REVIEW OF ENVIRONMENTAL FACTORS

Mine Safety and Remediation Work

Leadville, NSW

MAY 2024

Lesryk ENVIRONMENTAL

Cover photographs:

Left: Character of derelict mining equipment and filled in shafts within the Leadville Mine precinct.
Right: Character of grassland and woodland vegetation on-site.

Report produced at the request of:

NSW Public Works
117 Bull Street
Newcastle West, NSW 2302

on behalf of

The Legacy Mines Program,
Department of Regional NSW

by

Lesryk Environmental Pty Ltd
PO Box 3001
Bundeena NSW 2230
Telephone: (02) 9523 2016
Mobile: 0408 258 129
Email: admin@lesryk.com.au
www.lesryk.com.au

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This document has been prepared in accordance with the brief provided by NSW Public Works ('the client'). This investigation has relied upon information collected during the course of a field investigation, and as available in current known literature and data sources (including those available online). All findings, conclusions or recommendations contained within this document are based upon the abovementioned circumstances. The study has been prepared for use by the client, and no responsibility for its use by other parties is accepted by Lesryk Environmental Pty Ltd.

Please note that, given the dynamic nature of the relevant pieces of legislation considered in this report, the authors consider that this report only has a 'shelf life' of six months. If the REF is not submitted to a determining authority for consideration within this time frame, it is recommended that this report be reviewed and revised where required in light of any relevant legislative listings or changes.

This report is prepared in accordance with the 6th Edition of the Commonwealth of Australia (2002) Style Manual.

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Acronyms and Abbreviations

Abbreviation	Definition
˚C	Degrees Celsius
AHIMS	Aboriginal Heritage Information Management System
AOBV	Areas of Outstanding Biodiversity Value
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
Commonwealth DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DEC	NSW Department of Environment and Conservation
DECC	NSW Department of Environment and Climate Change
DPI	NSW Department of Primary Industries
DPIE	NSW Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ESCP	Erosion and Sedimentation Control Plan
ha	Hectares
KTP	Key Threatening Process
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
Lesryk	Lesryk Environmental Pty Ltd
LGA	Local Government Area
LMP	Legacy Mines Program
mm/cm/m/m^2/km	Millimetres, centimetres, metres, square metres, kilometres
NSW	New South Wales
NSW DCCEEW	NSW Department of Climate Change, Energy, the Environment and Water
MEG	Mining, Exploration and Geoscience
MNES	Matters of National Environmental Significance
NSW EPA	NSW Environment Protection Authority
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
PMST	Protected Matters Search Tool
Public Works	NSW Public Works
RAP	Remediation Action Plan
REF	Review of Environmental Factors
RFS	NSW Rural Fire Service
SEED	Central Resource for Sharing and Enabling Environmental Data in NSW
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SoHI	Statement of Heritage Impact
SVTM	State Vegetation Type Map
TSR	Travelling Stock Reserve
TTC	Terra Tech Consulting Pty Ltd

For the purpose of this REF:

Areas of outstanding biodiversity	An area of outstanding biodiversity value is: ○ an area important at a State, national or global scale, and ○ an area that makes a significant contribution to the persistence of at least one of the following: i. multiple species or at least one threatened species or ecological community ii. irreplaceable biological distinctiveness iii. ecological processes or ecological integrity iv. outstanding ecological value for education or scientific research. ○ The declaration of an area may relate, but is not limited, to protecting threatened species or ecological communities, connectivity, climate refuges and migratory species (BC Act).
Important population	Is a population that is necessary for a species' long-term survival and recovery; this may include populations identified as such in recovery plans, and/or that are: ○ key source populations either for breeding or dispersal ○ populations that are necessary for maintaining genetic diversity, and/or ○ populations that are near the limit of the species range (Department of the Environment 2013).
Local population (in regards to a threatened species)	The population that occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated that contiguous or interconnecting parts of the population continue beyond the study area (State of NSW through NSW DPI 2008).
Invasive species	Is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources, or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.
Critical habitat	An area of land that is crucial to the survival of a particular endangered species, population and/or ecological community.
Proposal	Is considered to include 'all activities likely to be undertaken within the area surveyed that permit the proposed work as described in Section 1.1 and 1.3 of this REF'.
Subject site	Means the area directly affected by the proposal. The subject site includes the footprint of the development and any ancillary works, facilities, accesses or hazard reduction zones that support the construction or operation of the development or activity (State of NSW and OEH 2018).
Study area	Means the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly (State of NSW and OEH 2018)
Study region	Is specified as a 10 km polygon around the outer edge of the defined construction activity footprint.
Direct impacts	Are those that directly affect the habitat of species and ecological communities and of individuals using the study area. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat (State of NSW and OEH 2018).
Indirect impacts	Occur when project-related activities affect species or ecological communities in a manner other than direct loss within the subject site. Indirect impacts may sterilise or reduce the habitability of adjacent or connected habitats. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, reduction in viability of adjacent habitat due to edge effects, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, noise, light spill, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas (State of NSW and OEH 2018).
Heritage	An item is considered to have heritage value if it: ○ occurs *in situ* at a shaft, adit or other mine site ○ exhibits the same degree of weathering as the shaft, adit or other mine feature ○ has an 'unnatural' alignment (e.g., log occurring parallel to shaft wall) ○ could be part of the mining history of the locality. A precautionary approach is adopted in regards to the heritage value of these items.
Remediation	Targeted, risk-managed work that addresses a specific safety or environmental risk.

1 Introduction

1.1 Proposal identification

This REF has been prepared by Lesryk at the request of NSW Public Works (Public Works) on behalf of the Department of Regional NSW, Legacy Mines Program (LMP). The program is an NSW Government initiative that assists with the rehabilitation or remediation of legacy mine sites where no owner can be held responsible for the site. It prioritises the sites it rehabilitates and remediates, using a risk assessment process that considers a variety of matters including public safety, environmental risks posed by the mine and cost effectiveness of proposed work.

The investigated Leadville Mine precinct is located to the south-west of the NSW township of Leadville, and about 90 km east of Dubbo (Figure 1 [Figure 2 is extracted from the RAP]). The area investigated was part of a former mining operation and now contains derelict shafts and other evidence of the precinct's former occupation and workings.

Public Works has been engaged by the LMP to prepare a Remediation Action Plan (RAP) for the former mining area (Terra Tech Consulting [TTC] 2024; Appendix 1). LMP identified contaminated media in several historic mining domains which present a risk to receptors (i.e., Stock – cattle and sheep for meat and wool, members of the public) via a range of exposure pathways related to land access scenarios.

Due to the presence of sub-surface geohazards, previous remedial designs (Okane 2022 cited in TTC 2024) comprising the encapsulation of heavy metal impacted mine waste materials are not constructable without significant subsurface works. As a result, the remedial designs presented in Okane have been revised by TTC.

Reviewing the RAP, the main objectives for the proposed remediation works would be to mitigate the potential off-site migration of heavy metals from the subject site as well as isolation and on-going management of impacted surface collection dams and sediment where heavy metals pose an unacceptable health risk. The remedial actions to be undertaken include:

- Excavation and off-site disposal of highly impacted heavy metal impacted materials which are leachable and potentially pose a significant risk to surface waters on and off-site.
- Construction of a drainage management system to limit volumes of meteoric water interacting with Potentially Acid Forming materials where geohazards are potentially present (precluding excavation and off-site disposal or encapsulation remedial approaches).
- Fencing areas to remove unacceptable health risks to future site receptors and livestock.

This REF, in support of both the RAP and the associated activities (such as the establishment of a site compound, water management structures, washdown facilities and so forth), and in compliance with Part 5 of the EP&A Act, is required to assess the environmental and ecological impacts associated with the proposed remediation actions, while also considering the heritage and ecological significance of the precinct.

The scope of the REF is to:

- Describe the proposed work as detailed in the RAP.
- Identify and consider any environmental, heritage or additional impacts of the proposed work.
- Develop mitigation measures to minimize and monitor any impacts that may arise from the activities.
- Provide information to assist in determining whether an EIS and/or SIS/BDAR is required.

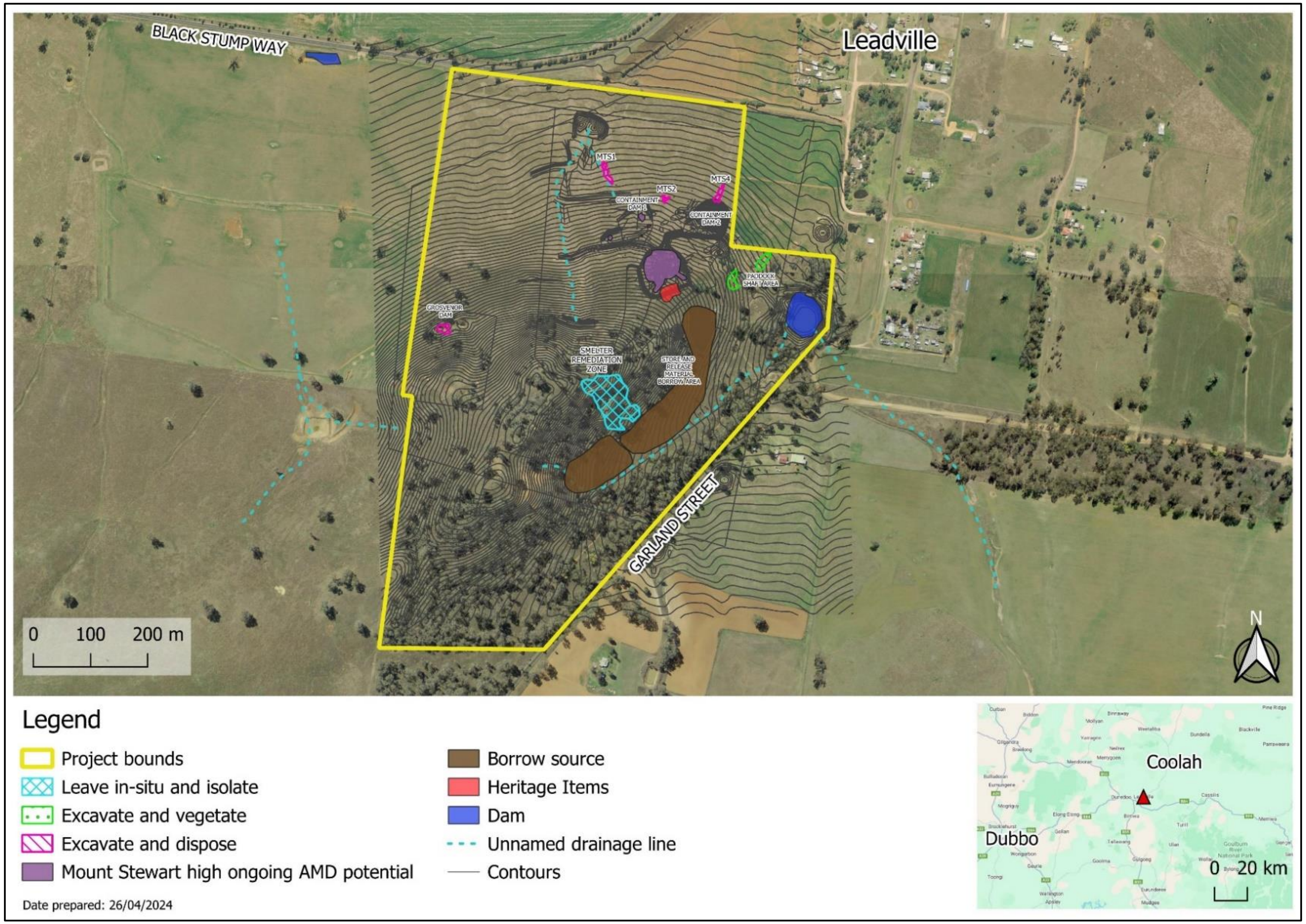


Figure 1. Leadville study area and greater locality

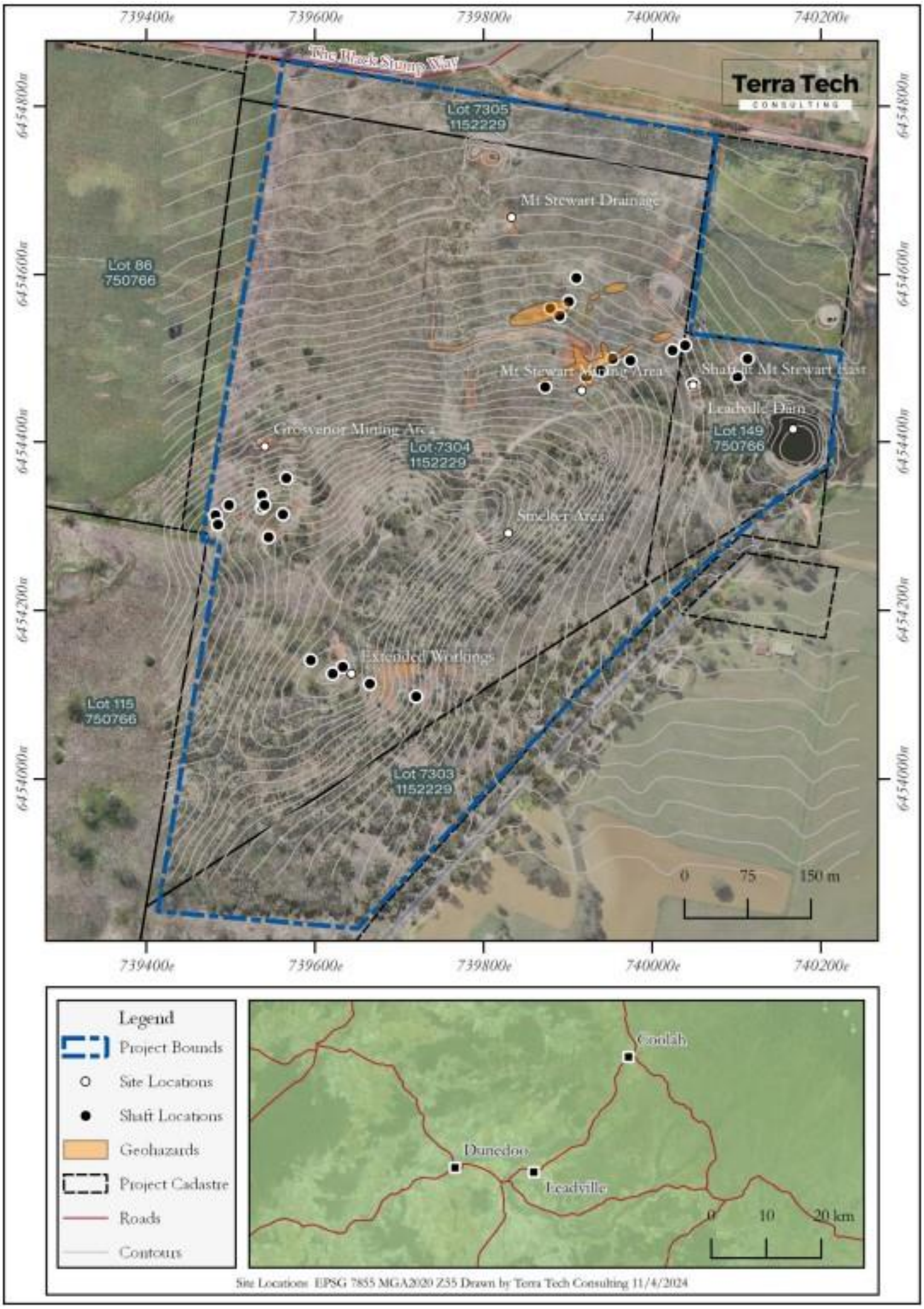


Figure 2. Site layout and Cadastre

It is noted that, as part of safety work that resulted in all of the former mine shafts present being sealed, Lesryk conducted two previous ecological investigations within the Leadville Mine precinct (Lesryk 2015, 2021). Where relevant, the results of these studies have been drawn upon and incorporated into this REF.

A Statement of Heritage Impact (SoHI) has been prepared for the Leadville Mine precinct by Everick Heritage Archaeologists (Everick) (Brassil, Marsh & Riley 2024; Appendix 2); the results of which are summarised in Section (s.) 5.2 of this REF. It is acknowledged a previous SoHI had been prepared by Everick (Hill *et al.* 2016) which assessed lesser impacts to the site prior to the preparation of the RAP.

1.2 Locality

The investigated Leadville Mine precinct is located on the western outskirts of the NSW township of Leadville (see Figure 1), about 90[1] km north-east of Dubbo, NSW; within the Warrumbungle LGA.

The following land tenures comprise the areas considered in this REF:

- A Crown Land parcel (Lot 7304 DP 1152229)
- Travelling Stock Route Part Reserve 68 (Lot 7305 DP1152229) and Part Reserve 47657 (Lot 7303 DP 1152229)
- An adjoining water reserve (Lot 149 DP 750766)

The precinct is zoned as RU1 (Primary production) in the Warrumbungle Shire LEP 2013 (NSW Government 2024a).

The use of the site for grazing, and the movement up the food chain of contaminated media, is one of the reasons LMP is proposing to remediate the former mining area.

1.3 Description of the activity

The preferred remedial strategy developed in consultation with the Principal are outlined in Section 5.3 of the RAP (Appendix 1). The remedial strategies by domain (as shown on Figures 3 and 4, extracted from the RAP) are as follows:

1. Smelter site (surface soils comprise Category 2) – Leave in-situ and fence.
2. Mt Stewart (surface soils comprise Category 3; and the area contains geohazards that preclude excavation) – Drainage controls to divert unimpacted meteoric water away from the Mt Stewart source point (where Acid Mine Drainage [AMD] potential was evident), collect contaminated runoff within a prescribed catchment area and fencing to prevent access.
3. Paddock shaft area (surface soils comprise Category 3) – Strip area of sulfidic material to a depth of 200 mm, place material within Mt Stewart contaminated water catchment (estimated volume 150 m^3).

[1] Direct line

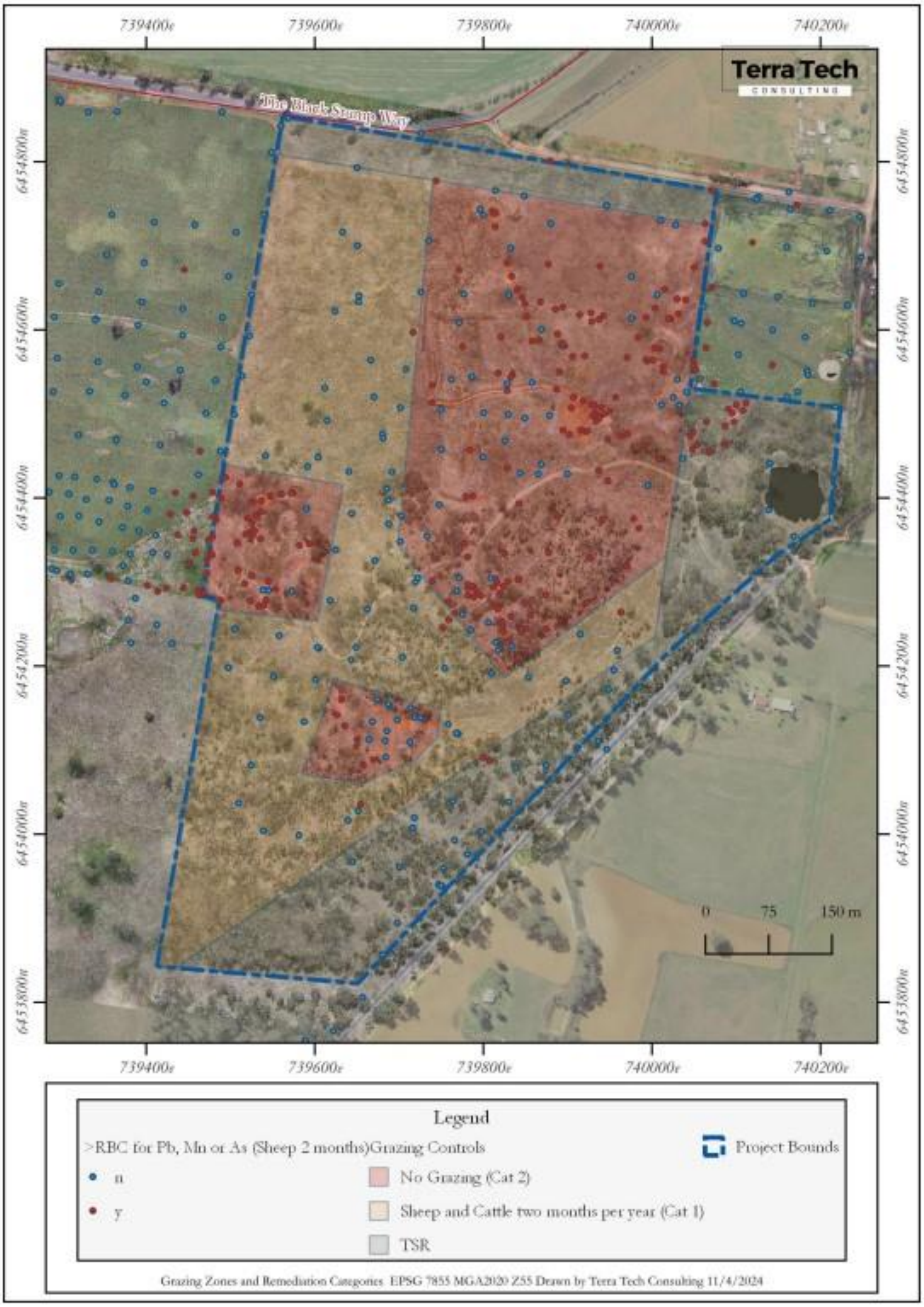


Figure 3. Remedial extents – Grazing Restrictions

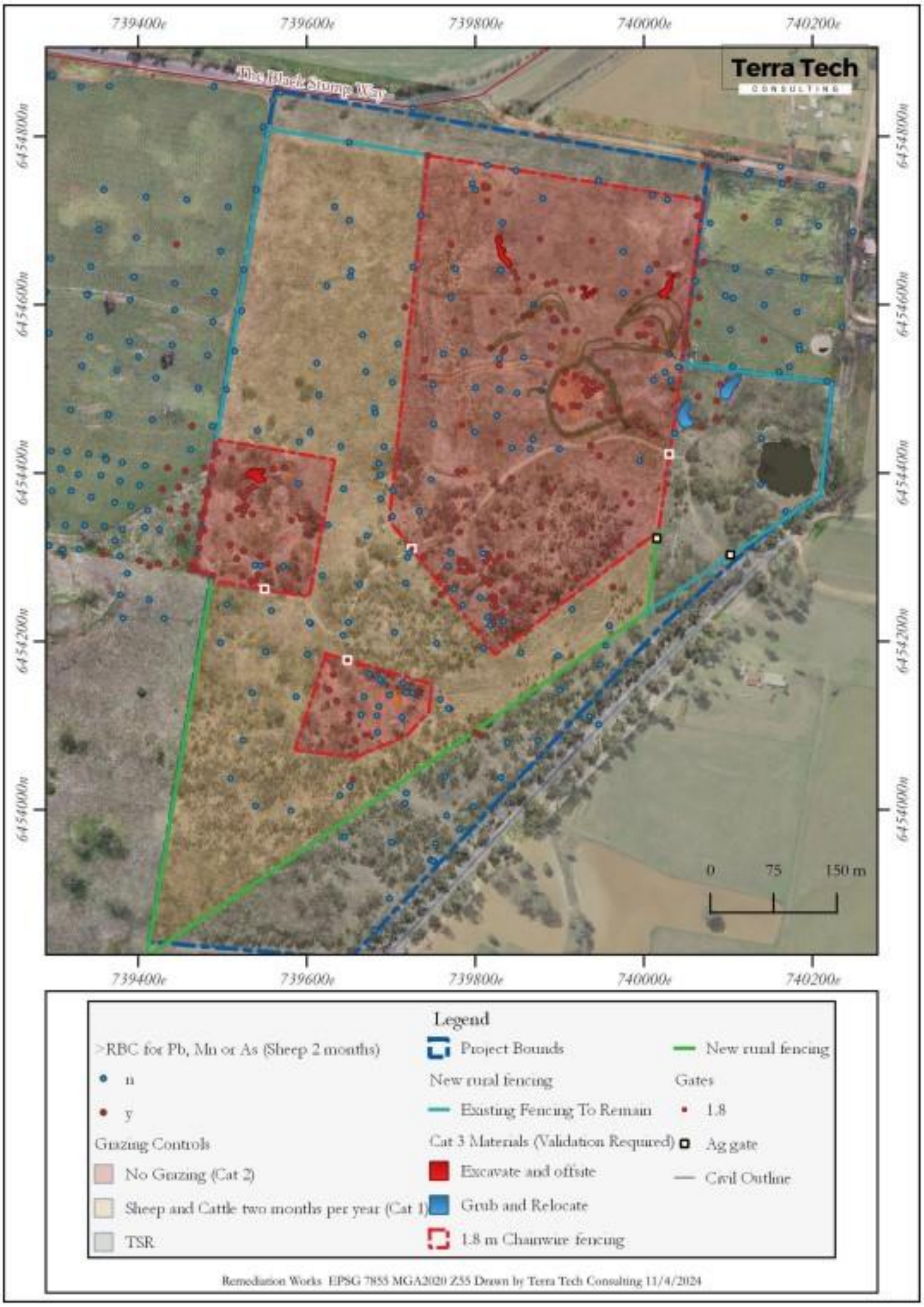


Figure 4. Remediation Extents – Fencing and Civils

4. Grosvenor general area (surface soils comprise Category 2) – Leave in-situ and fence due to location of shafts and mineralised workings.
5. Grosvenor Dam (surface soils comprise Category 3) – Excavate and send material offsite for disposal in a licenced waste disposal facility.
6. Mt Stewart drainage (surface soils comprise Category 3) – Excavate and send material offsite for disposal at a licenced waste disposal facility.
7. Install rural fencing around areas where grazing should be managed in accordance with the prescribed limitations included in the site Environmental Management Plan (EMP). This would include limiting access of livestock to the site for 2 months per annum.

Proposal design drawings are included in Appendix A of the RAP (Appendix 1). Section 6 of the RAP provides additional details of the works.

Locations where excavation and/or offsite disposal is required is presented in Figure 16 of the RAP. The total excavation extents (volumes and location) of material requiring removal are estimated for the following areas (extracted from drawings C20 and C40 in Appendix A of the RAP):

- Grosvenor Dam
  - Excavate 130 m^3 to 0.5 m within the prescribed boundary.
- Mount Stewart Drainage
  - MTS1: excavate 225 m^3 to 0.9 m within the prescribed boundary.
  - MTS2: excavate 60 m^3 to 1 m within the prescribed boundary.
  - MTS4: excavate 60 m^3 to 0.3 m within the prescribed boundary
    - MTS3: will remain in situ – this material is within the contaminated water catchment and is not interpreted to extend as fill below surface.
- Paddock Shaft
  - Strip area of sulfidic material to 200 mm (150 m^3) and place material within Mt Stewart contaminated water catchment.

Re-instatement of these areas to existing levels is achieved with ‘store and release’ material sourced from the borrow area (refer to Figure 15 of the RAP).

Controls for Mt Stewart, being the drainage management system, would include the diversion bunds, dam bunds and drainage channels that would be constructed out of borrowed material sourced from borrow areas.

Section 6.1 of the RAP and drawing number C20 to C27 (Appendix A of the RAP) details the series of diversion bunds to be developed in order to convey unimpacted water around the Mt Stewart zone.

- Within the geohazard zone a separate contaminated (dirty water) catchment will be developed and [resulting] flows are to be routed via a network of diversion bunds to their respective containment dams for each area (DW Bunds 1, 2 and 3).
- Flows from clean water catchments (CW Bunds 1, 2 and 3) are proposed to be routed via a network of diversion bunds and dispensed over non-contaminated ground to the downstream reaches of the catchment.

The areas identified as store and release within the borrow areas are considered to have suitable material for use in construction of the diversion bunds as they are not considered to be dispersive (TTC 2024). The estimated volumes for use within the borrow area is about 30,000 m^3.

Fencing of the site would assist in deterring access by third parties and livestock or other fauna that may be consumed by humans (TTC 2024). Fencing is to be hinged joint mesh fencing and specifications can be seen in Appendix A – Drawing C01 of the RAP.

The disturbance and removal of native vegetation required to permit access to, and work within, the contaminated areas, and to facilitate the remediation activities, includes 2.2 ha of Derived Native Grassland (borrow area).

A number of hollow-bearing trees that could be occupied by hollow-occupying microbats were recorded near both the Smelter and Grosvenor areas. Based on a worst-case scenario, within the Smelter area, depending on the fencing alignment selected, up to five of the hollow-bearing trees present may require removal / disturbance; however, it is highly likely that an alignment that negates the clearing of these can be selected.

It is assumed that, at both the Smelter and Grosvenor areas, an alignment for the proposed exclusion fencing can be selected that negates the clearing of any of the hollow-bearing trees recorded. Clearing of any heavy vehicle haulage routes between the Mount Stewart workings area, the Smelter site and Grosvenor Dam will be required; the chosen alignment, likewise, selected to negate significant vegetation removal.

Where implementation of the RAP affects areas of native vegetation, a vegetation management plan would be developed to assist and direct revegetation work.

As identified in the SoHI, the proposed works are minimal in scope, involving the stabilisation of existing conditions through the removal of contaminated topsoil and accumulated silt and the stabilisation and fencing of areas which present topographic threats (Brassil, Marsh & Riley 2024). No interference with or removal of existing site features is proposed, including the movable heritage items such as the stamper and boilers (Brassil, Marsh & Riley 2024). While there is a high probability of discovering artefacts or works relating to the mining history of the site during excavation works, there is little potential for the site to add significantly to the existing body of knowledge about mining or the settlement of NSW (Brassil, Marsh & Riley 2024).

The proposed work within the investigated mine precinct would primarily be restricted to the areas of contamination, which are near the abandoned mine features; as such, the extent of impact likely to arise due to the safety and remediation work would be significantly smaller than the overall precinct size.

Prior to commencing the remedial earthworks, site preparatory work may include establishing a temporary site compound, this located in a position that suits the activities of the Principal Contractor. Whilst establishment of this may require the disturbance of ground cover plants (mainly grasses), the site compound will be located within an area previously cleared of tree and shrub vegetation.

A Construction Environmental Management Plan (CEMP) will be prepared by the Remediation Contractor, with work conducted in accordance with the soil and water management details provided in the CEMP.

1.3.1 Plant and equipment

Machinery and equipment likely to be used, but not limited to, during the course of the project would include:

- Excavator
- Bulldozer

- Scrapers
- Truck with trailer
- Water cart
- Four-wheel drive utility vehicles.

1.3.2 Work hours

The proposed work would be carried out during standard working hours according to the *Draft Construction Noise Guideline* (NSW EPA 2020) and may be permitted:

- 7:00 am – 6:00 pm Monday to Friday
- 8:00 am – 1:00 pm Saturday
- No work would be carried out on Sundays or during public holidays.

No night work will be required.

1.3.3 Duration of work

Assuming no adverse weather conditions are encountered, the duration of the proposal is expected to take up to 8 weeks from site establishment.

1.4 Justification of the activity

Remedial strategies for Leadville mine were developed in consideration of:

- The characteristics of materials within domains at the site and the risk they present to receptors at the site under defined land use scenarios.
- Limitations on undertaking large scale bulk earthworks within the identified geohazards zone.
- The risk highly impacted materials present to offsite receptors (via impacts to water quality).

Section 4.2 of the RAP details the potential receptors and exposure pathways relevant to the proposed use of the site (and the current state of contaminants present on-site).

- Surface Soil / Public and recreational users (including site workers undertaking remedial works).
    - Inhalation of dust.
    - Ingestion of surface soil/sediments.
    - Dermal contact with sediments.
- Dams / Public and recreational users on the site – adults and children
    - Ingestion of surface water.
    - Dermal contact with surface water.
    - Ingestion of biota / produce (e.g., mussels and fish from Leadville Dam).

- Surface soils, pasture and dams / Stock – cattle and sheep for meat and wool
    - Inhalation of dust.
    - Ingestion of surface soil / sediments (e.g., uptake of soil particulate while grazing).
    - Dermal contact with sediments.
    - Ingestion of surface water (e.g., livestock drinking near contamination domains [LVD1 – marked as "excavate and vegetate" on Figure 1]).
    - Dermal contact with surface water.
    - Ingestion of biota / produce (e.g., mussels and fish from Leadville Dam).

The adjacent Water Reserve dam (to the east next to Sir Ivan Doherty Drive) is accessed by the public for livestock watering and recreational use, and may receive surface flows from the precinct, with surrounding private land used for agricultural purposes (grazing and cropping); while potential future land use options include water use by local RFS.

The LMP wishes to address this situation. The RAP sets the remedial goals of removing the risks posed by the identified potential contamination issues, to make the site suitable for agricultural purposes (that allows livestock grazing for a period of 2 months per year) whilst addressing migration of impacts from the site. The proposal is deemed an appropriate solution in achieving the aim of improving and protecting human, livestock and environmental health and safety.

1.5 Evaluation of alternatives

Alternative options to conducting the proposed remediation work considered were:

- *Retaining the mine precinct in its current condition ("Do Nothing" option)*

  This option is considered unreasonable and unviable due to the ongoing environmental, human and faunal health and safety risks the contamination poses if no remedial action is taken. This does not meet LMP's obligations or the objectives of the proposal.

- *Entirely restricting access to the precinct*

  Entirely restricting access to the precinct (e.g., fencing) does not ameliorate the risk posed to surrounding agricultural land and the adjacent Water Reserve Dam, which may receive contaminated surface flows from the precinct. It is noted potential future land use options include water use by the local RFS.

- *Erection of warning signs*

  The erection of warning signs does not remove the contamination risk posed by the former mine precinct and the off-site movement of hazardous material.

- *Encapsulation at Mt Stewart*

  Remedial works were planned for the subject site on the basis of Okane's 2022 findings. A number of underground workings were located during the development of technical oversight plans. Due to the risk of subsidence from the underground workings, encapsulation at Mt Stewart would require significant underground work, such as grouting. Therefore, it was not considered feasible to progress with this option.

Without intervention and the carrying out of the remediation work, health and safety deficiencies would persist and the investigated area would continue to present a danger to the environment, and those members of the public, wildlife and livestock that frequent this locality.

The remedial strategy presented in the RAP—being the preferred option—provides the best immediate, cost effective and permanent (long-term) solution to the present contamination concerns associated with the former mine precinct.

1.6 Stakeholder consultation

Consultation was conducted by LMP and Public Works.

The remedial strategies presented in the RAP have been developed on the basis of previous investigations (Okane 2021) and in collaboration with The Principal (i.e., LMP) and other stakeholders including NSW Crown Lands (TTC 2024).

The NSW DPI, NSW EPA, Local Land Services and managers of the proximate travelling stock route (TSR) were provided an overview of site investigations undertaken to date and the contamination issues identified at the site.

2 Statutory context

2.1 Legislation – NSW

2.1.1 Environmental Planning and Assessment Act 1979

The EP&A Act is the principal legislation regulating development in NSW. It establishes a regime for the making of development applications, assessment of their environmental impacts and the determination of those applications. It also allows for the making of environmental planning instruments such as SEPPs and LEPs.

The proposed remediation work is subject to the environmental impact assessment and planning approval requirements of Division 5.1 of the EP&A Act. Division 5.1 of the EP&A Act specifies the environmental impact assessment requirements for activities undertaken by public authorities, such as LMP, which do not require development consent under Part 4 of the EP&A Act.

In accordance with s.5.5 of the EP&A Act, LMP, as the proponent and determining authority, must examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposal.

Clause 171(2) of the Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) defines the factors which must be considered when determining if an activity assessed under Division 5.1 of the EP&A Act has or is likely to have a significant impact on the environment. Sections 5-7 of this REF provides an environmental impact assessment of the proposal in accordance with Clause 171(2).

2.1.2 Other legislation

Other relevant NSW legislation applicable to the proposed work is considered in Table 1; with relevant SEPPs and LEP applicable to the proposed remediation work considered in Table 2.

Table 1. NSW Legislation applicable to the proposed work

Legislation	Description	Licence/permit
Crown Lands Management Act 2016	Section 1.4 of the Act provides the basis/principles of management of Crown land for the people of NSW, including environmental conservation and other considerations to be considered when making decisions about Crown land. DPHI-Crown lands are represented on the Legacy Mines Steering Committee as a key stakeholder to guide/support proposed works on Crown land sites. Lot 7304 DP 1152229 is a Crown Land parcel. However, the LMP is a State government agency authorised to undertake remediation works on Crown land with DPHI – Crown Lands agreement/support; therefore, no formal approvals are required to do this work.	No
National Parks and Wildlife Act 1974	Provides the basis for the legal protection and management of Aboriginal sites and objects in NSW. Impacts of the proposal on Aboriginal heritage are discussed in s.5.1 of the REF, with mitigation measures provided in Section 6. No previously recorded sites of Aboriginal heritage have been identified within the study area, and none are considered to be uncovered due to the disturbed nature of the precinct.	No

Legislation	Description	Licence/permit
Biodiversity Conservation Act 2016 (BC Act)	Provides legal status for biota of conservation significance in NSW. A SIS is required if the assessment of significance indicates that there will be a significant effect on threatened species or ecological communities, or their habitats. The requirements for a SIS are set out under Division 5, Part 7 of the BC Act. Impacts of the proposal on biodiversity are discussed in s.4 of the REF. As the impacts to species from the proposal are limited, a SIS will not be required.	No
Biosecurity Act 2015	Provides for the prevention, elimination, minimisation and management of biosecurity risks; and for other purposes. Impacts of the proposal on biosecurity are discussed in s.4.4.1 of the REF, with mitigation measures provided in Section 6. The Principal Contractor would be responsible for managing biosecurity risks such as spreading of weeds.	No
Protection of the Environment Operations Act 1997	Focuses on protecting, restoring, and enhancing the environment within NSW, and reducing potential risks to human health and the environment. Also aims to provide opportunities for increased public involvement and access to information regarding environmental protection. The proposed safety work and remediation is not a Scheduled activity under Schedule 1 of the Act; therefore, an environment protection licence (EPL) is not required.	No
Water Management Act 2000	Controls the extraction and use of water, construction works such as dams and weirs, and the carrying out of activities in or near water sources in NSW. Under the Act, 'waterfront land' is defined as land within 40 m of a river, lake, estuary or shoreline. The proposal does not involve an activity in, on or under waterfront land.	No
Heritage Act 1977	Provides protection to heritage items that have been identified, assessed, and listed on various registers including State government section 170 registers, Local Environmental Plans, and the State Heritage Register. Non-Aboriginal heritage is discussed in s.5.2 of the REF, with mitigation measures provided in Section 6. No exemption under the Heritage Act is required to permit the proposed work	No
Mining Act 1992	A search of the existing mineral licences and titles under the *Mining Act 1992,* in reference to MinView (Department of Regional NSW 2024) has been conducted. One exploration licence applies to the study area: • EL 8665 – held by Bacchus Resources Pty Ltd, which expires on 23 October 2027.	No

Table 2. SEPPs and LEP applicable to the proposed work

Legislation	Description	Licence/permit/ consultation
State Environmental Planning Policy (Resources and Energy) 2021	Establishes appropriate planning controls to encourage ecologically sustainable development through the environmental assessment, and sustainable management, of development of mineral, petroleum and extractive material resources. Section 2.8(b) of the SEPP states that rehabilitation, by or on behalf of a public authority, of an abandoned mine site is permissible without consent. The proposal meets this description; therefore, the proposed remediation works is permissible without consent. Cl.2.13 (3) of the SEPP provides that *'Development for any of the following purposes is exempt development if it is of minimal environmental impact and is on land that is the site of an approved mine, an approved petroleum production facility or an approved extractive industry—'* (c) the demolition of a building or structure that is carried out in accordance with Australian Standard AS 2601—2001, The demolition of structures, but only if the building or structure is not, or is not part of, a heritage item, or in a heritage conservation area, identified by an environmental planning instrument. The Leadville Mine precinct is listed under Schedule 5 'Environmental heritage' of the Warrumbungle LEP (Item no. 129) (see segment below).	No
Warrumbungle Local Environment Plan 2013	The Warrumbungle LEP 2013 aims to make local environmental planning provisions for land in the Warrumbungle Shire LGA in accordance with the relevant standard environmental planning instrument under s.3.20 of the Act. The particular aims of the LEP relevant to the proposed work are as follows: (d) to identify, protect, conserve and enhance Warrumbungle's natural assets, (e) to identify and protect Warrumbungle's built and cultural heritage assets for future generations. The subject site is located within land zoned RU1 Primary Production (Figure 5). The Leadville Mine precinct is listed under Schedule 5 'Environmental heritage' of the Warrumbungle LEP (Item no. 129). Pursuant to cl.5.10(4) 'Effect of proposed development on heritage significance' of the LEP, the consent authority must, before granting consent under this clause in respect of a heritage item or heritage conservation area, consider the effect of the proposed development on the heritage significance of the item or area concerned. Heritage items recorded during the archaeological investigation as part of the SoHI prepared for the proposal, their description and the proposed impact has been included in tables within s.3.3.1 – 3.3.4 of the SoHI (Appendix 2). Section 5.2 of the REF discusses non-Aboriginal cultural heritage.	No

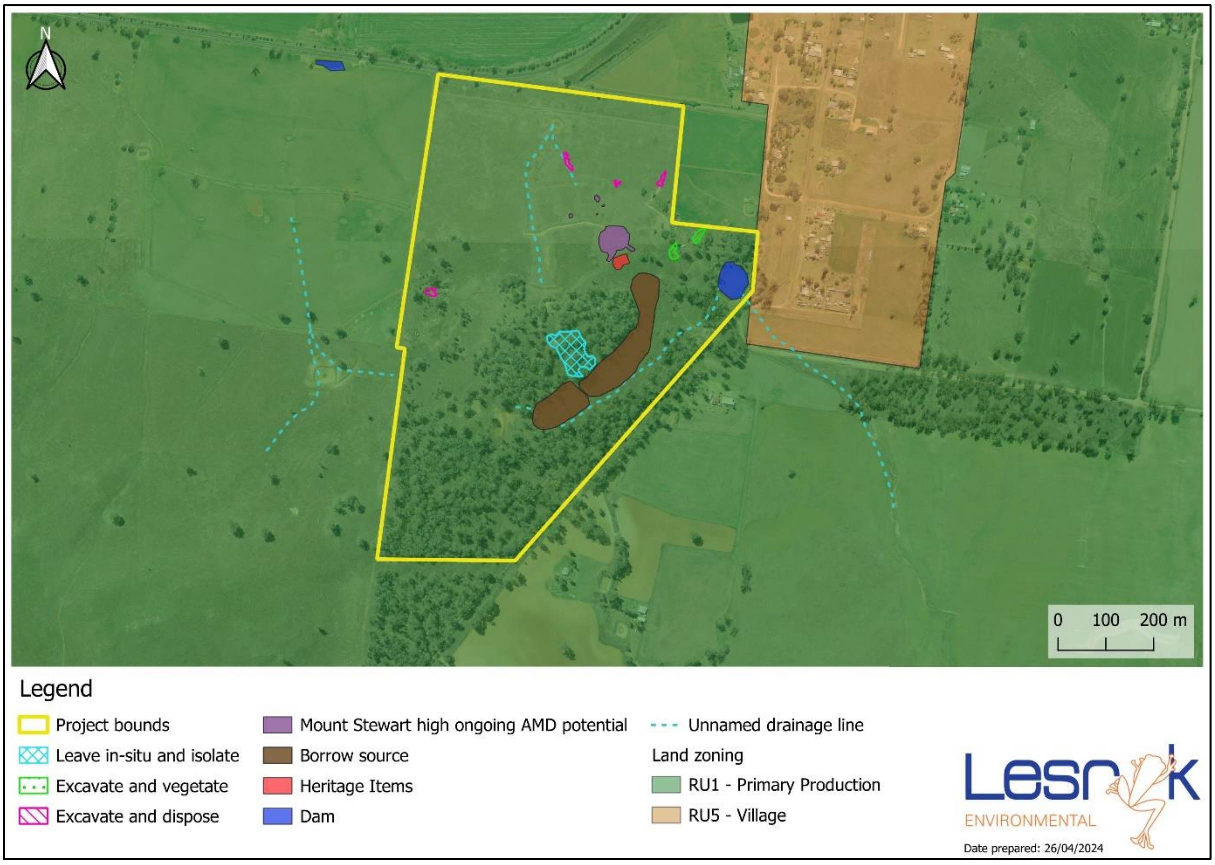


Figure 5. Land zoning within the study area

2.2 Legislation – Commonwealth

The EPBC Act is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora and fauna, ecological communities, and heritage places defined as MNES.

Approval from the Australian Government Minister for the Environment is required for:

- *An action which has, would have, or is likely to have a significant impact on MNES*

Impacts of the proposal on biodiversity listed under the EPBC Act are considered in s.4 of this REF. The proposal is not likely to have a significant impact on MNES; therefore, approval is not required under the EPBC Act.

- An action likely to have a significant impact on the environment in general (for actions by Commonwealth agencies or actions on Commonwealth land) or the environment on Commonwealth land (for actions outside Commonwealth land).

The works proposed are not being undertaken on Commonwealth land or by a Commonwealth agency.

3 Environment Assessment and Impact

A flora and fauna survey[2] of the Leadville Mine precinct proposed to be remediated was carried out by Deryk Engel [Ecologist] (B.Env.Sc.HONS), Paul Burcher (B..App.Sc) [Botanist] and Joseph Morton (B.Env.Bio) [Ecologist] on 4 August 2021. The weather conditions experienced during the site investigation were overcast skies with a light drizzle, cool temperatures of 9 ˚C and a light breeze. The investigation was conducted between the hours of 1415 and 1615.

Following the field investigation and subsequent update of the Leadville Mine RAP and revised strategy, a desktop study has been undertaken in April 2024 to inform relevant mapping and results. Where relevant, this information has been updated in the relevant sections below.

3.1 Description of existing environment

The former mining area is accessed from Garland Street/Sir Ivan Doherty Drive; present along the eastern boundary of the former mining precinct), via an existing unsealed earthen track (about 3 m wide) that provides egress across the precinct. Given the current good condition of the track and grassy terrain, its use would not require the clearing of any vegetation, though the occasional small over-hanging branch may require lopping.

The existing mine features identified within the SoHI were easily distinguished amongst the native grasses within the precinct.

The topography of the surrounding landscape is undulating hills and low hills/rises ranging from 420-530 m in elevation, with gently inclined slopes <15% and drainage lines 300 – 1000 m apart; set amongst agricultural pasturelands, rural properties and areas of woodland.

Section 2.3 of the RAP details that surface drainage on the Leadville site is ephemeral, with surface drainage following topographic relief, the majority of the site draining north from workings and mine infrastructure towards stock dams. These stock dams have low pH (acidic) with elevated levels of Pb, Zn, Mn, Cd and As. Extended workings south of the hill crest drain south-east.

For reference, a photographic record of areas investigated within the former mining precinct has been provided (Appendix 3).

The dominant land-use conducted in this portion of the Warrumbungle LGA is agriculture (grazing and cropping). Land uses that occur within, and in the vicinity of, the former mining precinct include:

- a TSR
- an adjacent Water Reserve dam accessed by the public for livestock watering and recreational use
- agricultural properties
- residential properties within the township of Leadville.

The Leadville Mine precinct is not located within, or in proximity to, a conservation area.

[2] For a distance of about 30 m beyond the limits of the existing mining features.

3.2 Geology, soils and topography

The Dubbo 1:250,000 Soil Landscape Sheet report (Murphy and Lawrie 1998) and SEED Dataset mapping (State Government of NSW and NSW DCCEEW 2024) identified the area investigated within two soil landscapes (Figure 6):

- Home Rule
- Rouse.

The Home Rule soil landscape is mapped as occurring on the lower slope in the north-west and north of the site, but probably also extends up the creekline in the east of the site. This soil landscape is composed from Quaternary alluvium and the Gulgong and Rouse Granites geological units, and is comprised of mainly Siliceous Sands and Earthy Sands on upper and mid-slopes, Bleached sands, Yellow Podzolic Soils and yellow Solodic Soils on lower slopes and flats, with layered Siliceous Sands in some larger drainage lines (Murphy and Lawrie 1998).

The Rouse soil landscape, which is derived from Gulgong, Botobolar and Havilah Granites geological units, is characterised by mainly shallow Siliceous Sands and Earthy Sands on mid-slopes and upper slopes; Yellow Soloths and yellow Solodic Soils on lower slopes and in depressions, deeper A_2 horizons on lower slopes adjacent to main drainage lines, with other soils including bleached sands and non-calcic Brown Soils and Red Earths on small areas of less siliceous rock (Murphy and Lawrie 1998).

Natural elevations within the area investigated are between 420 m and 465 m Above Sea Level.

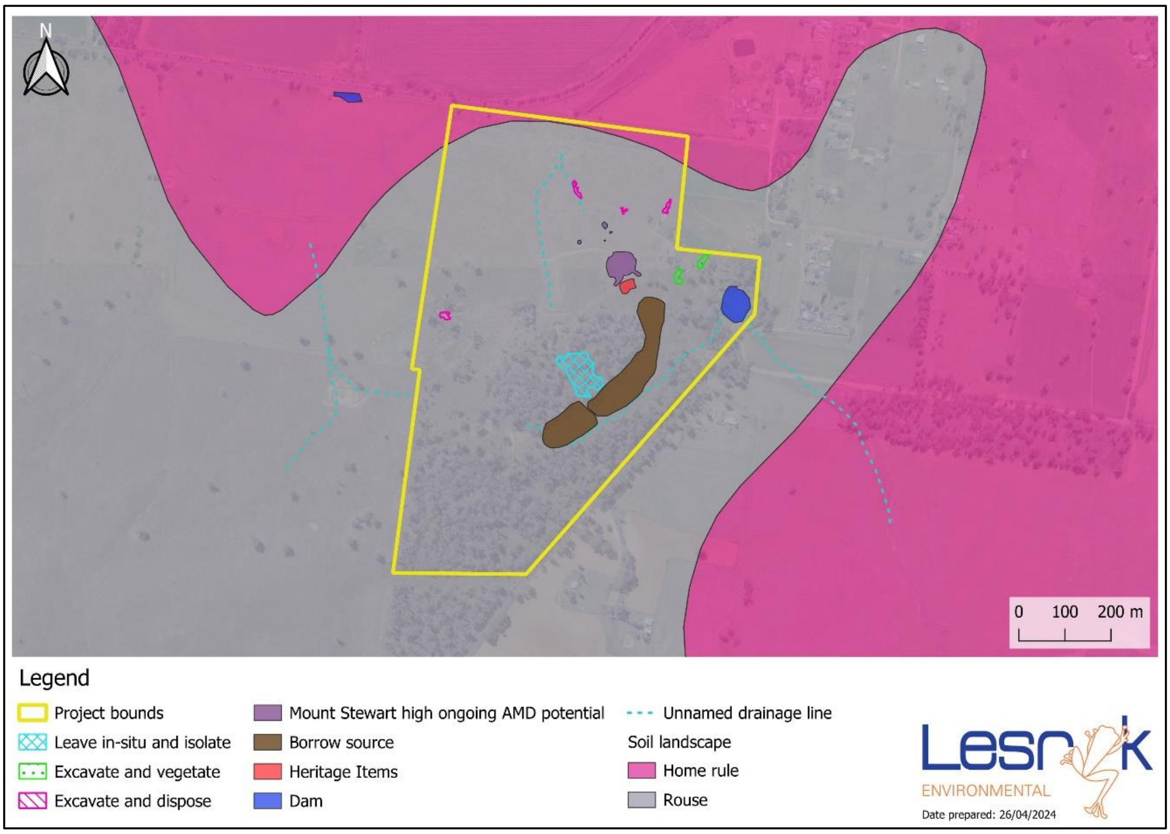


Figure 6. Soil landscapes

Areas which will be disturbed by the proposed work are contained within the Rouse Soil Landscape. Identified soil limitations include low fertility, acidic surface soils, moderate to very high erosion hazard (under cultivation) and low water-holding capacity (Murphy and Lawrie 1998).

The activities associated with the proposed remediation work would result in the disturbance and exposure of those soils present. Exposure of this material could potentially cause erosion of the soils during periods of high winds, heavy rainfall or where vegetation is sparse. Mobilised sediment also has the potential to enter the precinct's ephemeral drainage line.

The proposed work is not to be conducted during periods when high winds are predicted. To negate the generation of dust, areas of exposed, disturbed, loose and friable soil/areas/stockpiles would be treated regularly during dry conditions (e.g., through use of a water cart). Vegetation would be driven over as opposed to removed. If necessary, prior to traversing this, it would be slashed to a height of around 100 mm.

Temporary stockpile site(s) would be located in nominated areas previously disturbed and/or predominantly cleared of native vegetation.

As identified in in the Appendix A (Sheet C20) of the RAP (TTC 2024), scheduling of the proposed work, particularly dam construction, is required to minimise exposure of contaminated material.

3.2.1 Contaminated land

Section 3.2 of the RAP presents the contamination assessments of the site. Section 5.2 of the RAP identifies the source point, or contamination domains, which present a risk to receptors at Leadville (Plate A, extracted from the RAP) with s.4.4 of the RAP identifying management techniques (Plate B, extracted from the RAP).

Table 17 Categories Adopted for Guiding Remedial Requirements

#	Category	Domain	Characteristics	Remediation Requirements
0	Unimpacted	Remaining Areas of site	• COPC < 12 mo RBC for livestock	None
1	Diffuse impacted	Remaining Areas of site (excluding cat # 0, 2 and 3)	• Elevated metals in surface, no obvious signs of subsurface contamination. No obvious signs of phytotoxicity. No evidence of mobility or offsite pathways.	Limit on grazing to two months per annum (yellow area in Figure13)
2	Elevated metals content with low mobility	Grosvenor and Smelter Site	• Pb Content > RBC for Pb3 at smelter site 6,600 mg/kg. • ASLP<RBC for recreational/livestock drinking water guidelines.[4] • No AMD potential (NAG/NAPP)	Isolation (no grazing or public access) red area).
3	Elevated metals and corresponding high leachate potential or High ongoing AMD potential.	Mt Stewart, Mt Stewart Drainage, Paddock Shaft Area and Grosvenor Dam	• Pb Content > RBC for Pb5 at Mt Grosvenor Stewart Drainage 9800-10000 mg/kg. • ASLP> RBC for recreational/livestock drinking water guidelines. • Significant AMD potential (NAG/NAPP)	Offsite disposal or drainage controls *where geohazards are present.

Plate A. Remediation works in each identified domain

Table 16 Media requiring management or remediation.

Media	Impact	Action Required
Soil	Heavy metal impacted soils or sediment posing a potential risk to recreational users of the site or livestock.	Remediation (via isolation) or on-going management of access (Areas where limited grazing can occur).
	Highly impacted materials that exhibit on-going leaching or AMD characteristics.	Remediation (via excavation and off-site disposal or the construction of surface water diversion bunds in areas of geohazards) and on-going management
Surface Water	Heavy Metal Impact and pH (LVD1)	On-going management and control on access at source points.

Plate B. Actions required for soil and surface water remediation works

A component of the proposed remediation work is the isolation of the various significant mobile contaminants present within the subject site (as a result of the site's mining activities), which pose a risk to potential receptors (i.e., humans, stock – cattle and sheep for meat and wool) via a range of exposure pathways under current land use scenarios. Vectors such as rain, wind (i.e., dust), animals (bio-accumulation) and human movement can cause this to occur.

Machinery and vehicle fuels are likely to be the only imported hazardous substances that require management at the site. There is potential for spills and leaks from the operation of plant and equipment to impact soil and water quality. Hazards associated with these products would be managed in accordance with regulations and good practice to ensure that any such materials are handled with due consideration of environment protection, and health and safety requirements of personnel.

Potential impacts to the local environment associated with contaminated soils as presented in s.4.2 of the RAP have been addressed in the 'Summary of mitigation measures' in Section 6 of this REF.

3.3 Climate

Section 2.6 of the RAP presents climate statistics for the site – the information indicating that the site falls under the Köppen Geiger classification category of Warm temperature (Cfa).

According to data for Dunedoo Post Office, January typically has a mean maximum summer temperature of 32.2 ^{o}C, while July is the coldest month with a mean minimum of 2.1 ^{o}C (Bureau of Meteorology 2024).

3.4 Air quality

The investigated Leadville Mine is located within a rural/agricultural landscape. As such, the study area experiences low levels of air pollution.

A number of residences are located directly east adjacent to the study area, as part of the small township of Leadville; these being considered sensitive receptors. During the course of the proposed work, there is the potential for temporary, minor adverse impact on local air quality through the generation of dust resulting from the remediation activities, the carrying out of earthworks and through vehicle movements; as well as exhaust emissions from machinery and equipment.

Mitigation measures, including monitoring dust levels at the property boundary adjacent to Leadville village, have been addressed in Section 6 of this REF.

3.5 Water

Hobbins Gully, a tributary of the Coolaburragundy River, flows from south to north approximately 1 km east of the subject site. A second order tributary of Hobbins Gully is impounded by the Leadville Dam, located on the Crown Water Reserve. Section 2.3 of the RAP details that surface drainage at the Leadville site is ephemeral, shaped by the terrain, primarily flowing northward from the mining activity and infrastructure toward stock dams. Extended workings south of the hill crest drain to the south-east. There are no defined drainage lines or creeks to the immediate north of the site, which would otherwise be potential receptors of runoff and discharges from the site.

In 2021, Okane undertook surface water sampling on standing water (i.e., surface water storages) across the site; as detailed below:

- Sediment Dam (LVD6)
- Crown Water Reserve, Leadville Dam (LVD7)
- Grosvenor Dam (LVDS2)
- Stock dams (LVD3/LVD4) which are immediately adjacent and form a single reservoir when full
- Mount Stewart void (LVD1)
- Dirty Dam (LDD)
- There are also nearby stock dams on neighbouring private properties
- LVDHOOK (downstream stock dam located approximately 600 m northwest of Mount Stewart workings near Black Stump Way).

These dams exhibit variable low pH (acidic) conditions with elevated levels of metals at one location (LVD1 [see Figure 4 of the RAP]). The expanded mining operations south of the hill's peak drain in a south-eastern direction.

Section 5.5 of Okane (2021) indicates that at Mt Stewart, in shallow collection depression (LVD1) the concentration of Cadmium (Cd) and Zinc (Zn) surpassed the established guidelines for recreational water use[3] (TTC 2024). It should be noted that pH measurements at LVD1 would not be deemed safe for livestock drinking water purposes or human recreation. In addition, AMD processes were considered ongoing at the site.

Section 2.3 of the RAP identifies three groundwater bores are positioned within 1 km of the site, being:

- GW800847: situated on private land to the west near Black Stump Way
- GW010685: located in Leadville township and serves as the source for the town's water supply
- GW2: installed in 2020 as part of Okane's site investigation works.

A component of the proposed remediation work is the protection of water quality at the site and down-gradient (off-site) from disturbance areas.

Mitigation measures, including the preparation of an Erosion and Sedimentation Control Plan (ESCP), have been addressed in Section 6 of this REF.

[3] And for RBC Livestock drinking water.

3.6 Noise and vibration

A number of residences are located directly east adjacent to the study area; these being considered sensitive noise receptors (see Figure 1).

Background noise levels within this locality are low given the rural setting and agricultural character of the area; excluding that generated by surrounding property owners, there are no significant sources of noise or vibration.

The movement of vehicles and machinery, the presence of personnel and the occupation of the precinct during the course of the work would result in a temporary increase in noise and vibration levels for those nearby residential sensitive noise receptors (the nearest located about 150 m east of proposed work). Noise and vibration producing activities associated with the proposed work are expected to include:

- Excavation
- Operation of plant and equipment
- Truck movements
- The presence of personnel.

During this period those proximate noise receptors may experience some alteration to the current daytime noise and vibration levels. No night work would be required. The proposed work would be carried out during standard working hours according to NSW EPA's *Draft Construction Noise Guideline* and may be permitted:

- 7:00 am – 6:00 pm Monday to Friday
- 8:00 am – 1:00 pm Saturday
- No work would be carried out on Sundays or during public holidays.

Mitigation measures have been addressed in Section 6 of this REF.

3.7 Natural resource use

3.7.1 Resources on site

Given the evidence of an active soil seed bank in relation to the partial woodland areas, impacts from the remediation activities will be minimal with respect to natural resources.

Native and non-seed-bearing exotic vegetation is to be mulched and/or re-used on-site (i.e., brush matting).

The locally sourced fill material would be obtained from within the precinct's investigated borrow areas (eastern portion of the precinct). There would, therefore, be no net loss of soil material from the Leadville Mine precinct investigated. Similarly, there would be no use of natural resources to transport Virgin Excavated Natural Material to the site.

3.7.2 Waste

Waste materials expected to be generated during the course of the project are likely to be:

- Vegetation removed for the proposed work
- Used chemical/hazardous substances (e.g., oil, grease products)

- Rubbish associated with staff meals etc.

Any native vegetation cleared during the course of the project would be retained and repurposed on-site.

A licensed contractor is to be engaged to remove, recycle and/or dispose of used oil and grease products at licensed facilities as required during remediation.

Each contractor would be responsible for any personal items of rubbish associated with their meals or other activities.

3.8 Socio-Economic

3.8.1 Community

The proposed safety work and remediation would not impact on any community services or infrastructure, or on any sites of importance to the broader community. Rather, improvements to the health and safety concerns presented by the existing contaminated land are likely to have positive and beneficial impacts on the local community, those members of the public who access the precinct investigated and local fauna, in regards to the existing exposure pathways previously mentioned.

While nearby sensitive receptors may experience temporarily reduced amenity and disruption at times during the proposed work, these effects are not expected to significantly disadvantage these residents.

Use of a portion of the study area as a TSR is addressed in s.3.10.2 of this report.

No negative impacts to the economic activity, economic welfare or economic stability of the locality would occur as a result of the proposal.

No mitigation measures have been identified to reduce community economic impacts as economic impacts have been assessed to be negligible or positive as listed in Section 6 of this report.

3.8.2 Traffic

Access to Leadville Mine is from Garland Street/Sir Ivan Doherty Drive, utilising the existing surrounding road network. The nature of the proposed work is not expected to generate the need for a discernible increase in traffic to and from the precinct.

No road closures would be required; and the proposal would not impact on any nearby property access. Parking for site personnel and machinery will be located on-site and would not impact on the local road network.

With the relevant mitigation and management measures in place, road traffic noise is expected to have a low adverse impact on the sensitive receptors in the vicinity of the study area.

3.9 Aesthetic

Views of the remediation area are limited to several vantage points along Black Stump Way to the north. Views from Sir Ivan Doherty Drive are restricted due to the presence of a band of native vegetation along the western side of this road. The undulating character of the precinct, and the presence of developed woodland within the southern portions of the property, limit views from the south and west.

Within the precinct investigated, the proposed work is situated beyond the visibility of those residences that occur close to the former mining precinct. The work would be screened from the adjacent residents due to the topography of the landscape and/or the structure of the existing vegetation. Remediation activities (i.e., the movement of vehicles) would only be apparent to the public during the course of the project. Any disturbance has been previously addressed within this REF, with mitigation measures in place to minimise the impact.

No loss of privacy, overshadowing or glare will be experienced by nearby residents as a result of the proposal.

The proposed work is located within areas that have been previously highly disturbed due to historic mining practices and current land use. The main visual changes that will occur will likely be the short-term disturbance of the native grasses that have grown atop each of the areas to be excavated. Considering the vegetated character of the precinct, it is likely that the proposed revegetation of these areas would be successful; therefore, this change would be temporary.

Revegetation of excavated areas will be as per s.6.2. of the RAP. Post-work, any disturbed areas not part of the remediation work will be permitted to naturally revegetate; the precinct ultimately reflecting the current character of this area.

It is acknowledged, as part of the remediation of the precinct, that several heritage items primarily in association with the Mount Stewart site are proposed to be disturbed/removed. Ultimately, various mining features will be retained, reflecting the former history and character of this environment.

No Aboriginal heritage is likely to be disturbed by the remediation works proposed.

Overall, the carrying out of the remediation work is not considered to have an adverse impact on the visual amenity of the precinct.

Post-remediation and revegetation, the precinct would reflect its current character being a grazing paddock within a rural landscape within which stands of remnant trees occur.

3.10 Land uses

The study area is located within land identified as RU1 (primary production) in the Warrumbungle LEP 2013. Table 3 contains information extracted from the RAP on the future proposed land uses for the subject site.

Table 3. Land use scenarios by tenure

Cadastre	Tenure	Intended Future Land Use
Lot 7304 DP 1152229	Crown Land Parcel	Land management activities.
Lot 7305 DP 1152229	Crown Land Parcel (Travelling Stock Route Part Reserve 68)	Land management activities and limited grazing[4]
Lot 7303 DP 1152229	Crown Land Parcel (Travelling Stock Route Part Reserve 47657)	Land management activities and limited grazing
Lot 149 DP 750766	Crown Land Parcel (Water Reserve)	Water use by Local RFS for emergency response.

[4] Limited grazing assumes individual cattle would not graze the TSR within the project area for more than 2 months per annum.

The overall remedial goals for the precinct are the protection of human, livestock and environmental health under these current land use scenarios; as such, the proposed work would have a beneficial impact on the land use within the Leadville Mine precinct and the surrounding locality.

Access to the Leadville Mine precinct would be restricted; however, in operation, the remediation activities would not adversely alter the existing land use, or reduce the range of short or long-term activities able to be carried out within the Leadville study area. Access to the precinct will be limited post-treatment.

Examples of the locality's mining history would be retained and available to educate those members of the public that visit this locality.

3.10.1 Exploration and mining

The study area is set within a rural landscape, which is predominantly used for agriculture.

With reference to MinView (Department of Regional NSW 2024), there is one exploration licence for the proposed work area (Figure 7), being:

- EL 8665 – held by Bacchus Resources Pty Ltd, which expires on 23 October 2027.

The proposed work area is not mapped as Strategic Agricultural Land – Biophysical (SRLUP) under the Mining SEPP (2007).

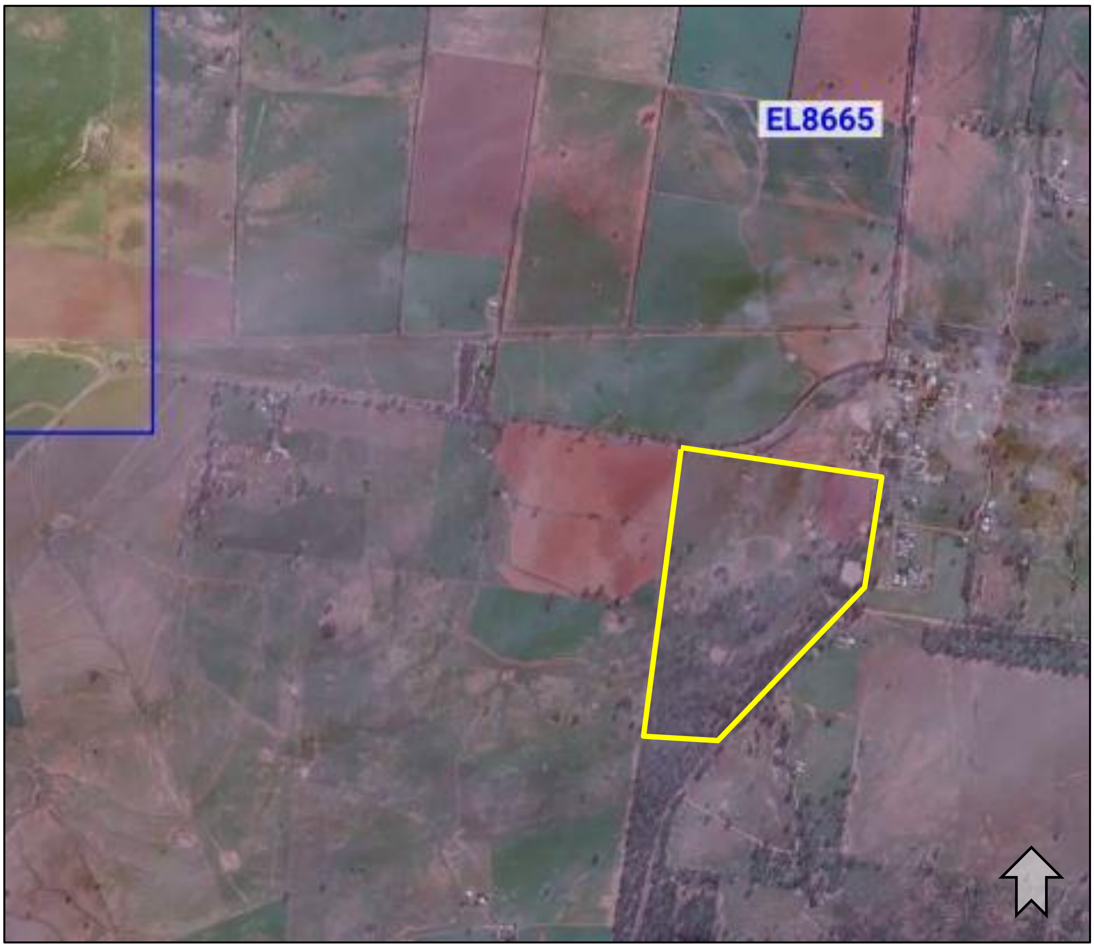


Figure 7. Exploration licence encompassing the proposed study area (yellow polygon)

In reference to SEED mapping (utilising the Land and Soil Capability Mapping for NSW layer) (NSW Government 2024e), the proposed work area is mapped as Capability 5 – 'Severe limitations' (Figure 8). The SEED Portal states:

> 'The mapping is based on an eight class system with values ranging between 1 and 8 which represent a decreasing capability of the land to sustain landuse. Class 1 represents land capable of sustaining most landuses including those that have a high impact on the soil (e.g., regular cultivation), whilst class 8 represents land that can only sustain very low impact landuses (e.g., nature conservation).'

The safety work and remediation within the Leadville Mine precinct would allow for the area to be used for low yield grazing outside of the heritage and contamination areas.

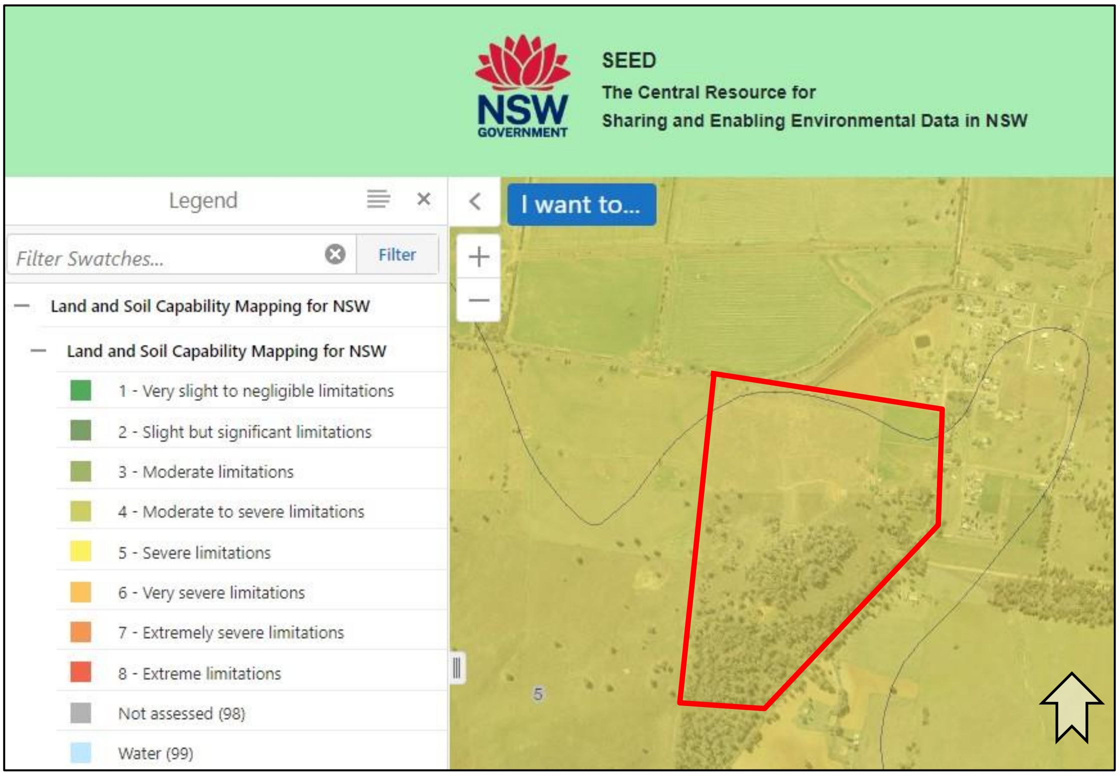


Figure 8. Soil capability mapping

3.10.2 Travelling Stock Reserve

Reference to the TSR – State Classification Map (LLS 2022b) identifies TSR within the area investigated as (Figure 9):

- Part Reserve 68 7305/1152229 as Category 2
- Part Reserve 47657 7303/1152229 as Category 3.

In accordance with the *Travelling Stock Reserves State-wide Plan of Management* (LLS 2022c), Category 2 TSRs are used for travelling stock, emergency management or biosecurity purposes, but they are also important and used for other reasons, e.g., biodiversity conservation, First Nations People'' cultural heritage or recreational purposes.

Category 3 TSRs are rarely, if ever, used for travelling stock or emergency management, but are important, valued and used for other reasons such as biodiversity conservation, First Nations People'' heritage or recreation. These TSRs are not Stock Watering Places.

The proposed work will not curtail any land uses practices; rather, it will result in beneficial outcomes. As previously discussed in s.1.4 of this REF, the overall remedial goals for the former mining area are the protection of human, livestock and environmental health under current land use scenarios. The remediation of the existing mine precinct will ultimately have a positive impact on land use, safety and environmental values, while conserving heritage significance.

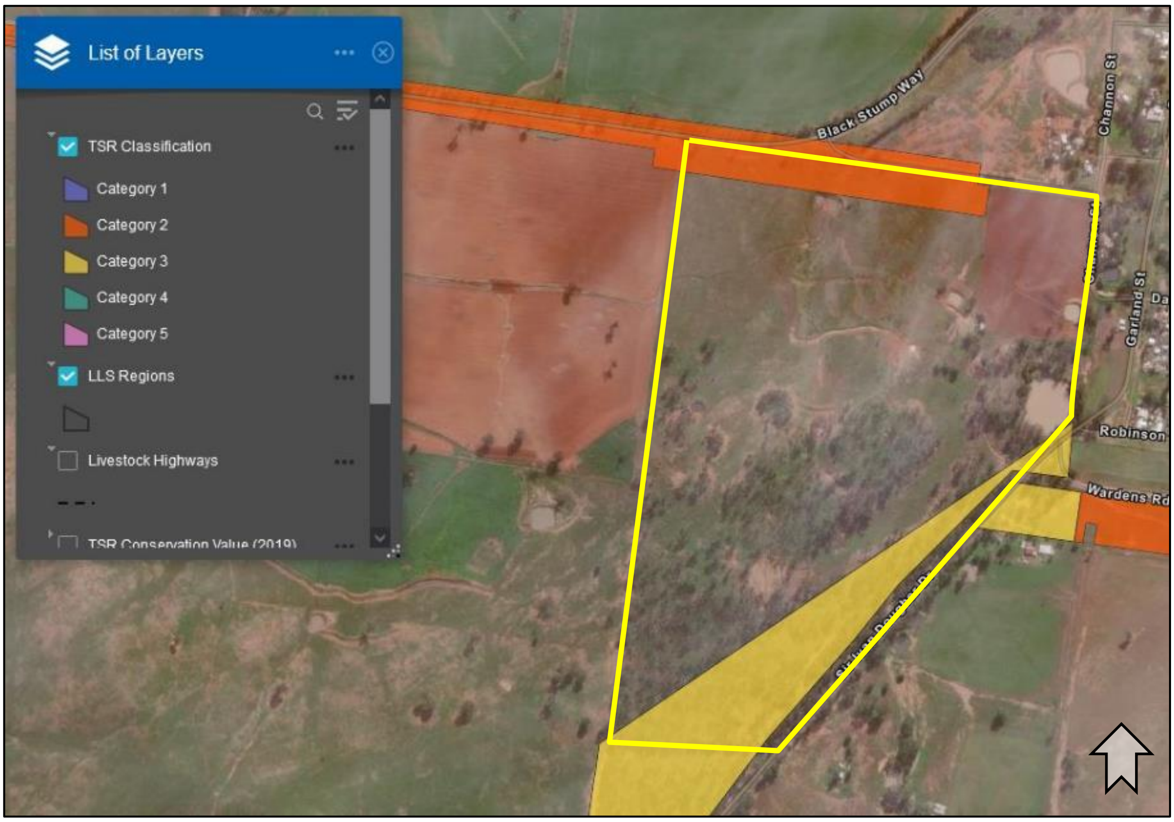


Figure 9. TSR State Classification Map

4 Biodiversity

4.1 Methodology

A field investigation was conducted by Lesryk in 2021 and the results of which are drawn on where relevant. A desktop study in April 2024 has been undertaken by Lesryk, drawing on information available on BioNet (NSW DCCEEW 2024a), the PMST (Commonwealth DCCEEW 2024a), and other relevant databases. The purpose of the field investigation was to identify those vegetation communities, fauna habitats, plants and animals present within, and in close proximity to, the Leadville Mine precinct, particularly those that are of State and/or national conservation significance as listed under the Schedules to the EPBC and/or BC Acts.

To achieve the objectives of the study, the following methods were employed during the field investigations:

- The identification of plants within the areas of likely disturbance, including both direct and indirect impacts.

- The identification of the structure of those vegetation communities and fauna habitats present.
- The direct observations of any fauna species present within, or close to, the seven mining precincts surveyed.
- Diurnal call identifications of fauna species, with all calls being identified in the field.
- The identification of any indirect evidence such as tracks, scats, diggings and scratchings.
- Ground debris, leaf litter and tree bark searches for any sheltering reptiles and amphibians.
- Targeted searches for those species of State and/or national conservation concern, or areas of their likely habitats/vegetation associations, that were identified during the literature review stage of the project.

Where required, a more detailed description on one or more of the survey methods employed is provided below.

While conducting the site investigation, efforts were made to document the diversity, structure and value of those communities and habitats present within, and adjacent to, the study area. This involved assessing the structure of the vegetation communities and fauna habitats present, and determining their significance for native species, particularly any that are of State and/or national conservation concern. While conducting the site assessments, efforts were made to identify features such as known vegetation associations, geological features, feed trees, mature trees with hollows, aquatic environments and other habitat features important to the lifecycle needs of those threatened species previously recorded in the study region (as listed in Appendix 4).

The survey methods employed and level of effort required were broadly based on the descriptions provided in the following:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (working draft)* (DEC 2004)
- *Threatened Species Test of Significance Guidelines* (State of NSW and OEH 2018)
- *Surveying threatened plants and their habitat – NSW survey guide for the Biodiversity Assessment Method* (State of NSW and DPIE 2020)
- DEWHA survey guidelines for Australia's threatened animals (2010a-c).
- DSEWPC survey guidelines for Australia's threatened mammals (2011a-b).

For reference, the cumulative survey effort achieved through use of the field survey techniques employed is presented in Table 4.

Table 4. Cumulative survey effort – ecological investigation

Technique	Accumulated effort
Non-specific fauna surveys[5]	4 person hours
Botanical	2 hours

[5] Investigator on site identifying fauna habitats, looking for carnivore scats or other indirect evidence (e.g., scratchings on smooth barked trees), conducting incidental bird and herpetofauna surveys, recording species observed/indicated while setting out equipment, locating mine features and so forth.

4.2 Botanical survey

Two survey methods were employed during the botanical investigation:

- Site-specific searches around flagged mine features and those sites of contamination.
- Random meander searches of each area of proposed disturbance to identify:
    - Any threatened plants
    - Likely access routes to the flagged mine features
    - Any machinery "no-go" areas.

The ''Random Meander Method'' (Cropper 1993) was employed during the general area botanical survey. This involved conducting random foot traverses through those vegetation communities that occur within each mining precinct investigated. During these traverses, notes were made on the structure and floristic composition of the native vegetation present. This method was employed to identify the general species composition of the precincts and to search for threatened plant species.

The 'Random Meander Method' is consistent with the stratified random sampling design as specified in s.5.1 (Stratification, sampling and replication) of the *Threatened Biodiversity Survey and Assessment: Guidelines for developments and activities (working draft)* (DEC 2004). This method is also mentioned under s.5.2.1 (Sampling techniques) and 5.2.7 (Targeting threatened plants) of that publication.

The 'Random Meander Method' is employed until no new species have been recorded for at least 30 minutes.

Where required, plant samples were collected (as per approval granted in accordance with Scientific licence SL100484) for later identification using standard texts and online identification guides.

Based on the results of the literature review and the habitat requirements of those threatened flora species identified as potentially occurring (see Appendix 4), targeted investigations were also carried out where areas of suitable habitat were observed.

4.2.1 Limitations

One limitation was encountered at the time of investigation, this being the winter timing of the survey. At this time, many groundcover species such as herbs and forbs and some grasses are unlikely to have been apparent or are difficult to identify to species level due to lack of fertile material. This is likely to have reduced the recording of the diversity of plant species.

Access to all parts of those areas likely to be directly or indirectly affected by the scope of work proposed was possible, thereby ensuring that all portions of the precinct were sampled. In addition, no adverse weather conditions were encountered during the field investigation.

Not all animals can be fully accounted for within any given study area. The presence of threatened species is not static; it changes over time, often in response to longer term natural forces that can, at any time, be dramatically influenced by human-made disturbances.

While targeted species-specific surveys were not a component of this study (e.g., spotlighting, echolocation detection and so forth), given the disturbed and modified nature of the site investigated (and lack of any significant developed native vegetation), it is not considered that the scientific rigour of the field inspection was compromised.

Though not considered a constraint, in order to overcome any limitations in regards to the level of survey effort employed:

a) database searches were conducted for threatened species, populations and ecological communities known to occur within the region

b) the precautionary approach was adopted where necessary (i.e., suitable habitat for those threatened species known to occur, or that have been previously recorded within the surrounding locality, was identified).

This report is based upon data acquired from the 2021 field investigation; however, it should be noted that the data gathered is indicative of the environmental conditions of the precinct at the time the field work was conducted. A desktop study has been undertaken in light of the updated scope of works.

4.3 Vegetation communities and fauna habitats

State Vegetation mapping has been undertaken (State of NSW and NSW DCCEEW 2023), this encompassing the subject site (Figure 10). This mapping indicates those PCTs predicted to be in the study area; being:

- PCT 0–- Not classified
- PCT 437–- Yellow Box grassy woodland on lower hillslopes and valley flats in the southern NSW Brigalow Belt South Bioregion.

During the field investigation it was found that the following anomalies in the mapping were apparent:

- Extensive areas mapped as PCT 0 were found to be derived grassland where there was greater than 50% cover of native species.
- A wooded area around Grosvenor Dam mapped as PCT 0 and the areas mapped as PCT 437 were more akin to PCT 3388 Central West Valleys White Box Forest in the reclassification of eastern NSW PCTs in the NSW vegetation classification database (NSW Government 2024b).

A description of the vegetation and fauna habitats recorded within the former mining area follows. It is recommended that the following be read in conjunction with reference to the photographic record provided (Appendix 3).

<u>Derived Grassland</u>

Vegetation over much of the precinct, including the borrow area, is dominated by a moderately dense growth to 1.2 m of Purple Wiregrass (*Aristida ayanaa*) and Speargrasses (*Austrostipa spp*) along with Blown Grass (*Lachnagrostis filiformis*) and herbs such as Sticky Everlasting (*Xerochrysum viscosum*), Kidney Weed (*Dichondra repens*), Wattle Mat-rush (*Lomandra filiformis*), the perennial weeds Purple-top (*Verbena bonariensis*) and Plantain (*Plantago lanceolata*) and the annual weed Saffron Thistle (*Carthamus lanatus*).

Conservation Significance

The derived grassland at the site conforms to PCT 1698 *Plains grass; Purple wiregrass; Wallaby Grass grassland on basalt soils of the Merriwa plateau* in the NSW vegetation classification database (NSW Government 2024b).

Although disturbed by past land use practices that include clearing of the canopy and understorey, subsequent grazing and invasion by weeds such as Purple-top and Plantain leading to reduced groundcover diversity, the native species comprise more than 50% of the groundcover. On this basis, a precautionary approach has been taken and it is considered that most of the subject site's grassland qualifies as the BC Act CEEC *White Box – Yellow Box –*

Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (hereafter referred to as Box–- Gum Woodland and Derived Native Grassland).

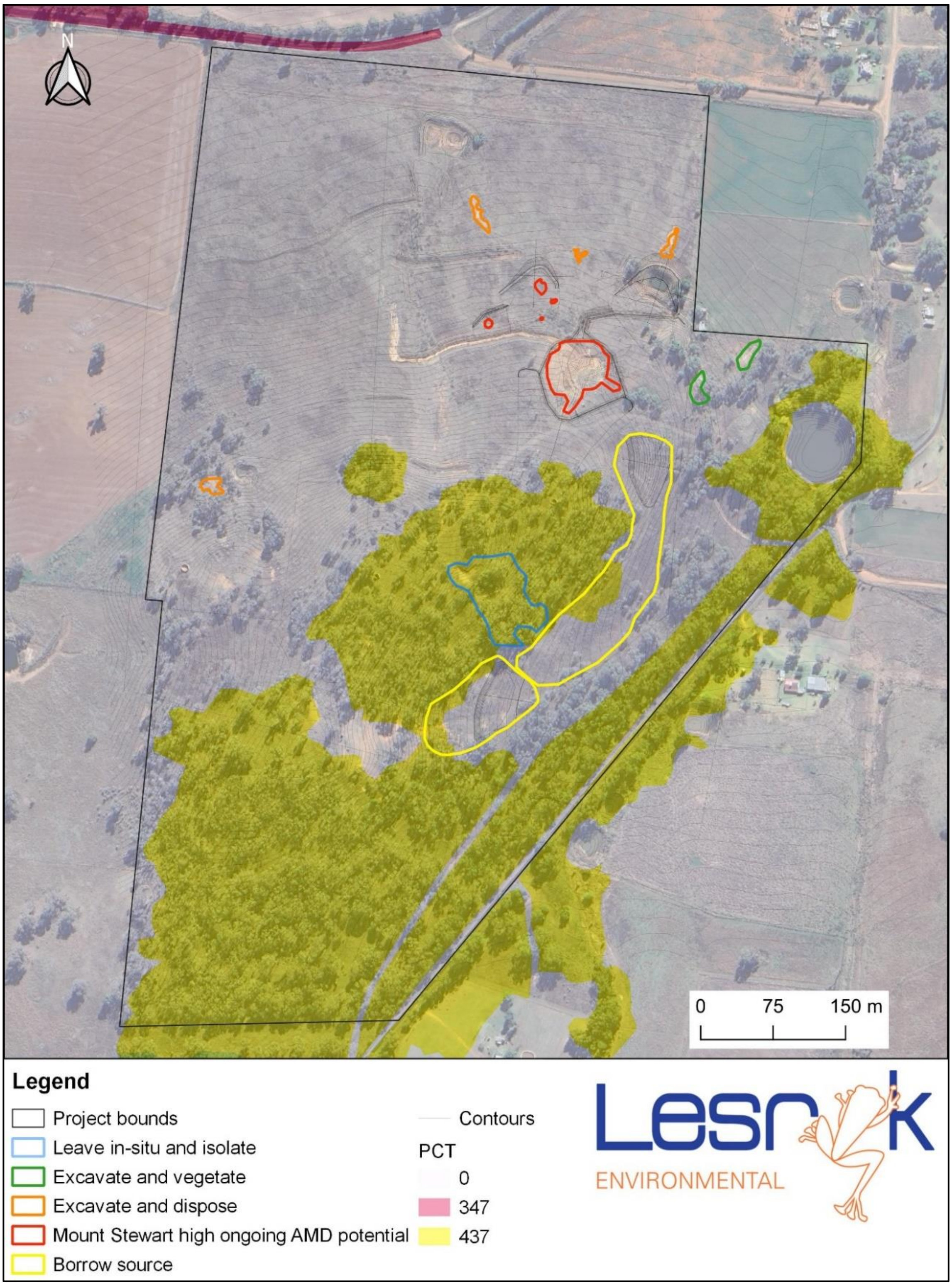


Figure 10. State Vegetation Type mapping

The advice that accompanied the EPBC Act listing of the synonymous CEEC (Threatened Species Scientific Committee 2006) states that:

> '*a patch in which the perennial vegetation of the ground layer is dominated by native species, and which contains at least 12 native, non-grass understorey species (such as forbs, shrubs, ferns, grasses and sedges) is considered to have a sufficiently high level of native diversity to be the listed ecological community*'.

In this regard, most of the grassland at the precinct qualifies as the EPBC Act Box–- Gum Woodland and Derived Native Grassland CEEC. This includes the borrow areas but excludes the Mount Stewart contamination domains where diversity is low and/or native species cover is less than 50%.

<u>White Box Woodland</u>

The vegetation in the vicinity of Grosvenor Dam is a woodland 8-15 m tall that is dominated by White Box (*Eucalyptus albens*). A number of the trees present are hollow-bearing (refer to s.4.3.1 of the REF). Apart from a small group of Hickory Wattle (*Acacia implexa*) there are few shrubs. The groundcover to 1.2 m is moderately dense and grassy. Common species are *Bothriochloa biloba*, Purple Wiregrass (*Aristida ayanaa*), Speargrasses (*Austrostipa spp*), Blown Grass (*Lachnagrostis filiformis*) and Snow Grass (*Poa sieberiana*). Herbs and forbs include Sprawling Bluebell (*Wahlenbergia gracilis*), Small St John's Wort (*Hypericum gramineum*) and Wattle Mat-rush along with Mulga Fern (*Cheilanthes sieberi*).

The woodland west of the borrow area has a similar groundcover and a canopy of White Box along with some Yellow Box (*Eucalyptus melliodora*) and Blakey's Red Gum (*E.blakelyi*) with Tumbledown Red Gum (*E.dealbata*) becoming common around the Smelter site. Hollow-bearing trees were also recorded in this area.

Conservation Significance

The White Box Woodland at the precinct conforms to PCT 3388 C*entral West Valleys White Box Forest* in the NSW vegetation classification database. The structure, composition and condition of the community at the precinct confirm that it is part of both the EPBC and BC Act CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

<u>Rough-barked Apple – Yellow Box Woodland</u>

On the lower slopes of the precinct, east of the borrow areas and around the dam is woodland composed of Rough-barked Apple (*Angophora floribunda*) and Yellow Box along with some White Box and Blakely's Red Gum. It has similar grassy groundcover to elsewhere though introduced pasture species such as Rhodes Grass (*Chloris gayana*) and Cocksfoot (*Dactylis glomerata*) are dominant in some areas.

Conservation Significance

The Rough-barked Apple – Yellow Box Woodland conforms to PCT 3397 *Northwest Flats Yellow Box Woodland* in the NSW vegetation classification database (NSW Government 2024b).

It is part of the EPBC and BC Act CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

4.3.1 Hollow-bearing trees recorded

Twenty-one hollow-bearing trees were recorded within the area investigated, and their position recorded through use of a Garmin^{TM} hand-held Global Positioning Unit (GPS) (refer to Figure 11). In addition to recording the GPS location of each tree, other features such as the plant's height, presence of hollows and so forth were recorded (refer to Table 5).

Figure 11. Location of recorded hollow-bearing trees

Table 5. Hollow-bearing trees recorded

HBT	Easting	Northing	Height (m)	Number of hollows	Orientation	Status	Remove
1	739526	6454352	12	1	Horizontal (H)	alive	No
2	739505	6454395	12	3	H	alive	No
3	739544	6454422	10	1	Vertical (V)	alive	No
4	739563	6454458	10	2	V	alive	No
5	739534	6454495	12	2	V	alive	No
6	739592	6454506	8	10	H+V	alive	No
7	739601	6454498	10	2	H	alive	No
8	740013	6454420	8	2	H	dead	No
9	739989	6454214	8	1	H	alive	No
10	739900	6454263	10	2	H+V	alive	No
11	739889	6454266	8	2	H	alive	No
12	739887	6454268	12	3	V	alive	No
13	739860	6454282	6	2	V	alive	Yes[6]
14	739839	6454290	10	3	V	alive	Yes
15	739861	6454226	10	2	H+V	alive	Yes
16	739853	6454214	10	2	H	alive	Yes
17	739841	6454215	12	2	H	alive	Yes
18	739843	6454121	8	7	H	dead	No
19	739843	6454116	12	2	H	alive	No
20	739876	6454142	10	2	H	alive	No
21	739925	6454170	8	4	H+V	alive	No

If a vertical dead limb/branch was noted, or a possible cavity/hollow seen, a precautionary approach was adopted. As all observations were made from the ground it was not possible to determine if these features were actually hollow-bearing or not.

Several of the hollow-bearing trees located within the Smelter area may be disturbed. Based on a worst-case scenario, it is assumed that up to five of the trees may require removal / disturbance (being trees #13-17). As this area is to be fenced, it is highly likely that an alignment that negates the clearing of these can be selected.

Should the fencing works require the removal of one or more hollow-bearing trees, an ecologist, or similar qualified person, is to be present on-site during the clearing of these plants. The ecologist, or similar qualified person is to:

- Develop lines of communication with the tree felling operator
- Inspect each plant prior to its clearing
- Inspect the plant once it is on the ground
- Collect and relocate locally any sheltering fauna
- Transport to a local veterinarian any animals that require treatment
- Provide advice on suitable off-setting measures.

[6] Given the accuracy of the hand-held GPS's used it is assumed these trees will require clearing or disturbance. Clearing of one or more of these may not be required but a precautionary approach has been adopted.

4.4 Flora recorded

By the completion of the flora survey, a mixture of native and exotic plants had been recorded (Appendix 5). It is noted that Appendix 5 is not intended to be a comprehensive list of all species within the study area (particularly given the winter timing of the recent survey), and only represents those plants that were recorded whilst conducting searches for:

- Those native species and ecological communities of State and/or national conservation concern that are known, or expected to occur, in the locality.
- Priority weeds that will require treatment.

Whilst their presence was considered and targeted investigations conducted, none of the plants listed in Appendix 5 (nor any species being considered for inclusion on the EPBC and/or BC Acts) were recorded within, or close to, the subject site, nor were any considered likely to occur. As such, the proposal is not likely to have a direct or indirect impact on any of these species.

No assessments referring to the Commonwealth's EPBC Act's Significant Impact Guidelines or s.7.3 of the BC Act that consider the impact of the proposal on a threatened flora species are considered necessary.

4.4.1 Weeds

Under the NSW *Biosecurity Act 2015* 'all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.'

Of the plant species detected on-site, the following is listed as a priority weed in the Central West Local Land Services Area (which includes the Warrumbungle LGA) under the *Biosecurity Act*:

- Common Prickly Pear (*Opuntia stricta*).

The regional recommendation measure for this species is "*The plant or parts of the plant are not traded, carried, grown or released into the environment. Land managers mitigate the risk of the plant being introduced to their land. Land managers reduce impacts from the plant on priority assets.*"

A small infestation of Common Prickly Pear occurs near Grosvenor Dam and should be removed prior to clearing of this area.

4.5 Fauna recorded

Those species recorded during the course of the field investigations conducted to inform this REF are listed in Appendix 6. Of those species detected, the Grey-crowned Babbler (*Pomatostomus temporalis*) is listed as Vulnerable under the BC Act.

The Grey-crowned Babbler was recorded during the course of the 2015 investigation, the species observed within woodland west of Garland Street and east of the proposed borrow area (at E740110; N6454359) (Lesryk 2015) (Figure 12).

Figure 12. Location of the Grey-Crowned Babbler (as indicated by the red star).

It is acknowledged that the Large Bent-winged Bat (*Miniopterus orianae oceanensis*), listed as Vulnerable under the BC Act, was recorded during the 2015 investigation (Lesryk 2015); however, this cave-dependent microbat was considered to have been detected traversing the area investigated as opposed to roosting on-site. With the exception of the fenced Shaft 10 (ID LV28), all remaining shafts on-site have subsequently been filled. As the proposed work is not considered to adversely affect any roosting habitat or significant areas of foraging habitat (insect-attracting plants) available to the Large Bent-winged Bat, no assessment for this species is required.

All of the non-threatened native species recorded during the current and previous investigations are protected, as defined by the BC Act, but considered to be common/abundant throughout the surrounding region. These species would not be solely reliant upon those habitats present within the remediation areas, such that the removal or short/long-term disturbance of these would threaten the local occurrence of these animals. The species are all expected to be present within both the study area and surrounding locality post-work.

It is expected that an ecologist or similar qualified person will conduct a pre-clearing survey within the precinct prior to the commencement of work.

4.5.1 Threatened species previously recorded in the study region

A review of the PMST and BioNet Atlas databases (Commonwealth DCCEEW 2024a, NSW DCCEEW 2024a) identified 13 threatened plants and 39 threatened animals listed under the Schedules of the EPBC and/or BC Acts that have been previously recorded, or are considered to have habitat, within a 10 km radius of the study area (Figure 13, Appendix 4).

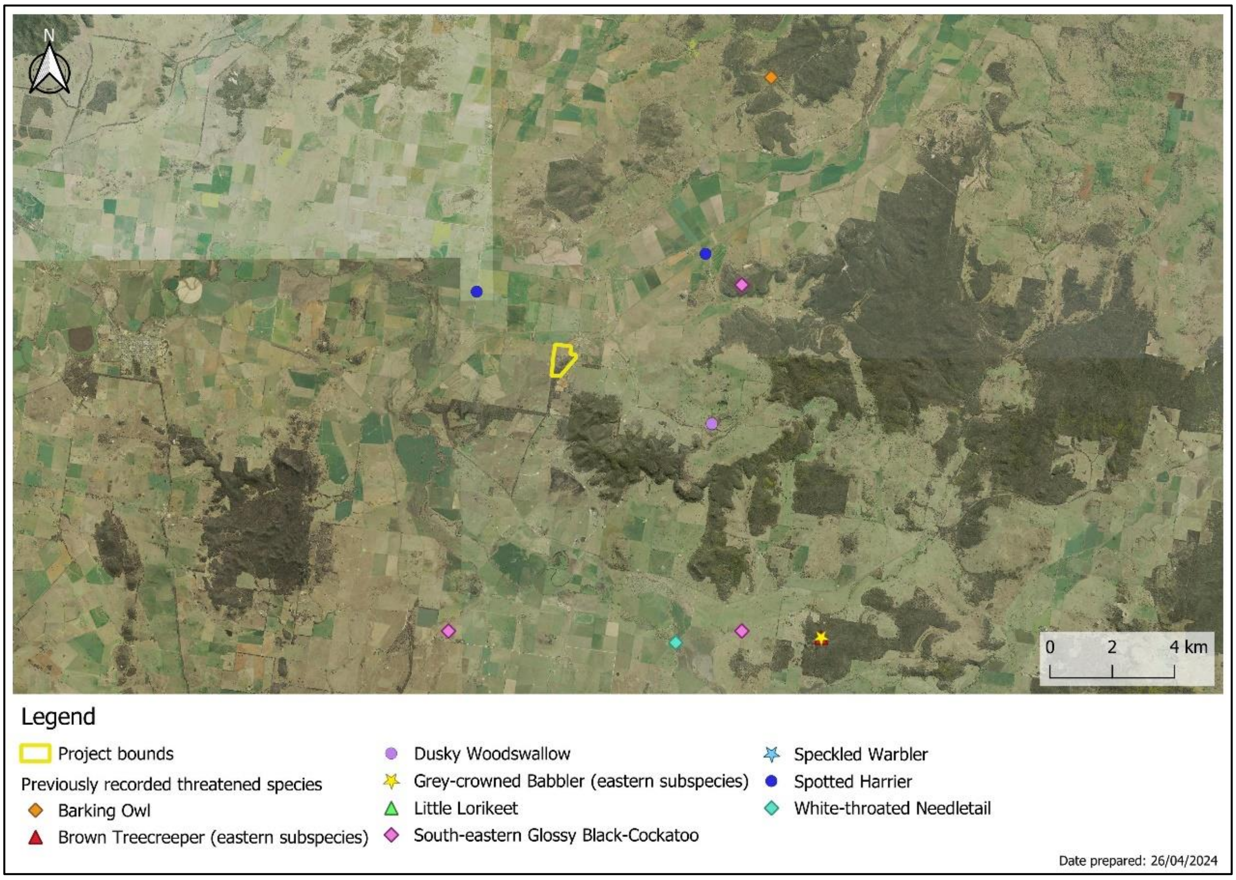


Figure 13. Previously recorded threatened species within the study area

In reference to the PMST (Appendix 4), Corben's Long-eared Bat (*Nyctophilus corbeni*) is predicted to occur within the study region. This microbat is a hollow-dependent species and it is noted that, during the 2015 ecological investigation, the common to abundant hollow-occupying Gould's Wattled Bat (*Chalinolobus gouldii*) was recorded (Lesryk 2015). In regard to the 2015 study, targeted microbat surveys were only conducted at those shafts that required filling, not within the proximate areas of surrounding woodland. Targeted microbat surveys were not undertaken during the 2021 investigation as this was conducted during the month of September when microbats would be hibernating. As up to 5 of the 21 hollow-bearing trees recorded may require removal, a precautionary approach to the presence of Corben's Long-eared Bat has been adopted.

To consider the impact of the proposal on this species, assessments drawing on the criteria provided under s.7.3 of the BC Act have been conducted on Corben's Long-eared Bat (Appendix 7).

A number of the fauna species listed in Appendix 4 may fly over the precinct on occasion (e.g., Grey-headed Flying-fox [*Pteropus poliocephalus*]), and potentially forage within those stands of vegetation present, whilst some arboreal and ground traversing native species may traverse the subject site on occasion. However, none are likely to be reliant on those habitats affected by the proposed work for their lifecycle requirements, and no barriers to their movement patterns would be permanently erected. Post remediation, with revegetation of the site in accordance with the vegetation management plan, if present, these species would still be able to traverse the subject site.

4.5.2 SEPP (Biodiversity Conservation) 2021

Chapter 4 Koala Habitat Protection

Chapter 4 'Koala habitat protection 2021' of the BCSEPP only applies to development applications assessed under Part 4 of the EP&A Act, not those considered under Part 5 (to which this proposal accords). Furthermore, s.4.4(3) of the BCSEPP states, despite subclause (1), this chapter does not apply to:

(d) land in the following land use zones, or an equivalent land use zone, unless the zone is in a local government area marked with an * in Schedule 2—
    (i) Zone RU1 Primary Production

The entirety of the Leadville Mine precinct investigated is zoned as RU1 Primary production.

4.6 Ecological Assessments – summary

4.6.1 Commonwealth – Environment Protection and Biodiversity Conservation Act 1999

By the completion of the field investigation, one MNES listed on this Act, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC was recorded at the subject site.

As it is predicted to occur in the study region, and given the presence of suitable habitat for its roosting/foraging requirements (i.e., hollow-bearing trees) and the detection of a hollow-utilising microbat during those field surveys conducted at this site, it is considered necessary to adopt a precautionary approach in regards to the potential presence of Corben's Long-eared Bat, a Vulnerable listed species.

Assessments drawing on the criteria provided under the EPBC's Significant Impact Guidelines were conducted (Appendix 7). These assessments found that the proposed remediation of the former mining area would not have a significant effect on the CEEC or Corben's Long-eared Bat. Therefore, referral of the matter as a controlled action to the Federal Minister for the Environment and Water for further consideration or approval is not considered necessary.

4.6.2 State – Biodiversity Conservation Act 2016

The BC Act listed CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland was recorded at the subject site and would be affected by the proposal.

As they have been either previously recorded in the subject site, or are predicted to occur, and as suitable habitat for each species is present, it is considered appropriate to adopt the precautionary approach in regards to the presence of the:

- Grey-crowned Babbler – species listed as Vulnerable
- Corben's Long-eared Bat – Vulnerable.

To consider the impact the proposal may have on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland and the two threatened fauna species, assessments drawing on the criteria provided under s.7.3 of the BC Act have been conducted (Appendix 7). These assessments concluded that the proposed safety and remediation work is unlikely to significantly affect White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, nor the Grey-crowned Babbler, Corben's Long-eared Bat, or their habitats. Consequently, the preparation of a SIS [or BDAR should the LMP elect that option] that further considers the impacts of the proposal on these BC Act listed entities is not triggered.

5 Heritage

5.1 Aboriginal heritage

The SoHI report prepared by Everick Heritage (Brassil, Marsh & Riley 2024) summarises all up-to-date findings regarding Aboriginal Heritage (Appendix 2). Section 6.4 of the SoHI states that no Aboriginal Cultural Heritage values have been identified for the project area that require assessment or further approvals under the NPW Act. The area is heavily disturbed by previous mining activities and any potential artefacts are likely to be out of context and of little research value.

To determine whether any Aboriginal Cultural Heritage items have been previously recorded within or in proximity to the study area, Lesryk conducted a desktop search of the Aboriginal Heritage Information Management System (AHIMS) on 26 April 2024 (NSW Government 2024c).

The results indicated that one previously recorded site of Aboriginal Cultural Heritage occurs within the search parameter centred on the study area [Lat, Long from: -32.027, 149.5295 - Lat, Long to -32.0165, 149.546 with a Buffer of 50 m] (Figure 14).

An extensive search was then conducted to reveal the exact location of this site (Table 6).

Table 6. Aboriginal cultural heritage: extensive search results

Site ID	Site Name	Easting	Northing	Datum/Zone	Site Feature
#36-3-0079	Leadville	739040	6454710	AGD; 55	Modified Tree (carved or scarred)

The 'Modified Tree (carved or scarred)' is located within Lot 86 DP750766, about 380 m north-west of the Grosvenor workings and not within the subject site (Figure 14). As such, the work proposed would not have a direct or indirect impacted upon this previously registered AHIMS site.

In accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Object in NSW* (DECCW 2010), a consideration has been given to the following factors listed on page 10 of that document:

1) *Will the activity disturb the ground surface or any culturally modified trees?*

   Response: Yes, ground disturbance will occur; however, no culturally modified trees will be disturbed.

2) *Are there any:*
   a) *relevant confirmed site records or other associated landscape feature information on AHIMS?*
   b) *any other sources of information of which a person is already aware?*
   c) *landscape features that are likely to indicate presence of Aboriginal objects?*

   Response: Yes, reference to the AHIMS confirmed a previously registered Aboriginal site to the west of the Grosvenor site.

3) *Can harm to Aboriginal objects listed on AHIMS or identified by other sources of information and/or can the carrying out of the activity at the relevant landscape features be avoided?*

   Response: Yes, harm to the previously registered AHIMS site can be avoided as it occurs beyond the limits of predicted disturbance.

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : Leadville
Client Service ID : 887308

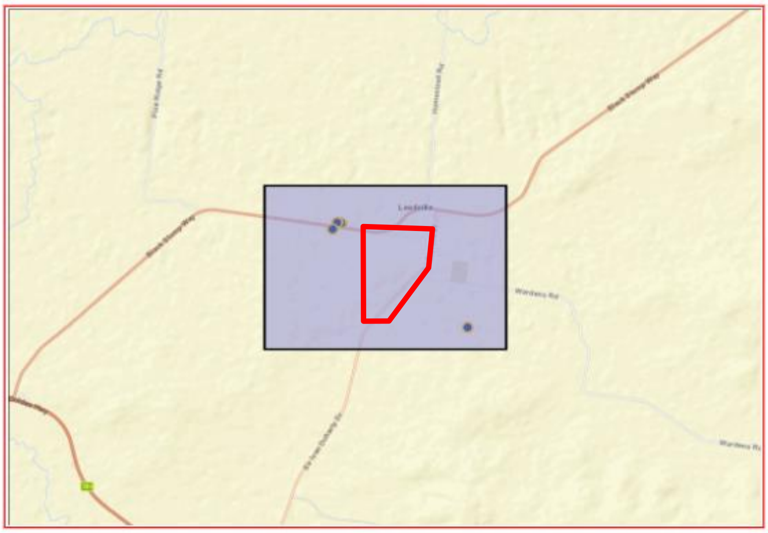
Lesryk Environmental Pty Ltd
20 Woodfield Ave
Bundeena New South Wales 2230
Attention: Deryk Engel
Email: admin@lesryk.com.au

Date: 26 April 2024

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -32.0302, 149.5233 - Lat, Long To : -32.012, 149.5542, conducted by Deryk Engel on 26 April 2024.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

4	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

Figure 14. AHIMS basic search result (study area denoted by approximate red boundary)

Based on the above, the proposal can proceed with caution without the need to obtain an Aboriginal Heritage Impact Permit.

In the unlikely event unexpected Aboriginal Cultural Heritage is uncovered during the course of the proposed work, the following recommendations have been made in line with the following Aboriginal protection measures:

- All land and ground disturbance activities will be confined to within the assessed study area. Should the parameters of the proposal extend beyond the assessed areas, then further assessment may be required.
- If suspected Aboriginal Cultural Heritage is discovered, it will be left in place with temporary fencing placed around the object (with a buffer of at least 10 m) to protect it from impact, with work to cease in the area.
- An appropriately qualified archaeologist and the LALC will be notified to assess the find(s).
- If the find is determined to be an Aboriginal object, Heritage NSW must be notified.
- In the unlikely event that suspected human remains are discovered, the *Coroners Act 2009* requires that all work should cease and the NSW Police and the NSW Coroner's Office should be contacted. Traditional or contemporary (post-contact) Aboriginal burials which

occur outside of designated cemeteries are protected under the NPW Act and should not be disturbed. Should the remains prove to be Aboriginal remains more than 100 years in age, notification of NSW Heritage and the LALC will be required. Notification should also be made to the Commonwealth Minister for the Environment and Water, under the provisions of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*.

5.1.1 Native Title

A search of the National Native Title Tribunal (NNTT 2024a) [search: Warrumbungle Shire Council], incorporating the Tribunal's Native Title Vision mapping (NNTT 2024b) (Figure 15), reveals that the Leadville Mine precinct is located within the external boundaries of the active Native Title Claim application: Gomeroi People (Tribunal file no. NC2011/006). A determination of native title for this application has not yet been made.

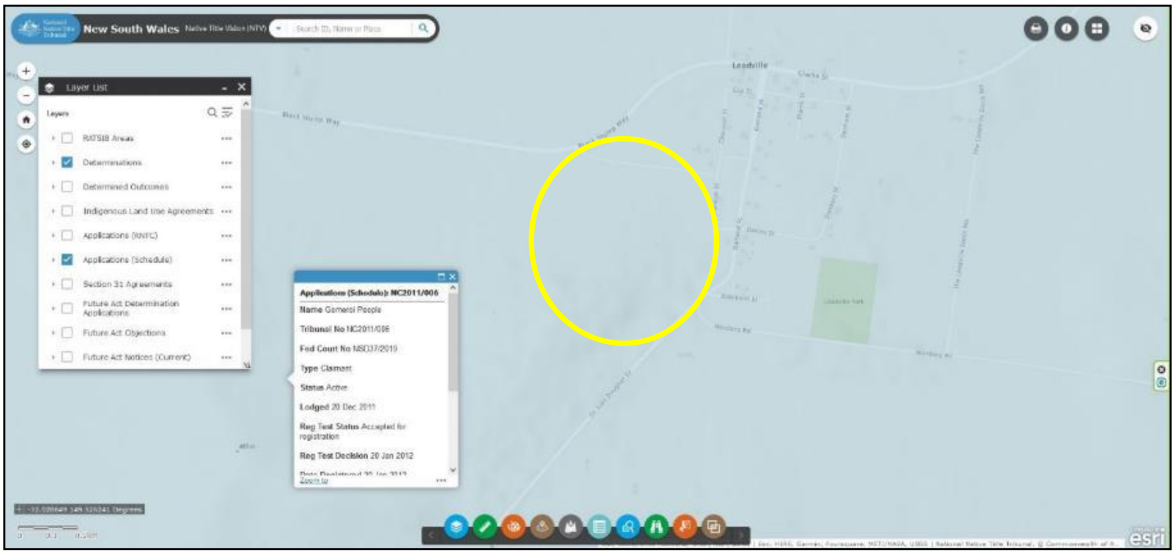


Figure 15. Native Title Vision mapping (indicative location of site - yellow circle)

In respect to the extract from the Register of Native Title Claims for the application (NNTT 2024c), the area covered by this application does not include the areas described at Point B:

Point B Areas within the external boundaries not covered by the application:

1. The area covered by the application excludes any land and waters covered by past or present freehold title or by previous valid exclusive possession acts as defined by section 23B of the *Native Title Act 1993* (Cth)
2. The area covered by the application excludes any land and waters which are:
   a) a Scheduled interest
      i. 'things that are covered by the expression Scheduled Interest' include
         1. a conditional lease under the *Crown Lands Act 1884*
         2. a special lease under Section 89 of the *Crown Lands Act 1884*
         3. a Crown lease (whether an original or an additional holding) under the *Crown Lands (Amendment) Act 1912* or the *Crown Lands Consolidation Act 1913* (e.g. a traveling stock route)
         4. a lease under section 34 of the *Crown Lands Act 1989* that permits the lessee to use the land or waters covered by the lease solely or primarily for, amongst other usages, a traveling stock reserve, agriculture and so forth.

   g) a lease dissected from a mining lease and referred to in s 23B(2)(c)(vii) of the *Native Title Act 1993*.

Reference to the above would conclude that the Crown Lands within the former Leadville Mining Precinct are excluded from the application.

A further review of the NNTT's Registers, using the Gomeroi People application tribunal number, does not identify the application as part of any Indigenous Land Use Agreements or Future Act Applications.

5.2 Non-Aboriginal cultural heritage

The NSW *Heritage Act 1977* defines a relic as 'any deposit, artefact, object or material evidence that:

(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and

(b) is of State or local heritage significance'.

Following the preparation of the proposal's RAP, a SoHI has been prepared for the Leadville Mine precinct by Everick Heritage Archaeologists (Brassil, Marsh & Riley 2024) (Appendix 2). It is acknowledged a previous SoHI had been prepared by Everick (Hill *et al*. 2016) and a draft SoHI prepared in 2022 by Marsh and Riley, for an earlier iteration of a RAP prepared by Okane Consultants.

A search of available historical heritage registers to identify heritage places within and immediately adjacent to the proposal area was conducted by Everick on 9 June 2022; these identified in s.3.3, s.3.4, s.3.5 and s.3.6 of the SoHI (Appendix 2). Of these, the investigated Leadville Mine precinct is listed under Schedule 5 'Environmental heritage' of the Warrumbungle LEP 2013 as Item no. 129. Section 4.3 of the SoHI provides a significance assessment on the listing (Figure 16).

The Leadville Mine consists of 29 individual relics, as recorded during an initial site inspection carried out during September 2015 (Brassil, Marsh & Riley 2024). A re-inspection of the precinct was conducted by Everick on 7 and 27 June 2022; the purpose, to revisit and update the condition of the sites identified, as well as conduct an archival recording of all features. The lands subject to assessment comprise Lot 7304 DP1152229 and Lot 149 DP750766. The Everick Heritage ID for all of the features recorded, their description and the proposed impact has been included in tables within s.3.3 – 3.6 of the SoHI (Appendix 2).

Installation of rural fencing around areas where grazing should be managed in accordance with the prescribed limitations included in the site EMP. This would include limiting access of livestock to the site for 2 months per annum.

As detailed in s.3.3-3.6 and s.5.2 of the SoHI, the four locations within the Leadville Mine precinct within which heritage features are identified, and associated remediation plan summary, is provided below.

Figure 16. Heritage items mapped in Warrumbungle LEP 2013 Map – HER 009 in relation to project area. Taken from Everick Heritage SoHI (Brassil, Marsh & Riley 2024).

<u>Mount Stewart workings</u>

The Mount Stewart works consists of a main shaft location (which has been filled in as part of the previous Legacy Mines remediation at the site), as well as the remains of foundations for additional mine structures. In addition to this, a number of heritage features were identified within the area including a boiler, a drain and the remains of an open shaft (which has since been filled as part of the 2016 remediation works). The only remaining un-remediated (and unfilled) shaft is located at Shaft Ten (LV28). It is located associated with a boiler to the east of the main shaft size.

- Drainage controls to divert unimpacted meteoric water away from the Mt Stewart source point (where AMD potential was evident), collect contaminated runoff within a prescribed catchment area and fencing to prevent access.
- Strip area of sulfidic material to 200 mm, place material within Mt Stewart contaminated water catchment.
- Excavate and send material offsite for disposal in a licenced waste disposal facility.

<u>Grosvenor workings</u>

The Grosvenor workings consists of a previously remediated shaft, the remains of processing equipment and a tailings dam and water holding tank which are currently empty.

This area consists of Shaft 6 (ID LV20) the remains of a stamper battery (ID LV17) and a holding dam and tank (ID LV18). ID LV20 has already been filled in, and is basically not visible anymore – although the old capping grate_has been placed at the location (this was modern/1990s at the earliest). Remediation actions in this area are as minimal as possible:

- Leave in situ and fence due to location of shafts and mineralised workings.
- Excavate and send material offsite for disposal in a licenced waste disposal facility.

<u>Retaining wall near the smelter site</u>

The remains of the smelter are located over two levels, with a retaining wall supporting the top layer which is surrounded by contaminated fill and tailings.

The preferred option for remediation of this site is to leave in-situ and fence.

As detailed in s.7.4 of the SoHI, in accordance with s.5.10(2) of the Warrumbungle LEP 2013:

Development consent is required for any of the following—

> (a) demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance)—
>
> > (i) a heritage item,
> >
> > (ii) an Aboriginal object,
> >
> > (iii) a building, work, relic or tree within a heritage conservation area,
>
> (b) altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in Schedule 5 in relation to the item,
>
> (c) disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed,

(d) disturbing or excavating an Aboriginal place of heritage significance,

(e) erecting a building on land—

(i) on which a heritage item is located or that is within a heritage conservation area, or

(ii) on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.

(f) subdividing land—

(i) on which a heritage item is located or that is within a heritage conservation area, or

(ii) on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.

However, it is outlined in the SoHI that *'this project is being undertaken under the provisions of the R & E SEPP* [*State Environmental Planning Policy (Resources and Energy) 2021*] *by a Government Agency and Development Consent from Warrumbungle Shire Council is not required. The R & E SEPP does not require any consultation with other authorities in respect of heritage items and potential impacts but, in any case, consultation with council should occur regarding the potential impacts upon the listed heritage item and their long-term aspirations for the site.'*

The works proposed for Leadville Mine are to address safety and health concerns due to contamination of the site. As such, the proposed works will not have any impacts on the current heritage structures identified. The surrounding environment of the Leadville Mine site will be altered, although, this was identified to have minimal impacts as the subject area is reminiscent of previous demolition and construction, thus not significantly impacting the current landscape. As described by Everick Heritage (Brassil, Marsh & Riley 2024) 'the proposed works will not have any associated impacts upon any other heritage items and no archaeological 'relics'. In many respects, the proposed works will result in a substantive benefit to the heritage significance of the site, enabling its ongoing conservation without the public health and safety concerns associated with its history of use.

6 Summary of mitigation measures

The following mitigation measures summarised in Table 7 have either been identified through the assessment conducted through this REF or are standard best practice environmental management controls. They will be incorporated into the CEMP. These control measures would avoid and/or minimise any potential adverse environmental, cultural and social impacts arising from the proposal. For reference, where mitigation measures are relevant to multiple facets of the proposal, these have only been stated once in their first instance.

Table 7. Summary of site-specific mitigation measures

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
General		1. A CEMP will be prepared for the remediation work. Development of the CEMP will make reference to the recommendation and measures presented in the RAP. 2. An EMP will be developed for the proposal—necessitated by the proposed on-site containment of contamination. 3. A Vegetation Management Plan will be prepared to assist and direct the revegetation work. 4. Site weather will be monitored using the nearest Bureau of Meteorology location at Dunedoo Post Office. Site specific rainfall will be monitored daily using a standard gauge located near the site office.	Project Manager, Principal Contractor	Pre-work
Soils	Excavation, Soil Erosion/ Stability Site Rehabilitation	5. Preparation of an ESCP that considers matters associated with implementing the RAP. 6. Where possible, remediation work is to be scheduled to coincide with periods of dry weather. 7. Mitigation of construction impacts, and erosion and sediment controls will be implemented in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1 ('Blue Book')* (Landcom 2004), *Managing Urban Stormwater: Soils and Construction Volume 2B, Waste Landfills* (DECC 2008a) and *Managing Urban Stormwater: Soils and Construction Volume 2E, Mines and Quarries* (DECC 2008b). 8. Daily inspections of control measures will be conducted during the site works; particularly following rainfall events, to ensure their maintenance and functionality. 9. Temporary erosion and sediment controls should not be decommissioned until 90% of any finished area has at least the equivalent of 70% ground cover.	Project Manager, Principal Contractor	Pre-work During work

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
		10. Restrict vehicle and earth movements during periods of wet weather. 11. Ensure any imported materials or vehicles used on site are weed-free. 12. Where practicable, exposed, stockpiled topsoils should be covered in a geotextile fabric membrane to retain soil moisture and limit erosion and stripping of soil nutrients. 13. Areas of exposed, disturbed, loose and friable soil/areas/stockpiles will be treated regularly during dry conditions – to negate the generation of dust (e.g., through use of a water cart). 14. Excavated material will be lightly moistened prior to leaving the site. 15. Vehicles will traverse existing stabilised access routes within the study area, thereby minimising damage to vegetation and limiting soil compaction. 16. Preference would be given to driving over the existing ground cover/lower stratum vegetation as opposed to clearing this to construct new tracks. If necessary, prior to traversing this, it would be slashed to a height of around 100 mm. 17. To avoid the compaction of soil around the base of those retained mature trees present, machinery and vehicle movements will occur beyond the drip line (i.e., outer limits of the tree canopy) of these plants. 18. Existing vegetation on site will be retained where possible to encourage water infiltration and stabilise soil surfaces. 19. Disturbed surfaces will be covered, stabilised or revegetated as soon as practicable (i.e., the placement of brush matting). 20. Temporary stockpiles will be located in nominated areas previously cleared/disturbed.		
Contaminated land and chemical / hazardous substances	Soil Contamination Site user contact Hazardous spills	21. Any hazardous substances must be appropriately stored and handled in accordance with relevant Material Safety Data Sheet (MSDS). 22. Fuels and other petrochemical products will be stored in accordance with AS 1940-2004, in purpose-built facilities (at least 50 m from any creek or drainage line) within the construction compounds where appropriate bunding and firefighting provisions are allowed for. – Diesel is to be stored in above ground bunded tanks from where it can be used for machinery. 23. A licensed contractor is to be engaged to remove, recycle and/or dispose of used oil and grease products at licensed facilities as required during remediation. 24. Spill kits and absorption materials commensurate with the type and	Principal Contractor, Project Manager	Pre-work During-work

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
		quantity of hazardous material used on-site would be kept on-site at all times, and emergency procedures adopted in the event of a spillage/leak. 25. Spills that cause material harm to the environment are to be reported in accordance with legislative and licensing requirements (i.e., the EPA). 26. Any spillages of hazardous materials are to be immediately contained and absorbed with spill kits. 27. Collected 'spill' material is to be transported to a Council licenced approved waste facility. 28. Adopt good Work, Health and Safety practices such as washing of hands prior to consuming meals and drink. 29. Provision of wash-down facilities.		
Air quality	Dust disturbance and airborne mobilisation of lead contaminated soils Transport of off-site windborne dusts Exhaust emissions from plant and equipment Odour & Fumes Greenhouse Gases	30. Inspect plant/equipment before start of construction on-site. 31. Conduct routine servicing and maintenance (to approved standards), and subsequent inspections to ensure that the plant/equipment continues to operate efficiently. 32. Stage work to minimise exposed areas and stockpiles. 33. Where possible, avoid work [with high potential to result in dust] during dry conditions when winds are blowing in the direction of nearby receptors. 34. Dust monitoring will be conducted at the eastern boundary (adjacent to Leadville village). – Install depositional dust gauges to monitor and measure depositional dust at one of the most potentially affected receptors. – Install HiVol particulate matter air quality samplers. 35. The site will be constructed and supplemented as required, to provide a stable base (e.g., coarse aggregate) beneath the entire site in order to minimise dust generation. 36. Truck loads entering or exiting the site will be securely covered. 37. Regularly water unsealed traffic routes. 38. Impose speed limits along unsealed routes. 39. Where possible, restrict movements along unsealed routes. 40. Machinery and equipment will not be left running or idling when not in use; these to be switched off.	Project manager, Principal Contractor	Pre-work During work
Water quality	Pollution/contamination/ leaching	41. Construction of a series of surface water diversion (clean and dirty water) bunds, dam bunds, and drainage channels in areas of	Principal Contractor, LMP	Pre-work During work

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
	Sedimentation Spills (i.e., fuel)	geohazards. 42. Where relevant, vegetation buffers would be retained and the compaction, disturbance or clearing of these would be avoided. 43. All vehicles and machinery used would be regularly inspected for leaks.		Post-work
Noise and vibration	Noise Vibration Adjoining landowners	44. The relevant land agencies will notify adjoining landowners of the project details and its duration. 45. Contractor to act on any noise and vibration complaints. 46. Activities to be restricted to standard construction hours: – 0700 to 1800 Monday to Friday – 0800 to 1300 on Saturday – No activity to occur on Sunday or Public Holidays. 47. All associated mechanical plant, equipment and the like used during remediation activities will use all practical and reasonable noise attenuating devices and measures to minimise noise being transmitted from the site. 48. Compliance of all vehicles to legal load limits. 49. No yelling or slamming of car doors. 50. The remediation works will comply with Australian Standard 2436-1981 Guide to Noise.	Project manager, Principal Contractor	Pre-work During work
Natural resource use and waste minimisation	Spoil Litter Chemicals Hazardous waste Solid waste	51. Clearing of vegetation would not be more than that required to permit the scope of work. 52. Native and non-seed-bearing exotic vegetation is to be mulched and/or re-used on-site (i.e., brush matting). 53. Weed contaminated green waste is to be disposed of off-site at a licensed landfill facility. 54. Personal rubbish is to be collected and deposited into a Council serviced bin. 55. Recycling methods would be enacted where applicable. 56. Visual inspections of the site are to be made at the completion of the work to ensure no rubbish remains.	Principal Contractor	During work Post-work
Community/Socio-economic effects	Land Use Property Effects Economic Effects Other community impacts	No further site-specific mitigation measures than those recommended.		

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
Transport	Traffic and access Transport	57. During the work period, in order to facilitate public awareness and safety, signage would be used where appropriate along the existing road network; while 'trucks turning ahead' and portable electronic variable message signs etc. may also be used. 58. Vehicle and machinery movements, including those transporting equipment to and from the work site, will be coordinated to reduce and minimise fuel consumption.	Principal Contractor	Pre-work During work
Visual Aesthetics	Visual Views Overshadowing	No further site-specific mitigation measures than those recommended.		
Biodiversity	Removal of vegetation, including 2.2 ha of CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (borrow area), and several trees Native vegetation Habitat	59. A Vegetation Management Plan would be prepared to provide adequate protection of retained CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland and fauna habitat, and guide revegetation of the affected areas. The plan should include but not be restricted to implementing the following: – Clear delineation on plans and *in situ* of retained native vegetation including information regarding the conservation significance of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. – Stockpiling of felled timber for subsequent placement on revegetated areas as habitat for ground fauna. – Detailing of appropriate plant species mixes for revegetation, including potential on-site or local harvesting of seed. – Monitoring and ongoing management. 60. All relevant controls will be in place prior to clearing. 61. An ecologist or similar qualified person will conduct a pre-clearing survey within the precinct prior to the commencement of work. 62. Identify the limits of clearing – these would be provided to the construction contractor, identified both on site maps/plans and on-site through the erection of temporary fencing, bunting or similar. 63. Areas beyond the proposal footprint that are to be retained will be clearly demarcated on-site as well as on plans provided to the contractor. These areas will be marked as 'no-go zones'. 64. The area of soil exposure as a result of clearing and grubbing during construction will be minimised (i.e., not cleared all at once). 65. Vegetation is to be pushed over (not chipped) and dragged (in	Project manager, Ecologist (or similar qualified person), Principal Contractor	Pre-work During work Post-work

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
		manageable portions) to a proximate adjacent location that does not impede safe ingress/egress or work. 66. Cleared materials will be stockpiled within the nominated areas. 67. The use of mulches (including hydromulch) and brush matting of felled and pruned vegetation can aid the establishment of a final ground cover – options will be determined mitigating potential risk of slumping due to high saturation levels following a significant rain event. 68. Revegetation of the Paddock Shaft area will be as per the RAP. 69. Once topsoil has been spread and the seedbed established, sowing can be carried out using a variety of methods that include: manual broadcasting using a chest-mounted spreader or similar for small areas, and hydroseeding for larger areas. 70. To ensure initial site stabilisation following neutralisation and capping (and reduce erosion and weed colonisation risk), a sterile 'nurse' crop of pioneer species, including non-native grasses, will also be utilised. 71. Vehicles and machinery will be parked/stored in areas previously cleared of vegetation. 72. Machinery will not be stored under the canopy of any mature trees. 73. Regular maintenance and watering of revegetation areas to aid the establishment of adequate vegetation cover. 74. Post-work, any disturbed areas not part of the remediation work will be permitted to naturally revegetate. 75. An alignment for any fencing will be selected that avoids the removal of mature trees. 76. Retained trees proximate to the proposed work will be clearly identified prior to the commencement of work. 77. During the removal of any hollow-bearing trees (if required), an ecologist or similar qualified person should be present on-site. – The ecologist or similar will develop lines of communication with the tree felling operator (e.g., provide appropriate advice on a removal method). – If feasible, an elevated work platform would be used to remove the trees in sections, with the hollow limbs being inspected prior to clearing and once on ground. – If structurally sound, the removed hollow limbs will be used in lieu of commercially purchased habitat boxes. 78. Should any hollow-bearing trees be removed, to offset this loss,		

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
		purpose-built habitat boxes should be erected within the retained stands of woodland. – Established boxes will be regularly monitored (i.e., once every six months) for a period of two years, with any boxes that are damaged or occupied by exotic species (e.g., European Bees) being removed and replaced. 79. Any native fauna collected will be relocated locally. 80. Any native fauna injured during the course of the construction work will be taken to a local veterinarian or wildlife carer for treatment. – Once rehabilitated, native species will be released at their point of capture. – Any introduced species will be ethically euthanised.		
Biosecurity	Weeds of significance Pathogens	81. Common Prickly Pear, a priority weed (found near Grosvenor Dam) will be removed prior to the proposed work commencing, and disposed of at a licensed waste facility. 82. *Phytophthora cinnamomi* is a microscopic organism that lives in soils and plant roots and is associated with the dieback of native plant species in Australia. Work must therefore avoid the potential spread of this organism as far as possible by adhering to the following hygiene protocols: – All vehicles/machinery will be washed and enter the precinct via stabilised access areas to prevent the introduction and spread of weed seeds and/or pathogens. – Upon entering and exiting the site, personnel must remove excess soil and mud and then spray boots, tools, gloves and small equipment with recommended disinfectant supplied by the contractor (70% Methylated spirits / 30% Water) until runoff is clear.	Ecologist (or similar qualified person) Principal Contractor	Pre-work During work
Heritage	Aboriginal Heritage	83. All land and ground disturbance activities will be confined to within the assessed study area. Should the parameters of the proposal extend beyond the assessed areas, then further assessment may be required. 84. In the unlikely event unexpected Aboriginal objects are discovered during the course of the proposed work, an unexpected finds protocol will be followed: – If suspected Aboriginal Cultural Heritage is discovered it will be left in place with temporary fencing placed around the object (with a buffer of at least 10 m) to protect it from impact, with work to cease	Principal Contractor	During work

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
		in the area. – An appropriately qualified archaeologist and the LALC will be notified to assess the find(s). – If the find is determined to be an Aboriginal object, Heritage NSW must be notified. 85. If human remains are discovered, the *Coroners Act 2009* requires that all work should cease and the NSW Police and the NSW Coroner's Office should be contacted. Traditional or contemporary (post-contact) Aboriginal burials which occur outside of designated cemeteries are protected under the NPW Act and should not be disturbed. Should the remains prove to be Aboriginal remains more than 100 years in age, notification of NSW Heritage and the LALC will be required. Notification should also be made to the Commonwealth Minister for the Environment and Water, under the provisions of the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*.		
	Non-Aboriginal Heritage	86. Everick Heritage (Brassil, Marsh & Riley 2024) have proposed the following mitigation measures to lessen impacts to relics at the site: a) Archival recording: Archival and LiDAR recording of the retaining wall at LV 24 was undertaken. The preparation of a 3D scan of the wall has been finalised and is included on the webmap. A copy of this Archival Record should be provided to the Warrumbungle Shire Council for their archives and Local History. b) Movable heritage: several items of movable heritage (including boiler shells and machinery remains) that will not be impacted by the works should be secured behind the exclusion fence. Warrumbungle Shire Council should be consulted as to the potential tourism opportunities associated with this material and its possible relocation to where it can be accessible. c) Records: records and plans of the works undertaken should be provided to Warrumbungle Shire Council for their archives. d) Change of works: should the proposed works as described in this REF and the RAP be changed, altered or extended, then a reassessment of the works as they apply to heritage significance may be required. e) Unexpected finds: while there was a moderate to high potential for artefacts to be found on the site, these are unlikely to have heritage significance. In the event that an object, artefact or work is exposed	LMP, Principal Contractor	Pre-work During work

ASPECT	POTENTIAL IMPACT	CONTROL MEASURE	RESPONSIBILITY	TIMING
		that falls outside of these expectations, an 'Unexpected Finds Protocol' should be in place to manage this material. f) Discovery of human remains: in the event that excavations of contaminated soil reveal possible human remains, the following protocol should be implemented: - All works must halt at that location immediately and the on-site supervisor would be immediately notified to allow assessment and management. - The on-site supervisor should contact police. - The on-site supervisor should contact Heritage NSW's Environment Line on 131 555.		

7 Summary of impacts and conclusion

7.1 Summary of impacts

The proposed safety and remediation work described in this REF may have short and/or long-term impacts on biophysical and social/community outcomes including:

- Reduced air quality through dust generation associated with remediation activities such as vehicle movement and earthwork.
- Increased temporary susceptibility for soil erosion and sediment movement within the site during earthwork activities.
- Creation of noise and vibration during the proposed activities.
- Potential hazards associated with temporary fuel and/or chemical storage.
- Modification/removal of 2.2 ha of White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland.
- Possible removal of hollow-bearing trees.
- Increased waste generation through the removal of vegetation and human presence.
- Temporary, short-term effects on aesthetic and amenity values
- Negligible harm of heritage items.

These combined impacts are likely to be of a minor and/or temporary nature and readily mitigated with the adoption of the proposed measures. Thus, they are not considered to be significant.

7.2 Conclusion

This REF has assessed the proposal in accordance with Part 5 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposal.

The proposed work would result in some minor temporary environmental impacts, including: limited vegetation clearing – including the modification/removal of 2.2 ha of a CEEC, possible removal of hollow-bearing trees, potential ‘low’ sedimentation impacts as a result of earthwork, reduced air and aesthetic quality and a minor increase in noise and traffic during construction. Implementation of the safeguards and mitigation measures detailed in this REF would ameliorate or minimise these limited impacts.

The proposed work would meet the proposal objectives, which are outlined in s.1.3 of this REF. The proposed work would primarily be confined to areas previously disturbed and modified, and would assist with the remediation of contaminated media in several of the site’s historic mining domains; ultimately reducing on-site safety risks and adverse environmental effects, resulting in long-term benefits to the physical and natural environments, protection of human, livestock and environmental health under current land use scenarios, and the conservation of heritage.

Everick Heritage (Brassil, Marsh & Riley 2024) concluded that while works will have a minor adverse impact on the remnant mining landscape, it will have an acceptable outcome on the need to make the subject site safe. The European heritage located on site is not considered to have substantial archaeological significance; merely comprising representative values.

No Aboriginal cultural heritage values have been identified for the subject that require assessment or further approvals under the NPW Act. The area is heavily disturbed by previous mining activities and any potential artefacts are likely to be out of context and of little research value.

One CEEC, White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, listed under both the EPBC and BC Acts was recorded within the study area. In addition, as they have been previously recorded and suitable habitat is to be impacted, a precautionary approach was adopted in regard to the potentially occurring Grey-crowned Babbler (Vulnerable, BC Act) and Corben's Long-eared Bat (Vulnerable, EPBC and BC Acts). Assessments drawing on the EPBC Act's Significant Impact Guidelines and the criteria provided under s.7.3 of the BC Act were conducted, concluding that the proposed work would not have a significant impact on the recorded ecological community or potentially occurring threatened fauna species.

This REF has considered the environmental and heritage impacts of the proposal and, in conjunction with the RAP and Heritage NSW, has developed mitigation measures to minimise and monitor these. The REF has determined that it is highly unlikely that the majority of the actions proposed in the RAP would have any significant effects on the environment, critical habitat, threatened species, populations, ecological communities and their habitats. It has assessed the extent and significance of environmental and heritage impacts and concluded that:

- Referral of the matter to the Federal Minister for the Environment and Water is not required
- Neither an EIS nor a SIS needs to be prepared for this proposal
- Appropriate mitigation measures can be implemented to manage any potential environmental effects
- Any adverse localised environmental effects would be managed and will be outweighed by the environmental and social benefits of the project
- The project would not have any significant adverse impacts on the natural or human environment
- Overall, the project would provide significant long term environmental and social benefits.

8 Certification

As the person responsible for the preparation of the REF, I certify that, to the best of my knowledge, this document is prepared in accordance with the *Environmental Planning and Assessment Act 1979*, Clause 171 of the Environmental Planning and Assessment Regulation 2021, and the information it contains is neither false nor misleading.

Mr Deryk Engel
Director
Lesryk Environmental Pty Ltd
Date: 21 May 2024

Marianne Moore (name)
Director Governance and Operations (role)
MEG LMP
Date: 18/06/2024

I have examined and accept this Review of Environmental Factors on behalf of:

Determined by
Marianne Moore
MEG LMP
Date: 18/06/2024

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Appendix 1. Leadville Remediation Action Plan

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Terra Tech
CONSULTING

Leadville Mine Remediation Action Plan

Terra Tech Consulting Pty Ltd
25a Oceana St
Old Uniting Church Hall
Austinmer NSW 2515
admin@terratechconsulting.com.au

Leadville Mine Remediation Action Plan

Final

15 April 2024

Prepared for:

Legacy Mines Program, Department of Regional NSW

Prepared by:

Simon McVeigh BSc, MSc, MAusIMM, CPPA
Principal Consultant
smcveigh@terratechconsulting.com.au

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Terra Tech
CONSULTING

EXECUTIVE SUMMARY

Terra Tech Consulting (TTC) was engaged by Legacy Mines Program (LMP) (The Principal) to develop a Remedial Action Plan (RAP) for the site of the former Leadville mine (The Site), located in the Warrumbungle Shire of central western New South Wales, Australia.

Due to the presence of sub-surface geohazards, identified by GHD (2023b), previous remedial designs developed by Okane, (2022) comprising the encapsulation of heavy metal impacted mine waste materials are not constructable without significant subsurface works. As a result, the remedial design presented in Okane (2021, 2022) requires amendment. The objectives of this RAP are therefore to develop a revised strategy that addresses the following aspects:

- Mitigate the potential off-site migration of heavy metals (primarily Pb) from mine waste materials. When considering potential risks to off-site receptors the remedial design was developed in accordance with the following rationale:
    - Where previous investigations indicate that there is a potential for impact to surface waters caused by the characteristics and volumes of mine and processing waste at Leadville - Remedial works should be undertaken to limit or eliminate this risk.
    - Where there are unacceptable safety risks (i.e. presence of near-surface underground workings, remediation plans should aim to achieve Acceptable Risk and Tolerable / As Low As Reasonably Practicable (ALARP) outcomes in consideration of identified safety and environmental risks.
- Isolation of areas (e.g. impacted surface water collection dams and exposed mine waste) in which heavy metal impacts pose a potentially unacceptable health risk to future site receptors.
- Isolation of areas in which heavy metal impacts (as assessed by comparison of historical datasets to the Risk Based Criteria (RBC) developed by EnRisks (2022) pose a potentially unacceptable risk to livestock to allow for grazing to occur across the balance of the site.

Accordingly, this RAP includes remedial measures which include:

- Excavation and off-site disposal of highly impacted heavy metal impacted materials which are leachable and potentially pose a significant risk to surface waters on and off-site.
- Construction of a drainage management system to limit volumes of meteoric water interacting with Potentially Acid Forming (PAF) materials where geohazards are potentially present, thus precluding excavation and off-site disposal or encapsulation remedial approaches.
- Isolating areas with fencing to remove unacceptable health risks to future site receptors as well as address risks to livestock.

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Table 1 List of Abbreviations

Abbreviation	Definition
ABA	Acid Base Accounting
AMD	Acid and Metalliferous Drainage
ARI	Average Recurrence Interval
ASL	Above sea level
ASLP	Australian Standard Leaching Procedure
BGL	Below ground level
BOM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
COPC	Contaminants of Potential Concern
CSM	Conceptual Site Model
EPA	Environmental Protection Agency
ESP	Engineering Service Provider
INAP	International Network for Acid Prevention
LEP	Local Environmental Plan
LGA	Local Government Area
LMP	Legacy Mines Program
LTEMP	Long Term Environmental Management Plan
NAF	Not Acid Forming
NAG	Net Acid Generation
NAPP	Net Acid Producing Potential
OH&S	Occupational Health and Safety
PAF	Potentially Acid Forming
QAQC	Quality Assurance and Quality Control
RAP	Remediation Action Plan
RBC	Risk Base Criteria
RWPC	Remedial Works Principal Contractor
SAQMP	Sampling Analysis and Quality Management Plan
SBRC	Solubility Bio accessibility Research Consortium
SEPP	State Environmental Planning Policy
SoW	Scope of Works
SOHI	Statement of Heritage Impact
TCLP	Toxicity Characteristic Leaching Procedure
WHS	Workplace Health and Safety

1 INTRODUCTION

1.1 Project Overview

Terra Tech Consulting (TTC) was engaged by NSW Public Works on behalf of the Legacy Mines Program (LMP The Principal) to develop a Remedial Action Plan (RAP) for the site of the former Leadville mine (The Site), located in the Warrumbungle Shire of central western New South Wales, Australia.

Due to the presence of sub-surface geohazards identified by GHD (2023b) (Figure 1), previous remedial designs developed by Okane, (2022) comprising the encapsulation of heavy metal impacted mine waste materials are not constructable without significant subsurface works. As a result, the remedial designs presented in Okane (2022) require amendment. The objectives of this RAP are therefore to develop a revised strategy that addresses the following aspects:

- Mitigate the potential off-site migration of heavy metals (primarily Pb) from mine waste materials.
- Isolation and on-going management of areas (e.g. impacted surface water collection dams and surface soils/sediment) in which heavy metal impacts pose a potentially unacceptable health risk to future site receptors and livestock (where allowed to graze for a maximum of 2 months per year on site).

The remedial strategies presented herein, have been developed on the basis of previous investigations (Okane, 2021) and in collaboration with The Principal and other stakeholders including NSW Crown Lands (Crown Lands) and the NSW Legacy Mines Program (LMP).

1.2 Objectives

The objective of this RAP is to document the procedures and standards to be followed in order to manage the risks posed by the identified potential contamination issues, to make the site suitable for agricultural purposes (grazing of livestock where possible) while ensuring the protection of human health and the surrounding environment.

2 SITE DETAILS AND HISTORY

2.1 Tenure and Land Use

The site is located 500 m west of the village of Leadville, NSW. Tenure of the site includes:

- A Crown Land parcel (Lot 7304 DP 1152229) (otherwise Part Reserve 750766 (7304/1152229) for the purpose of Future Public Requirements).
- The Travelling Stock Route Part Reserve 68 (7305/1152229) (Part Reserve 68 (7305/1152229) for the purpose of Travelling Stock Route).
- An adjoining water reserve (Lot 149, DP 750766) otherwise (Reserve 97441 (149/750766 for the purpose of Water Supply); and

All site tenure is identified as RU1 (primary production) in the Warrumbungle Shire Local Environmental Plan (LEP). Proposed future land uses are provided in Table 2.

Table 2 Tenure and Future Land Use by Cadastre

Cadastre	Tenure	Intended Future Land Use
Lot 7304 DP 1152229	Crown Land Parcel	Land management activities.
Lot 7305 DP 1152229	Crown Land Parcel (Travelling Stock Route Part Reserve 68)	Land management activities and limited grazing.[1]
Lot 7303 DP 1152229	Crown Land Parcel (Travelling Stock Route Part Reserve 47657)	Land management activities and limited grazing.[1]
Lot 149, DP 750766	Crown Land Parcel (Water Reserve)	Water use by Local Rural Fire Services for emergency response.

A site overview including relevant tenure is included in Figure 1.

[1] Limited grazing assumes individual cattle would not graze the TSR within the project area for more than 2 months per annum.

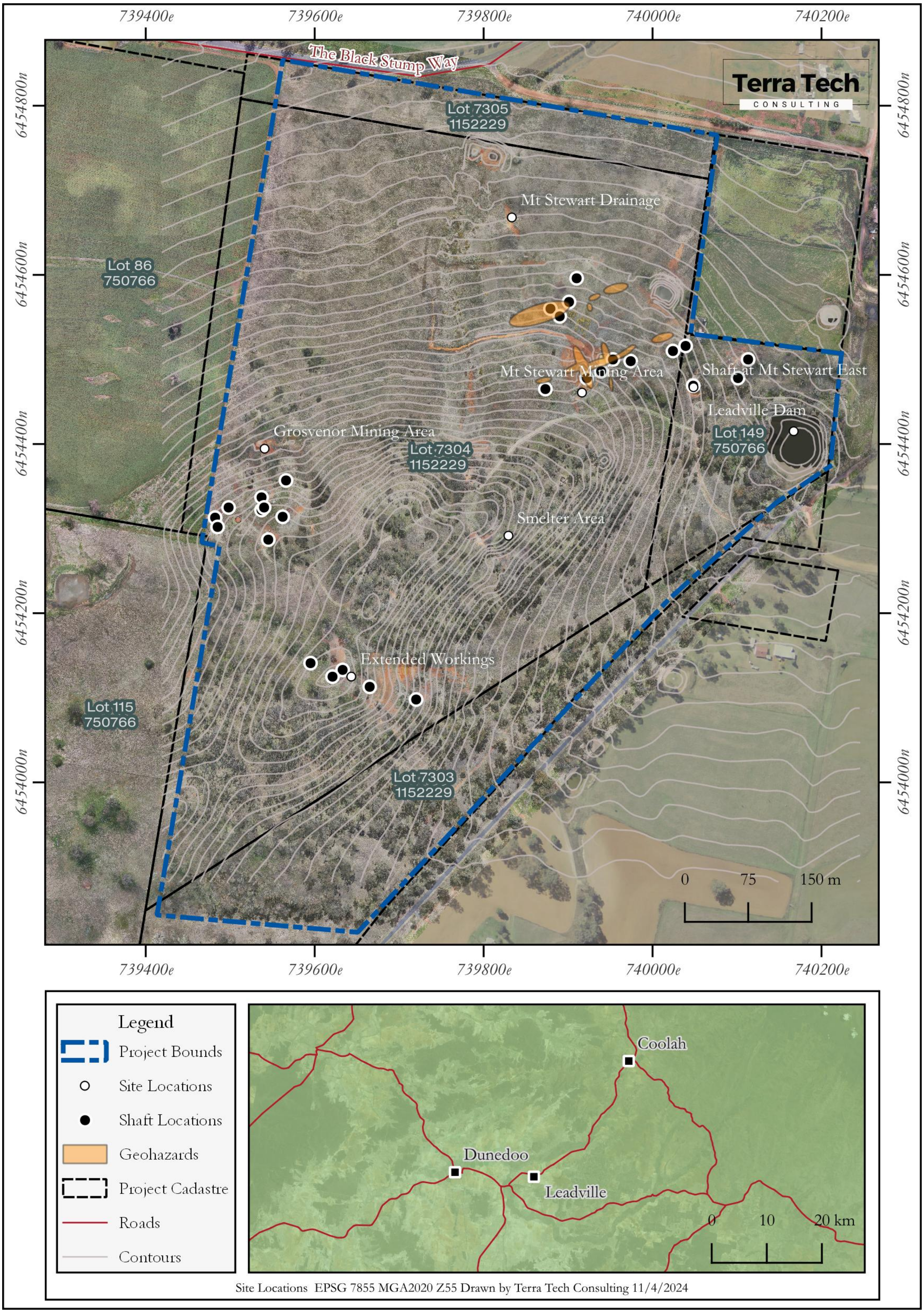

Figure 1 Site Location and Cadastre

2.2 Regional Landscape Topography, Setting and Access

The landscape surrounding the area consists of rolling hills and low rises, ranging from 420 to 530 metres in elevation. These features exhibit gently sloping inclines of less than 15%, with intermittent drainage lines spaced between 300 to 1000 metres apart. The terrain is interspersed with agricultural pastures, rural properties, and woodland patches.

A detailed survey was undertaken by TTC in November 2023. Elevations within the surveyed area range from 420 to 465 metres Above Sea Level.

Surface drainage within the Leadville Mine site is transient, following the natural topography. The primary flow directs northward from the mine workings and infrastructure toward the stock dams present in the area.

Access to the former mining area is facilitated via Garland Street, also known as Sir Ivan Doherty Drive. An existing unsealed earthen track, approximately 3 metres wide, provides passage throughout the precinct. The track and grassy terrain currently require no vegetation clearance for use, although occasional overhanging branches may need trimming.

2.3 Hydrology

Surface drainage at the Leadville site is ephemeral, shaped by the terrain, primarily flowing northward from the mining activity and infrastructure toward stock dams. These dams exhibit variable low pH (acidic) conditions with elevated levels of metals at one location (LVD1 Figure 4). The expanded mining operations south of the hill's peak drain in a southeastern direction.

Three groundwater bores are positioned within a kilometre of the site:

- GW800847 is situated on private land westward near Black Stump Way,
- GW010685 is located in Leadville township and serves as the source for the town's water supply.
- GW2 which was installed in 2020 as part of Okane’s site investigation works.

2.4 Environmental Setting

The site’s vegetation has been mapped by OEH (2012) and Lesryk (2021) including the subject site. This mapping identifies three distinct map units, which can be likened to plant community types (PCTs) within the study area:

- Map Unit 180 comprises Plainsgrass, Purple wiregrass, and Wallaby Grass grassland on basalt soils of the Merriwa plateau.
- Map Unit 175 represents White Box grassy woodland on basalt soils found in the upper Hunter and Liverpool Plains.
- Map Unit 176 encompasses Yellow Box and Rough-barked Apple grassy woodland prevalent in the upper Hunter and Liverpool Plains.

However, during field investigations conducted by Lesryk (2021), certain discrepancies between OEH mapping and field mapping were observed in the mapped data:

- Map Unit 180 appeared less extensive on the ground, with some areas devoid of vegetation or degraded to an extent where less than 50% of the ground cover comprised native species.
- The wooded region designated as Map Unit 180 around Grosvenor Dam actually aligned more with Map Unit 175.
- Vegetation on the lower slopes adjacent to the drainage line along the eastern boundary and near the dam likely resembled Map Unit 176 rather than Map Unit 175. Unfortunately, these areas, along with the region marked as Map Unit 176 in the southwestern part of the site, were not surveyed as they lie beyond the proposed work area.

Based on field mapping, a Statement of Environmental Effects (SEE) was prepared to assess environment impacts of works proposed by Okane (2021). This document provides a summary of:

- Vegetation communities and fauna habitats present at the Site.
- An assessment of the potential for significant impacts to matters listed within:
    - *Biodiversity Conservation Act 2016*
    - *Environment Protection and Biodiversity Conservation Act 1999.*
    - *State – State Environment Planning Policy (Koala Habitat Protection) 2021*.

The SEE concluded that no significant impact to matters listed within the legislation above was anticipated as a result of the works described in Okane (2021).

Figure 2 provides an overview of mapped vegetation communities within the Site.

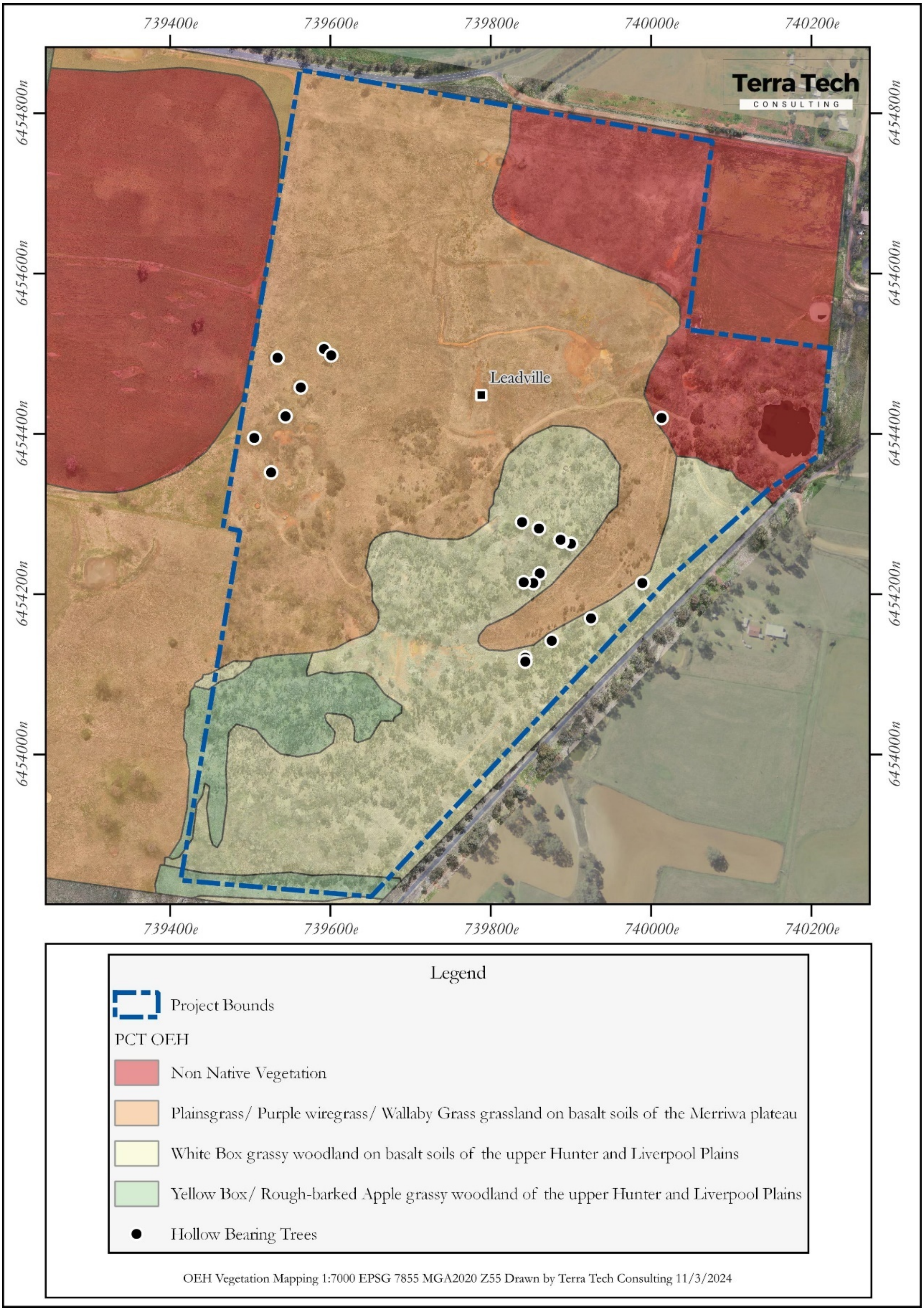

Figure 2 OEH Mapped Vegetation

2.5 Historical Operations and Site Layout

Underground mining operations were undertaken at the Site periodically from the late 1800s to the 1950s, extracting commodities such as Pb-Ag, Cu, Zn, and pyrite concentrates. The site encompasses multiple small groups of underground workings situated at Mount Stewart, Grosvenor, and Extended Workings, with processing occurring at a Smelting site located in the Southeast of the Site. (Okane, 2022).

Table 3 provides a summary of activities since commencement of operation to the present. An interpretative report was developed by GHD (2023b) based on historical mining records and provides details on the characteristics and locations of various relict mining infrastructure which persist on site.

Table 3 Summary of Historical Mining Activities

Year	Activity Type	Activity
1888	Mining	Mine opened as Pb-Ag operation
1892-1893	Mining	Water-jacketed furnace (smelter) erected. Total of 15,000 tons of ore treated, yielding 292,03 oz Ag and 1539 tons of lead
1894	Mining	Resumption of mining for 2 months. Voluntary liquidation after ore changed from carbonates to sulfides.
1918-1920	Mining	1674 tons of pyrite sold to acid and superphosphate manufacturers; 2400 tons of Ag and Pb ore mined.
1921	Mining	Sporadic operation with increasing investment in mine infrastructure
1925	Mining	All work suspended on site.
1932-1937	Mining	30,000 tons of pyritic ore, 419 tons of Ag-Pb ore produced (Mount Stewart Syndicate)
1937	Mining	Zinc ore mined
1950-1951	Mining	50 tons of Ag-Pb ore produced (Leadville Mining Company Pty. Ltd.)

2.6 Climate

Figure 3 presents a summary of climate data spanning the past 107 years at Dunedoo Post Office (Bureau of Meteorology Station 064009). Based on the available climate data, the Köppen Geiger classification indicates that the site falls under the category of Warm temperate (Cfa). This information has been considered in the development of remedial designs and nomination of design storms at Leadville.

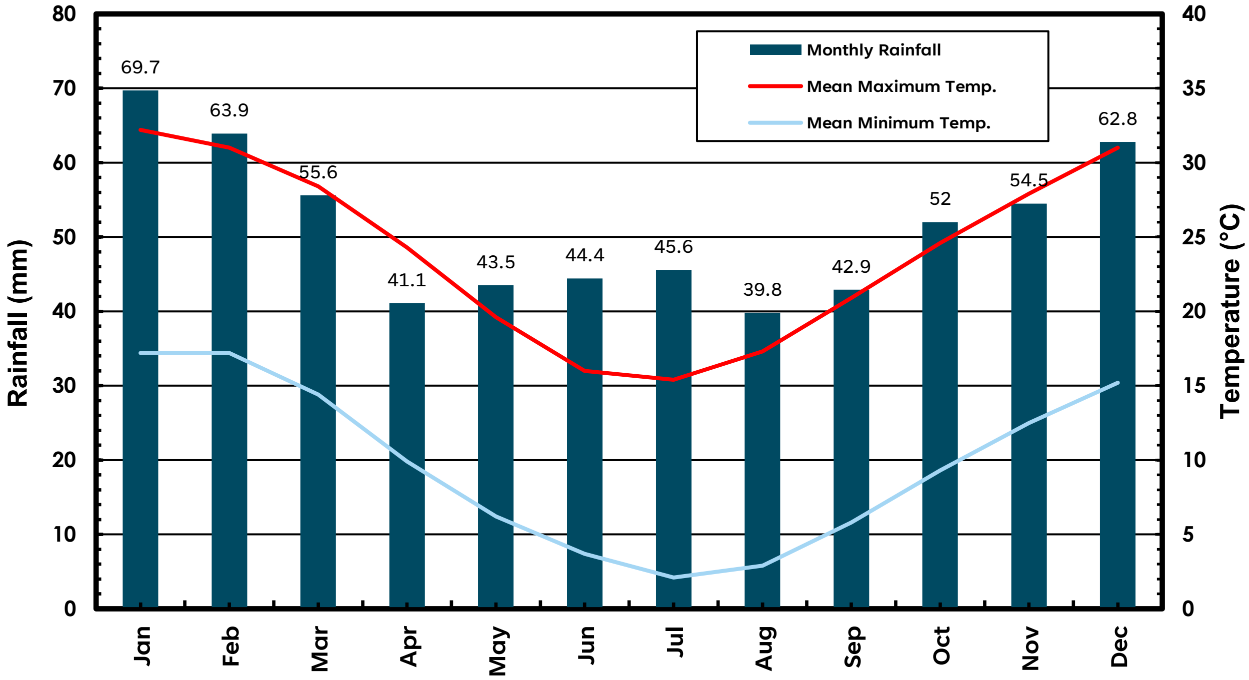

Figure 3 Climate Statistics for Dunedoo Post Office

2.7 Heritage Significance

The Leadville site is a registered historic site registered on the Warrumbungle LEP 2013 as a place of Local Heritage Significance. The site includes *in-situ* relict mine infrastructure at the site including mine shafts, building footings and processing relicts including slag, smelter locations, tanks and drains.

A detailed description of historical mining operations and their relevant locations is provided in the Hazard Assessment Report, GHD (2023b). The heritage significance of various relict features located at the site is described in *Statement of Heritage Impact,* Everick (2022). A Photographic Archival Report (PAR) was undertaken by Everick (2022) and provides detailed recordings of site features for the purpose of archival records.

A desktop search for registered Aboriginal Cultural Heritage (ACH) items and places was undertaken by Lesryk (2022). Three modified trees were identified on Lot 86 DP750766, however are outside the project area and not anticipated to be impacted by the works described herein.

3 PREVIOUS SITE INVESTIGATIONS

3.1 Historical Investigations and Remedial Work

Fredrickson, (1993) established that acid and metalliferous drainage (AMD) from the oxidation of sulfidic ore had led to sediment contamination in drainage lines and water within existing stock dams at The Site. The estimated volume of contaminated waste material stood at 10,000 m^3 before remedial action was initiated (El-Chamy, 1993). Remediation efforts conducted in 1995 encompassed various measures such as shaft filling, drainage enhancements, consolidation, waste dump compaction, chemical treatment of acidic soil through lime dosing, revegetation, and fencing (Land & Water Conservation, 1996).

Subsequent water quality assessments in 1996 and 2000 at the stock dams (LVD3 and LVD4 Figure 4) indicated that the water remained unsuitable for both stock consumption and irrigation. Analysis of sediment and water samples taken on-site by LMP in 2015 revealed persistent elevated levels of Pb, As, Cu, and Zn in sediment and water across multiple locations, including recently active stock dams.

Additional remediation and safety measures were executed in 2016. These actions involved backfilling or fencing of mine shafts and initiatives to mitigate soil erosion and runoff contamination (Soil Conservation Service, 2016). As part of these efforts, two new sediment dams were constructed to intercept runoff from Mt Stewart. Furthermore, grazing activities for livestock were prohibited at the site. Although no as built or final remedial reports from this period were available (solely photo records and memoranda), based on site observations, it is assumed that areas identified as Mt Stewart Drainage (See Figure 4) underwent remedial procedures during this phase.

For detailed reference information regarding the activities undertaken at the site and associated documents, Table 4 provides a comprehensive summary.

Table 4 Summary of Site Activities to Present

Year	Activity Type	Activity	Reference
1993	Rehabilitation / Sampling	Preliminary environmental investigation	Fredrickson, (1993) Preliminary Environmental Investigation at derelict mine site, Leadville NSW.
1995	Rehabilitation / Sampling	Water quality samples taken at two stock dams highly acidic with moderate concentrations of Contaminants of Concern (COC). Rehabilitation work on securing shafts and earthworks on contaminated areas/dump sites	
1999	Rehabilitation/Sampling	Water quality samples taken from dams and depression, highly acidic with moderate concentrations of COC.	Fredrickson, (1999) Follow up inspection and water sampling after rehabilitation works.
2019-2020	Rehabilitation/Sampling	Elevated blood Pb in cattle that grazed on site (unauthorised access). FP-XRF surveys, soil and water sampling	LMP (2019) Soil and water sampling -
2020-2022	Development of RAP by Okane	A RAP was prepared by Okane Consultants between 2020-2022 (Okane, 2022). Work included soil, water (including groundwater) and leachate sampling, Acid Base Accounting (ABA), development of Risk Based Criteria based on land use and bio accessibility of COC.	Okane, (2020) Leadville SAQMP. Okane (2021) Leadville RAP Rev A. Okane (2022) Leadville RAP Rev B. EnRisks (2022) Risk Based Criteria for Leadville Mine.
2022-2023	Remedial works planning	Legacy Mines Program planned remedial works on the basis of the Okane, (2022). During the development of technical oversight plans, GHD (2023a) identified a number of underground workings at Mt Stewart which presented subsidence risks and raised the need to review the remediation strategy.	GHD (2023b) Hazard Assessment Report GHD (2023a) Geophysical Interpretive Report

3.2 Okane Consultants Investigations and RAP

Okane, (2020) developed a Sampling Analysis and Quality Management Plan (SAQMP) to guide field investigations which were aimed at:

- Characterisation of potential contamination sources identified during field activities.
- Determining spatial extents and volumes of contaminated media at the site.
- Gathering further site-specific data to inform development of risk-based criteria.
- Characterising potential borrow materials for use in remedial works.
- Assessing potential for offsite migration to groundwater resources.
- Assess surface water quality.

Based on a background review of existing data (LMP, 2019) which indicated AMD process where ongoing at the site, Okane undertook a range of targeted activities including:

- Acid Based Accounting (to determine risk of acid mine drainage processes for each material type encountered) and further guide field investigations (An overview of these results, which were considered in developing remedial strategies presented in this RAP are presented in Figure 5.
- Further XRF surface screening based on field observations and site mapping (shown in Figure 4)
- Targeted test pitting at former processing areas, mine areas and disturbance areas (areas subject to previous remedial works) (shown in Figure 4)
- Geochemical assessment of contaminated media including via ICP-AES (used to calibrate XRF results), ASLP (to determine contaminant mobility).
- Surface water monitoring across the site (summarised in Section 3.2.5)
- Geotechnical assessment of potential borrows materials at the Site (Details provided in Section 6.1.4)
- Collection of bio accessibility samples to inform the development of RBC based on potential for uptake by receptors under current land use scenarios. (Summarised in Section 3.2.1 for each contamination domain.)
- Advancement and installation of a groundwater monitoring bore (LVGW2) to assess groundwater quality. (Shown in Figure 4 and discussed in Section 3.2.5).

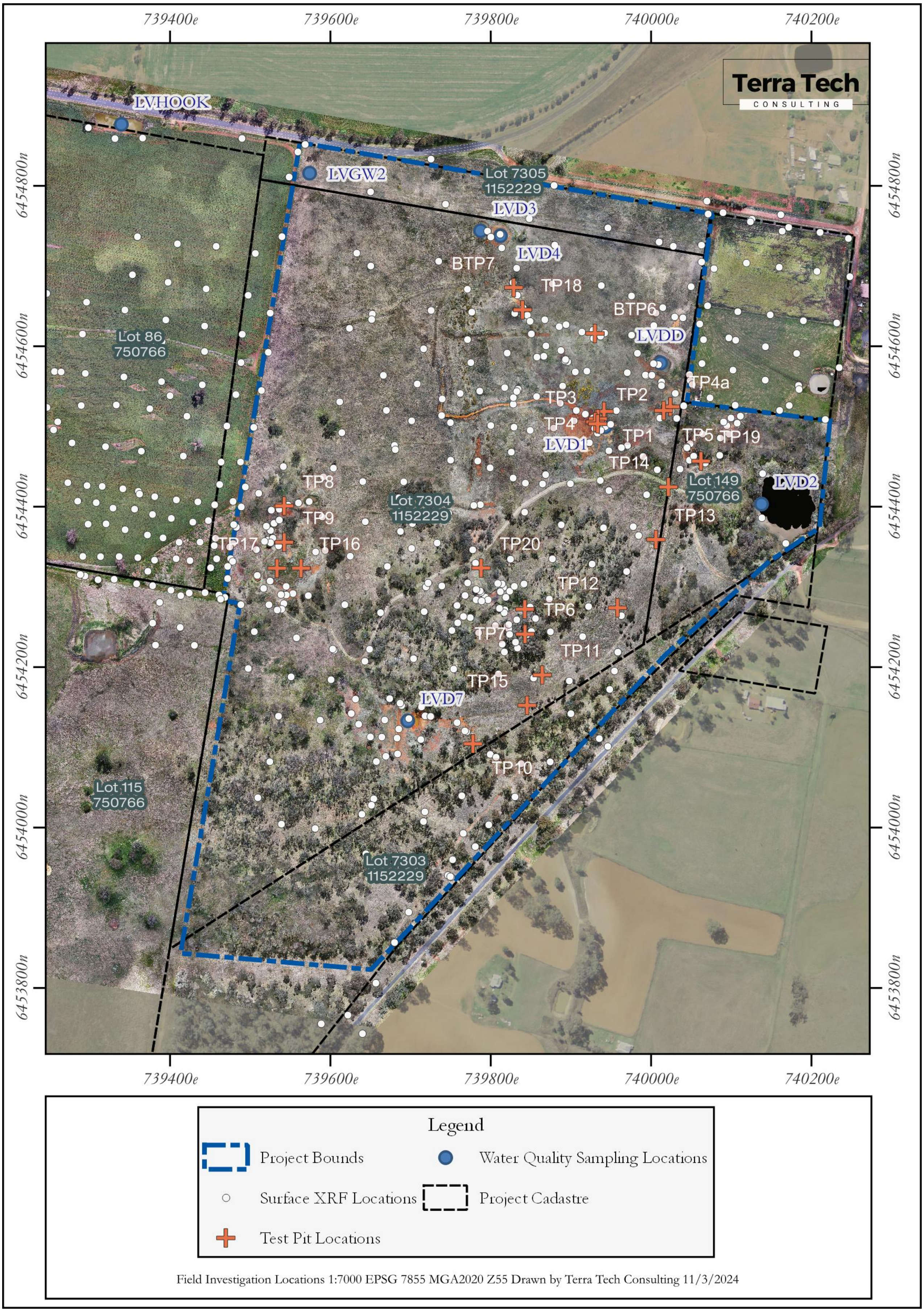

Figure 4 Locations of Okane field investigations.

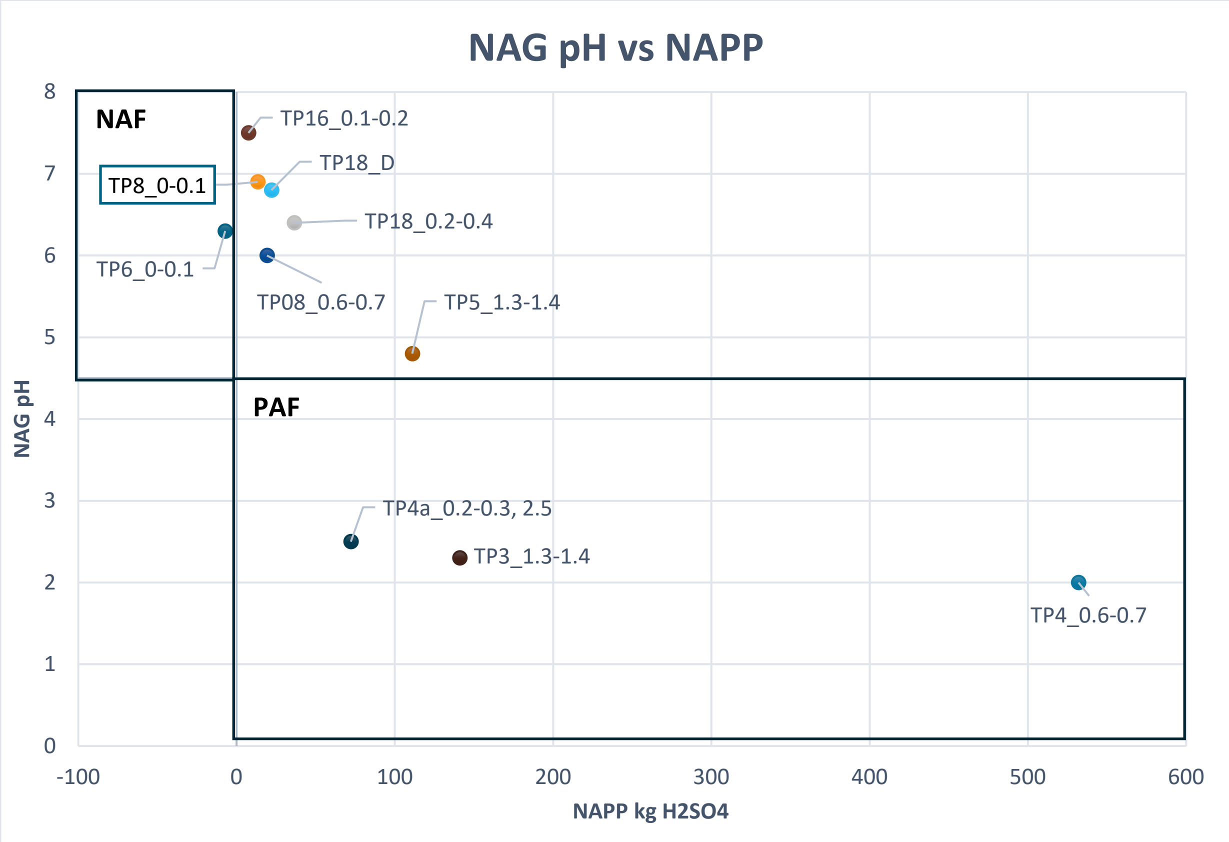

Figure 5 NAG pH Vs NAPP as indicator for AMD Risk at Leadville (Okane, 2022)

Detailed information collected during field investigations is included in the RAP developed by Okane (2021, 2022) with several interactions due to review by the NSW EPA, Crown Lands and the Legacy Mines Department.

Here we summarise key data from this work which has been relied upon to assess risk to offsite receptors based on physical characteristics of waste or contaminated media. It should be noted that Okane, (2022) relied upon XRF and paired 4 acid-digest as the primary tool for assessment of metals in soils. Supplemented with ABA data to determine AMD risk, these data are considered useful for identifying contamination domains and characterising the potential mobility mechanisms for COC which need to be addressed to control risk to offsite receptors.

3.2.1 Grosvenor

Test pitting was undertaken across the Grosvenor area where calibrated handheld XRF was used to guide characterisation and sampling activities. In addition to detailed down-pit XRF (presented in logs and Appendices in Okane (2021)) geochemical analysis was undertaken to assess the risk posed by Potentially Acid Forming (PAF) materials. Geochemical analysis also included bio-accessibility assessments and an assessment of leachable metals by ICP-MS.

On this basis, waste materials at Grosvenor are characterised by either:

- Being associated with naturally mineralised outcrops of mineralised ironstone (including scree and detritus) which is not PAF but high in metals (Pb, Zn, Mn, Fe) (TP16 in Table 5 and Table 6).

- Being associated with fine (silt sized) fraction materials which occur in the Western side of Grosvenor dam (separated from the Eastern dam by a bund – with the Eastern side not showing obvious signs of contamination. The material in the Western side of Grosvenor dam fills the dam depression and extends to 500 mm below ground surface. The material is not PAF but has high levels of total and leachable Pb (TP8 in Table 5 and Table 6).

Table 5 Water Leachable Metals by ICP-MS (Grosvenor)

Sample #	Location	Description	Pb ppm	Zn ppm	Mn ppm	As ppm	Cd ppm
TP8-0-0.1	Grosvenor Dam	Clayey Silt	11.9	2.43	0.392	0.205	0.0108
TP16-0.1-0.2	Grosvenor	Silt IS Fragments	0.821	4.24	2.21	0.006	0.0657
TP8-0.6-0.7	Grosvenor Dam	Clayey Silt	0.782	1.46	1.25	0.001	0.0848

Table 6 Total Metals by 4 Acid Digest

Sample #	Location	Pb %	Zn ppm	Mn ppm	As ppm	Cd ppm
TP8-0-0.1	Grosvenor Dam	4.8	6100	4330	1130	24.5
TP16-0.1-0.2	Grosvenor	1.29	8070	31100	707	55.9
TP8-0.6-0.7	Grosvenor Dam	1.23	2550	2960	243	8.23

Figure 6 Naturally Mineralised Surface Outcrops at Grosvenor and Silty Contaminated Material in Grosvenor Dam

3.2.2 Mt Stewart

Test pitting conducted across the Mt Stewart area where calibrated handheld XRF was used to guide characterisation and sampling activities. In addition to detailed down-pit XRF (presented in logs and Appendices in Okane (2021)) geochemical analysis was undertaken to assess the risk posed by PAF materials. Geochemical analysis also included bio-accessibility assessments, sampling of standing water in a depression at the Main Shaft and an assessment of leachable metals by ICP-MS.

On this basis, waste materials at Mt Stewart are characterised are having ongoing AMD potential as indicated by Net Acid Producing (NAP) results, readily mobilised acidity and dissolved metals. Without remedial works, ongoing oxidation of S is interpreted to continue, impacting runoff water quality with acidification and association dissolution and mobilisation of metals.

Table 7 Metals by 4 Acid Digest (Mt Stewart)

Sample #	Location	Pb %	Zn ppm	Mn ppm	As ppm	Cd ppm
TP3-0.0-0.1	Mt Stewart	1.47	3290	735	367	11.85
TP3-1.3-1.4	Mt Stewart	0.678	15350	3860	482	83
TP4-0.6-0.7	Mt Stewart	2.8	3400	1500	486	17.75
TP4a-0.2-0.3	Mt Stewart	1.075	2810	1280	1040	5.68

Table 8 Water Leachable Metals by ICP-MS (Mt Stewart)

Sample #	Location	Description	Pb ppm	Zn ppm	Mn ppm	As ppm	Cd ppm
TP3-0.0-0.1	Mt Stewart	Sulfidic Waste	0.569	23.9	6.63	0.034	0.155
TP3-1.3-1.4	Mt Stewart	Sulfidic Waste	3.8	9.32	7.25	0.007	0.0664
TP4-0.6-0.7	Mt Stewart	Sulfidic Waste	0.492	64.7	15.2	1.5	0.368
TP4a-0.2-0.3	Mt Stewart	Sulfidic Waste	3.2	22.8	9.02	0.016	0.135
TP5-1.3-1.4	Mt Stewart East	Slag like materials	2.6	119	59.3	0.016	1.14

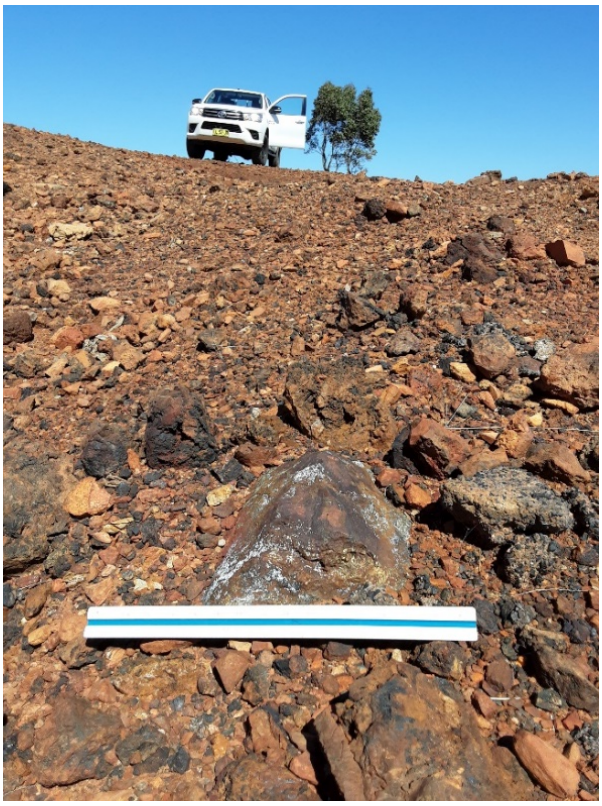

Figure 7 Test Pitting at Mt Stewart and surface photograph of salts on scree at Mt Stewart

3.2.3 Mt Stewart Drainage

Test pitting was conducted across the Mt Stewart Drainage area (TP18, BTP7, BTP6) where calibrated handheld XRF was used to guide characterisation and sampling activities. In addition to detailed down-pit XRF (presented in logs and Appendices in Okane (2021)) geochemical analysis was undertaken to assess the risk posed by Potentially Acid Forming (PAF) materials. Geochemical analysis also included bio-accessibility assessments, and an assessment of leachable metals by ICP-MS.

On this basis, waste materials at Mt Stewart Drainage Materials are characterised by the presence of surface scaring where areas lacking vegetation also indicate high metals (Pb primarily) are present. The material is not PAF and does not have ongoing AMD potential as indicated by Net Acid Producing (NAP) results. Pb is readily mobilised under circum-neutral pH conditions as indicated by Leachate Data (Table 10).

Table 9 Metals by 4 Acid Digest (Mt Stewart Drainage)

Sample #	Location	Description	Pb ppm	Zn ppm	Mn ppm	As ppm	Cd ppm
TP18-0.2-0.4	Mt Stewart Drainage	Clayey Silt	13.5	2.14	4.07	0.006	0.0741
TP18-D	Mt Stewart Drainage	Clayey Silt	6.82	3.51	7.94	0.002	0.192

Table 10 Water Leachable Metals by ICP-MS (Mt Stewart Drainage Materials)

Sample #	Location	Description	Pb ppm	Zn ppm	Mn ppm	As ppm	Cd ppm
TP18-0.2-0.4	Mt Stewart Drainage	Clayey Silt	13.5	2.14	4.07	0.006	0.0741
TP18-D	Mt Stewart Drainage	Clayey Silt	6.82	3.51	7.94	0.002	0.192

Figure 8 Backfilled contaminated material in areas devoid of vegetation (Mt Stewart Drainage)

3.2.4 Smelting Area

Test pitting was conducted across the former Smelting location where calibrated handheld XRF was used to guide characterisation and sampling activities. In addition to detailed down-pit XRF (presented in logs and Appendices in Okane (2021)) geochemical analysis was undertaken to assess the risk posed by Potentially Acid Forming (PAF) materials. Geochemical analysis also included bio-accessibility assessments, sampling of standing water in a depression at the Main Shaft and an assessment of leachable metals by ICP-MS.

On this basis, waste materials at The Smelting are characterised as being a slag like material, in both small stockpiles and cemented surface coverings. The material is (TP6 in Figure 5), relatively high in metals however these are immobile under circumneutral pH conditions as demonstrated by leachate data (Table 11 and Table 12). The materials are not PAF.

Table 11 Total Metals by 4 Acid Digest (Smelting Area)

Sample #	Location	Pb %	Zn ppm	Mn ppm	As ppm	Cd ppm
TP6-0-0.1	Smelting Area	3.79	6250	5800	406	12.1

Table 12 Water Leachable Metals by ICP-MS (Smelting Area)

Sample #	Location	Description	Pb ppm	Zn ppm	Mn ppm	As ppm	Cd ppm
TP6-0-0.1	Smelting Area	Vitreous Slag	1.39	0.199	0.116	0.035	0.0029

Figure 9 Slag Like material at and below surface at TP7 and TP6 (Smelter Site)

3.2.5 Surface Water and Groundwater

In 2021, Okane undertook surface water sampling on standing water across the site and installed a monitoring well in the NW of the site. These locations are shown in Figure 4. Field and lab water chemistry summarised in Section 5.5 of Okane (2021) indicates that at Mt Stewart, in shallow collection depression (LVD1) the concentration of Cadmium (Cd) and Zinc (Zn) surpassed the established guidelines for recreational water use[2]. It is noteworthy that the pH measurements at LVD1 (2.42) and the acidity represented by H_2SO4 align with the anticipated impact of Acid Mine Drainage (AMD). Consequently, these values would not be deemed safe for the purposes of providing drinking water for livestock (incidental consumption) or for human recreational activities (incidental access).

[2] And for RBC Livestock drinking water.

Groundwater quality at the monitoring bore was consistent with water chemistry at bore fed dam on the adjoining property (LVHOOK), being more alkaline and with conductivity.

Table 13 Summary of Water Quality Results for COPC

Analyte	Unit	LVGW1	LVDD	LVD4	LVD3	LVD2	LVD1	LVD6	LVD7
pH Value	pH	7.58	6.84	5.13	4.74	6.39	2.42	6.01	5.7
Electrical Conductivity @ 25Â°C	µS/cm	10200	104	61	103	110	2660	109	116
Arsenic	mg/L	<0.001	0.002	0.002	0.008	0.008	0.066	0.006	0.002
Cadmium	mg/L	0.0064	0.0008	0.0632	0.0392	0.0002	**0.56**	0.001	0.004
Lead	mg/L	0.001	0.023	0.033	0.036	0.049	0.017	0.069	0.031
Manganese	mg/L	0.011	1.58	1.44	1.3	1.54	44.1	0.891	3.56
Nickel	mg/L	<0.001	0.002	0.011	0.01	0.002	0.164	0.005	0.006
Zinc	mg/L	0.014	0.131	2.67	1.32	0.031	**78.6**	0.088	0.592

3.3 Borrow Area Characteristics

Okane (2020) undertook an assessment of potential borrow materials at the site. Okane focused on identification of materials which may be used in subsequent engineering designs in support of the remedial strategy. TP10 – TP15 (Figure 4) were the target locations for borrow materials.

On the basis of the test pitting undertaken and geotechnical sampling which included Emersons, Atterberg limits and Particle Size Distribution the following conclusions were made about the likely hydraulic performance of the material, its suitability for use in remediation works:

- There is an area of finer fraction materials in the South of the Site (based on Test pits TP10 and TP15 and associated results. Based on particle size, saturated hydraulic conductivity (k_{sat}) was estimated using the Kozeny-Carman equation. On this basis, with compaction the material in the low permeability zone is interpreted to be capable of attaining a k_{sat} in the order of $1x10^{-7}$ cm/s and therefore is considered suitable for the construction of features requiring a higher level of control on permeability such as low permeability layers in encapsulations or dam walls and bunds. The material is not considered dispersive and exists from surface to 1 m within the area identified as low permeability. The estimated volumes available for use are approximately 10,705 $m^{3.}$

- The area identified as general store and release is characterised by gravelly-clay sands The material has a 45% fines content with a low plasticity. Estimated k_{sat} is in the range of $1x10^{-4}$ cm/s to $1x10^{-6}$ cm/s. The material is considered suitable for use in construction of diversion bunds. The material is not considered dispersive and exists from surface to 1 m within the area identified as low permeability in. The estimated volumes available for use are approximately 30,000 $m^{3.}$

A summary of PSD and Plasticity is included in Section 3.3.1. Conceptual borrow areas are shown in Figure 15. For logs of relevant test pits and geotechnical lab results, see Okane (2022).

3.3.1 Summary of Results (Okane, 2020)

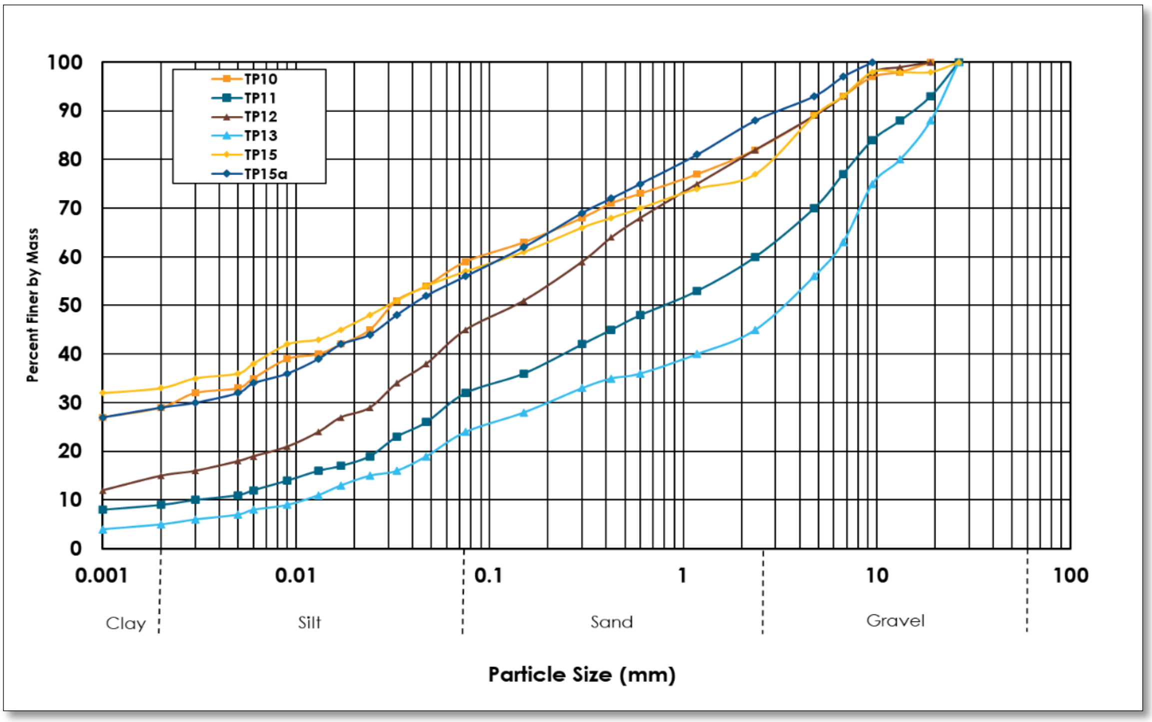

Figure 10 Particle Size Distribution – From PSD and Hydrometer

Okane (2020a)

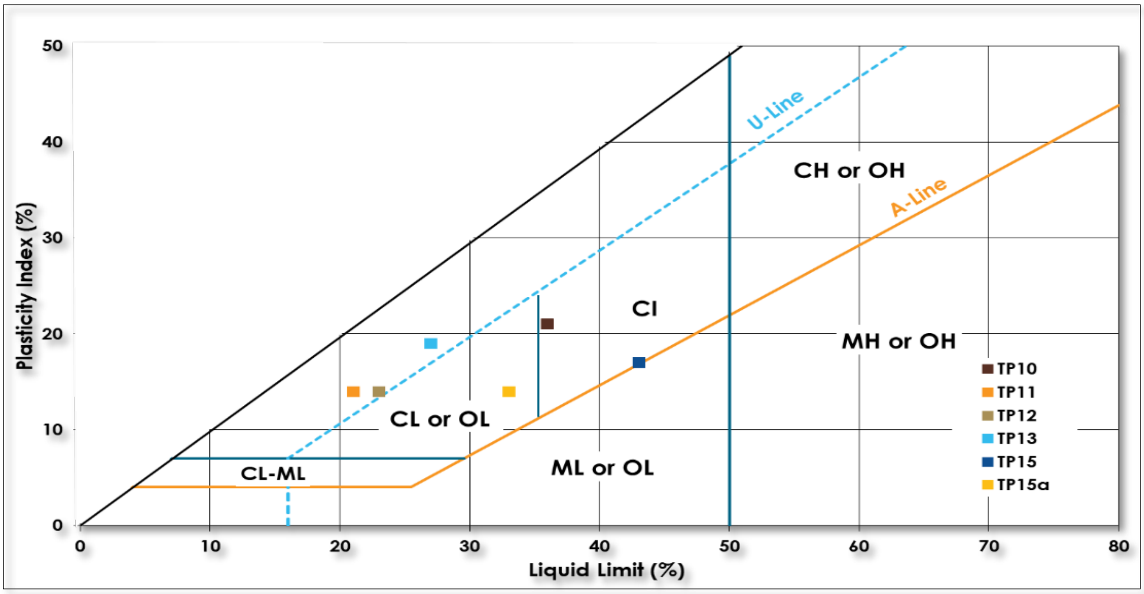

Figure 11 Cassagrande Plasticity Chart, after AS1726:2017

Okane (2020)

3.4 Terra Tech Consulting Survey

Previous Investigations and remedial plans relied upon photogrammetry without ground control points as a basis for survey data. This data was unsuitable for development of IFC documentation, and a recommendation was made within Okane, (2022) to undertake a detailed survey so IFC designs could be developed.

Therefore, as part of this SoW, a detailed survey of the site was undertaken. The survey was completed on 6th and 7th November 2023 at the Site, including:"

- The Site was surveyed using CORS RTK GPS methods and using the Dunedoo CORS base station. Position & height datum was verified locally to PM2977 & SSM1837.
- The coordinates of the survey are MGA2020 grid with a local scale factor at PM 2977 of 1.00024.
- Accuracy +/- 30 mm height, +/- 10 mm position.
- Outputs are 3D .dwg mesh surface, contour shapefile and 3D .dxf.

This data has been made available to the Principal and has been relied upon to develop the designs presented herein.

3.5 GHD Geohazards Assessment

During the planning phase for the remedial activities linked with Okane's (2022) RAP, technical oversight in 2023 involved conducting a hazard evaluation associated with proposed works near underground workings and shafts GHD (2023a). This assessment encompassed a geophysical survey and guidance on operations around historical mine workings and disused shafts.

Following interpretation of geophysical survey data (Resistivity) near-surface underground workings were identified in the Mt Stewart area (shown in Figure 1). GHD developed subsidence management measures to be implemented during works (demarcation, training, restrictions on positioning and movement of heavy plant in, and near to the identified geohazards area. Due to the complexity and residual WHS risk associated with working in and around the workings at Mt Stewart, the remedial work plans nominated in Okane, (2022) for Leadville were reviewed by the Principal, and a decision not to adopt the nominated strategy Mt Stewart (construction of an encapsulation) was taken. This decision included a review of land use goals by stakeholders, and the requirement to develop a new RAP based on these decisions.

4 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The development of a CSM is an essential part of all site assessments and remediation action plans and provides the framework for identifying contamination sources and how potential receptors may be exposed to contamination. A detailed CSM has been presented in EnRisks (2022) and key aspects summarised below in order to define the required extent of remediation.

4.1 Sources of Contamination

The potential sources of contamination relate to the former mining activities on the site. This includes naturally elevated metals, elevated metals as a result of mining processes as well as former and ongoing acid mine drainage. The site comprises two subsided mine shafts and a denuded area comprising waste rock, tailings and overburden. The media likely to be impacted as a result of the mining activities include:

- Mining waste and overburden.
- surface soil; and
- surface water and groundwater.

The various mining domains at Leadville are shown in Figure 1 and their characteristics described in Sections 4.1.1-4.1.6 below.

4.1.1 Extended Workings

Surface XRF results at the extended workings indicate that there are dispersed, elevated metals in soil at this location. Previous remediation efforts in this area include the construction of a run-off collection dam which, based on downstream data, indicates that any mobilised metals are being contained within this domain. Grazing of livestock in this area presents an unacceptable risk.

4.1.2 Mt Stewart

The Mt Stewart area is characterised by the presence of PAF materials actively undergoing oxidation, thereby generating Acid Mine Drainage (AMD). This process has been characterized by sulfuric acid production (ABA) and the mobilization of metals such as Fe, Pb, Cd, and Zn from sulfidic compounds. Analysis of sulfide speciation reveals a substantial potential for ongoing acidity production and the presence of soluble sulfur compounds that may be released from the system upon interaction with meteoric water. (Okane, 2021).

AMD processes have resulted in surficial soil scalding spanning approximately 3,200 m^2 within the Mt Stewart Area. These processes have notably influenced the quality of standing water with extremely acidic conditions observed (LVD1 (small depression at Mt Stewart returning pH of 2.64). Concentrations of Cd in standing water (LVD1) surpass recommended recreation and livestock drinking water levels, as specified in the Risk-Based

Concentration (RBC) for the site. Furthermore, the lower pH values observed at locations LVD3 and LVD4 may signify the downstream impact of AMD emanating from this specific area.

The primary source of contamination at Mt Stewart therefore is PAF materials and the associated mobilisation of metals and acidity when this material encounters meteoric water. The volumes of leachate mobilised being dependent on the volume of water interacting with this material.

GHD (2023a) identified an area of subsidence risk due to underground workings directly below the contaminated area at Mt Stewart as shown in Figure 1.

4.1.3 Paddock Shaft Area

Sulfidic material which occurs East of Mt Stewart (Paddock shafts) include a thin veneer of similar characteristics (PAF) as those at Mt Stewart. This material is interpreted to have similar PAF potential as the sulfidic material at Mt Stewart. This material is interpreted to be relict ore material from below zone of weathering and therefore is likely to occur in a thin veneer at surface.

4.1.4 Grosvenor

The area surrounding the Grosvenor workings includes relict backfilled shafts and the remnants of the former stamper battery, which served as an ore mill. Here, gossanous ironstone outcrops are prevalent, exhibiting heightened concentrations of metals, notably Fe, Mn, and Pb. Surface XRF readings showed elevated concentrations of Pb, Mn, and As within the surface layers of naturally mineralized rocks. However, the enrichment of Mn decreases considerably with depth. Materials subjected to Acid-Base Accounting (ABA) testing did not reveal any potential for Acid Mine Drainage (AMD) formation.

Within Grosvenor Dam, total metals in the leachate suggest that Pb, particularly in the western area, would be easily mobilized (Pb in leachate up to 11.9 ppm). Notably, sediment XRF screening in the eastern portion of Grosvenor Dam did not show any signs of contamination. The considerably heightened concentrations of Pb within the Western part of Grosvenor Dam and its observed mobility pose health risks to offsite receptors (neighbouring livestock and humans through impacts to water quality).

The presence of the stamper battery upstream of the Western dam implies that ore milling activities occurred in this area, suggesting that fine ore and waste in the dam likely originated from milling activities upstream. Sediment analysis through calibrated XRF readings and 4-acid digest assays returned a value of 4.8% Lead. The material is interpreted to extend from surface to around 0.5m (see Figure 6 and Test Pit 8 – Appendix D of Okane, 2022).

4.1.5 Smelting Site

The former smelting region is characterised by surficial contaminated features including a loading wall, slag stockpiles, buried slag extending from the surface to 0.8 m depth, and a consolidated slag surface measuring 0.2 m thick. This surface extends across an area believed to have served as a loading zone for a furnace. Analysis reveals markedly heightened concentrations of Pb, Zn, and As within this material. Based on ABA analysis undertaken by Okane (2021), the material is not PAF. In addition, based on ASLP results, these elements are not readily interpreted to be easily mobilized under neutral pH conditions however present an unacceptable risk to livestock through identified uptake pathways (incidental ingestion through grazing).

4.1.6 Mt Stewart Drainage

The area North of the Mt Stewart workings exhibit multiple bare, clayey patches of land where surface XRF analyses have revealed remarkably high concentrations of Pb (up to 200,000 ppm). Disturbance history in this specific area remains inadequately documented. However, focused test pitting at TP18, BTP7, and BTP6, located within areas devoid of vegetation, where the presence of anthropogenic artifacts like pipes and scrap metal suggests potential prior remediation efforts occurred in this location involving the use of contaminated materials as backfill. (Okane, 2022)The ABA (Acid-Base Accounting) suite conducted (Section 5.4 of Okane, 2022) indicates minimal sulfur content linked with heightened Pb levels. This suggests a probable association of this material with PbO_2 and potentially $PbCO_3$ linked to skarn-type ore and waste from early mining stages and is included with other waste material. The extensively elevated Pb content was mobilized upon ASLP analysis and presents a mobilisation risk to offsite receptors via impacts to water quality.

4.2 Potential Receptors and Exposure Pathways

Table 14 presents a summary of the potential receptors and exposure pathways relevant to the proposed use of the site.

Table 14 Exposure pathways and receptors

Media / Receptor	Potentially Complete Exposure Pathways	Comment
Surface Soil / Public and recreational users on the site – adults and children and site workers undertaking remedial works.	Inhalation of dust, ingestion of soil / sediments, dermal contact with sediments	Where the public or workers may have access to the site they have the potential to come into direct contact with contamination that may be present in surface soil. Direct contact may result in ingestion and dermal contact with contamination in soil. In addition, where surface soil is dry there may be some inhalation of dust, where generated by the wind or the recreational use of open areas for activities such as dirt-bike riding (should this occur). While dust inhalation is not expected to be a significant exposure pathway it has been included in this assessment
Dams / Public and recreational users on the site – adults and children	Ingestion of surface water, dermal contact with surface water, ingestion of biota / produce	Where the public has access to the site they may also come into direct contact with sediments and surface water in the dams, where ingestion and dermal contact may occur. Mussels are known to grow in the dams and may be harvested by the public for consumption. Such intakes would only be expected to be infrequent as the dams do not support large numbers of mussels. While the consumption of mussels from the dam is not known, this assessment has considered the risks, should they be consumed. Metals are not volatile and hence there are no exposure pathways identified for the inhalation of vapours.
Surface soil, pasture and dams / Stock – cattle and sheep for meat and wool	Inhalation of dust, ingestion of soil / sediments, dermal contact with sediments, ingestion of surface water, dermal contact with surface water, ingestion of biota / produce	Stock may drink water from the dams and consume pasture grown on the site which may also include surface soil. Intakes from dust is not expected to be significant. These intakes may be of concern for the health of the cattle and sheep (should they be present), or the uptake of metals into produce that may then be consumed (as home-slaughtered meat consumption[3]). Grain crops may also be grown on the site, and the community may be exposed to contaminants taken up into grains where used in consumable products.

4.3 Extent of Required Management or Remediation

The extent of remediation has been determined by:

- Comparison of heavy metal levels (specifically As, Pb and Mn) in surface soils / sediments to the Risk based Criteria (RBC) presented in EnRisks (2022). It is noted that EnRisks (2022) states any management measures implemented to address As, Pb, Mn will also address the presence of other metals in site soils and sediments. As such, the RBC presented in Table 15 for the key heavy metals have been used to inform the extent of required management or remediation, where any exceedances of these criteria have been shown on Figure 12.

- Comparison of heavy metal levels in surface water / dams to the RBC presented in EnRisks (2022). It is noted that for LVD1 (Mt Stewart) constituents in surface water exceeded the RBC and therefore will require management in order to address potentially unacceptable risks associated with recreational exposures as well as livestock ingestion.

[3] Commercial meat is subject to assessment for contaminants prior to sale in accordance with *Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption AS 4696 (Australian Meat Standard)*

- Highly impacted materials that exhibit on-going leaching or AMD characteristics require remediation in order to address potential off-site migration issues and on-going source to surface water impacts. The extent of highly impacted materials that exhibit on-going leaching or AMD characteristics was informed by the presence of sulphides identified in test pitting and associated ABA test work (Okane, 2021) by Okane, summarised in Figure 5.

Table 15 RBC for Soil / Sediment.

Contaminant	RBC (mg/kg)					
	Recreational exposures	Livestock Health (cattle – assuming 2 months grazing per year)	Livestock Health (sheep– assuming 2 months grazing per year)[4]	Livestock Health (cattle – assuming 12 months grazing per year)	Livestock Health (sheep– assuming 12 months grazing per year)
As	2,000	1,200	180	200	30
Pb	6,600	3,600	440	830	110
Mn	140,000	95,000	25,000	16000	4200

[4] RBC (Sheep) for COPC are lower than cattle. Therefore, these criteria have been applied in defining the extents of grazing can occur without exposure to materials which exceed RBC.

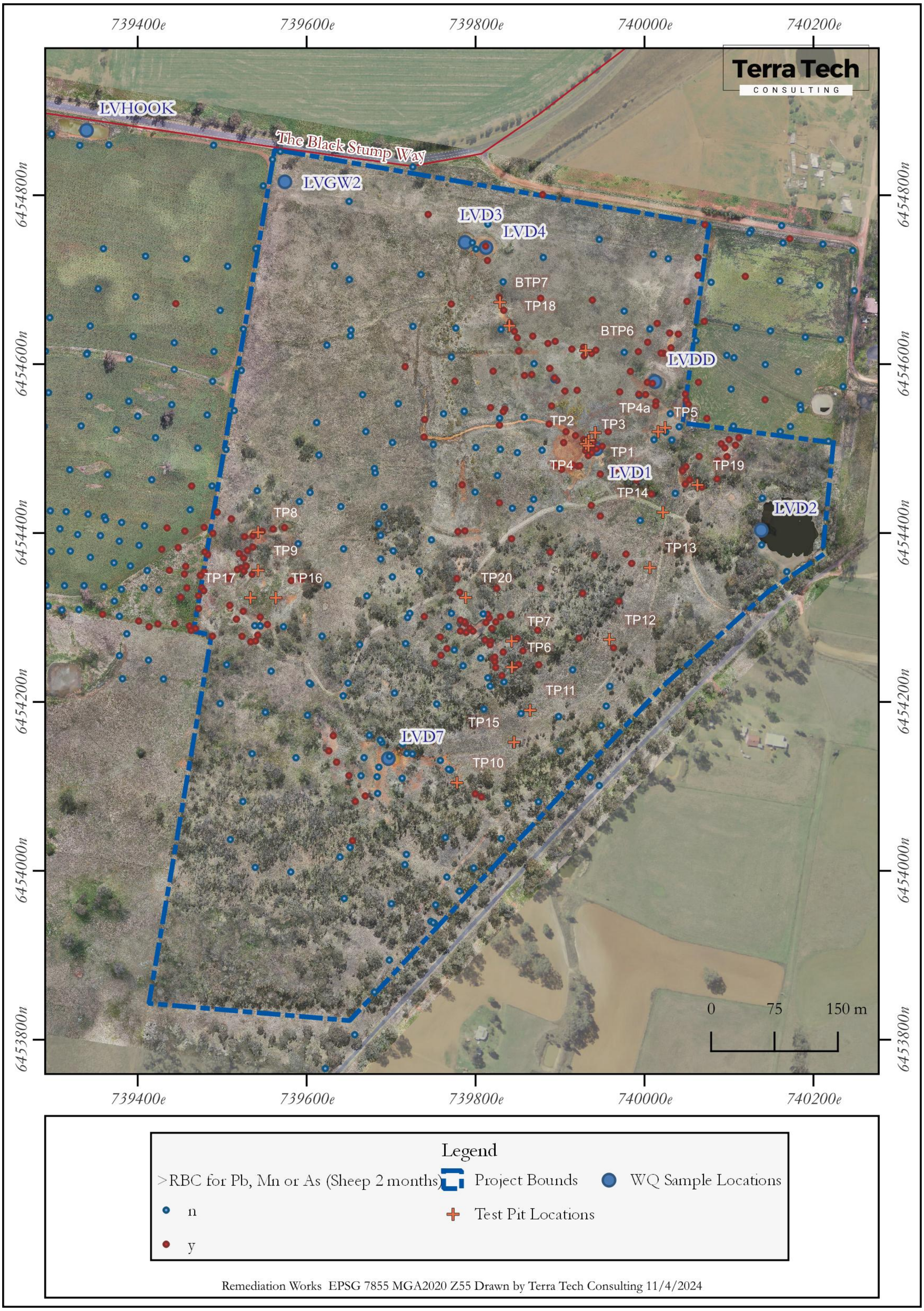

Figure 12 Exceedances of RBC for COPC

4.4 Summary of Impacts Requiring Management or Remediation

On the basis of the assessment presented in Section 4.3, Table 16 summaries the requiring management or remediation within each media at the site.

Table 16 Media requiring management or remediation.

Media	Impact	Action Required
Soil	Heavy metal impacted soils or sediment posing a potential risk to recreational users of the site or livestock.	Remediation (via isolation) or on-going management of access (Areas where limited grazing can occur).
	Highly impacted materials that exhibit on-going leaching or AMD characteristics.	Remediation (via excavation and off-site disposal or the construction of surface water diversion bunds in areas of geohazards) and on-going management
Surface Water	Heavy Metal Impact and pH (LVD1)	On-going management and control on access at source points.

5 DEVELOPMENT OF REMEDIATION STRATEGY

5.1 Site Goals

The remedial goals of the project, provided by the Principal are to develop remedial designs which:

1. *"Contain all contaminates to site and limits contaminates from leaving the site and;*
2. *"Allow grazing of livestock (Sheep and Cattle) on the remaining areas of the site in some capacity"*

In developing remedial designs which meet these goals, TTC have considered the following defining constraints which apply to the site:

- The limitations of undertaking heavy and bulk earthworks over areas proximal to geohazard risks identified in GHD, (2023a); and
- The elevated surface concentrations of COPC in soils across the site (primarily As and Pb) which exceed adopted RBC at 94% of soil sampling sites for cattle and sheep under a 12-month access scenario. As such, remedial measures have been designed to allow for livestock grazing over a maximum period of 2 months per year on site by isolating areas in which more elevated heavy metals are present.

As such, the RAP sets the remedial goals of removing the risks posed by the identified potential contamination issues, to make the site suitable for agricultural purposes (that allows livestock grazing for a period of 2 months per year) whilst addressing migration of impacts from the site.

5.2 Adopted Remediation Criteria

Previous investigations identified varying levels of heavy metal impacted materials that have been broadly categorised into the following three categories summarised below and outlined in Table 15.

1. Diffuse impact managed by institutional controls. These areas have been defined as those with elevated heavy metal impacts (with low risk of migration) in surface soils that preclude unrestricted grazing. These areas essentially comprise of all areas beyond those categorised as 2 or 3 below. Access to these areas will be restricted to minimise risk to the public and livestock will only be allowed to graze for a maximum period of 2 months per year in these areas.

2. Moderately to highly impacted materials which do not exhibit mobility of COPC (Smelter site and Grosvenor with the exclusion of Grosvenor Dam). These areas have been defined as those with heavy metal impacts that exceed the RBC protective of recreational exposures or protective of livestock when allowed to graze for a maximum period of 2 months per year. These areas are shown on Figure 14. Access to these areas will be restricted to minimise risk to the public and livestock grazing will not be permitted in these areas.

3. Highly impacted materials that exhibit on-going leaching or AMD characteristics as shown on Figure 14. These areas have been identified from previous investigations to exhibit potential for impact to surface waters and remedial works are required to address potential migration of impacts. It is noted that the

adopted remedial approach to address this category of impact will be contingent on the presence of unacceptable safety risks (i.e. presence of near-surface underground workings).

Table 17 Categories Adopted for Guiding Remedial Requirements

#	Category	Domain	Characteristics	Remediation Requirements
1	Diffuse impacted	Remaining Areas of site (excluding cat # 0, 2 and 3)	• Elevated metals in surface, no obvious signs of subsurface contamination. No obvious signs of phytotoxicity. No evidence of mobility or offsite pathways.	Limit on grazing to two months per annum (yellow area in Figure13)[5]
2	Elevated metals content with low mobility	Grosvenor and Smelter Site	• Pb Content > RBC for Pb at smelter site 6,600 mg/kg.[6] • ASLP<RBC for recreational/livestock drinking water guidelines.[7] • No AMD potential (NAG/NAPP)	Isolation (no grazing or public access) red area).
3	Elevated metals and corresponding high leachate potential or High ongoing AMD potential.	Mt Stewart, Mt Stewart Drainage, Paddock Shaft Area and Grosvenor Dam	• Pb Content > RBC for Pb at Mt Grosvenor Stewart Drainage 9800-10000 mg/kg[8] • ASLP> RBC for recreational/livestock drinking water guidelines. • Significant AMD potential (NAG/NAPP)	Offsite disposal or drainage controls *where geohazards are present.

Remedial strategies for Leadville mine were developed in consideration of:

- The characteristics of materials within domains at the site and the risk they present to receptors at the site under defined land use scenarios.
- Limitations on undertaking large scale bulk earthworks within the identified geohazards zone (See Section 3.5).
- The risk highly impacted materials present to offsite receptors (via impacts to water quality).

These domain-based strategies are summarised in Table 17.

5.3 Preferred Remedial Options

The remedial strategy developed in consultation with the Principal is:

1. Smelter site (surface soils comprise Category 2) – Leave in-situ and fence.
2. Mt Stewart (surface soils comprise Category 3) and the area contains geohazards that preclude excavation) – Drainage controls to divert unimpacted meteoric water away from the Mt Stewart source

[5] It is assumed that individual cattle would not graze the TSR more than two months per year therefore these areas are not fenced or included in the yellow area on the map.
[6] Recreational exposures for Pb based on Bioavailability of this material presented Table 22 EnRisk (2022)
[7] Recreational exposures for Pb based on Bioavailability of this material presented Table 22 EnRisk (2022)
[8] Recreational exposures for Pb based on Bioavailability of this material presented Table 22 EnRisk (2022)

point (where AMD potential was evident), collect contaminated runoff within a prescribed catchment area and fencing to prevent access.

3. Paddock Shaft Area (surface soils comprise Category 3) Strip area of sulfidic material to 200 mm, place material within Mt Stewart contaminated water catchment (estimated volumes 70m^3).[9]

4. Grosvenor general area (surface soils comprise Category 2)–Leave in-situ and fence due to location of shafts and mineralised workings.

5. Grosvenor Dam (surface soils comprise Category 3)– Excavate and send material offsite for disposal in a licenced waste disposal facility.

6. Mt Stewart Drainage (surface soils comprise Category 3) – Excavate and send material offsite for disposal in a licenced waste disposal facility.

7. Install rural fencing around areas where grazing should be managed in accordance with the prescribed limitations included in the site EMP. This would include limiting access of livestock to the site for 2 months per annum.

An overview of the adopted remedial strategies by domain are shown in Figure 13 and Figure 14. It should be noted that whilst minor exceedances of COPC occur in isolated occurrences outside prescribed restricted grazing areas, these are not considered significant. In addition, it is assumed that individual cattle would not graze in the TSR for more than 2 months per year. That is statistical analysis of the dataset was conducted in all areas proposed for grazing as provided in Appendix D. The 95% UCL of mean lead concentration was calculated at 173 mg/kg (below the grazing criterion for Sheep under a 2-month grazing scenario), the standard deviation (114 mg/kg) was less than half the criterion and the maximum concentration (73 mg/kg) was less than 250% of the criterion. As such, the extent of proposed fencing (as shown on Figure 14) will be adequately protective of livestock when allowed to graze for a maximum period of 2 months per year and any isolated exceedances of lead criterion are not considered to pose an unacceptable risk.

[9] The volume calculations presented here as estimates based on site observations undertaken during field works conducted by Okane, 2022. Validation that contaminated materials have been removed are required and are discussed in Section 6.2.2.

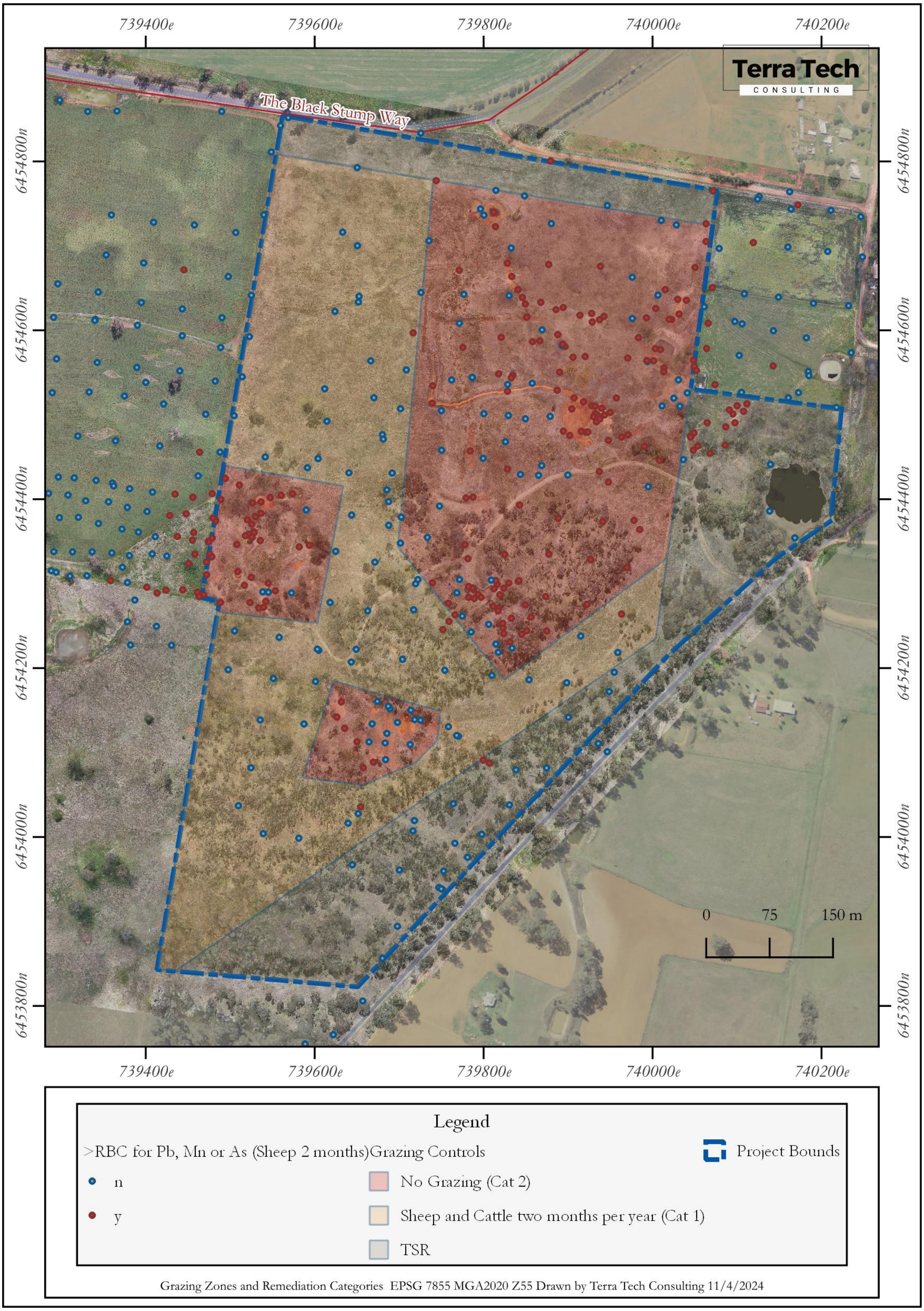

Figure 13 Remedial Extents – Grazing Restrictions

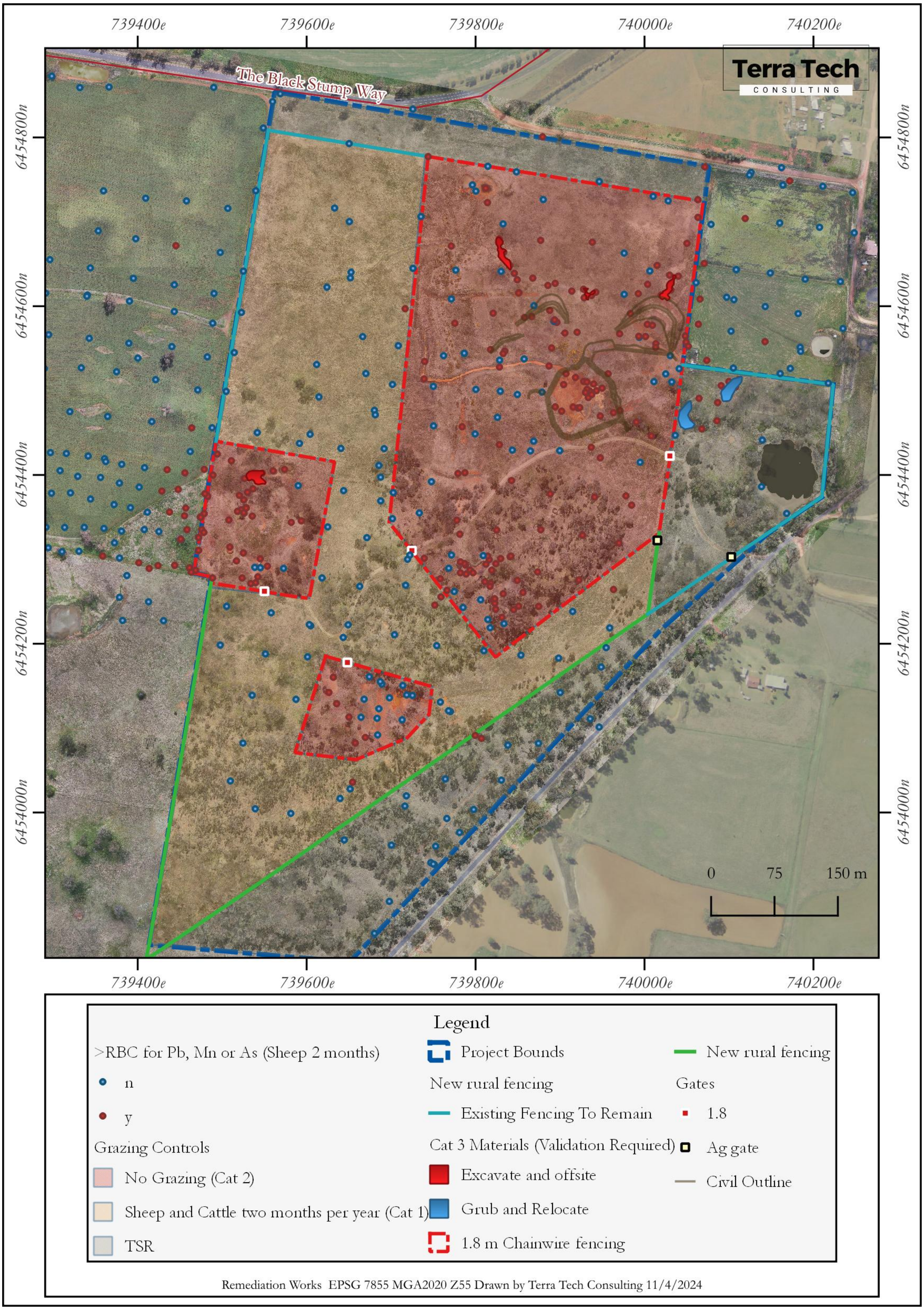

Figure 14 Remediation Extents – Fencing and Civils

5.4 Regulatory Policy of Remediation

5.4.1 State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007

The plans for remediation of the Site fall under SEPP 2007, which holds precedence over LEPs, as detailed in Part 1, Section 5 (3) of the Policy. This section asserts that in cases of inconsistency between this Policy and other environmental planning instruments, the Policy takes precedence.

Subclause 4 specifically excludes certain State Environmental Planning Policies from this rule, namely (a) *State Environmental Planning Policy (Major Projects) 2005* and (b) *State Environmental Planning Policy (Coastal Management) 2018*. Notably, the proposed mine rehabilitation area lacks coastal wetlands, littoral rainforests, or ongoing major projects.

SEPP's Clause 10(3) exempts development for minimal environmental impact on approved mine sites, petroleum production facilities, or extractive industry lands. This exemption includes demolition aligned with the Australian Standard AS 2601—2001 for structures not classified as heritage items or within heritage conservation areas. While the proposal would not be considered exempt under the SEPP, regarding Cl.6(b), development may be carried out without development consent for:

(a) rehabilitation, by or on behalf of a public authority, of an abandoned mine site

5.4.2 Other Approval Requirements

Whilst the SoW of this RAP does not include an assessment of approval requirements beyond identifying the potential eligibility of the works to be development exempt per the MPPEI SEPP (2007), it should be noted that a range of other environmental and planning legislation may apply to the works. These include:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Biodiversity Conservation Act 2016*
- *NSW Native Vegetation Act 2003*
- *NSW Heritage Act 1977* and the *Commonwealth Australian Heritage Council Act 2003*

Although a Review of Environmental Factors (REF) has been previously completed, remedial goals, their extent and nature have changed. Therefore prior to the works described herein being implemented, it is recommended that that the previous REF (Lesryk, 2022) be reviewed and revised if required to consider approval requirements for prescribed works within the context of applicable legislation and approval requirements.

6 REMEDIATION WORKS

6.1 Description of Design Methodology for Drainage Network

Scheduling and specific methodology for the construction of the drainage network should be provided by the nominated Principal Contractor. This section provides an overview of the materials required for construction of the design. Further details are included in the Drawings provided and associated Bill of Quantities (Appendix A and Appendix C). The design has been developed to ensure that all works including those conducted by heavy plant can be executed without use of heavy plant within geohazard zones. Refer to Section 7.4 for specific recommendations provided in GHD (2023a).

A series of diversion bunds will be developed to convey unimpacted water around the Mt Stewart zone. Within the geohazard zone, a separate contaminated (dirty water) catchment will be developed and the resulting flows to be routed via a network of diversion bunds to their respective containment dams for each area. Flows from clean water catchments are proposed to be routed via a network of diversion bunds and dispersed over non contaminated ground to the downstream reaches of the catchment.

The diversion bunds have been designed to convey runoff up to and including the 1% Annual Exceedance Probability (AEP) storm event. A minimum 300mm freeboard has been allowed for to account for silt up of the channel and the potential for damage from fauna over time.

The containment dams have been designed utilising continuous rainfall simulation utilising ‘MUSIC’ software. The rainfall data used in the model was sourced from the Bureau of Meteorology (BoM) for the Dunedoo Post Office rain gauge. Potential evapotranspiration data was sourced from the BoM for the Dunedoo area and was included in the model. The containment dams have been designed to empty over time via evapotranspiration after ‘frequent’ rainfall events (i.e 20% AEP storms and lower). The remaining storage volume in the Dam following ‘frequent’ rainfall events is sufficient to contain the 2% AEP design rainfall event without the dams overtopping.

For more severe rainfall events. i.e the 1% AEP rainfall event the dams may overtop via a spillway. The spillway has been designed to convey the 1% AEP flow event with rock scour protection to withstand the velocity of the flow and maintain the integrity of the dam bunds. The overtopping flow is controlled to reduce velocity of the flow to a level below the scour velocity of the downstream ground cover.

6.1.1 Overview of Construction Methodology for Drainage Network

The drainage management system including the diversion bunds, dam bunds and drainage channels are to be constructed out of borrow material soils sourced from borrow areas. The location of the drainage management system components has been placed to avoid construction work over geohazard locations. There are features which occur within the geohazard zone including bunds however placement of 3 m bunding width in this zone is achievable without placement of heavy plant on the zone via use of excavator reach from areas where geohazards do not occur in the subsurface. This will require demarcation of geohazard zones as discussed in Section 7.4.

The dam bunds are to be constructed out of low permeability soils sourced from borrow area designated as containing low permeability soil. The construction of the dam bunds are to be in accordance with the details provided on drawing C10. The toe of the dam bunds are to be protection by rip-rap scour protection underlain by non-woven geotextile.

The diversion bunds are to be constructed out of borrow materials sourced from the borrow area designated as containing ‘store and release’ materials. The construction of the diversion bunds are to be in accordance with the details provided on drawing C10. The toe of the bunds and invert of the diversion channel are to be protected by rip-rap scour protection underlain by non-woven geotextile. Concrete pits and uPVC pipes are proposed where required to drain trapped low points caused by the bund construction.

6.1.2 Scour Protection

As detailed in C01 (Appendix A) The following specifications apply to construction of contaminated catchment dam at Leadville:

- The thickness of the rip-rap protection shall be a minimum of the D50 stone size specified on the drawings. the stone shall be well graded in accordance with the table provided in drawing C01.
- Rock is to be hard, dense, durable, resistant to weathering and angular shape.
- It shall be free from overburden spoil, shale and organic matter. rock that is laminated, fractured, porous or otherwise physically weak is unacceptable.
- The properties of the rock shall be in accordance with AS2758.6 specification. For erosion control to the satisfaction of the principal’s representative.
- An approximate guide to stone shape is that breadth or thickness of a single stone should be not less than one-third its length. round material can be used as rip rap provided it is not placed on slopes greater than 3h:1v.
- Geotextile under rock filled mattress and rip-rap to be in accordance with TFNSW specification R63.
- Rocks and boulders to have total unit weight of 21 to 27kn/m3.
- All riprap specified on the drawings are placed rocks.

6.1.3 Dam Construction

As detailed in C01 (Appendix A) The following specifications apply to construction of contaminated catchment dam at Leadville:

- The base of the embankment should be stripped of all topsoil, silt, loose material, vegetable matter, and then scarified over its whole area.
- Topsoil is to be stripped to be a minimum 200mm to expose sub-grade and stockpiled in an appropriate location to be managed by the contractor.

- All fill material for the embankment should be placed in layers (or lifts) no greater than 150mm thick.
- The largest size particle should not be greater than 1/3rd the height of the lift, that is, 50mm.
- Each layer should be thoroughly compacted before the next layer is placed. A minimum of 6 passes to achieve the required compaction effort is generally required by a suitable machine (see below).
- The compaction effort achieved should be on average 98% standard maximum dry density (MDD) (non-structural fill) as in context to modified MDD (structural fill) as per Australian standard: AS1289.0-2000 methods of testing soils for engineering purposes.
- The minimum compaction effort should be 95% standard MDD. The moisture content should be in the range of –1% to + 3% of optimum moisture content (OMC). if the material is too dry, water should be added. if the material is too wet it should be spread and mixed.
- Prepare the site under the embankment by ripping a minimum of 100mm to ensure bond between existing substrate and compacted fill. before each additional 150mm lift is added to the embankment, the preceding lift should be scarified to ensure that the two lifts are properly joined so that no natural paths for seepage are present that may result in dam failure.
- Maintain cut-off trench free of water.

6.1.4 Earthworks Specifications

As detailed in C01 (Appendix A) the following specifications apply to earthworks to be conducted during the remedial works prescribed in this RAP:

- Earthworks to be in accordance with AS3798, the referenced current Australian standards.
- Spoil to be reinstated on-site as per drawing spec.
- All topsoil fill to be taken from borrow area (store and release) on-site.
- Stripping of topsoil and vegetation should only be completed within the remediation work extent. vegetation should be pushed over (not chipped) and dragged (in manageable portions to a location on-site which does not impede safe ingress / egress or works. re-use cleared vegetation on re-vegetated areas as appropriate.
- All fill should be placed and compacted under level 1 supervision as specified in AS3798. the contractor to provide level 1 certification upon completion of earthworks.
- Topsoil to be excavated minimum 200mm to expose sub-grade & stockpiled.
- Sub-grade to be compacted and tested as specified. any soft or weak areas detected are to be excavated and replaced by compacted fill as per specification.

- Tests shall be undertaken on any proposed fill materials to ensure that they do not have a high dispersion potential as defined by the emerson crumb/dispersion tests (AS1289 C8-1980).
- All earthworks shall be tested and certified by a NATA. registered laboratory. all test certificates, accompanied by an overall site plan, clearly indicating the location of each test and fill areas etc., and the laboratory certificate covering the whole of the area tested are to be forwarded to the design representative upon completion.
- Unsuitable materials (e.g. loose rock or soft soil, roots or other organic materials) must be removed and replaced by approved engineered fill or as approved by the principal.
- Backfill materials should be free from any organic, plastic, metal, rubber or any other synthetic material, inorganic contaminants, dangerous or toxic material or material susceptible to combustion. materials should consist of naturally occurring or processed materials that are capable of being compacted in accordance with AS3798.
- Fill is to be sourced from identified areas. no fill is to be imported without notifying the principals representative for approval.
- Fill to be compacted to achieve a compaction (standard compactive effort) when tested in accordance with AS1289.5.1.1.
- In areas to be filled where the slope of the natural surface exceeds 1(v):4(h), benches are to be cut to prevent slipping of the placed fill material.
- All batters are to be scarified to a depth of 50mm to assist with adhesion of top soil to batter face.
- Provide minimum 100mm and maximum 200mm topsoil to all filled areas and all other areas disturbed during construction. topsoiled areas to be stabilised with seed as per specification after topsoiling and is to be watered to ensure germination.

6.1.5 Management of Borrow Materials

The fill material required for the construction of the drainage network and the remediation of excavated areas are proposed to be sourced from borrow areas (Figure 15). The methodology for the excavation of borrowed material is as follows:

- Strip surface by 200mm to remove topsoil and vegetation. Stockpile adjacent to borrow areas for reinstatement after completion of excavation.
- Excavate required borrow material volume and type up to a maximum depth of 1.5m from existing levels.
- Shape bulk earthworks levels to ensure free flow of water off the surface and safe batters back to existing levels.

- Reinstate stripped topsoil material in an even layer over the disturbed area and apply seed mix as prescribed in Table 18. Apply granular fertiliser to the disturbed area at the rates prescribed in Section 6.2.

Refer to Appendix A for earthworks designs.

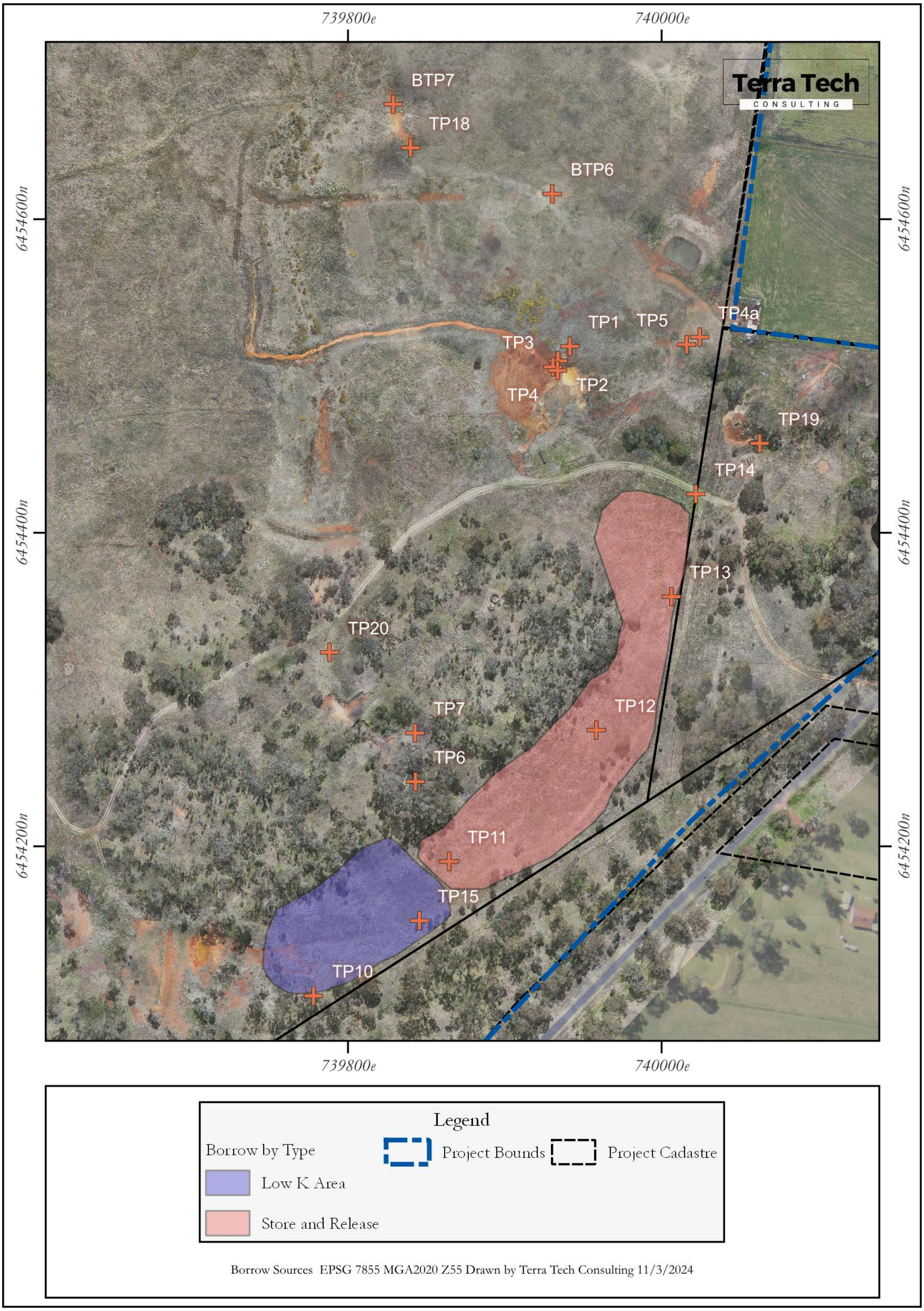

Figure 15 Borrow Areas by Type

6.2 Excavation and disposal of contaminated material

The remedial extents for excavation and offsite disposal are defined in Figure 16 and provided as .DXF for reference by the Remedial Works Principal Contractor'. The required methodology is as follows:

- Remove material to the depths and volumes prescribed for each location.
- Characterise the waste according to relevant state waste classifications (EPA, 2014) for NSW or DES, 2021)[10] prior to acceptance at licenced waste facility. (See Section 6.2.1)
- Dispose to a licenced waste disposal facility in accordance with applicable legislative requirements for transport and disposal of waste in nominated jurisdiction.
- Reinstate the void with borrow material sourced from the borrow area (Shown in Figure 15)
- Traffic compact and rip reinstated areas to surrounding surface RL.
- Apply the seed mix prescribed in Table 18 to the area disturbed. Seed should be mixed with a sand broadcast medium at a rate of 2.1 kg seed mix /250 kg and the mixture applied at a rate of 252 kg (sand and seed mixed) per Ha.
- Apply granular fertiliser to the disturbed area at the following rates (DPI, 2005)
    - Nitrogen (N): Around 40-60 kg/ha
    - Phosphorus (P): Approximately 20-30 kg/ha.

Table 18 Seed Mix for Revegetation of Excavated Areas

Species	Rate g/Ha
Any combination of the following species to 20 %: *Acacia buxifolia* *Acacia implexa* *Acacia paradoxa* *Acacia decora* *Acacia implexa*	100 g/ha
Any combination of the following species to 30 %: *Poa sieberiana* *Themeda australis* Rytidosperma spp Austrostipa spp. Austrodanthonia spp Aristida ramosa Aristida personata Cymbopogon refractus,	2000 g/ha

[10] As defined by Schedule 9 of the Environment Protection Regulation (QLD) 2019

6.2.1 Indicative Waste Classification for Materials to be Removed Offsite

During development of conceptual designs for consideration by the Principal TTC compared existing total metals and leachate data[11] against NSW Waste Classification Guidelines. Indicative classification has been provided in Table 19. The remedial works Principal Contractor will be responsible for classification of waste in accordance with the requirements of the licenced waste disposal centre which is designed and approved to accept relevant waste.

Table 19 Indicative Waste Classification Guidance for material to be disposed of offsite.

Domain	Max total Pb (mg/kg)	Max Pb (TCLP) (mg/L)	Max total As (mg/kg)	Max As (TCLP) (mg/L)	Max total Cd (mg/kg)	Max Cd (TCLP) (mg/L)
Mt Stewart Drainage	51800	13.5	541	0.006	15.1	0.192
Grosvenor Dam	48000	11.9	1130	0.205	24.5	0.0848
SCC1/TCLP 1	1500	5	500	5	100	1
SCC2/TCLP 2	6000	20	2000	20	400	4
Mt Stewart Drainage	Indicative Waste Classification per NSW EPA (2014) - Hazardous Waste					
Grosvenor Dam	Indicative Waste Classification per NSW EPA (2014) - Hazardous Waste					

6.2.2 Volumes and Location of Contaminated Materials to be Removed.

Figure 16 provides a plan view of required excavation extents. Each of the areas designated for offsite disposal should be excavated to the prescribed volumes and disposed of to a licenced waste disposal facility, material to be excavated should include heterogenous of fill material. Excavations should be ceased at the natural-fill boundary. These locations include:

Grosvenor Dam:

Excavate 44.5 m^3 to 0.5m within the prescribed boundary and transport material offsite for disposal in a licenced waste disposal facility.

Mt Stewart Drainage:

MTS1: – Excavate 196 m^3 to 0.9 m within the prescribed boundary and transport material offsite for disposal in a licenced waste disposal facility.

MTS2: – Excavate 58.4 m^3 to 1 m within the prescribed boundary and transport material offsite for disposal in a licenced waste disposal facility.

[11] Noting the leachate methodology Okane adopted does not comply with the requirements for TCLP as prescribed in EPA (2014) and is considered indicative

MTS4: – Excavate 44.5 m^3 to 0.3m within the prescribed boundary and transport material offsite for disposal in a licenced waste disposal facility.[12]

Paddock Shaft:

Strip area of sulfidic material to 200 mm (150m^3), place material within Mt Stewart contaminated water catchment.[13]

[12] MTS3 will remain in situ – this material is within the contaminated water catchment and is not interpreted to extend as fill below surface.
[13] Provided the area can be validated in accordance with the guidance set out in Section 8 of this document no ongoing management or grazing restriction in this area is required.

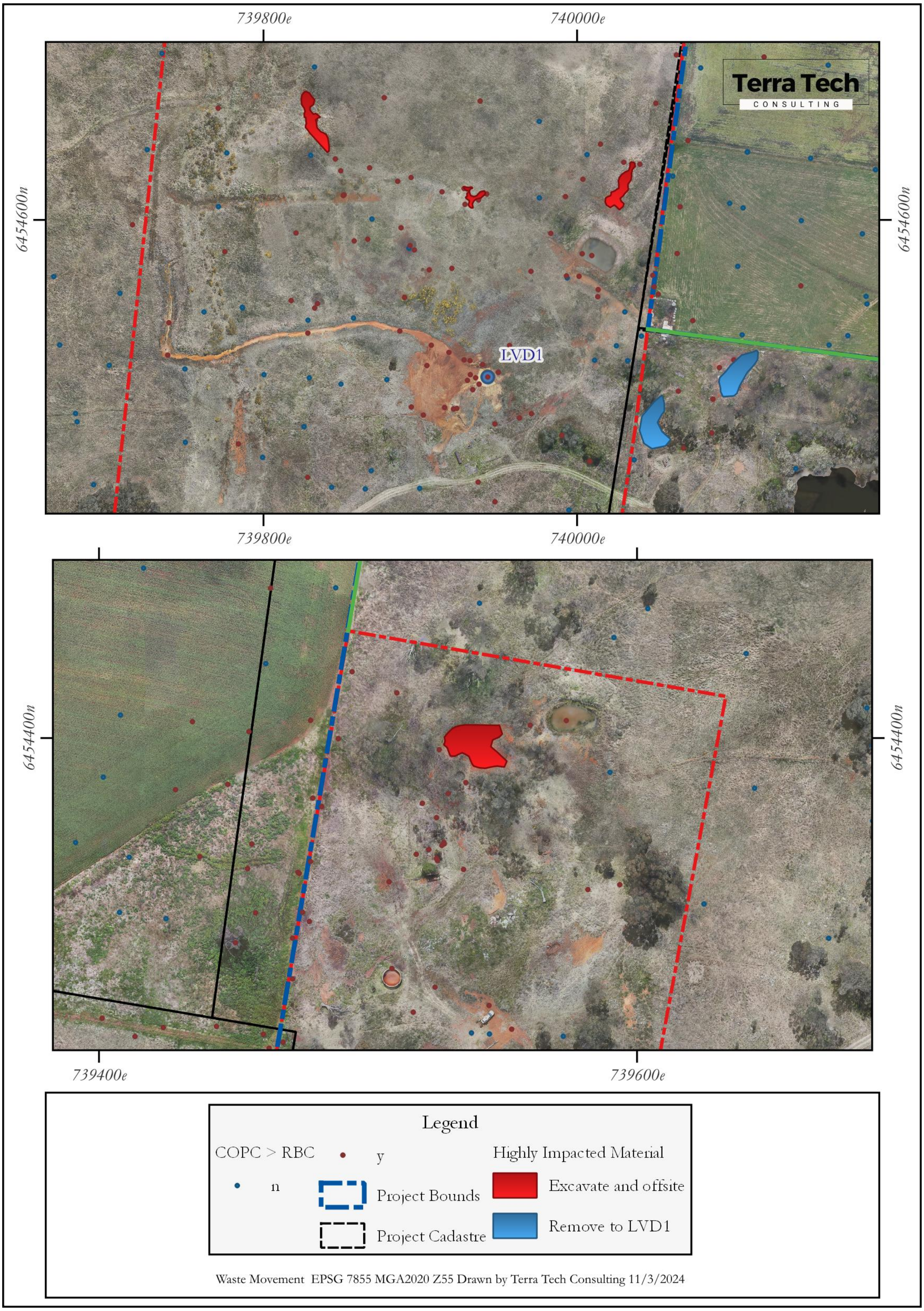

Figure 16 Locations where excavation and/or offsite disposal is required.

6.2.3 Materials Classification, Excavation and Offsite Disposal

Prior to disposal at a licenced waste disposal facility, waste must be classified according to the relevant state waste classification guidance. Relevant guidance may include:

- *Schedule 9 of the QLD Environmental Protection Regulation 2019.*
- EPA Waste Classification Guidelines (EPA, 2014*)* in accordance with Schedule 1 of the *Protection of the Environment Operations Act 1997 (POEO Act):*

6.3 Fencing

Fencing of the site is prescribed as an effective deterrent from access by third parties and incidental access and uptake by livestock and other fauna which may be consumed by humans. The nominated alignment is shown in Figure 14. Gates on the fencing are prescribed for access by land managers as needed, specifications are shown in C01.

7 REMEDIATION MANAGEMENT

7.1 Environmental Management Plan

Since this RAP proposes on-site containment of contamination, it necessitates the development of an Environmental Management Plan (EMP) specific to the site. This plan should outline its objectives and cover:

- Details regarding the remaining contamination on-site and its nature and location.
- Strategies for long-term site management ensuring continual protection of human health and the surrounding environment, both on and off the site. This would include monitoring of erosion, water quality and any evidence of phytotoxicity caused by contamination.
- Clear mechanisms for monitoring enforcement.
- Additionally, the environmental management plan should demonstrate its feasibility for long-term implementation and acknowledge the potential consequences of inadequate execution during its formulation. It must provide comprehensive details and clarity about the site and necessary actions, making it easily comprehensible as a standalone document (NSWEPA, 2020).: The EMP would also include measures for monitoring performance of the adopted remedial strategies in relation to achieving land use goals.
- Monitoring of the integrity of drainage features.
- Monitoring of the integrity of fencing and access controls.

7.1.1 Long term performance monitoring

The catchment dams have been designed to withstand and accommodate a 1:50 year ARI for 168 hours. Where the dam overtops under a severe storm scenario (> 1: 50 years) there is potential for contaminated water (although significantly diluted) to overtop and deposit contaminated sediment north of the dam wall on Lot 7304 DP 1152229 In addition, an event of this magnitude may cause minor erosion to the bunds. It is recommended that that a monitoring plan for competence of the drainage system and intermittent monitoring of surface sediment North of the dam be developed and implemented during other site management works including fire control measures and routine maintenance.

7.2 Construction Environmental Management

A Construction Environmental Management Plan (CEMP) for the remediation works will be required to ensure site works comply with relevant environmental legislation and mitigate potential impacts to offsite receptors. It will be the responsibility of the Remedial Works Principal Contractor to provide, install, monitor and maintain the environmental control measures established onsite. Inclusions for the CEMP should include, but not limited to:

- Protocols for handling contaminated waste (category 3).
- Soil management procedures such as limiting the height of topsoil stockpiles.

- Characterisation of imported and exported materials.

- Approved hours of work.

- Traffic management measures to be implemented to ensure safe operation of plant and ingress and egress from the site.

- Dust, Noise and Water Quality management measures to ensure compliance with relevant environmental legislation applicable to construction sites in NSW.

- Erosion and sediment control measures to eliminate the potential for offsite migration of material during construction.

- Management protocols measures designed to protect native vegetation and heritage features.

7.3 Management of Heritage Items

Should any items potentially tied to European or Aboriginal cultural heritage be discovered during the project, a precise protocol for unexpected archaeological findings needs immediate implementation. All operations within this area must cease, and a certified archaeologist must be engaged to conduct a thorough assessment. If this assessment identifies the exposed remains as 'relics,' as defined by the *NSW Heritage Act 1977*, prompt notification to the Heritage Division of the Department of Primary Industries and Environment is necessary, in accordance with Section 146 of the *Heritage Act.*

7.4 Works Near Geohazards

GHD (2023a) identified the presence of a number of relict mining features including underground workings which present a risk to safe surface operations. The RAP presented herein has been designed in consideration of these hazards, which are presented in Table 20. These locations should be demarcated and avoided during works.

In addition to shaft, underground workings and associated subsidence risk zones were identified by GHD (2023b) – shown in Figure 1. For full details of the areas of potential subsidence and geohazard risk, refer to GHD (2023b).

In accordance with the advice presented by GHD, the following measures should be implemented by the Remedial Works Principal Contractor when engaged in undertakings at site:

- **Risk assessment and risk mitigation advice: "***The PWC is advised to retain the services of a Geotechnical Engineer or Engineering Geologist experienced in mine subsidence and risk assessment to assist with documentation prior to commencement, risk assessments, risk mitigation measures as well as assisting with identifying and responding to changes in site conditions."*

- **Training, induction and awareness "***People entering the work site must be inducted and made aware of hazards. Incorporating explanation of mine subsidence hazards and their locations into site inductions and daily pre-work meetings is recommended. More detailed and up to date information should be* *provided in active work areas. Training should include how to recognise and report subsidence. Showing people the locations of hazards, in person, is recommended rather than relying on maps or photos.*

- **Delineation of hazard zones (fencing) and administrative controls "***The hazards zones presented in the figures in Appendix A (or amendments of them approved by LMP) should be delineated with flagging and/or fencing with signage. Access into these areas should be restricted with administrative controls such as, but not limited to:*

  - *At least daily pre-work inspection and clearance.*
  - *Change identification and reporting protocols.*
  - *No working alone.*
  - *Supervision by suitable experienced personnel*
  - *Restrictions on people on foot*
  - *Restrictions on light vehicle access and speed*
  - *Restrictions on plant and heavy vehicles*
  - *Restrictions on equipment and material storage*
  - *Restrictions on activities (e.g. no crane lifts, no excavation, no water storage)*
  - *Limiting duration spent within hazard zones.*
  - *Cessation of work during or immediately preceding heavy rainfall and poor visibility*

  Where site personnel change, knowledge on recent observations and hazard controls should be transferred. The delineation of hazard zones should be based on the actual observable feature where it is visible rather than locations scaled off plans or coordinates taken from spatial databases or this report. Where not visible, the coordinates extracted from this report can be used.Flagging fencing should surround the hazard zone with the addition of at least a 1 m wide buffer. For example, fencing around a 3 m diameter hazard zone would be at least 5 m in diameter.

Table 20 Identified Shaft Locations

Area	Shaft label	Easting (m)	Northing (m)	Estimated accuracy (m)[1]
Mount Stewart Western Lode	Western Shaft	739879	6454560	± 4.0
	Shaft to 90' level	739890	6454551	± 1.5
	Shaft to 50' level	739901	6454568	± 1.5
	unnamed shaft to north	739910	6454596	± 4.0
Mount Stewart Main/ Lode	No.1 South Shaft	739873	6454465	± 4.0
	Engine Shaft	739922	6454478	± 1.5
	No.1 Shaft	739939	6454486	± 4.0
	No.2 Shaft	739974	6454498	± 4.0
	No.3 Shaft	740024	6454510	± 4.0
	No.4 Shaft	740039	6454516	± 4.0
	No.2 Rise (surface)	739953	6454500	± 4.0
Mount Stewart Paddock Lode	No.1 Paddock Shaft	740101	6454478	± 1.5
	No.2 Paddock Shaft	740113	6454500	± 4.0
	No.3 Paddock Shaft	740048	6454469	± 1.5
Grosvenor	Rabbit Shaft	739482	6454313	± 4.0
	Wheat Shaft	739498	6454325	± 4.0
	No.1 Shaft	739537	6454337	± 4.0
	No.2 Shaft	739562	6454314	± 4.0
	No.3 Shaft	739545	6454287	± 1.5
	No.4 Shaft	739485	6454302	± 1.5
	No.5 Shaft	739566	6454357	± 1.5
	#103	739537	6454322	± 1.5
	#104	739540	6454325	± 1.5
Extended	Western Shaft	739595	6454141	± 4.0
	Copper Shaft	739633	6454133	± 1.5
	Blind Shaft	739621	6454125	± 1.5
	Engine Shaft	739665	6454113	± 1.5
	Marshall's Shaft	739720	6454098	± 1.5

7.5 Other Safety Considerations

The SoW has not included the development of Workplace Health and Safety protocol in regard to undertaking the works prescribed in the RAP. The Leadville site contains elevated levels of heavy metals which may exceed the relevant exposure standard. The ESP must prepare appropriate WHS controls in accordance with state and federal legislation to be protective of workers and the community. The advice provided herein is general in nature, the specific requirements of WHS plans should be developed in consideration of relevant legislation and guidance.

7.5.1 General Considerations

A workplace health and safety (WHS) plan is an essential part of all remediation projects to manage the health and safety of all personnel working on or visiting the site. A detailed WHS plan will be prepared by the ESP for the works prior to the commencement of any site activity. The WHS plan is to be developed in accordance with the relevant regulatory guidelines.

The purpose of the plan is to provide all relevant health and safety information for all personnel undertaking work at the site and to provide and maintain safety standards and practices which offer the highest practical degree of personal protection to the on-site workers, based on current knowledge. The plan will recognise the legislative obligations of the Remedial Works Principal Contractor.

All personnel must read the plan and confirm acceptance of its requirements prior to commencing work at the site. The information provided by the plan shall include:

- Induction requirements;
- Assignment of responsibilities;
- A discussion of site conditions;
- Details of the work;
- Identification of on-site and off-site hazards;
- Assessment of the potential risks associated with identified hazards;
- Procedures to eliminate, or if not possible, control the potential risks;
- Establishment of personnel protection standards and mandatory safety practices and procedures;
- Establishment of WHS monitoring protocols;
- Training and responsibilities of emergency team members;
- Evacuation procedures and emergency drills;
- Emergency information;
- Incident reporting;
- Provision for contingencies that may arise while operations are being conducted during the project; and
- Procedures to ensure that the Remedial Works Principal Contractor consults with, co-operates with, and co-ordinates its activities with the Principal (and with any other person or entity having concurrent health and safety duties arising out of the remediation works)

8 SITE VALIDATION

8.1 Data Quality Objectives

Data quality objectives (DQOs) have been developed for site validation to confirm remediation meets the required objective.

8.1.1 State the Problem

The site is proposed to be used for agricultural purposes (grazing of livestock for a maximum period of 2 months per year). Previous investigations have identified environmental impacts at the site require remediation in order to address potential unacceptable risks to future site receptors and address off-site migration of impacts (refer to Section 4). As such, a set of environmental data are required to verify that remediation works as documented in Section 6 have been implemented in a manner which causes potential risks associated with contaminated site media to reduce to low and acceptable levels.

8.1.2 Identify the Decision

The following decisions will need to be satisfied through the course of the remediation works:

- Have contaminated soils been remediated to a level that mitigates the potential for off-site migration of contamination to the extent practicable?
- Have contaminated soils been remediated (via isolation) to remove unacceptable health risks to future site receptors and allow for grazing across the balance of the site for a maximum period of 2 months per year?
- Were the impacted/surplus materials classified and disposed off-site to a facility licensed to accept the classified waste?
- Has all material imported to site as part of remediation activities been demonstrated as suitable for use?
- Is the site suitable for the proposed use subject to ongoing implementation of the LTEMP?

8.1.3 Identify Inputs to the Decision

The inputs to the decisions are:

- Previous investigation results as discussed in Section 3;
- The proposed land use and site features;
- Field observations in relation to inspection of all excavation bases, walls, stockpiles and final site surfaces for signs of potential contamination;
- Environmental data as collected from the validation of remedial excavations;
- Material characterisation data obtained during assessment of surplus material prior to off-site disposal;

- Disposal dockets and relevant documents in relation to appropriate disposal of material (if required) to be removed from site as part of the remediation works (landfill dockets, beneficial reuse / recycling dockets, trade waste disposal, etc.);
- Material characterisation data (including field observations, sampling and analytical data) obtained during assessment of material proposed to be imported to the site;
- Survey information on the height and lateral extent of the drainage features and areas of containment;
- Relevant guideline criteria for validation and waste classification;
- Management measures documented within a Long term Environmental Management Plan (LTEMP) to be prepared for the site following remediation to ensure the site remains suitable for the proposed use; and
- Data quality indicators (DQIs) as assessed by quality assurance / quality control (QA/QC).

8.1.4 Define the Study Boundaries

The validation study boundaries are restricted to the lateral extent of the site as shown on Figure 1. The vertical extent of the validation study is anticipated to be restricted to soils extending to the maximum depth of disturbance as part of remediation.

Ultimately the study boundaries will comprise the lateral and vertical extent of the site successfully validated in accordance with the requirements of this plan. The temporal limits of the assessment will comprise the duration of the remedial works and validation program.

8.1.5 Develop a Decision Rule

The decision rules adopted to answer the decisions identified in Section 8.1.2 are summarised following:

- *Have contaminated soils been remediated to a level that mitigates the potential for off-site migration of contamination to the extent practicable?*

  At the completion of remediation works, highly impacted soils (identified as Category 3 in Section 6) will have been remediated via excavation and off-site disposal or via the construction of surface water diversion bunds (in areas of geohazards). In instances of off-site disposal, soil samples collected from the base of remedial excavations and where the validation results meet the adopted validation criteria, then the answer is Yes. In instances of surface water diversions, if site observations (inspections and photographs) and site surveys are available to demonstrate that they have been appropriately installed in accordance with this RAP, then the answer is Yes.

  If there is uncertainty as to the above, then the answer is No.

- *Have contaminated soils been remediated (via isolation) to remove unacceptable health risks to future site receptors and allow for grazing across the balance of the site for a maximum period of 2 months per year?*

At the completion of remediation works, fencing will have been installed to restrict access to areas (containing impacted media identified as Category 2 in Section 6). If site observations (inspections and photographs) and site surveys are available to demonstrate that fencing has been appropriately installed in accordance with this RAP, then the answer is Yes.

If there is uncertainty as to whether these measures have been installed where required at the site, then the answer is No.

- *Were the impacted/surplus materials classified and disposed off-site to a facility licensed to accept the classified waste?*

  Soil analytical data will be compared against EPA (2014) criteria. Statistical analysis (comprising a review of 95% UCL of the mean, standard deviation and maximum values of dataset) of the data in accordance with relevant guidance documents will be undertaken, where appropriate, to facilitate the decisions (as detailed above). Documentation from the operation receiving the material including the dates, tonnage and classification of the accepted material will be required to facilitate the decision. If the statistical criteria stated above are satisfied, the decision is Yes, and if receipts are provided recording the disposal of material to an off-site licensed facility, the decision is Yes. If the material exceeds the criteria, and no disposal receipts are provided, the answer is No.

- *Has all material imported to site as part of remediation activities been demonstrated as suitable for use?*

  Analytical data sets and inspection data will be reviewed for each proposed material type/source against established definitions for acceptable material (i.e. VENM, resource recovery exemptions, etc) and EPA endorsed criteria as established in the RAP as validation criteria. If the complete data set for the applicable material meet the requirements relevant to the material type, the answer to the decision is Yes and material may be imported to site. If the data set exceeds the adopted criterion, the answer to the decision is No and the material cannot be imported to site for use in development activities.

- Is the site suitable for the proposed use subject to ongoing implementation of the LTEMP?

  If the answer to all the previous decision rules is Yes, then the answer to the decision is also Yes. Otherwise, the answer to the decision is No. In this instance further remediation/ management actions will require to be implemented and appropriately documented such that a future review of the above decisions may result in a different decision outcome.

8.1.6 Specify the Limits on Decision Error

This step is to establish the decision maker’s tolerable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data. Data generated during this project must be appropriate to allow decisions to be made with confidence.

Specific limits for this project have been adopted in accordance with the appropriate guidance from the NSW EPA, NEPC (2013) and appropriate indicators of data quality (DQIs used to assess quality assurance / quality control)/

To assess the usability of the data prior to making decisions, the data will be assessed against pre-determined DQI) established for the project as discussed below in relation to precision, accuracy, representativeness, comparability and completeness (PARCC parametres). The acceptable limit on decision error is 95% compliance with DQIs.

The DQIs and data assessment criteria are summarised following:

- **Precision** - measures the reproducibility of measurements under a given set of conditions. The precision of the laboratory data and sampling techniques is assessed by calculating the Relative Percent Difference (RPD) of duplicate samples.
- **Accuracy** - measures the bias in a measurement system. The accuracy of the laboratory data that are generated during this study is a measure of the closeness of the analytical results obtained by a method to the 'true' value. Accuracy is assessed by reference to the analytical results of laboratory control samples, laboratory spikes and analyses against reference standards.
- **Representativeness** – expresses the degree which sample data accurately and precisely represent a characteristic of a population or an environmental condition. Representativeness is achieved by collecting samples on a representative basis across the site, and by using an adequate number of sample locations to characterise the site to the required accuracy.
- **Comparability** - expresses the confidence with which one data set can be compared with another. This is achieved through maintaining a level of consistency in techniques used to collect samples; ensuring analysing laboratories use consistent analysis techniques and reporting methods.
- **Completeness** – is defined as the percentage of measurements made which are judged to be valid measurements. The completeness goal is set at there being sufficient valid data generated during the study.
- **Sensitivity** – expresses the appropriateness of the chosen field and laboratory methods, including the limits of reporting, in producing reliable data in relation to the adopted site assessment criteria.

8.1.7 Validation Inspections and Sampling

The validation inspections, sampling and analysis required for remediation areas are summarised in Table 21 below.

Table 21 Validation Inspection and Sampling Program

Item	**RAP Sampling Density**			**Analytical Suite**
Source Removal Excavation Validation				
	Excavation Floors	Excavation Walls	Materials	
Excavations formed to remove Category 3 Materials	1 / 100 m^2 (10 m grid)	1 / 10 m (from each distinct horizon or material type or 1 m vertical soil profile)	N/A	Total heavy metals and ASLP heavy metals
Materials Importation				
Imported VENM	Minimum of 3 samples per source site / material type to 500 m^3 then 1 sample per 500 m^3 thereafter			TRH/BTEX PAH Heavy Metals OCP/PCBs Asbestos (500 ml)
Quarry VENM Materials (e.g. blue metal, sandstone, shale)	Confirmation that the material is quarried rock (VENM) prior to importation, and visual confirmation.			Site Inspection required.

Item	RAP Sampling Density	Analytical Suite
Material subject to a NSW EPA Resource Recovery Order/Exemption	Confirmation by the supplier that the material meets the terms of the order. Then environmental consultant sampling at a minimum of 3 samples per source site / material type to 500 m^3 then 1 sample per 500 m^3 thereafter, prior to importation	TRH/BTEX PAH Heavy Metals OCP/PCBs Asbestos (500 ml)
Export of Materials		
Surplus waste materials for off-site disposal are to be classified in accordance with EPA (2014).	Stockpiled materials for off-site disposal require a minimum of 5 samples (up to 75 m^3) or a sample density of 1/25 m^3 to 200 m^3 (whichever is greater) Decreased sampling frequency to be justified on basis of stockpile homogeneity and risk of contaminants present.	Heavy metals and TCLP heavy metals

8.2 Validation Criteria

8.2.1 Site-won Materials

Risk-based validation criteria as derived in EnRisks (2022) for each of the constituent's requiring remediation in soil are summarised in Table 22.

Table 22 Summary of Risk Based Soil Criteria for Site Remediation

Contaminant	RBC (mg/kg)				
	Recreational exposures	Livestock Health (cattle – assuming 2 months grazing per year)	Livestock Health (sheep– assuming 2 months grazing per year)[14]	Livestock Health (cattle – assuming 12 months grazing per year)	Livestock Health (sheep– assuming 12 months grazing per year)
As	2,000	1,200	180	200	30
Pb	6,600	3,600	440	830	110
Mn	140,000	95,000	25,000	16000	4200

The site will be required to be validated as suitable for commercial / industrial land use pursuant to the NEPC (2013). With consideration of the preferred remediation approach (see Section 5), there have been no identified impacts that require remediation by excavation and removal by off-site disposal. Notwithstanding, the potential for encountering an unexpected find during site remediation works remains, in which there may be a requirement for excavation and removal of impacted materials, that would result in the requirement for the excavations to be validated. The appropriate validation criteria to be applied to the resulting excavations will be dependent on the nature of the impact and the remedial objectives of the excavation.

8.2.2 Imported Materials

With respect to imported materials, consideration will be given to validation criteria derived from the following:

- Health Investigation Levels (HILs) for recreational land use - HIL-C;
- Health Screening Levels (HSLs) for petroleum hydrocarbons considering potential for vapour intrusion, coarse grained soil for recreational land use at 0.0-1.0 m depth; and
- Ecological Investigation Levels (EILs) for recreational land-use.

[14] RBC (Sheep) for COPC are lower than cattle. Therefore, these criteria have been applied in defining the extents of grazing can occur without exposure to materials which exceed RBC.

Moreover, all imported materials will require confirmation that the materials meet requirements of the applicable Order/Exemption[15] as specific to the material proposed to be imported to the site.

8.2.3 Waste Disposal Off-site

All wastes requiring off-site disposal must be classified in accordance with Waste Classification Guidelines (EPA 2014). The Remedial Contractor is responsible for the lawful disposal of the classified waste to a licensed waste disposal facility lawfully able to accept the waste.

Disposal dockets for each individual off-site waste disposal load must be provided to the to the Remediation Consultant by the Contractor to demonstrate appropriate off-site disposal of waste occurred for site validation purposes.

8.3 Validation Reporting

At the completion of the remedial works, a validation report will be prepared in general accordance with the *Consultants Reporting on Contaminated Land Contaminated Land Guidelines* (EPA 2020), documenting the works as completed. The report will contain information including:

- Details of the remediation works conducted;
- Information demonstrating that the objectives of this RAP have been achieved, in particular the validation sample results and assessment of the data against both the pre-defined DQO and the remediation acceptance (validation) criteria;
- Information demonstrating compliance with appropriate regulations and guidelines;
- Any variations to the strategy undertaken during the implementation of the remedial works;
- Results of all environmental monitoring undertaken during the course of the remedial works;
- Details of any environmental incidents occurring during the course of the remedial works and the actions undertaken in response to these incidents;
- Verification of regulatory compliance;
- Details on waste classification, tracking and off-site disposal including landfill dockets;
- Photographic records of applicable remediation works;
- Survey data for all area subject to isolation (fencing) and surface water diversion systems; and
- Clear statement of the suitability of the site with respect to permissible land uses with references for ongoing management.

[15] https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/resource-recovery-framework/current-orders-and-exemption

9 LIMITATIONS AND ASSUMPTIONS

9.1 Limitations of Existing Scope of Works

This RAP has been developed on the basis of information and data made available to TTC and discussed herein. It is acknowledged that limited sampling and laboratory analyses were undertaken as part of previous investigations undertaken, as described herein. Conditions between sampling locations and media may vary, and this should be considered when extrapolating between sampling points. Chemical analytes are based on the information detailed in the site history. Further chemicals or categories of chemicals may exist at the site, which were not identified in the site history and which may not be expected at the site. Changes to the conditions may occur subsequent to the investigations described herein, through natural processes or through the intentional or accidental addition of contaminants. The conclusions and recommendations reached in this report are therefore based on the information obtained at the time of the investigations. Should information become available regarding conditions at the site including previously unknown sources of contamination, TTC reserves the right to review the report in the context of the additional information.

9.2 Use of XRF data.

This RAP was developed on the basis of available geochemical data provided by the Principal. TTC understands that XRF data was calibrated against ICP-MS for metals in accordance with the guidance provided in USEPA (2020). For COPC where the data returned an acceptable correlation (R^2 = > 79% for a particular analyte) between XRF data and ICPMS the XRF data was deemed reliable in providing an indication of the concentration for that COPC. The data provided is attached to this document as Appendix E.

9.3 Residual Environmental Risks

The remedial works aim to minimize the volume of water which could potentially mobilise contaminants from intersecting with contaminated media and remove media from site which is extremely elevated in total and leachable metals. This design is in alignment with the ALARP principle.

Given the presence of geohazards render remediation plans developed by Okane, (2021) for Mt Stewart technically impractical, associated revegetation is also impractical without extensive earthworks on the area. Gradient at Mt Stewart approach 40% in places and would require a revegetation strategy that adopts a geotechnical approach (rather than bulk earthworks) to neutralise acidity, install a suitable growth media and retain the amended substrate.

It is understood that the NSW EPA conducted a health risk assessment for the Leadville village and found no signs of adverse effect to air and water quality at premises under current site conditions.

In the future, should alternative remedial approaches be developed at Mt Stewart, then revegetation at the scaled areas of Mt Stewart could be achieved and would involve significant bulk earthworks including placing a capillary break layer to stop upwards migration of contaminants and salts to growth media.

9.4 Borrow Materials

In the 2020 field assessment led by Okane, an evaluation of the geotechnical properties of potential borrow materials was conducted. This assessment encompassed test pitting to a depth of 1.5 metres at intervals of 100 metres across a tree-free area exhibiting surface indications of clayey substances. Observations from the logs suggest a relatively consistent lateral uniformity of the material between test pits, with a higher concentration of finer materials observed around TP10. While some variability might be present within the borrow area, it is anticipated that achieving the required K_{sat} performance could be attained through material reworking involving dozing and compaction.

Field validation will be required to ensure that the prescribed drainage designs meet the specifications presented in IFC drawings and designs as prescribed in Section 8.1.3.

9.5 Workplace Health and Safety Protocol

The SoW has not included the development of Workplace Health and Safety protocol in regard to undertaking the works prescribed in the RAP. The Leadville site contains elevated levels of heavy metals which may exceed the relevant exposure standard. The ESP must prepare appropriate WHS controls in accordance with state and federal legislation to be protective of workers and the community. The advice provided herein is general in nature, the specific requirements of WHS plans should be developed in consideration of relevant legislation and guidance.

9.6 Work in or Near Geohazards zones.

It is acknowledged that the drainage network designed for Mt Stewart is in and around an area identified as including subsidence risk zones (GHD, 2023b). The designs have been developed in consideration of the requirement for heavy plant to avoid trafficking in these zones however, works plans developed by the Remedial Works Principal Contractor (for example on bund construction) should consider recommendations provided in GHD (2023b) relating to works around subsidence/geohazards zones (summarised in Section 7.4).

The development of safe work methods for construction of specified designs is the responsibility of the remedial works Principal Contractor. In addition, TTC accepts no liability for any safety issued encountered when the remedial works are performed. To ensure the nominated remedial works contractor has developed appropriate controls in consideration of the advice provided in GHD (2023b), it is recommended that that a geohazard management plan be developed and included in the execution SoW. This document will provide guidance as to the required safety management systems and measures to be implemented to safely construct the designs presented herein.

10 REFERENCES

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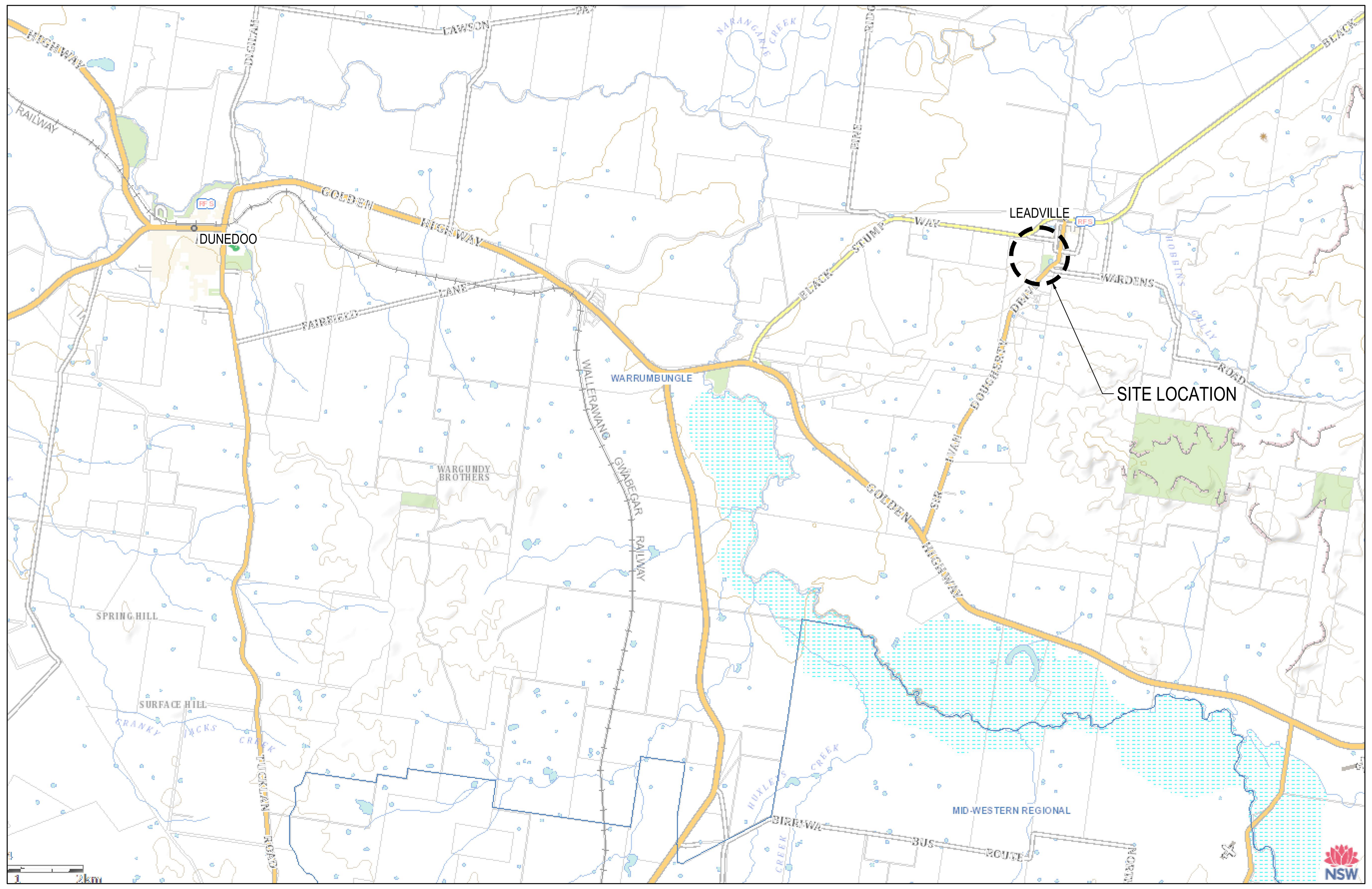
Appendix A

Drawings

ROC ENGINEERING DESIGN

LEGACY MINES PROGRAM
LEADVILLE MINE REMEDIATION



LOCALITY PLAN

DRAWING LIST

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

CLIENT

NSW GOVERNMENT

LEGACY MINES PROGRAM
DEPARTMENT OF REGIONAL NSW

ROC ENGINEERING DESIGN
Ph (02) 4244 4017
P.O. Box 216 Wollongong, NSW, 2520
Email info@rocengineering.com.au ABN 70 610 369 910

PROJECT
LEGACY MINES PROGRAM LEADVILLE MINE REMEDIATION

DRAWING TITLE
COVER SHEET AND DRAWING LIST

SCALE (A1)

JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C00	C

GENERAL

1. ALL WORKS TO BE UNDERTAKEN IN ACCORDANCE WITH CURRENT AUSTRALIAN STANDARDS AND WARRUMBUNGLE SHIRE COUNCIL'S SPECIFICATIONS.
2. ALL DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ALL OTHER CONSULTANTS DRAWINGS AND SPECIFICATIONS INCLUDING BUT NOT LIMITED TO ARCHITECTURAL, STRUCTURAL, HYDRAULIC AND LANDSCAPE.
3. DO NOT SCALE THESE DRAWINGS FOR DIMENSIONS.
4. THE CONTRACTOR SHALL PROVIDE SUFFICIENT NOTICE TO THE PRINCIPAL CERTIFYING AUTHORITY AND ENSURE ALL WORKS ARE INSPECTED TO ENABLE COMPLIANCE CERTIFICATES TO BE ISSUED.
5. RESTORE ALL PAVED, COVERED, GRASSED AND LANDSCAPED AREAS TO THEIR ORIGINAL CONDITION ON COMPLETION OF WORKS.
6. ALL SURVEY SETOUT TO BE BY A REGISTERED SURVEYOR.
7. CO-ORDINATES FOR SETOUT ARE MGA2020, THE SOURCE OF THE VERTICAL DATUM: PM2977 RL 420.314
8. VERIFY ALL DIMENSIONS AND EXISTING LEVELS AND CONDITIONS ON SITE PRIOR TO COMMENCING WORK.
9. SURVEY ACCURACY TO BE IN ACCORDANCE WITH TfNSW QA SPECIFICATION G71 TABLE G71.6

SERVICES

1. THE LOCATION OF EXISTING SERVICES SHOWN ON THE DRAWINGS ARE APPROXIMATE ONLY AND MAY BE INCOMPLETE. THE LOCATIONS HAVE BEEN OBTAINED FROM DATA SUPPLIED BY THE RELEVANT AUTHORITIES.
2. IT IS THE CONTRACTORS RESPONSIBILITY TO OBTAIN CLEARANCES FROM THE RELEVANT SERVICE AUTHORITIES PRIOR TO WORKS COMMENCING.
3. IT IS THE CONTRACTORS RESPONSIBILITY TO VERIFY THE LOCATION OF ALL EXISTING SERVICES PRIOR TO WORKS COMMENCING.
4. PROTECT AND MAINTAIN ALL EXISTING SERVICES TO BE RETAINED IN THE VICINITY OF THE PROPOSED WORKS.
6. NO MECHANICAL EXCAVATIONS TO BE UNDERTAKEN OVER COMMUNICATION, GAS OR ELECTRICAL SERVICES. HAND EXCAVATION ONLY IN THESE AREAS.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DAMAGE CAUSED TO EXISTING SERVICES AS A RESULT OF THE CONTRACTORS WORK.

REVEGETATION

1. SUBSTITUTION OF SEED SPECIES SPECIFIED SHALL BE SUBJECT TO APPROVAL BY PRINCIPALS REPRESENTATIVE.
2. PROTECT THE NEWLY SEEDED AREAS FROM TRESPASS AND TRAFFIC UNTIL THE GRASS IS WELL ESTABLISHED.
3. ALLOW FOR RE-SEEDING ALL AREAS WHERE GRASS FAILS TO GROW WITHIN 1 MONTH FROM THE DATE OF ORIGINAL SEEDING.
4. ALL REVEGETATED AREAS SHALL BE WATERED FREQUENTLY TO GERMINATION AND SUBSEQUENT GROWTH DURING THE CONTRACT PERIOD.
5. DISTURBED AREAS ARE TO BE SEEDED WITH ONE OF THE FOLLOWING SEED MIXES:
   ANY COMBINATION OF THE FOLLOWING SPECIES TO 20% MAX PER SPECIES AT A RATE OF 2.1kg/ha
   - ACACIA BUXIFOLIA
   - ACACIA IMPLEXA
   - ACACIA PARADOXA
   - ACACIA DECORA
   - ACACIA IMPLEXA

   ANY COMBINATION OF THE FOLLOWING SPECIES TO 30% MAX PER SPECIES AT A RATES OF 2.1kg/ha
   - POA SIEBERIANA
   - THEMEDA AUSTRALIS
   - RYTIDOSPERMA SPP
   - AUSTRISTIPA SPP
   - AUSTRODANTHONIA SPP
   - ARISTIDA RAMOSA
   - ARISTIDA PERSONATA
   - CYMBOPOGON REFRACTUS
6. THE SEED MIX SHALL BE MIXED WITH SAND BROADCAST MEDIUM AT A RATE OF 2.1kg SEED TO 250KG AND THE MIXTURE APPLIED AT A RATE OF 252kg/ha
7. APPLY GRANULAR FERTILISER TO THE DISTURBED AREA AT THE FOLLOWING RATES
   - NITROGEN - 40-60 kg/ha
   - PHOSPHORUS - 20-30 kg/ha

FENCING

1. FENCING TO BE IN ACCORDANCE WITH TfNSW BOUNDARY FENCES SPECIFICATION TS 01110:1.0 JAN 2022.
2. HINGED JOINT MESH FENCING IN ACCORDANCE WITH SECTION 4.2 OF THE BOUNDARY FENCES SPECIFICATION TS 01110:1.0 AND TfNSW DRAWING NUMBER CC0001-01.
3. GATES IN HINGED JOINT FENCING TO BE IN ACCORDANCE WITH TfNSW DRAWING NUMBER C0001-02 "BOUNDARY STOCK FENCE - GATES."
4. CHAIN LINK FENCING TO BE IN ACCORDANCE WITH SECTION 6.1 OF THE BOUNDARY FENCES SPECIFICATION TS 01110:1.0 AND TfNSW DRAWINGS CV 0285934.
5. GATES IN CHAIN LINK FENCING TO BE IN ACCORDANCE WITH TfNSW STANDARD DRAWING CV 0285939.

EARTHWORKS

1. EARTHWORKS TO BE IN ACCORDANCE WITH AS3798, THE REFERENCED CURRENT AUSTRALIAN STANDARDS.
2. STRIPPING OF TOPSOIL AND VEGETATION SHOULD ONLY BE COMPLETED WITHIN THE REMEDIATION WORK EXTENT. VEGETATION SHOULD BE PUSHED OVER (NOT CHIPPED) AND DRAGGED (IN MANAGEABLE PORTIONS TO A LOCATION ON-SITE WHICH DOES NOT IMPEDE SAFE INGRESS / EGRESS OR WORKS. RE-USE CLEARED VEGETATION ON RE-VEGETATED AREAS AS APPROPRIATE.
3. ALL FILL SHOULD BE PLACED AND COMPACTED UNDER LEVEL 1 SUPERVISION AS SPECIFIED IN AS3798 U.N.O. THE CONTRACTOR TO PROVIDE LEVEL 1 CERTIFICATION UPON COMPLETION OF EARTHWORKS.
4. TOPSOIL TO BE EXCAVATED MINIMUM 200mm TO EXPOSE SUB-GRADE & STOCKPILED.
5. PROOF ROLL EXPOSED SUBGRADE TO ACHIEVE THE MINIMUM COMPACTION SPECIFIED. ANY SOFT OR WEAK AREAS ARE TO BE EXCAVATED AND REPLACED BY COMPACTED FILL AS PER SPECIFICATION.
6. TESTS SHALL BE UNDERTAKEN ON ANY PROPOSED FILL MATERIALS TO ENSURE THAT THEY DO NOT HAVE A HIGH DISPERSION POTENTIAL AS DEFINED BY THE EMERSON CRUMB/DISPERSION TESTS (AS1289 C8-1980).
7. ALL EARTHWORKS SHALL BE TESTED AND CERTIFIED BY A N.A.T.A. REGISTERED LABORATORY. ALL TEST CERTIFICATES, ACCOMPANIED BY AN OVERALL SITE PLAN, CLEARLY INDICATING THE LOCATION OF EACH TEST AND FILL AREAS ETC., AND THE LABORATORY CERTIFICATE COVERING THE WHOLE OF THE AREA TESTED ARE TO BE FORWARDED TO THE DESIGN REPRESENTATIVE UPON COMPLETION.
8. REQUIRED DENSITY AND MINIMUM FREQUENCY OF TESTING FOR COMPACTION CONTROL AS DETAILED IN AS 3798-2007 ARE SUMMARIZED BELOW:
   - 1 TEST PER LAYER PER MATERIAL TYPE PER 2500 m^2.
9. TESTING SHOULD BE UNDERTAKEN IN ACCORDANCE WITH AS 1289.5. TESTED LAYERS THAT DO NOT SATISFY THE OUTLINED CRITERIA SHALL BE STRIPPED, REPLACED, RECOMPACTED AND RETESTED TO ACHIEVE THE MINIMUM COMPACTION REQUIREMENT MENTIONED ABOVE.
10. UNSUITABLE MATERIALS (E.G. LOOSE ROCK OR SOFT SOIL, ROOTS OR OTHER ORGANIC MATERIALS) MUST BE REMOVED AND REPLACED BY APPROVED ENGINEERED FILL OR AS APPROVED BY THE PRINCIPAL.
11. BACKFILL MATERIALS SHOULD BE FREE FROM ANY ORGANIC, PLASTIC, METAL, RUBBER OR ANY OTHER SYNTHETIC MATERIAL, INORGANIC CONTAMINANTS, DANGEROUS OR TOXIC MATERIAL OR MATERIAL SUSCEPTIBLE TO COMBUSTION. MATERIALS SHOULD CONSIST OF NATURALLY OCCURRING OR PROCESSED MATERIALS THAT ARE CAPABLE OF BEING COMPACTED IN ACCORDANCE WITH AS3798.
12. FILL IS TO BE SOURCED FROM IDENTIFIED AREAS. NO FILL IS TO BE IMPORTED WITHOUT NOTIFYING THE PRINCIPALS REPRESENTATIVE FOR APPROVAL.
13. FILL TO BE COMPACTED TO ACHIEVE A COMPACTION (STANDARD COMPACTIVE EFFORT) WHEN TESTED IN ACCORDANCE WITH AS1289.5.1.1 AS SHOWN BELOW:

FILL TYPE	LOCATION	MAXIMUM LAYER THICKNESS	RELATIVE COMPACTION
LOW PERMEABILITY MATERIAL	CONSTRUCTION OF DAM BUNDS	150mm	98% SMDD
STORE AND RELEASE MATERIAL	DIVERSION BUNDS	200mm	95% SMDD
	ALL OTHER LOCATIONS	200mm	95% SMDD
SUBGRADE	BELOW BUNDS	N/A	98% SMDD

14. MATERIALS DERIVED FROM ARGILLACEOUS ROCK SUCH AS SHALES AND CLAYSTONES OR OTHER FRIABLE MATERIALS WHICH ARE SUSCEPTIBLE TO BREAKDOWN NOT TO BE USED AS SELECT BACKFILL.
15. FILL MUST CONFORM TO THE REQUIREMENTS SHOWN BELOW, AND MUST BE CAPABLE OF ACHIEVING THE RELATIVE COMPACTION SPECIFIED.

PROPERTY	REQUIREMENT
MAXIMUM PARTICLE DIMENSION	53mm
PERCENTAGE PASSING: 2.36mm AS SIEVE 0.075mm AS SIEVE	 < 50% < 15%
PLASTICITY INDEX	≤ 15%

16. EXISTING FILL IF REUSED MUST CONFORM TO THE REQUIREMENTS SHOWN BELOW, AND MUST BE CAPABLE OF ACHIEVING THE RELATIVE COMPACTION SPECIFIED:

PROPERTY	REQUIREMENT
MAXIMUM PARTICLE DIMENSION	200mm
PERCENTAGE PASSING: 37.5mm AS SIEVE	> 60%

17. IN AREAS TO BE FILLED WHERE THE SLOPE OF THE NATURAL SURFACE EXCEEDS 1(V):4(H), BENCHES ARE TO BE CUT TO PREVENT SLIPPING OF THE PLACED FILL MATERIAL AS REQUIRED BY THE COUNCIL.
18. ALL BATTERS ARE TO BE SCARIFIED TO A DEPTH OF 50mm TO ASSIST WITH ADHESION OF TOP SOIL TO BATTER FACE.
19. PROVIDE MINIMUM 100mm AND MAXIMUM 200mm TOPSOIL TO ALL FILLED AREAS AND ALL OTHER AREAS DISTURBED DURING CONSTRUCTION. TOPSOILED AREAS TO BE STABILISED WITH SEED AS PER SPECIFICATION AFTER TOPSOILING AND IS TO BE WATERED TO ENSURE GERMINATION.
20. THE CONTRACTOR SHALL IMPLEMENT EROSION AND SEDIMENT CONTROL MEASURES AS NECESSARY, AND TO THE SATISFACTION OF COUNCIL PRIOR TO THE COMMENCEMENT OF CONSTRUCTION AND DURING CONSTRUCTION. MAINTENANCE OF THE EROSION AND SEDIMENT CONTROL IS TO BE UNDERTAKEN ON A REGULAR BASIS & AS PER PRINCIPAL'S DIRECTION AND IN ACCORDANCE WITH THE REQUIREMENTS OF THE CURRENT EDITION OF MANAGING URBAN STORMWATER: 'SOILS AND CONSTRUCTION' PRODUCED BY LANDCOM 4TH EDITION MARCH 2004"

TOP SOILING

1. PRIOR TO SPREADING, STOCKPILED SITE SUBGRADE MATERIAL AND/OR IMPORTED TOPSOIL SHALL BE INSPECTED BY THE PRINCIPALS REPRESENTATIVE. NO MATERIAL SHALL BE IMPORTED FROM OFF SITE UNLESS APPROVED BY THE PRINCIPALS REPRESENTATIVE.
2. UNLESS NOTED OTHERWISE, ALLOW FOR CLEARING AND REMOVING STONES EXCEEDING 25mm AND ANY RUBBISH BROUGHT TO THE SURFACE DURING THE CULTIVATION OF THE SUBGRADE.
3. AFTER PREPARATION OF THE SUBGRADE SURFACE, PLACE TOPSOIL AS APPROPRIATE FOR THE SPECIFIED LANDSCAPE TREATMENTS AND AS INDICATED BY THE DRAWINGS.
4. THE FINISHED SURFACE OF THE TOPSOIL SHALL BE SMOOTH, FREE OF LUMPS OF SOIL AND LEFT READY FOR CULTIVATING AND PLANTING.
5. TOPSOIL SHALL BE PLACED AND LIGHTLY COMPACTED TO A THICKNESS AS SHOWN BY THE DRAWINGS OR A MINIMUM OF 150mm.

DAM EARTHWORKS

1. THE BASE OF THE EMBANKMENT SHOULD BE STRIPPED OF ALL TOPSOIL, SILT, LOOSE MATERIAL, VEGETABLE MATTER, AND THEN SCARIFIED OVER ITS WHOLE AREA.
2. ALL FILL MATERIAL FOR THE EMBANKMENT SHOULD BE PLACED IN LAYERS (OR LIFTS) NO GREATER THAN 150mm THICK.
3. THE LARGEST SIZE PARTICLE SHOULD NOT BE GREATER THAN 1/3RD THE HEIGHT OF THE LIFT,THAT IS, 50mm.
4. EACH LAYER SHOULD BE THOROUGHLY COMPACTED BEFORE THE NEXT LAYER IS PLACED. A MINIMUM OF 6 PASSES TO ACHIEVE THE REQUIRED COMPACTION EFFORT IS GENERALLY REQUIRED BY A SUITABLE MACHINE (SEE BELOW).
5. THE COMPACTION EFFORT ACHIEVED SHOULD BE ON AVERAGE 98% STANDARD MAXIMUM DRY DENSITY AS PER AUSTRALIAN STANDARD: AS1289.0-2000 METHODS OF TESTING SOILS FOR ENGINEERING PURPOSES.
6. THE MINIMUM COMPACTION EFFORT SHOULD BE 95% STANDARD MDD.
7. THE MOISTURE CONTENT SHOULD BE IN THE RANGE OF –1% TO + 3% OF OPTIMUM MOISTURE CONTENT (OMC). IF THE MATERIAL IS TOO DRY, WATER SHOULD BE ADDED. IF THE MATERIAL IS TOO WET IT SHOULD BE SPREAD AND MIXED.
8. PREPARE THE SITE UNDER THE EMBANKMENT BY RIPPING A MINIMUM OF 100mm TO ENSURE BOND BETWEEN EXISTING SUBSTRATE AND COMPACTED FILL.
9. BEFORE EACH ADDITIONAL 150mm LIFT IS ADDED TO THE EMBANKMENT, THE PRECEDING LIFT SHOULD BE SCARIFIED TO ENSURE THAT THE TWO LIFTS ARE PROPERLY JOINED SO THAT NO NATURAL PATHS FOR SEEPAGE ARE PRESENT THAT MAY RESULT IN DAM FAILURE.
10. MAINTAIN CUT-OFF TRENCH FREE OF WATER.

SCOUR PROTECTION

1. THE THICKNESS OF THE RIP-RAP PROTECTION SHALL BE A MINIMUM OF THE D_{50} STONE SIZE SPECIFIED ON THE DRAWINGS. THE STONE SHALL BE WELL GRADED IN ACCORDANCE WITH THE FOLLOWING TABLE:

ROCK SIZE	% PASSING (BY WEIGHT)
2 x D_{50}	100%
D_{50}	40 - 60%
0.3 x D_{50}	10 - 20%

   ROCK IS TO BE HARD, DENSE, DURABLE, RESISTANT TO WEATHERING AND ANGULAR SHAPE. IT SHALL BE FREE FROM OVERBURDEN SPOIL, SHALE AND ORGANIC MATTER. ROCK THAT IS LAMINATED, FRACTURED, POROUS OR OTHERWISE PHYSICALLY WEAK IS UNACCEPTABLE.

   THE PROPERTIES OF THE ROCK SHALL BE IN ACCORDANCE WITH AS2758.6 SPECIFICATION FOR EROSION CONTROL TO THE SATISFACTION OF THE PRINCIPALS REPRESENTATIVE.

   AN APPROXIMATE GUIDE TO STONE SHAPE IS THAT BREADTH OR THICKNESS OF A SINGLE STONE SHOULD BE NOT LESS THAN ONE-THIRD ITS LENGTH. ROUND MATERIAL CAN BE USED AS RIP RAP PROVIDED IT IS NOT PLACED ON SLOPES GREATER THAN 3H:1V.
2. STONE SHOULD BE DARK IN COLOUR EITHER GREY OR DARK BROWN SMIILAR TO SOIL PROFILE.
3. GEOTEXTILE UNDER ROCK FILLED MATTRESS AND RIP-RAP TO BE IN ACCORDANCE WITH TfNSW SPECIFICATION R63.
4. ROCKS AND BOULDERS TO HAVE TOTAL UNIT WEIGHT OF 21 TO 27kN/m^3.
5. ALL RIP-RAP SPECIFIED ON THE DRAWINGS ARE PLACED ROCKS.

SAFETY

1. THE CONTRACTOR IS RESPONSIBE FOR SAFETY ONSITE.
2. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING ALL EXCAVATION WORKS IN A STABLE CONDITION, AND ENSURING NO PART SHALL BE OVERSTRESSED DURING CONSTRUCTION ACTIVITIES. PROVISION OF TEMPORARY BRACING, SHORING AND BATTERING IS BY THE CONTRACTOR AS REQUIRED TO PROVIDE A SAFE WORKING ENVIRONMENT.
3. THE CONTRACTOR MUST MAKE PROVISION FOR THE SAFETY OF NORMAL VEHICULAR TRAFFIC AND PEDESTRIANS, AND OTHERS INCLUDING UNAUTHORISED INTRUDERS.
4. ALL PITS, MANHOLES, PUMPSTATIONS AND OTHER CONFINED SPACES MUST BE FITTED WITH A CONFINED SPACE WARNING SIGN TO THE APPROVAL OF THE PRINCIPAL'S REPRESENTATIVE.
5. ALL CONDITIONS OF WITH THE REMEDIAL ACTION PLAN MUST BE MET.

SEDIMENT CONTROL NOTES

1. THE CONTRACTOR SHALL AT ALL TIMES BE RESPONSIBLE FOR THE ESTABLISHMENT & MANAGEMENT OF SEDIMENT AND EROSION CONTROL.
2. THE CONTRACTOR SHALL INSTIGATE ALL SEDIMENT AND EROSION CONTROL MEASURES IN ACCORDANCE WITH STATUTORY REQUIREMENTS AND IN PARTICULAR THE 'BLUE BOOK' (MANAGING URBAN STORMWATER SOILS AND CONSTRUCTION), PRODUCED BY THE DEPARTMENT OF HOUSING AND COUNCILS POLICIES. THESE MEASURES ARE TO BE INSPECTED AND MAINTAINED ON A DAILY BASIS.
3. THE CONTRACTOR SHALL INFORM ALL SUB CONTRACTORS OF THEIR RESPONSIBILITIES IN MINIMISING THE POTENTIAL FOR SOIL EROSION AND POLLUTION TO DOWNSLOPE LANDS AND WATERWAYS.
4. WHERE PRACTICAL, THE SOIL EROSION HAZARD ON THE SITE SHALL BE KEPT AS LOW AS POSSIBLE. TO THIS END, WORKS SHOULD BE UNDERTAKEN IN THE FOLLOWING SEQUENCE;
   - 4.1. CONSTRUCT TEMPORARY STABILISED SITE ACCESS INCLUSIVE OF SHAKE DOWN / WASH PAD.
   - 4.2. INSTALL ALL TEMPORARY SEDIMENT FENCES AND BARRIER FENCES. WHERE FENCES ADJACENT EACH OTHER, THE SEDIMENT FENCE CAN BE INCORPORATED INTO THE BARRIER FENCE.
   - 4.3. INSTALL SEDIMENT CONTROL MEASURES AS OUTLINED ON THE APPROVED PLANS.
5. UNDERTAKE SITE DEVELOPMENT WORKS SO THAT LAND DISTURBANCE IS CONFINED TO AREAS OF MINIMUM WORKABLE SIZE.
6. AT ALL TIMES AND IN PARTICULAR DURING WINDY AND DRY WEATHER, LARGE UNPROTECTED AREAS WILL BE KEPT MOIST (NOT WET) BY SPRINKLING WITH WATER TO KEEP DUST UNDER CONTROL ENSURING CONFORMITY TO REGULATORY AUTHORITY REQUIREMENTS.
7. ANY SAND USED IN THE CONCRETE CURING PROCESS (SPREAD OVER THE SURFACE) SHALL BE REMOVED AS SOON AS POSSIBLE AND WITHIN 10 WORKING DAYS FROM PLACEMENT.
8. WATER SHALL BE PREVENTED FROM ENTERING THE PERMANENT DRAINAGE SYSTEM UNLESS THE CATCHMENT AREA HAS BEEN STABILISED AND/OR ANY LIKELY SEDIMENT BEEN FILTERED OUT.
9. TEMPORARY SOIL AND WATER MANAGEMENT STRUCTURES SHALL BE REMOVED ONLY AFTER THE LANDS THEY ARE PROTECTING ARE STABILISED / REHABILITATED.
10. ALLOW FOR GRASS STABILISATION OF EXPOSED AREAS, OPEN CHANNELS AND ROCK BATTERS DURING ALL PHASES OF CONSTRUCTION.
11. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED TO ENSURE THAT THEY OPERATE EFFECTIVELY. REPAIRS AND/OR MAINTENANCE SHALL BE UNDERTAKEN REGULARLY AND AS REQUIRED, PARTICULARLY FOLLOWING RAIN EVENTS.
12. RECEPTORS FOR CONCRETE AND MORTAR SLURRIES, PAINTS, ACID WASHINGS, LIGHT-WEIGHT WASTE MATERIALS AND LITTER SHALL BE DISPOSED OF IN ACCORDANCE WITH REGULATORY AUTHORITY REQUIREMENTS. CONTRACTOR TO PAY ALL FEES AND PROVIDE EVIDENCE OF SAFE DISPOSAL.
13. DISTURBED AREAS ARE TO BE TOPSOILED AND REVEGETATED WITHIN 10 WORKING DAYS OF COMPLETION OF WORK.
14. CONTRACTOR TO ENSURE NO CONTAMINATED WATER AND MATERIAL IS TO ESCAPE SITE FOR THE DURATION OF THE WORKS.

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

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NSW GOVERNMENT

LEGACY MINES PROGRAM
DEPARTMENT OF
REGIONAL NSW

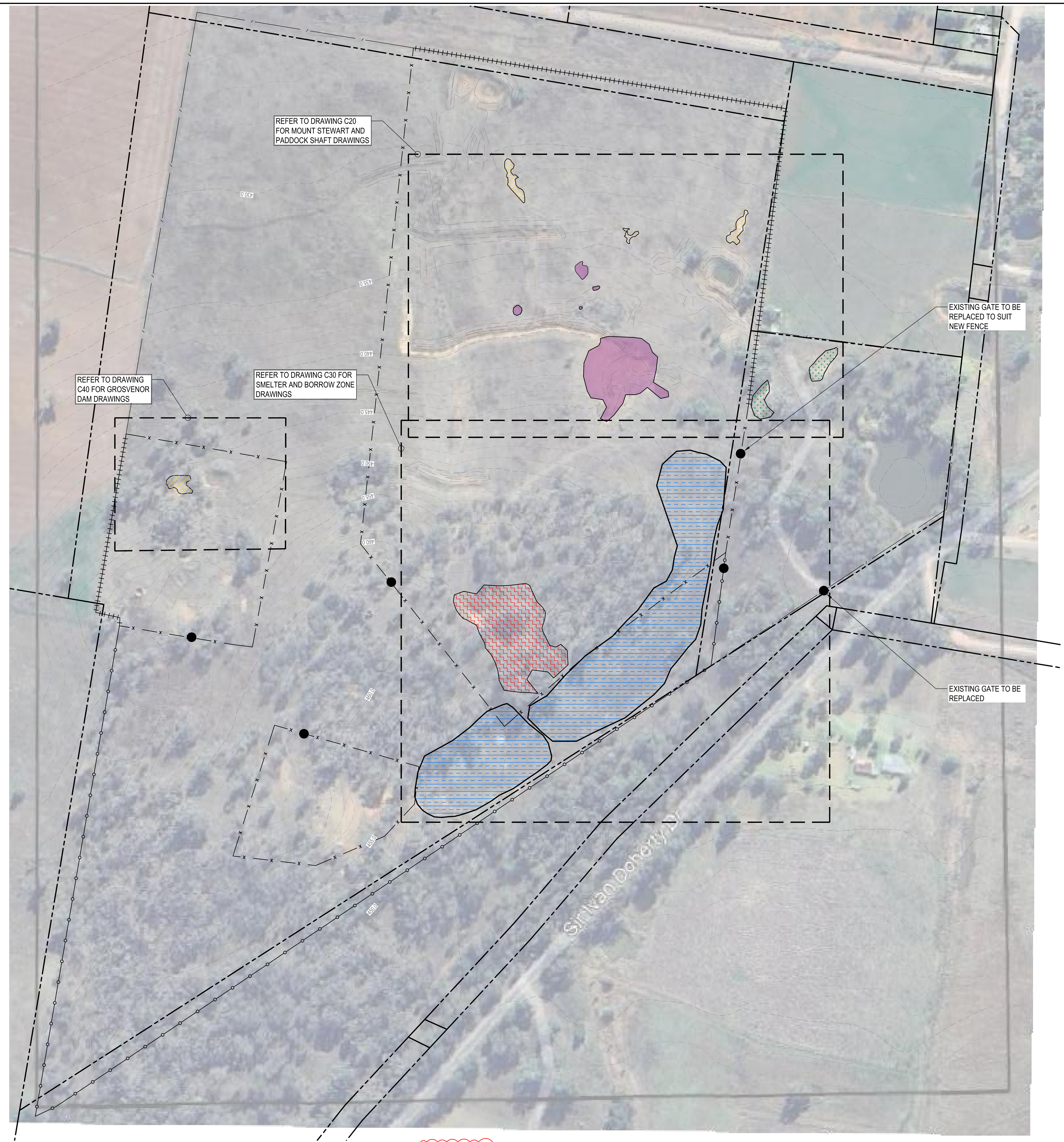
ROC ENGINEERING DESIGN
Ph (02) 4244 4017
P.O. Box 216 Wollongong, NSW, 2520
Email info@rocengineering.com.au ABN 70 610 369 910

PROJECT
LEGACY MINES PROGRAM
LEADVILLE MINE
REMEDIATION

DRAWING TITLE
CIVIL SPECIFICATION
SHEET 1

SCALE (A1)

JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C01	C



SITE PLAN
SCALE: 1:2000

LEGEND

- APPROX. BOUNDARY
- EXISTING CONTOUR (1m)
- EXISTING FENCE ALIGNMENT (APPROX.) TO BE RETAINED
- EXISTING FENCE ALIGNMENT (APPROX.) TO BE REPLACED WITH NEW HINGED JOINT FENCE ON SAME ALIGNMENT
- NEW 1.8m HIGH CHAIN LINK FENCE
- EXISTING FENCE ALIGNMENT (APPROX.) TO BE REPLACED WITH NEW 1.8m HIGH CHAIN LINK FENCE ON SAME ALIGNMENT
- GATE TO SUIT PROPOSED FENCE
- EXCAVATE AND DISPOSE
- EXCAVATE AND VEGETATE
- MOUNT STEWART HIGH ONGOING AMD POTENTIAL
- BORROW SOURCE
- LEAVE IN-SITU AND ISOLATE

NOTES

1. SURVEY PROVIDED BY CENTURION SURVEY. SURVEY OUTSIDE THE AREA SURVEYED HAS BEEN DERIVED FROM NSW SPATIAL SERVICES 'ELEVATION FOUNDATION SPATIAL DATA' (ELVIS).
2. COORDINATE ZONE - MGA2020 ZONE 55S.

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
D	FENCE ALIGNMENT REVISED	CW	RP		26.03.2024
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

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P.O. Box 216 Wollongong, NSW, 2520
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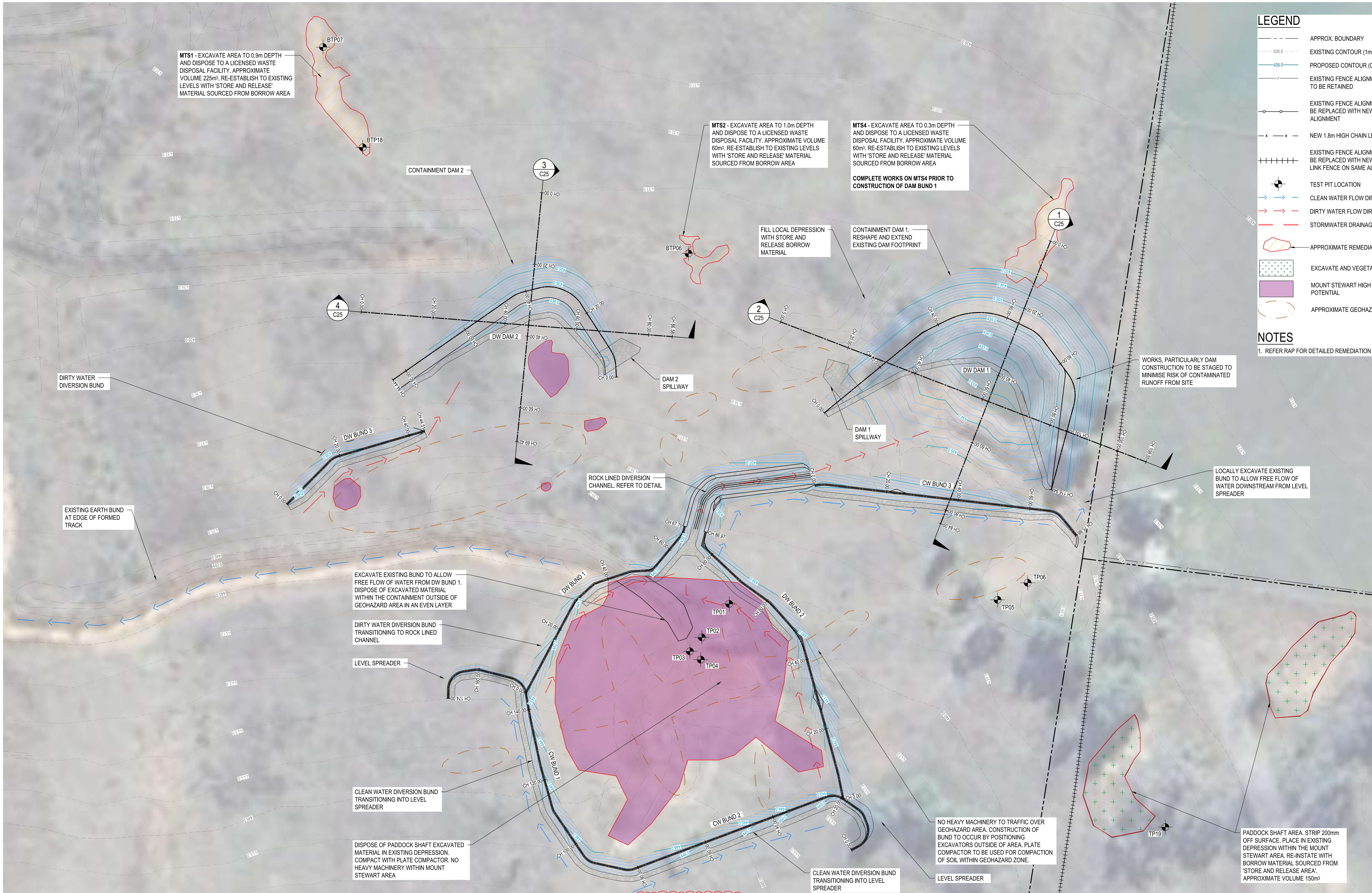
PROJECT
LEGACY MINES PROGRAM LEADVILLE MINE REMEDIATION

DRAWING TITLE
SITE PLAN

SCALE (A1)
0 20 40 60 80 120 160 200m
1 : 2000

JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C10	D



SITEWORKS PLAN

SCALE: 1:500

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
D	FENCE ALIGNMENT REVISED	CW	RP		26.03.2024
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

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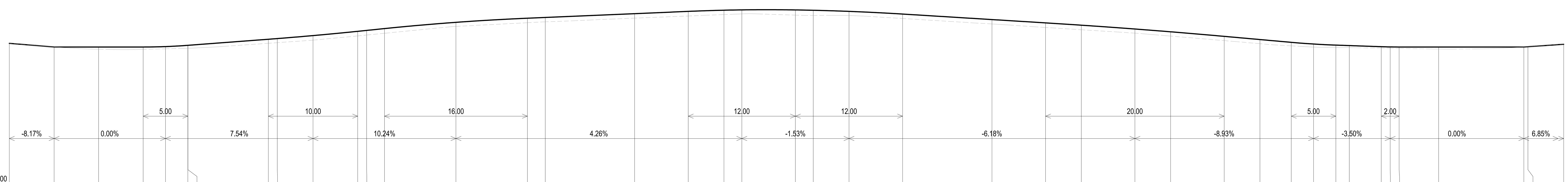
P.O. Box 216 Wollongong, NSW, 2520
Email info@rocengineering.com.au ABN 70 610 369 910

PROJECT
LEGACY MINES PROGRAM LEADVILLE MINE REMEDIATION

DRAWING TITLE
MOUNT STEWART AND PADDOCK SHAFT AREA SITEWORKS PLAN

SCALE (A1)
0 5 10 15 20 30 60 75m
1 : 500

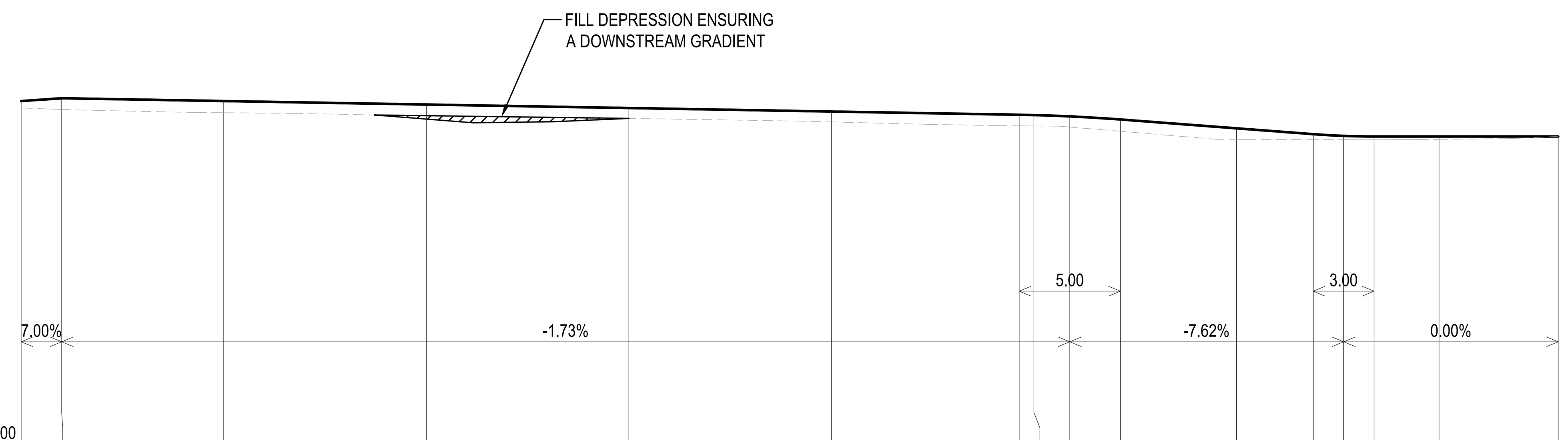
JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C20	D



CHAINAGE	DESIGN SURFACE	EXISTING SURFACE
0.00	443.06	443.06
5.02	442.65	442.65
10.00	442.65	442.40
14.99	442.65	442.39
17.49	442.70	442.45
19.99	442.84	442.52
20.00	442.84	442.52
29.00	443.52	443.07
30.00	443.59	443.14
34.00	443.93	443.42
39.00	444.41	443.89
40.00	444.51	443.99
42.00	444.71	444.19
50.00	445.41	444.96
58.00	445.87	445.37
60.00	445.96	445.47
70.00	446.39	445.88
76.00	446.64	446.13
80.00	446.77	446.28
82.00	446.81	446.36
88.00	446.80	446.22
90.00	446.77	446.19
94.00	446.64	446.18
100.00	446.34	445.84
110.00	445.72	445.23
116.00	445.35	444.84
120.00	445.10	444.59
126.00	444.67	444.21
130.00	444.35	443.88
136.00	443.84	443.36
140.00	443.49	443.02
143.50	443.17	442.78
146.00	442.98	442.65
148.50	442.86	442.59
150.00	442.81	442.58
153.58	442.68	442.52
154.58	442.66	442.51
155.58	442.65	442.49
160.00	442.65	442.42
169.54	442.65	442.65
170.00	442.68	442.68
174.00	442.96	442.97

CW BUND 1 AND 2 LONGITUDINAL SECTION

SCALE: V 1:250, H 1:250



CHAINAGE	DESIGN SURFACE	EXISTING SURFACE
0.00	437.00	436.66
2.00	437.14	436.59
10.00	437.00	436.42
20.00	436.83	436.11
30.00	436.66	436.14
40.00	436.48	435.97
49.27	436.32	435.78
50.00	436.31	435.77
51.77	436.24	435.72
54.27	436.09	435.51
60.00	435.65	435.11
63.79	435.36	435.09
65.29	435.28	435.09
66.79	435.25	435.09
70.00	435.25	435.11
75.89	435.25	435.26

CW BUND 3 LONGITUDINAL SECTION

SCALE: V 1:250, H 1:250

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
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A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

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P.O. Box 216 Wollongong, NSW, 2520
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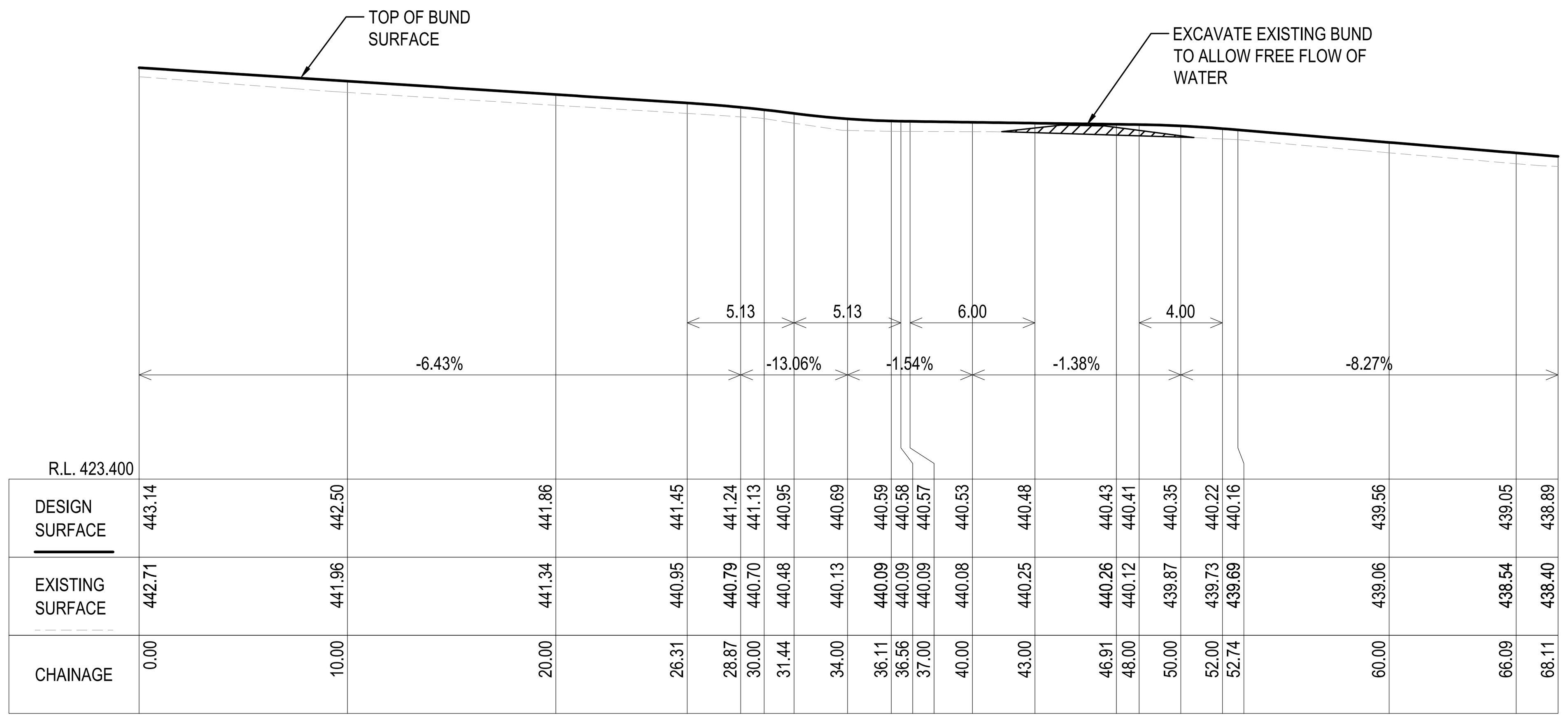
PROJECT
LEGACY MINES PROGRAM
LEADVILLE MINE
REMEDIATION

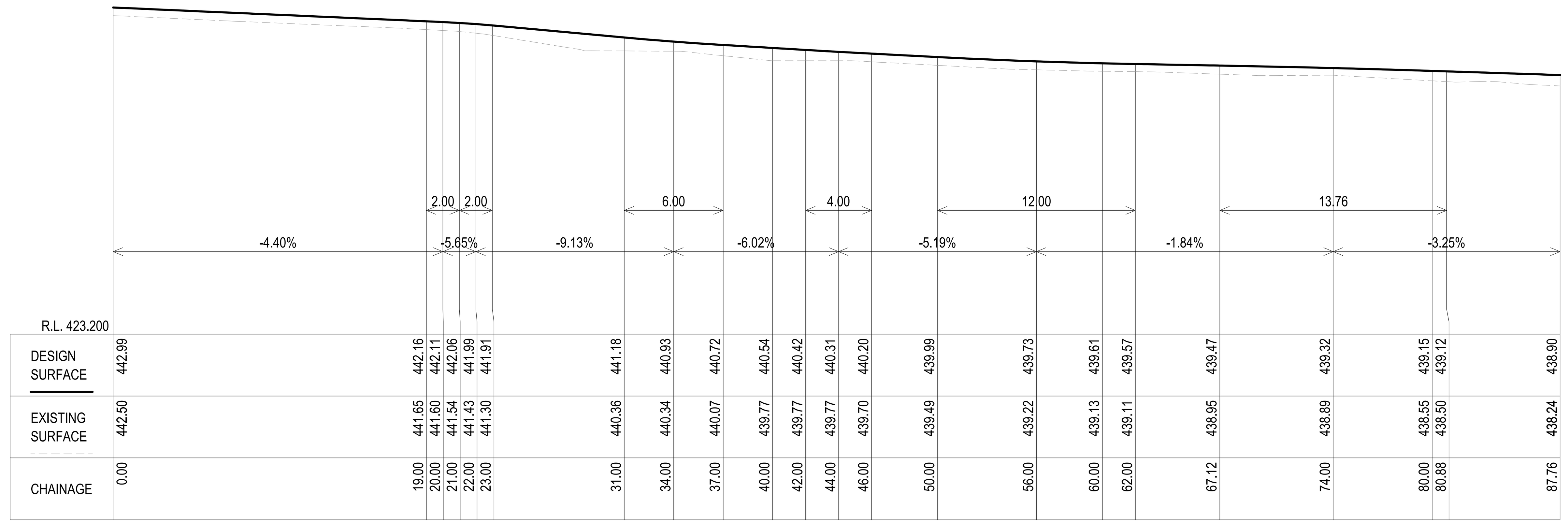
DRAWING TITLE
MOUNT STEWART
LONGITUDINAL SECTIONS
SHEET 1

SCALE (A1)
0 2.5 5 7.5 10 15 20 25m
1 : 250

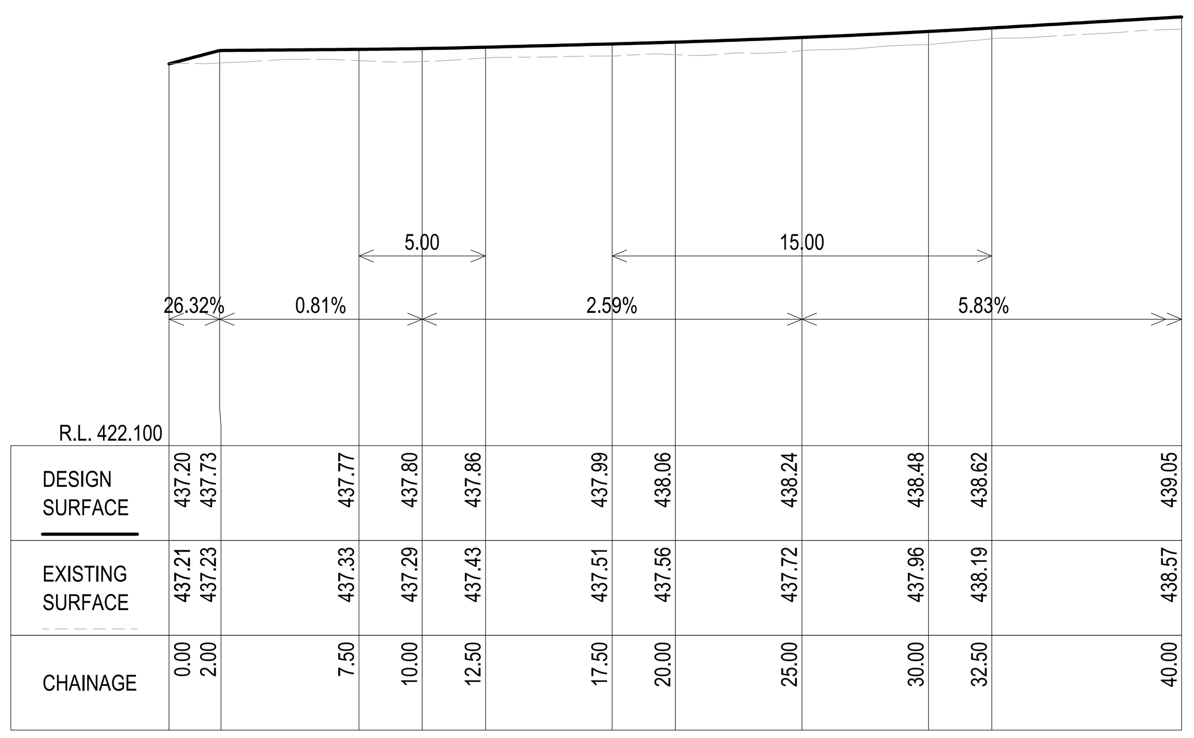
JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C23	C



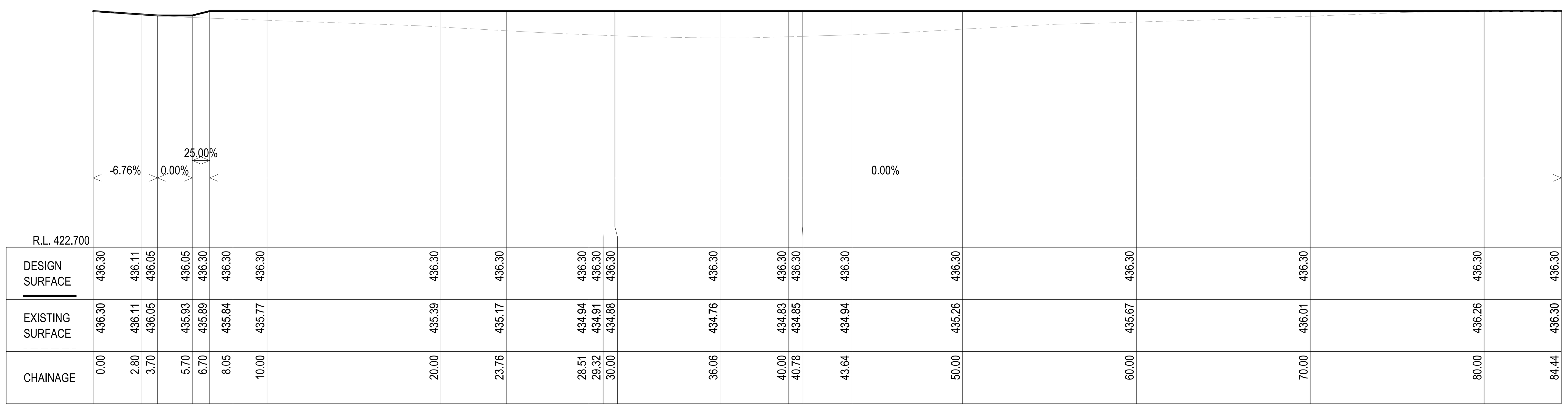
DW BUND 1
LONGITUDINAL SECTION
SCALE: V 1:250, H 1:250



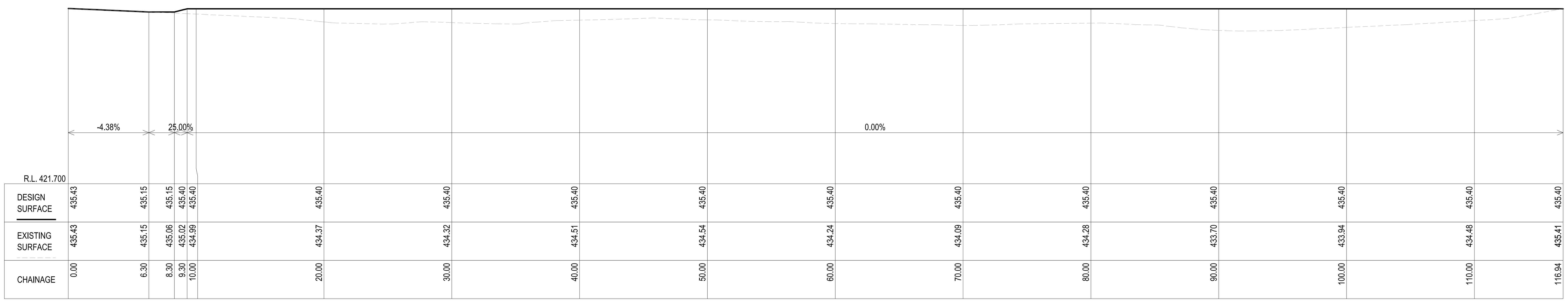
DW BUND 2
LONGITUDINAL SECTION
SCALE: V 1:250, H 1:250



DW BUND 3
LONGITUDINAL SECTION
SCALE: V 1:250, H 1:250



DAM 2 - TOP OF BUND
LONGITUDINAL SECTION
SCALE: V 1:250, H 1:250



DAM 1 - TOP OF BUND
LONGITUDINAL SECTION
SCALE: V 1:250, H 1:250

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
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Ph (02) 4244 4017
P.O. Box 216 Wollongong, NSW, 2520
Email info@rocengineering.com.au ABN 70 610 369 910

PROJECT
LEGACY MINES PROGRAM
LEADVILLE MINE
REMEDIATION

DRAWING TITLE
MOUNT STEWART
LONGITUDINAL SECTIONS
SHEET 2

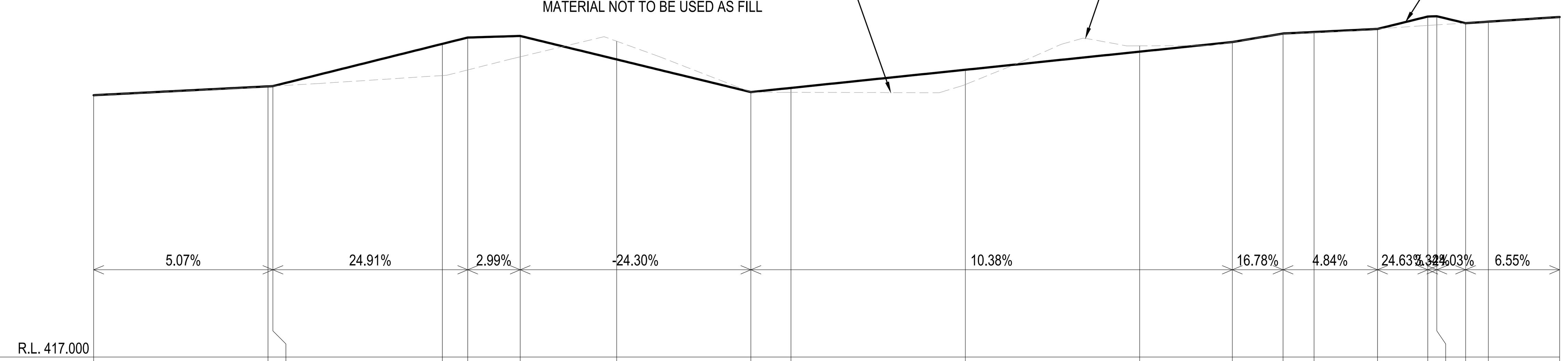
SCALE (A1)
0 2.5 5 7.5 10 15 20 25m
1 : 250

JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C24	C

CONTRACTOR TO ALLOW TO EXCAVATE CONTAMINATED SEDIMENT AT BOTTOM OF DAM. SEDIMENT MAY BE SPREAD IN MOUNT STEWART HIGH ONGOING POTENTIAL AREA. MATERIAL NOT TO BE USED AS FILL

RE-SHAPE EXISTING DAM. USE CUT MATERIAL AS FILL MATERIAL IN BASE OF DAM. DO NOT USE FOR DAM BUND

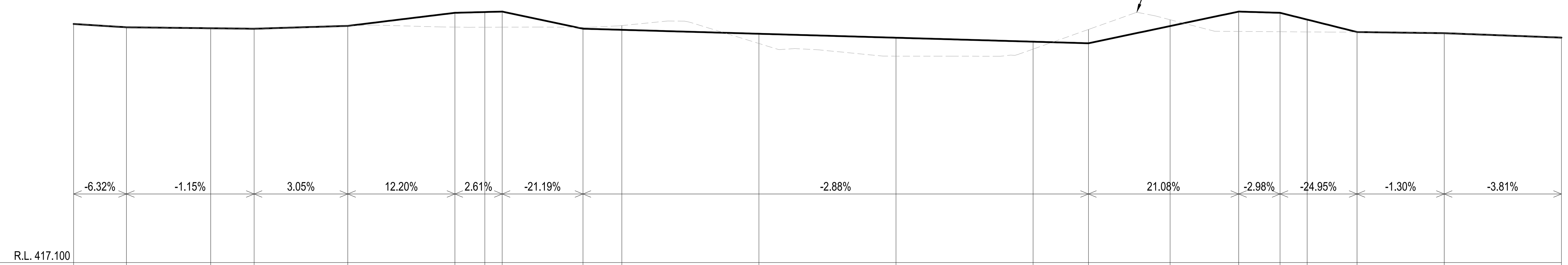
CONTRACTOR TO DISPOSE OR STORE CONTAMINATED WATER IN EXISTING DAM. WATER MAY BE PUMPED BACK INTO COMPLETED NEW DAM.



DESIGN SURFACE	432.01	432.51	432.53	434.95	435.31	435.40	434.06	432.18	432.42	433.46	434.50	435.05	435.54	435.63	435.80	436.51	436.53	436.13	436.22	436.49
EXISTING SURFACE	432.01	432.51	432.53	433.13	433.45	434.21	435.10	432.18	432.17	432.62	434.83	435.05	435.52	435.61	435.81	436.00	436.04	436.14	436.22	436.49
CHAINAGE	0.00	10.00	10.28	20.00	21.46	24.47	30.00	37.70	40.00	50.00	60.00	65.31	68.22	70.00	73.64	76.53	77.04	78.70	80.00	84.09

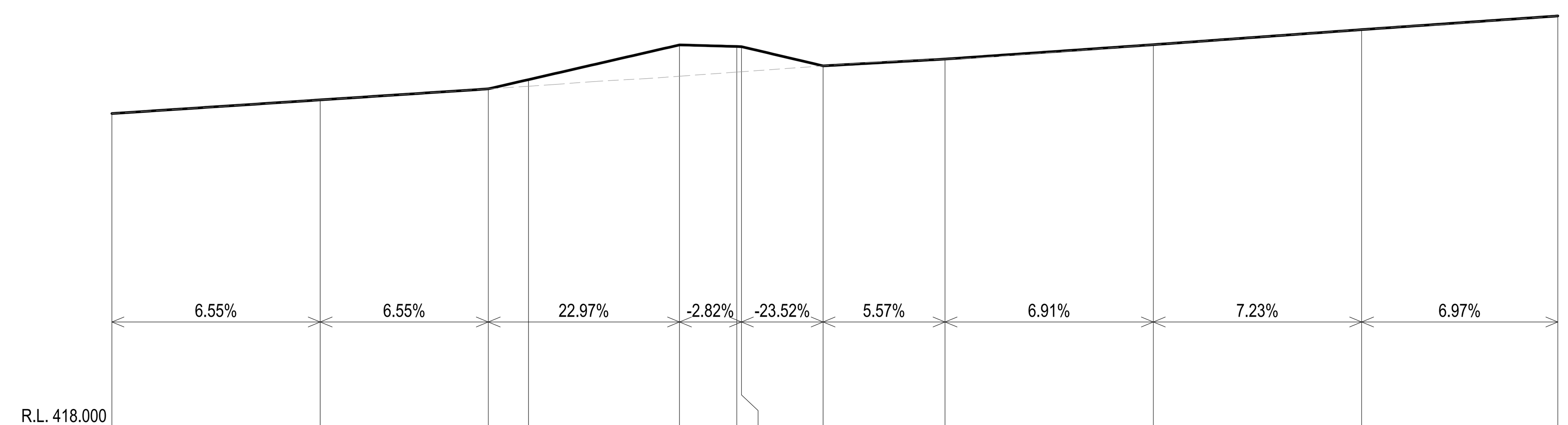
EARTHWORKS SECTION 1
SCALE: V 1:250, H 1:250

EXCAVATE EXISTING BUND TO ALLOW FREE FLOW OF WATER



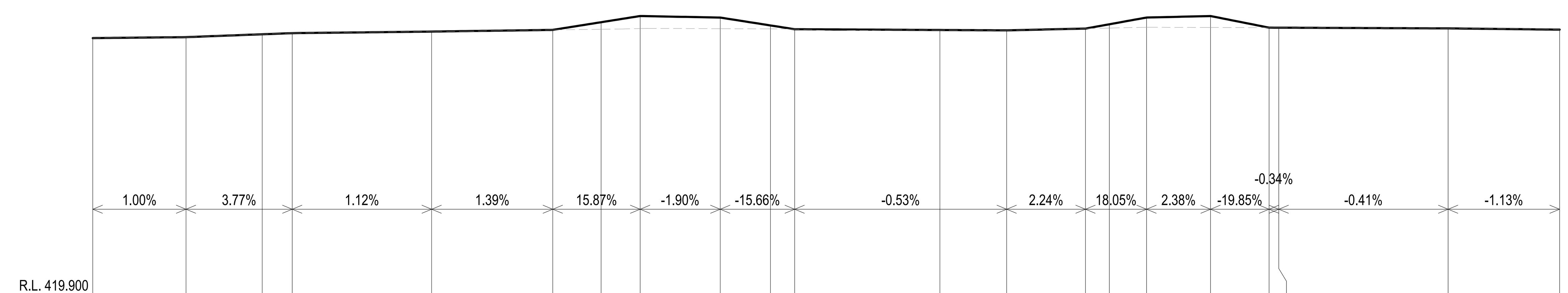
DESIGN SURFACE	434.50	434.26	434.18	434.15	434.36	435.31	435.37	435.40	434.15	434.07	433.78	433.49	433.21	433.09	434.34	435.40	435.31	434.82	433.91	433.83	433.50
EXISTING SURFACE	434.50	434.26	434.19	434.15	434.36	434.27	434.26	434.26	434.25	434.38	433.07	432.15	432.66	434.10	434.81	433.95	433.93	433.92	433.91	433.83	433.50
CHAINAGE	0.00	3.85	10.00	13.17	20.00	27.82	30.00	31.27	37.16	40.00	50.00	60.00	70.00	74.04	80.00	85.01	88.02	90.00	93.64	100.00	108.55

EARTHWORKS SECTION 2
SCALE: V 1:250, H 1:250



DESIGN SURFACE	433.00	433.66	434.18	434.63	436.29	436.22	436.21	435.29	435.61	436.30	437.03	437.68
EXISTING SURFACE	433.00	433.66	434.18	434.31	434.79	434.99	435.01	435.29	435.61	436.30	437.03	437.68
CHAINAGE	0.00	10.00	18.07	20.00	27.25	30.00	30.22	34.15	40.00	50.00	60.00	69.42

EARTHWORKS SECTION 3
SCALE: V 1:250, H 1:250



DESIGN SURFACE	435.00	435.05	435.22	435.29	435.38	435.48	435.93	436.30	436.21	435.75	435.52	435.48	435.46	435.56	435.81	436.21	436.30	435.61	435.61	435.57	435.50
EXISTING SURFACE	435.00	435.05	435.23	435.29	435.38	435.48	435.52	435.56	435.55	435.54	435.52	435.47	435.46	435.56	435.59	435.64	435.63	435.61	435.61	435.57	435.50
CHAINAGE	0.00	5.50	10.00	11.77	20.00	27.15	30.00	32.31	37.03	40.00	41.43	50.00	53.94	58.59	60.00	62.20	65.97	69.43	70.00	80.00	86.58

EARTHWORKS SECTION 4
SCALE: V 1:250, H 1:250

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

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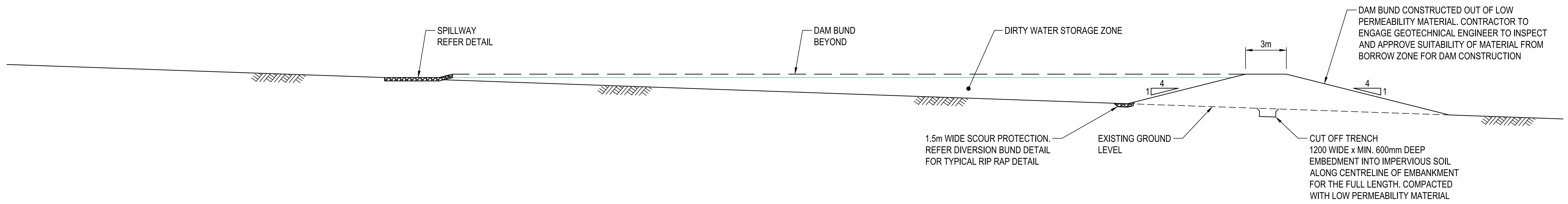
ROC ENGINEERING DESIGN
Ph (02) 4244 4017
P.O. Box 216 Wollongong, NSW, 2520
Email info@rocengineering.com.au ABN 70 610 369 910

PROJECT
LEGACY MINES PROGRAM
LEADVILLE MINE REMEDIATION

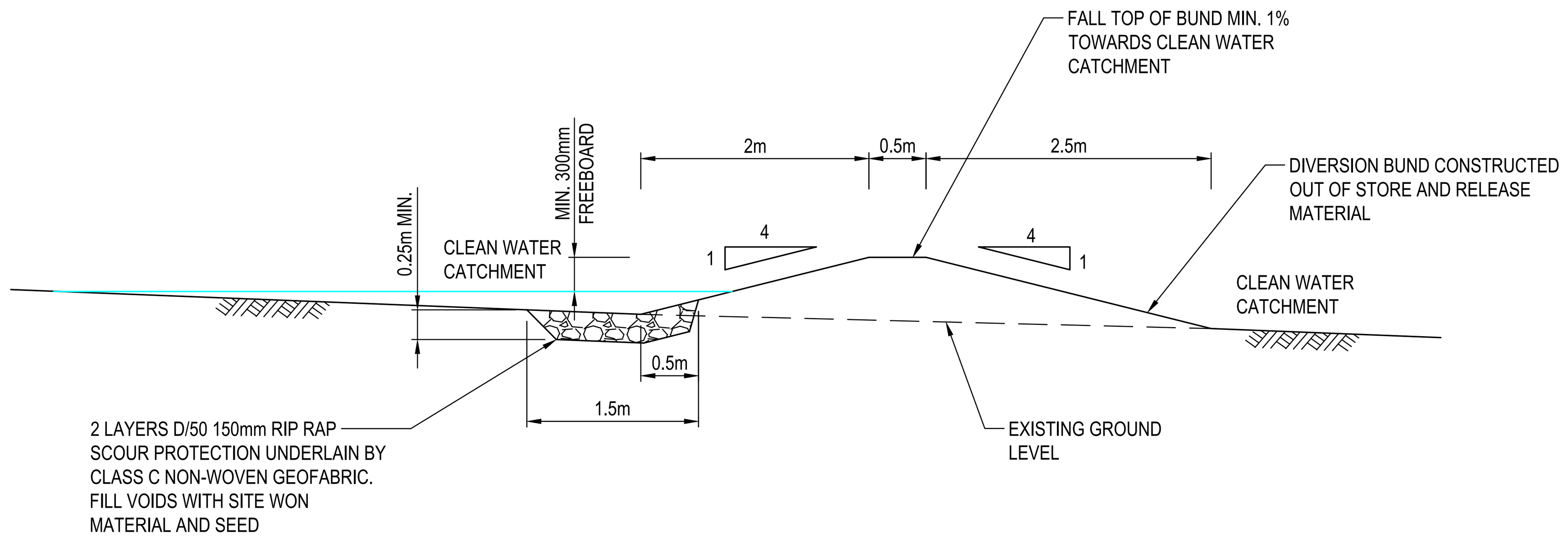
DRAWING TITLE
MOUNT STEWART EARTHWORKS SECTIONS

SCALE (A1)
0 2.5 5 7.5 10 15 20 25m
1 : 250

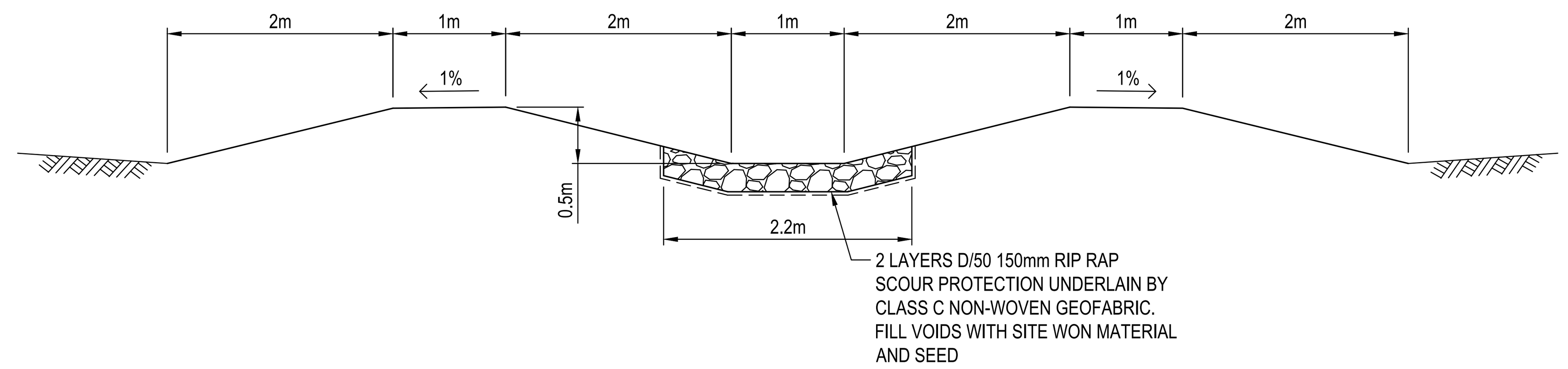
JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C25	C



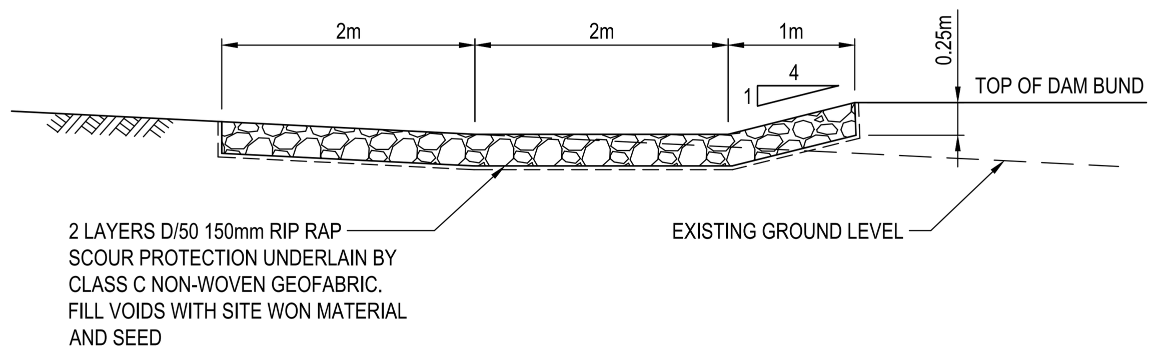
TYPICAL CONTAINMENT DAM DETAIL
NOT TO SCALE
NOTE: REFER C01 FOR DAM EARTHWORKS SPECIFICATION



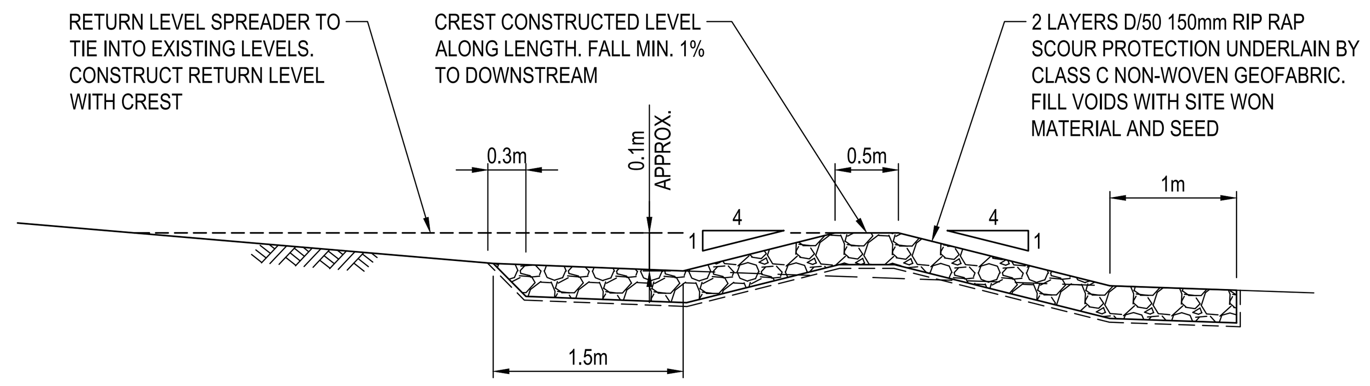
TYPICAL DIVERSION BUND DETAIL
SCALE: 1:50



DIVERSION CHANNEL DETAIL
SCALE: 1:50



DAM SPILLWAY DETAIL
SCALE: 1:50



LEVEL SPREADER DETAIL
SCALE: 1:50

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
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A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

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PROJECT
LEGACY MINES PROGRAM LEADVILLE MINE REMEDIATION

DRAWING TITLE
MOUNT STEWART EARTHWORKS DETAILS SHEET 1

SCALE (A1)
0 1000 2000 3000 4000 5000mm
1 : 50

JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C27	C

LEGEND

- APPROX. BOUNDARY
- EXISTING CONTOUR
- PROPOSED CONTOUR
- EXISTING FENCE ALIGNMENT (APPROX.) TO BE RETAINED
- EXISTING FENCE ALIGNMENT (APPROX.) TO BE REPLACED WITH NEW HINGED JOINT FENCE ON SAME ALIGNMENT
- NEW 1.8m HIGH CHAIN LINK FENCE
- EXISTING FENCE ALIGNMENT (APPROX.) TO BE REPLACED WITH NEW 1.8m HIGH CHAIN LINK FENCE ON SAME ALIGNMENT
- GATE TO SUIT PROPOSED CHAINLINK FENCE
- GATE TO SUIT PROPOSED HINGED JOINT FENCE
- TEST PIT LOCATION
- CLEAN WATER FLOW DIRECTION
- DIRTY WATER FLOW DIRECTION
- STORMWATER DRAINAGE LINE
- BORROW SOURCE
- LEAVE IN-SITU AND ISOLATE

SITEWORKS PLAN
SCALE: 1:750

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
D	FENCE ALIGNMENT REVISED	CW	RP		26.03.2024
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

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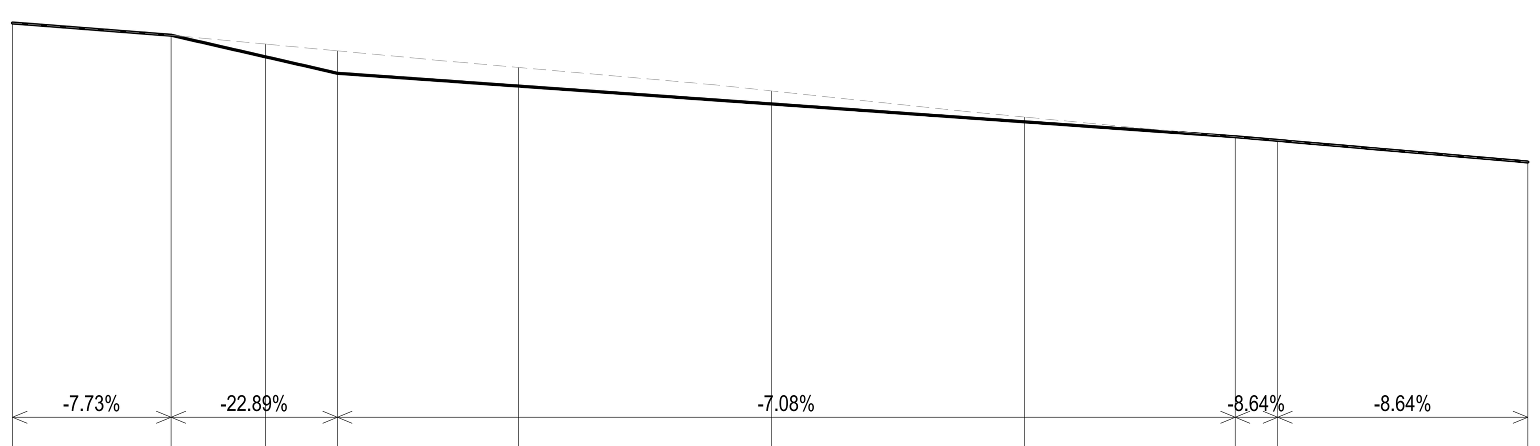
PROJECT
LEGACY MINES PROGRAM LEADVILLE MINE REMEDIATION

DRAWING TITLE
SMELTER AND BORROW ZONE SITEWORKS PLAN

SCALE (A1)
0 7.5 15 22.5 30 45 40 50m
1 : 750

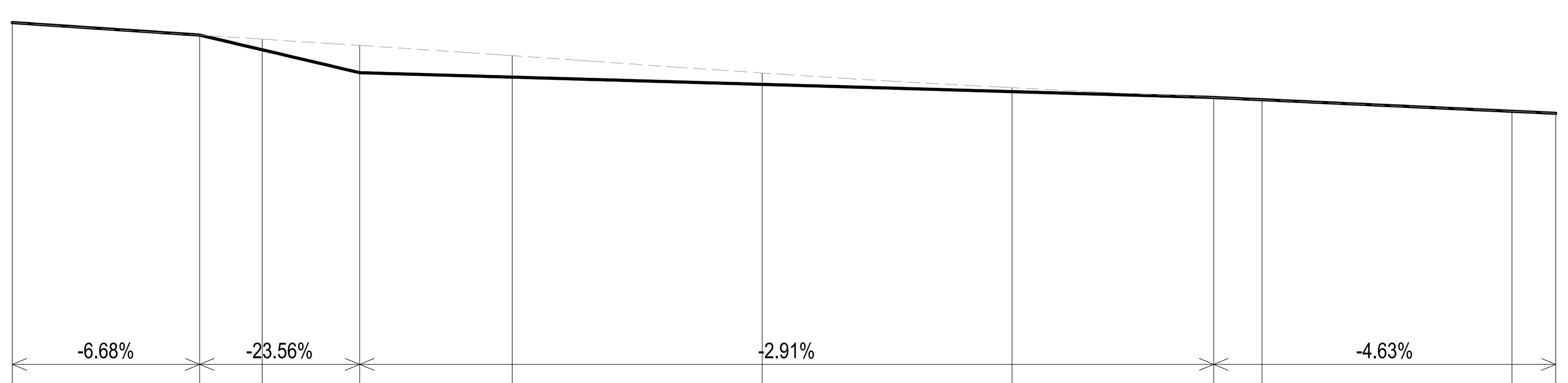
JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C30	D



R.L. 424.400

DESIGN SURFACE	445.00	444.51	443.66	443.01	442.50	441.79	441.09	440.50	440.35	439.50
EXISTING SURFACE	445.00	444.51	444.16	443.90	443.24	442.31	441.28	440.50	440.35	439.50
CHAINAGE	0.00	6.27	10.00	12.84	20.00	30.00	40.00	48.32	50.00	59.88

EARTHWORKS SECTION 5
SCALE: V 1:250, H 1:250



R.L. 428.300

DESIGN SURFACE	447.00	446.50	445.91	444.99	444.81	444.52	444.23	444.00	443.91	443.45	443.36
EXISTING SURFACE	447.00	446.49	446.34	446.08	445.67	444.98	444.39	444.00	443.91	443.45	443.36
CHAINAGE	0.00	7.50	10.00	13.90	20.00	30.00	40.00	48.07	50.00	60.00	61.75

EARTHWORKS SECTION 6
SCALE: V 1:250, H 1:250

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
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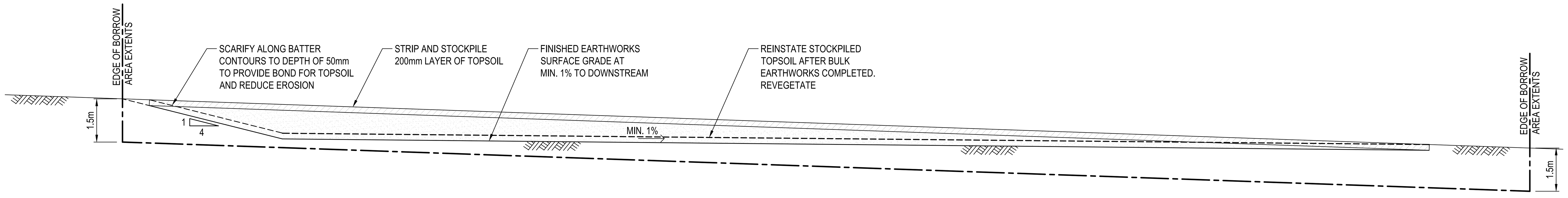
ROC ENGINEERING DESIGN
Ph (02) 4244 4017
P.O. Box 216 Wollongong, NSW, 2520
Email info@rocengineering.com.au ABN 70 610 369 910

PROJECT
LEGACY MINES PROGRAM
LEADVILLE MINE REMEDIATION

DRAWING TITLE
SMELTER AND BORROW ZONE EARTHWORKS SECTIONS

SCALE (A1)
0 2 4 6 8 12 16 20m
1 : 200

JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C35	C



TYPICAL BORROW AREA
EARTHWORKS SECTION
SCALE: 1:100

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

CLIENT

NSW GOVERNMENT

LEGACY MINES PROGRAM
DEPARTMENT OF
REGIONAL NSW

ROC ENGINEERING DESIGN
Ph (02) 4244 4017
P.O. Box 216 Wollongong, NSW, 2520
Email info@rocengineering.com.au ABN 70 610 369 910

PROJECT
LEGACY MINES PROGRAM
LEADVILLE MINE
REMEDIATION

DRAWING TITLE
SMELTER AND BORROW
ZONE EARTHWORKS
DETAILS

SCALE (A1)
0 2 4 6 8 12 16 20m
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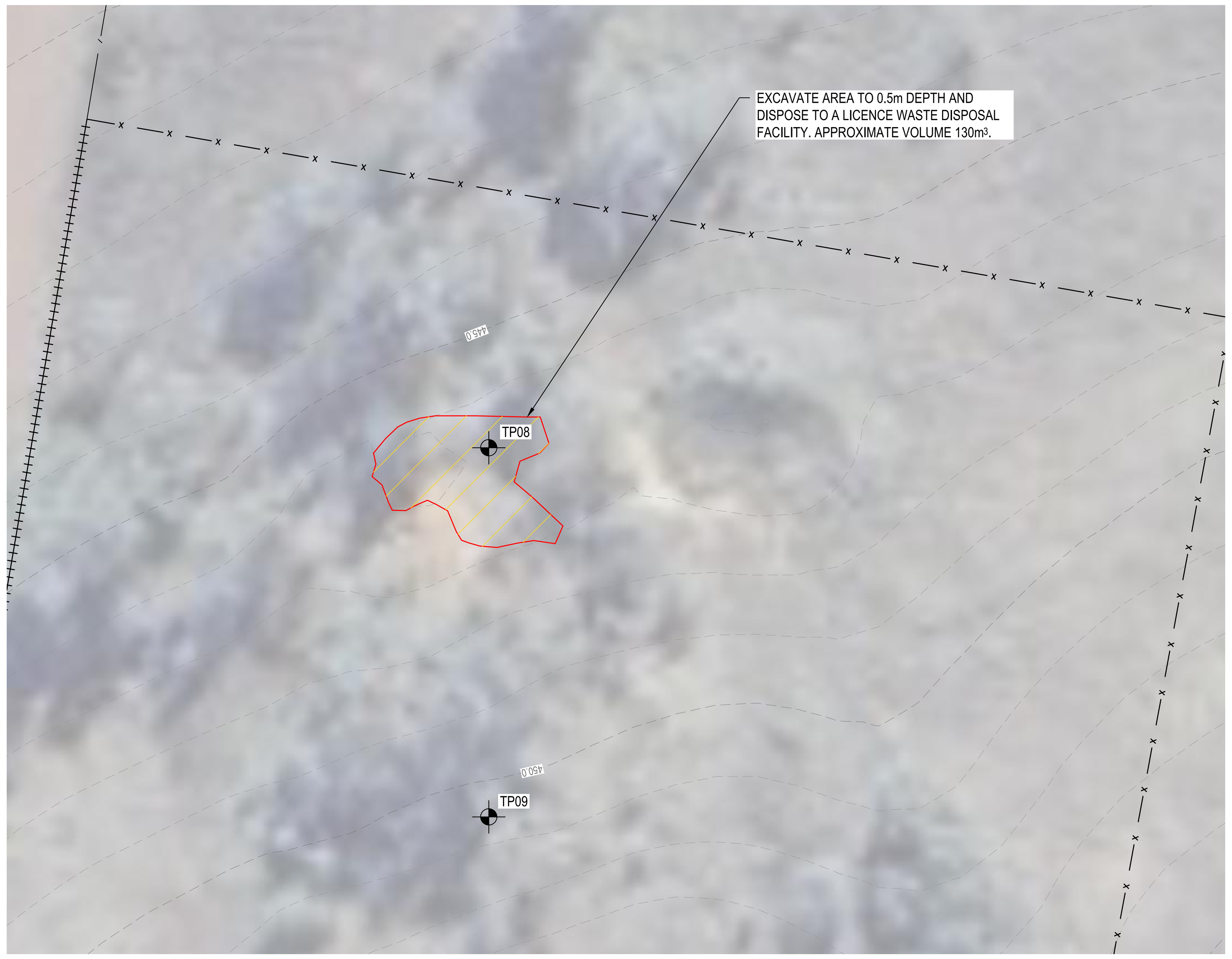
JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C37	C



SITEWORKS PLAN
SCALE: 1:500

LEGEND

435.0	EXISTING CONTOUR
	EXISTING FENCE ALIGNMENT (APPROX.) TO BE RETAINED
	NEW 1.8m HIGH CHAIN LINK FENCE
	EXISTING FENCE ALIGNMENT (APPROX.) TO BE REPLACED WITH NEW 1.8m HIGH CHAIN LINK FENCE ON SAME ALIGNMENT
	TEST PIT LOCATION
	APPROXIMATE REMEDIAL EXTENT

FOR CONSTRUCTION

REV	DESCRIPTION	DESIGN	DRAWN	CHECK	DATE
C	FOR CONSTRUCTION	CW	RP		18.03.2024
B	FOR CONSTRUCTION	CW	RP	TMC	19.01.2024
A	FOR CONSTRUCTION	CW	RP	TMC	22.12.2023

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ROC ENGINEERING DESIGN
Ph (02) 4244 4017
P.O. Box 216 Wollongong, NSW, 2520
Email info@rocengineering.com.au ABN 70 610 369 910

PROJECT
LEGACY MINES PROGRAM LEADVILLE MINE REMEDIATION

DRAWING TITLE
GROSVENOR DAM SITEWORKS PLAN

SCALE (A1)
0 5 10 15 20 30 60 75m
1 : 500

JOB NUMBER	DATUM	DRAWING NUMBER	REVISION
23293	AHD	C40	C

Appendix B

GHD Geohazards Assessment

Leadville Remediation Technical Oversight

Hazard Assessment Report

Department of Regional NSW (Legacy Mines Program)

08 August 2023

→ **The Power of Commitment**

Project name	Leadville Remediation Technical Oversight
Document title	Leadville Remediation Technical Oversight | Hazard Assessment Report
Project number	12588769
File name	12588769-REP_Hazard Assessment Report.docx

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S4	0	S Mackenzie	S Winchester		S Winchester		08/08/23

GHD Pty Ltd | ABN 39 008 488 373

GHD Tower, Level 3, 24 Honeysuckle Drive

Newcastle, New South Wales 2300, Australia

T +61 2 4979 9999 | **F** +61 2 9475 0725 | **E** ntlmail@ghd.com | **ghd.com**

The Power of Commitment

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1. Introduction

1.1 Background

GHD Pty Ltd (GHD) was commissioned by NSW Department of Regional NSW - Legacy Mines Program (LMP) to provide Technical Oversight of the Leadville Remediation Project (the Project). The Project is to be undertaken at the legacy Leadville Mine (the site), located approximately 500 m west of the village of Leadville and 16 km east of Dunedoo. A site location plan is presented as Figure 1 in Appendix A. Also in Appendix A are plans for the Mount Stewart, Mount Stewart Extended and Grosvenor working areas as Figures 2, 3, and 4 respectively.

The proposed remediation works broadly involve earthworks, including capping and drainage works, final landform shaping, revegetation and fencing of specific areas. Some of the remediation activities will be undertaken over and adjacent to former mine entries and/or areas of subsidence hazard associated with the abandoned underground mine workings. The Principal Works Contractor (PWC) undertaking the remediation work will be exposed to these hazards and will need to review, assess, and mitigate the associated risks.

A description of site surface conditions, as well as an overview of site geology is provided in the GHD report: *Environmental Monitoring Sampling, Analysis and Quality Management Plan* (GHD Ref. 12588769_SAQMP, Rev. 1, 31 January 2023). Information on the site's mining history is presented in Everick (2016), Fredrickson (1993) and Dickson (1963) in particular, and a collation of historical material is available from the DIGS database as report R00046075.

1.2 Purpose of this report

This report presents a hazard assessment in the form of a geotechnical assessment and subsequent advice regarding working around old mine workings and former shafts to facilitate the proposed remediation works. Specifically, advice is provided on subsidence hazards and their likelihood to assist LMP and the PWC with risk assessments and risk mitigation during the remediation works.

Aspects not included in this hazard assessment

This report does not provide assessment or advice on:

– Other geotechnical hazards such as slope instability (landslides and rock falls).
– Hazards posed to the general public or workers, other than the PWC and site inducted personnel.
– Subsidence hazards and associated safety and environmental risks post remediation project.
– Assessment of shaft seal adequacy/ durability.
– Unknown hazards. That is, subsidence hazards not listed in Table 5.1 of this report (hazard register).

1.3 Scope and limitations

This report has been prepared by GHD for *Department of Regional NSW* and may only be used and relied on by *Department of Regional NSW* for the purpose agreed between GHD and *Department of Regional NSW* as set out in Section 1 of this report. GHD otherwise disclaims responsibility to any person other than *Department of Regional NSW* arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

GHD has prepared this report on the basis of information provided by *Department of Regional NSW* and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The site walkover was limited in coverage and the location of many shafts have not been confirmed due to vegetation cover, ground disturbance, shaft backfilling or a combination of the these. As such, there is the possibility of other shafts / subsidence being present but obscured and for error in the mapped locations of shafts and mine workings.

2. Assessment methodology

The assessment comprised a desktop review, collation and georeferencing of historical plans into an ArcGIS project map and site walkover by a GHD Technical Director - Geotechnical Engineer (Sam Mackenzie) on 9 and 10 February 2023.

The desktop review included the following information types:

- Geological exploration reports including plans.
- Various historical plans of the mine workings showing shaft locations, areas of cave-in and stopes.
- Consulting reports associated with remediation.
- Aerial imagery, including historical aerial photographs from 1964, 1971, 1980, 1990, 1994, 1998 and a recent high-resolution orthophoto provided by LMP.
- Recent digital terrain model provided by LMP.

Specific references are provided in Section 6.

Before and after the site walkover, mine and geology plans, aerial photographs and the digital terrain model were imported into an ArcGIS project map and georeferenced (scaled and rotated to fit). As expected with hand drawn maps, georeferencing could only be approximated (nominally within 10 m). The high-resolution aerial orthophoto greatly aided this process and allowed visual identification (off the orthophoto) and location of some shafts to an accuracy of a few meters.

During the site walkover, mapped shaft locations and other areas of interest such as former cave-ins or existing surface anomalies were visited, with shafts located using a handheld GPS (iPad with ArcGIS Field Maps) and subsequently photographed. Selected photographs are included in Appendix B for each shaft or general shaft area (where a specific shaft location could not be confirmed). Notes regarding the location of a shaft, such as the dimensions of any surface depressions or other salient features were made and are included in Table 5.1. The extent of the walkover included all areas of mapped shafts within the Mount Stewart, Mount Stewart Extended and Grosvenor workings. The locations of these three workings are shown on Figure 1 in Appendix A; all of which are located within the project site.

Following the site walkover, field observations were compared to georeferenced maps and the subsidence hazard register in Section 5.2 finalised together with the figures in Appendix A to show:

- shaft locations
- tunnels (levels), generally only those labelled as shallower than 100 feet (about 30 m)
- recorded cave-in and reported stope areas
- subsidence hazard zones

The rationale for the subsidence hazard zones is discussed in Section 4.

3. Correlation with historical plans to identify shafts and georeferenced mine plans

Historical plans, sections and geological maps relating to mine workings were reviewed and selected maps georeferenced and compared to features such as holes and fences visible on the high-resolution orthophoto and observed during the walkover. These visible features and their correlation to named shafts, as described below, have been relied on to position non-visible shafts, mine workings and areas of reported cave-in.

A brief description of this process for each of the three mining areas is provided under the sub-headings below.

Measurements of hole dimensions for visible shafts are included in Table 5.1.

Historical aerial photograph resolution was too poor to be useful for identifying shafts, cave-ins or open cuts.

3.1 Mount Stewart workings

3.1.1 Western and Middle Lodes

Visible shafts within this mining area comprise:

– ‘Underlay Shaft’ or ’90 Feet Level’ Shaft in the Western Lode which reportedly extends (inclined) to the 90-foot level (about 27 m).

– ’50 Feet Level’ Shaft in the Western Lode which appears to be an underlay shaft (inclined) to the 50-foot level.

The above shafts are matched to visible features as shown in Figure 3.1. The Western Shaft is not visible but may be the rectangular area circled in the aerial photo in Figure 3.1.

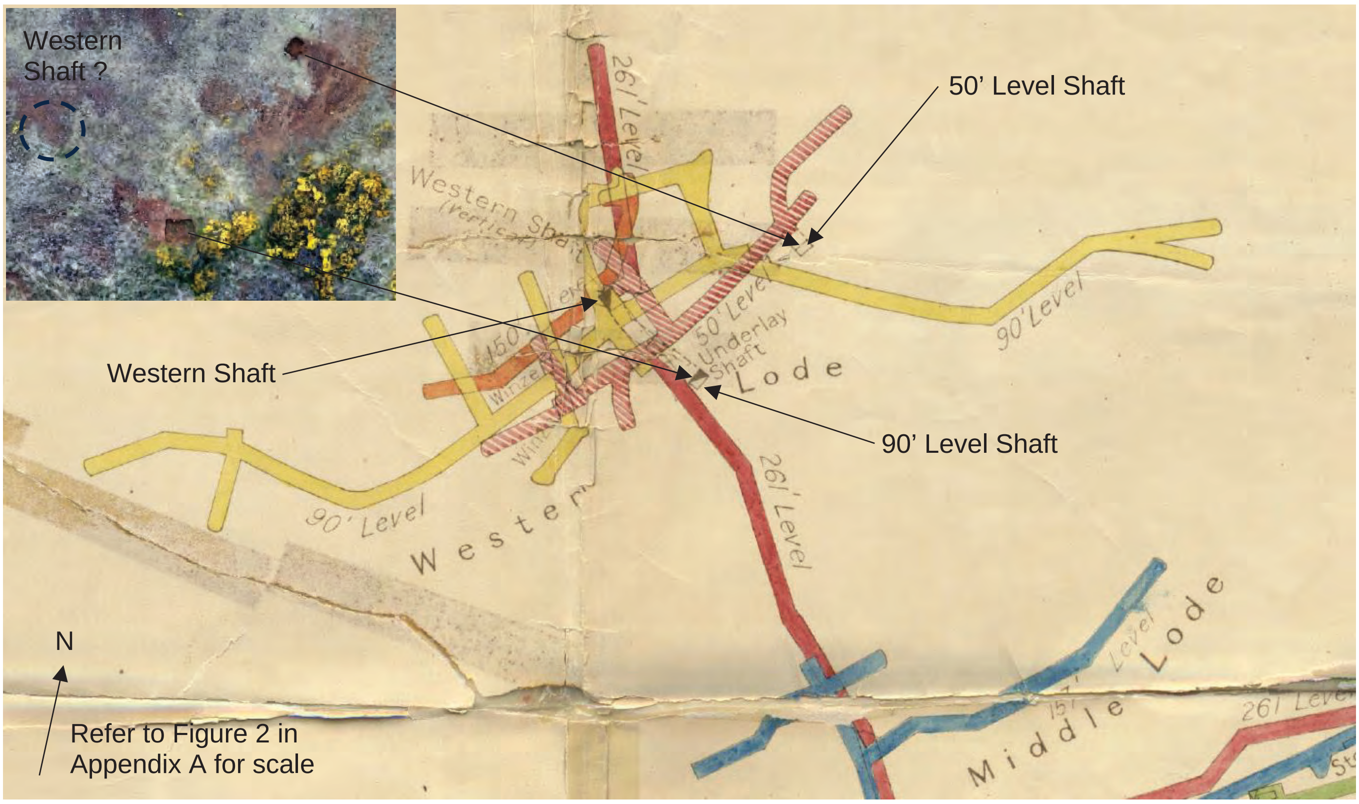

Figure 3.1 Mount Stewart Western and Middle Lode workings from ‘Plan of Mount Stewart Workings – Leadville’. 1922. In GS1922/016 (DIGS Ref. D003796350) with inset from orthophoto

A second unnamed shaft location to the north was marked by a small mound of rocks. This shaft is not shown to extend to any workings on the 1922 plan but is mapped on a 1948 geology map as shown in Figure 3.2.

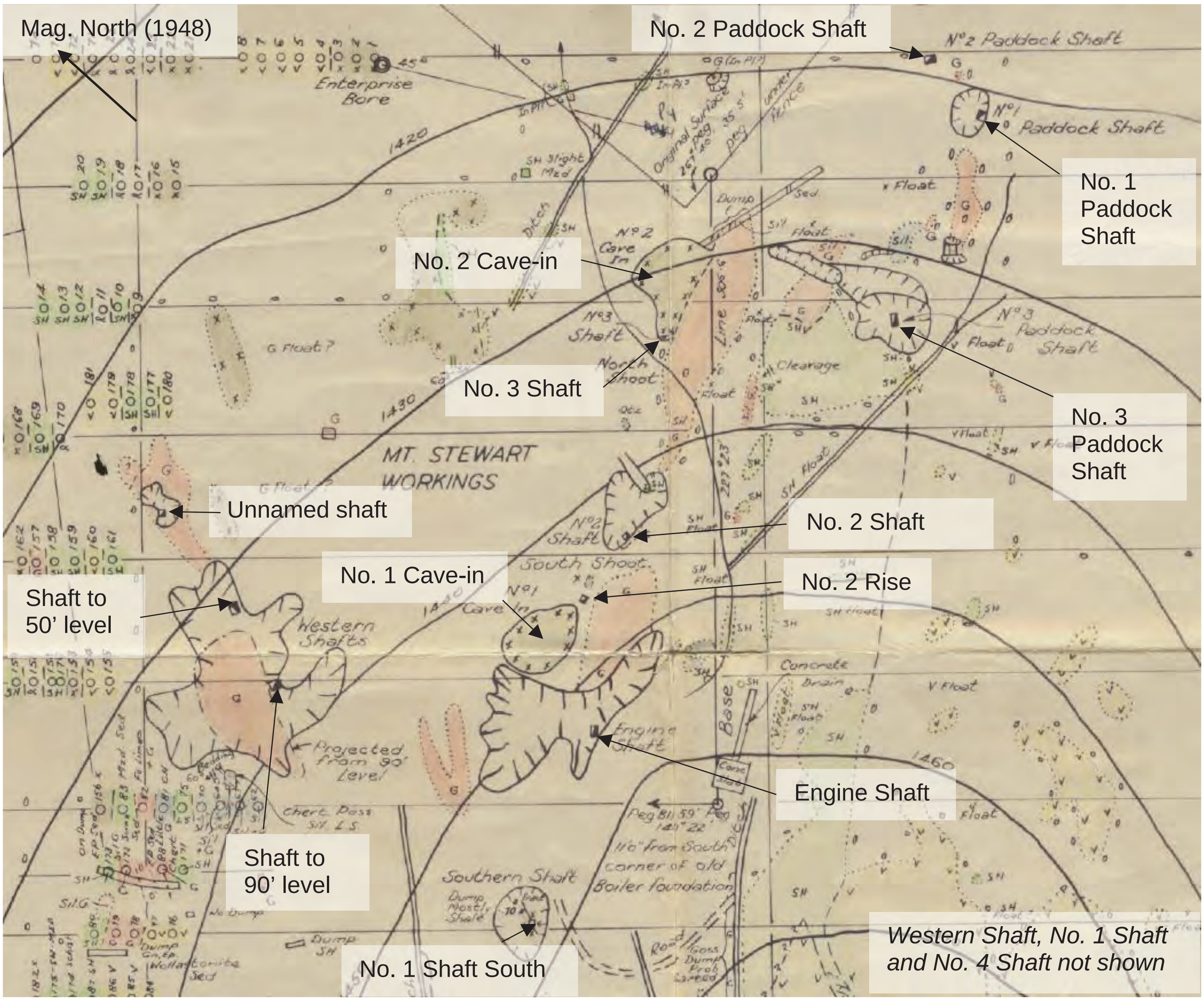

Figure 3.2 *Extract of Mount Stewart workings from 'Geological Map of Leadville – N.S.W' by The Zinc Corporation Ltd, 1948. In GS1948/008 (DIGS Ref. D00586920)*

Fordon-Bellgrove (1969, GS1970/304), referencing Willian (1925) noted that that the '90 Feet Level' shaft is shown in section as being vertical from the surface for 18 feet (5.5 m), before being inclined. However, the shaft is noted as now being underlay (inclined) from the surface toward the north-west "due to erosion of the collar". The 'erosion' of the collar noted by Fordon-Bellgrove (*ibid*) probably amounts to removal of the collar mounds which are shown around most shafts in the 1948 geology map (Figure 3.2).

The 'levels' are nominal depths referenced from the Engine Shaft datum (Fordon-Bellgrove, *ibid*). As the Engine Shaft collar is higher than other shafts (as shown in Figure 3.4), the actual depths of levels noted on mine plans below ground surface will be less than indicated. In the Western Lode area, the depth to levels below existing ground surface is generally expected to be about 3 m less than the nominal mine level depth. For example and as annotated in Figure 3.4, the '50 foot level' is more likely to be in the order of 35 feet (~11 m) below the existing ground surface.

Willan (1925) provides plans and sections of the workings following surface and underground geological mapping. These include depiction of geology at various levels as shown in Figure 3.3. In the Southern and Northern Shoots of the Eastern Lode workings, stopes are associated with what Willan labelled "silver lead gossan ore" and "pyrites ore". It follows that stoping in other areas of these ores is more likely and so these areas have been traced in the various plans and sections reproduced from Willan.

Note that Willan's labelling of the Western Shaft is in error on one occasion as shown below with this actually being the '90 Feet Level' Shaft.

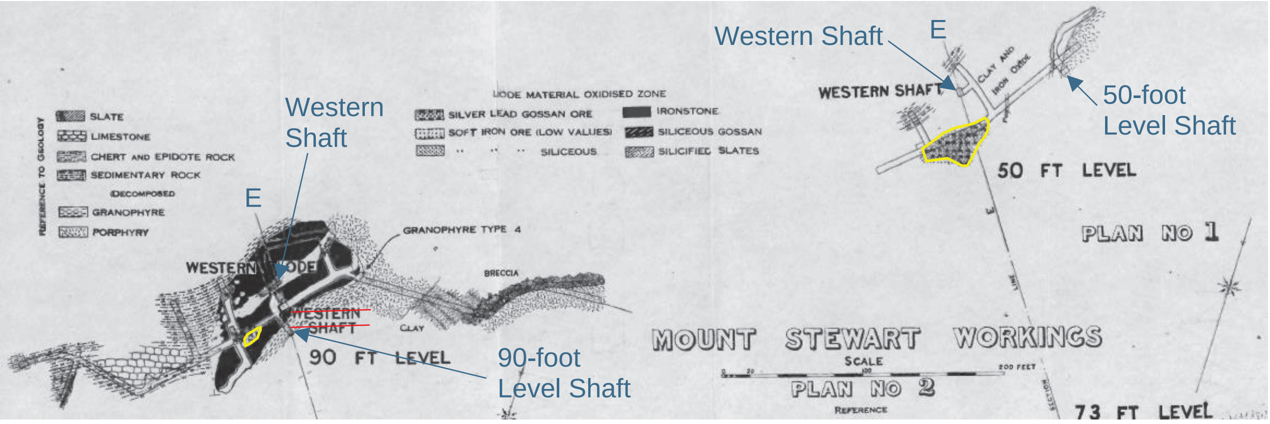

Figure 3.3 *Mount Stewart workings – Western Lode 50 to 90 foot levels after Willan (1925) with "silver lead gossan ore" area traced in yellow*

A section along "line E" is reproduced in Figure 3.4, again with "silver lead gossan ore" and "pyrites ore" areas traced in yellow and shaft names added.

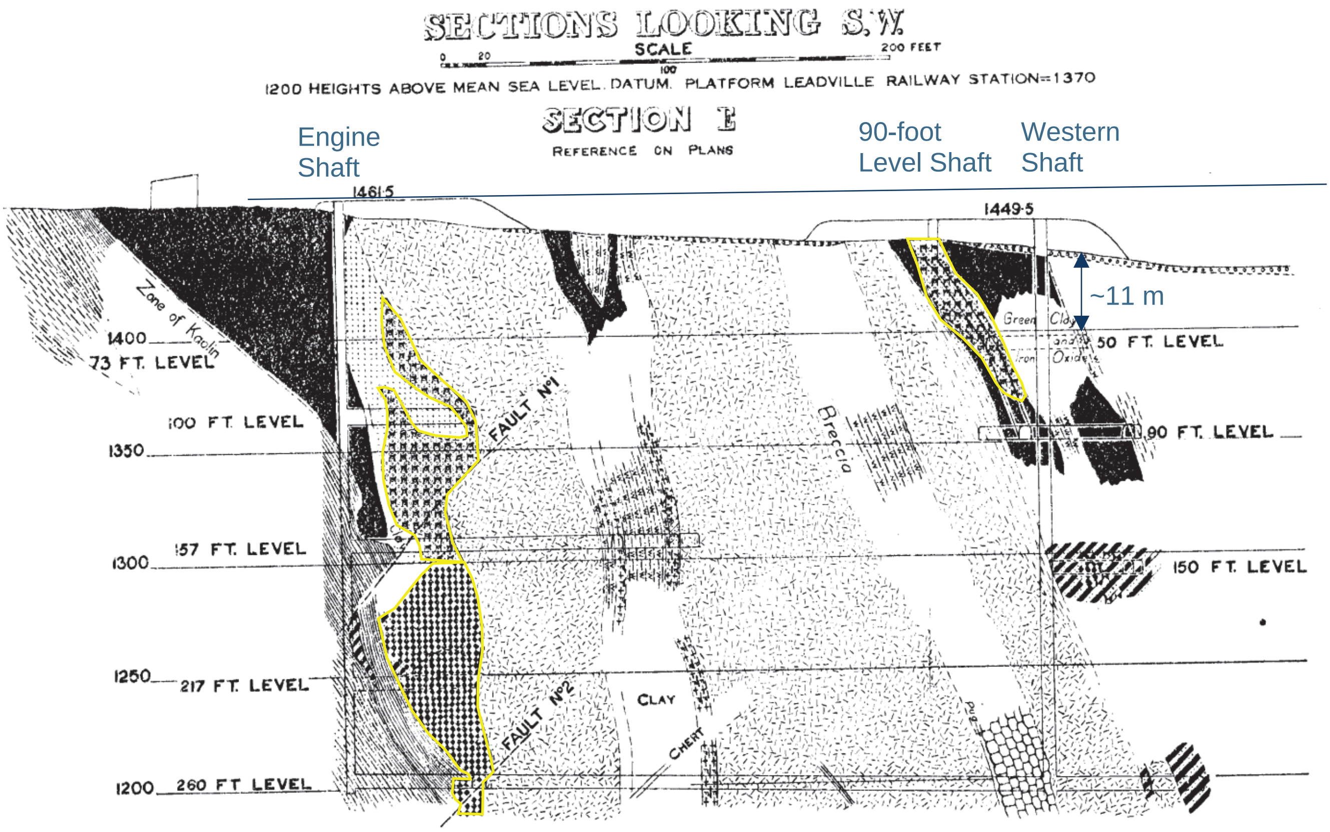

Figure 3.4 *Mount Stewart workings – Section E after Willan (1925) with "silver lead gossan ore" and "pyrites ore" areas traced in yellow*

Stoping / cave-in to the ground surface in the Western Lode area is mentioned in Fordon-Bellgrove (*ibid*) as follows: "Bad caving of the surface occurs westward from the '90' Feet Level' Shaft and may represent a collapse of the 50 feet level workings, north westward from the Western Shaft". Willan (1925) shows "silver lead gossan ore" in this area but no labelling of a stope in this area.

3.1.2 Eastern and Paddock Lodes

Visible shafts within this mining area comprise:

- 'Engine Shaft' – also known as Main Shaft
- 'No. 1 Paddock Shaft'
- 'No. 3 Paddock Shaft' (fenced and open) – also known as Burkhard's Shaft

The above shafts are matched to visible features as shown in Figure 3.5.

The No. 2 Paddock Shaft is probably marked by a pile of logs and the No. 1 Shaft South by a mound of rocks and grass beside a dead tree. The locations of other shafts and the two cave-ins and past open cuts shown on Figure 3.2 are not discernible.

Regarding the No. 3 Paddock Shaft', Fordon-Bellgrove (*ibid*) reports at least 81 feet (24.7 m) of vertical shaft was visible in 1969 and that the shaft is likely to have a 100 foot (30.5 m) vertical section as per McKeown (1951).

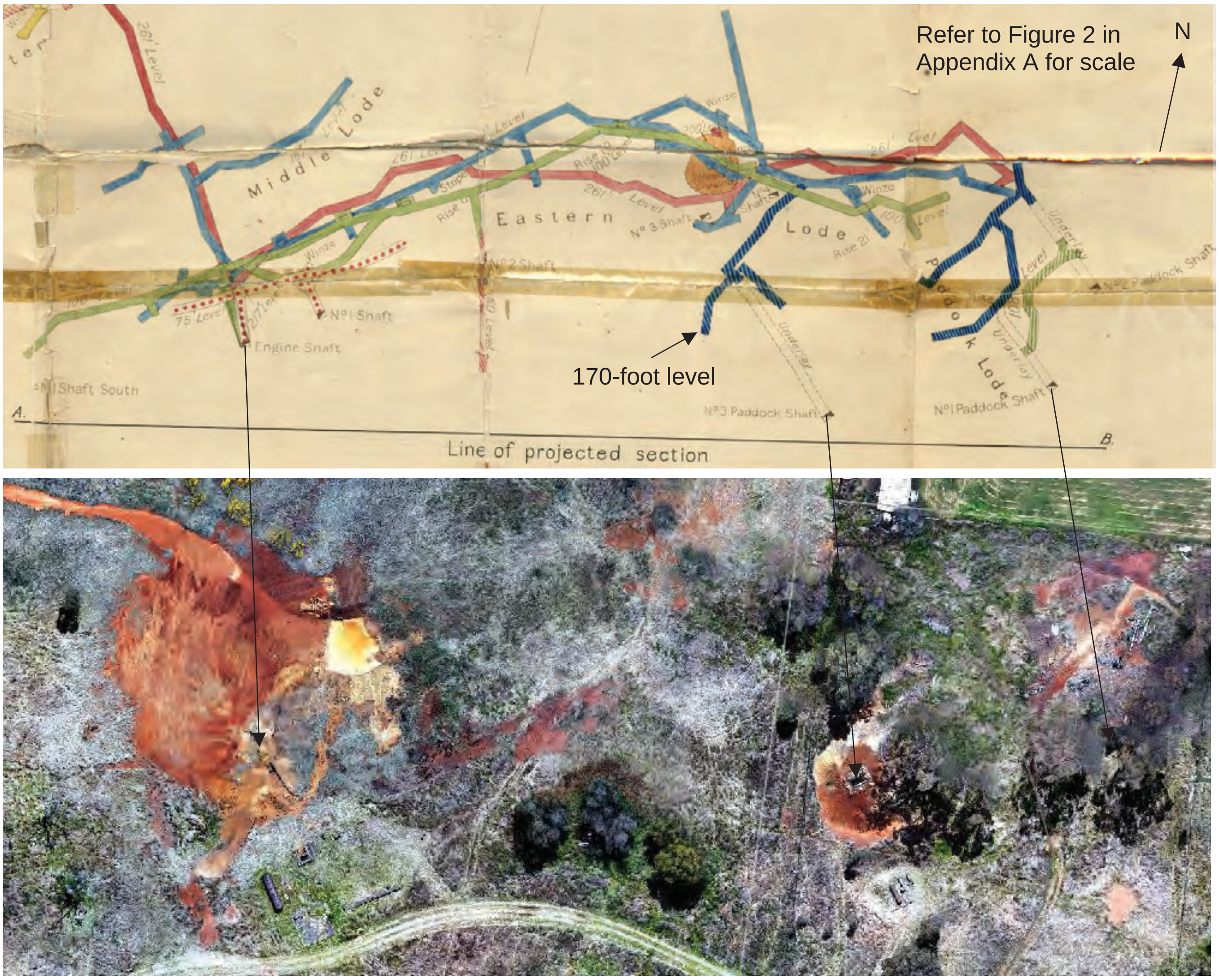

Figure 3.5 Mount Stewart Eastern and Paddock Lode workings from 'Plan of Mount Stewart Workings – Leadville'. 1922. In GS1922/016 (DIGS Ref. D003796350) and orthophoto

The noted in Section 3.1.1, 'levels' are nominal depths referenced from the Engine Shaft datum (at 1461.5 feet above mean sea level). In the Eastern Lode and Paddock Lode area, the depth to levels below existing ground surface is generally expected to be up to about 3 m less than the nominal mine level depth. For example, the 60 foot level off No. 2 Paddock Shaft is shown to be at a depth of about 50 feet (15 m) below ground surface in Figure 3.11.

The 'Line of projected section' indicated in the upper image in Figure 3.5 is included as Figure 3.6 below. Stoped ground is shown as hatching with a 'South Shoot' extending to the surface around the No. 1 Shaft and a 'North Shoot' almost reaching the surface around No. 3 and No. 4 Shafts. The 'South Shoot' corresponds to the 'No. 1 Cave-in' and the 'North Shoot' to the 'No. 2 Cave-in' shown on Figure 3.2.

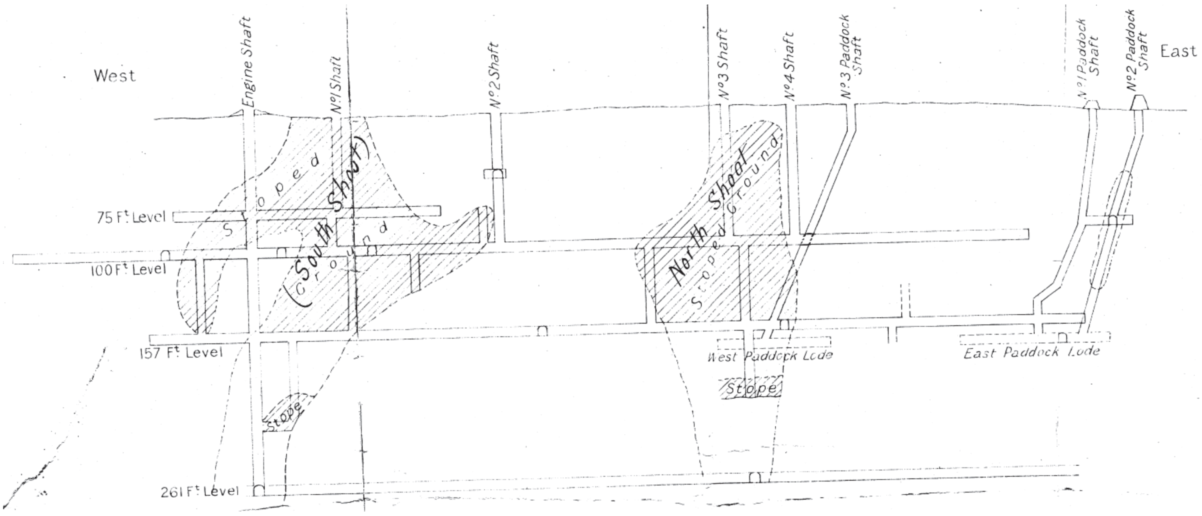

Figure 3.6 'Projected Section along Line A.B.' from GS1922/016 (DIGS Ref. D003796370)

A similar section from before 1915 and facing the opposite direction is provided in the Mine Record 0091 compilation (DIGS Ref. R00046075) and is shown in Figure 3.7. A trace of the stope outline (mirror image) from the 1922 section (Figure 3.6) is shown in red.

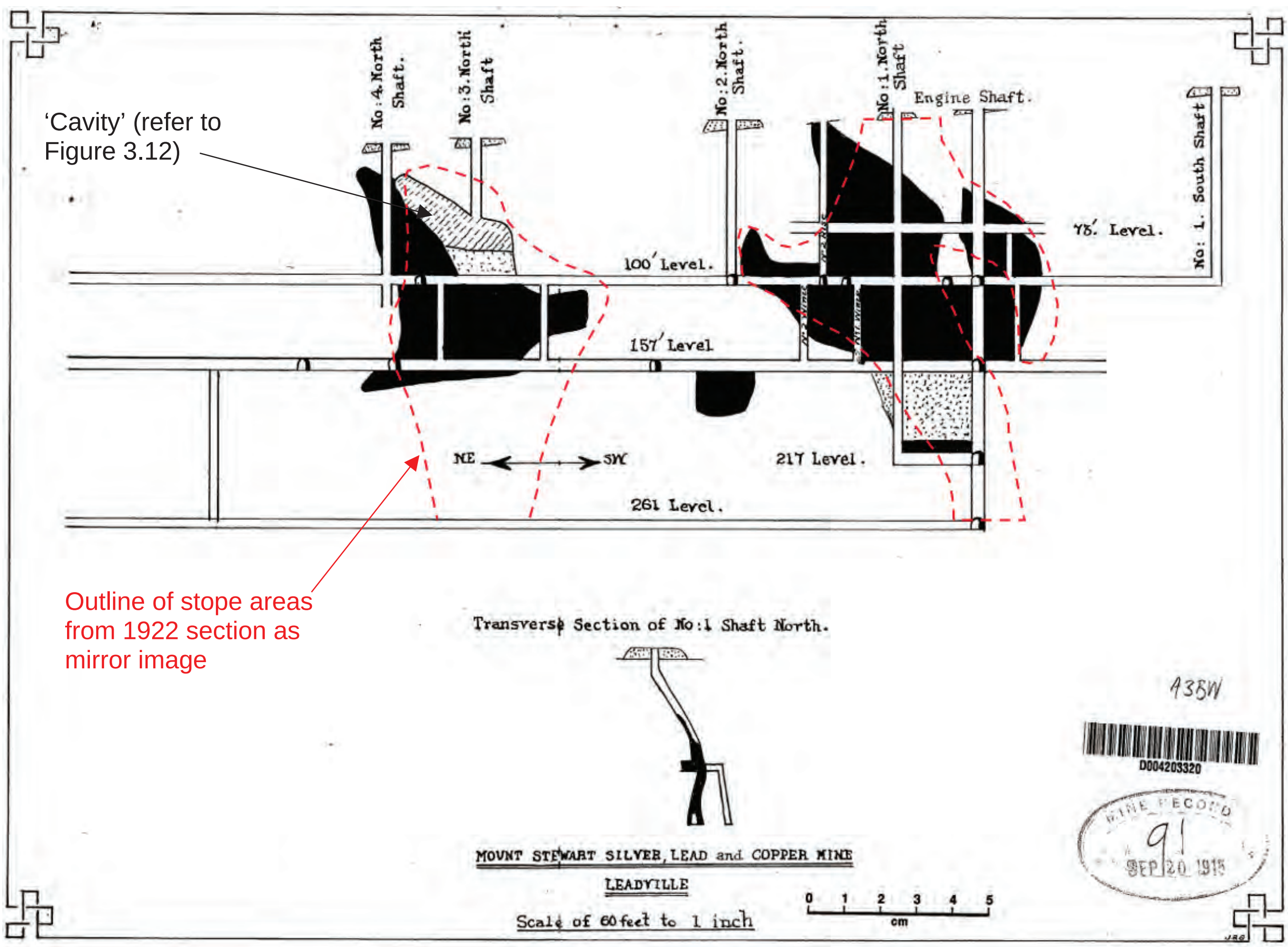

Figure 3.7 Pre 1915 section of Mount Stewart workings Eastern Lode (DIGS Ref. D004203320)

Accounting for measurement and drawing inaccuracy, the stope areas in the two sections appear similar above the 157-foot level.

The 1922 section shows additional stoping below the 157-foot level and also in the upper portions. In the South Shoot (around the Engine Shaft), both sections show the stope has progressed to the surface, although the 1922 section shows this as occurring around the No. 1 Shaft rather than the No. 2 Rise as in the pre-1915 section. The 1948 geology map (Figure 3.2) shows the cave-in at the South Shoot occurred between the No. 2 Rise and Engine Shaft and so agrees with the 1922 section. It's likely the area of cave-in started around the No. 2 Rise and extended toward the Engine Shaft but did not reach the Engine Shaft or No. 1 Shaft.

The width of stoping around the Engine Shaft at the 157-foot level is given in a 1920 report (MR 0091, p54, DIGS Ref. D004203110) to be 35 feet (10.7 m) for a length of about 40 feet (12.2 m) and up to about 17 feet (5.2 m) above the level. The same 1920 report indicates the Northern Shoot stope ("about 350' N.E. of Engine Shaft") has been stoped from the 157-foot level to the surface. At the 157 level the width is given as 35 feet. At the 205' level the width is reported as 30 feet and at 261' level only 6 feet.

Willan (1925) provides plans and sections depicting geology at various levels as shown in Figure 3.8 and Figure 3.9 with labels of 'stope' in some areas. In the Southern and Northern Shoots, the stopes are associated with what Willan labelled "silver lead gossan ore" and "pyrites ore". It follows that stoping in other areas of these ores is more likely and so these areas have been traced in the various plans and sections reproduced from Willan.

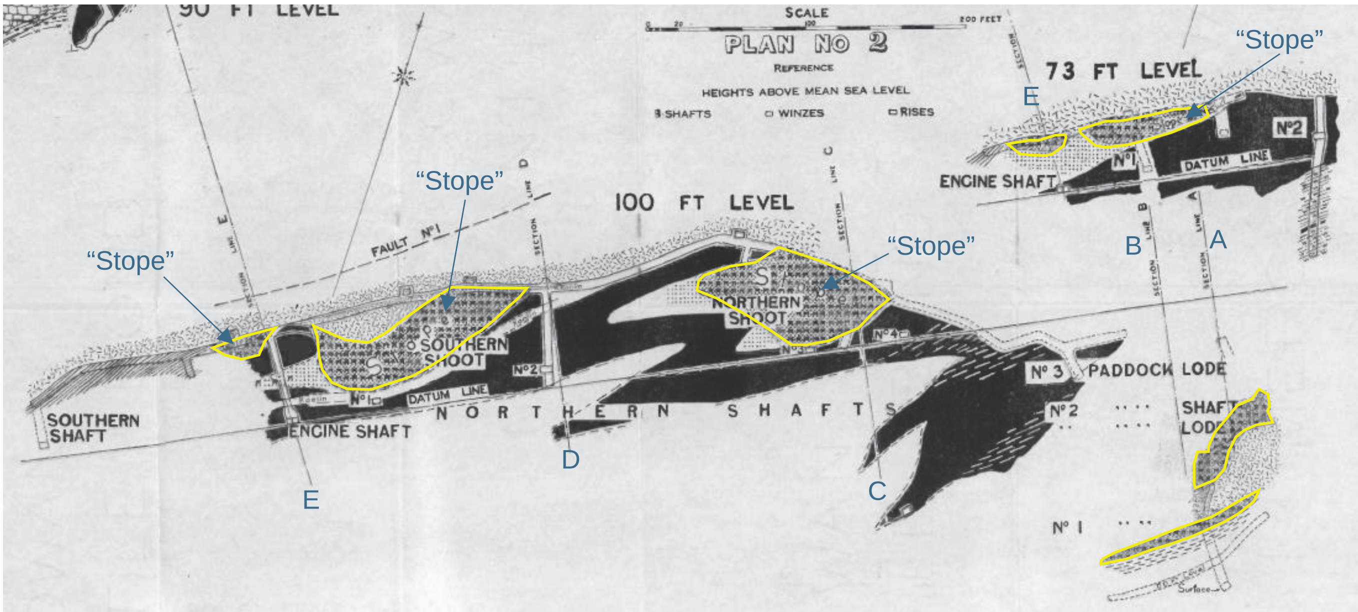

Figure 3.8 ***Mount Stewart workings Eastern Lode and Paddock Lode - 73 to 100 foot levels after Willan (1925) with "silver lead gossan ore" and "pyrites ore" traced in yellow***

Figure 3.8 shows splitting of the stope with the smaller area on section line E northwest of the Engine Shaft. The larger stope area progressed to the ground surface to form the No. 1 Cave-in as shown on Figure 3.2 from 1948.

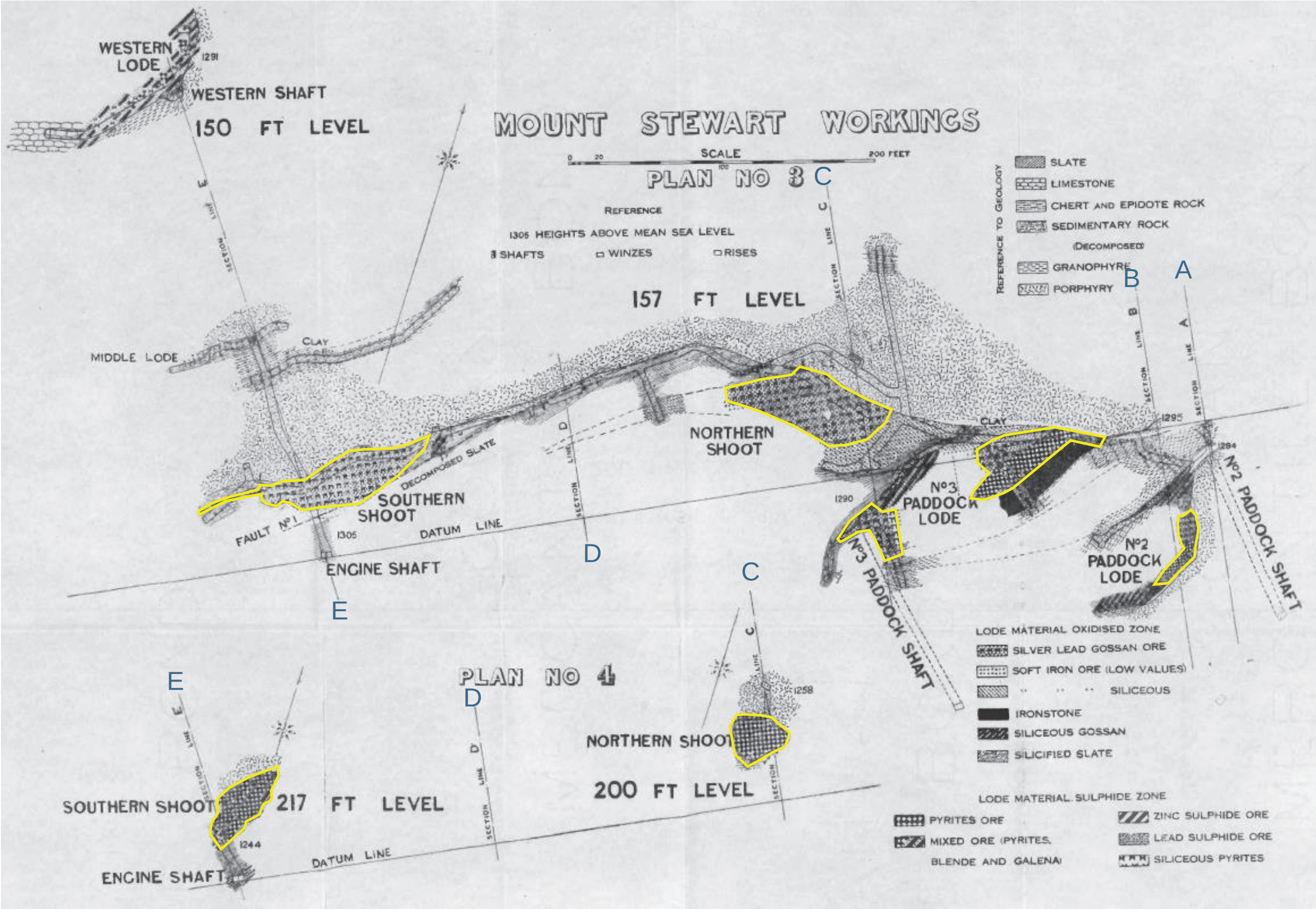

Figure 3.9 *Mount Stewart workings - 150 to 217 foot levels after Willan (1925) with "silver lead gossan ore" and "pyrites ore" areas traced in yellow*

Sections along lines C and D are reproduced in Figure 3.10 and section lines A and B in Figure 3.11, again with "silver lead gossan ore" and "pyrites ore" areas traced in yellow and shaft names added.

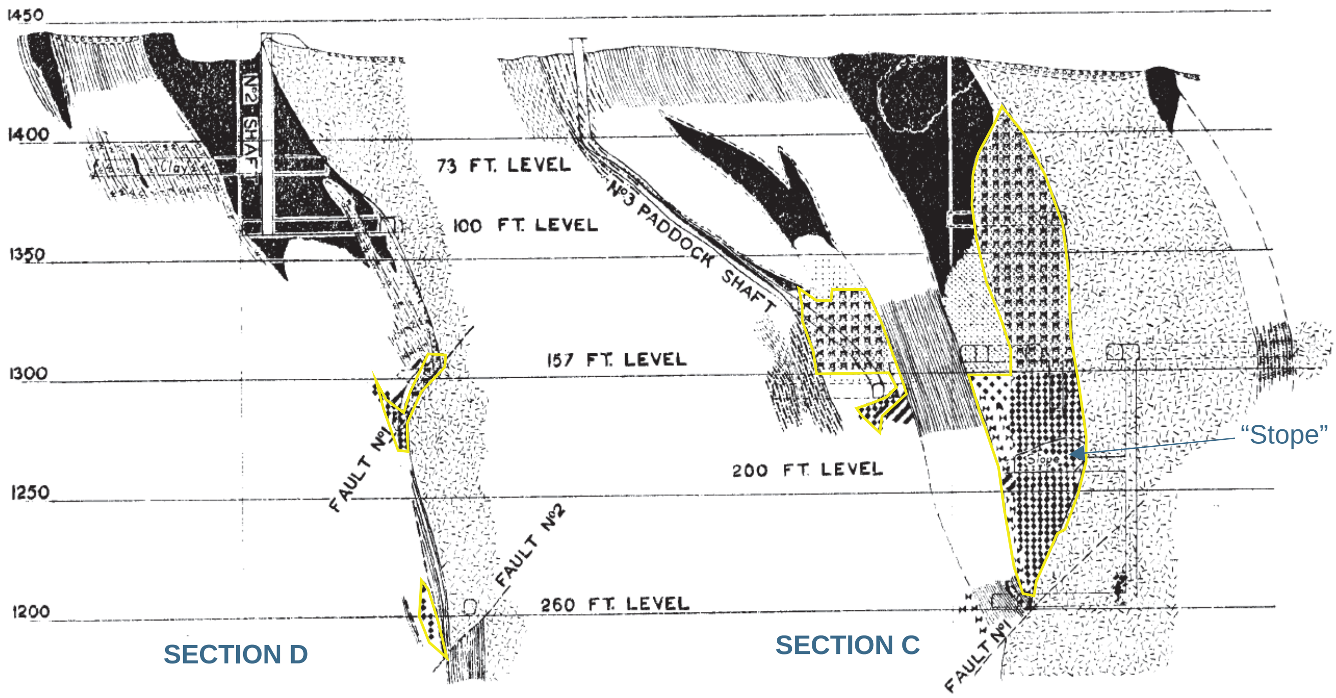

Figure 3.10 *Mount Stewart workings – Section C and D after Willan (1925) with "silver lead gossan ore" and "pyrites ore" areas traced in yellow*

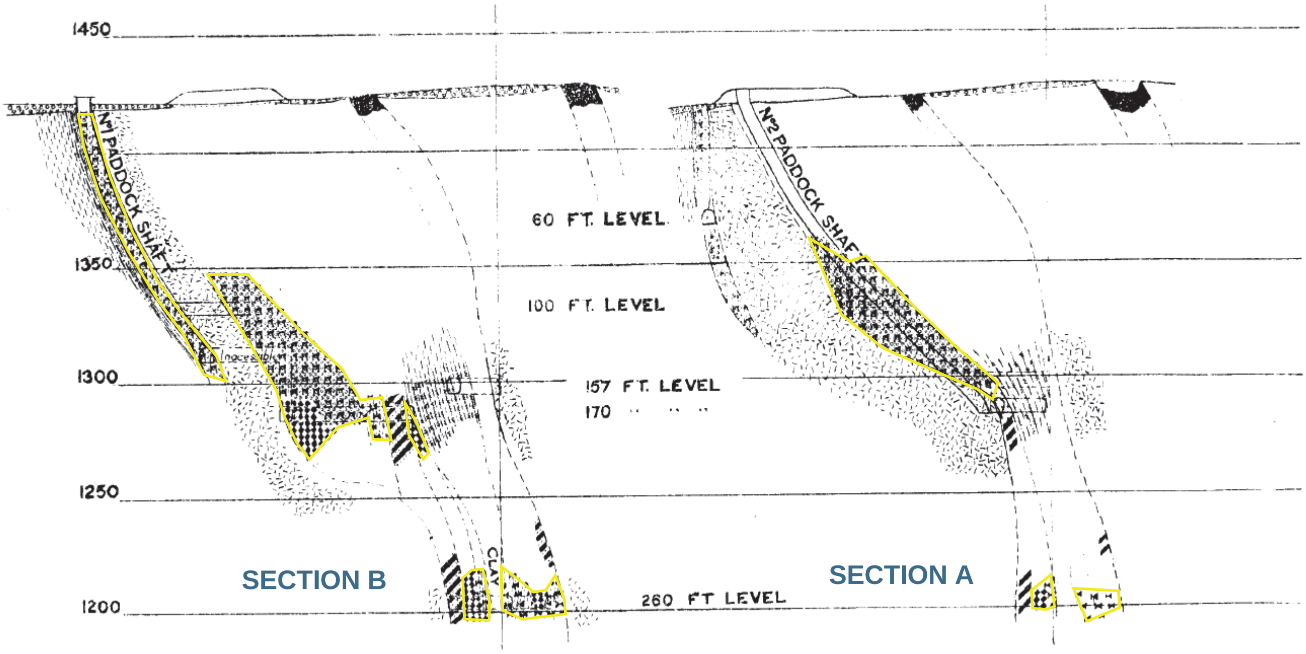

Figure 3.11 Mount Stewart workings – Section A and B after Willan (1925) with "silver lead gossan ore" and "pyrites ore" areas traced in yellow

A longitudinal section through the Eastern and No. 3 Paddock Lode is shown in Figure 3.12.

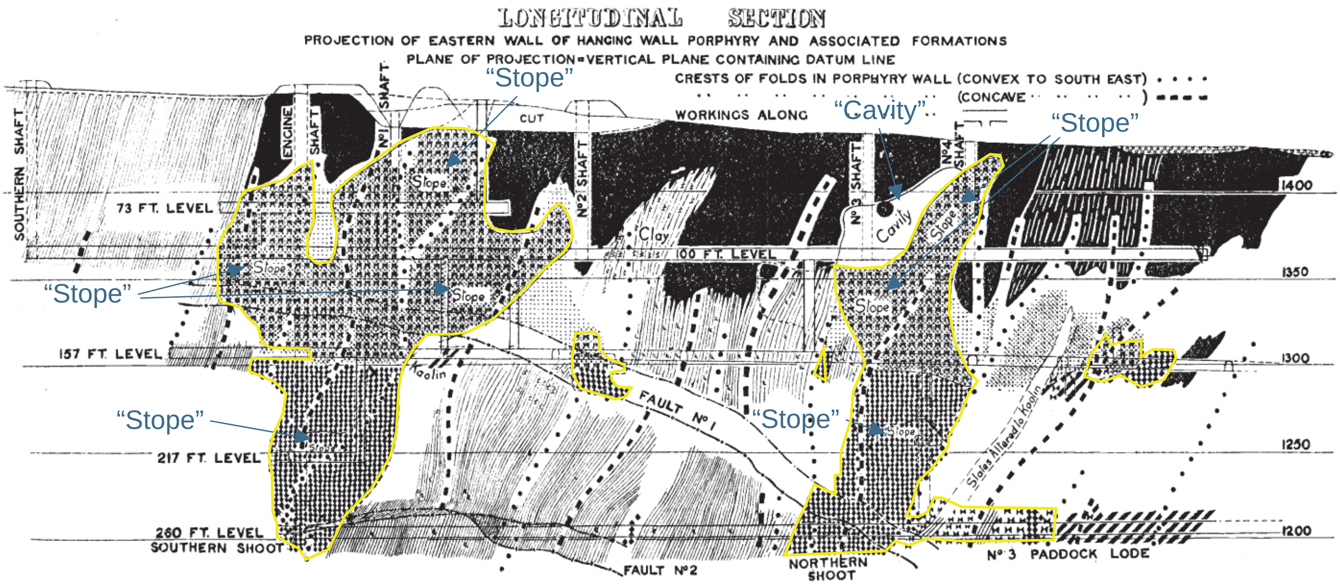

Figure 3.12 Mount Stewart workings – Eastern and No. 3 Paddock Lode longitudinal Section after Willan (1925) with "silver lead gossan ore" and "pyrites ore" areas traced in yellow

Plans of the workings at the 260-foot level is also included in Willan (1925).

3.2 Extended workings

Visible shafts within this mining area comprise:

- 'Engine Shaft' – also known as "Eastern Shaft"
- 'Blind Shaft'
- 'Copper Shaft' – also known as "Old Copper Shaft"
- 'Marshall's Shaft'

The above shafts are matched to visible features as shown in Figure 3.13. The Western Shaft is probably marked by a mound of rocks beside a tree.

Figure 3.13 Mount Stewart Extended workings from. 1922. In GS1922/016 (DIGS Ref. D003796360) and orthophoto

The 1948 geology map also shows the same shafts in this area although with slightly different names in some cases as shown in Figure 3.14.

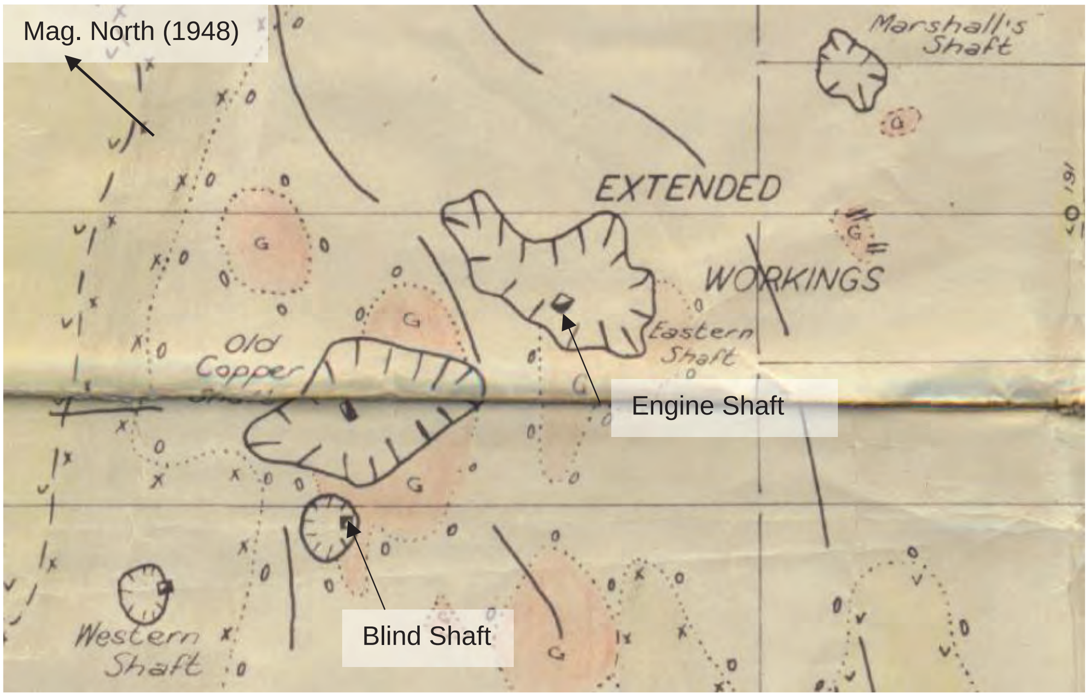

Figure 3.14 Extract of Mount Stewart Extended workings from 'Geological Map of Leadville – N.S.W' by The Zinc Corporation Ltd, 1948. In GS1948/008 (DIGS Ref. D00586920)

As noted in Section 3.1.1, 'levels' are nominal depths referenced from a datum. In the Extended Working area, the datum is the Engine Shaft (Eastern Shaft) which is given by Willan (1925) as having a collar level of 1496 feet above mean sea level. Marshall's Shaft (the lowest in the Extended workings area) has a collar 20 feet (about 6 m) lower and so the mine levels in this area are about 6 m shallower than indicated by the nominated level. For example, the 145-foot level would actually be at about 38 m depth rather than 44 m.

3.3 Grosvenor workings

Visible shafts within this mining area comprise:

– 'No. 3 Shaft'
– 'No. 4 Shaft'
– 'No. 5 Shaft'

The above shafts are matched to visible features as shown in Figure 3.15. Mining lease and portion boundaries and fence lines were used to assist in georeferencing of mine plans, but no physical boundary markers were observed. It was assumed that the visible fences are consistent with mapped portion boundaries.

As noted in Section 3.1.1, 'levels' are nominal depths referenced from a datum. In the Grosvenor area, the datum is the No. 4 Shaft with a collar level of about 1494 feet above mean sea level (Willan, 1925). The other shafts have similar or high collar levels and to the actual depth below ground surface to the mine levels is expected to be as indicated or slightly deeper.

Figure 3.15 Mount Stewart Extended workings from. 1922. In GS1922/016 (DIGS Ref. D003796380) and orthophoto

The 1948 geology map also shows the same shafts in this area although with slightly different names in some cases and two rises becoming the Rabbit and Wheat Shafts as shown in Figure 3.16.

Figure 3.16 Extract of Grosvenor workings from 'Geological Map of Leadville – N.S.W' by The Zinc Corporation Ltd, 1948. In GS1948/008 (DIGS Ref. D00586920) correlation to Grosvenor plan DIGS Ref. D003796380

Willan (1925) provides plans and sections depicting geology as shown in Figure 3.17. In the Southern and Northern Shoots of the Mount Stewart workings, stopes are associated with what Willan labelled “silver lead gossan ore” and “pyrites ore”. It follows that stoping in other areas of these ores is more likely and so these areas have been traced in the various plans and sections reproduced from Willan.

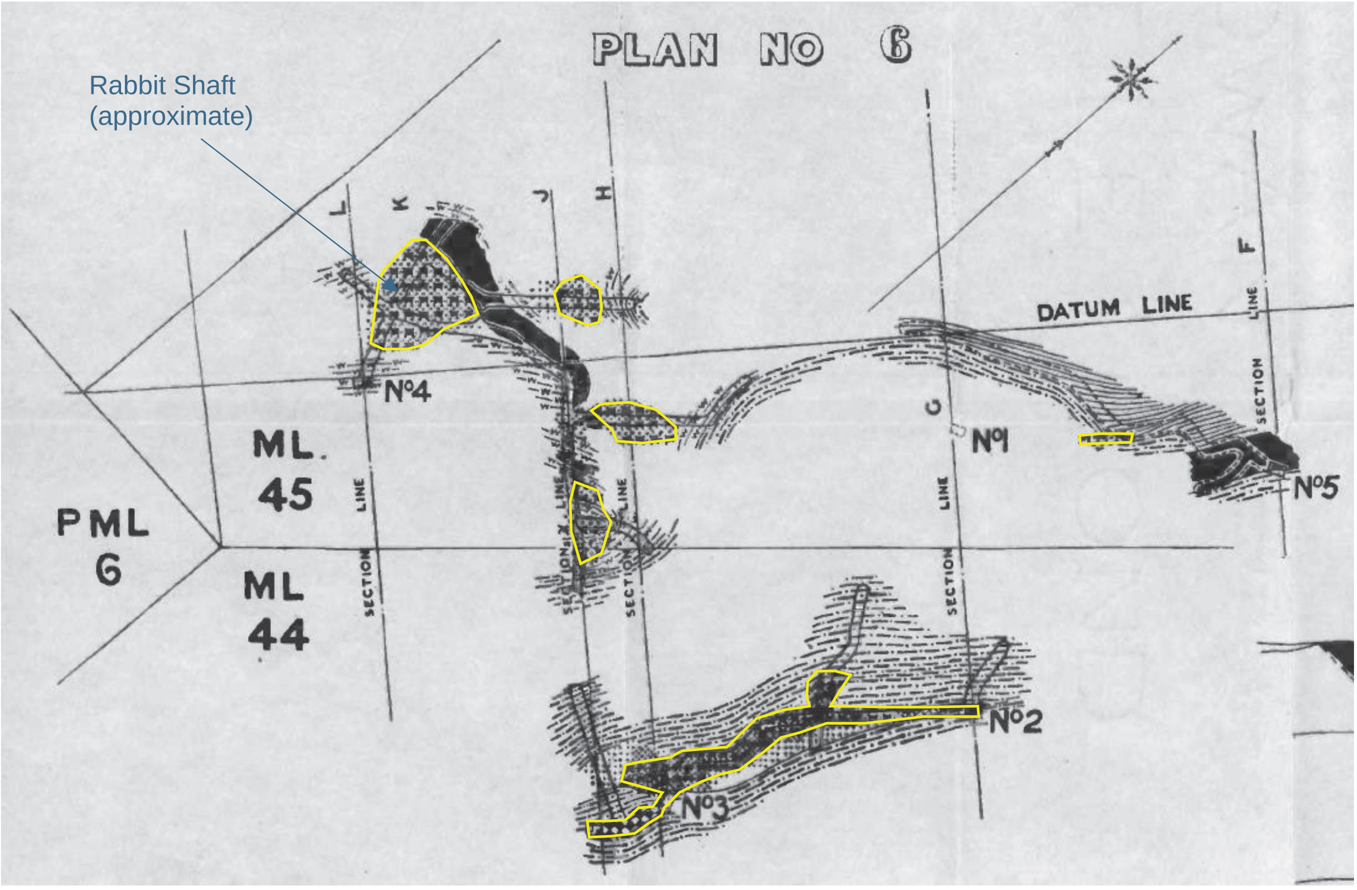

Figure 3.17 Grosvenor workings - after Willan (1925) with "silver lead gossan ore" and "pyrites ore" traced in yellow

A 12 July 1950 mine inspection report by Inspector Edwards (MR 0091, DIGS Ref. D004203190) mentions a 6 m (20 foot) by 4.6 m (15 foot) surface subsidence of 4.6 m depth (20 foot) between the No. 4 Shaft and Rabbit Shaft at the Grosvenor workings. As shown in Figure 3.18, this is where "silver lead gossan ore" is shown in section K to extend to about 2 m from the ground surface and may be where stoping was undertaken after 1925.

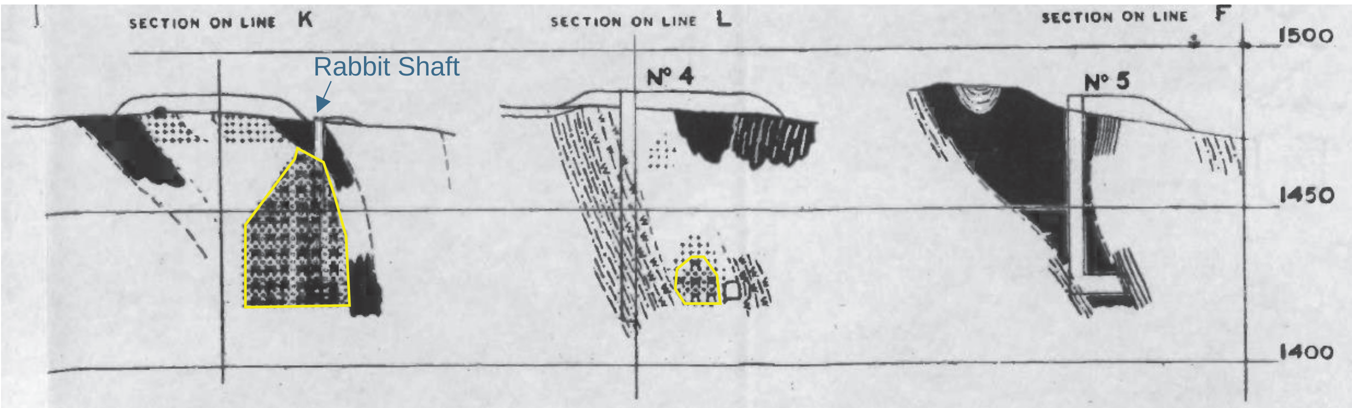

Figure 3.18 Grosvenor workings – Section lines K, L and F after Willan (1925) with "silver lead gossan ore" and "pyrites ore" traced in yellow

4. Historical filling of shafts and subsidence features

As reported in Fordon-Bellgrove (1969, GS1970/304), active mining of ore ceased in the early 1950's but in 1952 the mine was unwaterered (dewatered) and the main shaft (Mount Stewart Engine Shaft) re-timbered from the surface and a "considerable amount" of repair work was completed in the north-east drive on the 260-foot level.

Fordon-Bellgrove (*ibid*) also reports that following relinquishment of mining titles in 1966: "the dangerously caved areas were also fenced and the old shafts were either filled or covered with heavy timber". A summary of comments relating to shafts and caved areas is provided in Table 4.1.

Table 4.1 Summary of shaft and cave-in filling as per Fordon-Bellgrove (1969, GS1970/304),

<table>
<tr><th>Area</th><th>Feature label</th><th>Reported for 1969</th></tr>
<tr><td rowspan="5">Mount Stewart
Western Lode</td><td>Western Shaft</td><td>Filled at surface</td></tr>
<tr><td>Shaft to 90' level</td><td>Open – single compartment 4'6" x 4'6", partly collapsed</td></tr>
<tr><td>Shaft to 50' level</td><td>Open – single compartment 2'8" x 4'2", partly collapsed</td></tr>
<tr><td>unnamed shaft</td><td>Filled at surface</td></tr>
<tr><td>50' Level</td><td>"Bad caving of the surface occurs westward from the '90' Feet Level' Shaft and may represent a collapse of the 50 feet level workings, north westward from the Western Shaft"</td></tr>
<tr><td rowspan="9">Mount Stewart
Main/ Lode</td><td>No.1 South Shaft</td><td>Filled at surface</td></tr>
<tr><td>Engine Shaft</td><td>Open – water at 105 feet (32 m)</td></tr>
<tr><td>No.1 Shaft</td><td>Filled at surface</td></tr>
<tr><td>No.2 Shaft</td><td>Filled at surface</td></tr>
<tr><td>No.3 Shaft</td><td>Open – partly collapsed</td></tr>
<tr><td>No.4 Shaft</td><td>Open – extensive caving. "The ground is in a dangerous state, probably as a consequence of the extensive stoping that has taken place directly below, from the 157 feet level upwards to a few feet from the surface"</td></tr>
<tr><td>No.2 Rise (surface)</td><td>Not mentioned</td></tr>
<tr><td>No.1 stope / cave</td><td>"The ground, 50 to 100 feet to the north-east of the Engine Shaft or Main Shaft is caved at the surface. This is probably due to a collapse of the stope workings directly below it."</td></tr>
<tr><td>No.2 stope / cave</td><td>Not mentioned</td></tr>
<tr><td rowspan="3">Mount Stewart
Paddock Lode</td><td>No.1 Paddock Shaft</td><td>Filled at surface</td></tr>
<tr><td>No.2 Paddock Shaft</td><td>Filled at surface</td></tr>
<tr><td>No.3 Paddock Shaft</td><td>Open - water at 82 feet (25 m)</td></tr>
<tr><td rowspan="8">Grosvenor</td><td>Rabbit Shaft</td><td>Filled at surface</td></tr>
<tr><td>Wheat Shaft</td><td>Filled at surface</td></tr>
<tr><td>No.1 Shaft</td><td>Filled at surface</td></tr>
<tr><td>No.2 Shaft</td><td>Filled at surface</td></tr>
<tr><td>No.3 Shaft</td><td>Filled at surface</td></tr>
<tr><td>No.4 Shaft</td><td>Open - water at 55 feet (~17 m). Three compartment 8'0" x 4'0"</td></tr>
<tr><td>No.5 Shaft</td><td>Filled at surface</td></tr>
<tr><td>Cave-in</td><td>Not mentioned</td></tr>
</table>

Area	Feature label	Reported for 1969
Extended	Western Shaft	Filled at surface
	Copper Shaft	Filled at surface
	Blind Shaft	*Not mentioned*
	Engine Shaft	Open to about 61 feet (~19 m). Single compartment 3’ x 5’
	Marshall’s Shaft	Filled at surface

Pietsch (1988) makes no mention of shaft filling as this report is for relinquishment of an exploration lease rather than a mining lease.

Fredrickson (1993) includes a letter dated 17 March 1993 to the Department of Mineral Resources from the Department of Conservation and Land Management which briefly mentions open shafts, but no details are given. El-Chamy (1993) also includes mention of filling dangerous mine shafts and includes some photos of open shafts but no details.

Land and Water Conservation (1996) provides a summary of rehabilitation work carried out which included burial of overburden in underground shafts with heaping and sealing with 0.3 m of impervious clay. Only two shafts (presumable the Engine Shaft and No. 3 Paddock Shaft) were left open.

Of the eight shafts open in 1969, six are expected to be filled in 1995 / 1996, with these probably being the:

– Shaft to 90' level – Mount Stewart workings
– Shaft to 50' level – Mount Stewart workings
– No.3 Shaft – Mount Stewart workings
– No.4 Shaft – Mount Stewart workings
– No.4 Shaft – Grosvenor workings
– Engine Shaft – Extended workings

From the site visit on 9th and 10th February 2023, some 28 years later, the fill within Shaft to 90' level and Shaft to 50' level were found to have subsided up to about 0.8 m and 1.4 m respectively. The No. 4 Shaft of the Grosvenor workings has subsided up to about 0.4 m and the Extended workings Engine Shaft about 1.4 m.

Observations of other visible shafts made on 9th and 10th February 2023 are provided in Table 5.1.

5. Identified subsidence hazards and zones

5.1 Subsidence hazards register and map

The subsidence hazards identified are listed in Table 5.1 and their locations shown on the figures in Appendix A. Selected photographs of hazards or the general area where they are mapped are provided in Appendix B.

The type of hazard is listed as:

- **Shaft**: a vertical or steeply inclined (underlay) passage for people, ore or waste rock connecting with the surface. Shafts are distinguished from a 'pass' or 'winze' / 'raise' which are between levels (tunnel mine workings). In some cases, a pass may be converted to a shaft as is the case for the Rabbit and Wheat Shafts of the Grosvenor workings and the 'No. 2 Rise' of the Mount Stewart workings.
- **Tunnel**: horizontal mine working passages called levels along the lode and connecting shafts and passes (winzes and rises/raises).
- **Cave-in:** Where the rock above the mine workings has collapsed (caved) and propagated to the surface. The two cave-in locations at Mount Stewart are associated with stopes. The cave in at the Grosvenor workings may be due to stoping or could simply be collapse of the rock above a level, underlay shaft or cross-cut.
- **Unknown:** While many surface anomalies such as shallow depressions and piles of rocks were observed and may indicate other shafts, cave-ins or backfilled open cuts, two features in the Grosvenor workings area were noteworthy as they appeared likely to be a shaft in the case of #103 and a cave-in in the case of #104.

The visibility of the hazard relates to observed conditions during the site visit on 9 and 10 February 2023. The term 'not visible' is used where a shaft is shown on plans but no positive indications of it were observed on site. The locations of such hazards are therefore known with less certainty.

The approximate coordinates of identified shafts are provided in Table 5.2.

Table 5.1 Register of identified subsidence hazards within the project boundary

Area	Feature label	Type	Visibility	Source	Comment
Mount Stewart Western Lode	Western Shaft	Shaft	Not visible	2, 3	Rocky and fla.t
	Shaft to 90' level	Shaft	Visible	2, 3, 9	~3 m diameter and up to 0.8 m deep.
	Shaft to 50' level	Shaft	Visible	3, 9	1.2 by 1.9 m, up to 1.4 m deep.
	unnamed shaft	Shaft	Not visible	7	Probably bowl depression in grass, ~4 m diameter, up to 0.3 m deep.
	50' Level	Tunnel	Not visible	6	Connects to 'Shaft to 50' level' and 90' level via two winzes.
	90' Level	Tunnel	Not visible	6	-
Mount Stewart Main/ Lode	No.1 South Shaft	Shaft	Not visible	3, 4	Probably mound beside dead tree.
	Engine Shaft	Shaft	Visible	2, 3, 9	Mound subsided by ~ 0.5 to 1 m in centre.
	No.1 Shaft	Shaft	Not visible	2, 3	Possibly water filled depression.
	No.2 Shaft	Shaft	Not visible	2, 3	-
	No.3 Shaft	Shaft	Not visible	2, 3	-
	No.4 Shaft	Shaft	Not visible	2, 3	Possibly bare rocky ground beside fence.
	No.2 Rise (surface)	Shaft	Not visible	4	-
	No.1 stope / cave	Cave-in	Not visible	5, 6, 7, 9	Cave-in depression near Shaft No. 1.
	No.2 stope / cave	Cave-in	Visible	5, 6, 7, 9	Cave-in. Currently settling area within mound near Shaft No. 3.
	50' Level	Tunnel	Not visible	5, 6	Connects to Shaft No.2.
	75' Level	Tunnel	Not visible	5, 6	Connects to Engine Shaft and Shaft No.1.
	100' Level	Tunnel	Not visible	3, 5, 6	Connects all shafts in Main/Eastern Lode.

Area	Feature label	Type	Visibility	Source	Comment
Mount Stewart Paddock Lode	No.1 Paddock Shaft	Shaft	Visible	2, 3, 6, 9	1.2 by 2.2 m, 0.2 to 0.3 m rock fill settlement.
	No.2 Paddock Shaft	Shaft	Not visible	2, 3, 6	Possibly beside logs and rocks.
	No.3 Paddock Shaft	Shaft	Visible	2, 6, 9	Fenced and timbered. 1.6 by 2.8 m. Greater than 10 m depth to water.
	100’ Level	Tunnel	Not visible	5, 6	Joins to ‘No.2’ and ‘No.3’ paddock shafts.
Grosvenor	Rabbit Shaft	Shaft	Not visible	1, 7	Former rise.
	Wheat Shaft	Shaft	Not visible	1, 7	Former rise.
	No.1 Shaft	Shaft	Not visible	1, 3	Beside rocky outcrop. Possibly two shafts.
	No.2 Shaft	Shaft	Not visible	1, 3, 9	Grassed. Possibly two shafts.
	No.3 Shaft	Shaft	Visible	1, 9	Backfilled, meshed. Shallow depression ~ 4m toward tank possible 2nd shaft.
	No.4 Shaft	Shaft	Visible	1, 9	1.1 by 2.2 m depression, up to 0.4 m deep.
	No.5 Shaft	Shaft	Visible	1, 3, 9	1.7 by 3 m, up to 0.4 m deep.
	Cave-in	Cave-in	Not visible	10	20 ft by 15 ft and 20 ft deep between No.4 Shaft and Rabbit Shaft.
	#103	Unknown (cave-in)	Visible	9	~ 1 m by 10 m linear depression, ~ up to 0.8m deep with crack in rock.
	#104	Unknown (shaft)	Visible	9	Steep sided depression in grass, ~ 1.2 m diameter and 0.6 m deep. Adjacent to #103.
	60’ Level	Tunnel	Not Visible	1	Connects from No.5 Shaft.
	50’ Level	Tunnel	Not Visible	1	Connects from No.2 Shaft.
	90’ Levels	Tunnels	Not Visible	1	Two tunnels. One connects to No.2 and No.3 shafts, the other No.4, Rabbit and Wheat Shafts.
Extended	Western Shaft	Shaft	Not Visible	3	Pile of rocks with nearby depression (trench).
	Copper Shaft	Shaft	Visible	2, 3, 9	1.6 by 2.4 m, up to 0.6 m deep. Undercut on side.
	Blind Shaft	Shaft	Visible	2, 3, 9	1.2 by1.6 m, up to 0.5 m deep.
	Engine Shaft	Shaft	Visible	2, 3, 9	Mesh over. 1.7 by 2.7 m, up to 1.4 m deep.
	Marshall’s Shaft	Shaft	Visible	2, 3, 9	1.2 by 1.6 m, up to 1.4 m deep.

Information sources:

1. Plan 3267 Leadville; Grosvenor workings Rescanned (D005124501). 1915.
2. Map 3268 Geology SW of Leadville Rescanned (D005124511). 1915.
3. Plan of Workings Mt Stewart Leadville. Dickson, T.,1963 – page 109
4. Mount Stewart Silver, Lead and Copper Mine Leadville. 1915. Dickson, T.,1963 – page 116
5. Projected Section along Line A.B. Dickson, T.,1963 – page 119
6. Plan of Mount Stewart Workings. Dickson, T.,1963 – page 121
7. Geological map of Leadville-NSW. Berning, J., 1948 – page 29
8. Plan of Extended Workings Mount Stewart. *undated*
9. Observed by GHD during site visit on 9th and 10th February 2023
10. Mine Record MR.0091 "247. Mount Stuart zinc - Leadville - Inspected 25/7/57" Page 85 of Mt_Stewart_Mine,_Leadville,_Gulgong_(R00046075) 2020-01-23

Table 5.2 Approximate coordinates of identified shafts (MGA 2020 zone 55)

Area	Shaft label	Easting (m)	Northing (m)	Estimated accuracy (m)[1]
Mount Stewart Western Lode	Western Shaft	739879	6454560	± 4.0
	Shaft to 90' level	739890	6454551	± 1.5
	Shaft to 50' level	739901	6454568	± 1.5
	unnamed shaft to north	739910	6454596	± 4.0
Mount Stewart Main/ Lode	No.1 South Shaft	739873	6454465	± 4.0
	Engine Shaft	739922	6454478	± 1.5
	No.1 Shaft	739939	6454486	± 4.0
	No.2 Shaft	739974	6454498	± 4.0
	No.3 Shaft	740024	6454510	± 4.0
	No.4 Shaft	740039	6454516	± 4.0
	No.2 Rise (surface)	739953	6454500	± 4.0
Mount Stewart Paddock Lode	No.1 Paddock Shaft	740101	6454478	± 1.5
	No.2 Paddock Shaft	740113	6454500	± 4.0
	No.3 Paddock Shaft	740048	6454469	± 1.5
Grosvenor	Rabbit Shaft	739482	6454313	± 4.0
	Wheat Shaft	739498	6454325	± 4.0
	No.1 Shaft	739537	6454337	± 4.0
	No.2 Shaft	739562	6454314	± 4.0
	No.3 Shaft	739545	6454287	± 1.5
	No.4 Shaft	739485	6454302	± 1.5
	No.5 Shaft	739566	6454357	± 1.5
	#103	739537	6454322	± 1.5
	#104	739540	6454325	± 1.5
Extended	Western Shaft	739595	6454141	± 4.0
	Copper Shaft	739633	6454133	± 1.5
	Blind Shaft	739621	6454125	± 1.5
	Engine Shaft	739665	6454113	± 1.5
	Marshall’s Shaft	739720	6454098	± 1.5

1. Based on perceived error from high resolution orthophoto matching to visible shafts and overlaying of historical mine plans where shafts were not visible in the orthophoto

5.2 Hazard zones

The zones associated with each identified hazard are shown on Figures 2, 3 and 4 in Appendix A. These hazard zones are larger than the hazard features mapped to reflect uncertainty in their locations and / or the potential extent of subsidence associated with the feature.

For visible shafts, circular ‘specific’ hazard zones of 3 m diameter have been used. For non-visible shafts, circular specific hazard zones of 8 m diameter are used. While visible, the locations of shafts have not been surveyed. The establishment of specific hazard zone flagging / fencing should be based on the actual observed feature rather than locations scaled off plans or coordinates taken from spatial databases where survey has not been undertaken. Where not-visible, the coordinates extracted from this report can be used to ‘peg-out’ feature locations and establish flagging / fencing. Flagging / fencing should surround the hazard zone with the addition of at least a 1 m wide buffer. For example, fencing around a 3 m diameter hazard zone would be at least 5 m in diameter.

In addition to the specific hazard zones, general subsidence hazard zones are also provided to address the potential for future cave-ins associated with tunnels (levels) marked as less than 100 feet (about 30 m) and stopes that may extend above them. Additionally, lengths of inclined underlay shafts above 100-foot levels are also included as general subsidence hazard zones.

As noted in Section 3.1.1, ‘levels’ are nominal depths referenced from a datum. The depth to levels below existing ground surface will vary with the topography and elevation difference to the datum.

The purpose of this report is to identify geotechnical hazards that the PWC may encounter during remediation work. The choice of the 100-foot level as a limit for general subsidence hazard zones is based on defining the limits of shallow workings in each mining area and an assumption that caving would occur upwards and toward the lode sub-crop. Workings without levels shallower than 100 feet, such as the Mount Stewart Middle Lode and Extended workings could also be stoped along the lode with the potential for surface caving in these areas, albeit much less likely than where levels shallower than 100 feet are mapped.

Fordon-Bellgrove (ibid) reports that, “Bad caving of the surface occurs westward from the ‘90' Feet Level’ Shaft and may represent a collapse of the 50 feet level workings, north westward from the Western Shaft” and a 12 July 1950 mine inspection report by Inspector Edwards (MR 0091, DIGS Ref. D004203190) mentions a 6 m (20 foot) by 4.6 m (15 foot) surface subsidence of 4.6 m depth (20 foot) between the No. 4 Shaft and Rabbit Shaft at the Grosvenor workings.

Importantly, no documentation or evidence of subsidence or caving in areas without levels shallower than 100 feet was found. This is not to say that such subsidence may not occur in the distance future. As such, the possibility of caving (subsidence) associated with all mine levels should be reasonably considered within the context of future land use. This consideration, however, remains beyond the scope of this report.

5.3 Hazard mechanisms and triggers

5.3.1 General comments

Subsidence is often first observed as cracks and / or a depression in the ground surface. The rate of crack growth and deepening of the depression can vary widely. Typically, where surface water is present (either ponding or flowing), the rate of subsidence will be greater.

The surface impact from subsidence of a shaft would be expected to be localised and limited to the shaft excavation. In comparison, subsidence from collapse of a tunnel would probably affect a larger area and may be elongated along the axis of the tunnel. Subsidence of the workings generally (from caving) is likely to be similar to the two Eastern Lode cave-in areas (north and south shoots) mapped on the 1948 geology plan (Figure 3.2) or that reported in the Grosvenor workings in 1950 or Western Lode area by Fordon-Bellgrove in 1969.

The descriptions of subsidence presented below for each hazard type are provided as a general guide to assist the PWC with recognising when subsidence might be occurring, as well as for the purposes of assessing risk and revising risk assessments when changes occur, including when to seek advice. The ability to recognise and respond to changes in site conditions is critical in the management of subsidence hazards as the ground may not be stable and trigger events. This factor, along with the passage of time, can drastically change hazards, and therefore, the associated risks. To that end, the hazards identified in this report will likely change over time. Knowledge of the site and what is ‘normal’ is key in being able to recognise change. Additionally, knowledge of the mining conditions and subsidence hazards will assist in appreciating the significance of observed changes.

Brief recommendations regarding risk assessment, seeking advice and documenting site conditions are provided in Sections 5.4 and 5.5. However, the PWC is advised to retain the services of a Geotechnical Engineer or Engineering Geologist experienced in mine subsidence and risk assessment to assist with risk assessments, risk mitigation measures as well as assisting with identifying and responding to changes in site conditions.

5.3.2 Shafts

Shafts represent localised hazards in that people (and animals) can fall into them. The fall can result in fatality directly or debris and objects can fall on top of an individual. Where the shaft is water filled, the potential for drowning is also present. Examples and statistics of fatalities relating to abandoned mine shafts is presented in Mackenzie (2022).

Where shafts are earth filled, the fill often subsides over time with the shaft reopening to some depth. This appears to have occurred / be occurring at many of the shafts identified in this report (refer to Table 5.1). While the settlement of fill presents a 'fall' hazard, the settlement is often slow to progress and the location of the hazard evident such that it can be fenced, avoided and later filled. Where such fencing excludes the general public, and in particular children, the hazards associated with the shaft could be effectively managed in the interim.

Where shafts are capped with rigid material such as concrete, they generally appear safe. There is often an expectation that the capping is stable. However, it is sometimes the case that earth fill beneath a cap or plug has settled and that the concrete is spanning over a void which can deepen without any surface manifestation. Over time, the ground around a cap / plug can erode or the concrete itself can deteriorate and fail. This may occur rapidly and with little warning. The resulting void could be tens of meters deep and water filled.

Heavy and prolonged rainfall, particularly where water accumulates in and around shaft depressions could trigger fill settlement or capping collapse. Other conceivable triggers are the transport of earth backfill by water flow through the workings over time, or underground caving that could pressurise mine water and 'blow out' fill or erode around caps. In the absence of engineering details and as-built documentation for the shafts, earth filled and capped shafts should not be considered safe.

This report does not include an assessment of shaft filling / capping adequacy or longevity. Records of shaft filling such as Land and Water Conservation (1996) and Soil Conservation Service (1993) could be used to 'track' the rate of backfill settlement, and hence identify those shafts more likely to become hazardous.

5.3.3 Mine tunnels, stopes and caving

Collapse (caving) of mine workings reaching the ground surface has occurred at the Mount Stewart workings (three documented locations) and the Grosvenor workings (one documented location). Such caving could occur again. While filling of mine voids with waste rock appears to have occurred, a detailed review of historical records to ascertain where and to what extent has not been undertaken and, based on the limited mine sections seen, would probably not be a particularly useful exercise.

The size and depth of caving expressed at the ground surface would be dependent on the width of ore body (lode) extracted as well as the amount of mine filling and properties of the overburden material. Provided no people are present on the surface when caving occurs, a fatality would be highly unlikely given the hazard (caved ground) would be visible and hence avoidable, assuming vehicle speed and/or poor visibility weren't limiting factors. If people were present when such a caving event occurred, they may be able to escape the area without injury as the cave developed. However, the cave-in could occur rapidly over a large area and fatalities are a possibility.

Caving to the ground surface is more likely along the surface exposure of the ore body. A tracing of levels at the 100-foot level or shallower is provided in the figures in Appendix A and has been used to define (somewhat arbitrarily) general hazard zones being up-dip from this level and encompassing what is expected to be the ore body surface exposure and areas directly above underlay shafts. The shallowest level in the Extended working area is shown to be 145 foot (about 44 m) and whilst traced, is not included as a general hazard zone.

Settlement of waste rock over time, or gradual weathering of waste rock and host rock (above the ore body) are possible triggers for caving. This occurs through weathering of rock over time and/or changes in groundwater levels, particularly rapid draw-down of mine water levels. Mine dewatering in the 1950's is not reported to have triggered surface subsidence.

5.4 Risk assessment discussion

The ability to assess risk requires identification of hazards and development of scenarios that could lead to an unfavourable outcome. The risk associated with a particular scenario is the product of:

– The likelihood that a hazard exists and that there is an interaction with it, resulting in the unfavourable outcome being assessed.
– The consequence of the unfavourable outcome (e.g. property damage, single fatality, multiple-fatality).

The likelihood of a subsidence event occurring is often difficult to quantify with reliability and especially without geotechnical investigation. For mobile elements at risk (e.g. people on a worksite), it is often prudent to assume the hazard event will occur / exist and assess risk by considering the likelihood that a person will interact with the hazard and an unfavourable outcome will occur. Risk can be reduced by limiting interaction rather than eliminating the hazard, although the latter would be preferable.

In quantitative risk assessments, the risk-to-life is often expressed in terms of an annual likelihood of fatality of the individual most-at-risk, and also societal risk where the exposed population per annum is ten or more (Australian Geomechanics Society (AGS) 2007) and (Golder 2020).

Where qualitative or semi-quantitative risk assessments are undertaken, the same principals apply but generally there is insufficient information to be able to complete a quantitative risk assessment. With respect to risk-to-life, AGS (2007) recommends that at least a semi-quantitative risk assessment be undertaken and ideally a quantitative risk assessment. Where the risk can be quantified, the concepts of Acceptable Risk and Tolerable / As Low As Reasonably Practicable (ALARP) can be used as a guide to what risks require mitigation. However, the concept of 'Reasonably Practicable' as it applies to NSW workplace health and safety regulation must be satisfied. SafeWork NSW states on their website[1] that:

'Reasonably practicable' is a legal requirement. It means doing what you are reasonably able to do to ensure the health and safety of workers and others like volunteers and visitors.

and;

When determining what is reasonably practicable, you should take into account:

– *the likelihood of the hazard or risk occurring*
– *the degree of harm from the hazard or risk*
– *knowledge about ways of eliminating or minimising the hazard or risk*
– *the availability and suitability of ways to eliminate or minimise the risk*
– *cost.*

The SafeWork NSW website makes reference to Safe Work Australia (2013) to help determine what is reasonably practicable to meet a health and safety duty of care.

5.5 Risk reduction options

Geotechnical subsurface investigation would be required to assess the likelihood of subsidence events occurring with adequate reliability, and even then, elimination of hazards may not be practicable.

Given that the elimination of hazards is not expected to be possible by the PWC, risk reduction through administrative controls (avoidance) is recommended as the primary tool. Other measures such as engineering controls (e.g. grade beams, localised grouting and meshes) may be appropriate to supplement administrative controls but would require more detailed investigation of the hazard as well as engineering design to ensure the measures function satisfactorily.

This report is provided to assist the LMP and PWC in their understanding of mine subsidence hazards so that they can assess and mitigate risk during their project work. The following risk reduction options are provided for consideration and, if considered appropriate, further development and implementation by the PWC.

[1] https://www.safework.nsw.gov.au/about-us/glossary/glossary-acordion/reasonably-practicable

Risk assessment and risk mitigation advice

The PWC is advised to retain the services of a Geotechnical Engineer or Engineering Geologist experienced in mine subsidence and risk assessment to assist with documentation prior to commencement, risk assessments, risk mitigation measures as well as assisting with identifying and responding to changes in site conditions.

Training, induction and awareness

People entering the work site must be inducted and made aware of hazards. Incorporating explanation of mine subsidence hazards and their locations into site inductions and daily pre-work meetings is recommended. More detailed and up to date information should be provided in active work areas.

Training should include how to recognise and report subsidence.

Showing people the locations of hazards, in person, is recommended rather than relying on maps or photos.

Delineation of hazard zones (fencing) and administrative controls

The hazards zones presented in the figures in Appendix A (or amendments of them approved by LMP) should be delineated with flagging and/or fencing with signage. Access into these areas should be restricted with administrative controls such as, but not limited to:

– At least daily pre-work inspection and clearance
– Change identification and reporting protocols
– No working alone
– Supervision by suitable experienced personnel
– Restrictions on people on foot
– Restrictions on light vehicle access and speed
– Restrictions on plant and heavy vehicles
– Restrictions on equipment and material storage
– Restrictions on activities (e.g. no crane lifts, no excavation, no water storage)
– Limiting duration spent within hazard zones
– Cessation of work during or immediately preceding heavy rainfall and poor visibility

Where site personnel change, knowledge on recent observations and hazard controls should be transferred.

The delineation of hazard zones should be based on the actual observable feature where it is visible rather than locations scaled off plans or coordinates taken from spatial databases or this report. Where not visible, the coordinates extracted from this report can be used.

Flagging / fencing should surround the hazard zone with the addition of at least a 1 m wide buffer. For example, fencing around a 3 m diameter hazard zone would be at least 5 m in diameter.

Further geotechnical investigation and assessment

Where hazards can't be avoided or mitigated adequately with administrative controls, further geotechnical investigation and assessment would provide additional information that may increase the reliability of risk assessments through improved certainty of hazard locations and likelihood of occurrence. Ideally, such investigation work would be targeted to small areas to reduce cost.

In these circumstances, the following investigation activities are recommended for consideration:

– Surface (non-intrusive) geophysical survey using Electrical Resistivity Imaging (ERI) to identify possible voids and hence drilling targets.
– Survey and 3D modelling of shafts, stopes and mine workings from historical sources to relate these plans to the existing ground surface.
– Drilling of inclined boreholes and video inspection and laser scanning of cavities if encountered.

While drilling could be undertaken without an ERI survey, an ERI survey would provide focused targets for drilling. Survey and 3D modelling, at least in a simplistic form, is considered necessary prior to drilling to provide borehole locations, inclinations and directions. Survey work (using real-time kinetic GPS equipment) could be undertaken under the same mobilization as ERI work and by the same team.

An ERI survey would be undertaken along survey lines with sensors spaced along these lines. The survey can be designed to target the upper 20 m of materials, for example, to locate air filled voids and water saturated ground. The method relies on differences in ground resistance (or conductance) to differentiate between ground conditions. An air-filled void for example would be much more resistive than a water filled void or rock. Differences in ground resistance between soil and different rock types above and below the water table would also occur, and potentially, make definitive identification of voids more difficult.

Survey should comprise accurate levelling to AHD of visible shafts in the area of interest as well as establishing the current elevation of the Leadville Railway Station platform (if possible) as this was the datum used by Willan (1925) as being 1370 feet above mean sea level. Levelling of the No. 3 Paddock Shaft and Engine Shaft should also be undertaken and these related to the available digital terrain model. Combining this data with the historical mine plans and sections as well as ERI survey results can then be achieved using 3D geological modelling software such as Leapfrog by Seequent to identify drill targets, safe drill set up locations and the corresponding borehole inclinations and headings.

Borehole locations would be pegged by survey with the addition of a heading reference peg (to aim for). The drill pads would need to be located in safe areas away from suspected stopes and cave-ins and the selection of drilling rig and method would need to suit the hole inclinations. As a guide, most geotechnical site investigation rigs can drill at inclinations down to about 70° from horizontal (90° being vertical). Rigs used for installing ground anchors or horizontal directional drilling (HDD) can drill as flat as horizontal but are not suitable for steep boreholes. In either case, the boreholes need not be diamond cored and could be drilled using washboring or air percussive methods. Casing is likely to be required to maintain an open borehole, particularly where downhole video inspection and laser scanning is proposed.

Downhole video cameras are generally suspended from flexible cables in vertical boreholes. Deployment and retrieval of cameras and laser scanners into voids through inclined boreholes would require particular consideration. Systems such as C-ALS from Carlson Software would be suitable for laser scanning of air-filled voids accessed through inclined boreholes. For water filled voids, sonar scanning would be required. GHD operate a downhole video and sonar system (Imagenex GS-232) rated to 300 m water depth, suspended from a cable and only suited to vertical boreholes. Groundsearch Pty Ltd in Rutherford NSW operate a Flodim sonar system which uses rods (like the C-ALS laser system) and may be suitable for inclined boreholes. GHD have sub-contracted Groundsearch to undertake such surveys of abandoned coal mine workings in NSW.

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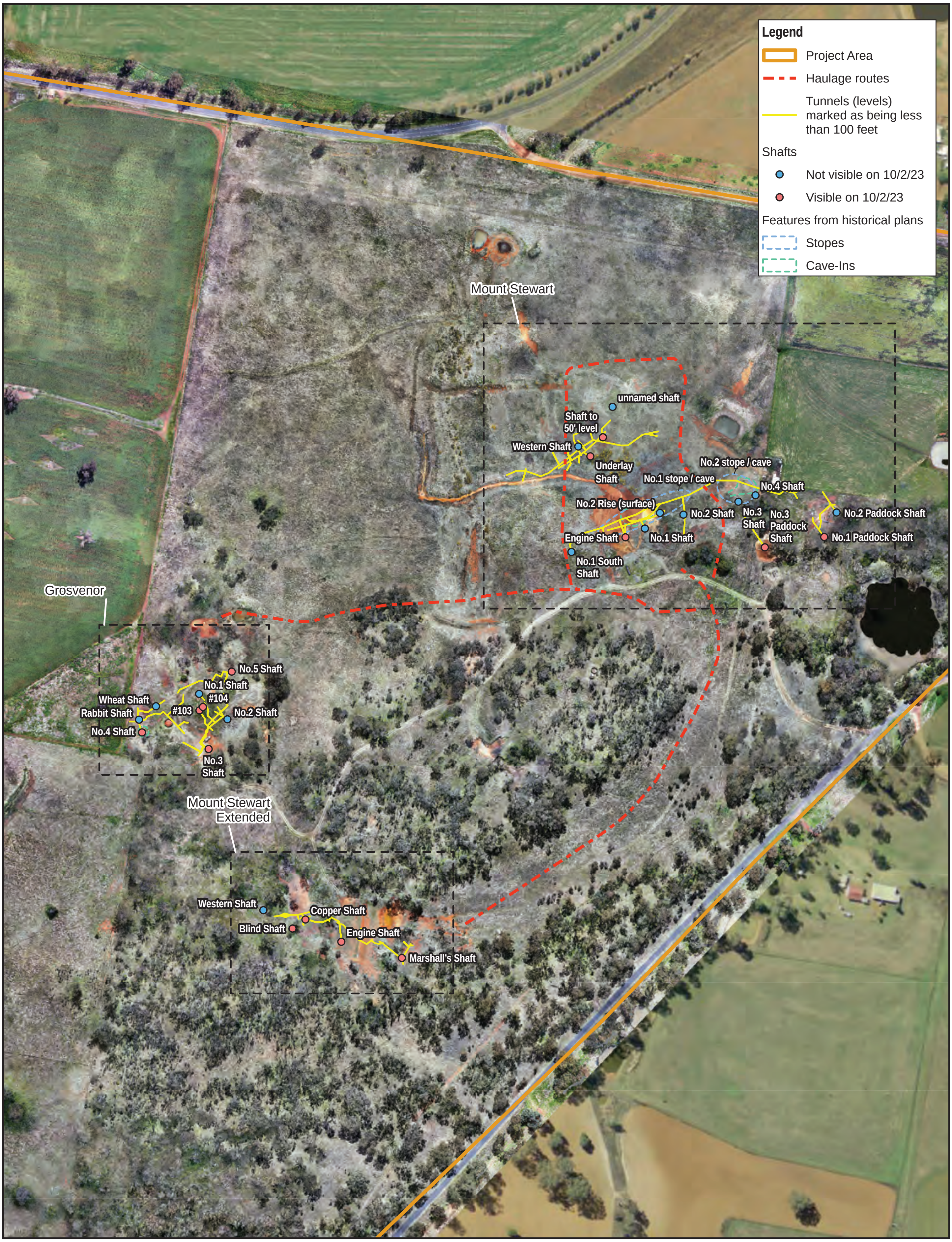
Appendices

Appendix A

Figures



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

N

Department of Regional NSW
Leadville Remediation Technical Oversight
Hazard Assessment Report

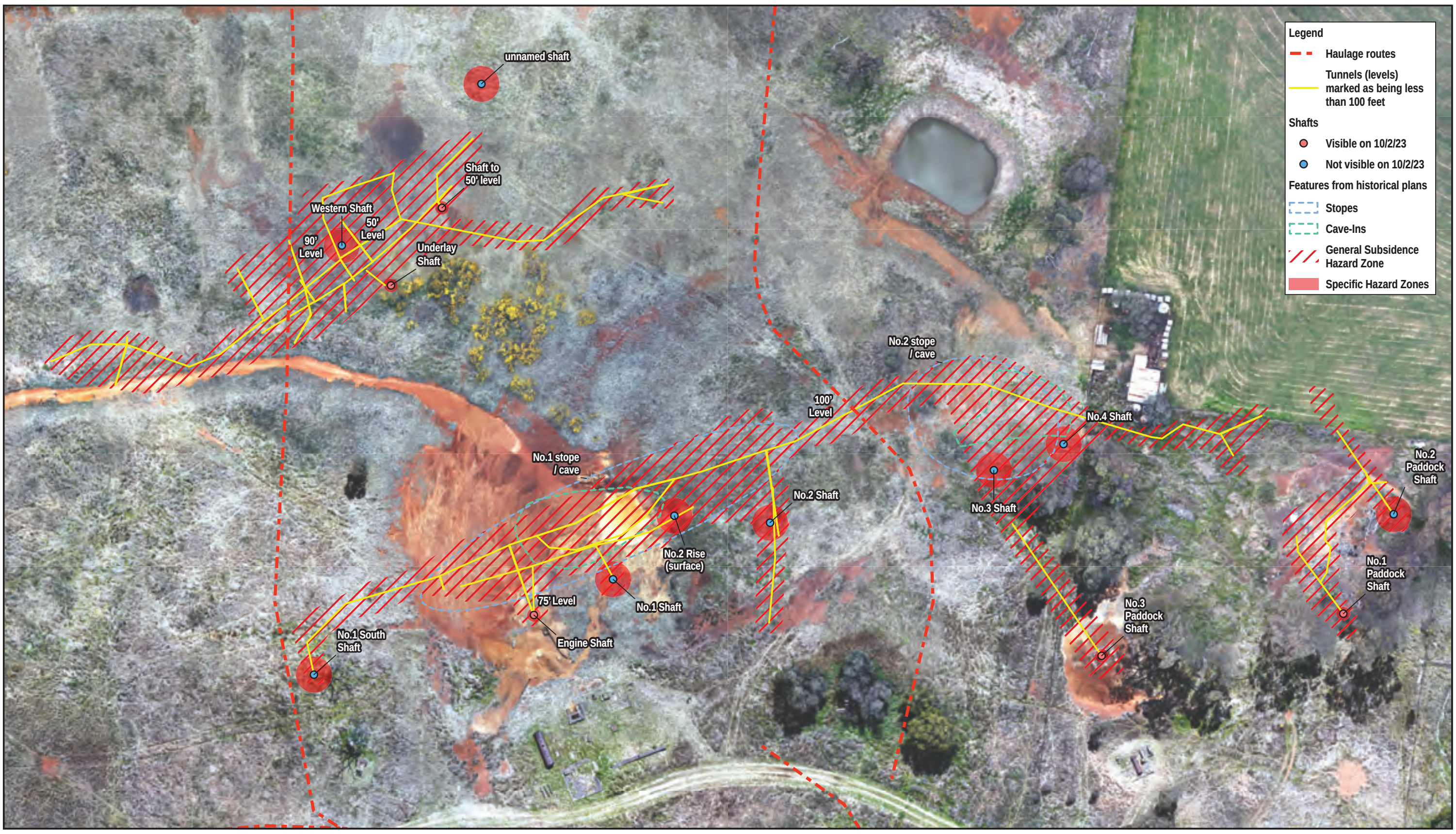
Project No. **12588769**
Revision No. **0**
Date **8/7/2023**

Site overview

FIGURE 1

\\ghdnet\ghd\AU\Sydney\Projects\21\12588769\GIS\Maps\Deliverables\12588769_LeadvilleRemediationHazardAssessment.aprx
Print date: 07 Aug 2023 - 13:02

Data source: public/NSW_Imagery_GDA2020: © Department of Customer Service 2020. Created by: rvillalon



Paper Size ISO A4

0 8.5 17 25.5 34

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

N

GHD

Department of Regional NSW
Leadville Remediation Technical Oversight
Hazard Assessment Report

Mount Stewart – Subsidence Hazard Zones

Project No. **12588769**
Revision No. **0**
Date **8/7/2023**

FIGURE 2

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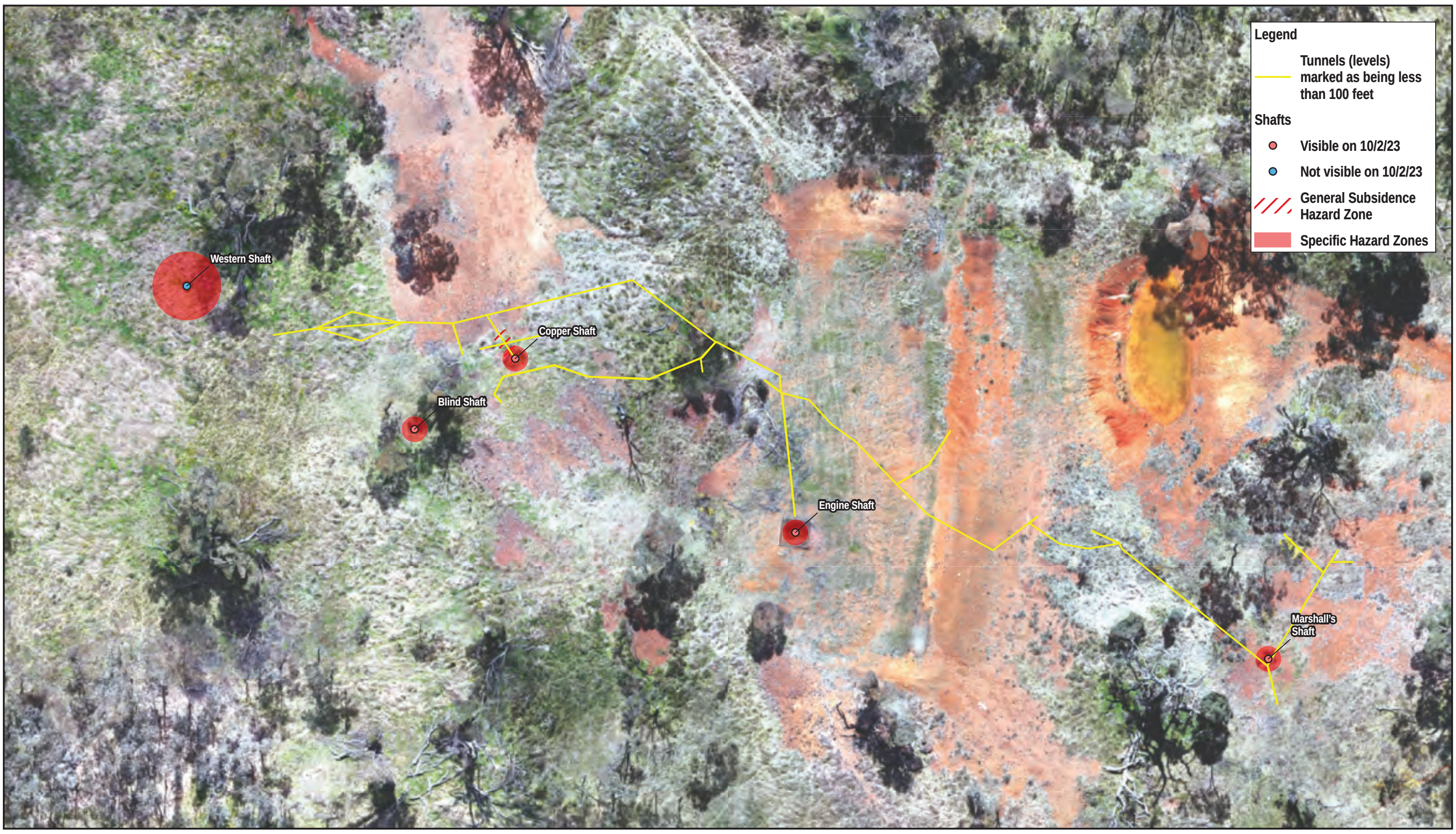
Data source: . Created by: rvillalon



Paper Size ISO A4

0 4.5 9 13.5 18

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

N

Department of Regional NSW
Leadville Remediation Technical Oversight
Hazard Assessment Report

Project No. **12588769**
Revision No. **0**
Date **8/7/2023**

Mount Stewart Extended – Subsidence Hazard Zones

FIGURE 3

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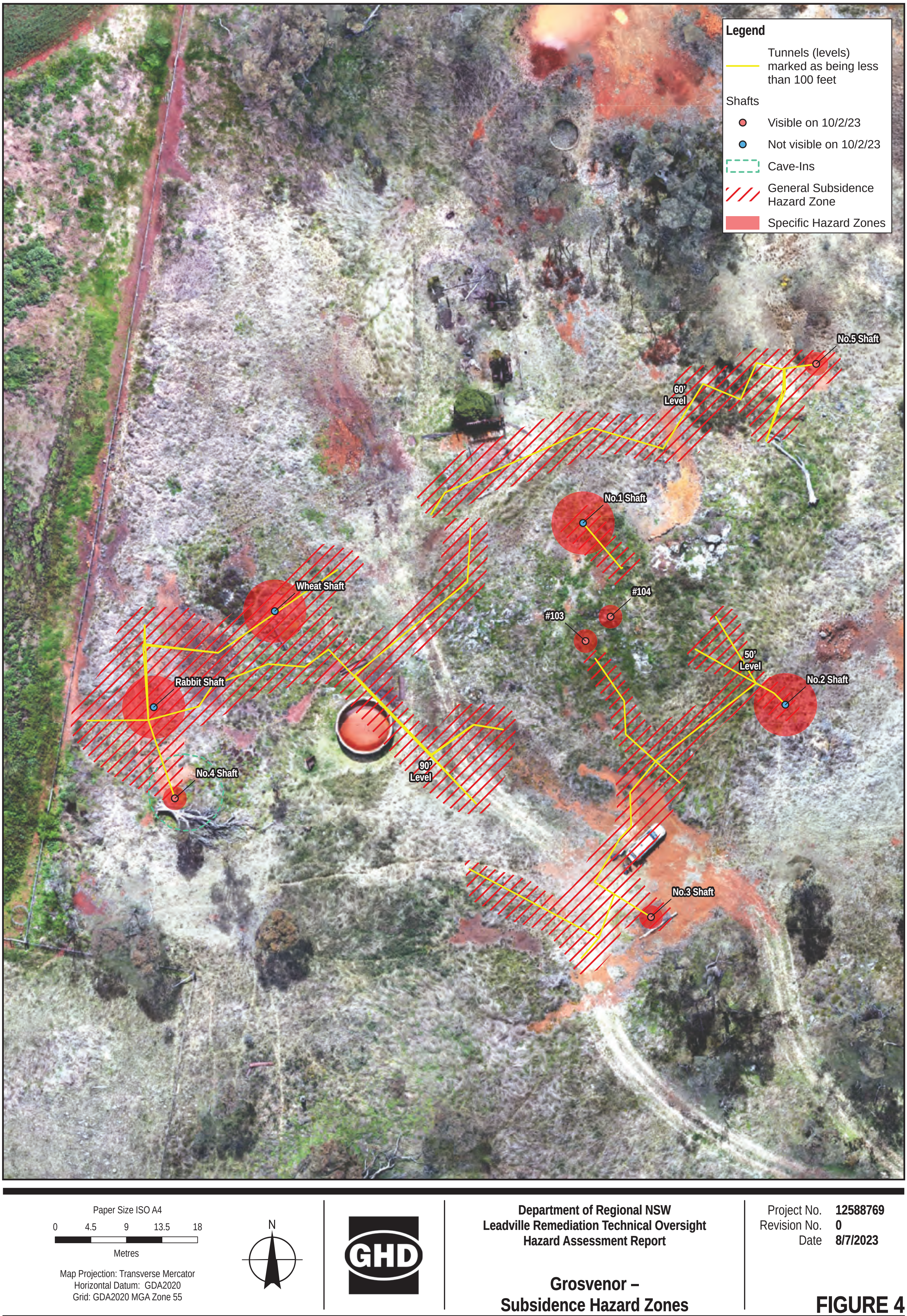


Department of Regional NSW
Leadville Remediation Technical Oversight
Hazard Assessment Report

Project No. 12588769
Revision No. 0
Date 8/7/2023

Grosvenor – Subsidence Hazard Zones

FIGURE 4

\\ghdnet\ghd\AU\Sydney\Projects\21\12588769\GIS\Maps\Deliverables\12588769_LeadvilleRemediationHazardAssessment.aprx
Print date: 07 Aug 2023 - 13:02

Data source: . Created by: rvillalon

Appendix B

Photographs

GROSVENOR WORKINGS: **Rabbit Shaft**

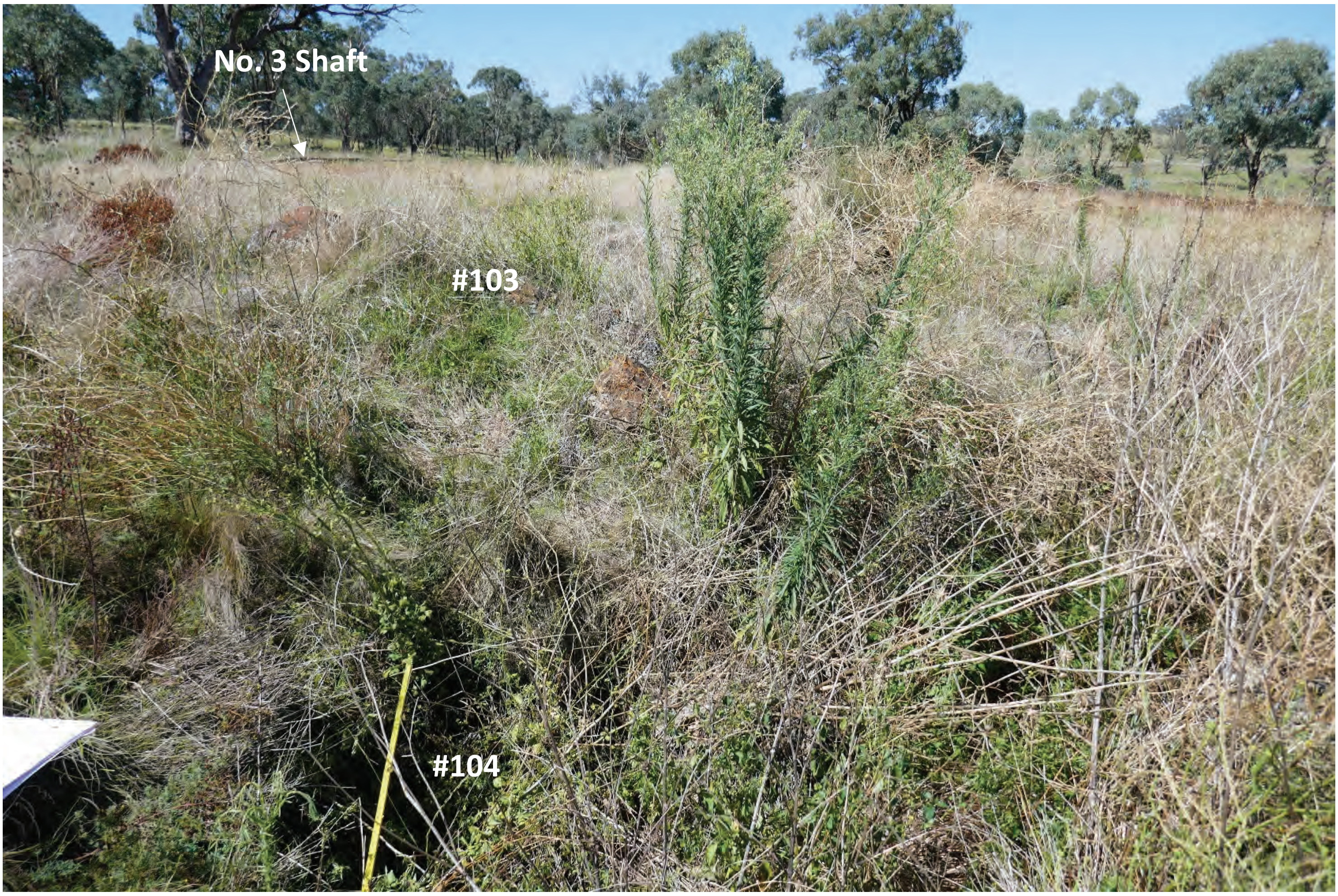
GROSVENOR WORKINGS: **No. 5 Shaft**

Department of Regional NSW (Legacy Mines Program)	job no	12581924
Leadville Remediation Project	file ref	
Subsidence hazard assessment	scale	N/A
	date	9th, 10th February 2023

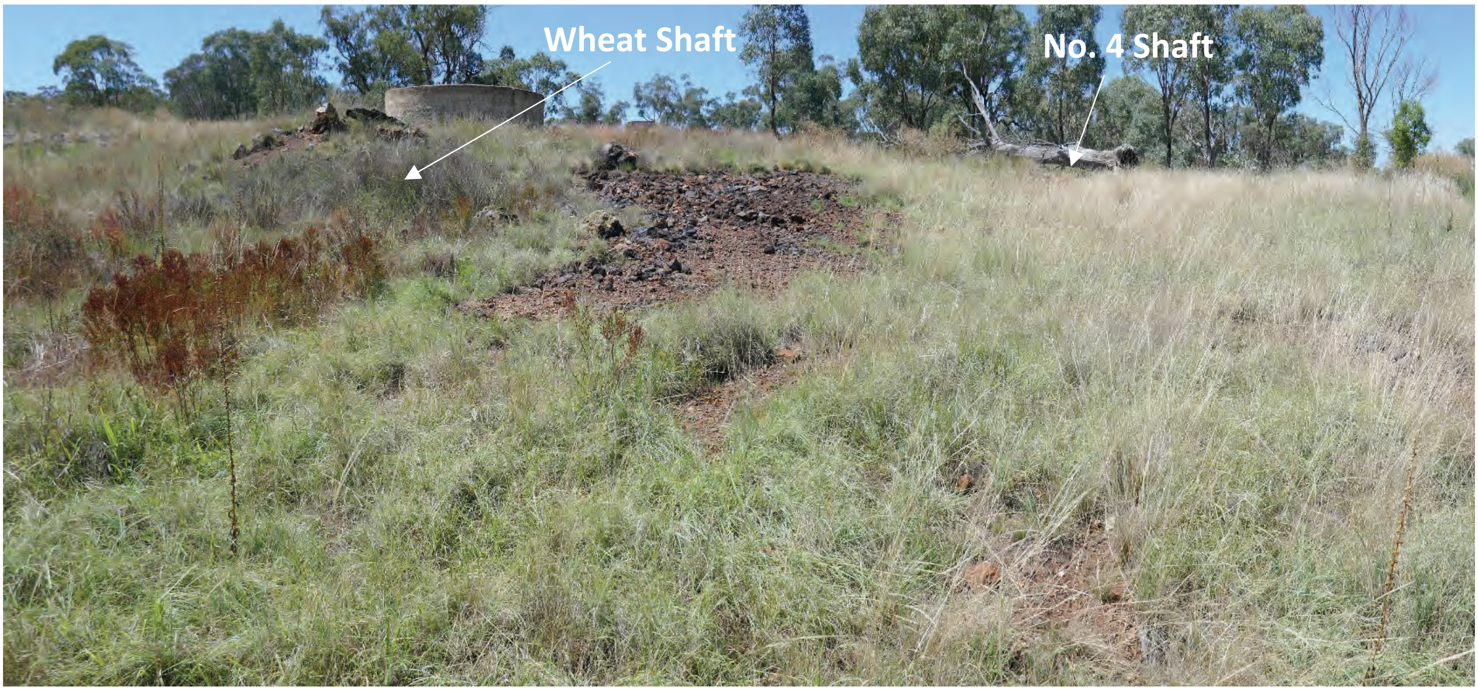
GROSVENOR WORKINGS: **No. 3 Shaft**

GROSVENOR WORKINGS: **No. 1 Shaft**

GROSVENOR WORKINGS: **Possible cave-in (#103)**



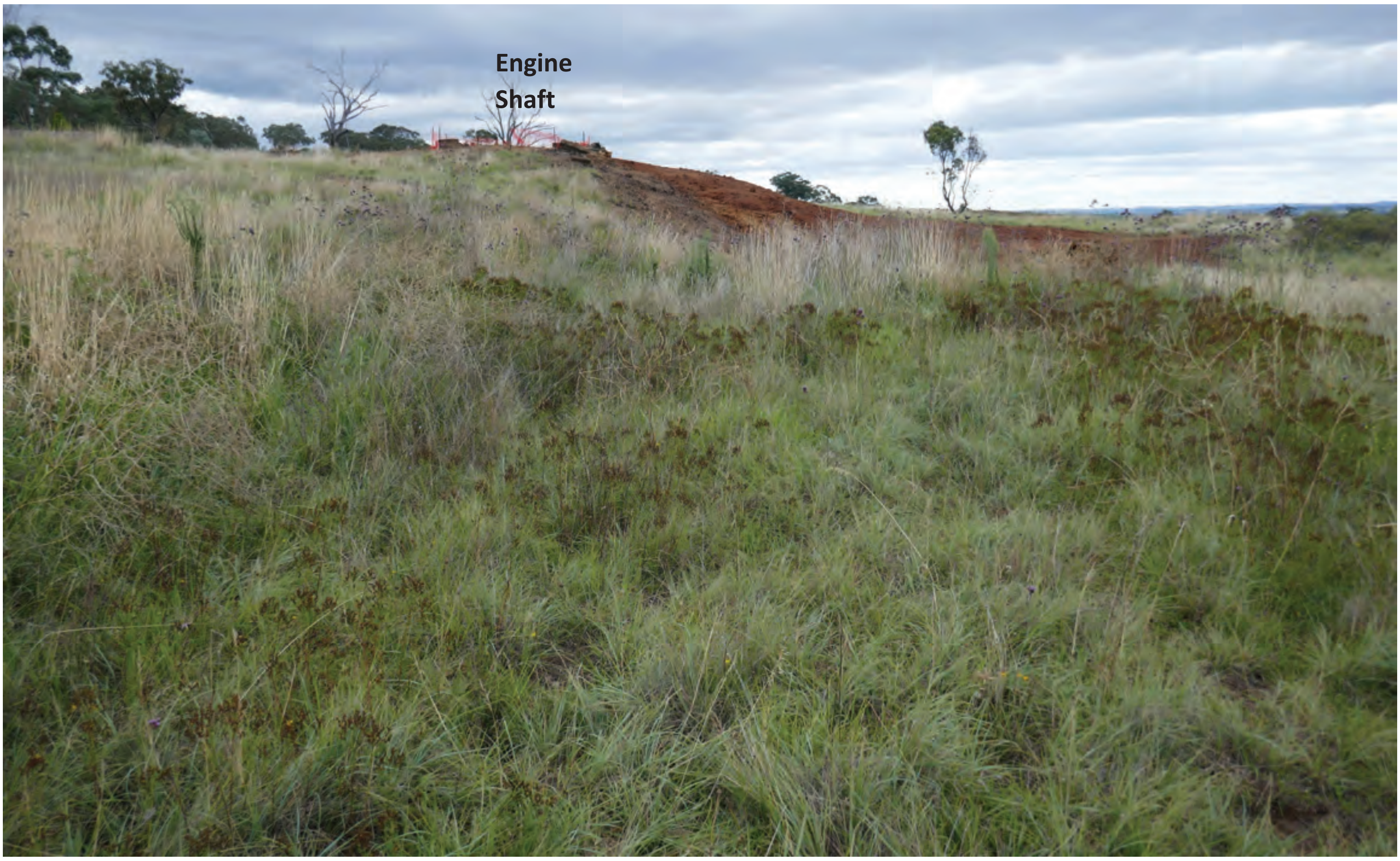
GROSVENOR WORKINGS: **Circular depression (#104)**


Wheat Shaft
No. 4 Shaft

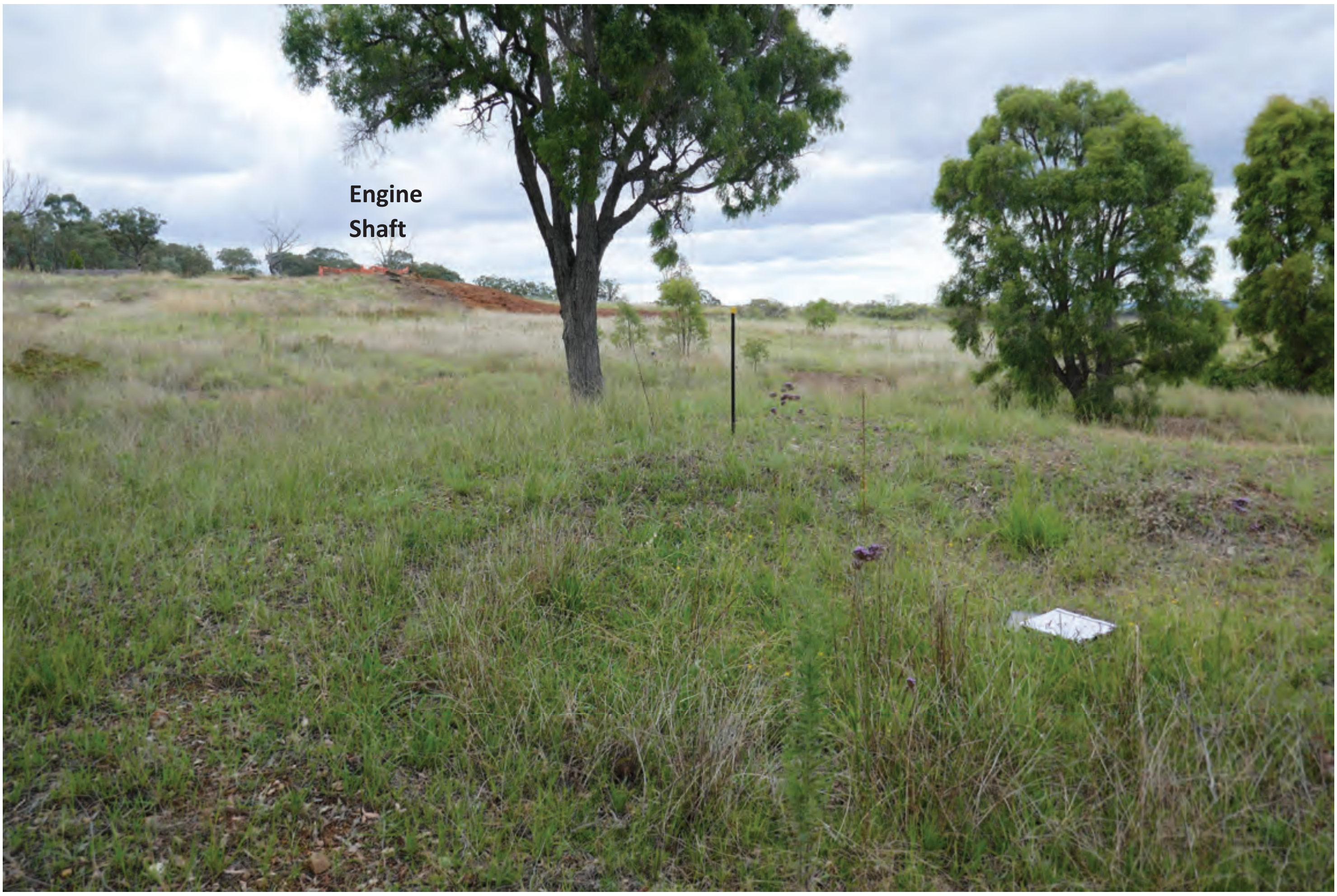
GROSVENOR WORKINGS: **No. 4 Shaft**

MOUNT STEWART WORKINGS: **Engine Shaft**

MOUNT STEWART WORKINGS: **No. 1 Shaft**



MOUNT STEWART WORKINGS: **No. 2 Shaft**



MOUNT STEWART WORKINGS: **No. 3 Shaft / No. 2 Cave-in**

MOUNT STEWART WORKINGS: **No. 4 Shaft**

MOUNT STEWART WORKINGS: **Underlay Shaft**

MOUNT STEWART WORKINGS: **Western Shaft**

MOUNT STEWART WORKINGS: **No.1 Paddock Shaft**

MOUNT STEWART WORKINGS: **No.2 Paddock Shaft**

MOUNT STEWART WORKINGS: **No.3 Paddock Shaft**

MOUNT STEWART WORKINGS: **No.3 Paddock Shaft**

MOUNT STEWART WORKINGS: **No.3 Paddock Shaft**

MOUNT STEWART WORKINGS: **Shaft to 50' level**

MOUNT STEWART WORKINGS: **No.1 South Shaft**

MOUNT STEWART WORKINGS: **unnamed shaft (#65)**

MOUNT STEWART EXTENDED WORKINGS: **Engine Shaft**

MOUNT STEWART EXTENDED WORKINGS: **Copper Shaft**

MOUNT STEWART EXTENDED WORKINGS: **Blind Shaft**

MOUNT STEWART EXTENDED WORKINGS: **Marshalls Shaft**

MOUNT STEWART EXTENDED WORKINGS: **Western Shaft and adjacent lineation** ghd.com

The Power of Commitment

Appendix C

Bill of Quantities

Bill of Quantities

ROC ENGINEERING DESIGN

Terra Tech CONSULTING

Leadville Mine - Remediation Works

Date	**Revision 26/03/2024**	**Job Ref: 23293**	
Item	**Description**	**Qty**	**Unit**
1	**Site Establishment/Preliminaries**		
1.01	Preliminaries. Note: Preliminaries to include preparation and management of Project Plans including but not limited to: - Construction Program - Quality Plan - Construction Environmental Management Plan including SECP - Inspection and Test Plan - Verification and Monitoring Plan	1	item
1.02	Establish site including all amenities and construction site fencing as necessary	1	item
1.03	Restore site at completion of works and remove all temporary structures	1	item
1.04	Geotechnical Testing and Inspections	1	item
1.05	Survey and Setting out	1	item
1.06	Verification survey and Works As Executed Survey as required	1	item
2	**Soil & Water Management Measures** **Contractor is to ensure the site is managed at all times for sediment an erosion control and provide appropriate measures to ensure sediment does not leave the site.**		
2.01	Establish & maintain sediment fencing	1	item
2.02	Establish & maintain temporary diversion measures	1	item
3	**Clearing and Grubbing**		
3.01	Remove and relocate trees, roots and trunks in vicinity of works as required.	1	item
4	**Bulk Earthworks**		
4.01	Stripping including reinstating topsoil onto distrubed areas	2950	BCM
4.02	Cut to fill from borrow areas (Contractor to allow for cut to stockpile, cut to fill if required by construction methodology)	3000	BCM
4.03	Removal and disposal of contaminated material to a licensed waste facility	475	BCM
4.04	Removal and relocation of contaminated material to a location on site	150	BCM
5	**Drainage works**		
5.01	Rock armour to channels, dams and spillway	1100	m^2
5.02	Class C non-woven geotextile	1400	m^2
6	**Fencing**		
6.01	Supply and Install hinged joint mesh fencing	1240	m
6.02	Supply and Install 1.8m high chain-link fence	2680	m
6.03	Demolish and dispose of existing fencing	2160	m
6.04	Demolish and dispose of existing gates	2	item
6.05	Supply and install gates to suit hinged joint fencing	2	item
6.06	Supply and install gates to suit chain-link fencing	4	item
7	**Revegatation**		
7.01	Seed and maintain disturbed areas	14800	m^2
P	**Provisional Items**		
P1	Topsoil and seed disturbed areas outside of immediate works, on completion and maintian till grass established (Provisional)		m^2

Bill of Quantities

ROC ENGINEERING DESIGN

Terra Tech CONSULTING

Leadville Mine - Remediation Works

Date	Revision 26/03/2024	Job Ref: 23293	
Item	**Description**	**Qty**	**Unit**
P2	Excavate and relocate contaminated sediment and soft material from base of dam construction		m^3
P3	Pump out and temporarily store existing dam water		Item
P3	Cut to stockpile		BCM
P4	Stockpile to fill		BCM
P5	Cut to fill		BCM

Appendix D

UCL Calculations

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Uncensored Full Data Sets											
2												
3			User Selected Options									
4			Date/Time of Computation	ProUCL 5.19/03/2024 3:52:20 PM								
5			From File	WorkSheet_b.xls								
6			Full Precision	OFF								
7			Confidence Coefficient	95%								
8			Number of Bootstrap Operations	2000								
9												
10												
11	As											
12												
13	**General Statistics**											
14					Total Number of Observations	91					Number of Distinct Observations	47
15											Number of Missing Observations	0
16					Minimum	0.114					Mean	70.67
17					Maximum	835					Median	48.68
18					SD	94.63					Std. Error of Mean	9.92
19					Coefficient of Variation	1.339					Skewness	6.289
20												
21	**Normal GOF Test**											
22					Shapiro Wilk Test Statistic	0.475	**Shapiro Wilk GOF Test**					
23					5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level					
24					Lilliefors Test Statistic	0.253	**Lilliefors GOF Test**					
25					5% Lilliefors Critical Value	0.0931	Data Not Normal at 5% Significance Level					
26	**Data Not Normal at 5% Significance Level**											
27												
28	**Assuming Normal Distribution**											
29	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
30					95% Student's-t UCL	87.15					95% Adjusted-CLT UCL (Chen-1995)	93.97
31											95% Modified-t UCL (Johnson-1978)	88.24
32												
33	**Gamma GOF Test**											
34					A-D Test Statistic	2.546	**Anderson-Darling Gamma GOF Test**					
35					5% A-D Critical Value	0.772	Data Not Gamma Distributed at 5% Significance Level					
36					K-S Test Statistic	0.117	**Kolmogorov-Smirnov Gamma GOF Test**					
37					5% K-S Critical Value	0.0955	Data Not Gamma Distributed at 5% Significance Level					
38	**Data Not Gamma Distributed at 5% Significance Level**											
39												
40	**Gamma Statistics**											
41					k hat (MLE)	1.479					k star (bias corrected MLE)	1.438
42					Theta hat (MLE)	47.77					Theta star (bias corrected MLE)	49.15
43					nu hat (MLE)	269.2					nu star (bias corrected)	261.7
44					MLE Mean (bias corrected)	70.67					MLE Sd (bias corrected)	58.93
45											Approximate Chi Square Value (0.05)	225.2
46					Adjusted Level of Significance	0.0474					Adjusted Chi Square Value	224.7
47												
48	**Assuming Gamma Distribution**											
49					95% Approximate Gamma UCL (use when n>=50))	82.11					95% Adjusted Gamma UCL (use when n<50)	82.3
50												
51	**Lognormal GOF Test**											
52					Shapiro Wilk Test Statistic	0.835	**Shapiro Wilk Lognormal GOF Test**					

5% Shapiro Wilk P Value	1.044E-14	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.134	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0931	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.172	Mean of logged Data	3.883
Maximum of Logged Data	6.727	SD of logged Data	0.961

Assuming Lognormal Distribution

95% H-UCL	96.37	90% Chebyshev (MVUE) UCL	103.9
95% Chebyshev (MVUE) UCL	116.2	97.5% Chebyshev (MVUE) UCL	133.4
99% Chebyshev (MVUE) UCL	167.2		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	86.98	95% Jackknife UCL	87.15
95% Standard Bootstrap UCL	86.56	95% Bootstrap-t UCL	104.7
95% Hall's Bootstrap UCL	157.8	95% Percentile Bootstrap UCL	87.87
95% BCA Bootstrap UCL	95.6		
90% Chebyshev(Mean, Sd) UCL	100.4	95% Chebyshev(Mean, Sd) UCL	113.9
97.5% Chebyshev(Mean, Sd) UCL	132.6	99% Chebyshev(Mean, Sd) UCL	169.4

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	113.9		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Pb

General Statistics

Total Number of Observations	91	Number of Distinct Observations	80
		Number of Missing Observations	0
Minimum	1.501	Mean	152.5
Maximum	732.2	Median	124.5
SD	114.7	Std. Error of Mean	12.02
Coefficient of Variation	0.752	Skewness	2.013

Normal GOF Test

Shapiro Wilk Test Statistic	0.849	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	2.861E-13	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.141	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0931	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	172.4	95% Adjusted-CLT UCL (Chen-1995)	175
		95% Modified-t UCL (Johnson-1978)	172.9
Gamma GOF Test			
A-D Test Statistic	0.329	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.765	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.06	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.095	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	1.982	k star (bias corrected MLE)	1.924
Theta hat (MLE)	76.94	Theta star (bias corrected MLE)	79.26
nu hat (MLE)	360.6	nu star (bias corrected)	350.1
MLE Mean (bias corrected)	152.5	MLE Sd (bias corrected)	109.9
		Approximate Chi Square Value (0.05)	307.7
Adjusted Level of Significance	0.0474	Adjusted Chi Square Value	307.1
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	173.5	95% Adjusted Gamma UCL (use when n<50)	173.8
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.927	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	3.4123E-5	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0813	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0931	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.406	Mean of logged Data	4.754
Maximum of Logged Data	6.596	SD of logged Data	0.834
Assuming Lognormal Distribution			
95% H-UCL	197.4	90% Chebyshev (MVUE) UCL	212.4
95% Chebyshev (MVUE) UCL	234.6	97.5% Chebyshev (MVUE) UCL	265.4
99% Chebyshev (MVUE) UCL	325.8		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	172.2	95% Jackknife UCL	172.4
95% Standard Bootstrap UCL	172	95% Bootstrap-t UCL	175.8
95% Hall's Bootstrap UCL	177.6	95% Percentile Bootstrap UCL	172.6
95% BCA Bootstrap UCL	174.8		
90% Chebyshev(Mean, Sd) UCL	188.5	95% Chebyshev(Mean, Sd) UCL	204.9
97.5% Chebyshev(Mean, Sd) UCL	227.6	99% Chebyshev(Mean, Sd) UCL	272.1
Suggested UCL to Use			
95% Approximate Gamma UCL	173.5		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Mn

General Statistics

Total Number of Observations	91	Number of Distinct Observations	90
		Number of Missing Observations	0
Minimum	-110.3	Mean	629.1
Maximum	2004	Median	613.7
SD	398.4	Std. Error of Mean	41.77
Coefficient of Variation	0.633	Skewness	0.763

Normal GOF Test

Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.0246	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0941	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0931	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	698.5	95% Adjusted-CLT UCL (Chen-1995)	701.4
		95% Modified-t UCL (Johnson-1978)	699.1

Gamma Statistics Not Available

Lognormal Statistics Not Available

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	697.8	95% Jackknife UCL	698.5
95% Standard Bootstrap UCL	697	95% Bootstrap-t UCL	704.1
95% Hall's Bootstrap UCL	703.4	95% Percentile Bootstrap UCL	695.6
95% BCA Bootstrap UCL	699.6		
90% Chebyshev(Mean, Sd) UCL	754.4	95% Chebyshev(Mean, Sd) UCL	811.2
97.5% Chebyshev(Mean, Sd) UCL	889.9	99% Chebyshev(Mean, Sd) UCL	1045

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	811.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix E

XRF data supplied by the Principal

Date	SAMPLE DESCRIPTION	Ag	As	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	Mn	Mo	Nb	Ni	P	Pb	Rb	S	Sb	Se	Sn	Sr	Th	Ti	U	V	W	Y	Zn	Zr	Ag	Pb	Zn
		ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%
3/11/2020	TP3-0.0-0.1	>100	367	1.58	331	0.7	11.85	9.1	36	194	14.8	0.787	1	735	9.17	5.6	6.6	190	>10000	78.9	>10.0	15.2	7	66	42.8	3.55	0.267	1.5	60	73.8	10.4	3290	59.2	152	1.47	
3/11/2020	13	92	682	#N/A	175	1449	12	-1038	594	136	18.0834	-7	6889	716	4	0	12	-1963	8211	67	13275	11	8	385	27	4	2291	-1	191	55	29	1418	154	92	8211	1418
3/11/2020	TP3-1.3-1.4	67.9	482	1.59	156	0.12	83	6.2	42	115.5	13.85	0.124	1.61	3860	5.7	7.2	11.9	280	6780	101	4.4	5.87	3	24.3	54	5.45	0.216	1.5	86	31.7	9.9	15350	69.7			1.535
3/11/2020	16	19	855	#N/A	88	52	-6	-1152	250	114	19.0194	-7	14201	813	10	13	7	-2212	6070	99	31488	16	-4	146	43	6	3322	-7	86	18	29	2139	289	19	6070	2139
3/11/2020	TP4-0.6-0.7	>100	486	0.73	548	0.13	17.75	20.1	25	362	14.25	1.575	0.43	1500	2.48	2.7	10	150	>10000	43	>10.0	18.05	12	149.5	20.4	3.47	0.104	1.2	43	32.7	6.7	3400	40.4	144	2.8	
3/11/2020	32	333	18314	#N/A	1197	-529	31	-1977	785	1306	31.0508	-36	9466	1191	4	47	9	-2939	11588	108	36983	22	17	1679	28	17	8707	4	216	146	45	4966	609	333	11588	4966
3/11/2020	TP4a-0.2-0.3	85.6	1040	1.71	152.5	0.08	5.68	2.7	44	407	14.75	0.448	1.48	1280	14.05	6.7	8.6	250	>10000	104.5	2.53	22.8	4	35.5	45.8	5.52	0.255	1.3	98	26.3	10.1	2810	70.9		1.075	
3/11/2020	39	56	1717	#N/A	144	0	40	0	-258	45	60.9069	26	0	2385	17	7	-200	0	10034	67	0	41	11	188	25	9	4819	-13	461	-17	13	9109	129	56	10034	9109
4/11/2020	TP5-1.3-1.4	51.8	535	4.86	203	1.61	81.2	13.4	30	581	22.5	0.534	0.68	17300	3.38	4.3	13.7	410	>10000	52.9	3.43	18.25	3	47.1	81.5	8.09	0.147	2.5	48	47.6	13.3	15700	44.2		3.41	1.57
4/11/2020	6	-5	141	#N/A	2	255	7	-452	79	142	6.0608	7	13215	4074	4	12	21	-1188	32134	95	7708	-34	2	23	25	13	3525	-3	36	-7	28	4881	338	-5	32134	4881
4/11/2020	TP6-0-0.1	>100	406	2.08	67.8	9.97	12.1	4.9	47	1095	28.2	0.042	0.38	5800	23.8	8.9	5	730	>10000	24.5	0.74	11.95	2	436	201	7.98	0.388	6.9	80	141	24.8	6250	171.5	105	3.79	
4/11/2020	7	6	1454	#N/A	71	171273	-28	-9190	303	1223	59.517	-12	6131	2931	35	0	66	-2601	18417	22	27492	39	8	1261	200	17	3015	9	65	92	94	7004	177	6	18417	7004
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4/11/2020	20	98	2148	#N/A	826	1574	20	-3505	170	781	28.5986	-17	8611	2162	12	19	29	-2154	35377	63	21587	66	19	200	27	17	1939	-16	57	14	-98	8598	124	98	35377	8598
4/11/2020	TP08-0.6-0.7	27.4	243	4.12	134.5	2.66	8.23	8.5	28	328	10.1	0.126	0.48	2960	2.2	6.3	11.4	280	>10000	37.2	0.66	7.36	2	18	238	7.54	0.195	2.9	49	50.5	18.7	2550	56.6		1.23	
4/11/2020	23	9	9	#N/A	-15	2239	7	104	931	111	4.201	-13	1627	1457	2	5	24	-389	16479	8	2356	-2	-2	18	187	9	9524	-1	338	41	37	3485	131	9	16479	3485
6/11/2020	TP16-0.1-0.2	36.4	707	5.1	107.5	0.96	55.9	9.6	34	289	20.9	0.368	0.31	31100	1.96	6.1	11.2	500	>10000	22.9	0.61	11.7	2	38	101	6.87	0.203	2.3	57	42.7	13.6	8070	57.5		1.29	
6/11/2020	2	28	1465	#N/A	85	9691	89	915	58	428	68.7736	-3	7942	16258	-3	#N/A	-79	2182	15101	37	14974	39	1	212	80	#REF!	3757	#REF!	56	-63	18	10170	129	28	15101	10170
6/11/2020	TP18-0.2-0.4	79.4	541	3.95	334	1.66	13.1	11	32	676	12.4	0.185	0.61	6130	3.34	6.4	12.7	390	>10000	54.7	1.23	15.45	5	41.8	180	8.07	0.248	2.2	64	75.9	18.9	3170	63.8		5.18	
6/11/2020	11	42	73	#N/A	183	8772	2	96	47	492	12.072	-1	8038	1371	1.3	#N/A	-13	847	41111	56	10238	7	-3	82	101	#REF!	3242	#REF!	58	11	24	2448	136	42	4.1111	2448
6/11/2020	TP18-D	45.3	309	4.95	136.5	2.03	15.1	24	34	535	11.3	0.14	0.53	10100	1.91	6	18.1	310	>10000	43.3	0.74	7.41	3	22.3	115	6.81	0.223	1.7	55	48.4	17.9	3450	53.7		1.925	
6/11/2020	11	42	73	#N/A	183	8772	2	96	47	492	12.072	-1	8038	1371	1.3	#N/A	-13	847	11111	56	10238	7	-3	82	101	#REF!	3242	#REF!	58	11	24	2448	136	42	11111	2448

Pb	
%	
Pb-OG62	XRF
0	0
1.47	0.8211
2.8	1.1588
1.075	1.0034
3.41	3.2134
3.79	1.8417
4.8	3.5377
1.23	1.6
1.29	1.5101
5.18	4.1111
1.925	1.1111

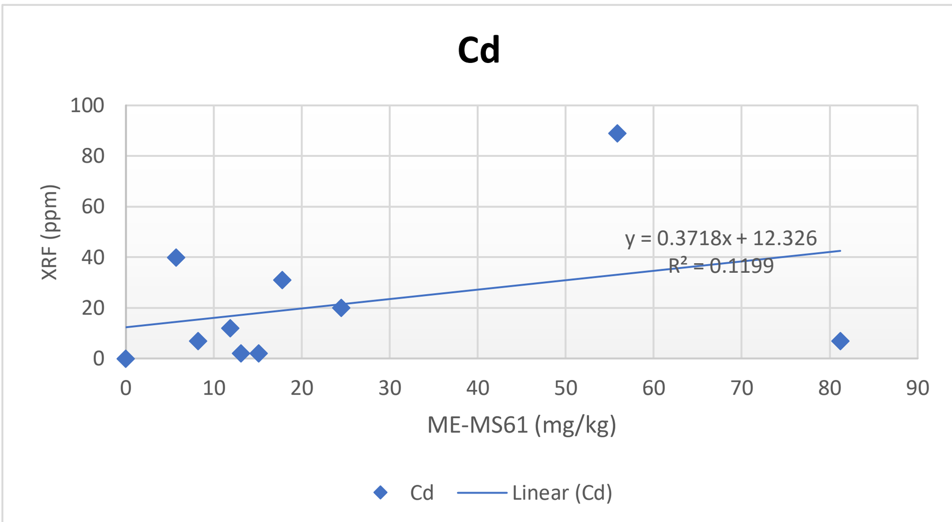
As	
ppm	
ME-MS61	XRF
367	682
482	855
1040	1717
535	141
	1454
1130	2148
243	9
707	1465
541	73
309	73

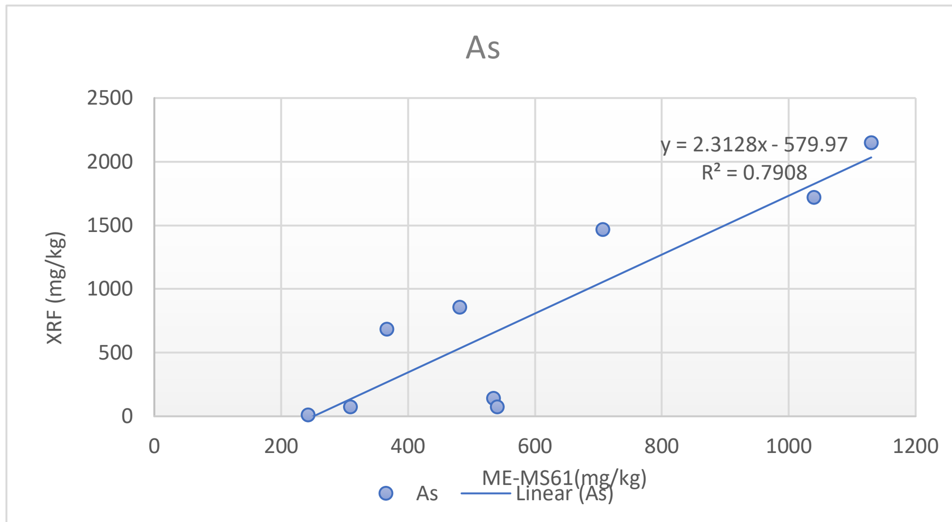
Mn	
ppm	
ME-MS61	XRF
735	716
3860	813
1500	1191
1280	2385
17300	4074
5800	2931
4330	2162
2960	1457
31100	16258
6130	1371
10100	1371

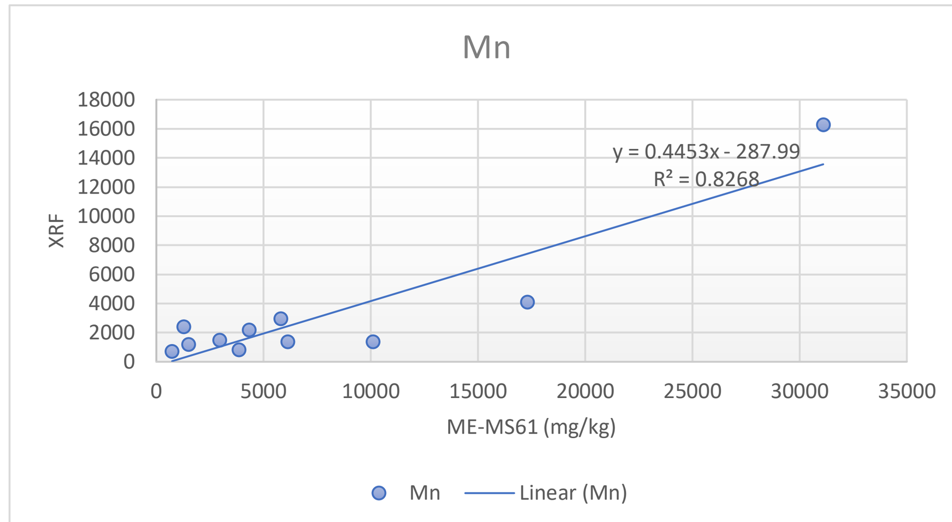
Zn	
ppm	
ME-MS61	XRF
3290	1418
15350	12139
3400	4966
2810	2109
15700	14881
6250	7004
6100	8598
2550	3485
8070	10170
3170	2448
3450	2448

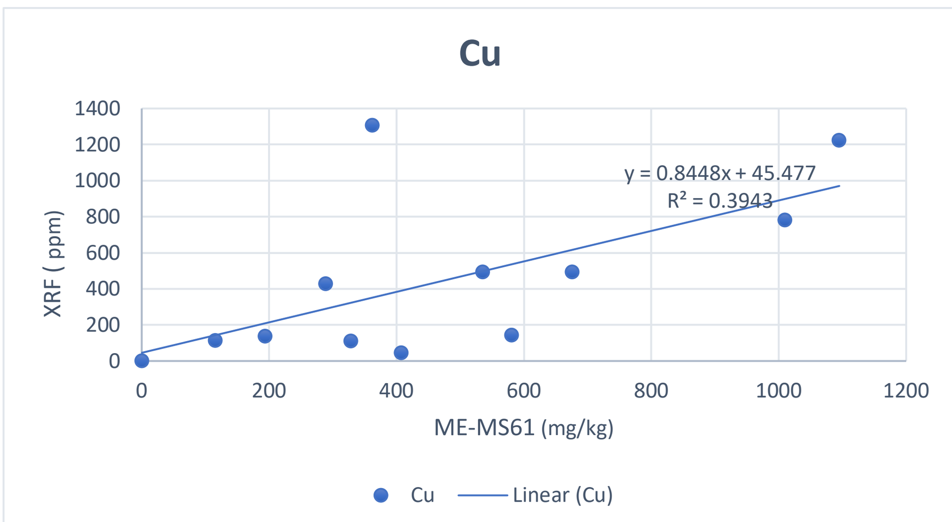
Cd	
ppm	
ME-MS61	XRF
11.85	12
17.75	31
5.68	40
81.2	7
24.5	20
8.23	7
55.9	89
13.1	2
15.1	2
0	0

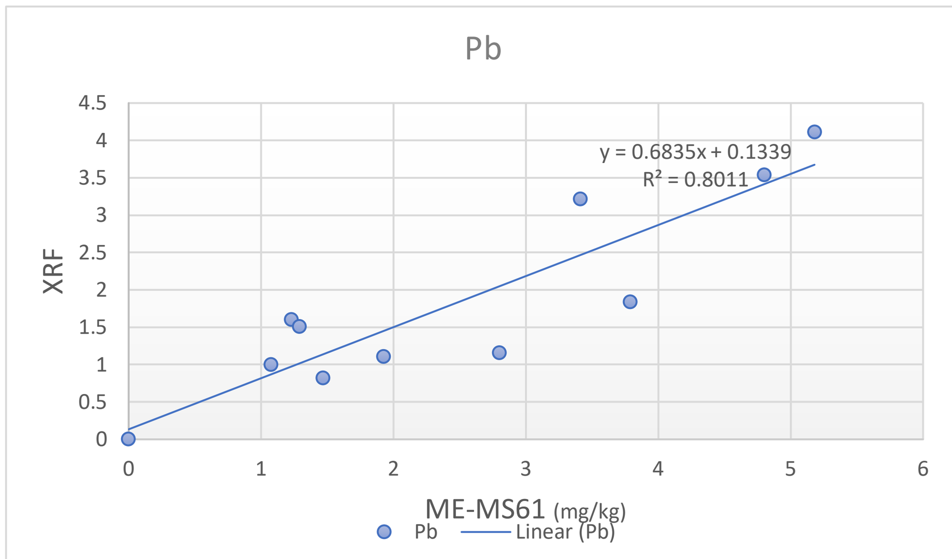
Cu	
ppm	
ME-MS61	XRF
194	136
115.5	114
362	1306
407	45
581	142
1095	1223
1010	781
328	111
289	428
676	492
535	492
0	0

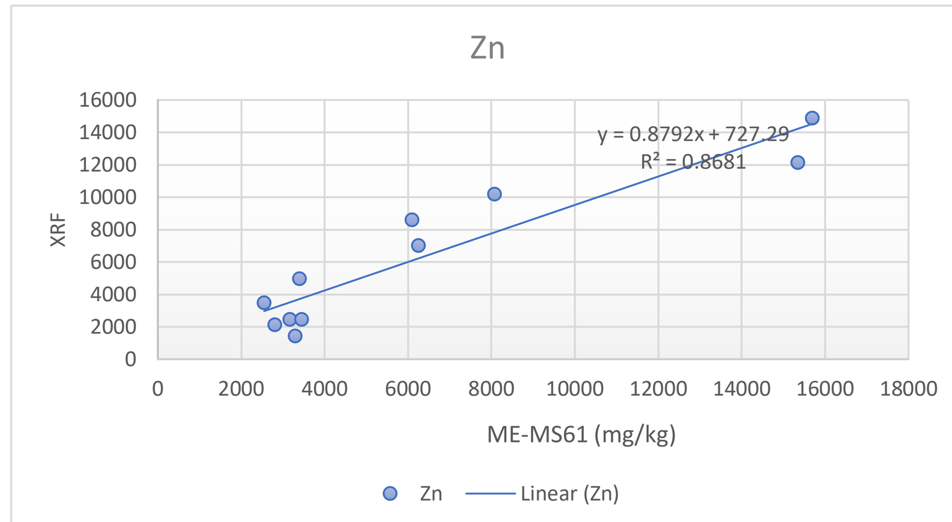












Full XRF Dataset in excel: This dataset are the paired results for ICP-MS

For further information contact:

Simon McVeigh BSc, MSc, MAusIMM, CPPA
Principal Consultant
smcveigh@terratechconsulting.com.au
www.terratechconsulting.com.au
0409319470
25 Oceana Pde
Austinmer NSW 2515

Appendix 2. Statement of Heritage Impact

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EVERICK HERITAGE

Leadville Mine

Statement of Heritage Impact

Written for Department of Regional NSW

Warrumbungle Local Government Area

April 2024

Report Reference:

Tony Brassil, Marsh, C. and S. Riley; 2024. Leadville Mine: Statement of Heritage Impact. Everick Heritage Pty Ltd unpublished report prepared for Department of Regional NSW.

EVERICK HERITAGE PTY LTD
ABN: 78 102 206 682
Head Office: Level 9, Matisse Tower
110 Mary Street Brisbane 4000
Sydney Office: 6B Reserve Street Annandale 2038
T: 02 9552 2944
E: info@everick.com.au
www.everick.com.au

Ver.	Author(s)	Review Type	Sections Edited	Date	Authorised
1	S. Riley	Draft	All	09.06.22	T. Robins
2	C. Marsh	Draft	All	18.07.22	V. Edmonds
3	C. Marsh and W. Riley	Final draft	All	05.08.22	V. Edmonds
4	C. Marsh	Final	All	18.08.22	V. Edmonds
5	T. Brassil	Update	All	23.04.04	K Christian

Executive Summary

Background

The Department of Regional NSW, under its Legacy Mines Program (LMP), proposes to undertake remediation works at the former Leadville Mine site, in Leadville NSW. Leadville Mine is listed on the Warrumbungle Shire Council Local Environmental Plan (LEP) as a place of Local significance. The site consists of a remnant mining landscape with open shafts, filled shafts, evidence of former structures and a number of examples of derelict machinery and boilers dating from the end of the nineteenth century to the middle of the twentieth century.

The site remains hazardous, both from the contamination and from the lack of clear data regarding the infill of mine shafts and the extent of underground workings.

Heritage Significance

The existing assessment of significance and Statement of Significance were reviewed and revised following a detailed assessment against the NSW State Heritage Assessment Criteria. The updated Statement of Significance is:

"The Leadville Mine site is significant to the mining and settlement history of the Leadville area and was the reason for the establishment of the town. It has played a small but notable role in the history of base-metal mining and refining in NSW and is associated with the Australian Fertiliser Ltd and the Electrolytic Refining and Smelting Company of Australia Ltd corporations as a supplier and an associated company. The site is an example of a remnant mining landscape and is representative of a wide range of remnant mining landscapes throughout NSW."

Proposed Works

The Remediation Action Plan (RAP) prepared by Terra Tech Consulting in April 2024 (REV E) specifies remedial measures which include:

1. Smelter site (surface soils comprise Category 2) – Leave in-situ and fence.

2. Mt Stewart (surface soils comprise Category 3)(and the area contains geohazards that preclude excavation) – Drainage controls to divert unimpacted meteoric water away from the Mt Stewart source point (where AMD potential was evident), collect contaminated runoff within a prescribed catchment area and fencing to prevent access.

3. Mt Stewart East - Paddock Shaft Area (surface soils comprise Category 3) – Strip area of sulfidic material to 200 mm, place material within Mt Stewart contaminated water catchment.

4. Grosvenor general area (surface soils comprise Category 2) – Leave in-situ and fence due to location of shafts and mineralised workings.

5. Grosvenor Dam (surface soils comprise Category 3) – Excavate and send material offsite for disposal in a licenced waste disposal facility.

6. Mt Stewart Drainage (surface soils comprise Category 3) – Excavate and send material offsite for disposal in a licenced waste disposal facility.

7. Install rural fencing around areas where grazing should be managed in accordance with the prescribed limitations included in the site EMP. This would include limiting access of livestock to the site for 2 months per annum.

Statement of Heritage Impact

The proposed works to the Leadville Mine site will be undertaken to address the current levels of contamination on the site, which pose a significant health and safety risk. The proposed works will not have any impact upon any of the remaining built structures or the existing movable heritage items such as the boiler shells, however, free public access will be restricted in the future by the exclusion fencing to be erected. The proposed works will alter the existing remnant mining landscape of the site, however, this landscape is the product of several phases of construction and demolition, followed by several phases of site remediation and decontamination and, whilst this landscape is representative of many similar former mining sites, it is also common to many other sites across NSW, Australia and other places in the world. Many of the other sites and places are not subject to the residual contamination issues present at this site and, consequently, the adverse heritage impact to this site arising from the proposed works is an acceptable outcome and appropriate approach to the management of the site into the future.

The proposed works will not have any associated impacts upon any other heritage items and no archaeological 'relics' will be disturbed. In many respects, the proposed works will result in a substantive benefit to the heritage significance of the site, enabling its ongoing conservation without the public health and safety concerns associated with its history of use.

Recommendations

Based upon the assessment of potential heritage impact of the proposed works, recommendations have been formulated to assist in the implementation of the works. Recommendations have been made in relation to:

- Archival Recording
- Movable Heritage
- Records
- Change of Works
- Unexpected Finds
- Discovery of Human Remains

Contents

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Abbreviations

The following definitions apply to the terms used in this report:

CHL means Commonwealth Heritage List

DPC means Department of Premier and Cabinet

EP&A Act means *Environmental Planning and Assessment Act 1979 (NSW)*

EPBC Act means *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*

Heritage Act means Heritage Act 1977

LEP means the Warrumbungle Local Environmental Plan 2013

ISEPP means *State Environmental Planning Policy (Infrastructure) 2007 (NSW)*

Everick Heritage means Everick Heritage Pty Ltd

LEP means Local Environment Plan

LGA means Local Government Area

LMP means Legacy Mines Program

NHL means National Heritage List

NSW means New South Wales

the Proposal means the remediation works at Sir Ivan Doherty Drive, Leadville

RAP means Remediation Action Plan

REF means Review of Environmental Factors

RNE means Register of the National Estate

s means section as in legislative terminology

s 170 means Section 170 Heritage and Conservation Registers

SHR means State Heritage Register

SOHI means Statement of Heritage Impact

1. Introduction

1.1. Project Background

In November 2022, Everick Heritage Pty Ltd (Everick Heritage) was engaged by the Department of Regional NSW to prepare a Statement of Heritage Impact (SoHI) for remediation works at the Leadville Mine site at Leadville. This report was prepared and submitted, however, following review and further analysis, the proposed methodology for remediation of the site has changed and Everick Heritage has been engaged to update the previous SOHI report to address the revised scope of proposed works.

1.2. Project Area Location

The Leadville Mine site is located on the western side of Sir Ivan Doherty Drive, 500m south of its intersection with Black Stump Way, at Leadville, NSW. The site comprises Lot 149 DP750766 and Lot 7304 DP1152229. The site is located within the Warrumbungle Local Government Area, Parish of Talbragar in the County of Bligh.

1.3. The Proposal

The Department of Regional NSW - Legacy Mines is proposing to undertake remediation activities, as specified in the Leadville Mine Remediation Action Plan Rev E (RAP) prepared by Terra Tech Consulting Pty Ltd in April 2024. A previous SoHI was prepared by Everick Heritage (2016) which assessed impacts to the site for an earlier set of proposed remediation works undertaken in 2016 and a draft SoHI was prepared in 2022 for an RAP prepared by Okane Consultants, which did not proceed. The current proposed works, in the 2024 RAP, are:

- Excavation and off-site disposal of materials highly impacted by heavy metal contaminants which are leachable and potentially pose a significant risk to surface waters on and off-site.
- Construction of a drainage management system to limit volumes of meteoric water interacting with Potentially Acid Forming (PAF) materials where geohazards are potentially present, thus precluding excavation and off-site disposal or encapsulation remedial approaches.
- Isolating areas with fencing to remove unacceptable health risks to future site receptors as well as address risks to livestock.

Further detail on the proposed works is provided in Section 5 of this report.

1.4. Aims and Methodology

The methodology used for this SoHI is consistent with the Australia ICOMOS Burra Charter and the NSW Department of Planning (Heritage Division) publication: *Assessing Heritage Significance, Statements of Heritage Impact* (NSW Office, 2002).

The significance assessment, together with an outline of statutory requirements, informed the impact assessment and recommendations. In accordance with the brief, the assessment methodology included:

- A review of background research for the existing site, including historical mapping and some primary research.
- Searches of statutory and non-statutory heritage registers, including the NSW State Heritage Register, NSW State Heritage Inventory, Warrumbungle LEP, Section (s) 170 Registers, Commonwealth Heritage List, Heritage List and World Heritage List.
- A description of the heritage significance of Heritage Items and Conservation Areas within or in the vicinity of the Project.
- A visual inspection to assess the potential impacts to surrounding archaeological relics as defined under the *Heritage Act 1977* (NSW). This included detailed photography of the features, remnant infrastructure and surrounding landscape.
- The SoHI and a discussion addressing the relevant sections of the *Warrumbungle Local Environmental Plan 2013* (LEP).

1.5. Authorship of the report

Tony Brassil (Industrial Archaeologist) and Caitlin Cole (Senior Archaeologist) undertook the revision and updating of this report. It is largely based upon the previous report prepared by Samuel Riley (Archaeologist), Caitlin Cole (Senior Archaeologist) and Attila Csaszar (Photographer/Videographer).

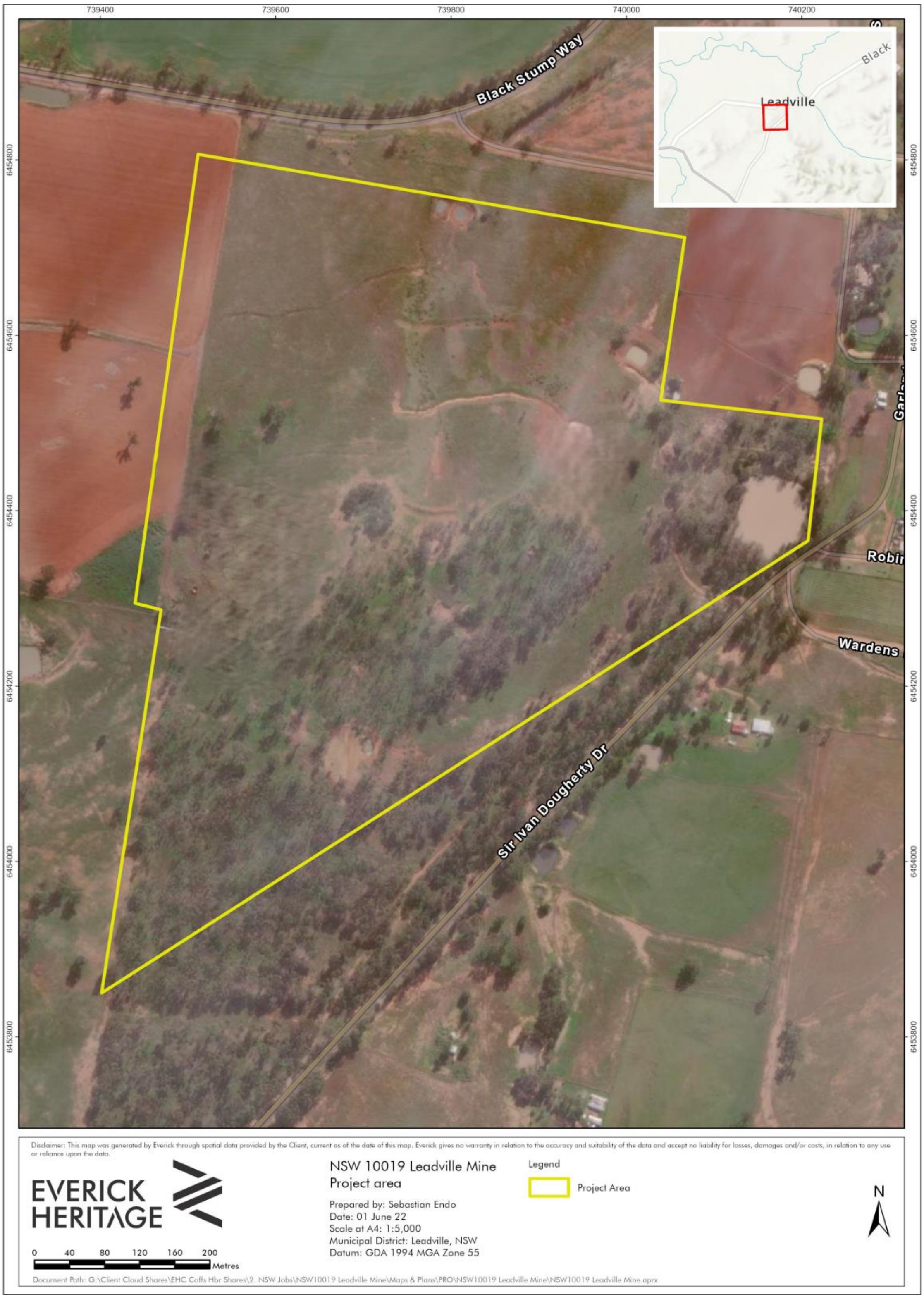

Figure 1-1: Project Area outlined in yellow for the Leadville Mine remediation area

1.6. Heritage Listings

A search of all available historical heritage registers was undertaken to identify heritage places within and immediately adjacent to the Project Area. The following registers were searched on 9 June 2022, using a combination of online databases:

- NSW State Heritage Register
- NSW State Heritage Inventory
- Section 170 Heritage and Conservation Registers (Section 170)
- Warrumbungle Local Environmental Plan 2013 (WLEP 2013)
- Commonwealth Heritage List
- National Heritage List
- World Heritage List
- Register of the National Estate (RNE)

The Project Area is located in the vicinity of the heritage items listed in Table 1-1:

Table 1-1: Heritage Items in the Vicinity

Item Name	Register	Number	Significance	Location	Land
Leadville Mines Site	WLEP 2013	I29	Local	Coolah-Dunedoo Road (now Black Stump Way)	Lot 157, DP 44930
Leadville General Cemetery	WLEP 2013	I28	Local	Leadville Road 2.2km South of Town (now Sir Ivan Doherty Drive)	Lot 7011, DP 96957

1.7. Identity Issues

The mapped location of the '*Leadville Mines Site*' (I29) provided in the LEP Heritage Maps (as shown in Figure 1-2) and the Lot/DP number provided in the LEP Schedule 5 are not at the location of the Project Area but are situated to the south, on the opposite side of Sir Ivan Doherty Drive. The SHI database report also identifies an address as: "*Land shown as 8a on map being Lot 10*", which has no clear application. However, the content of the SHI database report for the '*Leadville Mines Site*' clearly identifies features which are only located within the Project Area and describes the history of this mining site, so it is likely that the LEP statutory mapping and Land Title information is erroneous. While this is problematic from a legal perspective, the intent of the Listing is obvious and the Listing has been applied to the Project Area by all relevant parties. The correct address and Lot/DP numbers are provided in Section 1.2 above.

Figure 1-2: Heritage items mapped in Warrumbungle LEP MAP – HER 009 in relation to the Project Area. The Leadville Mine site details as shown are incorrect.

2. Historical Context

2.1. Regional History

Cameron (1993:300-302) provides a comprehensive history of the village of Leadville, providing important context the Leadville Mine and its operations.

Table 2-1: History of the Village of Leadville

Year	Event
Early 1850s	Martin Hobbins settles at 'Old Castle' near Leadville (transferred to 'Dhu Robin' in 1920).
1876-1877	Members of the Hobbins family die of diphtheria.
1887	Tommy Grosvenor (aka 'Governor')[Thomas Grosvenor subsequently changed his name to 'Governor'] discovers silver ore at Leadville. The mine site was named Mount Stewart and Tommy Grosvenor was given a 'purse of sovereigns' as a reward for his discovery.
1890	Martin Hobbins dies at Old Castle which was bequeathed to his son Martin Joseph Junior.
1891	The Mount Stewart/Leadville township is created by private sub-division by Mr C.L. Garland. The township consists of 253 Lots.
1892	A 'water-jacket furnace for smelting' is installed.
1894	The township is largely abandoned following the cessation of mining.
1905	An additional twelve Lots are subdivided.
1913	180 Lots are put up for auction. Only a few are sold.

2.2. History of the Project Area

2.2.1. Leadville Mine History

Valdja (1973:3-6) provides a history of the Leadville Mine Site and its operations.

Table 2-2: History of Leadville Mine Site

Year	Event
1888	Leadville Mine is opened as a 'silver-lead' mine.
1891	Township of Leadville is founded.
1892	Investment in mine infrastructure including two boilers (35 horsepower and 25 horsepower), the water-jacket furnace for smelting and two Baker's rotary pressure blowers.
1893	Total smelting of 15,000 tons of ore with recovery of 1,539 tons of lead and 292,093 ounces of silver. Operation suspended due to low silver prices.
1894	Resumption of mining in November for two months. Mining ceased due to a change in the ore body and the mine goes into voluntary liquidation.
1898	Mount Stewart is bought by Mr C. I. Garland and Mr J. Channon at auction.
1910	The railway line is extended from Mudgee to Craboon, 5 kilometres south of Leadville.
1921	Sporadic operation of the mine with infrastructure investment including two winches and a Main Engine Shaft with a poppet head and two cages.
1921	A geological survey and underground mine plan are produced by Mr. T.A. Willan.
1926-1927	Recommencement of mining operations for a short period.
1928	Electromagnetic surveys are completed for the Imperial Geophysical Experimental Survey.
1932-1935	Mount Stewart is reopened by the Mount Stewart Mine Syndicate. Considerable plant was erected at the site at this time.
1935-1936	Mount Stewart operated by Australian Fertilisers Ltd mining for sulphide ore
1937	Zinc ore mined is mined by the Mount Stewart Mine Syndicate
1937-1948	Mount Stewart is maintained as 'unwatered' and the plant sold.
1948	Leadville Mining Syndicate form the Leadville Mining Company Pty. Ltd. following a partnership with The Zinc Corporation Ltd.

1950-1951	Production of a small amount of silver-lead ore and concentrates.
1952	The mine was unwatered and the surface re-timbered. Total restoration works cost 10,000 Sterling.
1955	Inspection in November stated that the Mount Stewart Mine was not in operation – all plant except 'an old kerosene engine, pump and compressor has now been removed. No works on the Grosvenor mine and battery with the curvilinear tables deteriorating'
1962	The Leadville Mining Company Pty Ltd. is dissolved.

2.2.2. 1921 Mine Plan

A plan of the Mount Stewart Mine and Leadville township originally produced by T.A. Willan in 1921 (Figure 2-2) shows the locations the main operations at Leadville. By comparison with the information provided in a 1920 report on the Leadville mine (NSW Mines Department Files D004203110), the following general layout is determined:

- The Mount Stewart Workings (now the Main Shaft, Shaft 9 and Shaft 10)
    - In 1920, the only shaft which was equipped with steam winding gear was the Engine Shaft. The report noted two 'Galloway' boilers, with one in condition for steam raising, a winder and a compressor but also noted that a new winding engine would be required. A view of the main poppet head in 1892 is shown in Figure 2-7.
    - When Mount Stewart was under the management of the Mount Stewart Syndicate, considerable plant was erected in association with the main shaft. Additional buildings, including a Manager's Office and an Assay Office, were also constructed to the north-west of the Main Shaft site (Figure 2-9)
- The Grosvenor Workings (now Shaft 6)
    - Originally there were five shafts sunk into gossan, with one remaining in accessible condition in 1920. The depth of the shafts was approximately 80-90 feet (ft)
- The Extended Workings (now Shaft 7)
- The 'Old Smelter Site'
    - A water jacket smelting furnace was erected as part of the original mining operation. It was in operation for a period of 14 months with a total of 15,000 tons of oxidised ore treated, yielding 1539 tons of lead and 292,093 ounces of silver. A change in the composition of the ore resulted in the voluntary liquidation of the original company. The smelting furnace consisted of a chimney,

external corrugated metal double height building which likely contained the retaining wall within the building (Figure 2-8).

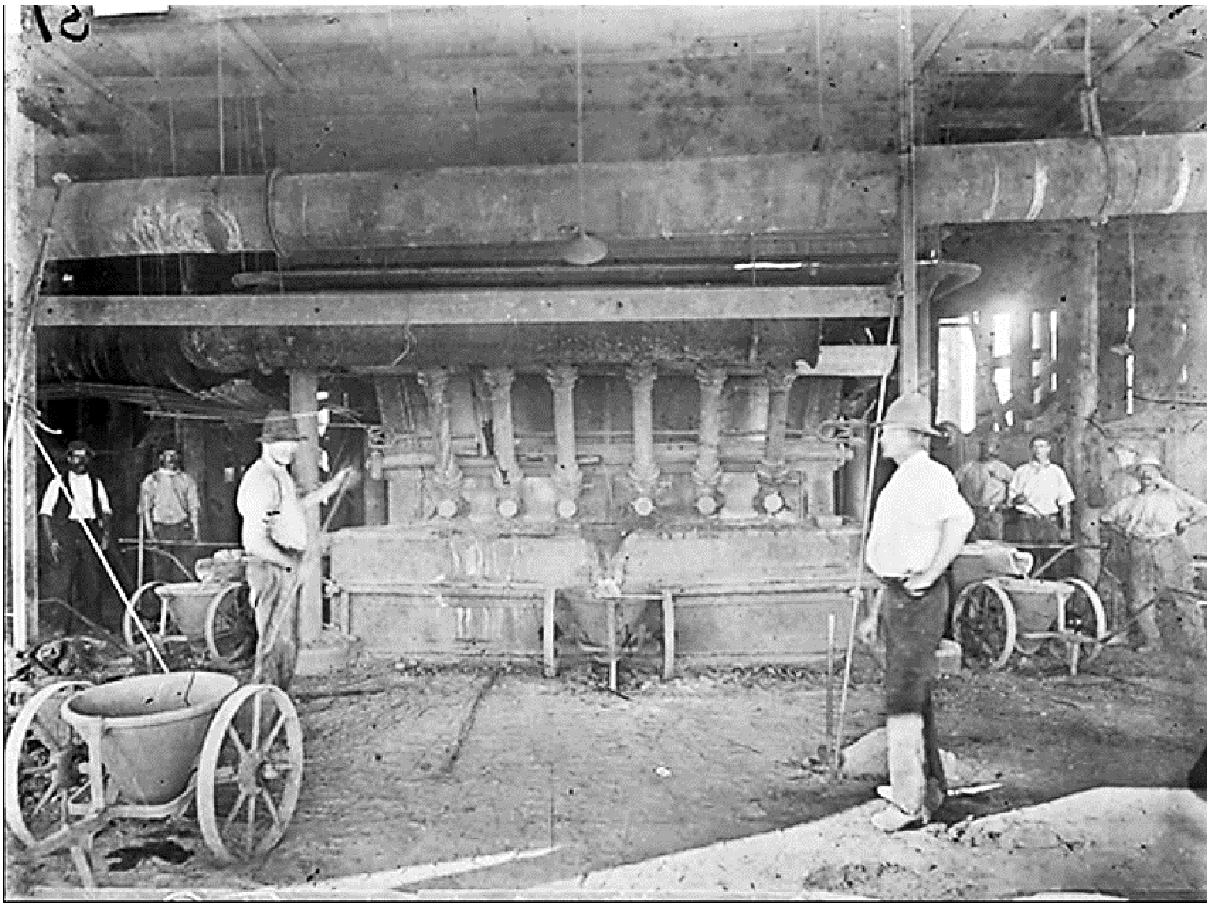

Figure 2-1: 'Water-jacket blast furnace at the Nymagee mine' (smelting copper), circa1900 (Source: K G Mcqueen; *Nymagee Copper: Birth, death and resurrection?* Journal of Australasian Mining History, Vol. 15, 2017; Oct 2017)

Figure 2-2: 1921 Mine Plan (Willan 1921).

2.3. Historic Aerial Photographs

The earliest historic aerial image available for the Project Area dates to 1964 and shows the Project Area shortly after cessation of mining operations (Figure 2-3). The four work areas identified in the 1921 Plan (Figure 2-2) are clearly visible. Of note is the complicated network of dirt tracks connecting the four work areas and what appear to be significant areas of denudation, presumably from run-off of minerals and chemicals across the Leadville Mine site.

Figure 2-3: 1964 historical aerial photograph

2.4. Parish Maps

The 1893 Talbragar Parish Map indicates that the Project Area comprised AL1848 (presumed Annual Lease) and M5413 with a subsequent annotation indicating that the Annual Lease was initially dated 3

Feb 1894 (Figure 2-4). The 1906 Parish map clearly shows the location of both ML 44 and ML 45 and the property owned by C.L. Garland marked 'Leadville' (Figure 2-5). The 1911 Parish map indicates that the adjacent Lot in the southern portion of ML44 has been resurveyed to align with the Mining Lease boundary (Figure 2-6). This Lot configuration is consistent with the current southern boundary of Lot 7034/DP1152229. The Parish map also shows the gazetted road, now 'Black Stump Way', and the alignment of the proposed railway line passing Leadville.

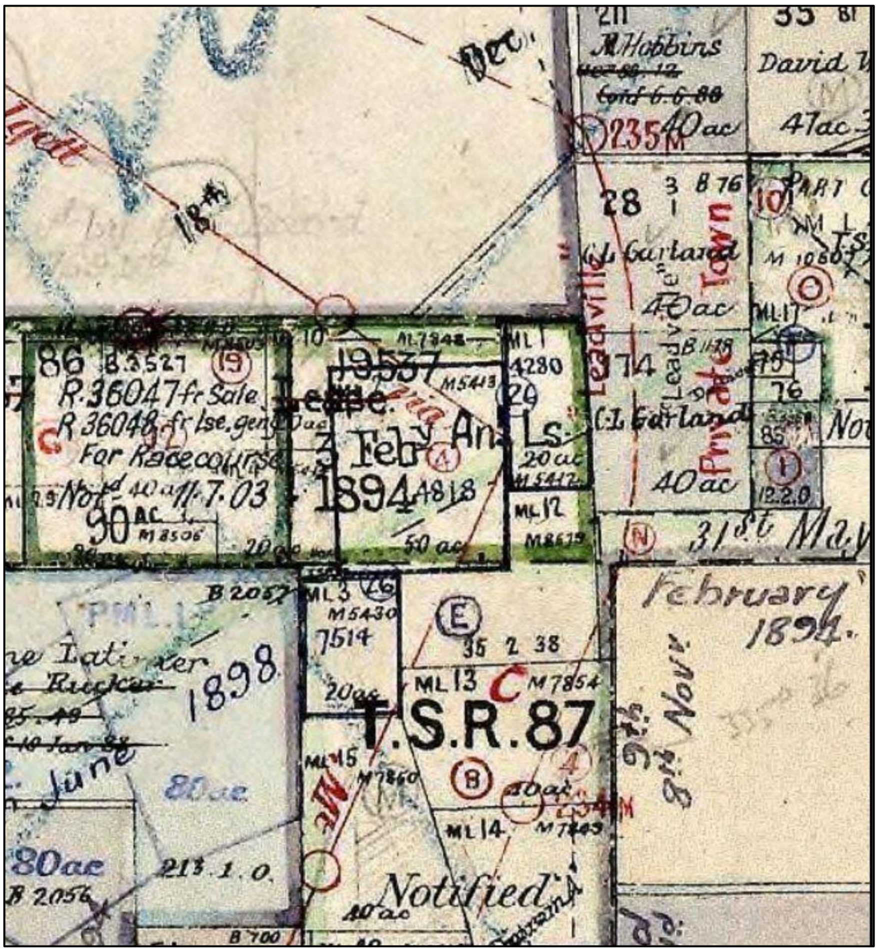

Figure 2-4: 1893 Talbragar parish map.

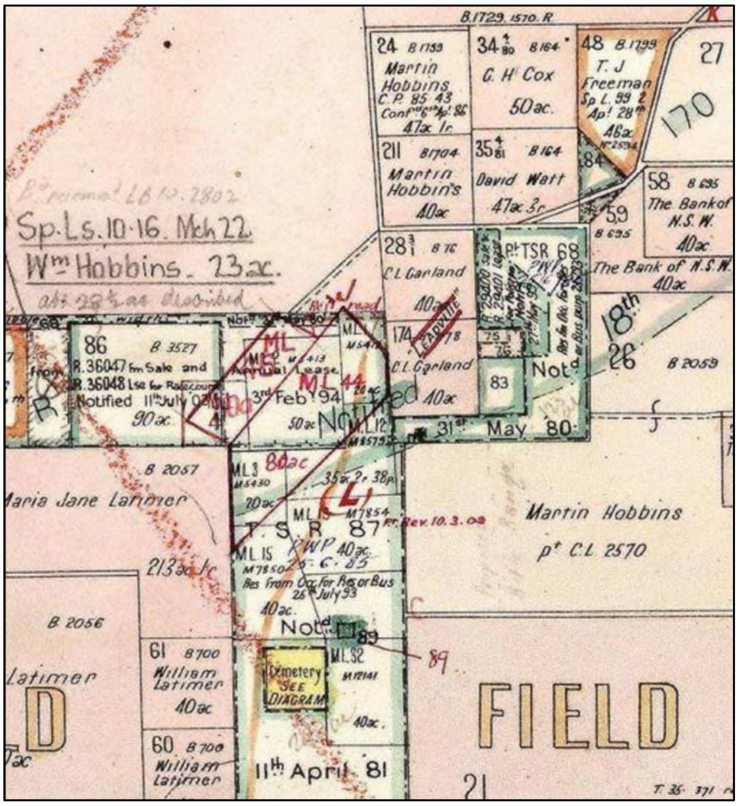

Figure 2-5: 1906 Talbragar parish map.

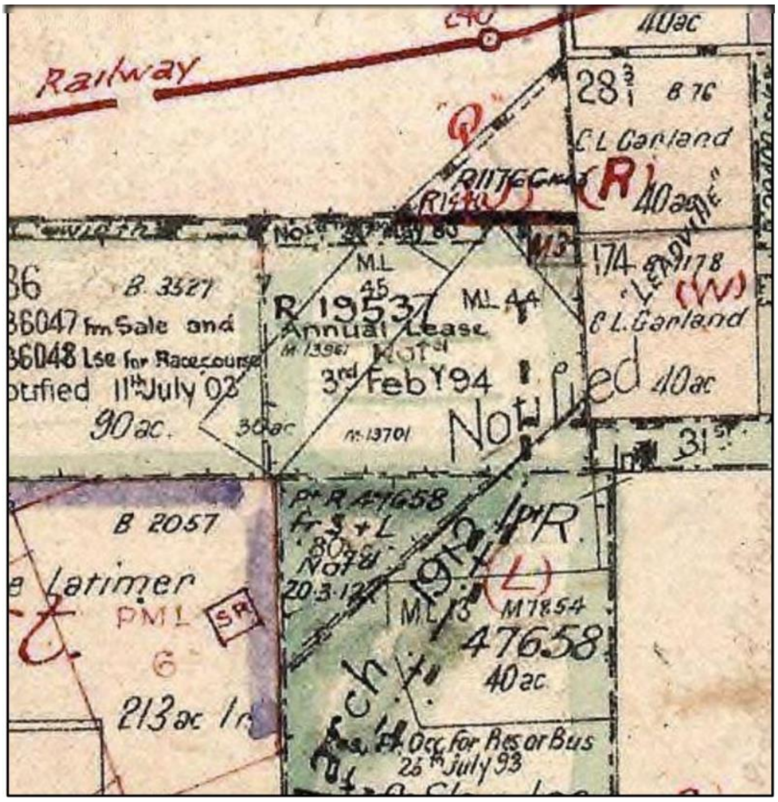

Figure 2-6: 1911 Talbragar parish map.

2.5. Known Machinery and Mine Buildings

Mine Inspector's reports list the machinery managed by the Leadville Mining Syndicate in 1952 (10.6.1952). At this time, the mine employed five men. Plant at the site consisted of:

> *"A Southern Cross BE C/BE. C diesel generator, approximately 25 horsepower, powering a 150 cubic ft min Broomwade compressor. A 25-horsepower kerosene engine drives a 5,000 gallon per hour Pomona pump operating against the 260 ft head. A 'take off' drives a 170 cubic ft per minute Richardson fan delivering through a 6 ft iron ventube. A 7.5 horsepower Homan hoist is in use…" (Source: Mine Inspector's report [10.6.1952])*

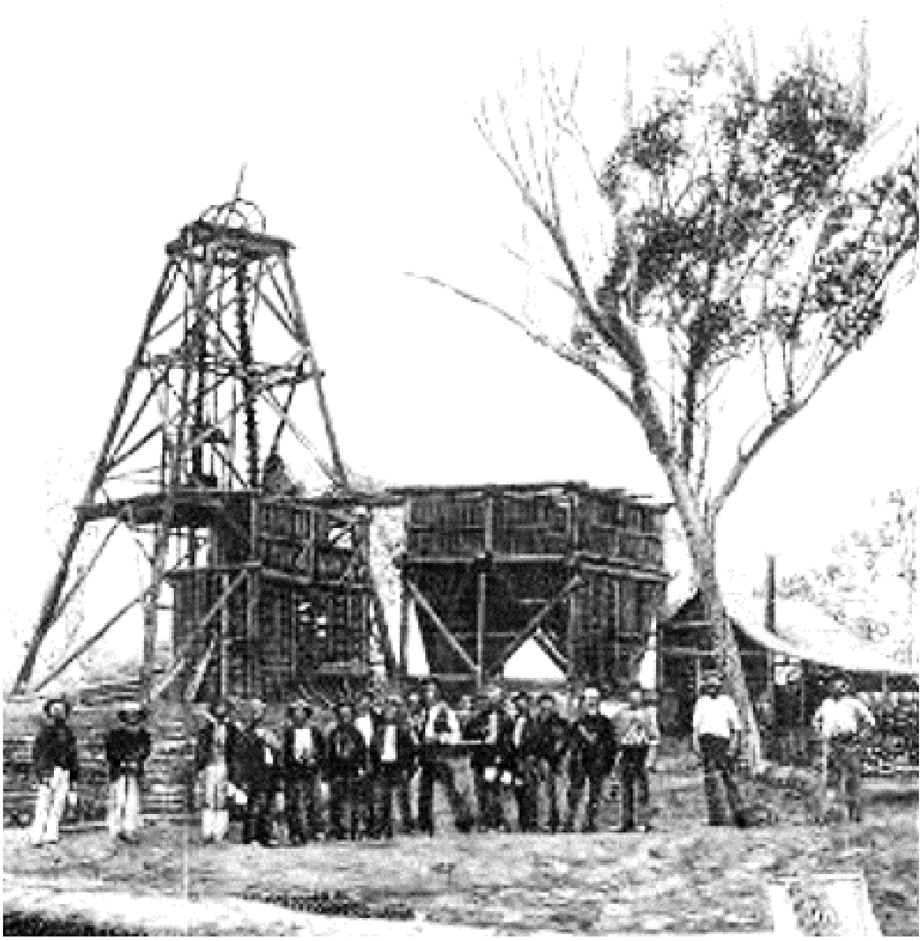

Figure 2-7: Etching showing the poppet head and hoppers at Leadville Mine (Source: Sydney Mail, 27 August 1892; via Trove)

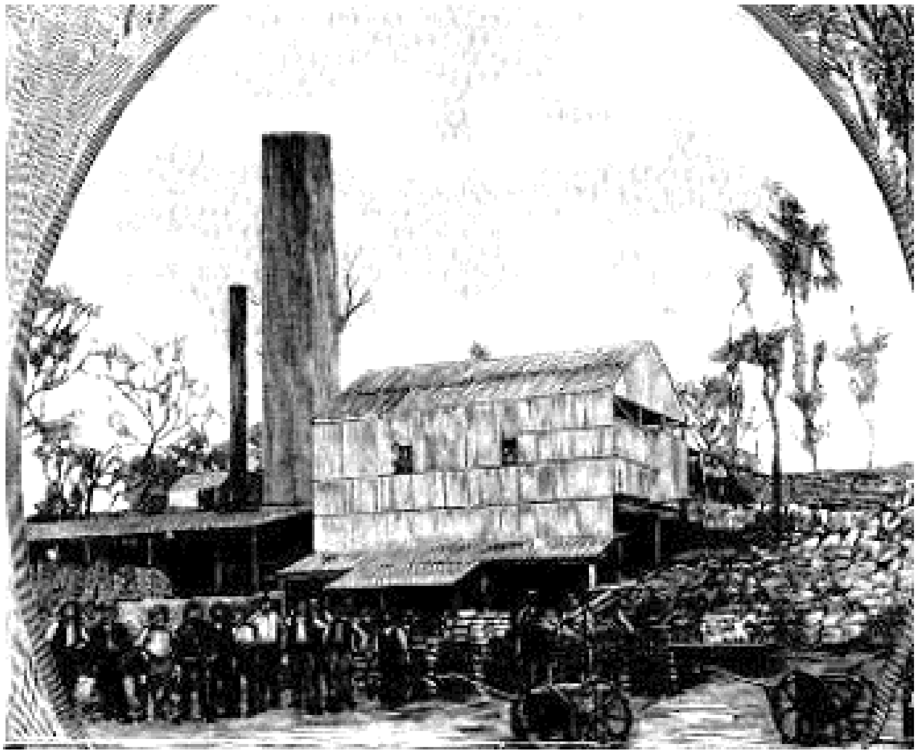

Figure 2-8: Front of Mount Stewart smelting works (Source: Sydney Mail, 27 August 1892; via Trove)

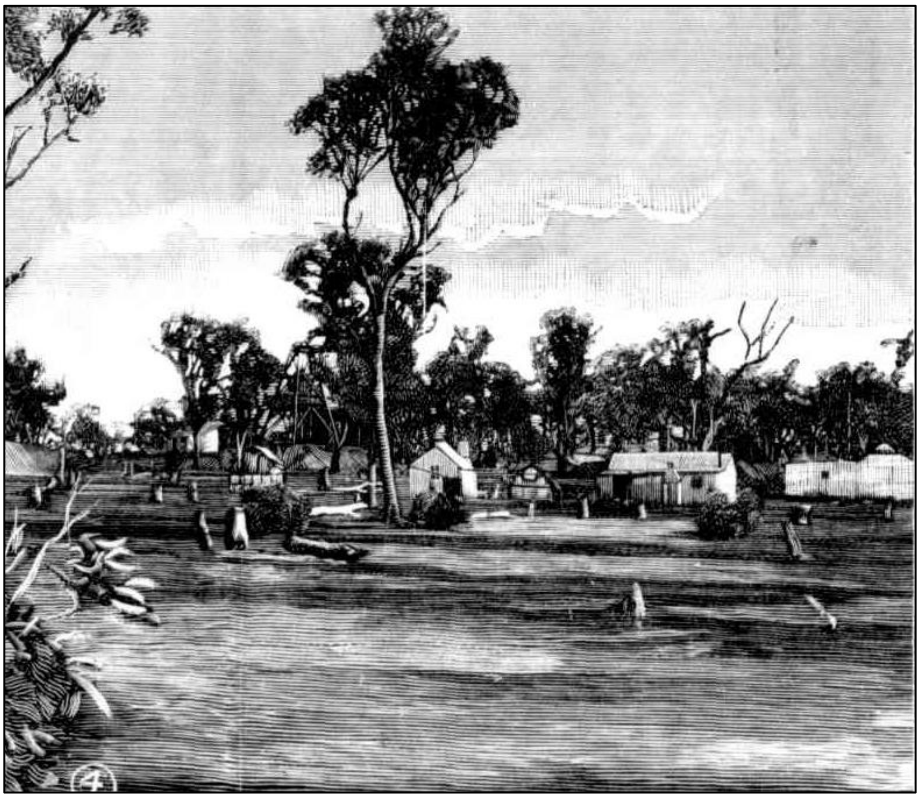

Figure 2-9: General view of mine and offices (Source: Sydney Mail, 27 August 1892; via Trove)

2.6. Previous Remedial Works

Scientific site investigations and monitoring has taken place within the Project Area over the previous thirty years. An investigation in 1993 concluded that acid and metalliferous drainage, resulting from the oxidation of sulfidic ore present at the site, has contaminated sediment within drainage lines and water in the existing stock dams (Frederick 1993 in Okane 2021). Actions resulting from this assessment resulted in shaft filling, drainage works, consolidating and compacting waste dumps, chemical treatment of acid soil by lime dosing, revegetation and fencing (Land & Water Conservation, 1996 in Okane 2021). There was no final remedial report made publicly available, so the true extent of works at this time is not known.

Monitoring of water quality between 1996 and 2000 indicated that elevated levels of lead, copper zinc and arsenic were present within standing water at the site.

Further remediation and safety works were undertaken in 2016. The works, which were supported by the previous Everick Heritage Statement of Heritage Impact (2016), involved further backfilling or fencing of mineshafts. The aim was to reduce soil erosion and contamination of run off. Two sediment dams were constructed and the use of the site to graze cattle was no longer permitted.

In 2019, during a period of severe drought, the Project Area was subject to illegal grazing, resulting in cattle being quarantined with elevated lead concentrations in blood samples. Following this, additional sampling in October and December 2019 and January 2020 involved extensive surface analysis by portable x-ray fluorescence (FP-XRF). The results of these studies resulted in the requirement for an updated management plan for the site to contain the higher levels of contamination than was previously assessed.

3. Site Description

3.1. LEP Description

The Leadville Mine Site is listed on the Warrumbungle LEP 2013 as I29. The following description is reproduced from the SHI Database report:

> *The Leadville mine site is on a rise above the village at Leadville. It employed perhaps 150 people at the height of its production and mining included lead, silver and zinc. The rise that accommodated the mine is sufficient to give a panoramic view of the surrounding landscape. There is quite a number of relics on the site covering a few acres of ground dating from the mining period. These include long concrete low wall or foundation, concrete mounting pads, various spoon drains and in ground drains, poppet head foundations, a covered and meshed timber lined shaft, slopes of scree and a pond of water below the main poppet head, some indications of former road works and tracks, two old concrete water tanks, heaps of the local or, a quarry area, machinery bases, a stone and rock faced wall of unknown purpose. The area is private and is fenced off completely.*

3.2. Site Inspection

The Leadville Mine consists of twenty-nine individual relics (as recorded by Everick Heritage in 2015). A reinspection of the site was undertaken over two days on the 7th and 27th June 2022. The purpose of the site inspection was the revisit and update the condition of the sites identified, as well as conduct an archival recording of all features at the site. Due to wet conditions, grass cover was an impeding factor to the recording of all features on the first day of survey, requiring grass to be cleared around heritage features – particularly at Mount Stewart. The Everick Heritage ID for all of the features, their description and the proposed impact has been included in the below tables, which have been divided by location.

3.3. Mount Stewart Workings:

The Mount Stewart works consists of a main shaft location (which has been filled in as part of the previous Legacy Mines remediation at the site), as well as the remains of foundations for additional mine structures. In addition to this, a number of heritage features were identified within the area including a boiler, a drain and the remains of an open shaft (which has since been filled as part of the 2016 remediation works).

Table 3-1: Mount Stewart Site Elements

Heritage ID 2016	Item description
LV1	Stone and brick solid structure with cement mortar. No visible signs of bolts or anchors for the connection to machinery. Red clay bricks in centre of stone structure.
LV2	Unknown shaft – small shaft or exploration pit with single wooden support beam.
LV3	Spoil heap, likely associated with the adjacent shaft (LV2).
LV5	Main Shaft, originally a timber lined shaft, with water race water feature located directly adjacent to the original shaft location. Works in 2016 filled in the shaft but retained the adjacent heritage features.
LV6	Collection of concrete drains below main shaft. During the heritage survey in June 2022, no evidence of extant drains was identified at this location. Concrete rubble was located on the downslope of the Main Shaft site, which may have been the remains of the drains which had been removed.
LV7	Drain – enclosed square formed concrete drain with single inspection hole at half-way point. 2 x metal pipes at head of drain.
LV8	Works Area. Concrete slab with 5 visible wooden post holes indicating roofed structure. Possible ramp on eastern portion of slab. Small square raised concrete.
LV8a	Three perpendicular concrete raised footings measuring 2.55 m by 200 mm by 200 mm with a distance of 700 mm between each of the three raised footings.
LV9	Small concrete slab with fallen red clay brick wall with cement render.
LV10	Fallen red clay brick wall with cement render. Likely to associate with LV9. No render visible on the exposed surface.
LV11	Concrete slab with a single large (500 mm diameter) wooden post support at the centre. Metal storage container in the NW corner of the slab. Various rusted iron debris surrounding the slab.
LV12	Coarse concrete footing. Four large threaded bolts extruding from the footings in a square formation.
LV13	Metal boiler or furnace.
LV14	Retaining wall – double course red brick retaining wall orientated east-northeast towards the main shaft. Concrete render intact in parts.
LV15	Partial remains or a car, including car chassis and front left fender.

Figure 3-1: LV 5 view towards the old shaft location, cement footing and water deviation (Everick Heritage 2022)

Figure 3-2: LV 14 retaining wall facing west (Everick Heritage 2022)

Figure 3-3: LV 11 Concrete slab and metal debris/ storage container, photo facing northeast (Everick Heritage 2022)

Figure 3-4: LV 12 Concrete slab and metal debris/ storage container, photo facing northeast (Everick Heritage 2022)

Figure 3-5: LV 15 remains of vehicle chassis and fender (Everick Heritage 2022)

3.4. Grosvenor Workings

The Grosvenor workings consists of a previously remediated shaft, the remains of processing equipment and a tailings dam and water holding tank which are currently empty. Descriptions of the features are listed in Table 3.2.

Table 3-2: Grosvenor Workings Site Elements

ID 2015	Item description
LV17	Stamper Battery – battery complex consisting of reciprocating engine, furnace and timber framing in situ.
LV18	Tank – located downslope of the stamper battery likely to collect water from the stamper. The tank is cement rendered around a corrugated galvanised water tank. A small separating drum is situated above the tank receiving water from the battery, a holding dam is located below the tank
LV19	Tank – cement rendered double brick water tank below LV20 and above LV17. Two moveable drains constructed from metal drums are located at the base.
LV20	Six Shaft – has been filled in following the previous remediation in 2016.

Figure 3-6: LV 12 Concrete slab and metal debris/ storage container, photo facing northeast (Everick Heritage 2022)

3.5. Smelter Site

The original location of the smelter dating from the 1890s. The remains of the smelter are located over two levels, with a retaining wall supporting the top layer which is surrounded by contaminated fill and tailings. Descriptions of each heritage feature are included in Table 3-3.

A LiDAR scan of the retaining wall was undertaken as part of the draft SoHI prepared in 2022. A snapshot of the finalised scan is included in Figure 3-8. The LiDAR scan allows a digital model of the wall to be preserved on a cloud-based webserver, allowing for further interrogation of size and detail.

Table 3-3: Smelter Site Elements

ID 2015	Item description
LV24	Smelter retaining wall – stone and brick wall built into the side of the hill. The wall has a slight curve to the top of the section of brick. The surrounding hill has been terraced above and below and the remains of slag. Brick footings with metal spikes protruding from external areas located at the top of the wall, and a metal settlement tank located at the base of the wall.
LV25	Located to the south of the smelter site. Brick and concrete machinery footings – possibly a steam boiler.

Figure 3-7: LV 24 Concrete slab and metal debris/ storage container, photo facing northeast. (Everick Heritage 2022)

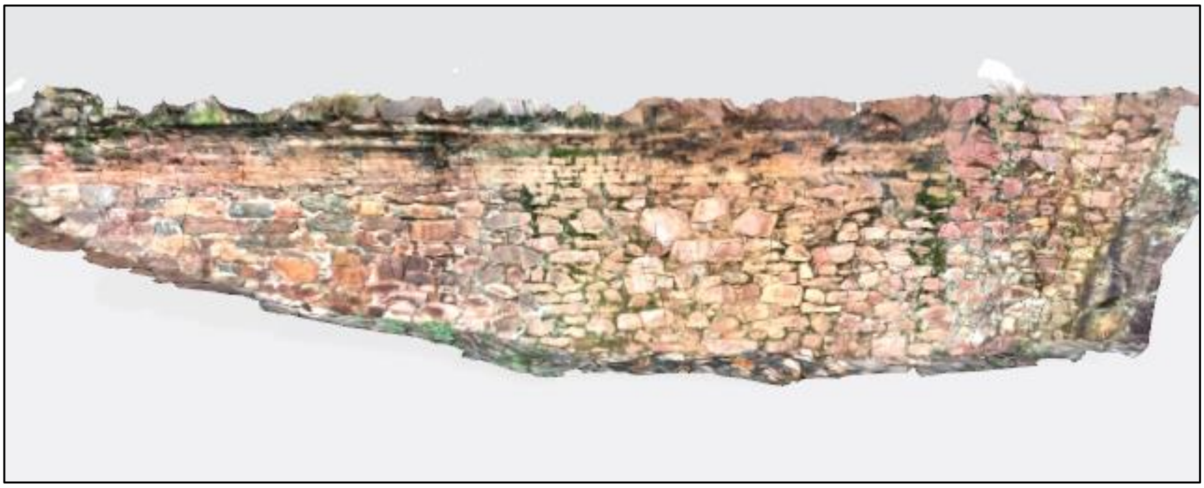

Figure 3-8: Snapshot of Lidar scan of LV24. A webmap can also be produced for public dissemination. (Everick Heritage 2022)

3.6. Shaft 10

The only remaining un-remediated (and unfilled) shaft is located at Shaft Ten (LV28). It is located associated with a boiler to the east of the main shaft size.

Table 3-4: Shaft 10 Site Elements

ID 2015	Item description
LV28	Shaft Ten' - Vertical shaft with engineered and intact wooden support structures. A metal grate has been installed over the opening of the shaft. Following the

	previous program of remediation, a permanent fence was installed around the opening of the shaft to prevent illegal or accidental access.
LV29	Partially intact boiler (4000mm x 1100 mm) adjacent to a concrete slab/footings (5700mm x 5400mm x 50mm)

Figure 3-9: LV 28 drone picture showing the previous remediation works (Everick Heritage 2022)

Figure 3-10: LV 29 view of the boiler footings, and metal boiler structure located adjacent to the original footing location (Everick Heritage 2022)

4. Cultural Heritage Assessment

4.1. Basis For Assessment

The concept of cultural heritage significance attempts to identify the value that places may have to current and future generations. Items which are likely to be significant are those which '*help an understanding of the past or enrich the present, and which will be of value to future generations*' (Australia ICOMOS 2000:12). The NSW Heritage Council has adopted specific criteria for heritage assessment, which have been gazetted pursuant to the Heritage Act. The seven criteria upon which the following assessment of significance is based are:

- Criterion (a): Historical significance
- Criterion (b): Associative significance
- Criterion (c): Aesthetic significance
- Criterion (d): Social significance
- Criterion (e): Scientific significance
- Criterion (f): Rarity
- Criterion (g): Representativeness.

The Heritage Council also considers the integrity and intactness in relation to heritage places. Places that are assessed are ranked as either of Local or of State significance, with places of State significance listed on the NSW State Heritage Register. Places of Local significance are typically listed on the local planning instrument.

4.2. Comparative Context

A comparative analysis of the heritage item against other listed and unlisted sites can help to ascertain whether the site is rare or representative in terms of extent, nature, integrity and preservation. If there are a large number of similar sites which have been already well documented in the historical record, then the research potential for the site would be lower than if the site was the only intact example of a particular feature or site complex.

There are many derelict and legacy mines within NSW, although only a small number have identifiable relics and even fewer are well documented. Examples of other derelict mining sites in New South Wales, which have been identified as having heritage values, are discussed in Table 4.1 below.

Table 4-1: Heritage Listed Derelict Mines in NSW and Comparison to Leadville Mine Site

Site name	Location	Heritage Significance Level	Comparison
Ottery Mine	Emmaville NSW	State	Archaeological remains, including derelict structures, open mine workings, eroding slimes dams, spoil heaps and pieces of machinery including primary kilns, the secondary kilns, the rotary kiln, refinery, cooperage and two twin banks of condensers leading up the hill to a common flue and chimney.
Sunny Corner Mine	Sunny Corner, NSW	Local	Sunny Corner Mine was the richest silver operation in Australia before the discovery of the Broken Hill lead-silver-zinc deposit in 1883. Archaeological remains, including a hillside flue and chimney stack, engine house (constructed of slag blocks), a manager's hut and timber posts. Numerous slag heaps, water diversions. In the hills surrounding the main Sunny Corner Mine site, ad hoc shafts and adits utilised to prospect for gold and silver are present (the majority of the shafts located within State Forestry land have been subject to remediation).
Wentworth and Reform Gold Mines	Michell Highway, Lucknow NSW	State	Archaeological remains, including battery shed – the only known example in NSW. Retained more standing buildings in association with the machine footings also located at the site
Bodangora Gold Mine (former) – Chimney, Shaft & Engine Footings	Gold Hill, 251 Dick Street BODANGORA NSW 2820	Local	A large brick chimney 27 m in height with adjacent intact shaft and associated footings have been retained in situ.
Kaiser Mine Site	Ahwahnee, 530 Driell Creek Road BODANGORA NSW 2820	Local	The site includes evidence of pre-1900 mining practice: two large open cut pits (18 x 27 x 4.5m, 18 x 15 x 6m) as well as signs of recent mining dating to the 1990s.

The above examples of mining sites in NSW contain a variety of different extant features, including standing structures, furnace chimneys and open cut workings. Other notable sites in NSW include (select examples):

Mining Sites and Landscapes:

- Glenrock State Recreation Area: Early Coalmining Sites
- Windeyer: Gold Mining Water Race
- Joadja: Kerosene Oil Shale Mining and Refining Site
- Burnt Yards Mining Sites
- Bywong Gold Mining Town
- Yerranderie Silver Mining Field and Settlement

Ore Smelting Sites

- Day Dream Smelter, Broken Hill
- Former Dapto Smelter, Kanahooka
- Pulganbar Mercury Smelter, Pulganbar
- Lake George Mine and Smelter Site, Captains Flat

4.3. Assessment against Criteria

The Leadville Mine site is listed on the Warrumbungle LEP 2013 but the SHI listing does not include a significance assessment against the NSW State Heritage Assessment Criteria. The following Table 4-2 briefly applies the assessment criteria to the Leadville Mine site.

Table 4-2: Significance Assessment Against Criteria.

Criteria	Description
Criterion (a) Historic Significance: An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area).	The Leadville Mine site is significant to the mining and settlement history of the Leadville area and was the reason for the establishment of the town. It has played a small but notable role in the history of base-metal mining and refining in NSW.

Criterion (b) Historical association: An item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area)	The Leadville Mine is associated with Tommy Governor, a notable indigenous person. The site is associated with Australian Fertiliser Ltd and the Electrolytic Refining and Smelting Company of Australia Ltd, both notable corporations in the early metals smelting industry in NSW.
Criterion (c) Aesthetic/creative/technical achievement: An item is important in demonstrating aesthetic characteristics and/ or a high degree of creative or technical achievement in NSW (or the local area).	No Values are identified under this criterion.
Criterion (d) Social, cultural, and spiritual: An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural, or spiritual reasons.	No Values are identified under this criterion.
Criterion (e) Research potential: An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area).	The item has the potential to reveal information about the history of silver-lead mining in the region. The development and construction over time may provide information on the changing nature of mineral extraction from the late nineteenth century through the middle of the twentieth century.
Criterion (f) Rarity: An item possesses uncommon, rare, or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area).	The item is a rare surviving example of silver, lead zinc and pyrites mining and smelting activity in this part of NSW.
Criterion (g): Representative An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments (or a class of the local area's cultural or natural places; or cultural or natural environments).	The remnant mining landscape and mining relics are representative of many similar small metals mining sites that operated for periods in the 19th and early 20th centuries in NSW.

4.4. Statement of Significance

4.4.1. Existing Statement

The following is the Statement of Significance as on the SHI:

> *"An interesting archaeological site of silver/lead mining that gave rise to the village of Leadville. A rare mining activity site for the Coolah Shire* (now the Warrumbungle Local Government Area) *the site has had a number of rises and falls in fortune as successive waves of mining sought a variety of ore products."*

4.4.2. Revised Statement

"The Leadville Mine site is significant to the mining and settlement history of the Leadville area and was the reason for the establishment of the town. It has played a small but notable role in the history of base-metal mining and refining in NSW and is associated with the *Australian Fertiliser Ltd* and the *Electrolytic Refining and Smelting Company of Australia Ltd* corporations as a supplier and an associated company. The site is an example of a remnant mining landscape and is representative of a wide range of remnant mining landscapes throughout NSW."

4.5. Archaeological Significance

4.5.1. General

Part 6 Division 9 of the Heritage Act protects archaeological 'relics' from being '*exposed, moved, damaged or destroyed*' by the disturbance or excavation of land. A 'relic' is defined by the Heritage Act as:

> *Any deposit, object or material evidence which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and has local or state significance.*

Section 146 of the *Heritage Act* requires any person who is aware or believes that they have discovered or located a relic must notify the Heritage Council of NSW, providing details of the location and other information as required.

4.5.2. Archaeological Potential

Leadville is a remnant post-demolition mining landscape with only the remnant footings of former buildings, partial remains of structures such as the former dams, and topographic elements such as infilled shafts and mounds of overburden and slag. There are also some movable objects, such as boiler shells and stamp-battery remains. The site was demolished, cleared and levelled following the cessation of mining and has been subject to several phases of remediation works, which have added landscaping elements such as drainage ditches and dams and have seen virtually all of the former shafts filled with material taken from onsite. There are only a few small areas that do not appear to have been affected by historical activities to some degree, leaving most of the site as highly disturbed. Subsequent soil testing programmes have confirmed that virtually all of the site is affected to some degree by contaminated soils, with mining waste and smelter waste used as fill and for land-shaping purposes.

As a result of these historical uses, the present site contains scatterings of artefacts, mostly in the form of rusty metal fragments and discarded bricks and timbers, and it is presumed that any excavation into the topsoil in certain areas of the site would have a moderate to high probability of finding such material buried in the disturbed fill.

4.5.3. Archaeological Significance

As discussed above, whilst the probability of finding artefacts associated with former activities and uses on the site is moderate to high, the majority of such material will exist within fill and disturbed soils. Based upon the typical findings from other similar sites and reflecting the experience of prior surveys of this site, the material found is likely to be fragmentary and dissociated from its original context. This material is unlikely to provide any meaningful information arising from its precise location, beyond providing evidence of one-time mining activity in the vicinity.

The Leadville mining site is one of many thousands of small mining sites in NSW that operated for a number of decades before being abandoned and the majority of these were shallow shaft mines, similar to the operations at Leadville. Consequently, there are many similar examples, with varying details and arrangements but all undertaking a similar extractive and limited processing process. Many of these sites would have a similar profile for the existence of scattered artefacts that reflect the former activities.

There are reasonable documentary records and reports of the mine from its various periods of operation, along with contemporary newspaper reports and photographs, to form an understanding of the basic layout and operations at Leadville (see Section 2). Mining and refining techniques at Leadville were not reported to be innovative or technologically advanced in any way (in a context where such 'difference' would be likely to be known and reported) and mining for the ores at Leadville did not require any significant departure from standard mining technologies, procedures or practices. The onsite smelting of ore was less common but still occurred at enough locations to be unremarkable, especially following the development of the package-plant water-jacket furnace. The smelting technology utilised applied to a wide range of ores and was not unique to this particular operation. Overall, there is little at Leadville (apart from the residual contamination) that distinguishes it from a wide selection of remnant mining landscapes in NSW, and in Australia generally.

In this context, it is clear that, although the probability of finding artefacts is reasonably high, the heritage significance of these artefacts is assessed to be relatively low. As set out in the NSW Heritage Office

Guideline[1] document: *"the key test that must be applied in understanding the scientific research values of a known or potential archaeological site is the question of whether further studies of the physical evidence may reasonably be expected to help answer research questions"* (Archaeological Assessment Guidelines 1996:26). The following questions are provided as a guide for assessing the research potential of an archaeological site:

> *1. Can the site contribute knowledge that no other resource can?*
>
> *2. Can the site contribute knowledge that no other site can?*
>
> *3. Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?*

The responses to these questions in relation to the Leadville site is, in each case, negative and, on this basis, there is little reason to consider that the artefacts and remnant evidence of former 'works' existing on the Leadville site are of local or state archaeological significance.

4.5.4. Conclusion

While there is a reasonably high probability of discovering or exposing works and artefacts relating to the mining history of the site as part of any excavations, the archaeological significance of these artefacts is relatively low. There is little potential for the site to add significantly to the existing body of knowledge about mining or the settlement of NSW.

If the works and artefacts have heritage value, their value is largely historical, as physical evidence of what is known to have occurred on the site historically. This is similar to the value attached to the movable heritage items. They may be useful as part of any interpretation display produced in the future for this site.

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[1] Heritage Branch Department of Planning; *"Assessing Significance for Historical Archaeological Sites and 'Relics'"*; 2009.

5. Proposed Works

5.1. Reason for Works

Following the cessation of mining in 1960s and the clearance of all structures from the site, the site remained relatively untouched until a series of investigations commenced in the early 1990s. These determined that acid and metalliferous drainage (AMD) from the oxidation of sulfidic ore had led to sediment contamination in drainage lines and water within existing stock dams at the site. In response, the site was partially remediated, with shaft filling, drainage works, consolidation and compaction of waste dumps, chemical treatment of acid soil by lime dosing, revegetation and fencing. The true extent of the works at this time, however, is not known.

Ongoing monitoring of water quality between 1996 and 2000 indicated that elevated levels of lead, copper zinc and arsenic were still present within standing water at the site and, consequently, further remediation and safety works were undertaken in 2016. The works involved further backfilling or fencing of mineshafts. The aim was to reduce soil erosion and contamination of run off. Two sediment dams were constructed and the use of the site to graze cattle was no longer permitted.

In 2019, during a period of severe drought, the Project Area was subject to illegal grazing, resulting in cattle being quarantined with elevated lead concentrations in blood samples. Following this, additional sampling in October and December 2019 and January 2020 involved extensive surface analysis by portable x-ray fluorescence (FP-XRF). The results of these studies resulted in the requirement for an updated management plan for the site to contain the higher levels of contamination than was previously assessed.

The site remains hazardous, both from the contamination and from the lack of clear data regarding the infill of mine shafts and the extent of underground workings.

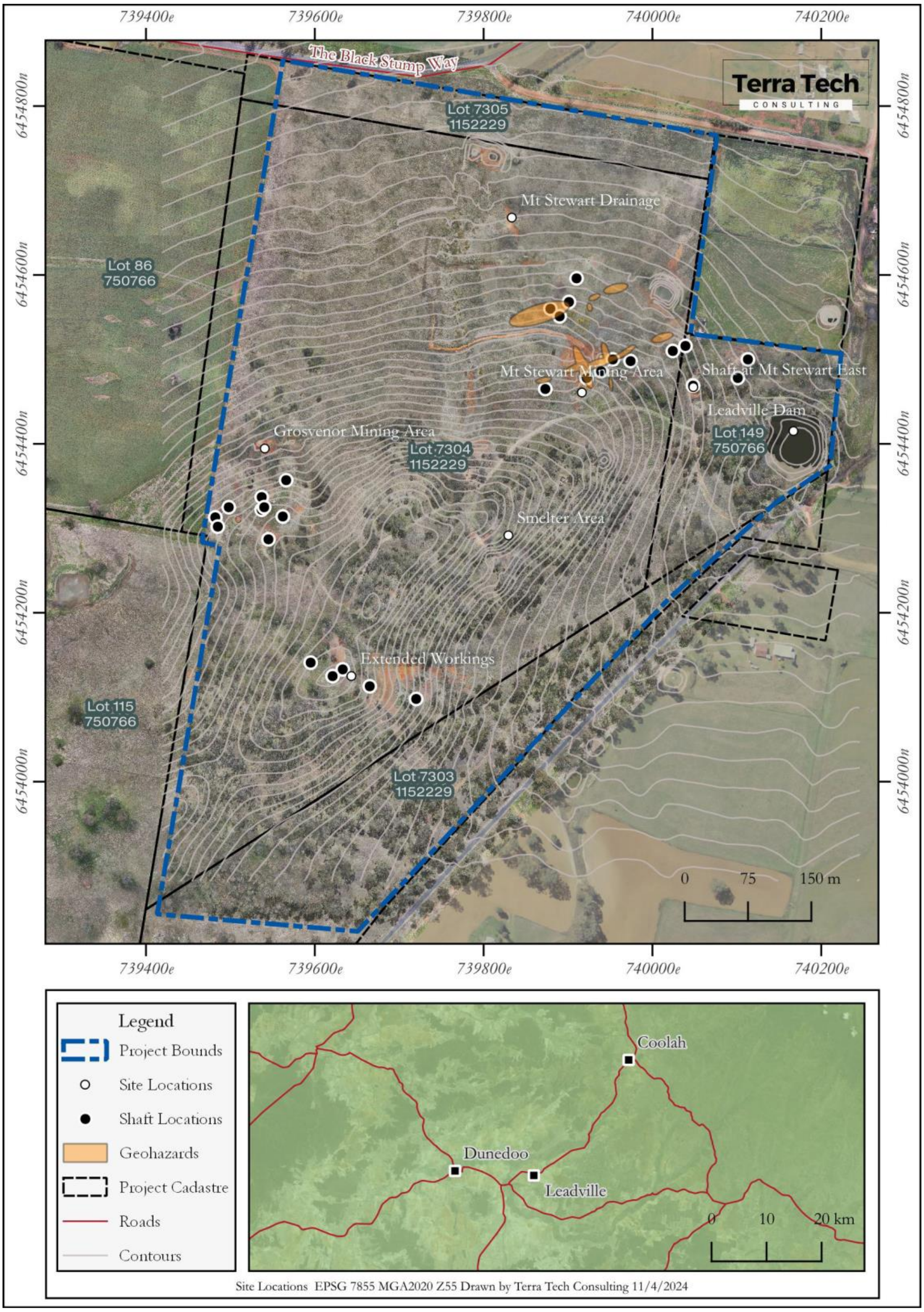

Figure 5-1: Identified Geohazards and shaft locations (Source: Terra Tech Consulting)

5.2. Remediation Action Plan Summary

The Remediation Action Plan (RAP) prepared by Terra Tech Consulting in April 2024 (REV E) specifies remedial measures which include, in general terms:

- Excavation and off-site disposal of materials highly impacted by heavy metal contaminants which are leachable and potentially pose a significant risk to surface waters on and off-site.
- Construction of a drainage management system to limit volumes of meteoric water interacting with Potentially Acid Forming (PAF) materials where geohazards are potentially present, thus precluding excavation and off-site disposal or encapsulation remedial approaches.
- Isolating areas with fencing to remove unacceptable health risks to future site receptors as well as address risks to livestock.

Specifically, the Preferred Option requires:

1. Smelter site (surface soils comprise Category 2) – Leave in-situ and fence.
2. Mt Stewart (surface soils comprise Category 3)(and the area contains geohazards that preclude excavation) – Drainage controls to divert unimpacted meteoric water away from the Mt Stewart source point (where AMD potential was evident), collect contaminated runoff within a prescribed catchment area and fencing to prevent access.
3. Mt Stewart East - Paddock Shaft Area (surface soils comprise Category 3) – Strip area of sulfidic material to 200 mm, place material within Mt Stewart contaminated water catchment.
4. Grosvenor general area (surface soils comprise Category 2) – Leave in-situ and fence due to location of shafts and mineralised workings.
5. Grosvenor Dam (surface soils comprise Category 3) – Excavate and send material offsite for disposal in a licenced waste disposal facility.
6. Mt Stewart Drainage (surface soils comprise Category 3) – Excavate and send material offsite for disposal in a licenced waste disposal facility.
7. Install rural fencing around areas where grazing should be managed in accordance with the prescribed limitations included in the site EMP. This would include limiting access of livestock to the site for 2 months per annum.

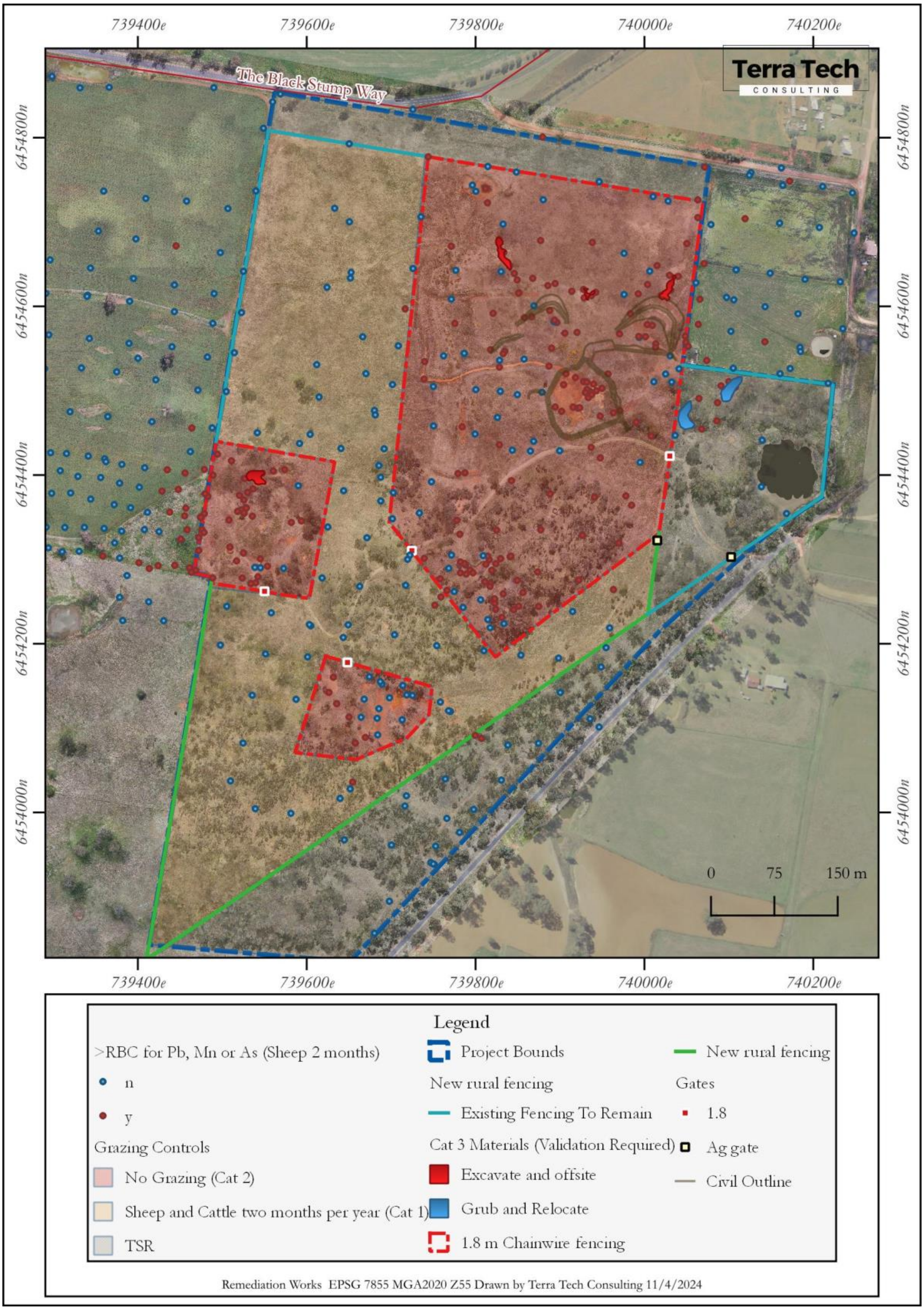

Figure 5-2: Remediation Extents – Fencing and Civil Works. (Source: Terra Tech Consulting)

5.3. Volumes / Locations of Contaminated Soils

Figure 5.2 provides the excavation locations and civil works in the site. Each of the areas designated for offsite disposal should be excavated to the prescribed volumes and disposed of to a licenced waste disposal facility. Excavations should be ceased at the natural-fill boundary. These locations include:

Grosvenor Dam:

Excavate 44.5 m^3 to 0.5m within the prescribed boundary and transport material offsite for disposal in a licenced waste disposal facility.

Mt Stewart Drainage:

MTS1: – Excavate 196 m^3 to 0.9 m within the prescribed boundary and transport material offsite for disposal in a licenced waste disposal facility.

MTS2: – Excavate 58.4 m^3 to 1 m within the prescribed boundary and transport material offsite for disposal in a licenced waste disposal facility.

MTS4: – Excavate 44.5 m^3 to 0.3m within the prescribed boundary and transport material offsite for disposal in a licenced waste disposal facility.[2]

Paddock Shaft:

Strip area of sulfidic material to 200 mm (150m^3); place material within Mt Stewart contaminated water catchment.[3]

Following these excavations, the resultant voids will be filled with borrow material sourced from the designated 'borrow' areas.

5.4. Fencing

The proposed fencing utilises hinged joint mesh fencing and chain link fencing in the nominated alignments shown in Figure 5.2. Hinged joint mesh fencing is to be in accordance with section 4.2 of the boundary fences specification TS 01110:1.0 and TfNSW drawing number CC0001-01. Chain link fencing is to be in accordance with section 6.1 of the boundary fences specification TS 01110:1.0 and TfNSW drawings CV 0285934. Gates will be provided in both fencing types.

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[2] MTS3 will remain in situ – this material is within the contaminated water catchment and is not interpreted to extend as fill below surface.

[3] Provided the area can be validated in accordance with the guidance set out in Section 8 of this document, no ongoing management or grazing restriction in this area is required.

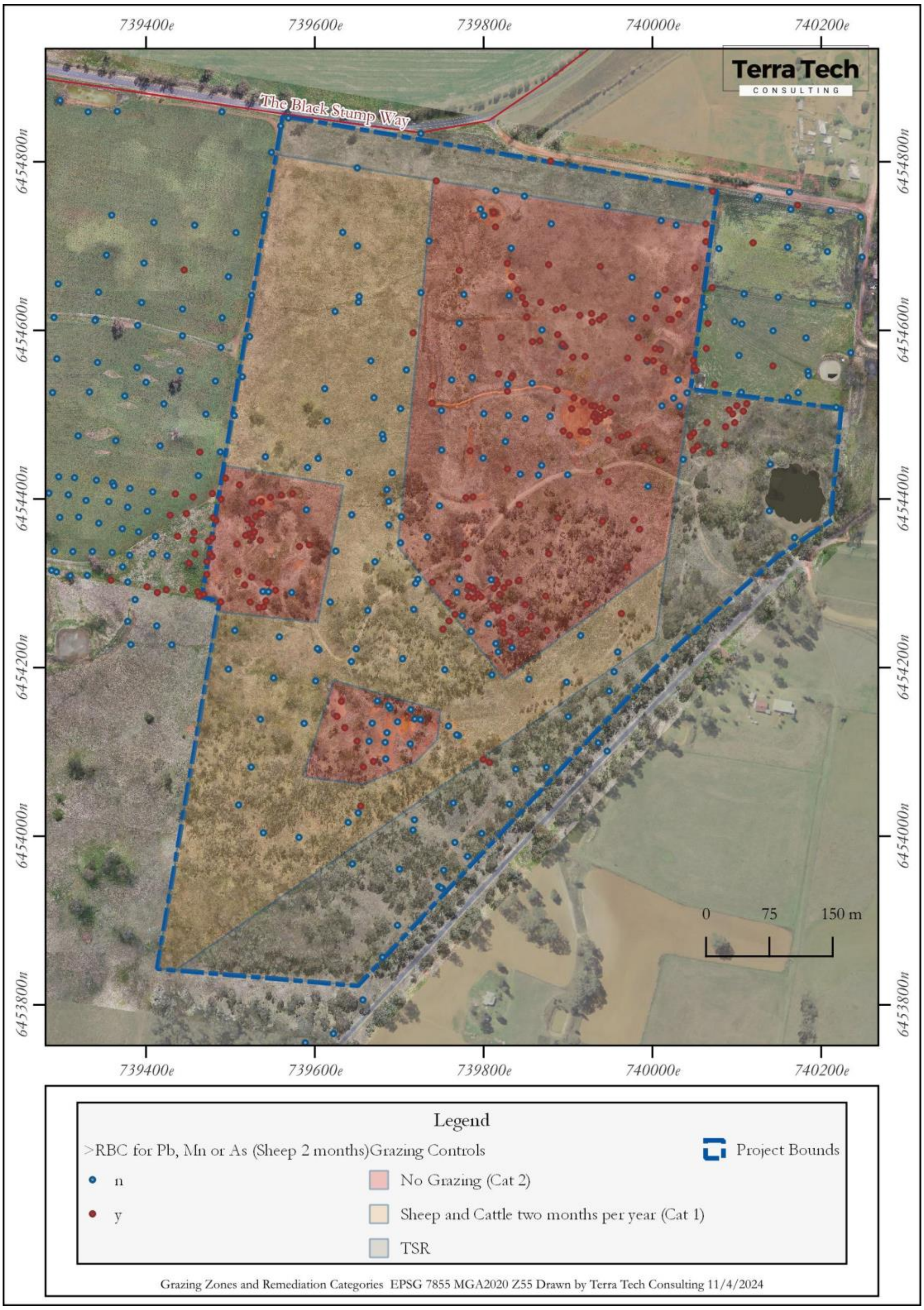

Figure 5-3: Remedial Extents – Grazing Restrictions required. (Source: Terra Tech Consulting)

6. Assessment of Heritage Impact

6.1. Discussion of Impacts

The proposed works are essential health and safety works to reduce the existing physical and environmental contamination hazards present at the site. Whilst the site in its present form retains much of the evidence of its history of mining, the resultant landscape poses significant threats to anyone traversing or using the site and, as time passes and the public-consciousness of the nature and history of the site fades, these existing hazards will potentially present an increasing risk. Consequently, there is no question as to the necessity for the works and no reasonable opportunity to leave the site as is.

The proposed works are minimal in scope, involving the stabilisation of existing conditions through the removal of contaminated topsoil and accumulated silt and the stabilisation and fencing of areas which present topographic threats (ie open or partially filled shafts). No interference with or removal of existing site features is proposed, including the movable heritage items such as the stamper and boilers. These may, in the future, be contained within fencing but will not otherwise be affected by the proposed works.

The works will, inevitably, alter the existing remnant mining landscape. This landscape, though, is not unique to the mining of lead, silver and zinc (or pyrites) but the contamination and its insidious threat to human health is not found in gold mining or other metal mining contexts. Therefore, insofar as the mining landscape is a feature of the site, it is a feature repeated across many other sites and the alteration of this lead-mining landscape for remediation purposes is a typical and acceptable next stage.

Ultimately, mining landscapes are very common in Australia (and across the world) and their value is largely centred on their ability to express the economic rise and fall of the mining operations in a local context. Mining has played a key role in the economic history of NSW and has been central to the spread and geography of European settlement. However, any remnant mining landscape is essentially a scar on the land and, often, an environmental liability and the preservation of this liability is not of value to present or future generations. The need to reduce this liability for future generations is also an important 'economic' factor, as the remnant mining landscape, especially where significant contamination is present, remains economically sterilised until remediated and made safe. The grazing of cattle on the land during recent (2019) drought conditions and the subsequent quarantine of the cattle owing to elevated lead concentrations in blood samples is a pertinent case-in-point.

Contamination at Leadville is a health issue and the proposed works are a minimalist response which will have little adverse impact upon the heritage values of Leadville. Whilst the proposed works will alter the remnant landscape, this will not be to a significant degree and will not have an impact on the key features, such as the remains of buildings and metal items such as the boiler shells and stamper battery.

Heritage conservation and interpretation opportunities in these post-industrial contexts have historically focussed upon the identification of key visual and historic features where the logistics of conservation are reasonable and can represent the history of the place, whilst allowing the remediation of the land and reinstatement of a more natural geography and ecosystem. In general terms, the future remediation of the site (beyond the present 'proposed works') would be facilitated by the development of a conservation and interpretation strategy which aimed to memorialise the history and significance of the Leadville mines in a practical and permanent way. Some potential strategies might include the creation of a single interpretative location where the relics and features may be concentrated; the erection of a historic 'marker' or storyboard within the town or in a publicly accessible location in the vicinity; and/or the creation of a tourist facility or rest area that memorialises the history of the site in a safe manner and establishes a minor but historically interesting tourist destination for the township.

6.2. Heritage Office Guidelines

The proposed works are addressed in relation to the relevant questions posed in the Heritage Office's Statement of Heritage Impact guidelines (Heritage Office and Department of Urban Affairs & Planning 1996, revised 2002).

Table 6-1: Heritage Office Guidelines.

Some questions to be answered in a Statement of Heritage Impact	Response
The following aspects of the proposal respect or enhance the heritage significance of the item for the following reasons:	The installation of cattle fencing around the workings will protect cattle from the majority of the contaminated soils in the area without the need to impact the physical. The majority of the mine features will be retained in situ as part of the proposed works.
The following aspects of the proposal could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts:	Excavation to move contaminated soils from identified locations to a licenced waste disposal facility. The following locations will be affected: **Grosvenor Dam:** 44.5 m^3 to 0.5m depth. **Mt Stewart Drainage:** MTS1: – Excavate 196 m^3 to 0.9 depth. MTS2: – Excavate 58.4 m^3 to 1 m depth. MTS4: – Excavate 44.5m^3 to 0.3m depth. **Paddock Shaft**: – Strip area of sulfidic material to 200 mm (150m^3).

	The removal of contaminated material from the site is a key means to reduce health risks on the site. This will alter the existing remnant mining landscape to a degree but this is an acceptable impact in view of the public safety outcomes and the relatively low heritage value of the landscape.
The following sympathetic solutions have been considered and discounted for the following reasons	The remains of the Leadville Mine, in its current condition, are a hazard to public health and the health of stock which might be able to be grazed on the property. The current proposed works are a minimal response to lowering and controlling the contamination and preventing exposure. The alternative option of 'doing nothing' is not an acceptable approach and other strategies considered would have a greater impact that the proposed works.
Demolition of a building or structure • Have all options for retention and adaptive re-use been explored? • Can all of the significant elements of the heritage item be kept and any new development be located elsewhere on the site? • Is demolition essential at this time or can it be postponed in case future circumstances make its retention and conservation more feasible? • Has the advice of a heritage consultant been sought? Have the consultant's recommendations been implemented? If not, why not?	No demolition of standing structures or features is proposed. The removal of contaminated topsoil will be followed by a reinstatement of ground levels by infill with fill from the designated 'borrow' areas.
Minor partial demolition • Is the demolition essential for the heritage item to function? • Are important features of the item affected by the demolition (e.g. fireplaces in buildings)? • Is the resolution to partially demolish sympathetic to the heritage significance of the item?	No demolition of standing structures or features is proposed. The removal of contaminated topsoil will be followed by a reinstatement of ground levels by infill with fill from the designated 'borrow' areas.

• If the partial demolition is a result of the condition of the fabric, is it certain that the fabric cannot be repaired?	
Major additions • How is the impact of the addition on the heritage significance of the item to be minimised? • Can the additions be located within an existing structure? If not, why not? • Will the additions tend to visually dominate the heritage item? • Are the additions sited on any known, or potentially significant archaeological deposits? If so, have alternative positions for the additions been considered? • Are the additions sympathetic to the heritage item? In what way?	A cattle-proof fence will be erected around the site and, within the outer fence, around specific areas of contamination. The primary purpose of the fence is to keep cattle out of the area and away from contaminated soils, with the dual purpose of preventing or discouraging public access to the land. Removal of these contaminated soils is not possible without also removing heritage features. The fence allows the remains to be revisited for study if required. At the current time, the stamper battery is not visible from any public viewpoint, so the installation of a fence will not impact views to or from the item. No visual connection between Grosvenor and Mount Stewart is notable due to vegetation and hill topography.

6.3. Moveable Heritage

No impacts to moveable heritage are anticipated as a result of the proposed works program.

6.4. Aboriginal Cultural Heritage

No Aboriginal cultural heritage values have been identified for the Project Area that require assessment or further approvals under the National Parks and Wildlife Act 1974 (NSW). The area is heavily disturbed by previous mining activities and any potential artefacts are likely to be out of context and of little research value.

6.5. Historical Archaeology

The proposed works will not comprise harm to any areas known, or reasonably suspected to contain, historical archaeological relics of local or State significance.

6.6. Natural Heritage

The proposed works will require impacts to existing vegetation to allow excavations and fencing construction. No significant trees will be removed as a result of the proposed works and the disturbed land will be seeded with grasses at the end of the remediation process.

6.7. Cumulative Impacts

The proposed works are not extensive and the overall cumulative impact of the proposed works on the heritage values of the site is low. As considered above, the works are necessary for public health and safety and the continued survival of the site in its present condition is inconsistent with other public and environmental goals. Cumulative impacts of ongoing remediation works should be managed by the implementation of a conservation strategy and an interpretation plan.

6.8. Other Heritage Items in the Vicinity

There are no Heritage Items in the vicinity that will be affected by the proposed works.

6.9. Statement of Heritage Impact

The proposed works to the Leadville Mine site will be undertaken to address the current levels of contamination on the site, which pose a significant health and safety risk. The proposed works will not have any impact upon any of the remaining built structures or the existing movable heritage items such as the boiler shells, however, free public access will be restricted in the future by the exclusion fencing to be erected. The proposed works will alter the existing remnant mining landscape of the site, however, this landscape is the product of several phases of construction and demolition, followed by several phases of site remediation and decontamination and, whilst this landscape is representative of many similar former mining sites, it is also common to many other sites across NSW, Australia and other places in the world. Many of the other sites and places are not subject to the residual contamination issues present at this site and, consequently, the adverse heritage impact to this site arising from the proposed works is an acceptable outcome and appropriate approach to the management of the site into the future.

The proposed works will not have any associated impacts upon any other heritage items and no archaeological 'relics' will be disturbed. In many respects, the proposed works will result in a substantive benefit to the heritage significance of the site, enabling its ongoing conservation without the public health and safety concerns associated with its history of use.

7. Legislative and Planning Context

A number of planning and legislative documents govern how historic heritage is managed in NSW. (There are no Commonwealth statutory requirements relevant to the site or its context). The following section provides an overview of the requirements under each as they apply to the Project Area.

The statutory development approval pathway for mine site remediation works undertaken on Crown Land by a Public Authority has not been communicated, however, it is assumed that, for the purposes of this report, that it would be a Crown development with a Part 5 approval pathway. The following sections identify the relevant statutory heritage controls and their requirements in various contexts.

7.1. Environmental Planning and Assessment Act 1979 (NSW)

The *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) requires that environmental impacts are considered in land-use planning, including impacts on Aboriginal and non-Aboriginal heritage. The EP&A Act requires councils to consider environmental effects when assessing new developments. Heritage is one of the matters for consideration. Sites of environmental heritage (including historic heritage sites and sometimes Aboriginal heritage sites) are protected by gazetted LEPs and Development Control Plans (DCP) which specify the constraints on development in the vicinity of these sites. Proposed activities and development are considered under different parts of the *EP&A Act*, including:

- Major projects (State Significant Development under Part 4.1 and State Significant Infrastructure under 5.1) require approval of the Minister for Planning.
- Part 5 activities which do not require development consent. These are often infrastructure projects approved by local councils or the State agency undertaking the project.

Notwithstanding this, under Section 5.5 of the EP&A Act, a determining authority has the duty to fully consider the environmental impact (including historical or Aboriginal heritage) of an activity and is required to 'take into account the fullest extent possible all matters affecting, or likely to affect the environment' arising from the proposal. This is facilitated through the current assessment which has the purpose of identifying, assessing and determining the significance of potential heritage impacts, as well as mitigating actions and responsibilities that can be taken to minimise the potential impacts.

For this Project, the Legacy Mines Program (LMP) is the statutory authority to undertake Part 5 assessments on behalf of the Crown for mine site remediation works. Mining, Exploration and Geoscience, a division of the Department of Regional NSW, is the determining authority.

7.2. The Heritage Act 1977 (NSW)

The Heritage Act contains various provisions to establish the NSW Heritage Council and the NSW State Heritage Register (SHR) and establishes statutory approval pathways for places listed on the SHR. The Act also contains provisions to protect archaeological 'relics' and provisions to regulate the management of heritage places owned by State Agencies.

7.2.1. Archaeological Relics

Part 6 Division 9 of the Heritage Act protects archaeological 'relics' from being '*exposed, moved, damaged or destroyed*' by the disturbance or excavation of land. This protection extends to the situation where a person has '*reasonable cause to suspect*' that archaeological remains may be affected by the disturbance or excavation of the land. It applies to all land in NSW that is <u>not</u> included in the SHR (which has a separate approval pathway). A 'relic' is defined by the Heritage Act as:

> *Any deposit, object or material evidence which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and has local or state significance.*

Section 139 of the Heritage Act requires any person who knows or has reasonable cause to suspect that their proposed works will expose or disturb a 'relic' to first obtain an Excavation Permit from the Heritage Council of NSW (pursuant to s 140), unless there is an applicable exception (pursuant to Section 139(4)). If there is an exception, an Excavation Permit Exception Notification Form must be submitted and endorsed by the Director of Heritage Division for places not listed on the SHR.

In some circumstances, a s140 permit may not be required when excavating land in NSW. In accordance with the NSW Government Gazette (n2019-14, 18 February 2022) Schedule of Exceptions to subsection 139 (1) and (2) of the Heritage Act, made under subsection 139 (4):

> *Excavation or disturbance of land of the kind specified below does not require an excavation permit under section 139 of the Heritage Act, provided that the Director-General is satisfied that [certain criteria] have been met and the person proposing to undertake the excavation or disturbance of land has received a notice advising that the Director-General is satisfied that:*
>
> *(a)* ***Any disturbance or excavation of land that has limited archaeological research potential, as demonstrated by a heritage management document, such as an Archaeological Assessment, completed within the last five years****.*

Section 146 of the *Heritage Act* requires any person who is aware or believes that they have discovered or located a relic must notify the Heritage Council of NSW, providing details of the location and other information as required.

Application

The site is a local heritage item but the assessment of archaeological significance undertaken in this report has determined that the land has no substantive archaeological research potential. Artefacts are, therefore, unlikely to meet the 'local' significance threshold for archaeological significance and are therefore not classed as relics for the purposes of s139.

In this case, no Excavation Permit under subsection 139 (4) is required.

7.2.2. State Agency Heritage Management

Under Section 170 (s.170) of the *Heritage Act 1977*, heritage items owned or managed by Government agencies are cared for and controlled by the relevant agency. The Project Area is located on Crown land and is subject to management by a government agency. Consequently, in accordance with Section 170(3), the management of the site should be undertaken in accordance with the *State-owned Heritage Management Principles*, published by the NSW Heritage Council in 2004.

7.3. State Environmental Planning Policy (Resources & Energy)

The *State Environmental Planning Policy (Resources and Energy) 2021* (R & E SEPP) includes the following clause in relation to mining site rehabilitation:

2.8 Development permissible without consent

Development for any of the following purposes may be carried out without development consent—

(a) mineral exploration and fossicking,

(b) rehabilitation, by or on behalf of a public authority, of an abandoned mine site,

(c) mining within a mineral claims district pursuant to a mineral claim under the Mining Act 1992,

(d) petroleum exploration,

(e) the construction, maintenance or use (in each case, outside an environmentally sensitive area of State significance) of any pollution control works or pollution control equipment required as a result of the variation of a licence under the Protection of the Environment Operations Act 1997, being a licence that applies to an extractive industry, mine or petroleum production facility in existence immediately before the commencement of this section.

Note—Development to which this section applies may require approval under Part 3A of the Act or be subject to the environmental assessment and approval requirements of Part 5 of the Act.

This development may be carried out without consent, however, the Part 5 obligation upon public authorities to fully consider environmental issues before they undertake or approve activities that do not require development consent from a council or the Minister remains. This report fulfils this obligation in respect of Aboriginal and Non-Aboriginal heritage matters.

7.4. Warrumbungle Local Environmental Plan 2013

Clause 5.10 of the *Warrumbungle Local Environmental Plan 2013* specifies the development approval conditions for heritage places, which are identified in the Heritage Schedule (Schedule 5). The 'Leadville Mines site' (I29) is an item of local heritage significance listed in Schedule 5 of the Warrumbungle LEP. Section 5.10 sets out when consent from the local council is required:

Development consent is required for any of the following—

> *(a) demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance)—*
>
> > *(i) a heritage item,*
> >
> > *(ii) an Aboriginal object,*
> >
> > *(iii) a building, work, relic or tree within a heritage conservation area,*
>
> *(b) altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in Schedule 5 in relation to the item,*
>
> *(c) disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed,*
>
> *(d) disturbing or excavating an Aboriginal place of heritage significance,*
>
> *(e) erecting a building on land—*
>
> > *(i) on which a heritage item is located or that is within a heritage conservation area, or*
> >
> > *(ii) on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance,*

(f) subdividing land—

(i) on which a heritage item is located or that is within a heritage conservation area, or

(ii) on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.

However, this project is being undertaken under the provisions of the R & E SEPP by a Government Agency and Development Consent from Warrumbungle Shire Council is not required. The R & E SEPP does not require any consultation with other authorities in respect of heritage items and potential impacts but, in any case, consultation with council should occur regarding the potential impacts upon the listed heritage item and their long-term aspirations for the site.

8. Conclusions and Recommendations

8.1. Conclusion

Soil testing and contamination studies have been undertaken at Leadville Mine and, as a result, the Department of Regional NSW - Legacy Mines is proposing to undertake remediation activities, as specified in the Leadville Mine Remediation Action Plan (RAP) prepared by Terra Tech Consulting Pty Ltd in April 2024. A review of the proposed works has identified that the works will have a minor adverse impact on the remnant mining landscape but this impact is an acceptable outcome of the need to make the site safe. The remnant mining landscape has representative values only and the site has no substantive archaeological significance.

8.2. Statement of Heritage Impact

The proposed works to the Leadville Mine site will be undertaken to address the current levels of contamination on the site, which pose a significant health and safety risk. The proposed works will not have any impact upon any of the remaining built structures or the existing movable heritage items such as the boiler shells, however, public access will be restricted in the future by the exclusion fencing to be erected. The proposed works will alter the existing remnant mining landscape of the site, however, this landscape is the product of several phases of construction and demolition, followed by several phases of site remediation and decontamination and, whilst this landscape is representative of many similar former mining sites, it is also common to many other sites across NSW, Australia and other places in the world. Many of the other sites and places are not subject to the residual contamination issues present at this site and, consequently, the adverse heritage impact to this site arising from the proposed works is an acceptable outcome and appropriate approach to the management of the site into the future.

The proposed works will not have any associated impacts upon any other heritage items and no archaeological relics will be disturbed. In many respects, the proposed works will result in a substantive benefit to the heritage significance of the site, enabling its ongoing conservation without the public health and safety concerns associated with its history of use.

8.3. Recommendations

The following mitigations measures have been devised to lesson impact to relics at the site.

8.3.1. Archival Recording

An archival recording was prepared concurrently with the draft Statement of Heritage Impact prepared by Everick Heritage in 2022. Archival and LiDAR recording of the retaining wall at LV 24 was undertaken. The preparation of a 3D scan of the wall has been finalised and is included on the webmap. A copy of this Archival Record should be provided to the Warrumbungle Shire Council for their archives and Local History.

8.3.2. Movable Heritage

There are several items of movable heritage identified on the site, including boiler shells and machinery remains, which are not proposed to be impacted by the works. However, these items will be secured behind the exclusion fencing for the foreseeable future. The proposed works provide an opportunity to address the conservation of these items, which have potential interpretation value. As an ancillary aspect of the project, Warrumbungle Shire Council should be consulted as to the potential tourism opportunities associated with this material and its possible relocation to an accessible context.

8.3.3. Records

One of the issues associated with this site was the lack of available/accessible records of the various remediation works undertaken during the last three decades, partly owing to different State Agencies involved and the various reorganisations of State Agency organisations that have occurred over this period. Records and plans of the works undertaken on the site should be provided to Warrumbungle Shire Council for their archives.

8.3.4. Change of Works

If the proposed works as discussed in Section 5.0 are changed, altered or extended, then a reassessment of the works as they apply to the heritage significance of the site may be required.

8.3.5. Unexpected Finds

The archaeological assessment carried out in this report determined that, while there was a moderate to high potential for artefacts to be found on the site, these are unlikely to have heritage significance. In the event that an object, artefact or work is exposed that falls outside of these expectations, an 'Unexpected Finds Protocol' should be in place to manage this material.

8.3.6. Discovery of Human Remains

In the event that excavations of contaminated soil reveal possible human skeletal material (remains), the following procedure would be implemented:

- All works must halt at that location immediately and the on-site supervisor would be immediately notified to allow assessment and management.
- The on-site supervisor should contact police.
- The on-site supervisor should contact Heritage NSW's Environment Line on 131 555.

References

Australia ICOMOS; *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*; Burwood, Victoria; Australia ICOMOS Incorporated; *1999*.

Cameron, R; *Around the Black Stump. The History of Coolah-Dunedoo-Mendooran Areas*. Published by the Council of the Shire of Coolah; 1993.

Heritage NSW '*Leadville Mine*' Heritage Inventory Sheet accessed 18 July 2022 <https://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=5001040>

NSW Heritage Office; *Archaeological Assessments: Archaeological Assessment Guidelines*. Sydney: Department of Urban Affairs and Planning; 1996.

NSW Heritage Office; *NSW Heritage Manual: Assessing Heritage Significance;* NSW Government; 2001.

Valja, A L; *The geology of the silver-lead-zinc-copper-pyrite ore deposits of Leadville, NSW*; Thesis submitted as part fulfillment of the requirements for the Degree of Bachelor of Science in Applied Geology, University of New South Wales; 1973.

Primary Resources:

Sydney Mail and New South Wales Advertiser; 27 Aug 1892; '*Mining in New South Wales. Leadville and Mount Stewart'*; Page 484.

Mine Records; *Inspection of Mines and Diamond Drill Branch 'Leadville Mine';* accessed through DIGS (Geological Survey of NSW).

Appendix 3. Photographic record of the subject site

	Character of the woodland stands near Grosvenor.
	Character of the grassland within the Leadville Mine precinct.
	Contaminated area, and character of heritage mining relics - Grosvenor.

	Stamper, within an area of contamination - Grosvenor.
	Character of a dam present on site - Grosvenor.
	Character of eucalypt woodland in southern and western limits of the precinct – Smelter area

	Character of one of the 21 hollow-bearing trees identified on-site to be retained.
	One of the hollow-bearing trees (no. 16) subject to potential removal.

	Relic LV24 (Stone and brickwall built in to side of hill) that is proposed to be removed – Smelter area.
	Character of proposed borrow pit area. Photograph taken looking southward.
	Character of proposed borrow pit area. Photograph taken looking northward.

Appendix 4. Likelihood of occurrence of threatened flora and fauna species previously recorded within 10 km of the study area

Key
V – vulnerable E – endangered CE – critically endangered M – migratory

A State or nationally listed threatened species is considered to have a:

- **High** likelihood of occurrence if it has been recorded within 10 km of the subject site and there is either suitable habitat present or the potential for the animal to fly over the site (while animal may fly over, it is acknowledged that for some species no suitable habitat will be present within the subject site).
- **Moderate** likelihood of occurrence if they have a predicted occurrence (via the PMST or BioNet Atlas geographic search) and there is either suitable habitat present or the potential for the animal to fly over the site (while the animal may fly over, it is acknowledged that for some species no suitable habitat will be present within the subject site).
- **Low** likelihood of occurrence if suitable habitat for a species is not present regardless of whether they have been recorded within 10 km or have a predicted occurrence.

Note: Species underlined are those which only the EPBC PMST predicted as having habitat in the search area. All other species have been recorded within 10 km of the study area.

Note: As these habitats are not present, no pelagic, estuarine, wetland or fish species have been included in the following table.
Given that the proposed work is not located within the Commonwealth marine area, this being from 3 to 200 nautical miles from the coast, no species listed as marine under the EPBC Act have been considered; nor has the marine status of any species been acknowledged.

* **-** habitat requirements were generally extracted from DEECCW (2024a), DPE (2024), Harden (1992-2002), Frith (2007), Churchill (2008), Cogger (2014) and Van Dyck and Strahan (2008) with other references used being identified in the bibliography.

Common and Scientific Name	Legislation		Primary habitat requirements	Likelihood of Occurrence[7]	Assessment
	EPBC Act	BC Act			
PLANTS					
Androcalva (Commersonia) procumbens	V	V	Recorded in a variety of habitats in the Dubbo-Mendooran-Gilgandra region, but also known in the Pilliga, Mount Kaputar National Park, north east of Gulgong and near Denman. Grows in sandy sites, often along roadsides.	Low. Habitat not present.	No
Bluegrass *Dichanthium setosum*	V	V	Associated with heavy basaltic black soils and red-brown loams with clay subsoil. Often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture.	Moderate. Suitable soils present.	No
Euphrasia arguta	CE	CE	*Euphrasia arguta* was rediscovered in the Nundle area of the NSW north western slopes and tablelands in 2008. Prior to this, it had not been collected for 100 years. Historically, *Euphrasia arguta* has only been recorded from relatively few places within an area extending from Sydney to Bathurst and north to Walcha. Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'.	Low. Though some suitable habitat present, not recorded locally and likelihood of occurring is small	No
Homoranthus darwinioides	V	V	Occurs in various woodland habitats with shrubby understoreys, usually in gravely sandy soil.	Low. Habitat not present.	No
Winged Pepper-cress *Lepidium monoplocoides*	E	E	Occurs on seasonally moist to waterlogged sites, on heavy fertile soils, with a mean annual rainfall of 300-500 mm. Predominant vegetation is usually an open woodland dominated by *Allocasuarina luehmannii* (Bulloak) and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *E. populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses. Also recorded in a wetland-grassland community.		
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	CE		Endemic to NSW, known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Occurs in open eucalypt woodland and grassland.	Low. Disturbance history of site likely to preclude this species' occurrence.	No
Tarengo Leek Orchid *Prasophyllum petilum*	E	E	Natural populations are known from a total of five sites in NSW; these are at Boorowa, Captains Flat, Ilford, Delegate and a newly recognised population c.10 k SE of	Low. Disturbance history of site likely to preclude this species' occurrence.	No

[7] For the site to support, and be important for the lifecycle requirements of, a locally viable population of this species

Common and Scientific Name	Legislation		Primary habitat requirements	Likelihood of Occurrence[7]	Assessment
	EPBC Act	BC Act			
			Muswellbrook. Grows in open sites within Natural Temperate Grassland, grassy woodland in association and within the grassy groundlayer dominated by Kangaroo Grass under Box-Gum Woodland at Ilford (and Hall, ACT). Apparently highly susceptible to grazing, being retained only at little-grazed travelling stock reserves (Boorowa & Delegate) and in cemeteries (near Queanbeyan, Ilford and Hall).		
Small Purple-pea *Swainsona recta*	E	E	Before European settlement Small Purple-pea occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum *Eucalyptus blakelyi*, Yellow Box *E. melliodora*, Candlebark Gum *E. rubida* and Long-leaf Box *E. goniocalyx*. Grows in association with understorey dominants that include Kangaroo Grass *Themeda australis*, poa tussocks *Poa* spp. and spear-grasses *Austrostipa* spp.	Low. Disturbance history of site likely to preclude this species' occurrence.	No
Austral Toadflax *Thesium australe*	V	V	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast.	Low. Disturbance history of site likely to preclude this species' occurrence.	No
Tylophora linearis	E	V	Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla and Allocasuarina luehmannii*. Also grows in association with *Acacia hakeoides, Acacia lineata, Melaleuca uncinata, Myoporum species* and *Casuarina* species.	Low. No suitable habitat present.	No
MAMMALS					
Spotted-tailed Quoll *Dasyurus maculatus*	E	V	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	Low. No suitable habitat present.	No
Koala *Phascolarctos cinereus*	E	E	Open eucalypt forest and woodland, containing a variety of 'preferred' food tree species.	As above.	No
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	High. Potential to fly over and/or forage within the study area; however, would not rely on the study area for any of its lifecycle requirements.	No
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	Cave-roosting bat that forages in timbered woodland and dry sclerophyll forest.	Moderate. No roosting habitat present, but may fly over and/or forage within the study area.	No

Common and Scientific Name	Legislation		Primary habitat requirements	Likelihood of Occurrence[7]	Assessment
	EPBC Act	BC Act			
Corben's Long-eared Bat *Nyctophilus corbeni*	V	V	Inhabits a variety of vegetation types, including mallee, bulloke and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. Roosts in tree hollows, crevices, and under loose bark.	Moderate. Potential to fly over, forage and/or roost within the study area. Five hollow-bearing trees require removal to permit the proposal.	Yes (Appendix 9).
New Holland Mouse *Pseudomys novaehollandiae*	V		Open heathland, open woodland with a heathland understorey and vegetated sand dunes.	Low. No suitable habitat present.	No
BIRDS					
Malleefowl *Leipoa ocellata*	V	E	Predominantly inhabit mallee communities, preferring the tall, dense and floristically-rich mallee found in higher rainfall (300 - 450 mm mean annual rainfall) areas.	Low. No suitable habitat present.	No
Australasian Bittern *Botaurus poiciloptilus*	E	E	Occupies shallow, vegetated freshwater or brackish swamps, usually dominated by tall, dense reed beds of *Typha* sp., *Juncus* sp. and *Phragmites* sp. Nests on platforms of reeds and rushes, usually built over water in dense cover.	As above.	No
Spotted Harrier *Circus assimilis*		V	Occurs in grassy open woodland (including *Acacia* and mallee remnants), inland riparian woodland, grassland and shrub steppe. Most common on native grassland	Moderate. May potentially fly over the study area; however, would not be reliant on the treated areas for any of its lifecycle requirements.	No
Fork-tailed Swift *Apus pacificus*	M		Almost exclusively aerial. Takes insects on wing over a range of habitat types, but also less than 1 m above open areas or over water. Mostly occur over inland plains but sometimes above foothills or in coastal areas.	Low. No suitable habitat present.	No
White-throated Needletail *Hirundapus caudacutus*	V, M		Almost exclusively aerial. Takes insects on wing over a range of habitat types. Recorded most often above wooded areas, including open forest and rainforest.	Moderate. Potential to fly over the study area; however, would not be reliant on the treated areas for any of its lifecycle requirements.	No
White-bellied Sea-eagle *Haliaeetus leucogaster*		V	Found in coastal habitats and around terrestrial wetlands in tropical and temperate regions of mainland Australia.	Low. No suitable habitat present.	No
Grey Falcon *Falco hypoleucos*	V	V	Sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great	As above.	No

Common and Scientific Name	Legislation		Primary habitat requirements	Likelihood of Occurrence[7]	Assessment
	EPBC Act	BC Act			
			Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.		
Australian Painted Snipe *Rostratula australis*	E	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	As above.	No
Latham's Snipe *Gallinago hardwickii*	M		Wet, treeless, tussocky grasslands, short grasses and/or marshes along freshwater streams and channels, though it can also be found in any vegetation around freshwater wetlands, in sedges, grasses, lignum, reeds and rushes, saltmarshes, creek edges, crops and pastures.	As above.	No
Gang-gang Cockatoo *Callocephalon fimbriatum*	E	V	Prefers tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests during summer, these being at higher altitudes. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, or in dry forest in coastal areas.	As above.	No
South-eastern Glossy Black-Cockatoo *Calyptorhynchus lathami lathami*	V	V	Occurs in coastal woodlands and drier forest areas, open inland woodlands, or timbered watercourses where its main food source, the casuarina (she-oak) is common.	As above.	No
Barking Owl *Ninox connivens*		V	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland.	As above.	No
Swift Parrot *Lathamus discolor*	CE	E	Eucalypt forests. When over-wintering on the mainland, this species is dependent on winter-flowering eucalypt species.	Low. No suitable habitat present.	No
Superb Parrot *Polytelis swainsonii*	V	V	Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest.	As above.	No
Pilotbird *Pycnoptilus floccosus*	V		Found in wet forested areas and heathland in eastern Victoria and south-eastern New South Wales. Forages on the ground, turning over leaf litter using strong legs.	As above.	No

Common and Scientific Name	Legislation		Primary habitat requirements	Likelihood of Occurrence[7]	Assessment
	EPBC Act	BC Act			
Grey-crowned Babbler *Pomatostomus temporalis*		V	Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. Woodlands on fertile soils in coastal regions.	High. Species previously recorded within the area investigated.	Yes (Appendix 9).
Regent Honeyeater *Anthochaera phrygia*	CE	CE	Inhabits dry open forest and woodland. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	Moderate. Potential to fly over the study area.	No
Painted Honeyeater *Grantiella picta*	V	V	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema*.	Low. No suitable habitat present.	No
Dusky Woodswallow *Artamus cyanopterus cyanopterus*		V	Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris.	Moderate. May potentially fly over/forage within the study area; however, would not be reliant on the remediation areas for any of its lifecycle requirements.	No
Yellow Wagtail *Motacilla flava*	M		Open country near swamps, salt marshes and sewage ponds.	Low. No suitable habitat present.	No
Satin Flycatcher *Myiagra cyanoleuca*	M		Mainly inhabit eucalypt forests, often near wetlands or watercourses.	As above.	No
Rufous Fantail *Rhipidura rufifrons*	M		Mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts.	As above.	No
REPTILES					
Pink-tailed Worm-lizard *Aprasia parapulchella*	V	V	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks.	Low. No suitable habitat present.	No
Striped Legless Lizard *Delma impar*	V	V	Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component.	As above.	No

Appendix 5. Flora species recorded

Key
* – denotes introduced species
P – species listed as a priority weed
? – uncertain identification

Family	Scientific Name	Common Name
Filicopsida		**Ferns**
Adiantaceae	*Cheilanthes sieberi*	Rock Felt Fern
Magnoliopsida - Magnoliidae		**Flowering Plants - dicots**
Anacardiaceae	*Schinus molle var. areira**	Pepper Tree
Araliaceae	*Hydrocotyle sp*	
Asteraceae	*Bidens pilosa **	Cobbler's Pegs
	Calotis cuneifolia	Purple Burr-Daisy
	*Carthamus lanatus**	Saffron Thistle
	Cassinia sifton	Sifton Bush
	*Cirsium vulgare**	Spear Thistle
	*Conyza sp **	Tall Fleabane
	Cymbonotus lawsonianus	
	*Hypochaeris radicata**	Catsear
	Poa sieberiana	Snow Grass
	*Silybum marianum**	Variegated Thistle
	Xerochrysum viscosum	Sticky Everlasting
Brassicaceae	*Brassica* sp*	Rape
Cactaceae	*Opuntia stricta**P	Common Prickly Pear
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell
Convolvulaceae	*Dichondra repens*	Kidney Weed
Fabaceae: (Faboideae)	*Grona varians*	Slender Tick-trefoil
	Medicago sp	Medic
	Trifolium repens	White Clover
	*Trifolium tomentosum **	Hairy Clover
Fabaceae: (Mimosoideae)	*Acacia implexa*	Hickory Wattle
	Acacia decora	Western Showy Wattle
Geraniaceae	*Erodium crinitum*	Blue Stork's-bill
	Geranium homeanum	
Hypericaceae	*Hypericum gramineum*	Small St. John's Wort
Lamiaceae	*Ajuga australis*	Austral Bugle
	*Marrubium vulgare**	Horehound
	?Teucrium betchei	
Malvaceae	*Brachychiton populneus*	Kurrajong
Myrtaceae	*Angophora floribunda*	Rough-barked Apple
	Eucalyptus albens	White Box
	Eucalyptus blakelyi	Blakely's Red Gum
	Eucalyptus dealbata	Tumbledown Red Gum
	Eucalyptus melliodora	Yellow Box
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum
Plantaginaceae	*Plantago lanceolata**	Plantain
Primulaceae	*Lysimachia arvensis**	Scarlet Pimpernel
Rubiaceae	*Pomax umbellata*	
Scrophulariaceae	*Eremophila debilis*	Amulla
	*Verbascum virgatum**	Twiggy Mullein
Solanaceae	*Solanum nigrum*	Blackberry Nightshade
Stackhousiaceae	*Stackhousia sp*	Stackhousia
Urticaceae	*Urtica sp. **	Stinging Nettle
Verbenaceae	*Verbena bonariensis**	Purple-top
Magnoliopsida - Liliidae		**Flowering Plants - monocots**
Asparagaceae	*Lomandra filiformis*	Mat-rush
	Lomandra longifolia	Spiny-headed Mat-rush
Cyperaceae	*Baumea sp*	Saw Sedge

Family	Scientific Name	Common Name
	Carex appressa	Umbrella Sedge
Juncaceae	*Juncus usitatus*	Common Rush
Phormiaceae	*Dianella longifolia*	Flax-lily
Poaceae	*Anthosachne scabra*	Wheat Grass
	Aristida personata	
	Aristida ramosa	Wiregrass
	Austrostipa aristiglumis	Plains Grass
	Austrostipa scabra	Speargrass
	Austrostipa verticillata	Slender Bamboo Grass
	Bothriochloa biloba	Red Grass
	*Bromus hordaceus **	Soft Brome
	*Chloris gayana **	Rhodes Grass
	Cymbopogon refractus	Barbwire Grass
	*Dactylis glomerata**	Cocksfoot
	*Digitaria sp. **	Finger Grass
	Lachnagrostis filiformis	Blown Grass
	*Lolium perenne **	Perennial Ryegrass
	Microlaena stipoides	Weeping Meadow Grass
	*Paspalum dilatatum **	Paspalum
	Rytidosperma ?racemosa	Wallaby Grass
	Themeda triandra	Kangaroo Grass

Appendix 6. Fauna species recorded during 2015 & 2021 investigation

Key
V – species is Vulnerable under the BC Act
* – indicates introduced species

Common Name	Family and Scientific Name
MAMMALS	
Eastern Grey Kangaroo	*Macropus giganteus*
Gould's Wattled Bat	*Chalinolobus gouldii*
V Large Bent-winged Bat	*Miniopterus orianae oceanensis*
* Fox	*Vulpes vulpes*
* Feral Cat	*Felis catus*
BIRDS	
Pacific Black Duck	*Anas superciliosa*
Crested Pigeon	*Ocyphaps lophotes*
Great Cormorant	*Phalacrocorax carbo*
Whistling Kite	*Haliastur sphenurus*
Brown Falcon	*Falco berigora*
Nankeen Kestrel	*Falco cenchroides*
Galah	*Eolophus roseicapillus*
Sulphur-crested Cockatoo	*Cacatua galerita*
Musk Lorikeet	*Glossopsitta concinna*
Australian King Parrot	*Alisterus scapularis*
Eastern Rosella	*Platycercus eximius*
Laughing Kookaburra	*Dacelo novaeguineae*
Sacred Kingfisher	*Todiramphus sanctus*
Superb Fairy-wren	*Malurus cyaneus*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Striated Pardalote	*Pardalotus striatus*
Red Wattlebird	*Anthochaera carunculata*
Noisy Friarbird	*Philemon corniculatus*
Noisy Miner	*Manorina melanocephala*
V Grey-crowned Babbler	*Pomatostomus temporalis*
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
Ground Cuckoo-shrike	*Coracina maxima*
White-winged Triller	*Lalage sueurii*
Olive-backed Oriole	*Oriolus sagittatus*
Pied Butcherbird	*Cracticus nigrogularis*
Australian Magpie	*Cracticus tibicen*
Pied Currawong	*Strepera graculina*
Willie Wagtail	*Rhipidura leucophrys*
Torresian Crow	*Corvus orru*
Magpie-lark	*Grallina cyanoleuca*
Rufous Songlark	*Cincloramphus mathewsi*
Welcome Swallow	*Hirundo neoxena*
* Common Starling	*Sturnus vulgaris*
* Common Myna	*Sturnus tristis*
* House Sparrow	*Passer domesticus*
REPTILES	
Robust Ctenotus	*Ctenotus robustus*
Three-toed Skink	*Saiphos equalis*

Appendix 7. Ecological assessments

1. Commonwealth - *Environment Protection and Biodiversity Conservation Act 1999*

By the completion of the field investigation, the following MNES had been recorded within the proposal area:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – CEEC.

Though not recorded during the current investigation, given the presence of suitable habitat for its roosting/foraging requirements (i.e., hollow-bearing trees) and based on the fact that hollow-occupying microbats were recorded during the previous ecological investigation, it is considered necessary to adopt the precautionary approach in regards to the potential presence of the following vulnerable species:

- Corben's Long-eared Bat.

The Significant Impact Guidelines prepared under the EPBC Act (DE 2013) are used to determine whether the action (i.e., the proposed remediation of the former mining area as detailed in this REF) has, will have, or is likely to have a significant impact on these MNES and, as such, whether the conducting of the proposal would require referral of the matter to the Federal Minister for the Environment and Water and for further consideration or approval.

1.1. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

- *reduce the extent of an ecological community;*

The proposed work would remove approximately 2.2 ha of Derived Native Grassland in the borrow area. The area would be rehabilitated after upon completion of the areas of the remediation work. The work would also require the removal of six to eight White Box near Grosvenor Dam and some minor removal of groundcover to permit fencing around it. The Mount Stewart encapsulation work would affect already heavily disturbed areas that are mostly devoid of native vegetation.

- *fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;*

Given the scale of the proposal, the remediation work is not considered to result in the further fragmentation of this endangered ecological community.

- *adversely affect habitat critical to the survival of an ecological community;*

The habitat expected to be affected is not considered critical to the survival of this ecological community.

- *modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;*

The proposed work does involve the stripping of 200 mm of topsoil in the borrow area and removal of material beneath it. Upon completion of the work, the borrow areas will be revegetated with Box-Gum woodland species, albeit at a different ground level. This will change soil character and surface flow patterns and may have impacts on the community adjacent to the creekline to its east.

- *cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;*

Currently, there is a narrow range of native species in the borrow area and considerable (though not dominant) growth of weeds. Rehabilitation of the borrow area would involve the use of a broader range of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland species and inclusion of canopy and shrub elements.

- *cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:*
  - *assisting invasive species, that are harmful to the listed ecological community, to become established, or*
  - *causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or*

Invasive species are already present in the subject site's White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. It is unlikely that the work would cause further establishment of invasive species apart from beside haul tracks where they can be readily controlled.

- *interfere with the recovery of an ecological community.*

The proposed work is unlikely to affect the recovery of this community. It is considered that given the scale of the work and the surrounding, similar, vegetation, natural regeneration is likely to take place.

Conclusion

In regards to the above assessment, it is considered that the proposed action is not likely to have a significant impact on the CEEC White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. As such, referral to the Federal Minister for the Environment and Water is not considered necessary.

1.2. Corben's Long-eared Bat

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of an important population of a species;*

Though not recorded during the current investigation, in respect of a review of the PMST (Commonwealth DCCEEW 2024a), Corben's Long-eared Bat, a hollow-dependent species, is predicted to occur within the study region.

As targeted surveys for microbats within the proximate areas of surrounding woodland were not conducted during the current investigation, and up to 5 of the 21 hollow-bearing trees recorded are being removed to permit the remediation work, a precautionary approach to the presence of the Corben's Long-eared Bat has been adopted.

It is acknowledged that, to off-set the loss of the five hollow-bearing trees, 10 purpose built habitat boxes are recommended to be erected within the retained stands of woodland.

The loss of five hollow-bearing trees and some insect-attracting plants, when compared to similar habitat to be retained within the study area and surrounding locality, will not significantly reduce the overall extent of roosting or foraging opportunities available to Corben's Long-eared Bat, nor adversely affect the life cycle of this microbat or lead to a long-term decrease in the size of an important population of this species.

- *reduce the area of occupancy of an important population;*

The proposal will not reduce the area of occupancy available to an important population of this species.

- *fragment an existing important population into two or more populations;*

The removal of five hollow-bearing trees and some insect-attracting plants is not considered to fragment an existing important population of this species into two or more populations.

- *adversely affect habitat critical to the survival of a species;*

No habitat critical to the survival of this species would be adversely affected by the proposal.

- *disrupt the breeding cycle of an important population;*

Given the retention of hollow-bearing trees within, and beyond the limits of, the area investigated, the proposed work is not considered to disrupt the breeding cycle of any potentially occurring important Corben's Long-eared Bat populations.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;*

The removal of five hollow-bearing trees and some insect-attracting plants, given the retention of similar habitat within the study area and beyond, is not considered to modify, destroy, remove or isolate or decrease availability or quality of habitat such that Corben's Long-eared Bat would decline.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;*

The proposal is not considered to result in the introduction of any invasive species that are harmful to this species or its habitat.

- *introduce disease that may cause the species to decline;*

The proposal is unlikely to introduce diseases that may cause Corben's Long-eared Bat to decline.

- *or interfere substantially with the recovery of the species.*

The proposal is not considered to interfere substantially with the recovery of Corben's Long-eared Bat.

Conclusion

The proposal is not considered to have a significant impact on Corben's Long-eared Bat or its habitat. As such, it is not considered necessary that the matter be referred as a controlled action to the Federal Minister for the Environment and Water for further consideration or approval.

2. State – *Biodiversity Conservation Act 2016*

By the completion of the field investigation, the following CEEC had been recorded within the proposal area:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

As it has been previously recorded within the study region and/or based on the observation of suitable habitat within the study area, it is considered appropriate to adopt the precautionary approach in regards to the potential presence of the:

- Grey-crowned Babbler – Vulnerable
- Corben's Long-eared Bat – Vulnerable.

The potential impact associated with the proposal on the recorded community and potentially occurring species, are considered with reference to the assessment criteria provided under s.7.3 of the BC Act (these commonly referred to as the 5-part test). These criteria are designed to determine whether there is likely to be a significant effect on these threatened species, or their habitats, and consequently whether a SIS [or BDAR if LMP pursues that option] is triggered.

2.1. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Five-part test

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Not applicable to a CEEC.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development of activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The proposed work would remove approximately 2.2 ha of Derived Native Grassland in the borrow areas. The area would be rehabilitated after upon completion of the areas of the remediation works. The work would also require the removal of six to eight White Box near Grosvenor Dam and some minor removal of groundcover to allow fencing around it. The Mount Stewart encapsulation work would affect already heavily disturbed areas that are mostly devoid of native vegetation.

Within the study area it is estimated that there is approximately 5.5 ha of intact Box-Gum woodland and about 8 ha of Derived Native Grassland. Given that the cleared areas would be rehabilitated with Box-Gum woodland species and that the work is unlikely to result in modification of remaining White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, the local occurrence of the community is unlikely to be placed at risk of extinction.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development of activity, and

The proposed work would remove approximately 2.2 ha of Derived Native Grassland in the borrow areas.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development of activity, and

Given the scale of the proposal and the extent of the community locally, the remediation work is not considered to result in the further fragmentation or isolation of this endangered ecological community.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

Whilst all remnants of the CEEC are considered important, the removal of 2.2 ha of derived native grassland would not compromise the long-term survival of the community in the locality.

(d) whether the proposed development of activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No declared AOBV would be directly or indirectly affected by the proposal. The subject site is not listed as a declared AOBV under Part 3 of the BC Regulation 2017.

(e) whether the proposed development of activity is part of a key threatening process or is likely to increase the impact of a key threatening process

The proposed action involves clearing of native vegetation which is listed as a KTP. While this is the case, the small amount of vegetation to be affected would not contribute significantly to this KTP in regards to the local or regional presence of this endangered ecological community.

Expected impact on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Given the scale of the work proposed and the amount of habitat expected to be disturbed in comparison to that which will remain unaffected, it is considered that the proposed work would not significantly affect White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, or its habitat. Preparation of a SIS (or BDAR) is not required.

2.2. Grey-crowned Babbler – Five-part test

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The Grey-Crowned Babbler was previously recorded during Lesryk's 2015 investigation of the Leadville Mine site at E740110; N6454359, within woodland west of Garland Street and east of the current proposed borrow area.

The Grey-crowned Babbler (eastern subspecies) is distributed from Cape York south through Queensland, NSW and Victoria and formerly to the south east of South Australia (OEH 2024). The species occurs in a range of different habitats, these being drier more open forest, scrubby woodlands or farmland with isolated trees (Simpson and Day 2008); inhabiting open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (OEH 2024). The Grey-crowned Babbler may form groups of up to 15 individuals. They feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. The Grey-crowned Babbler roost in dome-shaped stick nests that are lined with fine grass, fur or cow dung; located in outer tree branches within branch forks, usually about 4 m above the ground (OEH 2024; Frith 1997). The Grey-crowned Babbler breeds between July and February (Frith 1997).

During the current field investigation, no nests typical of this species were observed within the proposed remediation area, and this species was not observed or heard calling; as such, the species is unlikely to be breeding on site, though it may utilise the area for foraging purposes.

To permit the remediation work, the removal of approximately 2.2 ha of Derived Native Grassland (borrow area), and several trees (Smelter area and Grosvenor) will be required. This loss, given the similar habitat to be retained within the study area and beyond, is not considered to have an adverse effect on the lifecycle of this species such that a viable local population is likely to be placed at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Not applicable to threatened species.

(c) in relation to the habitat of a threatened species, population or ecological community:

- *(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,*

The removal of approximately 2.2 ha of Derived Native Grassland (borrow area), and several trees (Smelter area and Grosvenor) will be required.

- *(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,*

Suitable habitat for this species would be retained within both the former mining area and the surrounding locality; as such, the removal of some vegetation would not cause habitat to become fragmented or isolated from other areas used by the Grey-crowned Babbler.

Revegetation of the site post work would provide resources for this species in the long-term.

- *(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

The proposal is not considered to remove, modify, fragment or isolate a significant amount of vegetation such that the long-term survival of the Grey-crowned Babbler would be jeopardised. The habitats within the proposal area extend beyond the limits of the required work. Given that no major components of this species' habitat are to be further isolated or fragmented, it is not considered that the proposal would have an impact on the Grey-crowned Babbler such that the long-term survival of this species in the locality would be adversely affected.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No declared AOBV would be directly or indirectly affected by the proposal. The study area is not listed as a declared AOBV under Part 3 of the BC Regulation 2017.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

Currently 36 KTP for mainland NSW are listed under Schedule 4 of the BC Act. Of these, the ‘clearing of native vegetation’ would be applicable to the proposal. While it is acknowledged that the proposal would result in the removal of some vegetation, it is not considered that this clearance would significantly contribute to a KTP such that the lifecycle requirements of the Grey-crowned Babbler would be compromised.

Expected impact on the Grey-crowned Babbler

The conducting of the proposal would not disturb, remove, modify or fragment any habitats critical to the lifecycle requirements of the Grey-crowned Babbler. It is considered that the proposal would not have a significant impact on this threatened species, or its habitat. As such, the preparation of a SIS [or BDAR should LMP elect that option] that further considers the impact of the proposed work on the Grey-crowned Babbler is not required.

2.3. Hollow-dependent microbats

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

In respect of a review of the PMST (Commonwealth DCCEEW 2024a), Corben’s Long-eared Bat, a hollow-dependent species, is predicted to occur within the study region. Furthermore, it is noted that, during the previous 2015 ecological investigation, a hollow-occupying microbat: the common to abundant Gould’s Wattled Bat, was recorded within the Leadville Mine precinct (Lesryk 2015).

As targeted surveys for microbats within the proximate areas of surrounding woodland were not conducted during the current investigation, and up to 5 of the 21 hollow-bearing trees recorded are being removed to permit the remediation work, a precautionary approach to the presence of hollow-dependent microbats has been adopted.

It is acknowledged that, to off-set the loss of the five hollow-bearing trees, 10 purpose built habitat boxes are recommended to be erected within the retained stands of woodland.

Given the extent of suitable habitat being retained within both the study area and surrounding bushland, the potential removal of five hollow-bearing trees and some insect-attracting plants, is not considered to have an adverse effect on the lifecycle requirements of potentially occurring hollow-dependent microbats such that viable local populations of these species are likely to be placed at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction*

Not applicable to threatened species.

(c) in relation to the habitat of a threatened species, population or ecological community:

- *(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity,*

The proposal will require the removal of up to five hollow-bearing trees, and some insect-attracting plants; however, similar habitat, including several hollow-bearing trees, will be retained in the surrounding area.

Revegetation of the site post work, including the provision of habitat boxes, would provide resources for this species in the long-term.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity,

Hollow-dependent microbats can easily negotiate open areas and have been recorded flying over open spaces (author's field notes); as such, the loss of some native vegetation, this including five hollow-bearing trees and some insect-attracting plants, is not expected to result in significant disturbance to hollow-dependent microbats' dispersal or movement patterns. Suitable habitat for these species would be retained within the study area and surrounding bushland area; as such, the proposal would not cause any further fragmentation of, or isolation to, any areas of habitat used by hollow-dependent microbats.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality,

The proposal is not considered to remove, modify, fragment or isolate a significant amount of vegetation such that the long-term survival of hollow-dependent microbats would be jeopardised. While five hollow-bearing trees require removal to permit the proposed remediation work, similar habitat will be retained within the study area and surrounding area. Given that no major components of these species' habitat are to be further isolated or fragmented, it is not considered that the proposal would have an impact on hollow-dependent microbats such that the long-term survival of these species in the locality would be adversely affected.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No declared AOBV would be directly or indirectly affected by the proposal. The study area is not listed as a declared AOBV under Part 3 of the BC Regulation 2017.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process

Currently 36 KTP for mainland NSW are listed under Schedule 4 of the BC Act. Of these, the 'clearing of native vegetation' and 'loss of hollow-bearing trees' would be applicable to the proposal. While it is acknowledged that the proposed work will result in the removal of some native vegetation, this including five hollow-bearing trees and some insect-attracting plants, it is not considered that this clearance would significantly contribute to this KTP such that the lifecycle requirements of hollow-dependent microbats would be compromised.

Expected impact on hollow-dependent microbats

The conducting of the proposal would not disturb, remove, modify or fragment any habitats critical to the lifecycle requirements of any species of hollow-dependent microbats. Given the extent of suitable habitat being retained within both the study area and the surrounding bushland, the removal of five hollow-bearing and some insect-attracting plants, is not considered to have a significant impact on hollow-dependent microbats or their habitat. As such, the preparation of a SIS [or BDAR should LMP elect that option] that further considers the impact of the proposed work on hollow-dependent microbats is not triggered.