use Domain**:	Stockpiled materials removed and domain is safe, free from any hazardous materials and contaminants, and does not pose any hazard to the community.	All stockpiled material not suitable as resource material for final land rehabilitation are removed and appropriately encapsulated.	Stockpiled materials are identified, characterised, and material not suitable has been removed and encapsulated either within overburden emplacements, TSF, or open cut voids.	Materials analysed and results for growth media suitability included in the Materials Characterisation Report (Landloch, Aug 2021 Rev1). Survey reports, including photographs prepared by suitably qualified or experienced person.
		Base of stockpile areas of unsuitable material are remediated in order to support the final land use.	Any unsuitable material from the base of stockpiles has been removed and encapsulated either within overburden emplacements, TSF or open cut voids.	

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
B – Agricultural – Grazing **Spatial Reference:** B8	Removal of road network to, and within stockpile material areas not required for the final land use.	Unless specified to be retained, internal roads and access tracks no longer required for final land use are decommissioned, ripped and profiled.	Road network within the Mine reduced in width suitable for final land use.	Relinquishment inspection & report, including photographs.
	Contaminated land and stockpile material are remediated prior to the establishment of final landform.	Visible assessment of presence / absence of contamination and/or measured contamination levels (concentration of key parameters)	Contaminated land assessment confirms land is free from contamination or within acceptable limits for final land use.	Single occurrence contamination assessment report prepared by a suitably qualified person with follow up validation testing to be undertaken if required.
		Presence/absence of hazardous materials.	All hazardous materials removed from site and transported to an acceptable waste management facility.	Single occurrence hazardous materials audit undertaken with follow up inspections to be undertaken if required.
	Established final landform is non-polluting, free draining, geotechnically stable and permanent.	Visual indicators of erosion and land instability.	No 'active' erosion or sedimentation visible.	Visual inspection and photographs. Sampling and analyses of runoff – with continued compliance with criteria 5 years following completion of final landform works. Water quality and visible monitoring reported through ARRFPs.
	The final landform integrates with and complements the surrounding topography.	Free draining landform.	No observable pooling of water on the final landform.	
	Established final landform is free draining with erosion hazard consistent with the surrounding landforms and drainage features.	Results of surface water and groundwater monitoring.	Water quality meets the objective of Section 120 of the Protection of the Environment Operations Act 1997. Water quality criteria identified by EPL 20020, and Water Management Plan.	
	Establish soil / growing medium suitable for establishment of grassland vegetation community	Presence of surface compaction.	Compacted areas are deep ripped cross slope.	Single occurrence inspection and records including photographs.
		Appropriate depth of growth medium.	Where required, growth medium applied to a minimum depth of 150mm, unless rehabilitation trials indicate that an alternative thickness is acceptable	Single occurrence testing using small 'test pits' (5 per ha) and report, including photographs, following final placement/shaping of growth medium.
		Soil appropriately prepared prior to seeding.	Growth medium is pre-treated with gypsum (2t/ha topsoil stockpiles and 5t/ha for stockpiled clay and waste rock to be utilised as growth medium) prior to seed and fertiliser application (per Section 7 of Landloch Report Aug 2021, Rev1).	Single occurrence report including pre-treatment analysis results and records of ameliorant applied.
		Appropriate soil chemistry for vegetation establishment and sustainability.	Analysis of soil samples record parameters as follows. • pH – 5.5 to 8.5. • Electrical conductivity (EC) – less than 0.6 dS/m. • Cation Exchange Capacity (CEC) – 5 to 30 meq/100g. • Exchangeable Sodium Percentage (ESP) - 0.6 to 5.0% • Dispersion index – below 6 or within 20% of analogue sites after 5 years.	Soil samples taken (1 bulk sample per ha), analysed, and reported in ARRFP and relinquishment report. Samples taken annually for 5 years.
	Establishment of vegetation communities with a similar species composition to the surrounding native vegetation communities complementing regional and local biodiversity.	Establishment of target species as outlined in Rehabilitation Management Plan.	Revegetation monitoring confirms that, within 2 years following planting, >70% of the total number of species established are either in accordance with the applied species mix or local native species and represent >50% to 70% of the total projected foliage cover.	Establish a minimum of two monitoring points within final land use domain area (i.e., at least 1 per 20ha) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Annual survey and analysis reports (or as otherwise advised) by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs. Annual revegetation monitoring for a minimum of 5 years.
		The rehabilitated area does not constitute an erosion hazard.	Total projected foliage cover exceeds 70% or bare ground and litter coverage is equivalent to analogue sites.	
		Weeds are not competing or impacting on the rehabilitated area.	Revegetation monitoring confirms that, after 2 years, the non-native / non-target species (weeds) represent <30% of projected foliage cover or equivalent to analogue sites not disturbed by mining activities.	

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and the trends at relevant analogue sites.	
	Maintenance of self-sustaining vegetation communities capable of light intensity grazing.	Key soil characteristics remain within acceptable range.	Analysis of soil samples record parameters after 5 years from growth medium establishment are as follows. • pH – 5.5 to 8.5. • EC – less than 0.6dS/m. • CEC – 5 to 30 meq/100g. • ESP – 0.6 to 5.0%. • Erodibility (K) Factor – less than 0.05. or within 20% of analogue sites.	Soil samples taken (1 bulk sample per ha) at least 5 years following establishment of growth medium, analysed, and reported within relinquishment report. Single occurrence unless parameters non-compliant with criteria.
		Native species diversity and coverage consistent with local benchmark / analogue sites.	Revegetation monitoring reports confirm that, after 5 years from planting >80% of the total number of species established are either in accordance with the applied species mix or local native species and represent >60% to 80% of the total projected foliage cover.	Establish a minimum of two monitoring points within final land use domain area (i.e., at least 1 per 20ha) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Annual survey and analysis reports (or as otherwise advised) by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs. Annual revegetation monitoring for a minimum of 5 years.
			Revegetation monitoring confirms that, after 5 years from planting, the non-native / non-target species (weeds) represent less than 20% of projected foliage cover, or equivalent to analogue sites not disturbed by mining activities.	
		Weeds are appropriately controlled, do not compete with established vegetation, and do not impact on rehabilitated area.	No priority weeds are present or are controlled in accordance with relevant legislative requirements and relevant analogue sites.	
		Light intensity grazing is sustainable with evidence of a self-sustaining vegetation community.	Monitoring confirms: • evidence of new growth of endemic species. • evidence of successive generations of endemic species. • weed control requirements no greater than analogue sites.	
			Total projected foliage cover remains >70% or equivalent to analogue sites not disturbed by mining activities	
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators.	Demonstrated compliance with all completion criteria.	Relinquishment report prepared by suitably qualified or experienced person(s).
	Establishment of a sustainable land capability for grazing land use within 5 years of rehabilitation.	Successful land relinquishment and turnover of responsibilities to the new land managers.	Consultation meeting with future land managers and other relevant stakeholders with the Mine in preparation for the land relinquishment and turnover of management and monitoring responsibilities. Documented evidence of future land managers' acceptance of responsibilities.	Documentation of consultation process with future land managers and other key stakeholders
Mining Domain: 3 – Water Management Area **Final Land Use Domain:** F – Water Management Areas	Established final landform is non-polluting, free draining, geotechnically stable and permanent.	Free draining landform.	No visible evidence of water pooling within the diversion drains.	As constructed survey plans, photograph records. Sampling and analyses of runoff – with continued compliance with criteria 5 years following completion of final landform works. Water quality and visible monitoring reported through ARRFPs.
	The final landform integrates with and complements the surrounding topography.			
	Established final landform is free draining with erosion hazard consistent with the surrounding landforms and drainage features.			

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
Spatial Reference: F3	Remaining structures suitable for providing long-term water management (diversion drains).	Presence of erosion / sedimentation and water quality.	Water quality meets the objective of Section 120 of the *Protection of the Environment Operations Act 1997*. 'Downstream' water quality monitoring records total suspended solids <50mg/L or within 10% of 'upstream' levels (whichever is the greater).	
			No 'active' erosion or sedimentation visible.	
			Diversion drains contain a suitably stable outlet to disperse water to surrounding landform.	
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators.	Demonstrated compliance with all completion criteria.	Relinquishment report prepared by suitably qualified or experienced person(s).
	Establishment of a sustainable land capability for grazing land use within 5 years of rehabilitation.	Successful land relinquishment and turnover of responsibilities to the new land managers.	Consultation meeting with future land managers and other relevant stakeholders with the Mine in preparation for the land relinquishment and turnover of management and monitoring responsibilities. Documented evidence of future land managers' acceptance of responsibilities.	Documentation of consultation process with future land managers and other key stakeholders
Mining Domain: 3 – Water Management Area **Final Land Use Domain**: G – Water Storage (Excluding Final Void) **Spatial Reference:** G3	Established final landform is non-polluting, free draining, geotechnically stable and permanent. The final landform integrates with and complements the surrounding topography.	Sediment basins are stable and contain a suitably stable spillway for overflow of water to surrounding drainage lines.	Basin walls and spillways do not show signs of active erosion and are assessed to be stable.	Visual inspection and photographs reported in relinquishment report.
		Results of surface water monitoring.	Water quality meets the objective of Section 120 of the *Protection of the Environment Operations Act 1997*.	Sampling and analyses of runoff – with continued compliance with criteria 5 years following completion of final landform works. Water quality and visible monitoring reported through ARRFPs.
			'Downstream' water quality monitoring records total suspended solids <50mg/L or within 10% of 'upstream' levels (whichever is the greater).	
			Water management areas are free of contamination and meet the requirements for stock drinking water.	
	Structures redesigned (if required) to enhance habitat functionality.	The retained basin form is complementary to surrounding fauna habitat.	Sediment basins reshaped (if required) in accordance with advice from ecologist or other suitably qualified person in order to facilitate faunal access.	Visual inspection and photographs reported by ecologist / suitably qualified person in relinquishment report.
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators.	Demonstrated compliance with all completion criteria.	Relinquishment report prepared by suitably qualified or experienced person(s).
	Establishment of a sustainable land capability for grazing land use within 5 years of rehabilitation.	Successful land relinquishment and turnover of responsibilities to the new land managers.	Consultation meeting with future land managers and other relevant stakeholders with the Mine in preparation for the land relinquishment and turnover of management and monitoring responsibilities. Documented evidence of future land managers' acceptance of responsibilities.	Documentation of consultation process with future land managers and other key stakeholders
Mining Domain: 8 – Other (Heritage Area) **Final Land Use Domain:** H – Heritage Areas	Proper care, preservation and protection of any Aboriginal object or Aboriginal place, and other European heritage sites and artefacts within the approved disturbance footprint.	No unauthorised disturbance or excavation of Aboriginal and Cultural heritage sites and artefacts throughout the rehabilitation activities.	No observed unauthorised access or degradation of artefacts or sites. All site employees and contract workers are made aware of their obligations under the NSW (NPW Act).	Routine visual monitoring of Heritage sites in accordance with the Cultural Heritage Management Plan. .
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators.	Demonstrated compliance with all completion criteria.	Relinquishment report prepared by suitably qualified or experienced person(s).

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
Spatial Reference: H8	Establishment of a sustainable land capability for grazing land use within 5 years of rehabilitation.	Successful land relinquishment and turnover of responsibilities to the new land managers.	Consultation meeting with future land managers and other relevant stakeholders with the Mine in preparation for the land relinquishment and turnover of management and monitoring responsibilities. Documented evidence of future land managers' acceptance of responsibilities.	Documentation of consultation process with future land managers and other key stakeholders
Mining Domain: 5 – Active Mining Area (Open Cut Void) **Final Land Use Domain**: J – Final Void **Spatial Reference:** J5	Decommission and remove all surface infrastructure and associated services, unless required for a lawful post mining land use).	No infrastructure, equipment or associated services remain.	Services and infrastructure (pipelines, pumps etc) no longer required have been isolated, disconnected, terminated, and removed from the site.	Single occurrence relinquishment inspection & report prepared by a suitably qualified person, including photographs with follow up inspections to be undertaken if required.
			All remaining mobile equipment removed.	
	Ensure the final open cut void is safe and secure.	Barrier to access constructed or installed around the entirety of the pit.	Earth bund at least 2m high or suitable fence in place around the pit.	
	Established final landform is safe, geotechnically stable and non-polluting.	Previous select backfill of the Boundary and Manuka Pits and backfill within future pits to be stabilised and shaped.	Overall high wall slope no greater than 700 or as specified in geotechnical review.	Plan(s) prepared by surveyor and photographs included in ARRFPs or relinquishment report.
		Areas not backfilled and to be retained without further rehabilitation remain stable.	Geotechnical assessment based on site specific review and, determines that the retained slopes are not likely to actively erode or 'slip' to an extent requiring further earthworks and profiling.	Geotechnical review / report.
	Establish soil / growing medium suitable for establishment of grassland or woodland vegetation community on areas that can be suitably shaped and accessed.	Presence of surface compaction.	Gypsum applied at a rate of 5 to10t/ha to final landform surface and then ripped to a depth of 300mm.	Single occurrence report including pre-treatment analysis results and records of ameliorant applied.
		Appropriate depth of growth medium.	Area capped with secondary growth medium (low to moderate saline clay) to a depth of 150mm, followed by primary growth medium (topsoil) to a depth of 150mm.	Single occurrence testing using small 'test pits' (5 per ha) and report, including photographs, following final placement/shaping of growth medium.
		Soil appropriately prepared prior to seeding.	Growth medium is pre-treated with gypsum (2t/ha topsoil stockpiles and 5t/ha for stockpiled clay and waste rock to be utilised as growth medium) prior to seed and fertiliser application (per Section 7 of Landloch Report Aug 2021, Rev1).	Single occurrence report including pre-treatment analysis results and records of ameliorant applied.
		Appropriate soil chemistry for vegetation establishment and sustainability.	Analysis of soil samples record parameters as follows. • pH – 5.5 to 8.5. • Electrical conductivity (EC) – less than 0.6 dS/m. • Cation Exchange Capacity (CEC) – 5 to 30 meq/100g. • Exchangeable Sodium Percentage (ESP) - 0.6 to 5.0% • Dispersion index – below 6 or within 20% of analogue sites after 5 years	Soil samples taken (1 bulk sample per ha), analysed, and reported in ARRFP and relinquishment report. Samples taken annually for 5 years.
	Establishment of vegetation communities with a similar species composition to the surrounding native vegetation communities complementing regional and local biodiversity.	Establishment of target species as outlined in Rehabilitation Management Plan.	Revegetation monitoring confirms that, within 2 years following planting, >70% of the total number of species established are either in accordance with the applied species mix or local native species and represent >50% to 70% of the total projected foliage cover.	Establish a minimum of two monitoring points within final land use domain area (i.e. at least 1 per 20ha) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains).

Reference	Proposed Rehabilitation Objective	Indicator	Proposed Completion Criteria	Validation Method
		The rehabilitated area does not constitute an erosion hazard.	Total projected foliage cover exceeds 70% or bare ground and litter coverage is equivalent to analogue sites.	Annual survey and analysis reports (or as otherwise advised) by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs. Annual revegetation monitoring for a minimum of 5 years.
		Weeds are not competing or impacting on the rehabilitated area.	Revegetation monitoring confirms that, after 2 years, the non-native / non-target species (weeds) represent <30% of projected foliage cover or equivalent to analogue sites not disturbed by mining activities.	
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and the trends at relevant analogue sites.	
	Maintenance of self-sustaining vegetation communities with a similar species composition to the surrounding native vegetation communities complementing regional and local biodiversity.	Key soil characteristics remain within acceptable range.	Analysis of soil samples record parameters after 5 years from growth medium establishment are as follows. • pH – 5.5 to 8.5. • EC – less than 0.6dS/m. • CEC – 5 to 30 meq/100g • ESP – 0.6 to 5.0%. • Erodibility (K) Factor – less than 0.05. or within 20% of analogue sites.	Establish at least 1 monitoring point per 20ha within final land use domain area (i.e.) and at least three in the desired local benchmark community / analogue sites (applicable to all rehabilitation domains). Ongoing survey and analysis reports at frequency advised by a suitably qualified or experienced person. The reports include a summary of performance of the treatment area(s) against local benchmark / analogue monitoring points and photographs.
		Native species diversity and coverage consistent with local benchmark / analogue sites.	Revegetation monitoring reports confirm that, after 5 years from planting >80% of the total number of species established are either in accordance with the applied species mix or local native species and represent >60% to 80% of the total projected foliage cover.	
		Weeds are appropriately controlled, do not compete with established vegetation, and do not impact on rehabilitated area. .	Revegetation monitoring confirms that, after 5 years from planting, the non-native / non-target species (weeds) represent less than 20% of projected foliage cover, or equivalent to analogue sites not disturbed by mining activities.	
			No priority weeds are present or are controlled in accordance with relevant legislative requirements and relevant analogue sites.	
		Grazing pressure from domestic and/or native animals does not adversely affect vegetation development.	Monitoring confirms: • evidence of new growth of endemic species. • evidence of successive generations of endemic species. • weed control requirements no greater than analogue sites.	
			Total projected foliage cover remains >70% or equivalent to analogue sites not disturbed by mining activities.	
	Relinquishment of the mining tenements and the return of the security lodged over the Mining Lease within a reasonable timeframe after the end of the mine life.	Demonstrated compliance with all performance indicators.	Demonstrated compliance with all completion criteria.	Relinquishment report prepared by suitably qualified or experienced person(s).
	Establishment of a sustainable land capability for grazing land use within 5 years of rehabilitation.	Successful land relinquishment and turnover of responsibilities to the new land managers.	Consultation meeting with future land managers and other relevant stakeholders with the Mine in preparation for the land relinquishment and turnover of management and monitoring responsibilities. Documented evidence of future land managers' acceptance of responsibilities.	Documentation of consultation process with future land managers and other key stakeholders

4.2 Rehabilitation Objectives and Rehabilitation Completion Criteria – Stakeholder Consultation

Stakeholders consulted to develop rehabilitation objectives and completion criteria included the consent authority, landholders and regulatory agencies associated with regulatory requirements for rehabilitation listed in **Section 2.1** A summary of the Stakeholder consultation conducted for the rehabilitation objectives and completion criteria is provided in **Table 4.2** below.

Table 4.2 Final Land Use Options Assessment Consultation Process

Stakeholder	Consultation Activities and Method	Matter Subject to Consultation	Outcomes of Consultation (Rehabilitation and Land Use)
Resources Regulator	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	The Resources Regulator responded on 4 July 2022 Response: The Resources Regulator will review, assess and determine the rehabilitation objectives statement and rehabilitation completion criteria once submitted for approval.
Mining, Exploration and Geosciences	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	No response received as of 28 July 2022.
Cobar Shire Council	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	No response received as of 28 July 2022.
DPE Crown lands	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	The Department of Planning and Environment responded on 12 July 2022 Response: • The department requests details on the sourcing of clay material and the composition to determine the suitability of this process. • The department requests that due to the sporadic nature of significant rainfall in these areas, it is appropriate that areas should be inspected following a significant rainfall event to ensure the validity of no pooling water. • The department requests that a wildlife-proof fence and earth bund be put in place to prevent stock and other animals access to voids in drought years.
Environmental Protection Authority	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	No response received as of 28 July 2022.

Stakeholder	Consultation Activities and Method	Matter Subject to Consultation	Outcomes of Consultation (Rehabilitation and Land Use)
Department of Planning and Environment (Heritage NSW)	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	Heritage NSW responded on 18 July 2022 Response: No comments have been made in regard to Aboriginal cultural heritage regulation matters under the National Parks and Wildlife Act 1977
Department of Planning and Environment (Biodiversity Conservation and Science)	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	BCS responded on 22 July 2022 Response/ Recommendations: • Clear and quantitative performance measures and completion targets and trigger points for corrective action are required • BCS be consulted where local reference sites to establish completion criteria are proposed • Trigger points in the TARP must be quantitative and relate to performance or completion criteria • A detailed monitoring plan to track performance towards completion criteria must be in place • The number of monitoring plots be consistent with that suggested by BAM
DPE – Water	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	No response received as of 28 July 2022.
Cobar Local Aboriginal Land Council	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	No response received as of 28 July 2022.

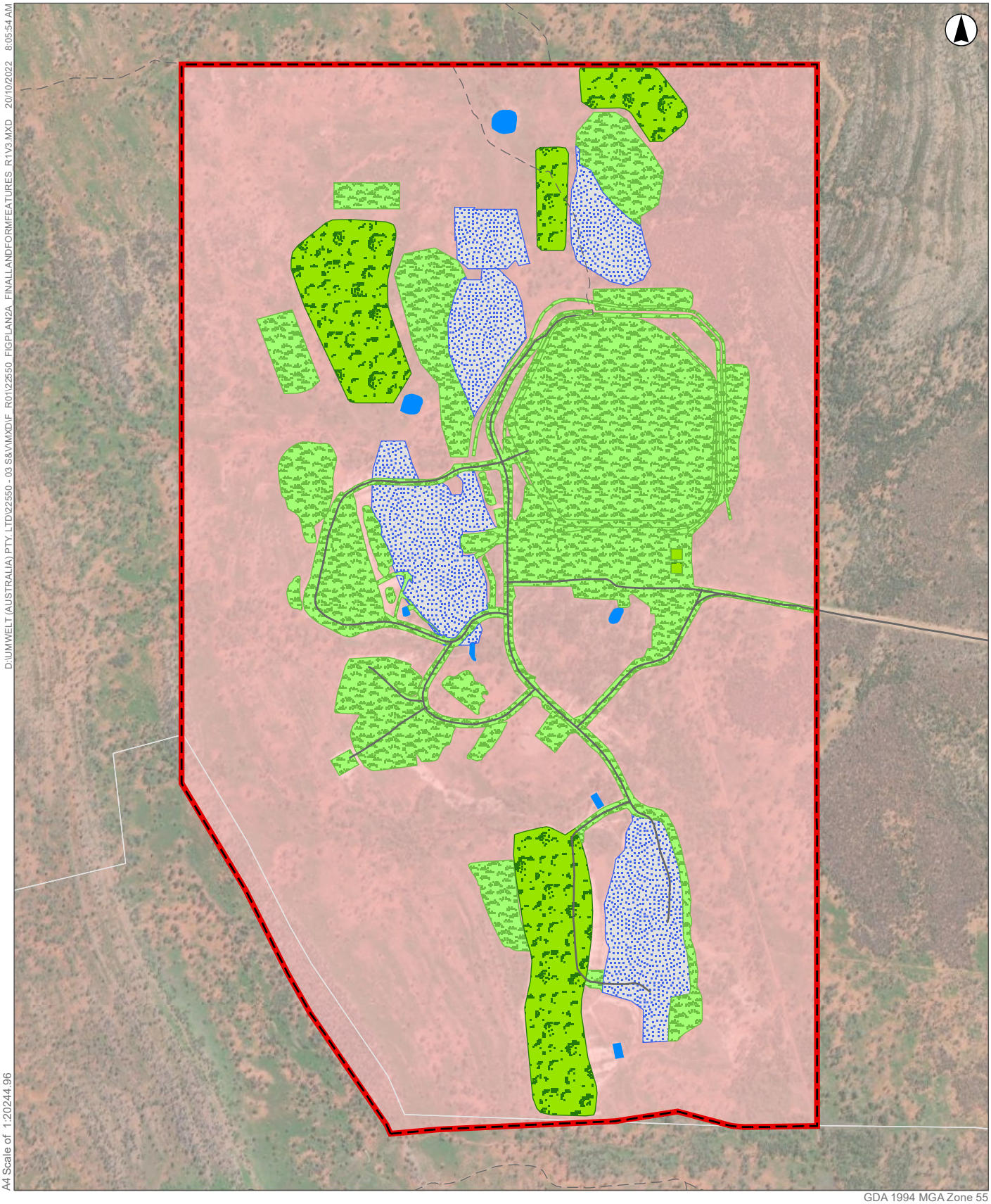
Stakeholder	Consultation Activities and Method	Matter Subject to Consultation	Outcomes of Consultation (Rehabilitation and Land Use)
Community – Mr Andrew Moseley (who holds an option to buy back the 'Manuka' property)	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	No response received as of 28 July 2022.
Community – Christine and Gary McDougall	Letter (Email transmission)	Subject to Consultation: Rehabilitation Objectives and Rehabilitation Completion Criteria, and Final Land Use Domain Plans.	No response received as of 28 July 2022.

5.0 Final Landform and Rehabilitation Plan

The final landform and rehabilitation plan are defined under Clause 12 of the Regulation as Rehabilitation Outcome Documents required to be submitted to the Secretary for approval. The final landform and rehabilitation plan is provided in this RMP to satisfy the requirement Clause 12(1)(c) of the Regulation.

5.1 Final Landform and Rehabilitation Plan – Electronic Copy

In accordance with the requirements of the RMP guidelines, a Final Land Use and Rehabilitation Plan (**Plan 2a** and **Plan 2b**) has been prepared to show the proposed final land use and final landform at the end of mine life for the site.



Legend

- Local Road
- Track-Vehicular
- Cadastre
- Project Approval Boundary
- Minerals - Current Titles

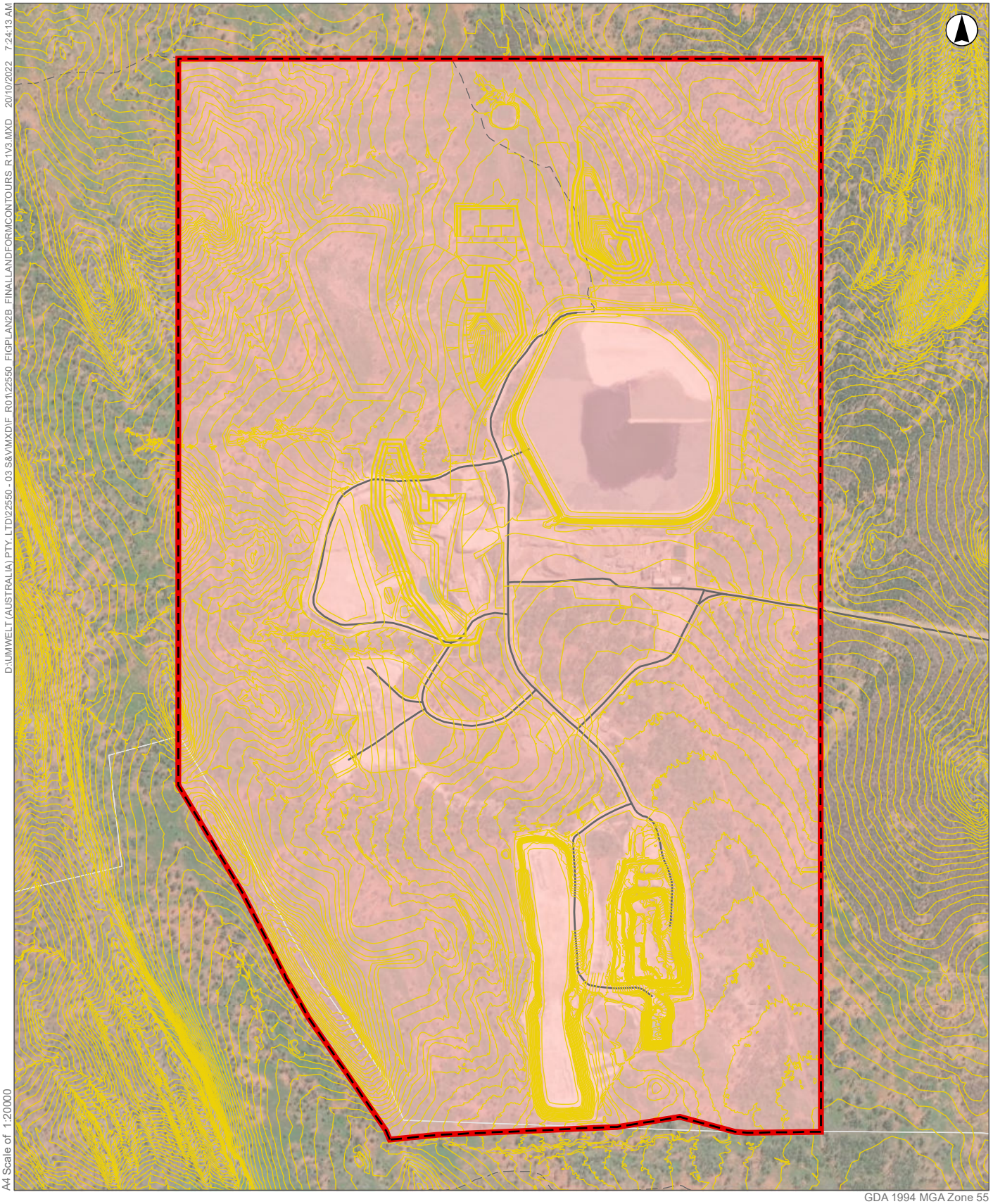
Final Landuse

- Agricultural – Grazing
- Final Void
- Native Ecosystem
- Water Storage (Excluding Final Void)

PLAN 2A

Final Landform and Rehabilitation Plan - Final Land Use Features

Data source: New South Wales State Government (SEED), Manuka Resources, Umwelt



Legend

- Local Road
- Track-Vehicular
- Final Landform Contours
- Cadastre
- Project Approval Boundary
- Minerals - Current Titles

PLAN 2B

Final landform and Rehabilitation Plan – Final Landform Contours

Data source: New South Wales State Government (SEED), Manuka Resources, Umwelt

6.0 Rehabilitation Implementation

6.1 Life of Mine Rehabilitation Schedule

This section describes the rehabilitation schedule over the life of the mine (LOM), from the commencement of the RMP until lease relinquishment. The summary (**Table 6 A**) includes the:

a. estimated timing of the construction and decommissioning of key infrastructure (e.g., tailings storage facilities); and

b. assumptions and principles that are relied on for the development of the LOM rehabilitation schedule (e.g., production milestones or anticipated volumes of overburden to be handled) to ensure that rehabilitation is undertaken progressively as soon as reasonably practical.

It should be noted that all future plans are subject to a review of the results of the past and proposed future exploration drilling results.

The LOM rehabilitation schedule includes a series of plans illustrating the proposed mine layout and sequence of progressive rehabilitation across the Mine at a minimum of five-yearly intervals until completion of mining and achievement of the final land use.

Figure 6.1 provides the conceptual rehabilitation and final landform status as of 2025, approximately 7 to 10 years from anticipated completion of rehabilitation and relinquishment. **Figure 6.2** provides the conceptual rehabilitation and final landform status as of 2030, approximately 3 to 5 years from anticipated completion of rehabilitation and relinquishment

6.2 Phases of Rehabilitation and General Methodologies

The rehabilitation hierarchy used in this RMP follows the new requirements outlined in the *Form & Way Guideline For Large Mines* (NSW Resources Regulator, 2021).

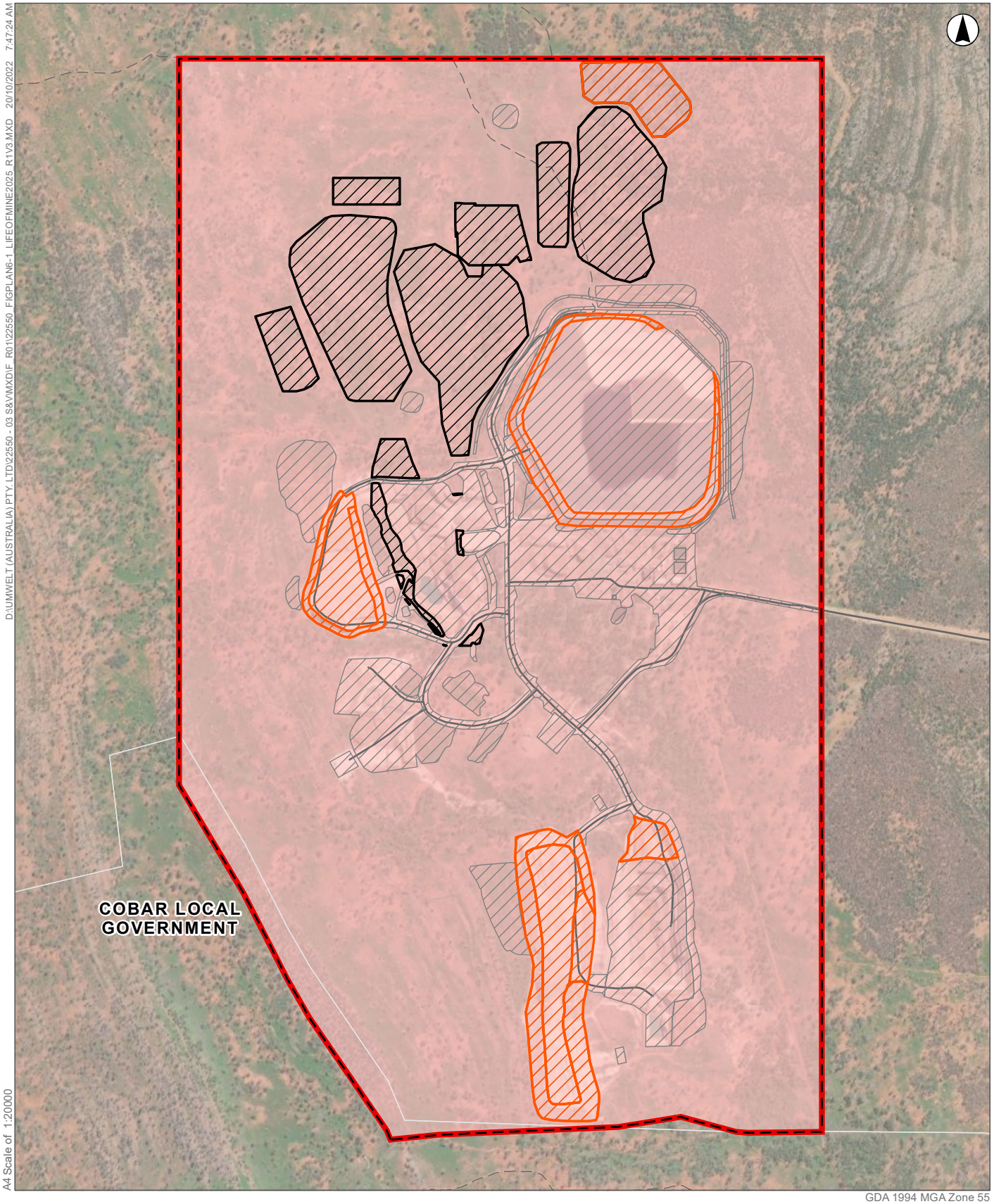
6.2.1 Active Mining

The following section summarises how key aspects in the active mining phase are managed at the Mine Site.

a. Soils and Materials

No land disturbance has occurred on the Mine since 2016. The current stockpiles within the disturbance footprint pre-date Manuka Resources' operations.

There is no evidence of cover crops being used by past owners to protect the soil quality and seed viability of the stockpiles. The current principal risk to rehabilitation is associated with the potential for degradation of soil quality and structure retained in stockpiles, and then if these stockpiles are re-excavated and immediately respread without pre-treatment or nutrient correction conducive for seed growth and development.



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A4 Scale of 1:20000

GDA 1994 MGA Zone 55

0 200 400

Metres

Legend

- Local Road
- Track-Vehicular
- Local Government Area
- Cadastre
- Project Approval Boundary
- Existing Disturbance
- Minerals - Current Titles

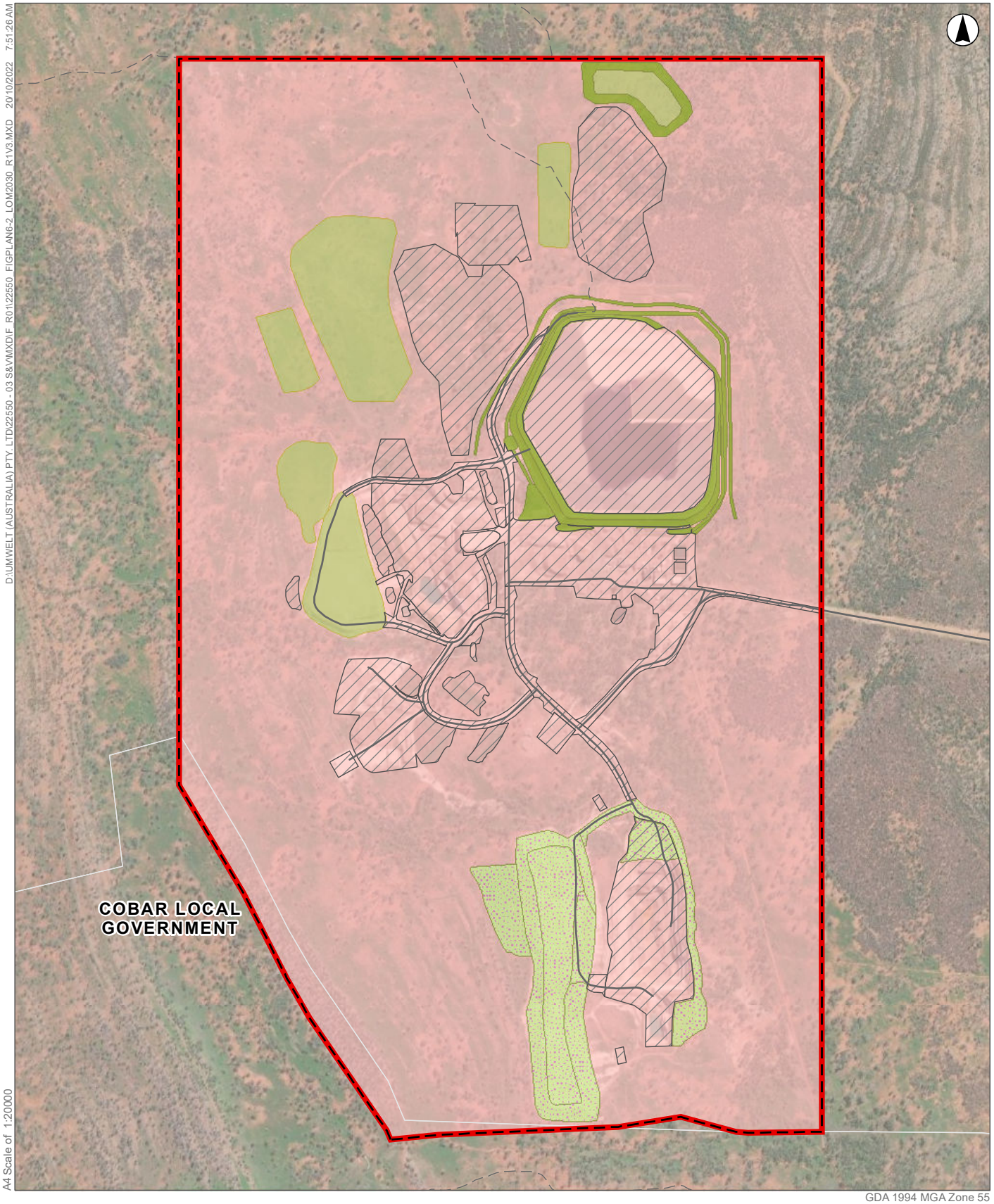
Forecast Data

- Forecast Disturbance
- Forecast Land Prepared for Rehabilitation

FIGURE 6.1

MANUKA MINE
Life of Mine Rehabilitation Schedule (Year 2025)

Data source: New South Wales State Government, SEED



Legend

- Local Road
- Track-Vehicular
- Local Government Area
- Cadastre
- Project Approval Boundary
- Disturbance Year 2030
- Minerals - Current Titles

Rehabilitation

- Ecosystem and Land Use Establishment
- Ecosystem and Land Use Development
- Rehabilitation Completion

FIGURE 6.2

MANUKA MINE
Indicative Life of Mine Rehabilitation Schedule (Year 2030)

Data source: New South Wales State Government, SEED

The general process for the management of topsoils to preserve their quality for future rehabilitation outcomes is as follows.

- Any salvaging or stockpiling of topsoil during the active mining activities will be undertaken in accordance with the steps below, adapted from the Blue Book (Landcom, 2004). This will enable soil quality and seed viability to be retained for future use in rehabilitation.
- The two recommended methods for soil stripping include:
    - Grading, pushing and stacking material into windrows using a grader, bulldozer or excavator for later loading into trucks; or
    - Direct stripping by a scraper.
- Prior to commencing surface disturbance activities, the following measures need to be in place:
    - Up-slope water diversion structures constructed in accordance with the Mine's current ESCP;
    - Areas to be disturbed clearly identified on both mine plans and on the ground, along with the depth of soil to be stripped and destination of the soil; and
    - An underlying layer of material prepared (i.e., ripped or scoured, weed control pre-treatment) prior to placing the stripped soil.
- Soil stripping, stockpiling, relocating, and respreading will be undertaken in campaigns and will aim to avoid periods when the soils are likely to be very dry (which will increase the potential for wind erosion) or very wet. If it is unavoidable to complete the works when the soils are very dry, they will be watered.
- Groundcover will be stripped along with the soil to assist in the maintenance of structure of the soil and to accelerate the establishment of groundcover over the stockpiled or respread soils.
- Topsoil stripping shall be to a depth of at least 150 mm and 250 mm, or the maximum in situ thickness, whichever is less.
- Where practicable, stripped soil must immediately be transferred to areas undergoing progressive rehabilitation and immediately respread to encourage germination of contained propagules/seeds and maximise the natural establishment of groundcover which will assist in minimising bare soil from exposure to elements (rainfall, wind erosion, etc).
- When relocating stripped soil for stockpiling,
    - Larger stockpiles are preferred to be isolated from up-slope runoff by constructed diversion embankments.
    - Soil stockpiles are to be aligned in parallel with the land contours.
    - Sediment fencing is to be positioned down-slope of stockpiles until adequate stabilisation is achieved.

- Maximum stockpile height shall not exceed 2 m for topsoil stockpiles and shall not exceed 3 m for subsoil stockpiles.
- To avoid soil compaction, operation of machinery on soil stockpiles shall be minimised.
- The surfaces of stockpiles are to be left with an even but roughened surface to assist in erosion control and seed germination.
- A vegetative cover crop shall be established on all stockpiles retained for more than 3 months to stabilise the soil surface and encourage biological activity in the soil.

A soil materials characterisation report (Landloch Pty Ltd, 2021) was prepared by a soil specialist from Landloch Pty Ltd (Landloch) in August 2021, to identify, quantify, characterise, and assess the suitability for rehabilitation of topsoil, subsoil and other material resources available onsite. The Soil Characterisation identified 3 main stockpile types at the Mine:

- Topsoil Stockpiles; Clay Stockpiles;
- Waste Rock Dumps (WRD); and
- Stockpiles that include the Manuka WRD, Boundary WRD, Hard Rock Stockpile and Limestone Low Grade Stockpile.

Stockpile volumes were measured to quantify soil resource availability, basic morphological descriptions of these stockpile materials were recorded to identify their soil profiles, and a total of 93 samples were collected for chemical and particle size analyses to assess the stockpiles' suitability for rehabilitation as growth media.

The Soil Characterisation confirmed that all stockpiled materials exhibited physical and chemical constraints. They have limited soil stability and nutrition-deprived of nitrogen, phosphorus and organic carbon. The stockpiled materials are at moderate risk for soil dispersal and have decreased capability of supporting new plant growth and development. These constraints can be corrected by:

- prioritising the soil application according to their soil classification i.e., primary or secondary growth media
- an in-field screening and amendment strategy undertaken immediately to convert the soil materials into suitable growth media before soil application and spreading over the final landform;
- thoroughly mixing in the correct portions of fertiliser, ameliorants and organic matter prior to application/spreading over the final landform; and
- preferably selecting plant species with moderate to high salt tolerance.

Another constraint noted by the Soil Characterisation was that many Clay and Waste Rock samples contained elevated levels of Lead. It was recommended to further assess both Clay and Waste Rock stockpiles by a suitably qualified professional in contaminated land. The assessment should be conducted prior to the use and application of these stockpiles.

The volumes of the various stockpiles have reduced significantly between those reported in the Mining Operations Plan for the Manuka Mine (RWC, 2020), the Annual Rehabilitation Report (Manuka Resources Ltd, 2021), and the Materials Characterisation Report (Landloch, 2021).

- A soil survey of the various stockpiled materials is routinely carried out to update current volumes and corresponding locations of each stockpile. Soil volume inventory is reported annually in the ARRFP.

b. Flora

The December 2010 Ecological Assessment completed by OzArk (see Appendix 7 of EIS) assessed that no flora species of conservation significance would have been disturbed by the approved mining operations. While there has not been a flora and fauna assessment since, a biodiversity assessment was recently conducted in October 2021. The Mine is currently awaiting the final Report.

The results from the 2021 biodiversity assessment are expected to provide an insight on the ecological changes over the last decade, and whether current vegetation species found at the Mine today are still similar if not the same. Should the results indicate presence of emerging threatened species within the Mining Lease boundary, then any recommended protection and conservation strategies from the report will be followed. These recommendations will be supported by adherence to best practice translocations in "Guidelines for the Translocation of Threatened Plants in Australia" (Commander, et al., 2019).

Future vegetation clearing at the Mine will only be for the Belah and Bimble Pits and their respective waste dumps should these pits become operational. This will be completed following the clearing approach outlined as follows:

- All personnel involved in vegetation clearing works will be made aware of the boundaries of the area to be cleared through Pre-starts and Project Plan Layouts posted in the offices and crib rooms (including those belonging to contractors), opportunistic toolbox talks and through Safe Work Method Statements (SWMS);
- The area/s of vegetation to be cleared will be clearly delineated and individual trees will be marked or tagged where necessary.
- Clearing of large vegetation:
    - Large vegetation (i.e., over 300 mm in diameter) will be cleared using a bulldozer with its blade positioned just above the ground to minimise soil disturbance.
    - Larger tree trunks are to be separated from branches and smaller matter. The trunks are then cut into manageable lengths and set aside for placement over sections of the final landform designated for native vegetation establishment, and
    - Larger sections of trees not required for rehabilitation will either be sold as fire wood or set aside for the future use for habitat augmentation, and or farm related activities by the future lease holder.
    - Storage of cleared vegetation will be on the edge of the cleared area, ready for future replacement over the final landform prior to revegetation.

- Smaller vegetation will be retained and subsequently collected with topsoil during the soil removal operation.

c. Fauna

The following habitat management strategies will be practised during clearing and progressive rehabilitation activities:

- During clearing and progressive rehabilitation, clearing of larger trees will be undertaken in accordance with the following:
  - All trees are to be checked for the presence of nesting or roosting fauna before tree felling or pushing.
  - Tree felling is to proceed immediately after visual inspection.
  - If any hollowed tree requires removal, such tree will be gradually nudged at intermittent intervals so that any animal occupying a habitat tree has the chance of vacating the area after the initial disturbance period.
  - Progressive relocation of old hollow trees from cleared areas will occur into undisturbed areas to provide habitat, and
  - Clearing of substantive trees will be scheduled between April and September to reduce any risk of potential impact to tree dependent microbats.
- Implementation of animal controls onsite, at crib rooms, and at the accommodation camp:
  - The Mine will be maintained to ensure it is a clean, rubbish free environment. This will be particularly important around administration and contractor areas to discourage scavenging and reduce the potential for colonisation of these areas by non-endemic fauna, such as introduced rodents and foxes.
  - Domestic pets are not allowed on the Mining Lease and employees and contractors are not allowed to feed or make pets of native or pest fauna.
- Speed limits are imposed on vehicles using roads and tracks within the Mining Lease to a maximum of 40km/h to reduce the potential of vehicular impact on wildlife.

While mining activities are unlikely to cause local extinction or any significant impact on any of the listed fauna species, the Mine is committed to protecting native wildlife within the ML, at any offset area and at the Manuka Property. Any injured native fauna found during the active mining and rehabilitation activities will be reported to the Environmental Officer for immediate action.

d. Rock/Overburden Emplacement

Two additional emplacement areas, the Belah WRE and Bimble WRE, are yet to be constructed and will only be constructed if the Belah and Bimble Pits become operational. If they become operational, the new WREs will be created adjacent to their respective new pits. The proposed Belah WRE A and B areas will be located north of the TSF. The proposed Bimble WRE will be located north-west of the TSF and north of Manuka Pit.

Waste rock was initially 'paddock dumped' within the proposed footprint of each of the WRE. The piles of waste rock material were pushed flat using a bulldozer prior to construction of the next layer. Subsequent layers were then built by establishing a tip head on the active emplacement face. The WREs were constructed as two 10 m lift from the outer margins of the emplacement towards the centre, allowing for the final face angle for each lift of 1:3 (V:H). Between each lift, a 5 m wide berm with a 1:20 (V:H) or 5% backslope and a 1:100 (V:H) or 1% longitudinal grade was then constructed.

The WREs were compacted during construction by heavy vehicles travelling across the surface.

Water management structures have been constructed during the shaping of each emplacement to reduce the risk of erosion.

The only area identified within the Mine site for capping is the TSF.

A materials deficit for life of mine rehabilitation is not anticipated.

e. Waste Management

Production waste is restricted to overburden and managed as described in **Section 6.2.1 d**.

In most cases, non-production waste generated during mining and rehabilitation activities will be collected at the Mine and removed for disposal or recycling by a suitably qualified contractor. **Table 6.2** presents an estimate of the non-production waste and briefly describes how each class of waste will be stored and subsequently removed from the Mine.

Table 6.1 Non-Production Waste Management

Waste Type	Storage/Management	Removal/Disposal
Putrescible waste (including food scraps)	Covered bins or skips located at lunch areas, offices, outside workshops and elsewhere as required. Where these bins are located in open areas, they will be fitted with animal proof lids.	Collected on a regular basis by a licensed contractor and transported to an appropriately licensed facility for disposal.
General Recyclables	Covered bins or skips located at lunch areas, offices, outside workshops and elsewhere as required. Where these bins are located in open areas, they will be fitted with animal proof lids.	Collected on a regular basis by a licensed contractor and transported to an appropriately licensed facility for recycling.
Waste Oils and Greases	Placed within the bunded tank within the workshop area. Where required, smaller, temporary storage containers may be positioned close to work areas, with the contents of those containers transferred to the larger storage tank.	Collected on an as needs basis by a licensed contractor and transported to an appropriately licensed facility for recycling.
Contaminated soils	Soils within and surrounding former infrastructure areas will be assessed for potential contamination. Contaminated material will be managed in accordance with the guidelines under the Contaminated Land Management Act 1997.	Any contamination present will be remediated, and contaminated material will be treated or appropriately disposed of.

c.

During operations, any hydrocarbon spills are immediately cleaned up and any contaminated material placed within the TSF for encapsulation. In the event of a hydrocarbon leak or spill, the following spill management procedure is implemented.

f. Geology and Geochemistry

The geophysical and geochemical risks related to the WREs, and proposed management, is from the mobilisation of lead, zinc and other metals and metalloids in the created final landform.

The bulk of the mineralised zone will be processed to recover the silver resource, with the remainder sent as tailings to the TSF.

Development of the approved Belah and Bimble Pits will only proceed if they are found to be economically feasible. Geochemical studies, including material characterisation, will be undertaken if Manuka Resources decides to proceed with their development.

Given the proximity of the Belah and Bimble pits to existing operations, it is likely that the soil, subsoil, waste rock, mineralised waste and ore material would have similar geological and geochemical characteristics to those encountered in the Manuka pit.

Whilst retained in stockpiles, runoff from the ore will be captured by dirty water diversion drains and redirected to sediment basins. Water from sediment basins is sampled and analysed for metal contamination in accordance with the Mine's environmental protection licence (EPL 20020).

g. Material Prone to Spontaneous Combustion

As no ore material on site is prone to spontaneous combustion no specific management measures are necessary.

h. Material Prone to Acid Mine Drainage

The Mine has identified the ore and waste materials which are sulphidic and potentially acid generating and has stockpiled these separately, either within the Boundary Pit or a segregated and bunded stockpile area.

If not processed, the sulphidic ore will be placed within the TSF, where the presence of limestone and oxidised limestone tailings would neutralise the material, to prevent discharge or leaching of acid to the local catchment.

Similarly, the sulphidic waste would be retained and encapsulated within the final landform, either within the Boundary Pit or the TSF.

i. Ore Beneficiation Waste Management (Rejects and Tailings Disposal)

Manuka Resources has received approval to process ore from the Mt Boppy operations through the facilities at Wonawinta. As such, waste from the Mt Boppy ore beneficiation will also be managed through the Wonawinta facilities.

An analysis of the acid generating potential of the ore of the Manuka Mine and Mt Boppy Mine has been completed (RWC, 2015a). These analyses indicate the following:

- The Manuka ore tailings are typically slightly alkaline (pH of 7.8 to 8.2) and considered to be non-acid forming (NAF) / acid consuming, with an acid neutralising capacity of between 129kg H2SO4/t and 735kg H2SO4/t.
- The Mt Boppy tailings are typically acidic (pH of 3.7 to 4.2) and Potentially Acid Forming – Low Capacity (PAF-LC), with a low Net Acid Producing Potential (NAPP).

The TSF has been designed in accordance with the Australian National Committee on large Dams (ANCOLD) Guidelines and to satisfy the requirements of Dam Safety NSW. A Construction Certificate has been completed, including Work-as-Executed Drawings and a Construction Report, as well as a QA/QC Plan to meet the Specification requirements. A geotechnical inspection and assessment of the TSF occurs every 3 to 5 years.

The TSF has been constructed with a compacted layer of clay achieving a permeability of 1 x 10-9m/s which will effectively prevent leaching from the TSF. This notwithstanding, the Mine maintains a series of shallow piezometers around the TSF which are monitored in accordance with a Water Management Plan (RWC, 2012a) and will detect any increase in contaminants. An increase in contaminants indicating a failure of the compacted containment layer would trigger contingency management to recover the contamination and prevent further pollution. As nominated in the Mine Waste Management Plan (RWC, 2012b), these measures could include:

- the construction of several test pits or trenches to confirm the extent of the seepage zone;
- the construction and operation of a collection drainage trench to capture and return water to the TSF; and/or
- the installation and operation of a series of recovery bores beyond the downstream toe of the TSF to capture and return water to the TSF
- specialist and regulatory advice would be sought prior to the commencement of any contingency action.

In order to prevent the spillage / leakage of tailings from the processing circuit, bunding has been constructed around the processing plant (capable of containing a spill from the largest tank), vehicle access is restricted to the processing plant area and plant operators are appropriately trained in the operation of the processing plant and able to recognise an uncontrolled spillage or leak. If a spillage or leak is identified, the processing circuit is shut down so that the section of the plant responsible can be fixed. The spilt tailings are excavated and manually transferred to the TSF.

The tailings delivery pipeline is placed within a drainage channel to restrict the dispersal of tailings in the event of a spill.

The outer walls of the TSF Stage 2 lift have been formed and spread with soil. As part of the stage 2 lift the downstream batter has been profiled to 3H:1V (~18°). Erosion on the outer walls of the TSF was identified, cost-effective remediation strategies and appropriate actions to address this erosion issue are being explored with a trial set to be implemented during the next reporting period. Surface drainage is prevented from inflowing by constructed water diversion drains up-slope of the TSF, ROM pad and stockpiles.

A risk to biodiversity within the current and rehabilitated landform is the risk that elevated cyanide concentration within water pooling on the TSF may lead to bird or other fauna fatalities. During operation of the TSF, the Mine operates a cyanide destruction circuit within the processing plant to reduce the concentration of cyanide in the tailings delivered to the TSF.

The TSF is managed to minimise the standing water present to reduce the perceived habitat value to birds and other wildlife. Alternative water sources are maintained in the vicinity of the Mine, e.g., sediment basins and farm dams. There is also an operational bird scarer and the TSF is inspected daily.

j. Erosion and Sediment Control

The principal potential for erosion and sedimentation impacts to rehabilitation sources of surface water pollution, erosion and sediment during the LOM include stormwater runoff:

- during the construction of the TSF lift;
- from the waste rock emplacements and other disturbed areas; and
- from rehabilitated areas prior to successful establishment of vegetation.

The Erosion and Sediment Control plan (ESCP) (MRL-ENV-PLN-004) for the Mine incorporates the Stormwater Management Scheme – Manuka Mine (RWC, 2015b) for Black Oak Minerals in 2015, which contains a plan that shows that the drainage lines within the ML and surface water runoff are managed via a series of diversion drains to capture water runoff onsite and into sediment basins. The ESC Site Plan also presents other contingency measures at strategic locations to assist with the management of erosion and sedimentation across the site.

A summary of the key erosion and sediment control measures taken from the current Erosion and Sediment Control Plan (MRL-ENV-PLN-004) that will continue during stormwater runoff events are provided as follows:

- Diversion of ‘clean’ water flows around disturbed areas to minimise the mobilisation of sediments.
- Capture of all ‘dirty’ water flows utilising the ‘dirty’ water management system including catch banks, drop structures and sediment basins.
- Use of temporary erosion and sediment control structures including sediment fencing and check dams to minimise the discharge of sediment-laden water from erosion susceptible areas (installed prior to commencement of disturbance) and non-vegetated stockpile areas.
- Use of permanent erosion control structures including check dams, jute mesh and rock armouring where required.
- Ensuring all topsoil and subsoil stockpiles are protected from direct surface water flow.

- Leaving the surface of soil stockpiles rough and ensuring rapid establishment of vegetative cover over topsoil and subsoil stockpiles to be retained for a period of greater than 3 months.
- Sowing of a sterile groundcover mix on topsoil spread over rehabilitation areas to be returned to native vegetation to stabilise the soil whilst native vegetation establishes.
- Surface water monitoring will be undertaken within the sediment retention basins and upstream and downstream within the creek diversion during flow events, on at least a quarterly basis.

The sediment basins will be inspected monthly by the Environmental Officer throughout the LOM, with particular attention at areas being progressively rehabilitated. Rehabilitation areas shall also be inspected immediately following significant rainfall events (>25 mm in 24 hrs) to record the following which will assist in determining the success of the rehabilitation program:

- general condition
- evidence of overflow and condition of downstream catchment
- water colour, e.g., highly turbid, brown, clear etc
- evidence of eroding surfaces
- evidence of sediment discharge
- approximate retained capacity
- any maintenance works that may be required, such as removal of accumulated sediments, will be identified and actioned through these inspections
- a summary of surface water monitoring and erosion and sediment control inspections will be provided within the respective ARRFP.

k. Ongoing Management of Biological Resources for Use in Rehabilitation

Refer to **Section 6.2.1** for specific details on the ongoing management of biological resources for use in rehabilitation.

l. Mine Subsidence

No underground mining of any kind has been undertaken, nor is any anticipated. Therefore, mine subsidence management measures are not required.

m. Management of Potential Cultural and Heritage Issues

Should any further site or artefact be uncovered during the planned activities, work in the area surrounding the relic would cease and the Heritage NSW and the Local Aboriginal Land Council shall be informed of the find. Work would not recommence in the area immediately surrounding the find until the area has been inspected and permission has been given to proceed.

Staff and contractors have undergone cultural heritage inductions alerting them to the location of recorded cultural heritage sites within the Mine and its immediate surrounding area and to their legislative protection under the NPW Act. These inductions are recorded in a register, with all those present signing their complicity with these guidelines.

Should the Mine site disturbance footprint change, the Mine will take care to ensure that sites currently avoided remain so, and that impacts remain within previously assessed areas. Should impacts be altered, the management measures will be reviewed and updated as required. A specialist archaeological investigation to develop additional conservation plans will be considered and a suitably qualified consultant and/or archaeologist will be engaged to undertake the investigation. The progress towards completing any cultural and heritage assessments and/or investigations will be provided in the ARRFP.

No further Aboriginal heritage sites or artefacts in situ are planned to be disturbed or demolished for the LOM. However, should any new site or artefact be found and be impacted (directly or indirectly), the following management strategies (EIS, 2010) shall be implemented:

- Work in the area surrounding any new archaeological site, artefact or relic will cease and:
    - contact Heritage NSW and the Local Aboriginal Land Council, and other relevant agencies as soon as practicable.
    - work will not recommence in the area immediately surrounding the new find until the area has been inspected and permission has been given to proceed.
- Through consultation with the Heritage NSW, Local Aboriginal Land Council (LALC) and Local Aboriginal Elder or nominated representative:
    - all new archaeological find shall be surveyed for correct identification, then salvaged and relocated to a nearby safe location or safe keeping place in accordance with the relevant permits awarded under the NPW Act
    - the location and context of each artefact will be recorded for archaeological documentation
    - if required and unavoidable, an AHIP application requesting for the salvage and destruction of specific sites shall be submitted to Heritage NSW.
    - if required by the AHIP, infrastructure required for heritage management, e.g. protective fencing, be installed to control access to the newly identified site.
- Training and awareness of workers on their regulatory obligations under Part 6 of the NPW Act:
    - All site workers involved with the new archaeological find will be made aware of their obligations under the NPW Act thru site inductions, tool box talks, during pre-starts, and relevant information added to the contractor's SWMS.
    - A large-scale plan showing the location of all heritage features will be prepared and kept in a visible location within the Project Office, Contractor's Office and crib room.

- Records keeping and Reporting.
    - A brief report, including an artefact analysis, would be prepared by a suitably qualified consultant and or Archaeologist to ensure that information pertaining to these sites is preserved. Copies of the Report shall be forwarded to the Heritage NSW and LALC for historical archiving.
    - Details of any new archaeological find recorded during the reporting period will be included in the ARRFP.

Following lease relinquishment, the responsibility for managing existing heritage sites will be transferred over to the new landholder. Copies of all supporting documentation, permits, reports and studies will be provided as part of the land relinquishment process.

n. Exploration Activities

During 2020 an infill drilling program was undertaken by the Mine to determine the inferred resource of the Bimble, and Belah Pits located in the north and in the area between the existing Boundary and Manuka Pits. A total of 393 holes were drilled, 375 Reverse Circulation (RC) and 18 Diamond Drill (DD). The drilling program totalled 14,700 m, 14,350 m of which were RC and 350 m DD.

An extensive exploration drilling program has been underway over 2021 and continued into 2022 to assist Manuka Resources in identifying and determining the presence and suitability of potential future silver reserves and resources. The Company is also investigating the suitability of neighbouring resources in the region which could be suitable feedstock.

6.2.2 Decommissioning

Decommissioning of the Mine include the cessation of infrastructure usage, disconnection of remaining services, demolition, and removal from site. Remediation of any contamination will also be undertaken during this phase.

Manuka Resources will develop a detailed Closure RMP in consultation with the Resources Regulator and other stakeholders within three years of mine closure. This will include details covering the evaluation of re-use opportunities for facilities, infrastructure, and services on the site.

a. Site Security

Access to the Mine is restricted by rural fencing which is regularly maintained and repaired as required. Additional bunding is also in place around the pits. Fencing is inspected on a regular basis and access of public to the site restricted.

Considering the isolated nature of the site and restricted access there will be minimal risk to public safety.

b. Infrastructure to be removed or demolished

Infrastructure such as buildings, fixed plant, internal roads and hardstands, and services longer required for mining or post-mining land use activities will be removed.

Electrical services will first be disconnected, with other services, e.g. water, telecommunications, etc. then disconnected from buildings and fixed plant. The buildings will either be directly removed from the site (if demountable) or demolished and removed. The processing plant will be dismantled and removed from the mining lease.

All concrete footings and foundations of buildings, or structures to be dismantled or demolished, will be broken up and removed. Any areas of contamination will be removed for correct disposal in Cobar.

All non-essential haul roads and access tracks will be reshaped to blend with the existing terrain and rehabilitated according to the final landform design of its mining domain. Updated Mine Plans reflecting any revised road plans onsite will be posted at the main office, crib rooms and contractor office.

All infrastructure will be decommissioned and/or demolished in accordance with the regulatory requirements and the Safe Work Australia Code of Practice for Demolition Work 2016.

Any associated linear infrastructure (pipes, hose, etc) no longer required will be removed. Bores no longer needed for groundwater monitoring will be decommissioned and holes backfilled.

The TSF will be covered by a combination of up to 2m of coarse waste rock (to form a capillary break) and minimum of 600 mm of clay (to form an impermeable barrier), to create the construction of an overlying store and release cover.

The TSF will then be covered by pre-treated growth media and spread to a minimum of 150 mm, followed by seeding with a suitable groundcover and grass species.

Limited rehabilitation activities are to occur within the water management areas but do include measures required to provide for the long-term stability of structures with appropriate vegetation establishment, discharge (scour) protection and any other recommended measures.

Sediment basins and dirty water diversion drains no longer required will be backfilled and reshaped suitable for final land use.

Following excavation of waste for capping of the TSF, the remaining WREs dumps will be shaped to provide for outer slopes not exceeding 18°. The upper surface would be slightly convex (slightly steeper at the top and slightly shallower at the base) to assist in reducing the erosive force of runoff travelling from the top of the landform to the bottom. Soil available in adjacent stockpiles will be spread, following in-field screening and pre-treatment with ameliorants.

The Manuka Waste WRE will be left open as it may be used as a source of clay for TSF capping and/or material for final landform creation and rehabilitation. However, temporary stabilisation works, in the form of sterile cover crops or down-slope sediment fencing will be undertaken during the term of this MOP over the northern 50% (approximate) of the Manuka waste dump batters.

Any remaining stockpiles (limestone, hard rock mineralised waste/low grade ore and clay) will be rehabilitated as follows.

- Limestone. The material will either be preferentially used as a neutralising agent where sulphidic waste or ore is to be retained in the final landform (see below). The limestone will be placed below the sulphidic waste allowing any runoff or leachate to filter through the acid consuming material. Any additional limestone will be used as a general rehabilitation medium on the waste dump, TSF or infrastructure areas. The final area will be ripped, spread with topsoil and returned to a shrubby woodland community type.

- Hard Rock. The material will be preferentially used as a rehabilitation medium across the Mine. Any remaining material will be profiled to produce a slope not exceeding 18°, spread with suitable growth media and returned to a shrubby woodland community type.

- Mineralised Waste / Low Grade Ore. The material will be preferentially used as capping material for the TSF. The final area will be ripped, spread with suitable growth media and returned to a shrubby woodland community type.

- Clay. The material will be preferentially used for lining the progressive lifts of the TSF and encapsulation material of any acid generating material retained at the Mine. Any remaining material will be used for capping the TSF. The final area will be ripped, spread with suitable growth media and returned to a shrubby woodland community type.

- Sulphidic Ore / Waste. Any sulphidic waste will be added to the current stockpile of this material or used to back fill the upper northern bench of the Boundary Pit. In the event the sulphidic ore cannot be effectively processed, included in further progression of northern Boundary Pit rehabilitation. A stockpile of limestone will be placed beyond the toe of the stockpiled material where any runoff or leachate will be filtered. The acid consuming potential of the limestone will prevent a lowering of the pH of any water which accumulates in the void over time.

- Proposed rehabilitation within the voids will vary based on the geotechnical stability of the batters and the material used to backfill the void. A geotechnical assessment of batter stability will be completed to identify those batters and berms deemed stable be retained, and any batter or berms deemed unstable will be profiled in accordance with recommendations provided in the assessment.

c. Buildings, Structures, and Fixed Plant to be Retained

Items of infrastructure currently planned to be retained on the mining lease include the water management infrastructures and the Mine access road.

Water Supply Pipeline from the Wirlong Property will be retained.

Seven sediment basins and an associated diversion drainage system will be retained as part of the final land use. The basins will be reshaped to allow for safe access by fauna species.

The retained basins will be SB2, sediment basin south of Manuka Pit, SB1N, SB5, SB6, SB3 and the sediment basin north of SB3. There will be a drainage diversion around the TSF running clockwise from its north-western section and travelling past its south-eastern corner.

The road network within the Mine will be reduced to a single access road.

d. Management of Carbonaceous/Contaminated Material

There is no carbonaceous material at the Mine.

During site decommissioning, any areas suspected of being contaminated will be tested and any contaminated material, which cannot be encapsulated within the TSF, i.e., if discharge to the TSF is complete and rehabilitation has commenced, then contaminated material will be removed and transported to the Cobar Waste Disposal Depot, a licenced waste disposal facility (EPA Reference no. 195).

Follow-up testing will be undertaken following the removal of the contaminated material to ensure no contaminants are left at the area.

Results from the Landloch Material Characterisation Report (Aug 2021) (refer to **Appendix 1**) found that lead was elevated in many Clay and Waste Rock samples. This will be assessed further by a suitably qualified professional in contaminated land. Results from the report provided will be included in the ARRFP.

e. Hazardous materials management

All handling, storage and transportation of dangerous goods has been undertaken in accordance with relevant Australian Standards and guidelines, including AS 1940, AS1596 and the Dangerous Goods Code. Safety Data Sheets will be retained on site for all hazardous materials, independent of the quantity held. All contractors are required to supply SDS for any hazardous materials they propose to bring to the Mine.

Hazardous Materials Management will continue as per the existing site processes documented in Hazardous Substances Procedure (MRL-ST-SOP-003) until closure, at which point all hazardous materials will no longer be required and thus removed from site.

f. Underground infrastructure

Whilst exploratory drilling has occurred within the Mine, no underground mining of any kind has been undertaken nor is any anticipated as future mine plans treat Manuka as open-pits. Furthermore, with no underground mining, there will be no underground infrastructure to decommission.

6.2.3 Landform Establishment

The section provides an overview of the key characteristics of the final landform as shown in the final landform and rehabilitation plan (**Plan 2a** and **Plan 2b**), with the key items addressed below.

a. Water Management Infrastructure

Following the completion of mining, the Water Supply Pipeline from the 'Wirlong' property bore field will remain in place.

Raw and process water dams will be decommissioned and prior to being backfilled, the soil will be tested to confirm the land is not contaminated. The empty dams will then be backfilled with waste rock material and reshaped for final land use. The final landform will be scarified and covered with available growth media to achieve a topsoil layer of minimum 150 mm deep, then directly sown with selected tree, shrub and grass species from **Table 6.4**.

Seven sediment basins will be retained as part of the final land use to capture runoff from final landforms. The retained basins will be SB2, sediment basin south of Manuka Pit, SB1N, SB5, SB6, SB3, and the sediment basin north of SB3. The basins will be redesigned to accommodate a 1:5 ARI event, shaped to blend with the surrounding topography and profiled to allow for safe access by fauna species.

Sediment basins no longer required will be backfilled using waste rock material. As the drainage system of the final landform is developed, existing dirty water diversion drains no longer required will be deconstructed and backfilled and profiled to integrate with the surrounding topography. The final landform will be scarified and covered with available growth media to achieve a topsoil layer of minimum 150 mm deep then directly sown with selected tree, shrub and grass species from **Table 6.4**.

A diversion drain around the base of the TSF is designed to run clockwise from its north-western section and travelling past its south-eastern corner.

The only water management infrastructure to remain in place is the Water Supply Pipeline from the 'Wirlong' property bore field. There will no management required during decommissioning; the periodic inspections of the line will continue for as long as the mine remains under the ownership of Manuka. When it is relinquished, the ongoing maintenance and inspections will become the responsibility of the landowner who will use and continue to benefit from the water supply into the future.

b. Final landform Construction: General Requirements

An assessment of geotechnical stability will be undertaken to determine any unacceptable risks such as wall slippage or failure, seeping of capped material, etc.

Materials used in the formation of roads will be salvaged if useable elsewhere, or if not salvageable will be ripped to assist in landform profiling.

The ground surface will be profiled by bulldozer to return the land to approximate the pre-mining topography so that the landform morphology will fit in with the surrounding landscape. The profiled landform will be ripped or lightly scarified to assist in the keying in of the growth media when applied. The profiled landform will be covered with available growth media to achieve a topsoil layer of minimum 150 mm deep. Fast growing non-persistent cover crops shall be directly sown together with selected tree, shrub, grass and groundcover seeds sourced from local nursery stock which had been collected from within the Mine's local bioregion.

Final landform will be designed with slope gradients no more than 18^{o} (~30%) to ensure rehabilitated areas do not represent an erosion hazard (erosion will not exceed 0.3 m [gully] deep). Water drainage features are incorporated in the final landform to allow for captured surface water runoff be redirected to the final landform's catchment basin.

Ongoing water quality assessments will be required to demonstrate the final landform is non-polluting (to both surface land and water, and groundwater) until the completion criteria are met. Criteria or targets identified by EPL 20020 or the Water Management Plan (RWC, 2012a) will define pollution. If criteria are not provided, pollution will be considered against the definition provided by Section 120 of the POEO Act. In particular, 'downstream' water quality monitoring will record total suspended solids <50mg/L or within 10% of 'upstream' levels (whichever is the greater).

c. Final landform construction: reject emplacement areas and tailings dams

Emplacement Area

Final landform construction methods for the WREs include:

- The outer slopes of the waste dumps will be profiled by bulldozer to create slope gradients no greater than 18^{o} (~30%) and generally concave in shape (steeper at the top and shallower at the bottom).
- Any large rocks will be buried within the dump and the layer of weathered waste rock of at least 2 m will be placed below the final soil layer.
- Berms between the 10 m lifts of the WREs will also be profiled by bulldozer to ensure a back slope towards the dump of 3^{o} (< 5%) and along the berm of 1.5^{o} (2%). The slopes along the berms will be directed towards constructed drop down structures to allow for the controlled and non-erosive shedding of water.
- At roughly 400 m intervals, rock flumes will be constructed using larger gabion of available or rolled erosion control products (RECPs).
- The upper surface of the waste dumps will be profiled by bulldozer to create a gently undulating surface that is generally convex in shape (i.e., water shedding).
- Surveys will be completed to confirm the desired slopes are achieved.
- The profiled surfaces will be lightly ripped to assist in the 'keying in' of the growth media. The profiled landform will be covered with available growth media to achieve a topsoil layer of minimum 150 mm deep.

Stockpiled Material

Following the completion of ore transportation, all ore will have been removed from the ROM pad. The ROM pad will then be profiled using a bulldozer to provide a free-draining landform deep ripped and, if available, soil material or suitably weathered overburden spread to a thickness of 50mm. The area will then be revegetated in accordance with the species and revegetation process outlined in **Section 6.2.5**.

Tailings Storage Facility

Final landform construction methods for the TSF include:

- Following completion of processing-related operations, the TSF will be allowed to dry out and settle. During this period, surface water and groundwater monitoring will continue.
- The outer slopes of each lift of the TSF will be profiled to create slopes no greater than 18o. As overlap of each lift will leave a 4 to 5 m wide berm between lifts, the overall slope of the TSF will be approximately 14^{o}.
- Berms between the TSF lifts will also be profiled to ensure a back slope towards the dump of 3^{o} (< 5%) and along the berm of 1.5^{o} (2%). The slopes along the berms will be directed towards constructed drop down structures to allow for the controlled and non-erosive shedding of water.
- At roughly 400 m intervals, rock flumes will be constructed using larger gabion if available, or RECPs.

- Capping rock (waste rock from the pits) will be transferred to the upper surface of the TSF by haul truck and paddock dumped on the dried and consolidated surface of the TSF. Bulldozers will push the capping rock to create a 2 m thick cap over the tailings. The capped upper surface of the TSF will be profiled to create a gently convex surface, i.e., water shedding. This will prevent the potential for leachate containing elevated concentrations of cyanide to build up within the TSF before seeping from the structure to natural drainage lines.
- The progressively capped TSF will be continuously monitored to ensure rainfall runs off the final landform and does not pool or seep into the structure.
- Surveys will be completed to confirm that the desired slopes have been achieved.
- Surveys will be repeated several months after capping and profiling to determine if any slumping of the upper surface has occurred. If slumping is identified, additional rock will be placed over the upper surface and profiled to ensure the convex surface is maintained and the landform remains water shedding.
- The profiled surfaces will be track rolled then lightly scarified to assist in the 'keying in' of the growth media. The profiled landform will be covered with available growth media to achieve a topsoil layer of minimum 150 mm deep.
- A Geotechnical Survey and Assessment for the TSF will be completed by a suitably qualified engineer. If satisfactory, the Dam Safety NSW will deregister the dam and the NSW Resources Regulator will be provided details on capping and water controls.

d. Final landform construction: final voids, highwalls and low walls

Manuka Pit Final Void

Key design features of the Manuka Pit:

- Area: 26 ha
- Maximum Depth: 40 m (215 m AHD)
- Orientation and Location: West of the ROM Pad; GDA94 – E:381140, N: 6432934
- Commenced in Year 1 following approval of the EIS, coincident with the construction of the process plant.

Processes associated with Manuka Pit as approved in the development consent:

- The pit was mined by the previous owners in three separate phases:
    - The first phase mined the eastern shallower parts of the ore body and was accessed via a temporary ramp to a floor elevation of 220 m AHD.
    - The second phase mined the deeper parts of the ore body and was accessed via a final ramp constructed of backfilled overburden to a floor elevation of 215 m AHD.

- The third phase lowered the floor elevation of the second phase to extract the remaining lower grade ore.

- No extraction has occurred from the Manuka Pit since 2016.

Impacts to public safety are minimised due to the Mine being remotely located away from the urban community of Cobar. Considering the isolated nature of the site there will be minimal risk to public safety.

There are no further additional strategies or requirements prescribed in the development consent.

Boundary Pit Final Void

Key design features of the Boundary Pit:

- Area: 25ha
- Maximum depth: 55m (193m AHD)
- Orientation and location: Southern end of the ML and situated East of the Boundary Waste Dump; GDA94 – E: 381940, N: 6431573
- This pit was the first pit developed and commenced in Year 1 following approval of the EIS, coincident with construction of the process plant.

Processes associated with Boundary Pit approved in the development consent

- The pit consisted of two distinct stages, a north stage and a south stage, and was mined by the previous owners over three separate phases:
  - The first phase mined the eastern shallower part of the north stage via a temporary ramp to an elevation of 205 m AHD.
  - The second phase developed the western and northern sections of the north stage. The deeper parts of the north stage were accessed via a final ramp constructed on back-filled overburden to a final floor elevation of 195 m AHD.
  - The third phase mined the stage in a single campaign down to a floor elevation of 193m AHD.

The Boundary Pit is now exhausted of leachable oxide material.

Sulphidic ore has been excavated from the Boundary Pit and stockpiled a few hundred metres south of Manuka WRE. Final benching and pit stabilisation activities have been completed, and perimeter bunds are in place.

Partial backfilling has been undertaken and will continue to at least 5 m above the recognised groundwater level, which is currently understood to be between 193 m and 196 m AHD. A portion of the sulphidic material has been used to backfill the upper northern section of the Boundary Pit and will be retained in this location.

In the event seepage is identified in any of the other pits, or at an elevation greater than 196m AHD within the Boundary Pit, final landform design will be reviewed and modified as necessary to ensure that the void is backfilled to at least 5 m above the highest elevation of groundwater seepage with at least 5 m of backfill material.

Belah and Bimble Pit

These pits are yet to be developed.

Results from the 2020 and 2021 drilling programs will be reviewed and used to develop the Manuka Resources Conceptual Mine Plans (incorporating the Bimble and Belah Pits). Based on these results and the proposed Mine Plans, some work may begin in the Additional Approved Disturbance Areas (as identified in the current MOP), to prepare for future mining of the Belah and Bimble Pits.

- Final landform construction methods for the Final Voids include:
- The perimeter safety bund around the edge of the pits will be extended across any ramps, profiled as required to enable soil spreading and revegetation and retained.
- The backfilled sections of the pits will be profiled by bulldozer to create slopes with a gradient of no greater than 10^{o} (~17%). Any large rocks will be buried and covered with at least 0.5 m of material.
- A geotechnical investigation of the remaining pit walls will be undertaken, and additional landform establishment works completed based on recommendations provided by this assessment.
- Surveys will be completed to confirm the desired slopes are achieved.
- The backfilled and profiled surfaces will be lightly ripped by bulldozer to assist in the keying of the growth medium (soil) to be applied.

As there will be no water stored in the voids a water balance and groundwater monitoring program to determine the likely final void water level and water quality assessments or geochemical studies are not required to inform management of potential pollution impacts.

There are no future water licensing requirements for the final voids following mine closure.

e. Construction of Creek/River Diversion Works

There are no construction of creek or river diversion works planned for the Mine.

6.2.4 Growth Medium Development

The growth medium development phase involves the placement of oxidised overburden, subsoil and available topsoil on the final landform and preparation of the surface for revegetation. Soil preparation will include fertiliser and ameliorant application (e.g., gypsum, etc), and ripping or scarifying the surface. Use of non-persistent cover crops will be used to stabilise the soil surface.

Growth medium development activities include:

- Characterisation of the geochemical nature of the substrate and associated materials.
- Soil Preparation using fertilisers to provide:
    - Phosphorus (Colwell) content of the topsoil to within a target concentration of 25–40 mg/kg, being comparable to analogue sites (i.e., Natural Ground Topsoil).
    - An appreciable source of nitrogen.
    - Improved levels of calcium.
    - Reduced potential for dispersion.
- Fertiliser will be applied at seeding. It can be broadcast with a spreader, applied hydraulically, or pneumatically. Spreaders are typically suitable for slopes with gradients less than 35 %, and pneumatic or hydraulic applications will be required for steeper slopes.
- Gypsum has been recommended for sodic/dispersive materials or where calcium is low. Gypsum will be applied during soil preparation stages in a manner that allows for as thorough mixing as is practicable into the surface materials. It will be applied prior to seed and fertiliser applications

Soil preparation for slopes on site will include the following:

- Slope gradients less than approximately 35 %:
    - Aim to incorporate gypsum into the upper 0.3 m of materials.
    - Relieve compaction by deep ripping along the contour to a depth of 0.5 m to 1.0 m, with rip lines 1.0 m apart.
    - Deep ripping should be followed by shallow ripping/scarifying to incorporate gypsum amendments more thoroughly into the upper 0.3 m of materials.
- Slope gradients greater than approximately 35 %, or when ripping/scarifying along the contour is not practicable (or safe):
    - Aim to incorporate gypsum into the upper 0.5 m of materials.
    - Double the gypsum rate recommended.
    - When shaping up the batters in preparation for rehabilitation, incorporate gypsum into caping materials on the plateau of the landform then pushing down the batter.

Types of erosion and sediment controls to be implemented to protect the substrate from surface water runoff and wind exposure etc, while the vegetative cover is being established include:

- Rock-raking along the final landform contours to remove or bury exposed surface rock greater than 200 mm in diameter. The “rough surface” will assist to minimise erosion until vegetation can be established but also improve drainage.

- Sowing of a sterile groundcover mix (cover crop) on topsoil spread over rehabilitation areas to stabilise the soil whilst native vegetation establishes.

- Long or steep slopes will be divided up by the construction of contour banks to collect and divert water off the slopes. Contour banks will run the surface water at a drop of no greater than 1 in 100 into a drainage line (via a sediment basin) or into some form of protected drop structure that will run the water down the gradient in a controlled or protected manner.

To maximise water infiltration into the substrate and provision of adequate seedbed, the following mechanical treatments could be used:

- Deep ripping – to loosen up any near surface strata within the landform that have been compacted during placement, aiding root penetration during vegetation establishment.

- Rock-raking – undertaken during the final stage of reshaping along the contour, leaving a cultivated surface allowing for growth media and seeds to "key in" and improve water infiltration.

- Rolling – this presses the spread seed, increasing contact with the soil and increasing the probability of germination. It also pushes down any exposed rocks, decreasing surface rockiness.

- Scarifying - in the event of a delay between soil spreading and seeding, a surface crust may form as the soil dries. In these circumstances, light surface ripping/scarifying will be completed prior to seeding.

A summary of the soil management procedures (conducted as part of the growth medium establishment phase) to be followed (for this and all domains) is as follows:

- Soil will be preferentially sourced from areas being stripped in advance of mining or, if no such materials are available, from previously established stockpiles. Soil will be placed on the shaped landform.

- Any large rocks will be buried within the final structure and the landform and profiled to create a moderately sloping feature.

- Soil will not be respread when moist, to avoid excessive compaction, or too dry to avoid excessive dust and wind erosion.

- The topsoil will be spread on an even but roughened surface, which will be ripped along the line of the contour to break any compacted and/or smooth surfaces. Ripping will also assist the keying in of the topsoil, maximise aeration and infiltration and minimise erosion.

- The soil will be spread with a minimum thickness of 150 mm on the flatter areas and 100 mm thick on the moderate slopes (>10^{o}).

- If required, artificial covers such as bitumen impregnated straw or mulches will be used to stabilise the soils on the shaped landform.

- Soil will be ameliorated prior to revegetation to prevent surface crusting, increase moisture and organic content, and/or buffer surface temperatures to improve germination.

- Finally, the profiled and soil covered landform would be seeded with a suitable groundcover and native grass species.

Weed Control

Strategies to reduce the establishment of weed species on the rehabilitated landforms are as follows:

- Inspection of source soils stockpiles and if dominated by weed species, an herbicide targeting the particular weed species will be applied prior to respreading.
- Regular inspection of rehabilitation sites. A 1 m x 1m quadrat monitoring approach will be undertaken with the percentage cover by weeds recorded. On initial establishment of vegetation, weed species coverage of 50% (no noxious weed species) will be acceptable as the cover is important in stabilising the soil. After 6 months, the acceptable weed species coverage will be 20% (and no noxious weed species). If the threshold coverage percentage is exceeded, targeted weed spraying will be commissioned.
- If weed species coverage cannot be reduced to the target threshold, additional advice will be sought from the Western LLS and or Cobar Shire Council Weeds Officer.

6.2.5 Ecosystem and Land Use Establishment

The ecosystem and land use establishment phase involves the establishment and maintenance of vegetation on the completed landform. On completion of ecosystem and land use establishment for a final land use of native vegetation, a cover of native groundcover will have replaced the non-persistent cover crop.

Where appropriate, timing of due diligence pre-clearing surveys will be seasonal to target key threatened species known to occur or deemed to have potential to occur.

Seeding will be completed as soon as practicable after placement of soil material / growth medium, preferably in the period from late winter to early spring (August – October) when temperatures begin increasing (but do not typically exceed 30°C).

The decommissioned domains, following any remediation (if required), will be initially revegetated with appropriate native ground cover. Revegetation will then comprise seeding with a native tree / shrub / grass mixture for woodland establishment or a grass mixture for grassland establishment. Direct seeding lines for tree species will be spaced a minimum of 6 m apart on flat areas and 8 m on slopes to provide sufficient space for establishment and maintenance of groundcover species.

Seeding rates will be moderate to high (to account for the relatively harsh climate), approximately 1.0 to 1.5 kg per kilometre. A standard commercial fertiliser will be applied with the seed to assist in vegetative germination and initial growth.

The progress of the rehabilitation will be monitored, and the domains will not be progress to Phase 6 until monitoring shows that adequate ground cover has been achieved. Maintenance will continue within all domains until adequate ground cover is achieved.

As rehabilitation progresses, additional species can be planted to mimic succession processes, where necessary, to achieve the target native ecosystem communities.

The species range to be used during rehabilitation is restricted to local species known to inhabit the Western region of NSW. Seed will be sourced from local nursery stock, with seed collected from within the Mine's bioregion in preference to seed where provenance is outside the bioregion or not known. **Table 6.4** provides a list of recommended type and range of species to be planted, including short lived species (non-persistent cover crops), to achieve the Mine's intended revegetation outcome.

Table 6.2 Recommended flora species for the revegetation

Genus	Species	Common Name	Comments
Trees			
Brachychiton	populneus	Kurrajong	Local to Mine Site
Eucalyptus	populnea	Bimble Box	Local to Mine Site
Eucalyptus	viridis	Green Mallee	Locally occurring on shallow / rocky soils
Callitris	glaucophylla	White Cypress Pine	Indigenous to Mine Site
Callitris	endlicheri	Black Cypress Pine	Locally occurring on shallow / rocky soils
Eucalyptus	dwyeri	Dwyer's Red Gum	Locally occurring on shallow / rocky soils
Eucalyptus	vicina	Hill Red Gum	Locally occurring on shallow / rocky soils
Eucalyptus	morrisii	Grey Mallee	Locally occurring on shallow / rocky soils
Eucalyptus	intertexta	Coolibah	Indigenous to Mine Site
Shrubs			
Acacia	brachystachya	Umbrella Mulga	Locally occurring on shallow / rocky soils. Seedlings very susceptible to grazing.
Acacia	colletioides	Wait-a-while	Locally occurring in Box Woodlands.
Acacia	deanei	Green Wattle	Occurs in similar setting within the bioregion
Acacia	decora	Western Golden Wattle	Locally occurring in Box Woodlands. Very susceptible to grazing.
Acacia	hakeoides	Hakea Wattle	Locally occurring in Box Woodlands. Very susceptible to grazing.
Acacia	triptera	Spur-wing Wattle	Locally occurring in Mallee / Box Woodlands.
Senna	artemisioides	Silver Cassia	Locally occurring in Box Woodlands.
Pittosporum	Angustifolium	Butterbush	Regionally occurring on a variety of soils
Geijera	parviflora	Wilga	N/A
Acacia	aneura	Mulga	Indigenous to mine site area
Acacia	excelsa	Ironwood	Indigenous to mine site
Acacia	doratoxylon	Currawang	Locally occurring on shallow / rocky soils
Acacia	oswaldii	Miljee	Indigenous to Mine Site
Acacia	rigens	Needle Wattle	Indigenous to Mine Site
Dodonaea	viscosa	Broad-leaf Hopbush	Indigenous to Mine Site
Pandorea	pandorana	Wonga Vine	Indigenous to Mine Site
Groundcover			
Poaceae	Aristida ramosa	-	Locally occurring.

Genus	Species	Common Name	Comments
Poaceae	Austrodanthonia caespitosa	White-Top	Locally occurring.
Poaceae	Austrostipa scabra	-	Locally occurring.
Poaceae	Chloris truncata	Windmill Grass	Locally occurring.
Poaceae	Digitaria brownii	Cotton Panic Grass	Locally occurring.
Poaceae	Themeda australis	Kangaroo Grass	Locally occurring.
Chenopodiacae	Einadia nutans	Climbing Saltbush	Locally occurring.
Chenopodiacae	Enchylaena tomentosa	Ruby Saltbush	Locally occurring.
-	-	Sterile Millet	Temporary stabilisation only – non persistent.
-	-	Perennial Ryegrass	Temporary stabilisation only – non persistent.
		Source: OzArk Environment and Heritage Management Pty Ltd	

Appropriate seedbed preparation will be carried out prior to revegetation. In the event of delay between soil spreading and seeding, a surface crust may form as the soil dries. In these circumstances, light surface ripping will be completed prior to seeding.

Seeding will be completed after placement of soil material / growth medium, taking into account the seasonal consideration for optimal environmental conditions to increase chance of germination and juvenile growth.

Native seed (including Poplar Box, Inland Red Box, Belah, Mulga and native grass species) will be sown and watered as seasonal conditions dictate.

Only grass and groundcover species will be sown on the final landform of the TSF.

Cover crops are used for temporary stabilisation and to protect juveniles/seedlings. Non-persistent species are used. They are typically a fast growing temporary / short lived species used as an interim measure to stabilise a disturbed area, minimise dust generation and erosion, and provide organic and binding matter back into the soils while the slower growing and long-term target species establish in the area. The target species are the dominant plant which will 'take over'/remain when the cover crop dies back. The use of cover crops also helps to minimise the invasion of weed species.

A standard commercial fertiliser will be applied with the seed to assist in vegetation germination and initial growth.

6.2.6 Ecosystem and Land Use Development

Weed and Pest Management Controls

- Strategies to reduce the establishment of weed species on the rehabilitated landforms are as follows.
- Inspection of source soils stockpiles and if dominated by weed species, an herbicide targeting the particular weed species will be applied prior to respreading.

- Regular inspection of rehabilitation sites. A 1m x 1m quadrat monitoring approach will be undertaken with the percentage cover by weeds recorded. On initial establishment of vegetation, weed species coverage of 50% (no noxious weed species) will be acceptable as the cover is important in stabilising the soil. After 6 months, the acceptable weed species coverage will be 20% (and no noxious weed species). If the threshold coverage percentage is exceeded, targeted weed spraying will be commissioned.

- If weed species coverage cannot be reduced to the target threshold, additional advice will be sought from the Local Land Service or Council weeds officer.

- Weeds are often colonising species and as a result, the risk of excessive weed establishment during final land use establishment has been identified as moderate.

Opportunistic grazing by pest animals will be controlled through boundary fencing. Rehabilitation areas will be selectively fenced to prevent soils of new landforms from being dug up, to further reduce grazing pressure from large pest animals (pigs and goats), and to allow for juvenile vegetation to grow during progressive rehabilitation onsite.

- Targeted observation for pest animals will be conducted to monitor their presence and population growth and will be addressed as the need arises. Baiting programs will be carried out twice a year (January and July) for foxes and cats. Ripping of rabbit burrows to be undertaken following their discovery.

Erosion and Drainage Controls

Erosion and sediment controls measures that have been put in place during the previous phases will be monitored and any remediation work will be undertaken as required.

Drainage controls will be maintained and temporary fences installed to exclude grazing by domestic fauna.

Environmental monitoring and management

Rehabilitation monitoring and management is further discussed in **Section 8.2.**

<u>Maintenance Fertilising</u>

Fertiliser application will be kept to a minimum and if required will be undertaken simultaneously with seeding. Maintenance fertilising will be conducted as required. Fertiliser type and application rates will be determined by prior soil analysis.

<u>General Land Management .</u>

Revegetated areas will provide a vegetation community with maintenance requirements no greater than adjoining vegetation / analogue sites not disturbed by mining activities and contain species consistent with surrounding vegetation communities.

The Mine would be returned to the management of the “Manuka” property lessee following completion of mining and rehabilitation. The “Manuka” property is managed under a Property Vegetation Plan (PVP) which is focussed on sustainable grazing practices, and specifically the development and maintenance of sustainable grassland communities.

Grazing pressure is likely to be managed in accordance with the PVP. Regular inspections will be undertaken to confirm that this strategy is sufficient to prevent adverse impacts of grazing in the final landform. In the event that grazing pressure begins to adversely affect revegetation success on the final landform, the Mine will erect exclusion fencing around these areas. The fence will comprise a small hinge joint netting fence with additional salvage wires, resulting in a fence approximately 1,200 mm high. This style of fencing is low maintenance, discourages kangaroo movement and will stop re-population by feral goats. The movement of small mammals and reptiles will not be impacted.

6.3 Rehabilitation of Areas Affected by Subsidence

No underground mining of any kind has been undertaken nor is any anticipated as future mine plans treat Manuka as open-pits, therefore, mine subsidence management measures are not required.

7.0 Rehabilitation Quality Assurance Process

7.1 Rehabilitation Quality Assurance Process for Each Rehabilitation Phase

A Rehabilitation Quality Assurance Process (RQAP) will be implemented though the Life of Mine for each phase of rehabilitation. The RQAP will ensure that:

- rehabilitation is being implemented in accordance with the nominated methodologies
- identified risks to rehabilitation are being adequately addressed at each phase of rehabilitation
- identification of those responsible for implementation.

Manuka Resources will implement the RQAP through every phase of rehabilitation. The RQAP will include inspections, monitoring and documentation to ensure that each step of rehabilitation activity has been completed in accordance with the nominated methodologies prior to proceeding to the next phase of rehabilitation.

The quality assurance process will be implemented throughout the life of the operation, refer to **Table 7.1.**

Table 7.1 Rehabilitation Quality Assurance Process

Rehabilitation Phase	Quality Assurance Actions and Processes	Methods for Documenting and Recording Process	Method and Timeframe for Reviewing and Refining Process
Active Mining	• up to date mine plans. • maintenance of a topsoil inventory to document stripped, stockpiled and re-spread resources. • regular inspections of temporary and permanent erosion and sediment controls. • regular inspections to identify potential weed infestations. • documentation of all weed management and eradication programs and follow-up inspections.	Inspections and documentation. Rehabilitation monitoring program. Annual monitoring and reporting.	Process reviewed annually and/or following an incident.
Decommissioning	• inspections and demolition reports to confirm all relevant infrastructure and utility services has been removed. • validation testing to ensure any contamination has been appropriately remediated and/or removed.	Inspections and documentation. Compliance reporting.	Process reviewed annually and/or following an incident.
Landform Establishment	• survey and preparation of as constructed drawings of final constructed slopes, landforms, and water drainage structures. • recording depths of ripping of rehabilitation areas.	Inspections and documentation, Landform establishment records. Annual monitoring and reporting.	Process reviewed annually and/or following an incident.
Growth Medium Development	• registers of topsoil and/or soil substitute stockpiles (e.g., biosolids), including management records (such as stripping/stockpiling dates, weed control, inoculation with microbes, etc), and land and soil capability assessments to confirm that rehabilitation meets the nominated land capability classes. • records of identification and management of actual acid forming, potentially acid forming (PAF) and non-acid forming (NAF) material and ongoing monitoring. • soil testing results to confirm appropriate soil geochemical parameters for plant establishment.	Inspections and documentation. Rehabilitation monitoring program. Annual monitoring and reporting.	Process reviewed annually and/or following an incident.

Rehabilitation Phase	Quality Assurance Actions and Processes	Methods for Documenting and Recording Process	Method and Timeframe for Reviewing and Refining Process

Ecosystem and Land Use Establishment	• Documentation of seeding or planting activities undertaken including:
	  ○ date of planting;
	  ○ weather conditions;
	  ○ seed mix;
	  ○ seeding rate (kg/ha) and/or planting rate (tubestock/ha);
	  ○ fertiliser rate (kg/ha);
	• records of the salvage of all rehabilitation resources including suitable capping materials, topsoils/subsoils, seeds, habitat structures (e.g., tree hollows and rocks) for use in rehabilitation;
	• regular site inspections of rehabilitated areas to allow early identification of any emerging threats to rehabilitation;
	• rehabilitation monitoring in accordance with PART 8 – on page 118 to monitor the success of rehabilitation;
	• water monitoring to confirm runoff from the landform is within EPL criteria;
	• regular inspections to identify potential weed and feral animal infestations; and
	• documentation of all weed management and eradication programs and follow-up inspections.
		Rehabilitation monitoring program. Annual Monitoring and reporting.	Process reviewed annually and/or following an incident.

Ecosystem and Land Use Development	• rehabilitation monitoring in accordance with PART 8 – on page 118 to monitor the success of rehabilitation. • regular site inspections of rehabilitated areas to allow early identification of any emerging threats to rehabilitation. • regular inspections to identify potential weed infestations. • documentation of all weed management and eradication programs and follow-up inspections	Rehabilitation monitoring program. Annual monitoring and reporting.	Process reviewed annually and/or following an incident.

7.2 Rehabilitation Quality Assurance Process Implementation Program

7.2.1 The Responsibilities for Implementation

Table 7.2 outlines the roles and responsibilities of personnel who have responsibility for monitoring, review, and implementation for this RMP.

Table 7.2 Responsibilities for the implementation of the rehabilitation QA process.

Role	Responsibilities
Mine Manager	Accountable for the overall environmental performance of the operations, including the outcomes of this RMP. Ensure that mine planning is compliant with the requirements of the RMP and applicable approvals. Provide necessary resources required to implement the rehabilitation process outlined within the RMP. Ensure employees are competent through training and awareness programs.
Environmental Officer	Ensure the implementation of this RMP, including reporting of non-compliances with the trigger values, and subsequent implementation of the relevant action plan. Ensure that monitoring, report review, and preparation are undertaken as outlined within this RMP and associated management plans. Report the progress of rehabilitation and monitoring in the relevant AEMR.
All workers	Follow direction provided by the NSW Resources Regulator. Ensure operations are consistent with the plans and objectives detailed in this RMP.

7.2.2 How the Process will be Formally Documented and Recorded

Manuka Resources will maintain records of each rehabilitation phase which will assist to provide context to rehabilitation monitoring results and to inform potential contingency measures and/or changes to rehabilitation methods and practices. The records will include, but will not necessarily be limited to:

- plans showing the location and type of rehabilitation activities conducted (e.g., woodland, pasture or native grassland rehabilitation
- the target vegetation communities and species list for the target community
- substrate characterisation details where relevant
- details of site preparation techniques (e.g., ripping depth, soil replacement depth, soil source, any soil ameliorants applied and associated rates of soil ameliorants)
- seed source, record of any seed pre-treatment undertaken and species ratios within seed mix or tube stock planted
- revegetation methodology (i.e., direct seeding or tube stock planting);
- time of sowing/planting and weather conditions at the time.

To verify that the work processes are effective inspection and testing activities shall be performed.

Inspection and Testing Plans (ITP's) are a pre-determined and documented methodology for ensuring Quality Control (QC) throughout an activity or program of works. ITP's are developed at the design or specification stage and in accordance with the scope of work. These are available on site and completed as works progress, with identified hold and witness points included to ensure quality standards are met.

Inspection Check Sheets shall be used to verify the activities outlined in the ITP have been carried out. Completed check sheets (signed and dated by respective parties) shall be maintained in the project file for verification and records keeping.

Compliance with critical aspects of the rehabilitation phase is addressed via the use of nominated Hold Points and Witness Points. Hold points and witness points are developed to ensure key steps of the rehabilitation phase are captured to form part of the ITP.

Hold Points and Witness Points are addressed in Work Methodologies and ITPs where appropriate. It is the responsibility of the Project Engineer/Supervisor to ensure that hold points identified in the Contract and ITP's are implemented.

Records shall be maintained of all hold points and witness points that have been passed.

Opportunities for improvement are identified through the Monthly Reporting, Audit results, and seeking input from the project team. They are managed through the ***Manuka Hub,*** action registers or meeting minutes to ensure proposed improvements are completed in a timely manner. Opportunities and outcomes will be communicated using email and site meetings.

From a QA/ QC perspective, non-conformances include:

- re-work
- missed witness/hold points
- deficiencies identified during audits and inspections
- items that are inspected or tested and are found not to comply with defined acceptance criteria or specified requirements.

If nonconformance is detected after delivery or use, Manuka Resources will act appropriate to the effects, or potential effects, of the non-conformity.

7.2.3 How the Process will be Reviewed and Refined over Time to Promote Continuous Improvement

Rehabilitation practices will be subject to regular review to ensure to identify areas that may require improvement. The review process may include formalised procedures such as internal and external audits or feedback from consultation, and/or following special occurrences.

Rehabilitation practices will be regularly reviewed against current industry recognised rehabilitation controls and techniques to identify out-of-date methodologies and/or verify any gaps with the response plans and monitoring programs currently implemented and cross-check any differences in the desired long-term sustainable outcomes. The rehabilitation objectives and completion criteria are redefined accordingly and rehabilitation practices consequently redesigned and executed as soon as practicable to:

- achieve the rehabilitation outcomes in an acceptable timeframe
- monitor the rehabilitated areas, and
- results are assessed against the agreed criteria.

Management plans specific to the Mine's rehabilitation program will be reviewed and updated to ensure that routine monitoring and inspection of control measures onsite are maintained, risks promptly addressed, and outcomes of the inspection are always recorded.

Formalised quality assurance process will be designed and followed throughout the life cycle of rehabilitation. Procedures on recording of key data at each rehabilitation phase (e.g., actual methodologies undertaken, weather, etc) will be captured by responsible personnel.

8.0 Rehabilitation Monitoring Program

Rehabilitation monitoring focuses upon determining whether progress towards achievement of relevant performance indicators and completion criteria. **Table 4.1** presents a summary of the rehabilitation monitoring methodology and frequency for each indicator and criteria identified. The following provides an overview of the monitoring that will be undertaken with respect to these performance indicators and completion criteria.

An independent ecologist is to be engaged to undertake monitoring of vegetation on rehabilitated lands in spring each year or as otherwise advised by the ecologist.

The floristic and other biometric parameters of monitoring sites contained within the rehabilitated landforms of the Mine and analogue sites within the BOA are to be collected and compared. The following number of vegetation monitoring sites ("plots") will achieve the following minimum standard.

- Rehabilitated Landforms: One site per 20ha of rehabilitated land (rehabilitation phase 4). These sites will be established once rehabilitation progresses to Phase 4.
- BOA: At least one site within each variant of the Benson 103 vegetation community (grassland, woodland with predominantly grassy understorey, woodland with shrubby understorey). **Figure 8.1** identifies the approximate locations of these analogue monitoring locations (final locations to be established by the independent ecologist).

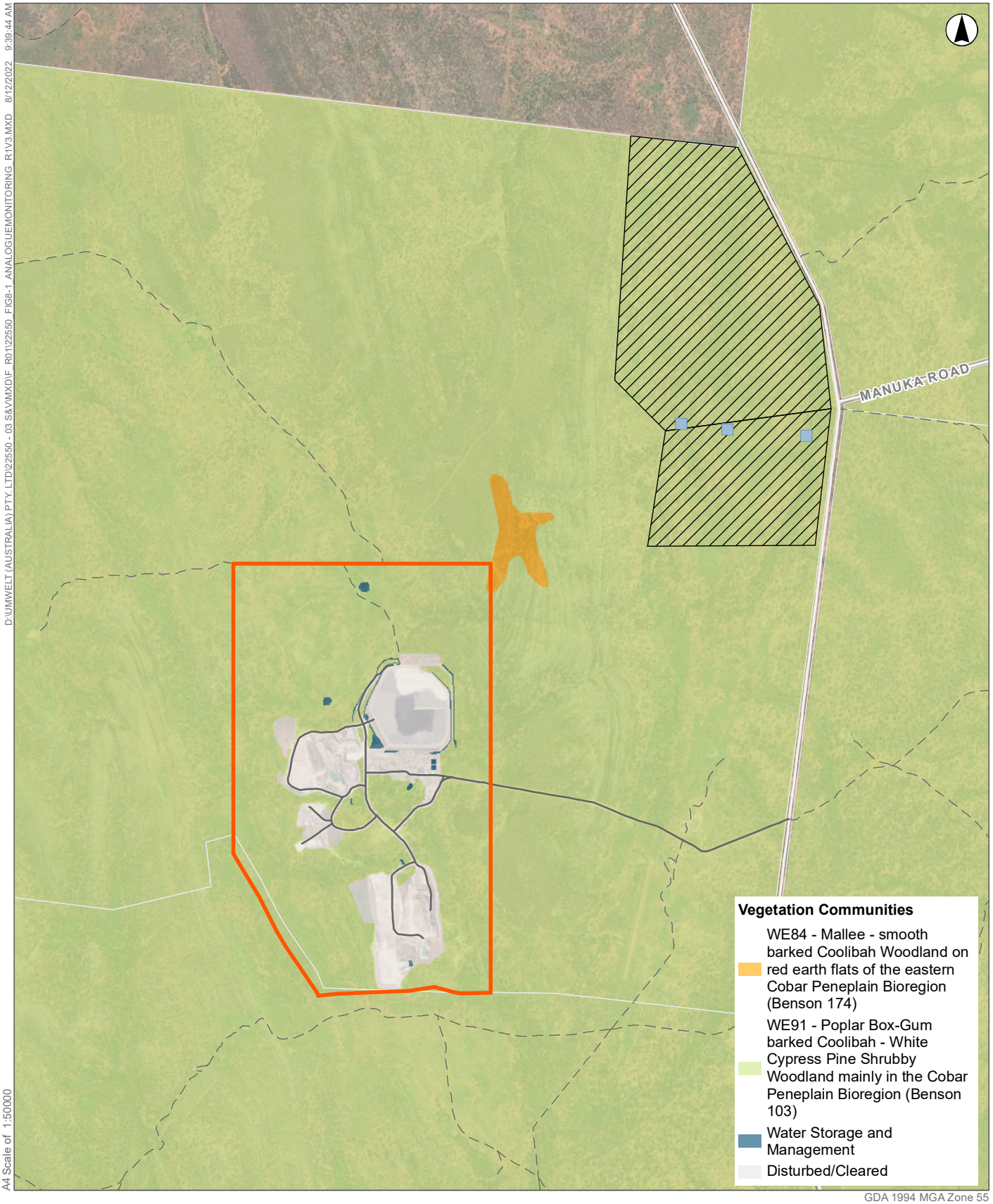
Floristic and biometric survey methodology will be in accordance with the Framework for Biodiversity Assessment published by the (then) OEH in 2014 but modified to provide for the collection of data aligned to the completion criteria of **Table 4.1**.

Each vegetation monitoring site will be marked by a star picket at the start and end of a 50m transect. Within each transect a 20 m x 20 m quadrat (nested in the 20 m x 50 m Biometric Quadrat, all vascular plant species observed in the plots are to be identified (where possible), recorded and compiled into the species list. Those species unable to be identified in the field are to be collected for later identification using a microscope and a combination of field guides, e.g., the Flora of New the Public Reference Collection of the National Herbarium of NSW in Sydney.

Additional information to collect will include:

- a 50 m transect along which native over-storey cover, native mid-storey cover, native groundcover (grasses, shrubs and other) and exotic cover was recorded.
- a 50 m x 20 m quadrat in which the number of trees with hollows, over-storey regeneration and total length of logs will be recorded.

Two photos are to be taken per plot, one from each end of the transect towards the centre of the transect. As described in **Table 4.1** the objective of the monitoring is to demonstrate achievement of floristic and other biometric parameters in the treatment plots of the rehabilitated lands and BOA which are equivalent to the analogue sites and are self-sustaining in the long-term. Results of the rehabilitation monitoring will be reported annually in the respective ARR.



Legend

- Rehabilitation Analogue Monitoring Sites
- Sub Arterial Road
- Local Road
- Track-Vehicular
- Cadastre
- Manuka Mine
- Biodiversity Offset Area

FIGURE 8.1

MANUKA MINE
Rehabilitation Analogue Monitoring Sites

Data source: New South Wales State Government, SEED

8.1 Rehabilitation Establishment Monitoring

8.1.1 Soil Quality and Depth Analysis

Following soil application, test pits will be established on the various aspects of the rehabilitated landforms: elevated plateau, slopes and ground level. One test pit will be established per hectare for each aspect of the landform.

The depth of soil within each test pit will be measured and then averaged across the rehabilitated landform before being compared to the completion criteria nominated in **Table 4.1**. Soil will be reapplied or respread where the minimum depth is not achieved, or not achieved over one specific aspect of rehabilitation.

Annually for a period of 3 years, samples of the soil are to be taken for analyses as described below.

Prior to respreading, soil stockpiles may be sampled to be determine whether soil ameliorants should be incorporated as part of the respreading. Sampling will preferentially be undertaken through creation of a sample trench and collection of composite samples to provide a more representative sample of the stockpile quality.

Following spreading, annually for a period of 3 years, composite soil samples will be collected from soils of the rehabilitated landforms (samples could be collected concurrently with the soil depth testing). Samples are to be collected at a rate of one sample per hectare. These samples are to be sent to and analysed by a Soil Laboratory for key chemical parameters as outlined in **Table 4.1**.

The results of the analyses of soils from the rehabilitated landforms ('treatment sites') will be compared to the performance indicators of **Table 4-B**, and, if non-compliant with those performance indicators, to soil samples taken from analogue sites within the Biodiversity Offset Area (BOA). The objective of soil management is to achieve soil parameters for the treatment soils that will provide for the establishment of the desired vegetation communities. Therefore, achieving equivalence to the parameters of the analogue soils hosting similar vegetation provides a suitable alternative performance indicator.

8.1.2 Water Quality Monitoring

Water quality testing in accordance with the surface water and groundwater monitoring plans approved as part of the Water Management Plan (RWC, 2012a).

8.2 Measuring Performance Against Rehabilitation Objectives and Rehabilitation Completion Criteria

Performance indicators and completion criteria provide a means by which the progress of rehabilitation can be measured to quantitatively demonstrate the successful achievement of a biophysical process, i.e., the standards that are to be met by successful rehabilitation.

Rehabilitation indicators and performance criteria are inter-related as a performance indicator is an attribute of the biophysical environment (e.g., percentage cover of native vegetation, pH, slope, soil depth etc.) that can be used to approximate the progression of the biophysical process against a defined end point, i.e., the completion/relinquishment criterion.

Table 4.1 provides the performance indicators and completion criteria developed for the Mine to achieve the nominated post mining land use goals and rehabilitation objectives (refer to **Section 4.0**).

It is noted that details of monitoring completed against completion criteria will be reported through the respective Annual Rehabilitation Report (ARR) and either a final ARR or separate relinquishment report for relinquishment of the Mine Site.

9.0 Rehabilitation Research and Trials

9.1 Current Rehabilitation Research and Trials

The Mine's resident caretaker has continued harvesting seeds of local species since the last reporting period. These have predominately been Native Blackthorn and Warrior Bush.

Several previous rehabilitation trials have been undertaken at the Mine Site. The most recent trial work occurred between 2007 and 2015 and covered an area of 1 ha and included four photo monitoring points and seven transect lines. Monitoring was undertaken on an annual basis and included measurement of number of seedlings, assessment of grazing pressure, presence of weed species and groundcover (e.g., bare soil, vegetation, litter, rock etc.). The results of this monitoring were presented within the respective AEMRs by previous operators.

Four analogue sites were also established in 2011 and were also monitored in the same manner to provide comparative data. The results of this monitoring were also presented within the respective AEMRs.

Whilst the rehabilitation trial areas are now incorporated into the modified WRE and monitoring of the analogue sites is not active, one of the sites that has pest exclusion fencing provides a good control site for observation of the impact of feral goats and their impact on natural revegetation in the area after rainfall.

9.2 Future Rehabilitation Research and Trials

The soil materials characterisation report (Landloch, 2021) recommended soil remediation trials be conducted on site to confirm the recommended application rates of fertiliser for optimum vegetation establish and growth. The application of this trial will be reviewed and confirmed as part of the first Annual Rehabilitation Report.

Given the status of operations at the Mine, no other rehabilitation research or trials are proposed. However, future rehabilitation of the supplementary pits and waste dumps, should they proceed, could be planned around what has been most successful at the Mine to date.

10.0 Intervention and Adaptive Management

10.1 Adaptive Management

Adaptive management of this RMP will be responsive to any new and relevant data that may arise through the rehabilitation monitoring (**Section 8.0**), legislative change or any other studies completed for the Mine's rehabilitation program (refer to **Section 6.0**). This will enable a flexible approach to management commitments, allowing ongoing feedback and continually improve and implement rehabilitation practices described in this RMP.

Adaptive management will be a key mechanism to address the major threats to, current and emerging risks to, the successful implementation of rehabilitation. Adaptive management steps include regular review of the RMP, including adaptation of targets and performance indicators, recognising potential risks to the successful implementation of the RMP and having a framework in place for corrective actions.

Where rehabilitation monitoring indicates that there is a significant threat to rehabilitation, Manuka Resources will undertake adaptive management in accordance with the Rehabilitation Trigger Action Response Plan (TARP) described in **Section 10.2**.

10.2 Threats to Rehabilitation and Trigger Action Response Plan

Section 3.0 of this RMP presents an assessment of environmental risks associated with the Mine. Similarly, this subsection presents an analysis of the specific risks or threats to rehabilitation within the Mine Site. This analysis of threats to rehabilitation has been prepared broadly in accordance with the requirements of *AS/NZS ISO31000:2009 Risk Management – Principles & Guidelines.*

Threats to rehabilitation were identified based on the rehabilitation risks identified in the risk assessment conducted by Manuka Resources (refer to **Section 3.0**. Risks were determined based on implementation of industry standard mitigation measures and the rehabilitation commitments. Where risks were determined to be unacceptable, namely those risks classified as "Moderate" or above, a Trigger Action Response Plan (TARP) has been developed and is presented in **Table 10.1**.

Table 10.1 Trigger Action Response Plan

Rehabilitation Threat	Trigger	Response	Risk Ranking	TARP ID
Inappropriate biological resource (e.g., subsoil, topsoil, vegetative material, seedbank, rocks, habitat resources) through clearing, salvage, and handling practices.	Materials characterisation data does not meet rehabilitation objectives and relevant completion criteria. Inadequate topsoil available.	A suitably qualified professional in sediment and erosion control will be engaged to prepare an assessment report and recommendations to be implemented. Continue monitoring and taking photo records.	Moderate	T-01
Limited pre-existing biological resources for use (e.g., topsoil, woody debris).	Soil inventory indicates a deficit of soil material. Soil and materials do not meet rehabilitation objectives and relevant completion criteria.	Suitable source of additional soil material / growth medium to be identified, including the need for importation of material from off site. Investigation into measures that may be implemented to ameliorate other materials to make them suitable for use as a growth medium.	Moderate	T-02
Adverse meteorological conditions during salvage of biological resources.	Bushfires and rain fall events pass control measures. Soil and materials do not meet rehabilitation objectives and relevant completion criteria.	A suitably qualified professional in sediment and erosion control will be engaged to prepare an assessment report and recommendations to be implemented. Investigation into measures that may be implemented to ameliorate other materials to make them suitable for use as a growth medium.	Moderate	T-03
Handling and containment of geochemical and geotechnically unsuitable process residue and reject materials.	Landform does not meet the rehabilitation objectives and relevant completion criteria.	Suitably qualified geotechnical engineer engaged to assess the instability and provide a range of recommendations to remediate the instability.	Moderate	T-04

Rehabilitation Threat	Trigger	Response	Risk Ranking	TARP ID
Adverse surface and/or groundwater quality and quantity.	Elevated water quality readings. Water quality triggers are exceeded. Water management structures fail. Visual inspections identify pooling water / poorly drained areas.	Re-profile slopes or install drainage to provide a stable free-draining landform. Recommendations of contamination assessment implemented. Verification monitoring / testing undertaken to confirm contamination has been completely removed.	Moderate	T-05
Hazards associated with retained infrastructure.	Contamination assessment identifies contaminated land present within Mine Site. Soil or vegetation criteria do not meet the Rehabilitation Monitoring Report criteria	Recommendations of contamination assessment implemented. Verification monitoring / testing undertaken to confirm contamination has been completely removed.	Moderate	T-06
Exposure or release of geochemical and/or geotechnically adverse material associated with containment design and construction, including capping/cover system.	Elevated water quality readings. PAF encapsulation causing acid mine drainage.	Contamination assessment conducted and recommendation of contamination assessment implemented.	Moderate	T-08
Lack of availability of suitable materials for encapsulation or capping of adverse materials.	Soil inventory indicates a deficit of soil material. Soil and materials do not meet rehabilitation objectives and relevant completion criteria.	Suitable source of additional soil material / growth medium to be identified, including the need for importation of material from off site. Investigation into measures that may be implemented to ameliorate other materials to make them suitable for use as a growth medium.	Moderate	T-09
Inappropriate physical and structural properties of substrate.	Landform does not meet the rehabilitation objectives and relevant completion criteria.	Slopes to be reduced until all slopes meet approved final landform unless final landform considered stable by geotechnical review and vegetation establishment success meets completion criteria.	Moderate	T-10

Rehabilitation Threat	Trigger	Response	Risk Ranking	TARP ID
Substrate inadequate to support revegetation or agricultural land capability (e.g., lack of organic matter, nutrient deficiency, lack of soil biota, adverse soil chemical properties, exposed hostile geochemical materials, and any other factors impeding the effective rooting depth).	Soil inventory indicates a deficit of soil material. Soil and materials do not meet rehabilitation objectives and relevant completion criteria.	Suitable source of additional soil material / growth medium to be identified, including the need for importation of material from off site. Investigation into measures that may be implemented to ameliorate other materials to make them suitable for use as a growth medium.	Moderate	T-11
Weed infestation associated with both introduction and control (or lack thereof).	Elevated weed and feral animal populations identified within surveys	Implement improvement program in consultation with ecologist and monitor through rehabilitation monitoring program.	Moderate	T-12
Adverse weather and climatic influences (e.g. drought; intense rainfall events; bushfire and climate change).	Bushfires and rain fall events pass control measures. Diversity of vegetation does not meet rehabilitation objectives and relevant completion criteria.	A suitably qualified professional in sediment and erosion control will engaged to prepare an assessment report and recommendations to be implemented. Suitably qualified ecologist or revegetation / rehabilitation expert engaged to assess reasons for divergence of failure of target or local vegetation establishment and recommend actions to ensure that the final vegetation community corresponds as closely as possible to the target community.	Moderate	T-13

Rehabilitation Threat	Trigger	Response	Risk Ranking	TARP ID
Insufficient establishment of target species and limited species diversity.	Incorrect species established on final landform. Miscalculation of species mix required. Diversity of vegetation does not meet rehabilitation objectives and relevant completion criteria.	Suitably qualified ecologist or revegetation / rehabilitation expert engaged to assess reasons for divergence of failure of target or local vegetation establishment and recommend actions to ensure that the final vegetation community corresponds as closely as possible to the target community. Additional actions may include: • sowing of additional seed mix for targeted species or additional local species • use of tubestock, seed and mulch mix or other application techniques • soil amelioration works such as addition of gypsum, lime, fertiliser etc.; and • additional weed control activities (mechanical and / or chemical) and/or pest management as required.	Moderate	T-14

11.0 Review, Revision, and Implementation

This RMP will be reviewed annually and amended under the following circumstances:

- to substitute the proposed version of a rehabilitation outcome document with the version approved by the Secretary—within 30 days after the document is approved,
- as a consequence of an amendment made under clause 14 to a rehabilitation outcome document—within 30 days after the amendment is made,
- to reflect any changes to the risk control measures in the prepared plan that are identified in a rehabilitation risk assessment—as soon as practicable after the rehabilitation risk assessment is conducted,
- whenever given a written direction to do so by the Secretary—in accordance with the direction.

The RMP will also be reviewed and amended as required under the following:

- receipt of any approvals under the *Environmental Planning and Assessment Act 1979* and/or at least 2 months prior to expiry
- major changes in delivery methodology of a rehabilitation phase
- changes to landform or revegetation design, and/or
- identification of new risks or foreseeable hazards to rehabilitation are identified.

Review and revision to the RMP could also be triggered by (but may not be limited to) the following circumstances:

- changes to the rehabilitation objectives, rehabilitation completion criteria or final landform and rehabilitation plan
- any changes to the risk control measures in the rehabilitation management plan that are identified in a rehabilitation risk assessment
- where a directive in writing is made by a regulatory agency to the Mine, or
- updates required to provide more detailed information and additional specifics on the rehabilitation activities.

Any change to the RMP will be communicated to all site personnel during daily start-ups and displayed in the crib room. Changes will also be discussed and communicated as part of the implementation plan.

12.0 References

Landcom. (2004). Managing Urban Stormwater. *Fouth Edition, Volume 1. Soils and Construction (the 'Blue Book')*. NSW.

Landloch Pty Ltd (2021) Wonawinta Mine: Material Characterisation Report. Redhead, NSW.

NSW Office of Environment and Heritage. (2012). The land and soil capability assessment scheme – second approximation. A general rural land evaluation system for New South Wales. Sydney, NSW, Australia: Office of Environment and Heritage. Retrieved from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Land-and-soil/land-soil-capability-assessment-scheme-120394.pdf

NSW Resources Regulator. (2021). *Form and Way: Rehabilitation Managment Plan for Large Mines*. NSW: NSW Resources Regulator.

R.W. Corkery & Co. Pty. Limited (RWC) (2010). *Wonawinta Silver Project Environmental Impact Statement*. Orange, NSW. Prepared on behalf of Cobar Consolidated Resources Limited.

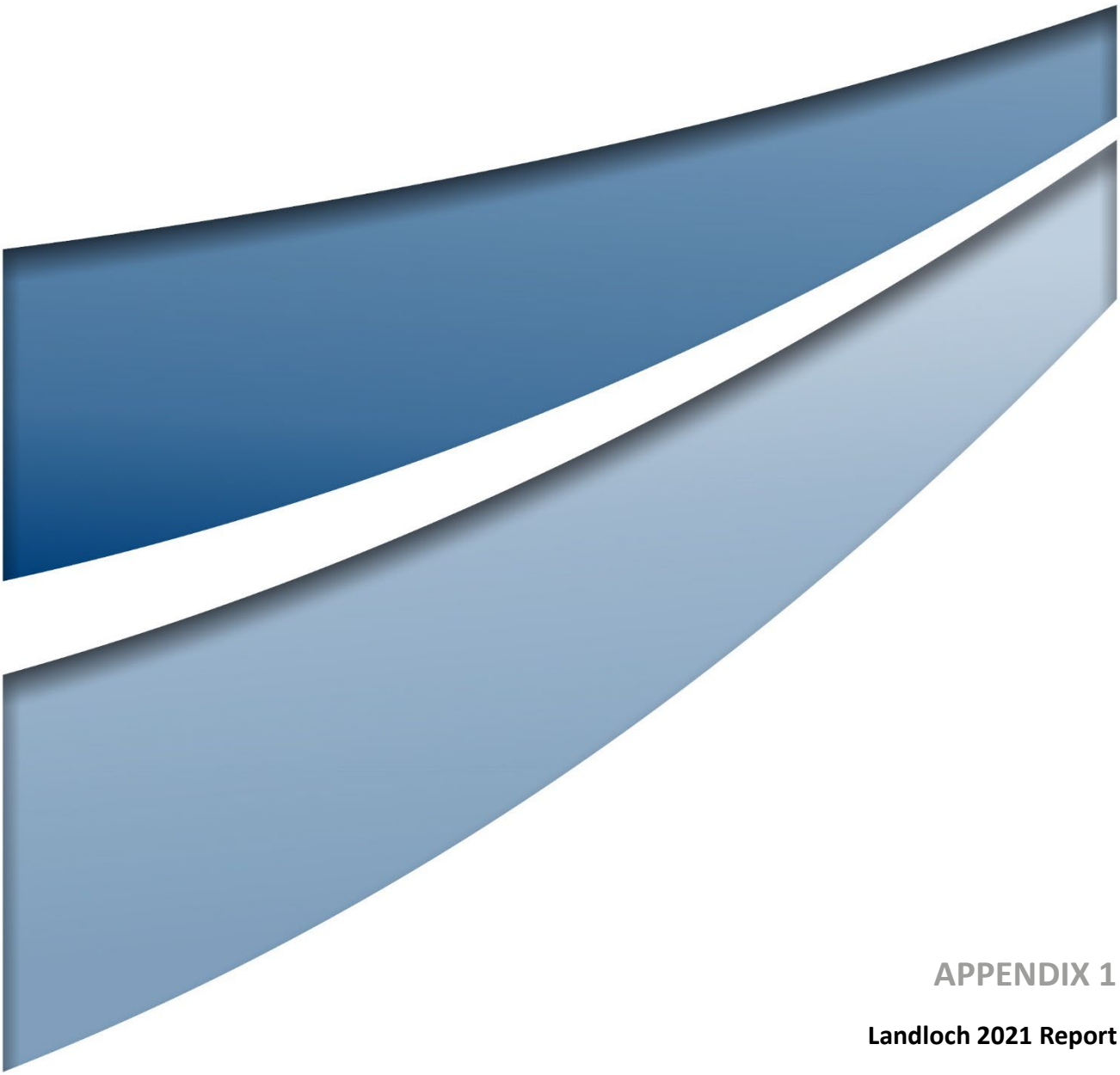
R.W. Corkery & Co. Pty. Limited (RWC) (2012a). *Water Management Plan for the Wonawinta Mine*. Orange, NSW.

R.W. Corkery & Co. Pty. Limited (RWC) (2012b). Waste Management Plan (including Acid Mine Drainage Management) for the Wonawinta Mine. Orange, NSW.

R.W. Corkery & Co. Pty. Limited (RWC) (2015a). Statement of Environmental Effects for a Proposed Modification to the Manuka Mine (Importation and Processing of Mt Boppy Mine Ore), Orange, NSW.

R.W. Corkery & Co. Pty. Limited (RWC) (2015b). *Stormwater Management Scheme – Manuka Mine*, Orange, NSW.

R.W. Corkery & Co Pty Limited (RWC) (2020). Mining Operations Plan for the Manuka Mine (Report No. 802/39), Version 1. Orange, NSW.

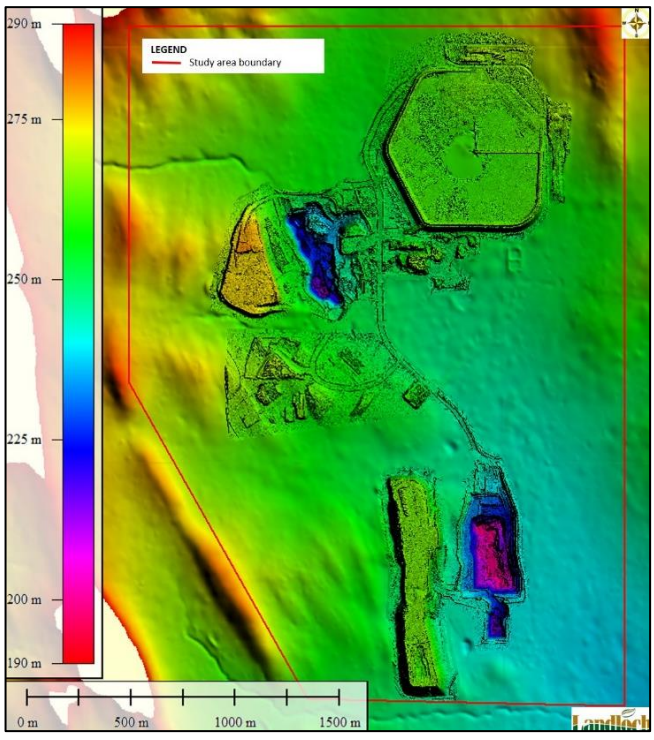


APPENDIX 1

Landloch 2021 Report

Wonawinta Mine: Material Characterisation Report

Manuka Resources Ltd



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Project Number: 3467.21a

Report Title: Wonawinta Mine: Material Characterisation Report

Client: Manuka Resources Ltd

Review History

Version	Prepared by	Reviewed by	Date
Rev A	Glenn Bailey	Cathie Shorthouse	8 July 2021
Rev B	Simon Buchanan	Glenn Bailey	12 July 2021
Rev C	Glenn Bailey	Simon Buchanan	15 July 2021
Rev 0	Simon Buchanan	Glenn Bailey	19 July 2021
Rev 1	Glenn Bailey	Simon Buchanan	**3 August 2021**

CONTENTS

1 INTRODUCTION

Manuka Resources engaged Landloch to undertake characterisation of rock, waste, substrate and soil materials at the Wonawinta Silver Mine (the Mine) (Figure 1). The characterisation aimed to assess the physical and chemical properties of the materials, and their suitability for supporting vegetation and post mining land uses. This report discusses the results of the sampling process, and provides recommendations for the amendment of various materials.

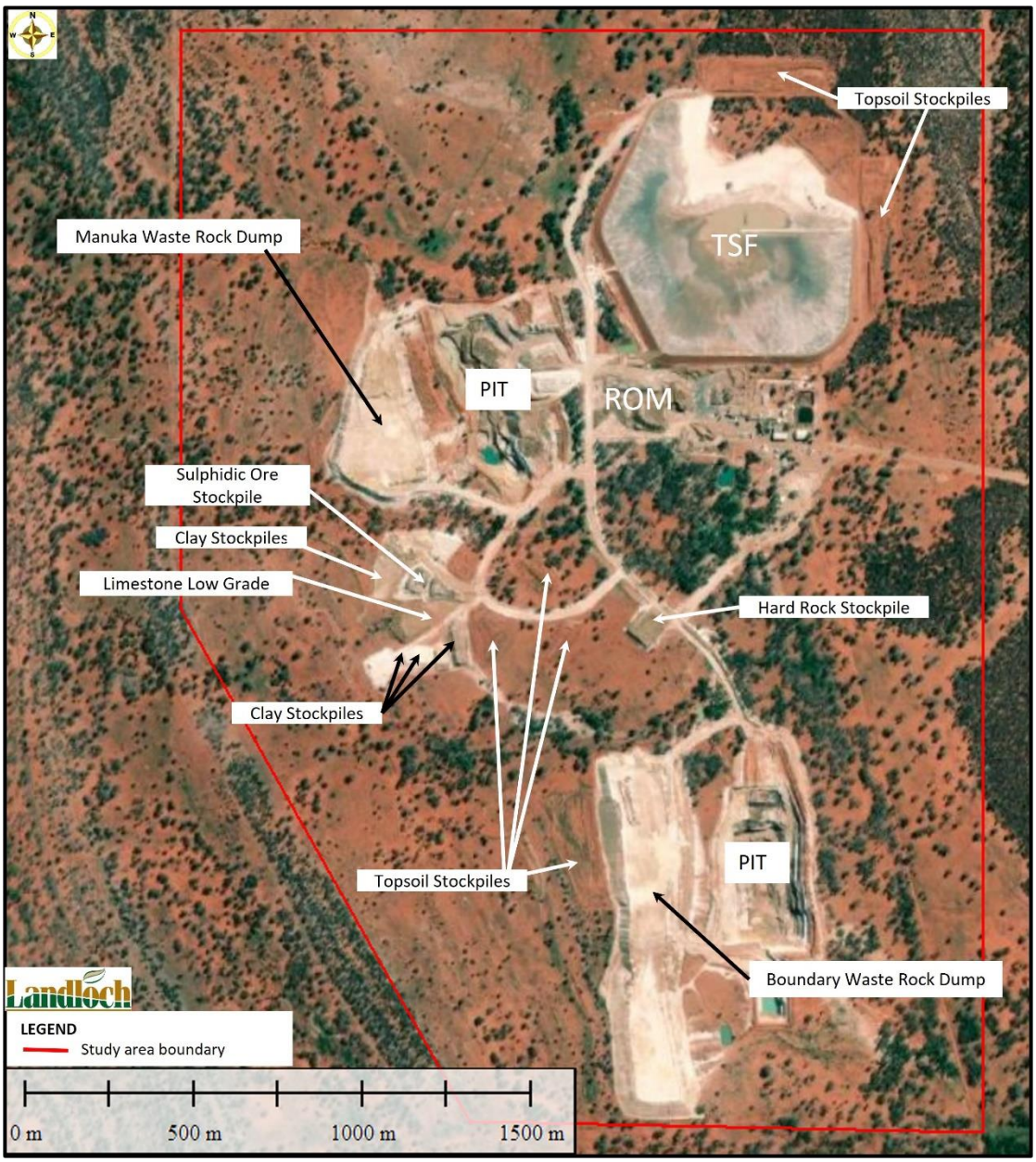


Figure 1: Aerial image of Wonawinta Mine, with locations of sampled stockpiles.

1.1 Project Description

The Mine is located approximately 80 km south of Cobar, NSW. It commenced in 2011/12 as a shallow silver oxide project. It includes two pits and their associated waste dumps, a processing plant, Run-of-Mine (ROM) Pad, Tailings Storage Facility, stockpile areas, offices, workshops and water management structures.

Currently the mine is processing Mt Boppy gold ore and undergoing exploration of silver, lead, and zinc reserves on the lease.

1.2 Scope of Work

Landloch understands Manuka Resources were seeking technical support to address directions raised by the NSW Resources Regulator in *Notice NTCE00006662* (the Notice) dated 6 November 2020 (Dept of Regional NSW, 2020). Relevant sections of this notice are provided below:

> *As a minimum, this report must include an assessment of the following:*
>
> a. *Characterisation (including physical and chemical properties) of overburden, waste rock emplacements, tailings, subsoil and topsoil material that will be present in the final landform.*
> b. *Justification of sample collection and testing protocols: sampling location; density; field testing and analytical testing undertaken. Note that testing will be required to focus on characterisation of material that presents a risk due to potential problematic geochemical properties, such as AMD potential as well as dispersive properties.*
> c. *An assessment of the potential for soil and material properties to affect the establishment of vegetation and or the quality of surface runoff and groundwater seepage.*
> d. *Recommended controls including management and amelioration measures to address any constraints / opportunities identified under measures 2a, b and c in order to achieve rehabilitation objectives nominated in the Mining Operations Plan dated January 2020.*

The scope of work was to assess the issues identified in the Notice. Details of the assessment and findings are provided in this report.

Three stockpile types were identified at the Mine:

- **Topsoil Stockpiles:** Mostly comprising soil materials originating from the surface, with some subsoil materials also included. Stockpiles to be used a primary growth medium for vegetation.
- **Clay Stockpiles:** Mainly pale grey and brown soil-like materials. Stockpiles largely to be used for construction of earthen structures (e.g. tailings dams), and may function as a secondary growth medium for vegetation.
- **Waste Rock Dumps (WRD) and Stockpiles** include the following:
  - Boundary WRD and Manuka WRD are mainly pale grey and brown soil-like materials, similar to the Clay Stockpiles, with a minor proportion of rock.
  - Hard Rock Stockpile is comprised of large boulders to small, hard rocks. A proportion of soil-like materials are also present.
  - Limestone Low Grade Stockpile is comprised of cobble and stone sized hard rocks (The National Committee on Soil and Terrain, 2009), and soil-like materials.

Please note – assessment of acid mine drainage is not included in this scope of work, but is a requirement of the Notice.

1.3 Sampling and Analysis

A Sampling and Analysis Plan (SAP) was developed for the project, and is presented in Appendix E. The SAP details the background information used in the design of the sampling program, including:

- Climate summary;
- Topography based on recent Lidar;
- Gamma radiometric total dose map; and
- 1:250,000 to 1: 1,000,000 scale geology, native vegetation and soil mapping.

The field sampling locations were guided by the SAP, and maps of the locations are presented in Figures C1 to C6 in Appendix C.

A total of 93 samples were taken from the site:

- 17 composite samples from the Clay and Topsoil Stockpiles for detailed analysis;
- 38 discrete Clay and Waste Rock Dump and Stockpile samples for semi-detailed analysis; and
- 38 discrete Topsoil Stockpile samples for basic analysis.

The samples were sent to a NATA and ASPAC accredited laboratory for the analysis detailed in Table 1.

Table 1: Laboratory analysis suites.

Analysis	Suite		
	Detailed	Semi-detailed	Basic
pH and electrical conductivity.	✓	✓	✓
Exchangeable cations (with calculations of effective cation exchange capacity and exchangeable sodium percentage) and chloride.	✓	✓	
Total nitrogen, phosphorous, heavy metals; available phosphorous, potassium, and sulphur; trace nutrients (Cu, Zn, Mn, Fe, B), chloride, organic carbon and phosphorus buffer index (PBI), field texture.	✓		
Dispersion potential.	✓	✓	
Particle size analysis (PSA).	✓	✓	
Photogrammetry PSA.		✓*	

*Selected samples

2 METHODOLOGY

2.1 Sampling Locations and Intensity

The density of sample locations was designed with reference to *Guidelines for Surveying Soil and Land Resources (2ed)* (McKenzie, Grundy, Webster, & Ringrose-Voase, 2008). The frequency of sampling was derived from Topsoil Stockpile volumes (Manuka Resources Ltd, 2021), based on the final landscape area that the materials are projected to cover following rehabilitation, with a cover thickness of 0.15 m as detailed in the Mining Operation Plan (R.W. Corkery, 2020) (R.W. Corkery, 2011). Using this criterion, the sampling intensity provided an approximate observation equivalent for the topsoil materials of 1 observation/ 4 hectares (ha). This is based on 38 samples being taken from the Topsoil Stockpiles. The sampling intensity translates to an observation scale of 1:10,000 (McKenzie, Grundy, Webster, & Ringrose-Voase, 2008).

To put this sampling scale (intensity) of 1:10,000 into perspective, the rate is more intense than modern consent conditions for mines in NSW. They commonly require soil survey at an intensity no less than 1 observation/ 20 ha, that correlates with survey scale of 1:25,000. The Clay Stockpiles' volume is approximately a third of the Topsoil Stockpiles. In order to capture a similar intensity sampling, a total of 12 samples were collected from the Clay Stockpiles.

Locations for each sample were selected using the available GIS and stockpile volume information, and were modified based on observations made in the field. In-field observations were also used to select the accessible points that were most representative of the stockpiled materials. Samples and descriptions of materials were taken from freshly excavated test pits.

2.2 Topsoil and Clays Stockpiles

Depth of excavation was to the base of the stockpile, or to the limit of excavation (up to 3 m). Samples were collected at depth intervals provided in Table A1 in Appendix A.

Sampling included composite and discrete samples of approximately 500 g each. Each composite sample was composed of materials from up to three discrete samples from the same test pit. Composite samples were prepared for the Topsoil and Clay Stockpile materials.

Brief morphological details about the collected materials were recorded. Soil and material descriptions were in reference to the *Australian Soil and Land Survey Field Handbook 3rd Ed* (The National Committee on Soil and Terrain, 2009). Attributes included colour, texture, structure, HCl fizz, coarse fragments, and consistence. Results of the morphological descriptions of the materials are provided in Table A2 in Appendix A.

A variation from the volumes tabled in the SAP, most of the Clay Stockpiles appeared to have been removed at the time of the survey. It was advised that they had been used recently as materials to increase the storage capacity of

the Tailings Storage Facility (TSF). Approximate field estimates indicate that only around 20 % (~50,000 m^3) of the Clay Stockpiles still remained.

2.3 Waste Rock Stockpiles and Dumps

The majority of the stockpiled Waste Rock (~99 %) is pale and ferruginous oxidised clay or oxidised limestone, and given the already oxidised nature of the material, represents a very low acid generating potential (R.W. Corkery, 2020). Samples and descriptions of materials were taken from shallow test pits over 1 m deep in the Waste Rock Dumps and Stockpiles. Waste rock samples were screened (< ~ 50 mm diameter) in the field, with the fines component being submitted for laboratory analysis. Photogrammetry PSA was undertaken on samples with sufficient rock content greater than 20 mm in diameter.

A variation from the volumes tabled in the SAP was observed, as the Limestone Waste Rock Stockpiles appeared to have been mostly removed from the site at the time of the survey. Only a small portion of the Limestone Low Grade stockpile remained. The Hard Rock Stockpile had also had significant materials removed, however, a substantial stockpile remained.

3 MATERIAL MORPHOLOGICAL DESCRIPTIONS

Results of the morphological descriptions of the stockpiled materials are provided in Table A2 in Appendix A.

3.1 Topsoil Stockpile materials

The materials found in the Topsoil Stockpiles were mostly recovered surface soil (topsoil) materials. The stockpiles were generally similar in morphology. These materials were predominantly red to red-brown in colour. They were apedal, powdery, friable and loamy textured. The exception is a sample taken from TSP07 that was identified as a subsoil material, and was lower in organic carbon and higher in coarse fragments than the surface soil materials.
A representative photo of a Topsoil Stockpile is provided in Photograph 1, and a representative photo of topsoil materials is provided in.Photograph 2.

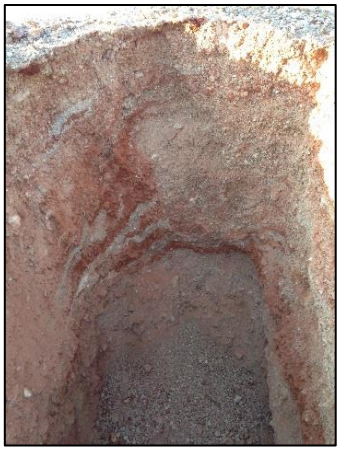
Photograph 1 Landscape of Topsoil Stockpile at Site TSP01.

Photograph 2 Excavated material in Topsoil Stockpile at Site TSP02.

3.2 Clay Stockpile materials

The materials found in the Clay Stockpiles were all substrate (non-pedogenic) materials. They were predominantly pale, dense, massive, firm to hard, clay loams and clays. Representative photos of Clay Stockpile materials are provided in Photograph 3 and Photograph 4.

Photograph 3 Surface of Clay Stockpile at Site5.



Photograph 4. Excavation in Clay Stockpile at Site CSP06.

3.3 Waste Rock Dump and Stockpile materials

The materials found in the Waste Rock Dumps and Stockpiles were all substrate (non-pedogenic) materials. The Manuka WRD and Boundary WRD, which make up the great majority of the volume of the materials, were predominantly pale, dense, massive, firm to hard, clays. They were similar in appearance to the Clay Stockpile materials.

The Hard Rock Stockpile and Limestone Low Grade Stockpile were similar in appearance to each other. Both were dominated by hard rocky materials, with a soil-like component amongst the harder material.

Representative photos of WRD and Stockpile materials are provided in Photograph 5 to Photograph 8.

Photograph 5 Excavated material at the Boundary WRD.

Photograph 6. Excavated material at the Boundary WRD Site M4.

Photograph 7 Surface of Hard Rock Stockpile.

Photograph 8. Excavated material at the Limestone Low Grade Stockpile.

4 LABORATORY CHEMISTRY ANALYSIS

A complete set of the laboratory results are presented in Appendix B.

4.1 Nutrients

The macro-nutrient status of the Topsoil and Clay Stockpiles is summarised in Table 5. The plant available phosphorus (P- Colwell) levels are very low (Peverill, Sparrow, & Reuter, 1999), and plant requirements will need to be supplied from applications of fertiliser. The phosphorus buffer index (PBI) is low (Burkitt & Gourley, 2003), meaning that much of the phosphorus applied as fertiliser should remain readily available to plants.

The soil store of exchangeable potassium (K) is high, and further K is not required for the growth of healthy plants. Similarly, sulphur (S) levels are moderate to very high. The S that will be applied incidentally with other nutrients should be sufficient to sustain cover vegetation for many years.

Organic carbon (OC) and total nitrogen (N) levels are linked. Both were universally very low across the stockpiled materials. All the N required to promote the establishment of plants will need to be applied as fertiliser.

Table 2: Soil and substrate material macro-nutrient summary.

Material	Statistic	Total P (%)	P (Colwell) mg/kg	PBI	Exch K (mg/kg)	Total N %	OC %	S (mg/kg)
Topsoil stockpiles	Average	0.017	7.8	56.4	488	0.07	0.5	16
	Std dev.	0.005	2.14	10.1	76	0.0166	0.11	7.8
Clay stockpiles	Average	0.079	<5	67.8	175	<0.05	<0.2	155
	Std dev.	0.052	-	50.1	116	-	-	85

Table 3 summarises the trace element status of the Topsoil and Clay Stockpiles. The topsoils were all adequate for copper (Cu), manganese (Mn) and boron (B). Stockpiles TSP02 and TSP07 were marginal for zinc (Zn).

Table 3: Soil and substrate material micro-nutrient summary.

Material	Statistic	Cu (DTPA) (mg/kg)	Fe (DTPA) (mg/kg)	Mn (DTPA) (mg/kg)	Zn (DTPA) (mg/kg)
Topsoil stockpiles	Average	0.60	15.6	7.5	0.75
	Std dev.	0.12	6.9	5.1	0.55
Clay stockpiles	Average	1.7	4	0.7	17.29
	Std dev.	1.5	1.3	0.4	23.07
Waste rock stockpiles	Average	-	-	-	-
	Std dev.	-	-	-	-

4.2 Salinity, cations and pH

Table 4 summarises the key pH, salinity and cation data for each of the stockpile groups. Of all the Topsoil Stockpiles, only sample (T7-1) from stockpile TSP07 returned a pH outside that which may be considered suitable for many plant species. The strong alkalinity of this sample is most likely driven by the presence of bicarbonate, and may be treated by applying gypsum. The gypsum will precipitate bicarbonate to form the less alkaline mineral, calcite. Alternatively, mixing the high pH materials with the other Topsoil Stockpile materials will reduce alkalinity by dilution.

The Clay and Waste Rock Stockpiles were commonly strongly alkaline, and these would require amendment with gypsum. Contrastingly, one sample, Boundary WRD-4, was strongly acidic and highly saline. As the sample had a relatively low chloride level for its $EC_{1:5}$, it is likely that the sample represents, at least partially, a sulphidic ore material. Mixing and diluting the acidic, saline material with the surrounding alkaline material is likely to ameliorate the material.

All the Topsoil Stockpile samples had low salinities, and will suit even the more salt sensitive plant species. However, the very low salinities will have a negative impact, in that low soil electrolyte content increases the dispersion potential of the soil at a given exchangeable sodium saturation. This is generally overcome with a light, even application of gypsum across the site following topsoil

spreading. Alternatively, the gypsum can be mixed with the stockpiled material during deconstruction of the stockpile.

The Clay and Waste Rock Stockpiles commonly exhibited moderate to high salinities, such as would affect plants that are low to moderately salt tolerant. The materials exhibited high degrees of spatial variability within a given stockpile, with ranges commonly from 0.5 mS/cm to 1.0 mS/cm. It may be beneficial to better map this spatial variability using an Electromagnetic Indication (EMI) device. In-field testing of both electrical conductivity ($EC_{1:5}$) and pH are recommended during deconstruction, amendment and utilisation of the clay and waste rock materials, should they be used as secondary growth media.

Table 4. Soil material salinity, sodicity, pH summary.

Material	Statistic	pH_w	EC (1:5) (mS/cm)*	Cl (mg/kg)	CEC (cmol/kg)	ESP (%)
Topsoil stockpiles	Average	7.2	0.22	44	11.3	2.0
	Std dev.	0.75	0.07	34	4.86	1.8
Clay stockpiles	Average	8.5	0.68	543	15.56	21.1
	Std dev.	0.77	0.27	317	8.79	9.1
Waste rock stockpiles	Average	8.4	0.99	495	17.8	15.2
	Std dev.	1.01	1.08	258	12.47	9.0

*mS/cm is numerically equal to dS/m.

The cation exchange capacity (CEC) of all the materials indicate that they have a moderate capacity to retain fertility. CEC is related to a soils ability to supply plants with nutrients such as calcium, magnesium and potassium, as well as its ability to retain some applied fertilisers. Exchangeable sodium influences a soils tendency to disperse and loose porosity. Dispersion greatly increases a soils risk of eroding. The exchangeable sodium percentage (ESP) is used to determine the sodium influence on soil structure, with critical ESP levels varying depending on soil salinity.

The relationship between ESP and salinity is quantified using the electrochemical stability index (ESI), with values under approximately 0.05-0.1 being at risk of being dispersive (McKenzie D. , 1998). Although the Topsoil Stockpiles generally had low ESPs, they also had very low salinity, and correspondingly low ESIs. The topsoil materials tended to be dispersive, as laboratory Emerson aggregate tests (EAT) showed that most either dispersed spontaneously (EAT=2), or dispersed following remoulding (EAT=3). The Topsoil Stockpile materials are likely to respond positively to a low application rates of gypsum.

The Clay and Waste Rock Stockpiles almost all tested as sodic (ESP>6), as well as having low (dispersive) ESIs. However, less than half the samples dispersed using the EAT likely due to the elevated salt levels. If these materials are used in rehabilitation, it is likely salts will leach over time and materials will become

dispersive. Therefore, gypsum is recommended for these materials in order to moderate pH, as well as to reduce dispersion risk.

4.3 Heavy metals

Elevated concentrations of Mn, Zn and lead (Pb) were reported in the Clay and Waste Rock Dumps and Stockpiles samples (Table 5), with lead concentrations on average 200 times that of the topsoil materials.

The reported total lead values were measured using the 17B1 laboratory method from *Soil chemical methods, Australasia* (Rayment & Lyons, 2011). This may differ from the laboratory method required for contaminated land assessments. Regardless, these results suggest Clay Stockpile samples CSP04 & CSP05 and Boundary WRD may contain lead levels above the Health Investigation Levels for commercial land prescribed in the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (Australian Government, 2013). Further assessment is recommended by a *Suitably Qualified Professional in Contaminated Land.*

Table 5: Soil and substrate material heavy metal summary.

Material	Statistic	Total Mn (mg/kg)	Total Zn (mg/kg)	Total Pb*. (mg/kg)
Topsoil stockpiles	Average	246	38	25.7
	Std dev.	114	17	14.3
Clay stockpiles	Average	1020	496	4450
	Std dev.	1199	610	3165
Waste rock stockpiles	Average	1810	1238	931
	Std dev.	3394	2368	1306

*Contaminated land consideration

5 PARTICLE SIZE ANALYSIS

All samples except the discrete samples from the Topsoil and Clay Stockpiles were assessed for particle size analysis (PSA). This included size class distributions for clay (<0.002 mm), silt (0.02-0.002 mm), fine sand (0.02-0.2 mm), coarse sand (0.2-2 mm) and gravel (>2 mm). Select samples of the waste rock materials also underwent photogrammetry analysis of the coarse materials greater than 20 mm.

The clay to gravel sized analysis is presented in Appendix B. A PSA summary is presented in Table 6. The Topsoil Stockpiles could be broadly categorised as loams, the Clay Stockpiles as clay loams to light clays, and the Waste Rock Dumps and Stockpiles as loams to clay loams.

Table 6: Particle size analysis (%)

Material	Statistic	Clay	Silt	Fine sand	Coarse sand	Gravel
Topsoil stockpiles	Average	20.7	9.7	48.8	21	4.4
	Std dev.	3.5	3.9	4.7	9.0	3.1
Clay stockpiles	Average	32	29.7	31	8	5.8
	Std dev.	7.8	3.5	4.2	4.7	3.4
Waste rock stockpiles	Average	25.7	23.0	33.2	18.1	6.9
	Std dev.	9.8	7.6	6.6	13.6	5.1

The photogrammetry PSA results of the samples with appreciable coarse material are presented in Table 7 and Appendix D. Most of the waste rock materials had too little coarse material to be assessed via photogrammetry. Only the Hard Rock (HR) stockpile and the Low Grade Limestone (LL) stockpile were dominated by coarse, rock-like materials. The Manuka and Boundary waste rock dumps were predominantly fine (sand/silt/clay) sized materials. Table 7 provides the rock size classes at which 50% and 90% of the rocks are smaller in diameter.

Table 7: Particle size analysis (>20mm) – photogrammetry - % smaller than diameter

Passing	B-6	HR-2	HR-3	HR-6	LL-1	M-6	M-8
50%	30 mm	56 mm	39 mm	49 mm	58 mm	33 mm	46 mm
90%	67 mm	143 mm	128 mm	102 mm	205 mm	83 mm	93 mm

6 GROWTH MEDIA SUITABILITY

The materials encountered have been classified according to their ability to support plant growth, as either *primary* or *secondary* growth media.

6.1 Primary Growth Media

Primary growth media infers the ability of materials to be used as a surface soil material.

It is the upper-most layer of soil/materials placed over the rehabilitated area. In most situations at the Mine it is to be applied at approximately 0.15 m deep (R.W. Corkery, 2020).

6.1.1 Topsoil Stockpiles

Of the stockpiles assessed at the site, only those identified as Topsoil Stockpiles were found to be suitable to be used as primary growth media. Most of the materials will require some form of amendment in order to support healthy vegetation cover. All Topsoil Stockpile samples were deficient in nitrogen, phosphorus and organic matter (Table 8).

Table 8: Nutrient deficiency summary for Topsoil Stockpiles.

Relevant material	Deficiency		
	Phosphorous	Nitrogen	Organic matter
All topsoil samples	✓	✓	✓

All of the Topsoil materials presented some risk of soil dispersion, mainly due to low electrochemical stability index (ESI), and this is corroborated by the results of the Emerson aggregate test (EAT). Amendment recommendations are provided in Section 7.

Table 9: Soil material limitation requiring amendment for Topsoil Stockpiles.

Limitation	Stockpile	Treatment
Strong alkalinity	TSP07	gypsum- 2 t/ha
Potentially dispersive ESI* (<0.1)	TSP01, TSP02, TSP07, TSP08	gypsum- 2 t/ha
Spontaneous dispersion	TSP02, TSP08	gypsum- 2 t/ha
Dispersion following re-moulding	All Topsoil Stockpiles tested.	gypsum- 2 t/ha

*electrochemical stability index

6.1.2 *Clay Stockpiles and Waste Rock Dumps and Stockpiles*

Materials from the Clay Stockpiles and Waste Rock Dumps and Stockpiles may have some limited suitability to be used as a surface layer in areas where there is a shortage of Topsoil Stockpile material. This should be avoided on batters or gradients over 6%, due to their greater erosion risk. Material from the Topsoil Stockpiles should be prioritised for the batters and steeper slopes. In-field screening for salinity is required to determine if the non-topsoil material can be used as a surface layer. The screening limit for the materials should be less than 0.6 mS/cm. Note that in-field screening for salinity needs to take place before any gypsum is added to the material.

6.2 Secondary Growth Media

Secondary growth media infers the ability of materials to be used as a sub-surface layer placed on the rehabilitation area prior to covering with a primary growth media. Its prime purpose is to increase the soil water storage capacity of the soil profile and/or to meet the soil depth criterion for certain vegetative post-mining land uses and target vegetation communities.

The non-topsoil materials (Clay and Waste Rock Dumps and Stockpiles) assessed at the site presented numerous constraints. Most of the Clay and Waste Rock materials were significantly more saline, sodic and strongly alkaline than would be expected for a natural subsoil at the site. With amendment, some may be suitable to be secondary growth media. Further screening of materials for salinity, at a higher intensity, will be required to determine suitability.

Materials from the Clay and Waste Rock Stockpiles would need to have chloride values less than 600 mg/kg, or an electrical conductivity ($EC_{1:5}$) less than 0.6 mS/cm in order to be considered suitable for being a secondary growth media for vegetation with low to moderate salt tolerance.

Approximately 40 % of the Clay Stockpile samples met this criteria. In-field testing during stockpile deconstruction would be required to determine a materials suitability. Note that in-field screening for salinity needs to take place before any gypsum is added to the material. Alternatively, plant species that can tolerate higher subsurface salinity levels may be selected for the site.

Should the clay and waste rock materials be placed within the rootzone of plants, the amendments found in Section 7 are recommended.

Table 10: Substrate material limitation requiring amendment

Limitation	Stockpile	Treatment
Strong alkalinity	Clay stockpiles CSP04 & CSP06. All Waste Rock stockpiles	Apply gypsum to precipitate bicarbonate
Strong acidity/high aluminium	Boundary WRD*	Mix with more alkaline WRD materials
Sodic ESP	Clay stockpiles CSP04, CSP05, & CSP06. All waste rock stockpiles	Apply gypsum 5t/ha
Moderate salinity	Clay stockpiles CSP04 & CSP05. All waste rock stockpiles.	Placement depth/ species selection
Potentially dispersive ESI (<0.1)	Clay stockpiles CSP04, CSP05 & CSP06. All waste rock stockpiles.	Apply gypsum 5t/ha
Spontaneous dispersion	Clay stockpiles CSP04, CSP05, & CSP06. Boundary, Manuka and HR WRD	Apply gypsum 5t/ha
Dispersion following re-moulding	Clay stockpiles CSP05, CSP06, HR WRD	Apply gypsum 5t/ha
High lead	Clay stockpiles CSP04, CSP05, Boundary WRD	Further assessment by a Suitably Qualified Professional in Contaminated Land

*Boundary WRD was neutral to strongly alkaline for all samples except B-4, which was strongly acidic.

6.3 Sulphidic Ore

Sulphidic ore has been excavated from the Boundary Pit and stockpiled a few hundred metres south of Manuka WRD, as shown in Figure 1. A portion of the sulphidic material has been used to backfill the upper northern section of the Boundary Pit, and will be retained in this location. The stockpiled sulphidic ore materials are segregated from natural runoff to prevent discharge of low pH water from the Mine. If not processed, these materials will be placed within the TSF prior to capping and rehabilitation (R.W. Corkery, 2020).

Based on the stockpile design, and the end use of the sulphidic materials, Acid Mine Drainage (AMD) testing was not undertaken on the Sulphidic Ore Stockpile. Apart from sample B-4, all other weathered substrate materials were strongly alkaline, and so did not warrant AMD testing. While sample B-4 was acidic, it was not below those commonly found in natural soil conditions. Also, the overwhelming bulk of the surrounding materials were strongly alkaline, and more than sufficient to neutralise the acidity of the materials represented by sample B-4.

7 FERTILISER AND AMELIORANTS

7.1 Gypsum

All Topsoil Stockpile samples were non-sodic, having exchangeable sodium percentages (ESP) below 6 %. However, as their salinities were also very low, they generally presented a moderate dispersion risk based on their electrochemical stability index (ESI) (McKenzie D. , 1998). Laboratory Emerson Aggregate Tests (EAT) also confirmed that most of the samples either dispersed spontaneously, or dispersed following remoulding (simulating a recently worked material). Consequently, it is recommended that a rate of gypsum be applied at a rate of 2 t/ha in order to increase the surface soil electrolyte content to a level that reduces dispersion risk.

Gypsum should be applied during soil preparation stages in a manner that allows for as thorough mixing as is practicable into the surface materials. It should be applied prior to seed and fertiliser applications.

Gypsum treatment is required for all the Clay and Waste Rock Stockpile samples that are to be used as primary or secondary growth media. A rate of 5 t/ha is recommended per 0.15 m thickness of material.

7.2 Fertiliser

All the stockpiled topsoil materials to be used as primary growth media were uniformly deficient in nitrogen, phosphorus and organic carbon. Table 11 provides a recommended rate of fertiliser to be applied across the site following topsoil spreading.

The coated urea will enable nitrogen nutrition to extend beyond the first season of plant growth.

Table 11: Fertiliser recommendation

Deficiency	Nutrient supplied	Fertiliser	Rate
Nitrogen & Phosphorus	42 kg N /ha	Coated urea (270 day release)	100 kg/ha
	54 kg N & 60 kg P /ha	DAP	300 kg/ha
Zinc	As a blend with the DAP fertiliser (1-2%)		

7.3 Organic matter

Compost, or similar organic material, is desirable to reduce hardsetting, and so to enhance water infiltration and seed germination. Given the proximity of the

mine importation of compost is likely not practicable. The compost, while a desirable addition to the soil amendment products, is not as important as the N and P fertiliser requirement. In the absence of compost, organic matter production through the use of sufficient nitrogen fertilisers becomes even more important.

8 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are provided:

1. The volumes of the various stockpiles have reduced significantly between those reported in the *Mining Operations Plan for the Manuka Mine* (R.W. Corkery, 2020), the *Annual Rehabilitation Report* (Manuka Resources Ltd, 2021), and the field survey. It is recommended that a more up to date inventory be made of the various stockpile locations and volumes.

2. The Topsoil Stockpiles assessed had few chemical or physical constraints. They are generally suitable for use as primary growth media, as long as nutritional and stability limitations are amended with fertiliser and gypsum.

3. The main chemical constraints of the Clay and Waste Rock materials were salinity, sodicity, and alkalinity. Gypsum will ameliorate the sodicity and pH constraints. For the Clay and Waste Rock materials, in-field pH and $EC_{1:5}$ measurements are recommended during deconstruction of stockpiles, amending of the materials, and prior to spreading materials across the site. Screening for salinity and pH needs to take place before any gypsum is added to the material.

4. Plant species used in rehabilitation of Clay and Waste Rock materials will need to have a moderate to high salt tolerance.
5. An appropriately designed EMI survey of the Clay and Waste Rock materials may be desirable to delineate the spatial variability of salinity.

6. The Clay and Waste Rock materials were structureless and dense, and would require deep ripping should they be selected as a secondary growth media.

7. Lead was found to be elevated in many Clay and Waste Rock Samples. This should be assessed further by a Suitably Qualified Professional in Contaminated Land.

9 REFERENCES

Australian Government. (2013). Volume 10: Schedule B7- Appendix C. In *National Environment Protection (Assessment of Site Contamination) Measure 1999* (p. 10). Canberra: National Environment Protection Council.

Burkitt, L., & Gourley, C. (2003, March-April). New soil phosphorus test. *The Australian dairy farmer*.

Dept of Regional NSW. (2020). *Notice under the Mining Act 1992 section 240- NTCE0006662.* Maitland: NSW Goverment.

Manuka Resources Ltd. (2021). *ANNUAL REHABILITATION REPORT- 19 January 2020 to 18 January 2021- Wonawinta Silver Project.* Sydney: Manuka Resources Ltd.

McKenzie, D. (1998). *Soilpak for cotton growers 3rd edition.* Orange: NSW Agriculture.

McKenzie, N. J., Grundy, M. J., Webster, R., & Ringrose-Voase, A. J. (2008). *Guidelines for Surveying Soil and Land Resources (2ed).* Melbourne: CSIRO Publishing.

Peverill, K., Sparrow, L., & Reuter, D. (1999). *Soil Analysis: an interpretation manual.* Collingwood, VIC: CSIRO publishing.

R.W. Corkery. (2011). *ENVIRONMENTAL IMPACT STATEMENT. Wonawinta Silver Project. COBAR CONSOLIDATED RESOURCES LIMITED. Section 2.15.* R.W. Corkery.

R.W. Corkery. (2020). *Mining Operations Plan for the Manuka Mine.* R.W. Corkery.

Rayment, G. E., & Lyons, D. J. (2011). *Soil chemical methods, Australasia.* Collingwood, VIC: CSIRO Publishing.

The National Committee on Soil and Terrain. (2009). *Australian Soil and Land Survey Field Handbook. 3rd edition.* Melbourne: CSIRO Publishing.

APPENDIX A: TABLES

Table A1: Sample collection details

Stockpile (Sample label)	Locations per stockpile	Samples per location	Sampling interval depths
TSP01 (T1)	2	3	T1-1: 50-80, 130-150, 180-200 cm T1-3: 50-80, 150-180, 250-300 cm
TSP02 (T2)	3	3	50-70, 100-120, 150-170 cm
TSP07 (T7)	1	3	50-80, 150-180, 250-300 cm
TSP08 (T8)	2	3	50-80, 150-180, 250-300 cm
TSP09 (T9)	2	3	50-80, 150-180, 250-300 cm
TSP10 (T10)	6	1-2	T10-1- 70-100 cm x3 T10-2- 70-100 cm x2; 170-200 cm T10-3- 70-100 cm; 170-200 cm
CSP02 (C2)	1	0	n/a
CSP04 (C4)	2	3	50-80, 150-180, 250-300 cm
CSP05 (C5)	1	3	50-80, 100-130, 170-200 cm
CSP06 (C6)	1	3	50-80, 100-130, 170-200 cm
Boundary Waste Rock Dump (B)	8	1	100-130 cm
Manuka Waste Rock Dump (M)	8	1	100-130 cm
Hard Rock Stockpile (HR)	8	1	100-130 cm
Limestone Low Grade (LL)	2	1	100-130 cm

Table A2: Sample field descriptions

Field label	Texture*	Colour	% Coarse fragments*	Structure	Consistence	HCl fizz	Roots
T1-1	Light sandy clay loam	Red	8.2	apedal	weak	nil	present
T1-3	Sandy loam	Red	6.4	pedal	firm	nil	present
T2-3	Light sandy clay loam	Red	4.5	pedal	firm	nil	present
T2-4	Sandy loam	Red	5.9	apedal	weak	nil	present
T2-5	Sandy loam	Red	6.9	apedal	Very firm	nil	present
T7-1	Sandy Clay Loam	Red	1	apedal	strong	nil	absent
T8-2	Sandy Clay Loam	Red	1.3	apedal	weak	nil	present
T8-3	Sandy Clay Loam	Red	0.7	pedal	firm	nil	present
T9-1	Sandy Clay Loam	Red	2.7	apedal	weak	nil	present
T9-2	Sandy Clay Loam	Red	1.2	apedal	weak	nil	present
T10-1	Loam	Red	2.1	apedal	weak	nil	present
T10-2	Sandy Clay Loam	Red	6.3	apedal	weak	slight	present

Field label	Texture*	Colour	% Coarse fragments*	Structure	Consistence	HCl fizz	Roots
T10-3	Sandy Clay Loam	Red	10.1	apedal	weak	nil	present
C4-1	Silty Clay Loam	Grey	1.5	apedal	very firm	nil	absent
C4-2	Silty Clay Loam	Brown	8.2	apedal	very firm	nil	absent
C5-1	Silty medium clay	Grey	4.8	apedal	strong	nil	absent
C6-1	Silty Loam	Red	8.8	apedal	very firm	medium	absent
B-1	Silty Loam	-	7.5	apedal	weak	high	absent
B-2	Silty Loam	-	6.1	apedal	weak	nil	absent
B-3	Silty light clay	-	1.1	apedal	very firm	nil	absent
B-4	Light clay	-	7.7	apedal	firm	nil	absent
B-5	Silty light clay	-	4.2	apedal	firm	slight	absent
B-6	Sandy Loam	-	6.2	apedal	very firm	slight	absent
B-7	Medium clay	-	3.8	apedal	very firm	slight	absent
B-8	Silty light clay	-	1.9	apedal	very firm	nil	absent
HR-1	Loam	-	10.1	apedal	weak	medium	absent
HR-2	Sandy Loam	-	1.2	apedal	weak	nil	absent
HR-3	Sandy Loam	-	21.4	apedal	strong	slight	absent
HR-4	Sandy Loam	-	1.1	apedal	very firm	nil	absent
HR-5	Loam	-	3.2	apedal	very firm	slight	absent
HR-6	Sandy Loam	-	20.2	apedal	strong	medium	absent
HR-7	Sandy Loam	-	10.6	apedal	strong	medium	absent
HR-8	Silty Loam	-	8.6	apedal	very firm	medium	absent
LL-1	Silty Loam	-	6.3	apedal	weak	nil	absent
LL-8	Loam	-	8.4	apedal	-	high	absent
M-1	Silty Clay Loam	-	10.4	apedal	strong	slight	absent
M-2	Silty light clay	-	5.8	apedal	very firm	nil	absent
M-3	Light clay	-	6.9	apedal	firm	nil	absent
M-4	Silty Loam	Brown	9.4	apedal	very firm	slight	absent
M-5	Silty light clay	-	2.5	apedal	firm	nil	absent
M-6	Silty light clay	-	2.4	apedal	very firm	nil	absent
M-7	Loam	-	7.5	apedal	weak	high	absent
M-8	Silty light clay	-	3.9	apedal	weak	nil	absent

*Based on laboratory particle size

APPENDIX B: LABORATORY DATA

Table B1: Detailed analysis of Topsoil and Clay Stockpiles - 17 composite samples

Paddock Name		C4-1	C4-2	C5-1	C6-1	T10-1	T10-2	T10-3	T1-1	T1-3	T2-3	T2-4	T2-5	T7-1	T8-2	T8-3	T9-1	T9-2
pH w		8.3	8.7	7.8	9.6	7.9	8	7.4	7.2	7	6.9	6.1	6.3	8.8	7	7.5	7.6	6.4
pH CaCl2		7.9	8.3	7.4	8.5	7.4	7.6	7	6.7	6.4	6.3	5.4	5.6	8.2	6.5	6.8	7.1	6
EC (1:5 water)	dS/m	0.44	0.93	0.82	0.4	0.29	0.36	0.27	0.19	0.16	0.21	0.17	0.16	0.24	0.25	0.08	0.26	0.16
Chloride	mg/kg	380	800	700	180	20	20	17	96	50	110	41	33	93	25	23	22	17
Nitrate Nitrogen	mg/kg	0.7	1	4	2.3	73	100	95	24	35	25	47	47	21	84	10	77	59
Ammonium Nitrogen	mg/kg	0.6	0.9	0.6	<0.6	93	28	47	2.8	0.7	0.7	11	4.1	0.6	13	19	19	4
P (Colwell)	mg/kg	<5	<5	<5	<5	11	6	9	<5	<5	<5	<5	<5	<5	9	6	6	<5
(PBI-Col)		33	63	35	140	48	66	37	48	59	61	46	53	53	58	72	63	69
Avail K	mg/kg	78	94	180	330	550	560	520	530	370	370	420	380	530	590	510	510	500
Calcium (Amm-acet.)	cmol(+)/kg	1.8	9.6	4.1	17	8.7	16	8.6	5.6	4.8	4.7	4.2	3.9	15	6.6	6.8	8.8	5.7
Potassium (Amm-acet.)	cmol(+)/kg	0.2	0.24	0.47	0.85	1.4	1.4	1.3	1.4	0.95	0.96	1.1	0.97	1.4	1.5	1.3	1.3	1.3
Magnesium (Amm-acet.)	cmol(+)/kg	2	4	4	5.1	1.5	2	1.8	2.6	1.8	2.3	1.5	1.7	5.8	2	2	2.5	1.3
Sodium (Amm-acet.)	cmol(+)/kg	1.3	2.8	3.2	3	0.03	0.03	0.03	0.32	0.28	0.4	0.2	0.14	1.3	0.12	0.09	0.1	0.05
Aluminium (KCl)	cmol(+)/kg	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
CEC	cmol(+)/kg	5.4	16.7	11.8	25.5	11.7	19.2	11.7	9.9	7.9	8.4	7	6.7	23.4	10.3	10.2	12.7	8.4
ESP)	%	24	17	27	12	0.23	0.18	0.24	3.2	3.5	4.8	2.8	2	5.6	1.2	0.91	0.76	0.61
Copper (DTPA)	mg/kg	3.4	2.5	0.42	0.46	0.59		0.61	0.48	0.59	0.48	0.59	0.49	0.46	0.77	0.89	0.57	0.65
Iron (DTPA)	mg/kg	2	4.8	4.6	4.6	16	13	12	14	23	10	18	18	4.5	25	29	11	9.9
Manganese (DTPA)	mg/kg	0.2	1.1	0.9	0.5	6.7	7.4	5.5	7.9	4.3	3	6.9	4.2	1.1	9.4	22	8.1	11
Zinc (DTPA)	mg/kg	17	50	1.7	0.46	0.63	2.3	0.51	0.57	1.1	0.52	0.25	0.18	0.3	0.64	0.74	1.1	0.87
Boron (Hot CaCl2)	mg/kg	0.9	1.3	0.8	3.8	0.6	0.6	0.6	1.1	0.9	1.1	1	1.2	2.3	1.2	0.9	1	0.8
Sulphur (KCl40)	mg/kg	120	260	180	60	15	15	10	16	29	35	20	13	9	17	10	11	11
OC (W&B)	%	<0.2	<0.2	<0.2	<0.2	0.6	0.7	0.6	0.6	0.4	0.4	0.4	0.4	<0.2	0.6	0.4	0.4	0.5
Soil Colour		Grey	Brown	Grey	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red	Red
Silt	%	34	31	28	26	12	14	13	7	8	6	6	6	19	9	7	10	9
Clay	%	27	32	43	26	20	25	23	19	16	19	15	16	26	22	24	22	22
Sand (Coarse)	%	6	9	3	14	15	13	12	29	26	31	35	36	14	16	15	14	17
Sand (Fine)	%	34	29	26	35	53	49	52	44	51	44	44	43	42	54	53	54	52
Aluminium (KCl)	mg/kg	<9.0	<9.0	9.2	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0
Calcium (Amm-acet.)	%	34	58	35	65	75	82	73	57	61	57	60	59	64	64	67	69	68
Magnesium (Amm-acet.)	%	38	24	34	20	13	10	15	26	23	27	22	25	25	20	20	20	16
Potassium (Amm-acet.)	%	3.7	1.4	4	3.3	12	7.5	11	14	12	11	15	15	5.8	15	13	10	15
Emerson Class		6	6	2	3	3	3	3	3	2	2	3	7	3	3	2	3	3
Total Al	%	1.1	1	1.7	1.8	2.5	2.8	2.3	2.6	2.3	2.7	2.2	2.3	3.5	2.5	2.7	2.8	3
Total Cd	mg/kg	<0.130	1.9	<0.130	<0.130	0.13	0.74	0.36	0.18	<0.130	<0.130	<0.130	<0.130	0.25	0.14	0.32	<0.130	0.46
Total Calcium	%	0.05	2.5	0.17	2.2	0.23	0.53	0.27	0.17	0.12	0.13	0.11	0.11	0.69	0.18	0.18	0.21	0.15
Total Chromium	mg/kg	20	18	15	19	32	36	29	24	26	26	24	24	31	27	28	34	30
Total Copper	mg/kg	93	85	37	20	12	14	12	10	10	10	9	9	14	12	12	12	13
Total Iron	mg/kg	2,700	29,000	8,500	10,000	26,000	27,000	23,000	18,000	17,000	19,000	16,000	17,000	26,000	20,000	22,000	25,000	23,000
Total Lead	mg/kg	8,100	5,900	2,800	1,000	19	29	19	20	68	27	12	10	21	30	22	24	33
Total Magnesium	%	0.075	1.1	0.14	0.42	0.18	0.22	0.19	0.18	0.13	0.17	0.12	0.13	0.37	0.17	0.19	0.2	0.16
Total Manganese	mg/kg	560	2,800	540	180	350	440	300	120	110	110	140	110	320	290	240	340	330
Total Nickel	mg/kg	6	18	18	9	15	19	14	11	10	12	10	11	18	14	15	16	15
Total Phosphorus	%	0.14	0.1	0.053	0.022	0.023	0.021	0.026	0.015	0.014	0.013	0.013	0.012	0.014	0.023	0.019	0.016	0.018
Total Potassium	%	0.32	0.34	0.29	0.38	0.43	0.47	0.45	0.34	0.29	0.34	0.28	0.29	0.48	0.39	0.42	0.41	0.41
Total Sodium	%	0.029	0.08	0.082	0.073	<0.003	0.007	<0.003	<0.003	<0.003	0.007	<0.003	<0.003	0.079	0.011	0.004	<0.003	0.005
Total Sulphur	%	0.059	0.17	0.086	0.029	0.009	0.01	0.012	0.007	0.008	0.009	0.006	0.006	0.008	0.009	0.007	0.007	0.007
Total Zinc	mg/kg	190	1,400.00	310	84	38	86	34	25	26	24	22	20	42	36	39	47	50
Gravel (>2mm)	%	1.5	8.2	4.8	8.8	2.1	6.3	10.1	8.2	6.4	4.5	5.9	6.9	1	1.3	0.7	2.7	1.2
Total N (Combustion)	%	<0.05	<0.05	<0.05	<0.05	0.09	0.09	0.09	0.06	<0.05	<0.05	<0.05	0.05	<0.05	0.07	0.05	0.07	0.06

Table B2: Semi-detailed analysis suite.

Boundary Waste Rock Stockpile

Paddock Name		B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8
pH w		8.8	8.9	7.8	4.8	8.2	8.8	8.5	6.9
pH CaCl2		8.1	8.4	7.7	4.8	8	8.4	8.3	6.7
EC (1:5 water)	dS/m	0.44	0.69	1.87	5.9	1.13	0.73	1.73	0.9
Chloride	mg/kg	180	630	920	570	640	190	760	350
Nitrate Nitrogen	mg/kg	2.6	1.2	0.9	<0.5	3.1	3.4	3.3	1.2
Ammonium Nitrogen	mg/kg	<0.6	<0.6	<0.6	1.3	1	<0.6	<0.6	<0.6
Avail K	mg/kg	64	84	150	13	95	99	190	120
Calcium (Amm-acet.)	cmol(+)/kg	20	7	7.3	46	9.5	13	10	3
Potassium (Amm-acet.)	cmol(+)/kg	0.16	0.22	0.38	0.03	0.24	0.25	0.48	0.31
Magnesium (Amm-acet.)	cmol(+)/kg	2	3.5	5.6	27	3.8	4.2	8.8	4.3
Sodium (Amm-acet.)	cmol(+)/kg	0.75	1.8	4.1	0.15	2.4	1.2	4	2.3
Aluminium (KCl)	cmol(+)/kg	<0.1	<0.1	0.1	0.7	<0.1	<0.1	<0.1	0.1
CEC	cmol(+)/kg	22.7	12.5	17.4	73.9	16	18.5	23.7	10
ESP)	%	3.3	14	23	0.21	15	6.6	17	23
Silt	%	25	27	33	18	30	19	6	34
Clay	%	22	21	38	34	35	12	45	36
Sand (Coarse)	%	23	21	2	25	5	24	2	1
Gravel (>2mm)	%	7.5	6.1	1.1	7.7	4.2	6.2	3.8	1.9
Sand (Fine)	%	30	32	27	23	30	45	47	29
Aluminium (KCl)	mg/kg	<9.0	<9.0	9.1	65	<9.0	<9.0	<9.0	12
Calcium (Amm-acet.)	%	87	56	42	62	59	69	44	30
Magnesium (Amm-acet.)	%	8.9	28	32	37	24	23	37	43
Potassium (Amm-acet.)	%	0.72	1.7	2.2	0.04	1.5	1.4	2	3.1
Emerson Class		2	2	6	6	6	6	6	6

Manuku Waste Rock Stockpile

Paddock Name		M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8
pH w		9.1	8	8.2	8.7	8.1	7.9	9.3	8.5
pH CaCl2		8.5	7.6	7.6	8.3	7.9	7.6	8.5	8.2
EC (1:5 water)	dS/m	0.67	0.94	0.57	0.91	1.22	1.11	0.39	1.12
Chloride	mg/kg	590	720	420	550	670	990	250	900
Nitrate Nitrogen	mg/kg	0.7	1.8	6.5	6.3	1.1	7.5	2.8	2.5
Ammonium Nitrogen	mg/kg	<0.6	<0.6	<0.6	1.3	<0.6	2	0.7	<0.6
Avail K	mg/kg	160	160	290	190	180	160	270	150
Calcium (Amm-acet.)	cmol(+)/kg	6.6	3.8	5.4	10	5.3	2.5	15	3.6
Potassium (Amm-acet.)	cmol(+)/kg	0.4	0.4	0.74	0.49	0.46	0.41	0.69	0.38
Magnesium (Amm-acet.)	cmol(+)/kg	5.6	5.1	3.9	4.9	4.6	3.9	5.4	4.6
Sodium (Amm-acet.)	cmol(+)/kg	2.4	3.1	2.3	2.5	3.7	3.6	2	3.6
Aluminium (KCl)	cmol(+)/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
CEC	cmol(+)/kg	15	12.4	12.3	17.9	14	10.4	23.1	12.3
ESP)	%	16	25	19	14	26	35	8.5	29
Silt	%	26	30	16	28	31	30	23	27
Clay	%	29	36	33	25	36	34	24	34
Sand (Coarse)	%	17	2	13	14	2	3	25	4
Gravel (>2mm)	%	10.4	5.8	6.9	9.4	2.5	2.4	7.5	3.9
Sand (Fine)	%	28	33	38	34	31	33	28	34
Aluminium (KCl)	mg/kg	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	<9.0	10
Calcium (Amm-acet.)	%	44	31	44	56	38	24	65	30
Magnesium (Amm-acet.)	%	37	41	32	27	33	37	23	37
Potassium (Amm-acet.)	%	2.7	3.2	6	2.7	3.3	3.9	3	3.1
Emerson Class		2	2	2	2	2	2	2	2

Hard Rock Waste Rock and Limestone Stockpiles

Paddock Name		HR-1	HR-2	HR-3	HR-4	HR-5	HR-6	HR-7	HR-8	LL-1	LL-8
pH w		9	6.6	9.4	8.2	9.1	9.5	9.2	9	8.5	8.8
pH CaCl2		8.4	6.3	8.5	7.6	8.6	8.4	8.5	8.6	8.2	8.2
EC (1:5 water)	dS/m	0.57	0.41	0.39	0.28	0.75	0.32	0.7	0.94	0.53	0.58
Chloride	mg/kg	420	230	260	70	590	180	520	730	220	320
Nitrate Nitrogen	mg/kg	4.1	2.2	4.9	2.2	7.8	1.7	6	1	0.8	7.3
Ammonium Nitrogen	mg/kg	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.7	<0.6	1.1	1.8
Avail K	mg/kg	81	120	54	36	98	55	95	210	66	110
Calcium (Amm-acet.)	cmol(+)/kg	15	2.3	12	2.2	9.6	14	16	10	3.9	14
Potassium (Amm-acet.)	cmol(+)/kg	0.21	0.31	0.14	0.09	0.25	0.14	0.24	0.53	0.17	0.28
Magnesium (Amm-acet.)	cmol(+)/kg	3.6	2.5	3.2	2	2.6	2.9	2.8	5.3	3.2	4.3
Sodium (Amm-acet.)	cmol(+)/kg	1.6	2	0.79	0.84	2.7	0.73	2.2	3.3	0.84	1.2
Aluminium (KCl)	cmol(+)/kg	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
CEC	cmol(+)/kg	20	7.2	16.6	5.2	15.2	18	21.3	19.3	8.2	19.6
ESP)	%	7.9	28	4.8	16	17	4.1	10	17	10	6.2
Silt	%	20	10	16	9	23	16	19	29	28	24
Clay	%	22	14	13	10	20	13	13	26	20	22
Sand (Coarse)	%	28	29	44	43	13	44	30	10	21	26
Gravel (>2mm)	%	10.1	1.2	21.4	1.1	3.2	20.2	10.6	8.6	6.3	8.4
Sand (Fine)	%	29	47	27	38	44	27	37	35	30	28
Aluminium (KCl)	mg/kg	<9.0	<9.0	<9.0	10	<9.0	<9.0	<9.0	11	<9.0	<9.0
Calcium (Amm-acet.)	%	74	32	75	41	63	79	75	52	48	71
Magnesium (Amm-acet.)	%	18	35	19	39	17	16	13	27	40	22
Potassium (Amm-acet.)	%	1	4.3	0.83	1.8	1.7	0.78	1.1	2.7	2.1	1.4
Emerson Class		6	2	6	6	6	6	3	6	6	6

Clay Stockpiles

Paddock Name		C4-1A	C4-1B	C4-1C	C4-2A	C4-2B	C4-2C	C5-1A	C5-1B	C5-1C	C6-1A	C6-1B	C6-1C
pH w		8	8.4	8.9	8.8	8.1	8.7	7.6	7	8.1	9.6	9.5	9.5
pH CaCl2		7.5	8.1	8.5	8.4	7.9	8.4	7.2	6.6	7.6	8.6	8.6	8.7
EC (1:5 water)	dS/m	0.28	0.68	0.4	0.98	0.97	0.98	1.06	0.94	0.65	0.44	0.45	0.53
Chloride	mg/kg	150	560	400	990	1,000	750	930	850	430	220	200	150
Nitrate Nitrogen	mg/kg	1.2	0.7	0.7	2.6	0.6	1	2.1	3.5	8.7	2.1	1.5	4
Ammonium Nitrogen	mg/kg	<0.6	<0.6	<0.6	1.1	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	0.7
Avail K	mg/kg	100	56	58	100	71	100	190	180	180	370	400	310
Calcium (Amm-acet.)	cmol(+)/kg	1.9	1.2	2.2	20	2	9.4	5.2	3.4	5.2	18	17	16
Potassium (Amm-acet.)	cmol(+)/kg	0.27	0.14	0.15	0.26	0.18	0.26	0.5	0.46	0.46	0.95	1	0.8
Magnesium (Amm-acet.)	cmol(+)/kg	2.4	2.1	1.8	4.6	2.9	4.2	5.2	4.1	4.2	5.6	5.9	5.2
Sodium (Amm-acet.)	cmol(+)/kg	0.85	2	1.2	3.1	2.9	2.8	4.3	3.7	2.8	3.4	3.3	2.8
Aluminium (KCl)	cmol(+)/kg	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.1	<0.1
CEC	cmol(+)/kg	5.4	5.4	5.4	28.2	8.1	16.7	15.3	11.6	12.7	28.2	27.2	25.3
ESP)	%	16	38	23	11	36	17	28	32	22	12	12	11
Aluminium (KCl)	mg/kg	<9.0	<9.0	<9.0	<9.0	9.9	<9.0	<9.0	<9.0	<9.0	14	12	<9.0
Calcium (Amm-acet.)	%	35	21	41	72	24	56	34	29	41	64	62	65
Magnesium (Amm-acet.)	%	45	39	33	16	36	25	34	35	33	20	22	21
Potassium (Amm-acet.)	%	4.9	2.6	2.7	0.93	2.2	1.5	3.2	4	3.7	3.4	3.7	3.2
Emerson Class		2	6	6	6	6	2	2	3	8	3	2	2

Table B3: Total metals analysis suite.

Manuku Waste Rock Stockpile

		M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8
Total Aluminium	%	0.6	0.73	2.1	0.68	0.84	0.64	1.2	0.72
Total Cadmium	mg/kg	<0.130	0.17	0.16	2.4	1.8	0.53	0.17	1.2
Total Calcium	%	1.7	0.19	0.1	2	0.29	0.11	1.6	0.23
Total Chromium	mg/kg	10	10	20	12	11	12	15	14
Total Copper	mg/kg	13	9	10	17	12	27	14	34
Total Iron	mg/kg	33,000	15,000	18,000	25,000	7,300	12,000	36,000	26,000
Total Lead	mg/kg	23	43	55	210	730	1,200	32	1,000
Total Magnesium	%	0.88	0.16	0.17	0.96	0.15	0.11	0.45	0.17
Total Manganese	mg/kg	570	260	110	1,400	600	130	640	150
Total Nickel	mg/kg	19	14	9	24	7	8	22	10
Total Phosphorus	%	0.036	0.018	0.01	0.032	0.013	0.019	0.024	0.031
Total Potassium	%	0.3	0.33	0.35	0.31	0.37	0.32	0.38	0.29
Total Sodium	%	0.061	0.067	0.055	0.056	0.075	0.084	0.045	0.074
Total Sulphur	%	0.016	0.086	0.031	0.053	0.092	0.05	0.018	0.06
Total Zinc	mg/kg	26	61	31	430	480	360	25	530

Boundary Waste Rock Stockpile

		B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8
Total Aluminium	%	0.36	0.44	0.75	0.98	0.74	0.62	1.1	0.99
Total Cadmium	mg/kg	3.9	0.61	2.5	33	5.2	2.8	3.4	<0.130
Total Calcium	%	15	0.74	0.3	2.2	0.83	0.88	1.2	0.06
Total Chromium	mg/kg	9	19	16	21	15	18	14	13
Total Copper	mg/kg	13	28	21	16	44	3	5	20
Total Iron	mg/kg	39,000	39,000	14,000	67,000	18,000	2,300	2,300	13,000
Total Lead	mg/kg	920	3,600	340	2,700	3,900	77	28	32
Total Magnesium	%	2.3	0.36	0.2	1	0.41	0.4	0.68	0.1
Total Manganese	mg/kg	5,800	1,800	340	13,000	4,000	57	83	19
Total Nickel	mg/kg	30	19	12	100	18	9	8	6
Total Phosphorus	%	0.015	0.04	0.022	<0.002	0.017	0.004	0.008	0.012
Total Potassium	%	0.13	0.13	0.34	0.091	0.19	0.16	0.47	0.45
Total Sodium	%	0.017	0.045	0.085	0.078	0.069	0.037	0.095	0.061
Total Sulphur	%	0.035	0.063	0.099	1.7	0.084	0.056	0.19	0.16
Total Zinc	mg/kg	3,600.00	1,200.00	540	9,200.00	2,900.00	180	180	59

Table B3: Basic analysis suite of Topsoil Stockpiles - 38 discrete samples

Paddock Name	-	T10-1A	T10-1B	T10-1C	T10-2A	T10-2B	T10-2C	T10-3A	T10-3B	T1-1A	T1-1B	T1-1C	T1-3A	T1-3B
pH w	-	8	6	7.4	8.1	7.2	8	7.6	7.5	6.1	6.9	7.1	6.6	6.4
pH CaCl2	-	7.5	5.4	6.7	7.6	6.8	7.6	7.2	7.1	5.6	6.1	6.5	5.9	6
EC (1:5 water)	dS/m	0.31	0.18	0.24	0.31	0.34	0.36	0.3	0.29	0.24	0.14	0.16	0.16	0.39
Paddock Name	-	T1-3C	T2-3A	T2-3B	T2-3C	T2-4A	T2-4B	T2-4C	T2-5A	T2-5B	T2-5C	T7-1A	T7-1B	T7-1C
pH w	-	7.5	6.8	7.2	6.8	6.1	5.9	6.5	6.3	5.9	5.9	9	8.7	8.8
pH CaCl2	-	6.9	6	6.6	6.3	5.6	5.2	5.7	5.7	5.3	5.3	8.3	8.1	8.2
EC (1:5 water)	dS/m	0.2	0.11	0.23	0.37	0.26	0.18	0.08	0.2	0.19	0.19	0.29	0.24	0.25
Paddock Name	-	T8-2A	T8-2B	T8-2C	T8-3A	T8-3B	T8-3C	T9-1A	T9-1B	T9-1C	T9-2A	T9-2B	T9-2C	
pH w	-	6.8	6.4	6.8	7.2	7.4	7.6	8	6.9	7.9	6.2	5.8	6.4	
pH CaCl2	-	6.4	5.9	6.2	6.5	6.4	6.8	7.5	6.4	7.4	5.7	5.2	5.8	
EC (1:5 water)	dS/m	0.31	0.19	0.18	0.1	0.06	0.11	0.31	0.23	0.23	0.16	0.15	0.17	

APPENDIX C: SAMPLING LOCATION MAPS

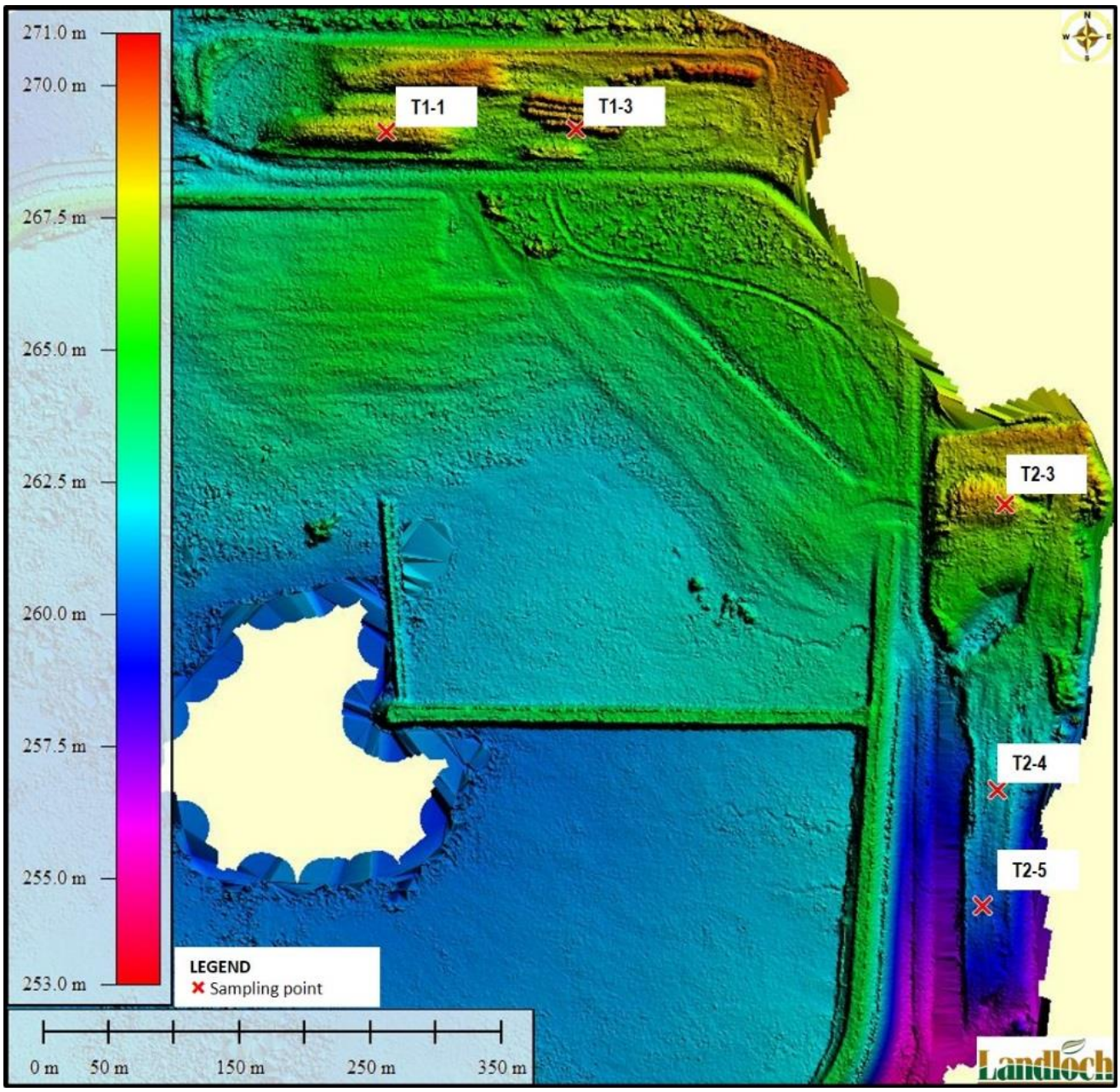


Figure C1: Topsoil stockpiles near TSF

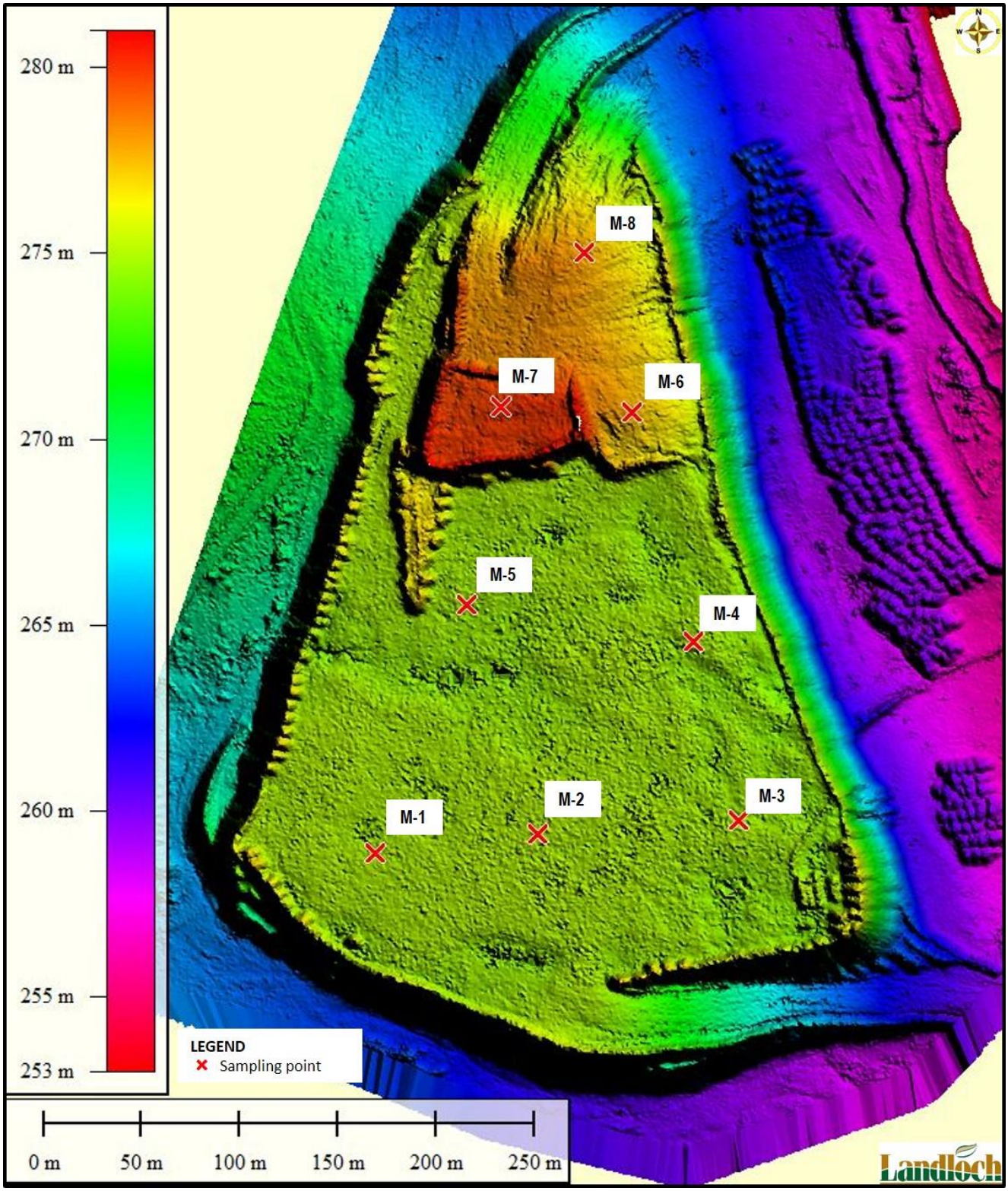


Figure C2: Manuka waste rock dump

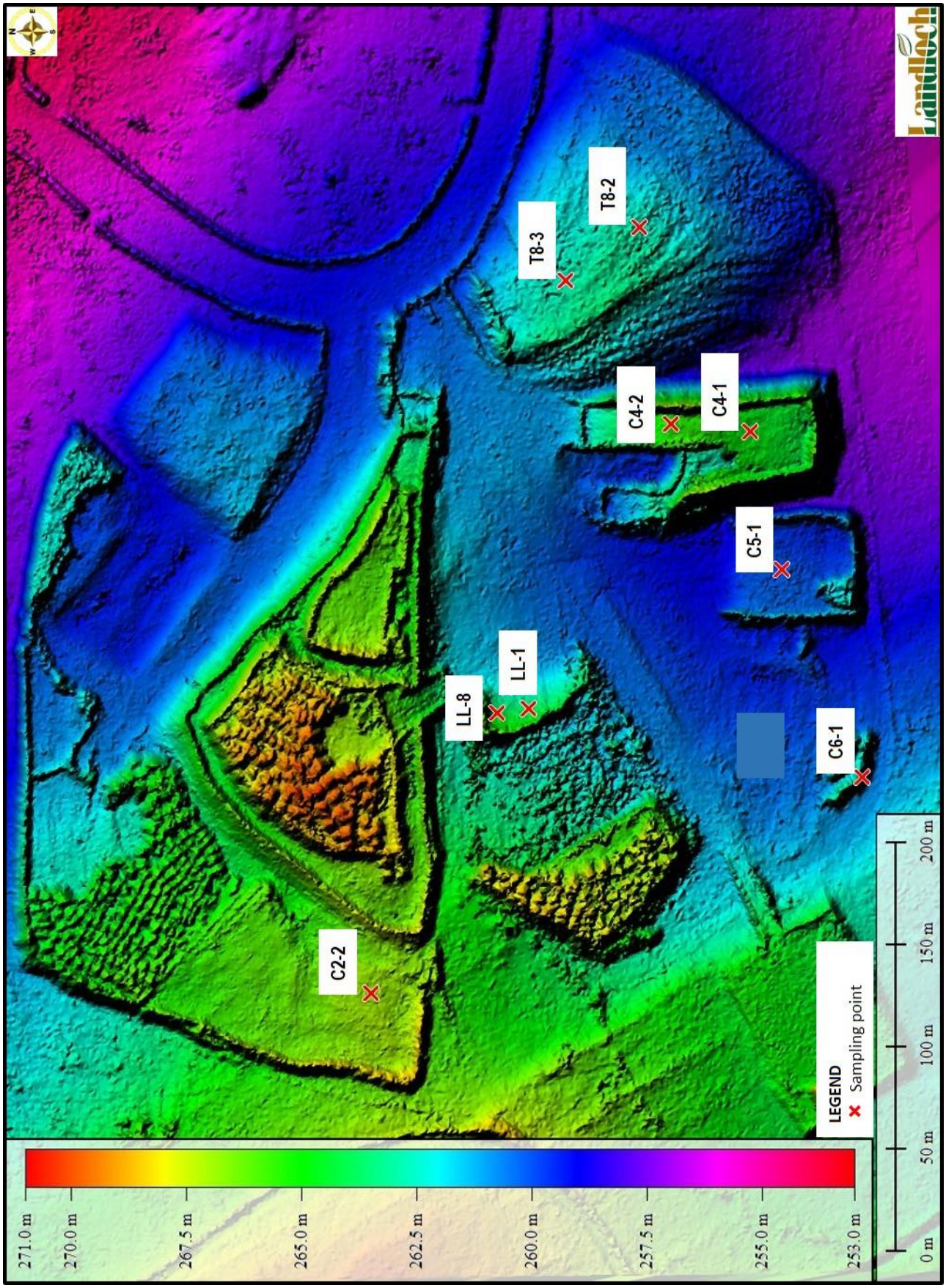


Figure C3: Stockpiles located in central west portion of mine

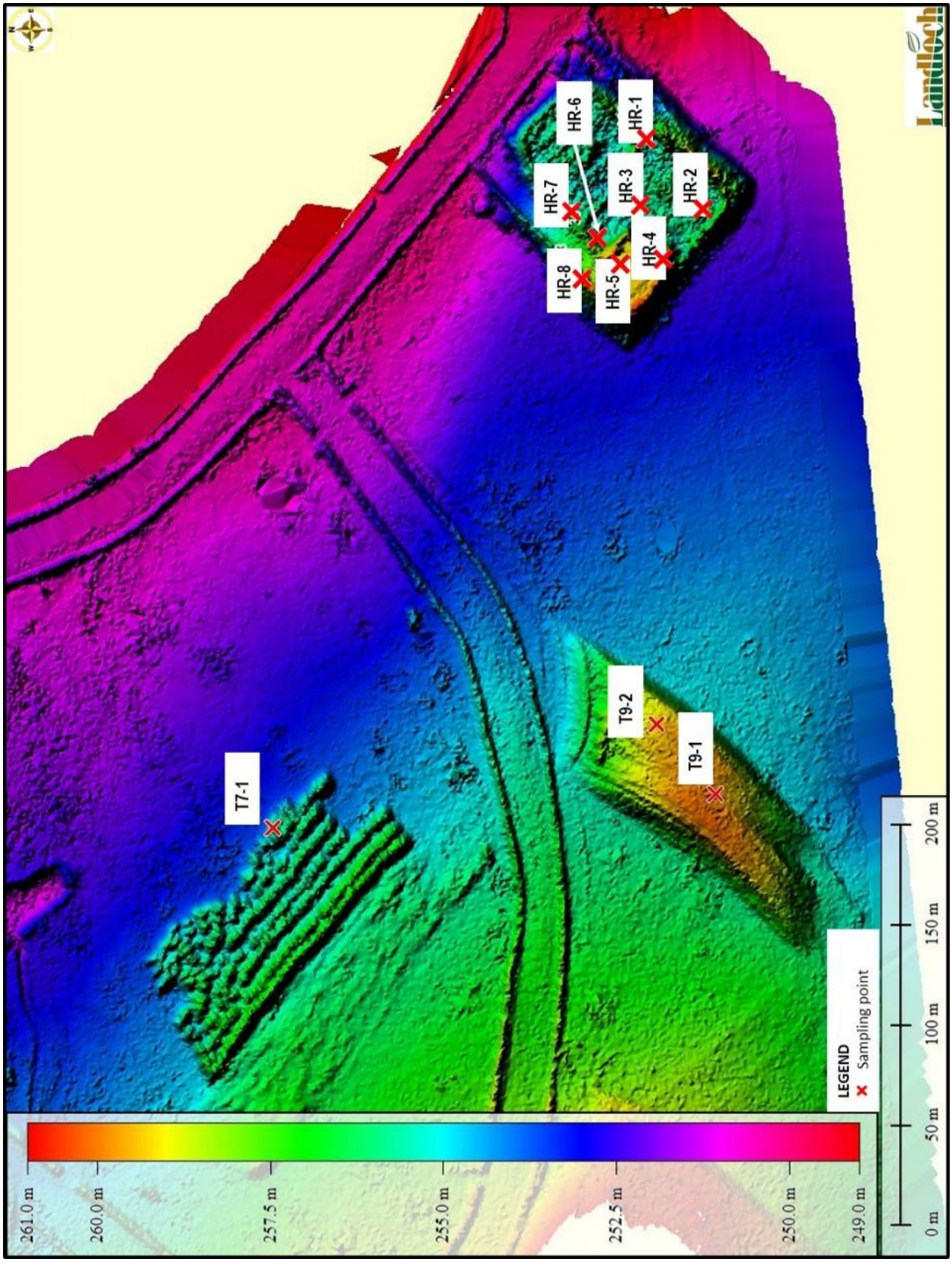


Figure C4: Stockpiles located in central portion of mine

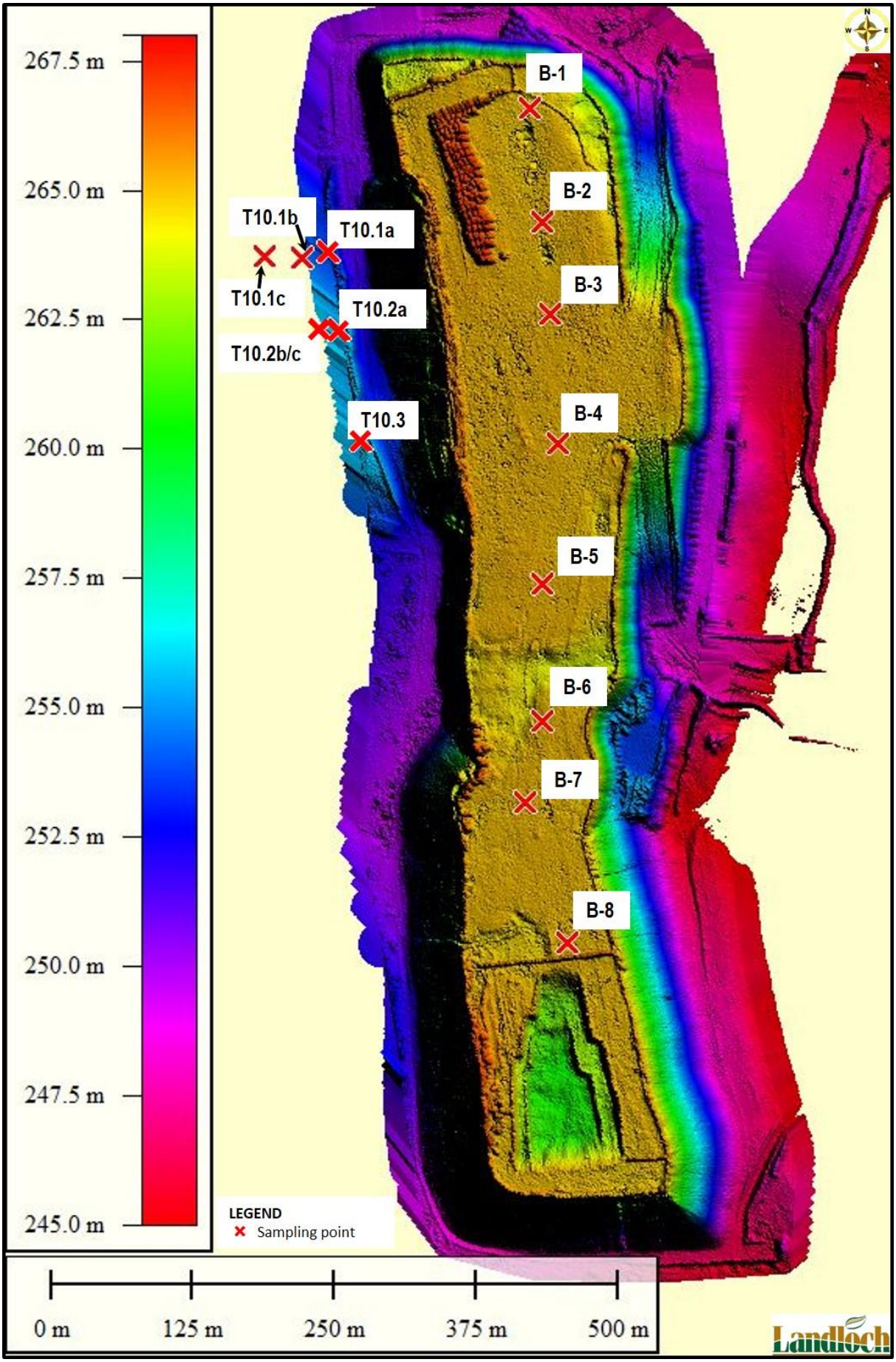


Figure C5: Boundary waste rock dump

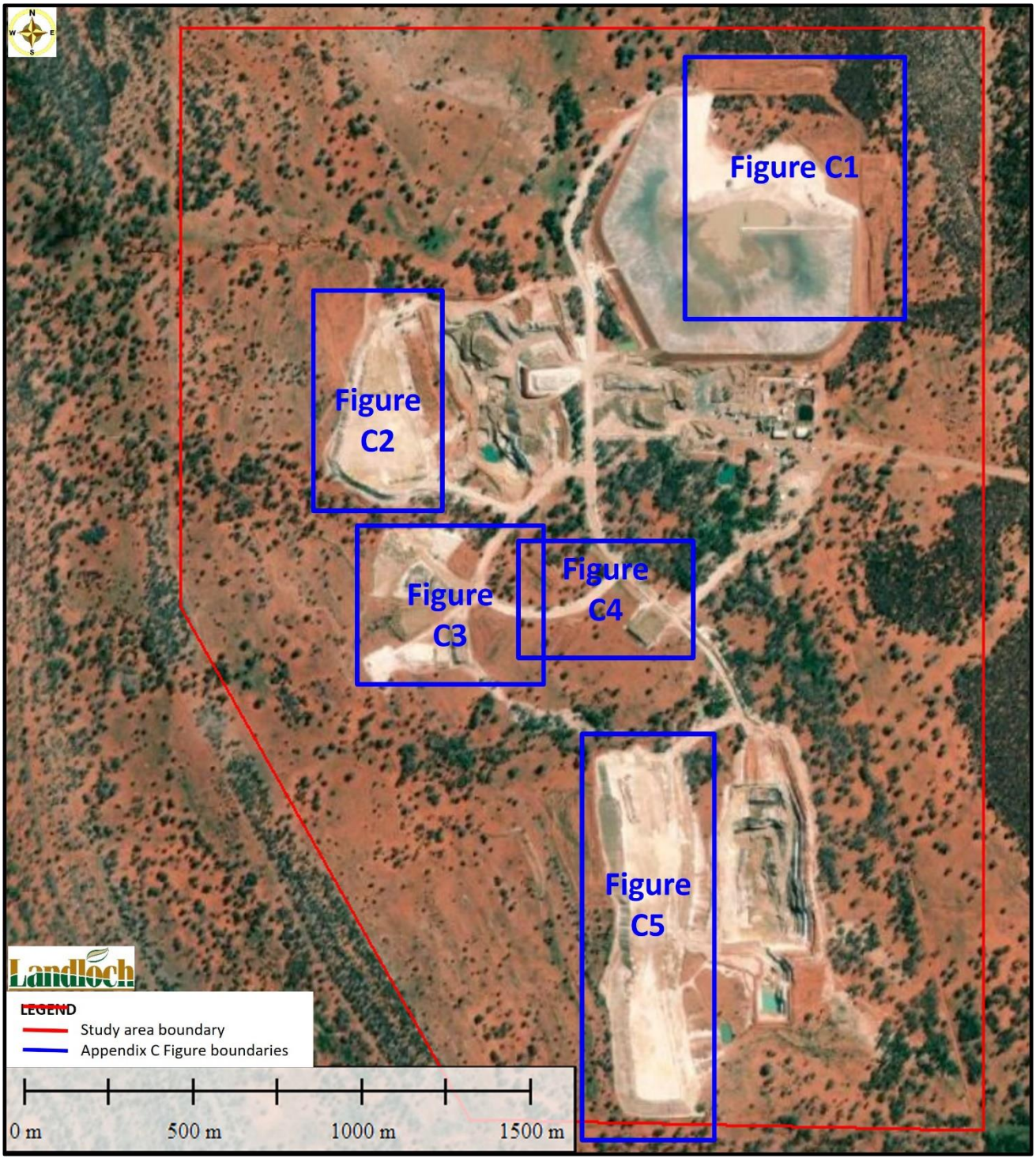


Figure C6: Locations of Figures C1 to C5.

APPENDIX D: PHOTOGRAMMETRY PSA

Rock Cover	%	#DIV/0!
	% Passing	Size (mm)
PSD ex 20mm Particles	0	20
	10	22
	20	23
	30	25
	40	27
	50	30
	60	33
	70	39
	80	48
	90	67
	100	122

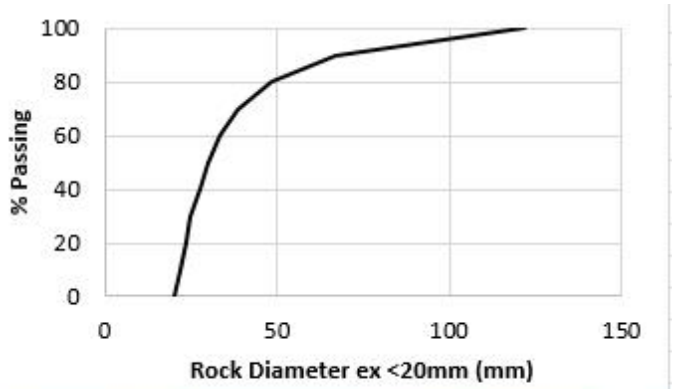


Figure D1: Undisturbed surface of the waste rock materials at the Boundary WRD -Site B-6.

Rock Cover	%	#DIV/0!
	% Passing	Size (mm)
PSD ex 20mm Particles	0	20
	10	22
	20	23
	30	25
	40	28
	50	33
	60	37
	70	48
	80	58
	90	83
	100	116

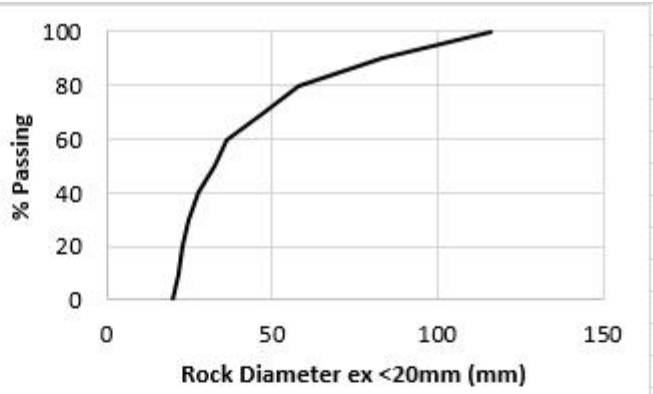


Figure D2: Undisturbed surface of the waste rock materials at the Manuku WRD -Site M-6.

Rock Cover	%	#DIV/0!
	% Passing	Size (mm)
PSD ex 20mm Particles	0	20
	10	25
	20	31
	30	35
	40	42
	50	46
	60	53
	70	59
	80	65
	90	93
	100	128

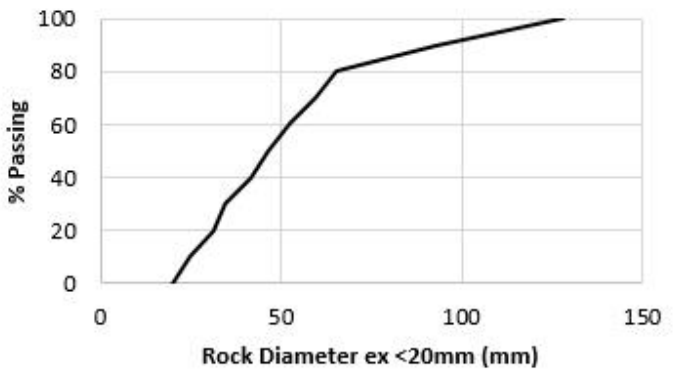


Figure D3: Undisturbed surface of the waste rock materials at the Manuku WRD -Site M-8.

Rock Cover	%	#DIV/0!
	% Passing	Size (mm)
PSD ex 20mm Particles	0	20
	10	26
	20	32
	30	39
	40	47
	50	58
	60	64
	70	80
	80	121
	90	205
	100	428

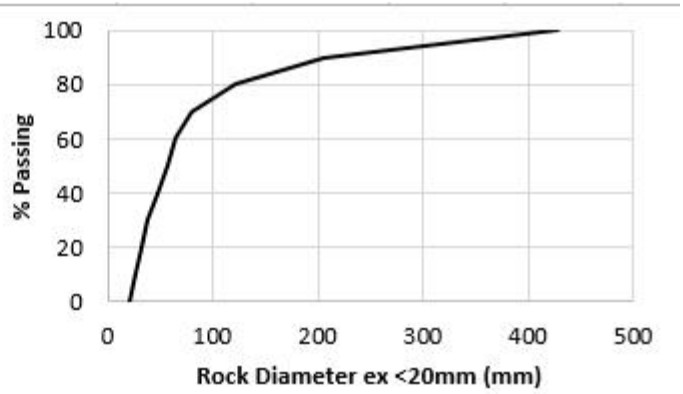


Figure D4: Undisturbed surface of the waste rock materials at the Limestone Stockpile - Site LL-1.

Rock Cover	%	#DIV/0!
	% Passing	Size (mm)
	0	20
	10	26
	20	34
	30	40
PSD	40	48
ex 20mm	50	56
Particles	60	68
	70	86
	80	115
	90	143
	100	221

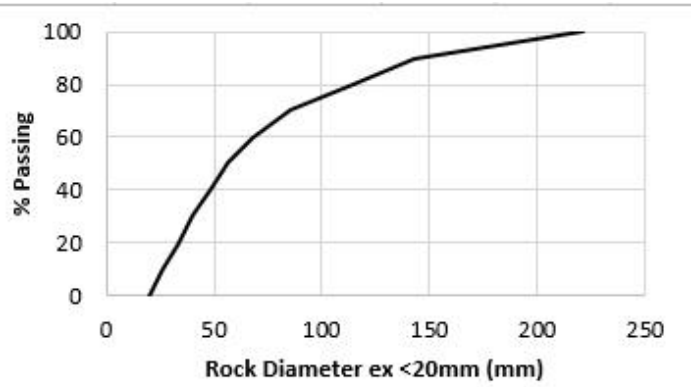


Figure D5: Undisturbed surface of the waste rock materials at the Hard Rock Stockpile - Site HR-2.

Rock Cover	%	#DIV/0!
	% Passing	Size (mm)
PSD ex 20mm Particles	0	20
	10	23
	20	26
	30	29
	40	34
	50	39
	60	48
	70	57
	80	83
	90	128
	100	170

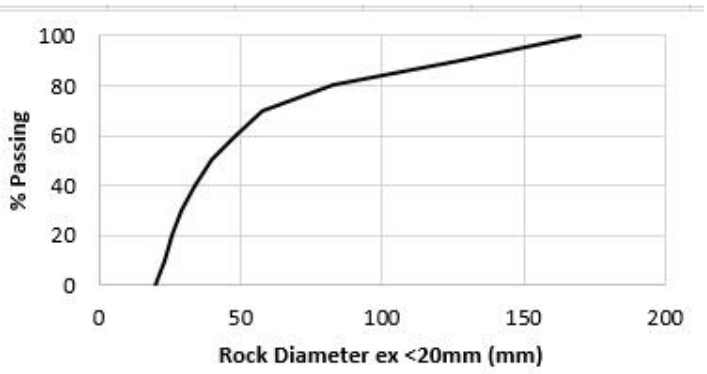


Figure D6: Undisturbed surface of the waste rock materials at the Hard Rock Stockpile - Site HR-3.

Rock Cover	%	#DIV/0!
	% Passing	Size (mm)
PSD ex 20mm Particles	0	20
	10	25
	20	31
	30	36
	40	44
	50	49
	60	59
	70	72
	80	85
	90	102
	100	159

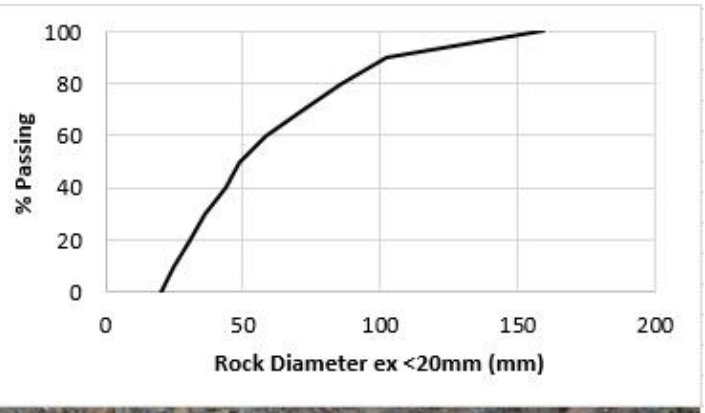


Figure D7: Undisturbed surface of the waste rock materials at the Hard Rock Stockpile - Site -6.

APPENDIX E: SAMPLING AND ANALYSIS PLAN (SAP)

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