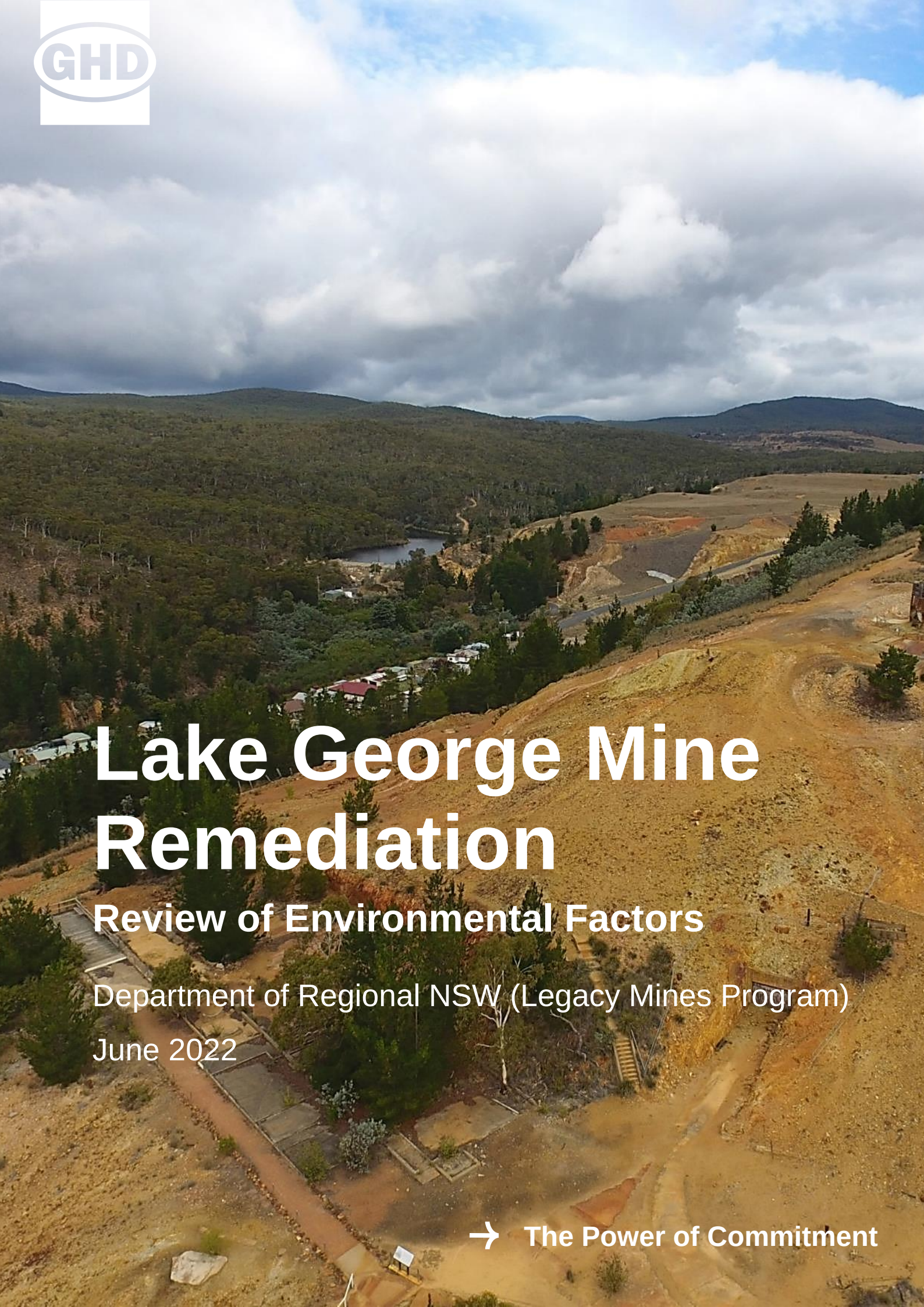

Lake George Mine Remediation

Review of Environmental Factors

Department of Regional NSW (Legacy Mines Program)

June 2022

The Power of Commitment

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Acknowledgment of Country

We acknowledge Aboriginal and Torres Strait Islander peoples as the Traditional Owners of all lands throughout Australia on which we do business, and we pay our respects to Elders, past, present and emerging.

Executive summary

Introduction

The Legacy Mines Program (LMP) within the Department of Regional NSW propose to undertake remediation works at the legacy Lake George Mine, located immediately west of the township of Captains Flat, New South Wales (NSW). Mining operations in the area commenced in the early 1880s and continued until 1962, when the Lake George Mine officially closed. The site is heavily contaminated with metals and metalloids (including lead, arsenic, copper, and zinc) and sulfur and has undergone a succession of remediation works since 1972.

The proposed remediation works include site preparatory early works, fencing historic mining structures, strategic structural works, remediation earthworks, augmentation of surface water drainage, and revegetation across several key domains in the northern portion of Lake George Mine (the proposal). The works are proposed to take place in the Lake George Mine area as depicted in Figure 2.1 by the 'maximum extent of remediation' boundary (the proposal site).

The purpose of the proposed remediation works is to reduce the risk of offsite contamination through airborne dust and surface erosion generating contaminated runoff from the continued oxidation of sulfidic mineral waste at Lake George Mine. The proposed remediation works are required to prevent potential environmental and human health risks to people accessing the site, to residents in the vicinity of the site and in the township of Captains Flat, and to aquatic ecosystems and downstream users of the Molonglo River.

This Review of Environmental Factors (REF) has been prepared to assess all matters affecting or likely to affect the environment by reason of the construction (remediation) and operation (post-remediation) of the proposal under the provisions of Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Proposed works

Site preparatory works

Site preparatory works include site establishment, establishing a site office, installation of a truckwash and water tank, preparation of bunded laydown areas, importation and stockpiling of remedial materials, preparation of the Northern Dumps access track, installing site safety fencings, geotechnical investigations and installation of erosion and sediment controls.

Fencing of historic mining structures

Prior to, and following the proposed remediation works, historic structures located within the proposal site would be fenced to prevent public access (to minimise on site safety risk) and to protect the historic structures. The majority of historic structures would be preserved and fenced.

Strategic structural works

Due to public safety issues associated with the Concentrate Loading Tunnels it is proposed that they are either fenced, filled or demolished. The Surge Bin will likely be removed (or fenced *in situ*), depending on geotechnical and heritage considerations. The preferred option is to remove the Surge Bin for safety reasons. Pending safety and heritage inspections, it is proposed the Concentrate Bins remain *in situ* with remediation occurring either by installing a rock-filled trench to create a preferred drainage pathway to redirect the groundwater currently leaching through the retaining wall into the bottom of the concentrate bins around the structure or by emptying the bins by removing the inert gravel and the sulfidic waste and placing the material into the Northern Dumps encapsulation cell.

Remedial earthworks

The proposed remediation works include, depending on location, in situ liming, importation and spreading of sub and topsoil, rock mulch or installing a cellular confinement system. Various areas of more significant contamination would be excavated and encapsulated in the proposed Encapsulation Cell on the Northern Dumps. The works would be undertaken across several key site domains, predominantly in the northern portion of Lake George Mine. These areas are:

- North Mine Ridge/Elliot's
- Old Mill
- Mill Area (west of the Central Mine Area)
- Central Mine Area
- Creeks Area
- Rail Loading Area
- Minor areas of eroded capping on the Northern and Southern Dumps.

In addition, mine waste from the following sources are proposed for relocation to a containment cell that would be located on the Northern Dumps. These include:

- A sulfidic waste stockpile located on the junction of Miners Road and the Council wastewater treatment plant access road.
- A slag heap located on the western side of Jerangle Road in Forster's Gully, adjacent to the northern end of the Southern Dumps.
- TfNSW lead contamination from around the Captains Flat Railway Precinct. TfNSW propose to remediate the Captains Flat Railway Precinct by removing approximately the surface 500 millimetres of contaminated topsoil for encapsulation in the containment cell on the Northern Dumps, before importing railway ballast, sub- and topsoil to site for backfilling. Prior to excavation of the contaminated surface soils, existing railway infrastructure including the railway line, signalling, gantry, signs, posts and fencing would be removed and temporarily stored on, or nearby the site. Once excavation and backfilling had been completed, the railway infrastructure would be replaced into its original location as far as reasonably practicable.
- Crown Land / QPRC land within the Captains Flat township. That is, the Captains Flat Lead Management Taskforce is currently undertaking an assessment of the Captains Flat township with the aim to prepare abatement plans for the higher risk public spaces. One option being investigated is moving up to a maximum of 20,000 tonnes of contaminated soil from these Crown Land / QPRC-owned abatement areas into the containment cell on the Northern Dumps. These remediation works would be subject to a separate approval under the *NSW Planning and Assessment Act 1979*.

Augmentation of surface and sub-surface drainage

The proposed remediation works would involve augmentation of existing surface and sub-surface drainage in most remedial domains.

Revegetation

Each domain slated for remediation would be re-vegetated (or vegetated if currently bare), following neutralisation and capping, with the exception of the central portion of the Central Mine Area, around one-third of the Mill Area and other minor areas, which would be remediated using rock mulch (i.e. Capping Option 3). The rock mulch remedial option was agreed upon through stakeholder consultation to retain the industrial feel of the site, in addition to being more amenable to remediating steeper slopes.

The purpose of revegetation is to establish a self-sustaining vegetation community that would maintain site stability and reduce erosion risks from both wind and water. Revegetation would also increase the visual amenity of the site. Careful consideration would be given to balancing the management of erosion risk and maintaining the mining heritage character of the site. The long-term objective is that certain parts of the site are dominated by native grasses, herbs and shrub species found in the grassy woodlands and dry sclerophyll forests of the surrounding area. The Northern and Southern Dumps, including the containment cell, will remain grassed.

Key findings

This REF identifies potential environmental benefits and impacts of the proposal and outlines mitigation measures to reduce the identified impacts.

The proposal would provide the following benefits:

– Improved water quality leaving Lake George Mine
– Reduction of windborne dust risk
– Improvement to public health and safety
– Increased aesthetic and tourism value of Lake George Mine
– Post-remediation increased vegetation coverage of the site.

The following key construction (remediation) impacts have been identified should the proposal proceed:

– Minor vegetation clearing during construction
– Potential minor sedimentation impacts during the remedial works
– Temporarily decreased air quality during construction
– Temporarily decreased aesthetic quality during construction
– Increased in noise and traffic during construction.

Further information regarding these impacts is provided in Section 6 of the REF.

Further, given the maximum spatial extent of the proposed remedial works being around 20 hectares, an Environment Protection Licence is required for scheduled activities or scheduled development work outlined in Schedule 1 of the *Protection of the Environment Operations Act 1997 (POEO Act)*. Specifically, Clause 15(2)(b) of Schedule 1 relates to activities requiring an EPL concerning the treatment of contaminated soil. An Environment Protection Licence would, therefore, be required under Clause 15(2)b (iii) due to the proposal disturbance of more than three hectares of contaminated soil.

Conclusions

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 REF found that the proposal would be unlikely to cause a significant impact on the environment. Indeed, the aim of the remedial works is to improve the condition of the environment at, and downstream of, the Lake George Mine, including the township of Captains Flat. The assessment found that a species impact statement is not required and that an environmental impact statement does not need to be prepared. No approval is required to be sought from the Minister for Planning under Part 5.1 of the EP&A Act.

In addition, the REF proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. Therefore, a referral to the Australian Department of Agriculture, Water and the Environment is not required.

On balance, the proposal is considered justified as the environmental impacts would be outweighed by the improvement to the environment at Lake George Mine and increased public health and safety.

Abbreviations

Abbreviation	Definition
AHD	Australian height datum
As	Arsenic
Ba	Barium
C	Celsius
Co	Cobalt
Cu	Copper
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW).
EP&A Regulation	*Environment Planning and Assessment Regulation 2000*
DPE	NSW Department of Planning and Environment
GHD	GHD Pty Ltd
LEP	Local Environmental Plan
LGA	Local Government Area
LMP	Legacy Mines Program
μS/cm	microSiemens per centimetre
Mo	Molybdenum
NML	Noise Management Level
NSW	New South Wales
Pb	Lead
ppm	parts per million
QPRC	Queanbeyan-Palerang Regional Council
RBL	rating background level
REF	Review of Environmental Factors
S	Sulfur
SEPP	State Environment Planning Policy
TfNSW	Transport for NSW
TSP	Total Suspended Particulates
Zn	Zinc
°	degrees

Glossary

Term	Definition
The proposal	The proposed remediation works including excavation and containment, *in situ* neutralisation of surface material, capping, and revegetation across several key areas in predominantly the northern portion of the Lake George Mine. Specifically, these areas include: North Mine Ridge/Elliot's; Old Mill; Mill Area (west of the Central Mine Area); Central Mine Area; Creeks Area; Rail Loading Area; and minor areas of eroded capping in the Northern and Southern Dumps. The proposed remediation works also include a sulfidic waste stockpile, a slag heap, an area called the Captains Flat Railway Precinct identified by TfNSW and importation of contaminated soil from lead abatement areas on Crown Lands / QPRC property in the Captains Flat township. The lead abatement remediation works would be subject to a separate approval under the *NSW Planning and Assessment Act 1979*.
Proposal site	The spatial area that is subject to the maximum extent of impact associated with the proposed remediation works as depicted in Figure 2.1. That is, it represents the land envelope in which the proposal may be undertaken.
Study area	The study area comprises the proposal site plus a slightly larger land area surrounding the proposal site, including land that has the potential to be indirectly impacted by the proposal (for example, as a result of noise impacts). The Study area depicts the area used in some of the impact assessment technical studies reported in this REF and is shown in Figure 2.3.

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Appendices

1. Introduction

1.1 Background

The Legacy Mines Program (LMP) within the Department of Regional NSW propose to undertake remediation works at the legacy Lake George Mine, located immediately west of the township of Captains Flat, New South Wales (NSW) (refer to Figure 1.1).

Mining operations (for silver, gold, copper, lead and zinc) in the area commenced in the early 1880s with several small operations amalgamating to form Lake George Mine. Mining continued until 1962, when the Lake George Mine officially closed. The site is contaminated with metals and metalloids (including lead, arsenic, copper, and zinc) and sulfur and has undergone a succession of remediation works since 1972.

In 2017, the LMP commissioned a review of previous remediation works, and an additional site contamination delineation assessment, to establish the current situation at Lake George Mine. The purpose of the work was to formulate a way forward to reduce the risk of off-site environmental impacts from the Lake George Mine. The work was documented in *Lake George Captains Flat Mine Review: Assessment of Remediation Options* (GHD 2018), which reported that the most significant contributors to ongoing contamination from the Lake George Mine were:

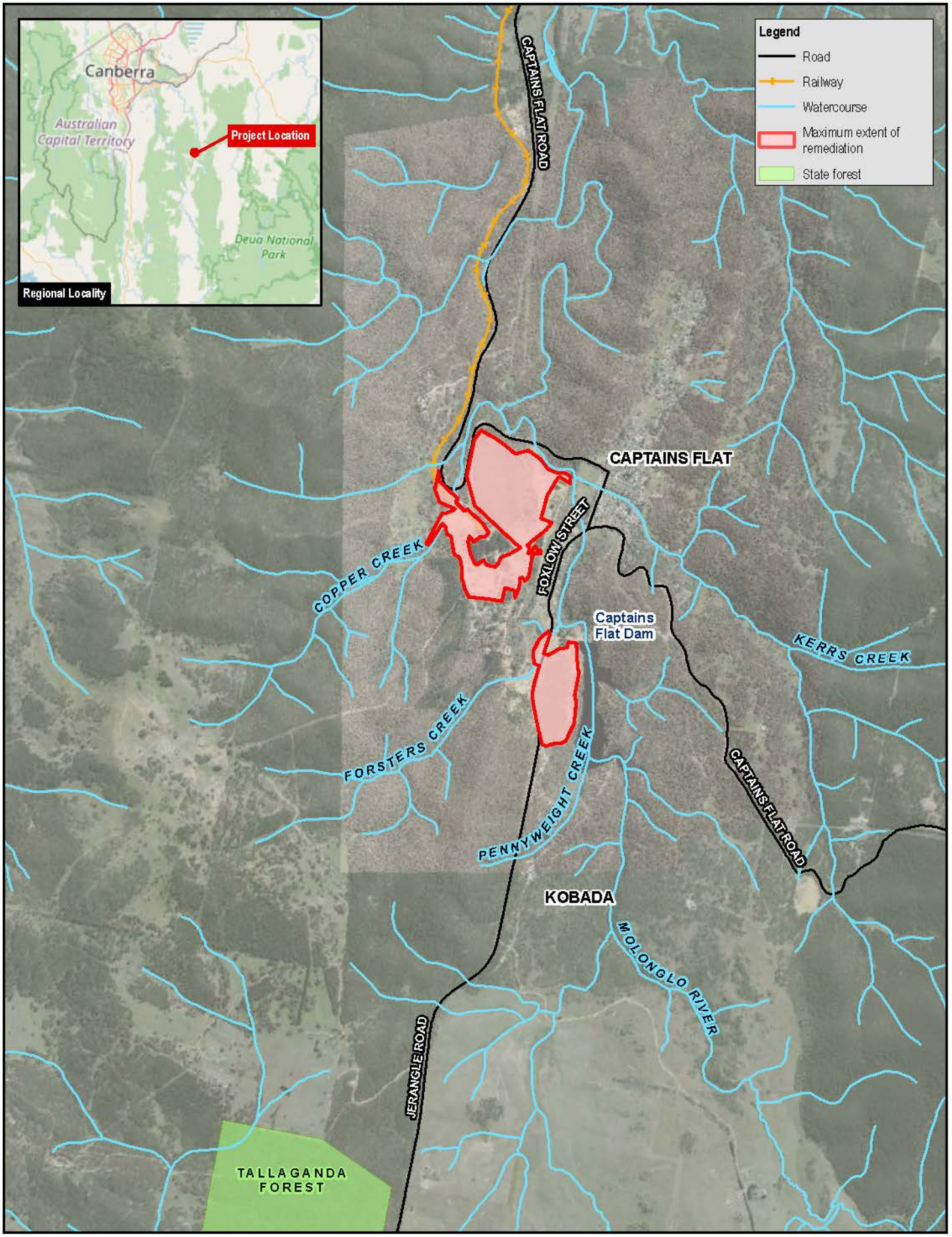
– The Main Adit Spring, which as a point source, contributes around 80 to 90 per cent of dissolved zinc and some 99 per cent of dissolved lead loads into the Molonglo River under dry weather conditions
– Exposed, or partly vegetated, contaminated mineral waste and soil in the Rail Loading and Mill Areas within the Copper Creek sub-catchment
– Exposed waste rock and mineralised *in situ* rock in the Central and Elliot's Mine Area within the Molonglo River catchment and Copper Creek sub-catchment.

A separate works package is assessing the feasibility of water treatment for the acid and metalliferous drainage (AMD) emanating from the Main Adit Spring.

To progress remedial work on the exposed, or partly vegetated contaminated soil in the Rail Loading and Mill Areas, and the exposed waste rock and mineralised *in situ* rock in the Central and Elliot's Mine Area, GHD were tasked to prepare a soil treatment, capping and vegetation design in late-2018. The resultant *Lake George Mine, Captains Flat Detailed Design Report* was the output (GHD 2020). An updated version of GHD (2020) is attached to this report as Appendix B.

Additionally, Transport for NSW (TfNSW) has identified lead contamination in surface soils in the Captains Flat Railway Precinct, immediately to the north of the Rail Loading Area. TfNSW is planning to align remediation of the Captain's Flat Railway Precinct with the works described herein at Lake George Mine. Concurrently, Crown Lands / QPRC are proposing to implement remedial works to property they own in the township of Captains Flat. Not greater than 20,000 tonnes of contaminated soil from the proposed Crown Lands / QPRC remedial works are to be managed by receiving the waste from premises outside the regulated area through macroencapsulation in the containment cell proposed for construction on the Northern Dumps.

This Review of Environmental factors (REF) document is the statutory instrument that seeks approval to implement the remedial works as described in Appendix B in addition to the Captains Flat Railway Precinct remediation and receipt of Crown Lands / QPRC waste soil as described above.



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Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA1994
Grid: GDA1994 MGA Zone 55

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GHD

Department of Regional NSW
Lake George Mine Remediation

Regional location and maximum spatial extent of remediation

Project No. 12551771
Revision No. A
Date 14/03/2022

FIGURE 1.1

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Data source: General topography - Sixmaps via SSNSW © OpenStreetMap (and) contributors, CC-BY-SA © Department of Customer Service 2020. Created by: eibbertson

1.2 Mining and site remediation history

1.2.1 Mining history

There have been three phases of mining at the Lake George Mine, with the first mining operations starting in 1882 to mine for gold. In 1887, the Vanderbilt Mine was opened on the eastern side of Captains Flat. Open heap roasting of ore began in 1890 which released sulfur into the atmosphere killing most of the surrounding vegetation.

Pyritic smelting replaced the wood and coal fuels as the mining company attempted to boost metal production. The principal commodity was now copper, with northern and southern workings having been developed. New stacks, flues and furnaces were built at the southern end of town between the Molonglo River and Jerangle Road. The mines produced silver, gold, and copper. However, high lead and zinc concentrations meant that copper yields could not be improved. In 1899, Lake George mine stopped smelting for copper and attempted to extract gold by cyanidation. However, this attempt failed, and the mine shut down, with mine equipment subsequently dismantled.

The second phase of mining occurred from 1937 to 1962, with large-scale mining operations being employed. This included bringing electricity and a railway into the mine, with a dam constructed across the Molonglo River. Ore was recovered using froth flotation and transported to market via the railway. Much of the second phase of mining comprised sulfide ores containing pyrite (FeS_2), in addition to pyrite ore which was used to produce pyrite concentrate for the subsequent production of sulfuric acid (Glasson *et al*. 1965).

Mining wastes including slurries were initially stored in the area known as the Northern Dumps, which was compromised in 1939 due to a breach in the wall of Dump 6A (in the area now known as the North Dumps) – with tailings and slimes entering the Molonglo River. Following this, tailings were disposed of to a Southern Dumps, which on 3 July 1942 also collapsed sending approximately 30,000 m^3 of tailings into the town water reservoir (Dobos and Associates 2002).

After the Southern Dumps failure, disposal of mine and process wastes reverted again to the Northern Dumps area. There were no recorded tailings impoundment failures after this. A major flood in 1954 mixed, and further dispersed, the contaminated riverbed sediments already in the Molonglo River, further impacting the river downstream to Queanbeyan around 55 kilometres downstream (Dobos and Associates 2002).

1.2.2 Remediation history

Since the 1939 Northern Dumps and 1942 Southern Dumps failures, various tranches of site remedial works have been undertaken to decrease the risk of off-site environmental impact from the Lake George Mine. In summary, these were:

1. Remedial works undertaken by the NSW Department of Public Works in 1976, at a cost of $2.3 million, including:
    - Reshaping of the Northern and Southern Dumps to slopes of between 1:3 and 1:20 to improve stability, reduce scouring, promote vegetation and reduce infiltration
    - Covering the reshaped dumps with a capping (from top down) of:
        - 30 centimetres of topsoil / growth medium
        - 45 centimetres of crushed rock and pebbles to promote drainage and act as a capillary break
        - 22 centimetres of compacted clay
    - Revegetation of the dumps
    - Diversion of Forster's Creek and removal of a dam, to prevent it entering the mine through Keating's Collapse.
2. Capping of slag heaps on the eastern side of Jerangle Road adjacent to the Southern Dumps in 2002.
3. Between 2006 and 2014, various site works were undertaken by the NSW Legacy Mines Program and Department of Lands – Soil Conservation Service. These included:
    - Construction and periodic cleaning out of sediment dams above the Rail Loading Area
    - Cleaning out the V-notch weir at the Main Adit Spring

- Re-profiling and ameliorating the area above the Rail Loading Area
- Adding inert gravel into the Ore Concentrate Bins in the Mill Area to attempt to supress acid generation from the sulfidic ore stored in the bins
- Additional fencing and sealing of some shafts
- Rehabilitating the northern face of the Southern Dumps, which had eroded.

Additional diversion drains were also installed to reduce runoff over contaminated areas, primarily in the Creeks and Rail Loading Areas in the Copper Creek sub-catchment.

1.2.3 Additional remediation required

Despite the remedial works listed in Section 1.2.2 above, various site investigations over the recent past (e.g. Brooks 1980, Hogg 1990, Dobos and Associates 2002, URS 2004 and GHD 2018) have broadly concluded that the most likely remaining areas of significant contamination contributions are:

– The Main Adit Spring, which contributes around 80 to 90 per cent of dry weather, point source dissolved zinc and some 99 per cent of dissolved lead loads into the Molonglo River
– Exposed or only partly vegetated contaminated mineral waste and soils in the Rail Loading and Mill areas (Copper Creek sub-catchment)
– Exposed waste and mineralised rock in the Central and Elliot's Mine area (Molonglo River and Copper Creek sub-catchment).

Cumulatively, the above three issues are reported to contribute around 90 per cent of known, off-site dissolved contamination at Captains Flat. Therefore, they have become the focus of current design and remedial works by the Legacy Mines Program, with the water treatment project which addresses the Main Adit Spring contamination being progressed under a separate project. This REF, therefore, addresses the proposed capping works in the areas described below in Section 1.3.

1.3 Overview of proposed remediation works

The proposed remediation works include, and build on, those described in the *Lake George Mine, Captains Flat Detailed Design Report* (GHD 2020). The proposed remediation works broadly include:

– Site preparatory early works
– Fencing historic mining structures
– Strategic structural works
– Remediation earthworks
– Augmentation of surface and subsurface drainage
– Revegetation.

The proposed remediation works would be undertaken across several key domains, predominantly in the northern portion of Lake George Mine. These include:

– North Mine Ridge/Elliot's
– Old Mill
– Mill Area (west of the Central Mine Area)
– Central Mine Area
– Creeks Area
– Rail Loading Area
– Minor areas of eroded capping in the Northern and Southern Dumps.

In addition, mine waste from the following sources are proposed for relocation to a containment cell that would be located on the Northern Dumps. These include:

– A sulfidic waste stockpile located on the junction of Miners Road and the Council wastewater treatment plant access road
– A slag heap located on the western side of Jerangle Road in Forster's Gully, adjacent to the northern end of the Southern Dumps.
– TfNSW lead contamination from around the Captains Flat Railway Precinct. TfNSW propose to remediate the Captains Flat Railway Precinct by removing approximately the surface 500 millimetres of contaminated topsoil for encapsulation in the containment cell on the Northern Dumps, before importing railway ballast, sub- and topsoil to site for backfilling. Prior to excavation of the contaminated surface soils, existing railway infrastructure including the railway line, signalling, gantry, signs, posts and fencing would be removed and temporarily stored on, or nearby the site. Once excavation and backfilling had been completed, the railway infrastructure would be replaced into its original location as far as reasonably practicable.
– The Captains Flat Lead Management Taskforce is currently undertaking an assessment of the Captains Flat township with the aim to prepare abatement plans for the higher risk public spaces. One option being investigated is moving up to a maximum of 20,000 tonnes of contaminated soil from these Crown Land-owned abatement areas into the containment cell on the Northern Dumps. These remediation works would be subject to a separate approval under the NSW Planning and Assessment Act 1979. The maximum spatial extent of remediation is shown in Figure 2.1, excluding Crown Lands abatement areas.

Collectively, the areas identified above comprise the proposed remediation works (or 'the proposal') to be carried out at Lake George Mine.

The purpose of the proposed remediation works is to reduce the risk of off-site migration of airborne dust and contaminated runoff generated from the continued oxidation of sulfidic mineral waste at the Lake George Mine. The proposed remediation works are required to prevent potential environmental and human health risks to people accessing the site, to residents in the vicinity of the site, and in the town of Captains Flat, and to aquatic ecosystems and downstream users of the Molonglo River.

To allow for the proposed remediation works to proceed, a Review of Environmental Factors (REF) is required to be prepared under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) (NSW) for self-assessment by the proponent being the LMP.

1.4 Document purpose and structure

This REF has been prepared by GHD on behalf of the LMP to assess the potential impacts of the proposed remediation works at Lake George Mine. For the purposes of these works, the LMP is the proponent and the determining authority under Division 5.1 of the EP&A Act.

The purpose of this REF is to describe the proposed remediation works, to assess the potential impacts of the remediation works, and to identify mitigation measures to reduce the potential impacts of the proposed remediation works. This REF has been prepared in accordance with Clause 171(2) of the *Environment Planning and Assessment Regulation 2021* (EP&A Regulation) and with reference to *ESG2: Guideline for preparing a Review of Environmental Factors* (Department of Planning and Environment 2015).

The structure and content of the REF is summarised in Table 1.1.

Table 1.1 Structure and content of the REF

Section No.	Section title	Content
-	Executive summary	Provides an overview of all aspects of the environmental impact assessment of the proposal.
1	Introduction	Provides background to, and an overview of, the proposed remediation works and outlines the document purpose and structure.
2	The site	Provides a description of the proposal site, including site plans.
3	Description of existing conditions	Provides a description of the existing environment of the proposal site and surrounding area that may be affected by the proposed remediation works.
4	The proposed activity	Provides a description of the proposed remediation works, including stakeholder consultation undertaken.
5	Statutory context	Provides the statutory context of the proposal, including an outline of the relevant legislation and environmental planning instruments applicable to the proposal.
6	Impact assessment	Provides an assessment of: – Physical and pollution impacts, including air impacts; soil and stability impacts; noise and vibration impacts; and other physical or pollution impacts – Biological impacts, including flora and fauna impacts; and ecological and biosecurity impacts – Resource impacts, including community resources; and natural resources – Community impacts, including social impacts; economic impacts; heritage impacts; aesthetic impacts; cultural impacts; land use impacts; and transportation impacts – National impacts – Cumulative impacts. Provides mitigation/management measures to avoid or reduce impacts associated with the proposed remediation works.
7	Summary of impacts	Provides a summary of impacts associated with the proposed remediation works and ranks the potential significance of the impacts (positive, negligible, adverse).
8	Conclusion	Provides an overview of the conclusions from the environmental impact assessment – specifically whether there is likely to be a significant impact on the environment from the proposed remediation works.
9	Statement of commitments	Provides a consolidated summary of commitments – describing the measures for management, mitigation, and monitoring of the impacts of the proposed remediation works.
10	References	Provides a list of references used throughout the REF.

2. The site

2.1 Site description

Lake George Mine is located immediately to the west of the township of Captains Flat NSW, about 50 kilometres south-east of Canberra (refer to Figure 1.1). The areas to the north, west and south of the site are vegetated, mountainous areas that includes Yanununbeyan State Conservation Area and Yanununbeyan National Park.

Lake George Mine lies adjacent to the Molonglo River, which flows in a northwesterly direction through Captains Flat to the east of Lake George Mine. The Molonglo River then flows toward Queanbeyan, joining the Queanbeyan River before flowing into Lake Burley Griffin in Canberra, approximately 70 kilometres downstream of Captains Flat. Captains Flat Dam (also known as the town water supply dam) lies on the Molonglo River, immediately to the south-east of Lake George Mine and adjacent to the Southern Dumps.

Lake George Mine is accessed via the sealed Miners and unsealed Old Mines Road from Captains Flat. Public access is therefore possible to Lake George Mine, in fact, it is promoted for mining heritage interpretation.

As described in Section 1.3, the proposed remediation works would be undertaken across several site domains located predominantly within the northern portion of Lake George Mine. These areas are:

– North Mine Ridge/Elliot's
– Old Mill
– Mill Area (west of the Central Mine Area)
– Central Mine Area
– Creeks Area
– Rail Loading Area and Captains Flat Railway Precinct
– Minor areas of eroded capping on the Northern and Southern Dumps.

The general locations of these areas are listed in Table 2.1. Appendix A lists the Lot/DPs that intersect with the site as well as their ownership (i.e., Crown Land, freehold land, NSW Government land), with their location shown on Figure 2.5.

In addition, mine waste from sources identified in Section 1.3 are proposed to be relocated to the containment cell that would be located on the Northern Dumps.

The location of key site domains (excluding the Captains Flat abatement areas) subject to the proposed remedial works are shown in Table 2.1.

Table 2.1 Location of key site domains subject to proposed remediation works in MGA94

Area	Zone	Easting (m)	Northing (m)
North Mine Ridge / Elliot's	55	721443.801	6058756.636
Old Mill	55	721439.247	6058657.286
Mill Area (west of the Central Mine Area)	55	721220.715	6058445.025
Central Mine Area	55	721237.069	6058504.785
Creeks Area	55	721062.31	6058635.004
Rail Loading Area and Captains Flat Railway Precinct	55	720987.429	6058737.989
Northern Dumps	55	721278.748	6058832.33
Southern Dumps	55	721511.643	6057881.758
Sulfidic waste stockpile	55	721409.087	6058647.711
Slag heap	55	721374.377	6057965.761

2.2 Site plan

2.2.1 Layout of the proposed works

The Lake George Mine hosts several key site domains and features as shown in Figure 2.1. Figure 2.1 also shows the maximum spatial extent of the proposed remediation works under the proposal. Site domains are subject to different levels of contamination, and as such, will receive bespoke remedial approaches as described in Section 4.2.1.

The bulk of the remediation works will be undertaken by the LMP using NSW Soil Conservation Service as Principal Contractor. The remediation works proposed for the TfNSW Captains Flat Railway Precinct will be undertaken by a yet to be determined TfNSW sub-contractor. Both the LMP and TfNSW proposed remedial works are assessed in this REF. In addition to the proposed remedial earthworks, strategic structural work to the Concentrate Loading Tunnels, Concentrate Bins and Surge Bin are also proposed (refer Section 4.2.1.3 and Figure 4.1).

A containment cell that would encapsulate approximately 75,000 m^3 of contaminated mineral waste and soil and an alkaline amendment is to be located on the Northern Dumps. It is proposed that this area be used to accommodate contaminated material from:

– The Mill Area
– Cut material from steeper areas in the Central Mine Area, Old Mill and North Mine Ridge (Elliots)
– The Captain's Flat Railway Precinct
– A sulfidic waste stockpile next to the access road to Council's Sewage Treatment Plant
– A slag heap from the western side of Jerangle Road opposite the Southern Dumps
– Captains Flat lead abatement areas.

Access to the site is via public roads, specifically from the north via Miners Roads off Captains Flat Road and from the east from Miners Road off Foxlow Street. Access is discussed further in Section 4.4.

2.2.2 Heritage

Lake George Mine has local heritage significance, and several heritage items are listed under the Palerang-Queanbeyan Local Environment Plan (LEP). There are no Aboriginal heritage sites within the proposal site. Heritage at the site is discussed in Sections 3.9 and 3.10 while impacts to heritage are discussed in Sections 6.4.3 and 6.4.4.

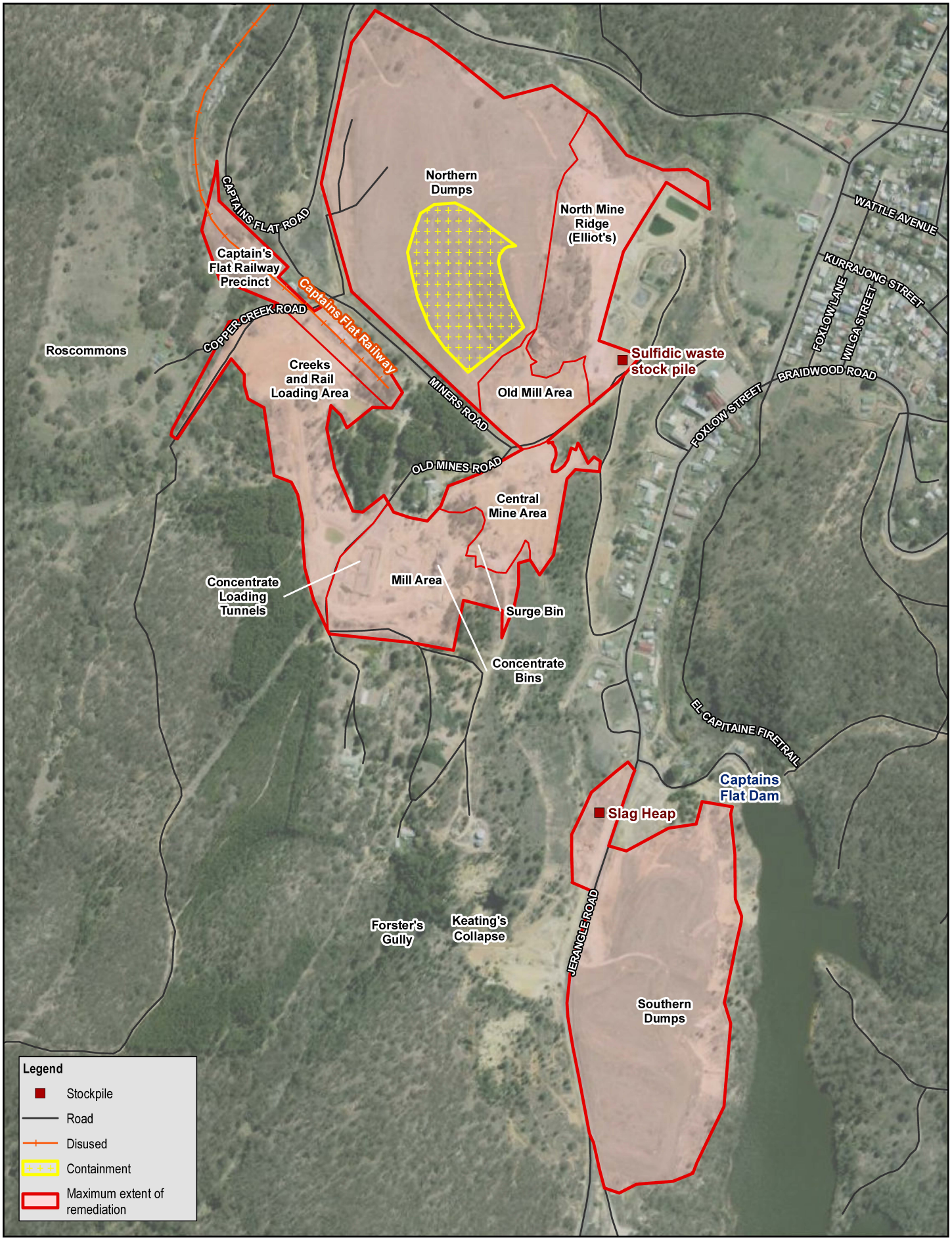
Listed heritage items, along with the location of specific heritage structures, are shown on Figure 2.2. Many of the infrastructure items will be fenced to ensure they are not damaged during the proposed remediation works, and for post-remedial works safety.

2.2.3 Biodiversity

The vegetation communities present at the study area are mapped in Figure 2.3. Direct biodiversity impacts including vegetation clearance are discussed further in Section 6.2.

2.2.4 Slope and topography

Slope and topography within the proposal site are shown in Figure 2.4 and described in Section 3.3.1. The proposal site is made up of rugged terrain with significant areas of slope over 18 degrees.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Key site domains and features including the maximum spatial extent of remediation

Project No. 12551771
Revision No. A
Date 14/03/2022

FIGURE 2.1

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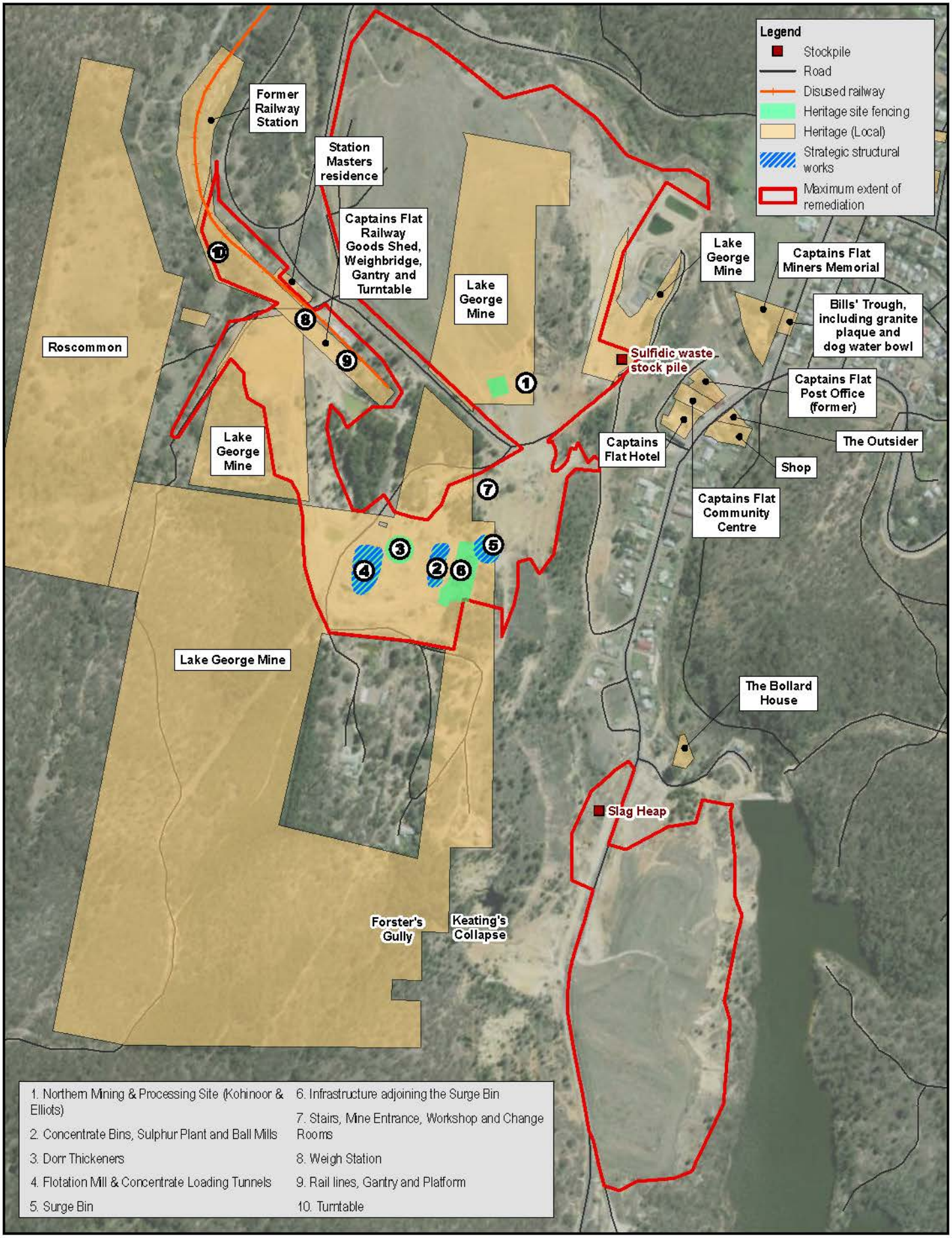
Data source: General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: eibbertson



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Lake George Mine Remediation

Project No. 12551771
Revision No. A
Date 23/03/2022

Heritage

FIGURE 2.2

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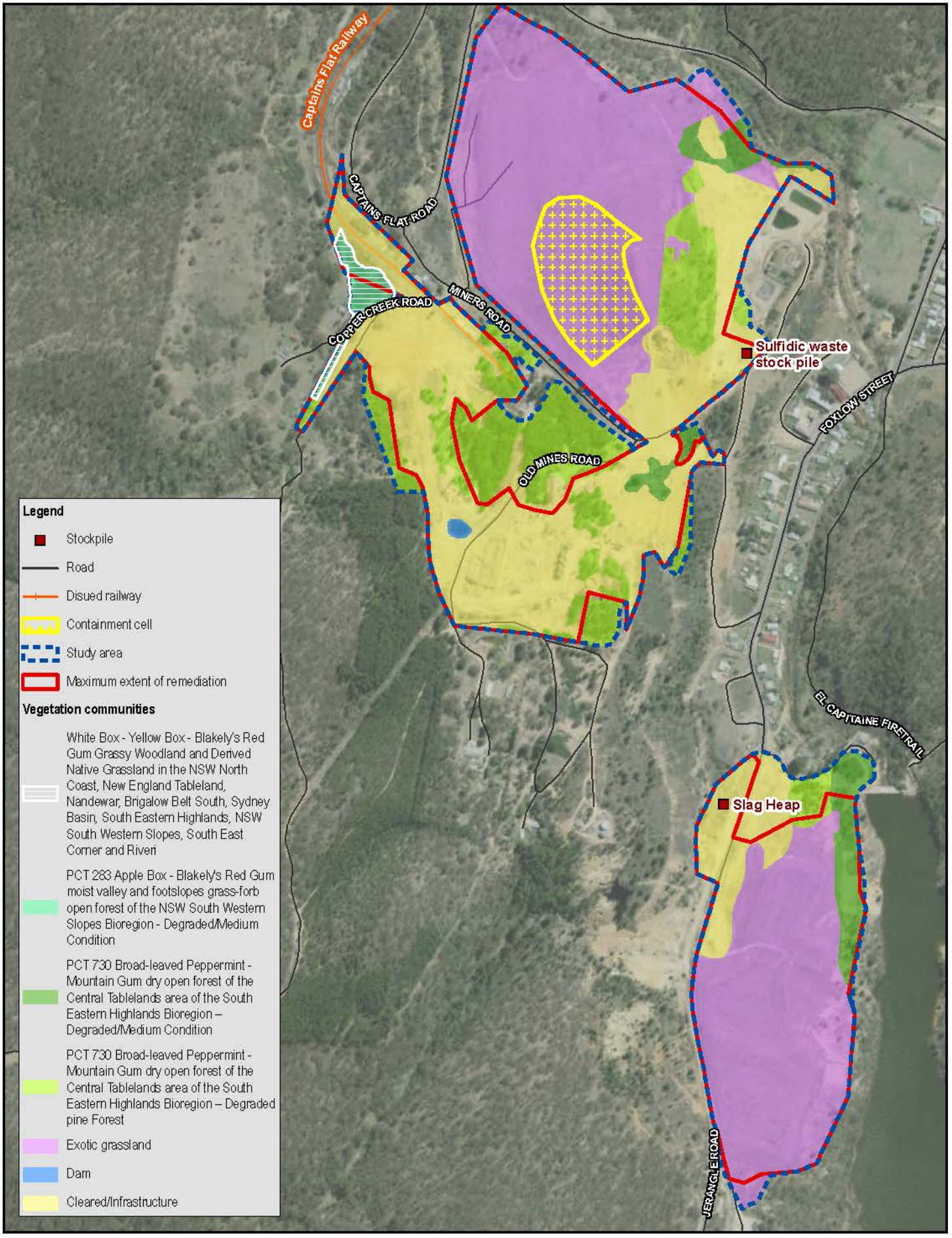
Print date: 23 Mar 2022 - 10:14

Data source: Heritage - OEH, 2021; General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: eibbertson



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Map Projection: Transverse Mercator
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Grid: GDA1994 MGA Zone 55

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Lake George Mine Remediation

Project No. 12551771
Revision No. A
Date 24/03/2022

Biodiversity

FIGURE 2.3

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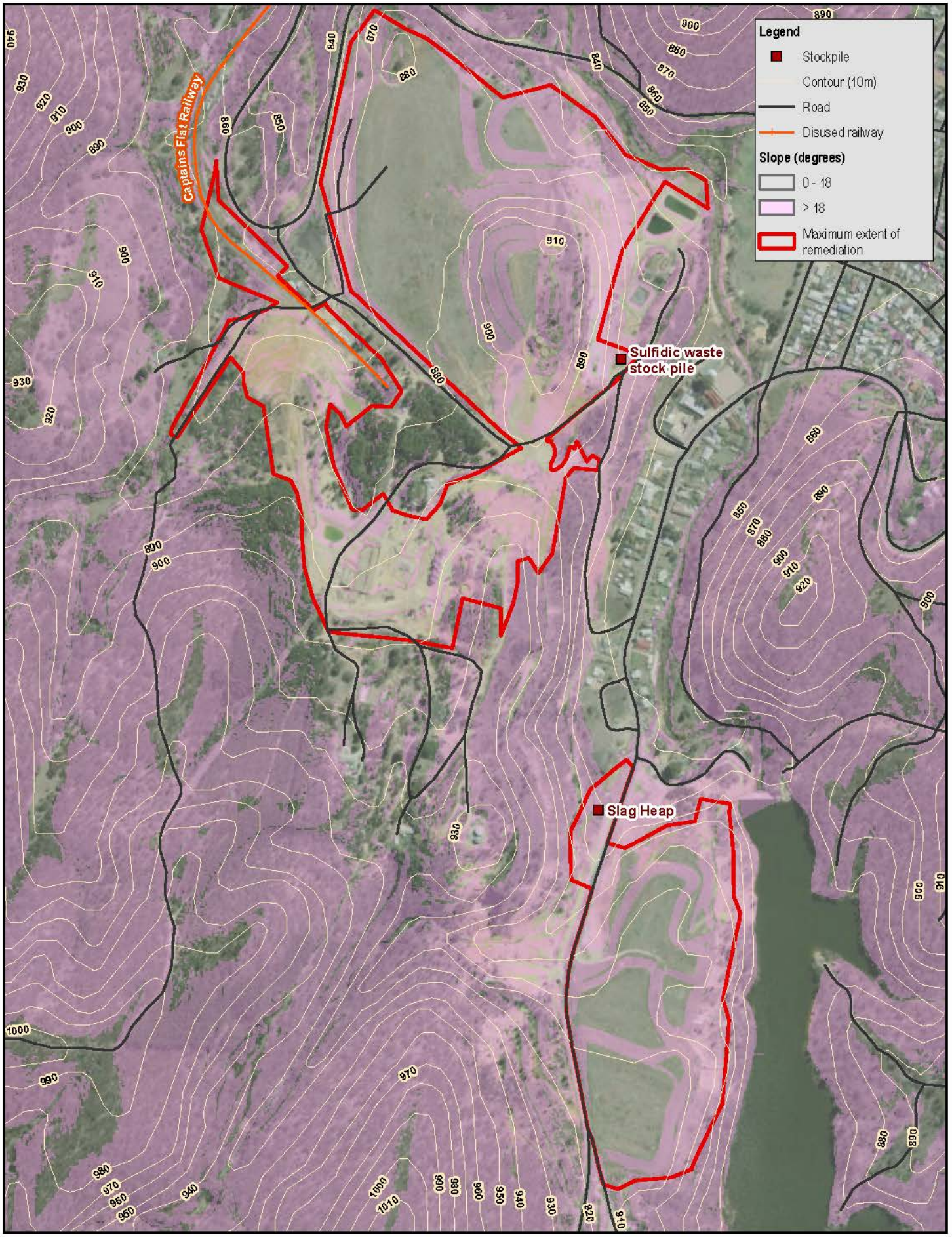
Print date: 24 Mar 2022 - 15:46

Data source: General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: eibbertson



Paper Size ISO A4

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Map Projection: Transverse Mercator
Horizontal Datum: GDA1994
Grid: GDA1994 MGA Zone 55

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Lake George Mine Remediation

Project No. 12551771
Revision No. A
Date 23/03/2022

Slope and topography

FIGURE 2.4

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Print date: 23 Mar 2022 - 10:11

Data source: Crown land - DPIE, 2021; General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: ebbertson

2.2.5 Sensitive land

Sensitive land at the proposal site is described in Appendix N. Sensitive land not already shown on other site plans is shown on Figure 2.5 and includes areas of crown land, water-front land and a drinking water catchment.

Lot and DP details are also shown on Figure 2.5, with details listed in Appendix A.

Database searches were undertaken to identify sensitive land within the proposal site and within 20 kilometres of Lake George Mine. Sensitive land is defined as per Appendix 1 of *ESG2: Guideline for preparing a Review of Environmental Factors* (Department of Planning and Environment 2015). The database search results are provided in Appendix N.

The following sensitive land was identified within the proposal site, or within 20 kilometres of Lake George Mine:

– 'Conservation areas'. The proposal site contains areas defined as 'conservation areas', namely crown reserves and crown land. There are no other forms of conservation areas within the proposal site, however, the Tallaganda National Park, the Yanununbeyan National Park and the Yanununbeyan State Conservation Area are within 20 kilometres of Lake George Mine. Impacts to crown reserves and crown land are discussed in Section 6.4.6. These areas are shown on Figure 2.5.
– 'Drinking water catchment protection areas'. The proposal site is located within a 'drinking water catchment protection area' as it is part of the Captains Flat Dam drinking water catchment. Impacts to water are discussed in Section 6.1.2. This area is shown on Figure 2.5.
– 'Environmentally sensitive areas'. The proposal site is located within 'environmentally sensitive areas' as it contains land with slopes greater than 18° and waterfront land as it is within 40 metres of the Molonglo River. The site is not a wetland of significance. Impacts to water, soils and stability, and biodiversity are discussed in Section 6.1.2, Section 6.1.3 and Section 6.2.1. Slopes at the site is shown on Figure 2.4 and watercourses are shown on Figure 2.5.
– 'Historic or natural heritage protection areas'. The proposal site contains items of local heritage significance listed on the Palerang Local Environment Plan 2014. Impacts to heritage are discussed in Section 6.4.3. Heritage is shown on Figure 2.2.

2.2.6 Sensitive receivers

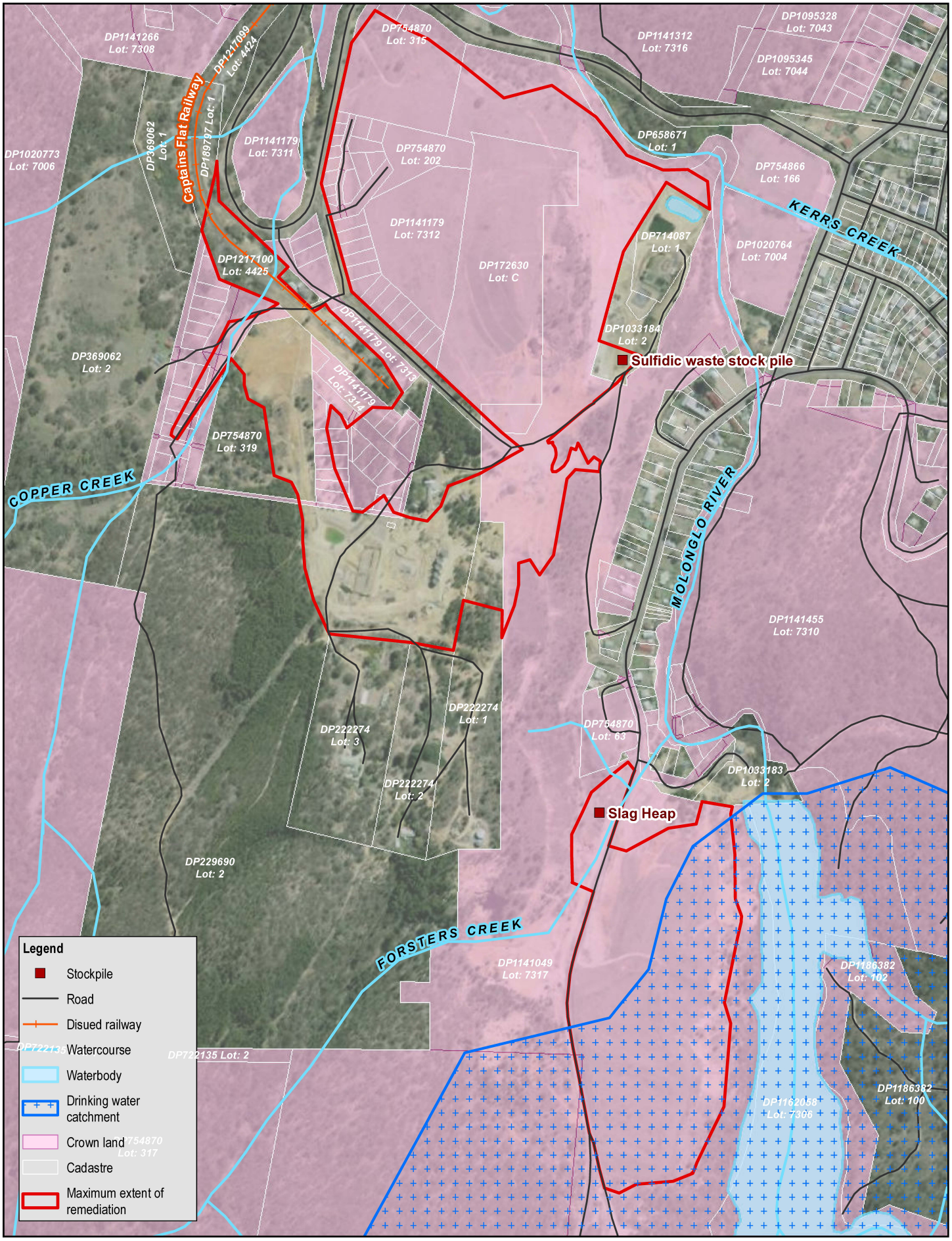
Sensitive receivers at, and near, the proposal site are listed in Table 2.2 and shown on Figure 2.6. It has been assumed that the Station Masters Cottage will remain vacant through remedial works and has therefore not been listed as a sensitive receiver.

Sensitive receivers have been grouped into catchment areas of similar impact for assessment purposes. Receivers isolated from other buildings (e.g. 8 Copper Creek Road) were given individual catchment areas to avoid unnecessarily large catchment areas close to the proposal site.

Table 2.2 Sensitive receivers at or near the proposal site

Location	Land Use	Distance from site (m)	Catchment ID
6-18 Foxlow Street	Residential	69.9	1
Railway Cres, Beverley Hills Road	Residential	232.8	2
66 Old Mines Road	Residential	258.2	3
8 Copper Creek Road	Residential	68.5	4
73 Foxlow Street	Active Recreation	47.9	5
Spring St, Beazley Street, Blatchford Street, Foord Street, 119-274 Foxlow Street	Residential	631.1	6
1-15 Schardt Street	Residential	547.2	7
44 Old Mines Road	Residential	172.0	8
4-8 Lewis Street, 39-43 George Street	Residential	417.4	9

Location	Land Use	Distance from site (m)	Catchment ID
2-20 Mulga Street	Residential	362.2	10
14 Montgomery Street	Educational	383.5	11
200 Foxlow Street	Residential	485.9	12
101-115 Foxlow Street	Residential	478.4	13
178 Foxlow Street, 1-11 Mulga Street	Residential	270.3	14
Cnr Captains Flat Road & Foxlow Street	Residential	180.0	15
12 Montgomery Street, 180-196 Foxlow Street	Residential	326.4	16
6-10 Montgomery Street, 79-99 Foxlow Street	Residential	269.4	17
25-31 Kurrajong Street	Residential	397.2	18
4-22 Wattle Avenue	Residential	250.0	19
168-172 Foxlow Street, 1-13 Wattle Avenue	Residential	220.3	20
2-18 Willow Road	Residential	402.2	21
16-36 Kurrajong Street	Residential	339.6	22
1-15 Braidwood Road, 38 George Street	Residential	348.1	23
1-23 Kurrajong Street	Residential	248.3	24
150 Foxlow Street	Residential	206.2	25
106-130 Foxlow Street	Residential	206.0	26
70-90 Foxlow Street	Residential, Commercial	155.7	27
2-14 Wilga Street, 8-12 Kurrajong Street	Residential	299.4	28
1-17 Wilga Street, 2-6 Kurrajong Street	Residential	249.0	29
51-59 Foxlow Street	Passive Recreation, Residential	80.4	30
39-49 Foxlow Street	Residential	90.5	31
54-68 Foxlow Street	Residential	159.5	32
20-42 Foxlow Street	Residential	158.0	33
15-19 Foxlow Street	Residential	75.6	34
2 Foxlow Street	Residential	22.1	35
27-37 Foxlow Street	Residential	99.7	36
2 Braidwood Road	Residential	265.3	37
5 Old Mines Road	Residential	0.0	38
NSW State Emergency Service, Copper Creek Road	Community	0.0	39



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Lake George Mine Remediation

Project No. **12551771**
Revision No. **A**
Date **23/03/2022**

Other sensitive land

FIGURE 2.5

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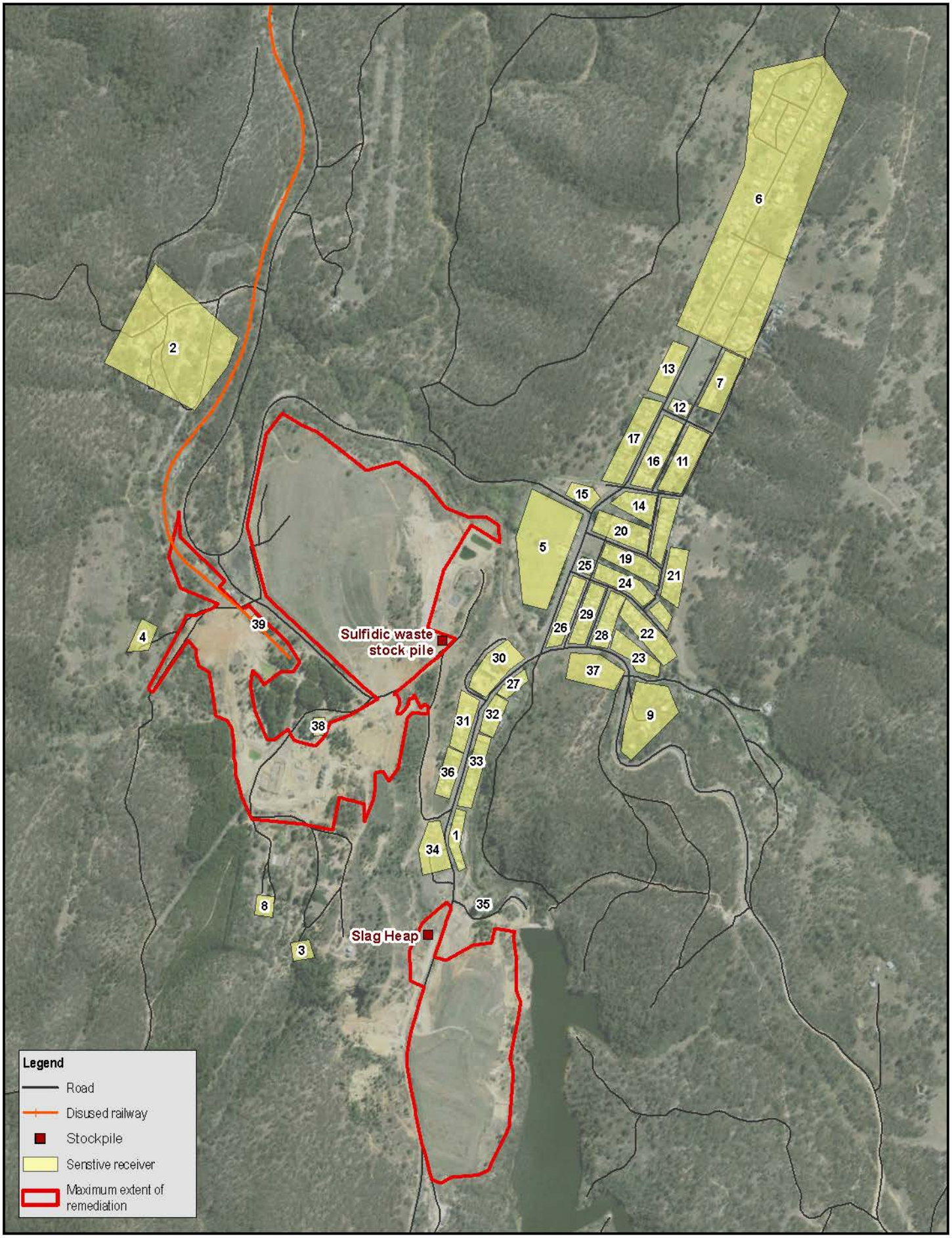
Data source: Crown land - DPIE, 2021; Drinking water catchment - QRPC, 2021; General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: eibbertson



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Map Projection: Transverse Mercator
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Grid: GDA1994 MGA Zone 55

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Lake George Mine Remediation

Project No. 12551771
Revision No. A
Date 14/03/2022

Sensitive Receivers

FIGURE 2.6

Data source: Heritage - OEH, 2021; General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: eibbertson

3. Description of existing conditions

3.1 Air quality

3.1.1 Climate and weather

Lake George Mine is located immediately west of the township of Captains Flat, which is located within a cool, temperate zone (Stinton *et al*., 2020). It has an annual mean maximum temperature of 19.3 C and a mean monthly minimum of 6.1 C, with an average of 742 millimetres of rain per year. The region tends to receive more rain in spring and summer than winter, with the maximum average rainfall being received in November and the minimum in July (Bureau of Meteorology, 2021; Stinton *et al*., 2020).

Average site wind speeds and direction are discussed in more detail in Section 6.1.1.

3.1.2 Ambient air quality

The existing ambient air quality at the proposal site will influence the potential impacts associated with air emissions from the proposal. Existing air quality is understood through a review of the existing sources of air pollution surrounding the proposal site as well as a review of publicly available air quality monitoring data.

Given the regional location of the proposal, ambient air quality across the proposal site is likely to be largely influenced by natural sources of air pollution including wind-blown dust with major air pollution events likely associated with bushfires or dust storms. Generally, ambient concentrations of gaseous and toxic air pollutants (e.g., volatile organic compounds) are expected to be low in regional locations, such as the proposal location. However, Captains Flat town is known to have high air pollution during winter from wood heaters and the occasional temperature inversions in the valley in which the township is located.

The above characterisation of the proposal site is likely to be changed at locations close to any existing or proposed sources of ambient air pollution. No key sources of air pollution were observed based on observations by key project staff during several visits to the proposal site, review of aerial imagery, review of Environmental Protection Licences (EPLs) and review of the National Pollutant Inventory (NPI) database.

The Department of Regional NSW has installed a network of five ambient air quality monitoring high-volume air samplers (HVAS) measuring total suspended particles (TSP) and heavy metals as well as weather at one station. The sampling commenced on 22 June 2021 and all 24-hour TSP concentrations were below the annual average TSP air quality criteria. The sampling report (Ramboll 2021) summarises that 24-hour lead concentrations were below the annual average lead air quality criteria. The monitoring shows spatial and temporal variations in concentrations of arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, titanium and zinc around Captains Flat.

The monitoring is limited in the duration it has been going for, and the monitoring program is on-going with review planned at six months to determine if the locations and analysis parameters remain suitable for the aims of the monitoring.

3.1.3 Air quality sensitive receptors

The *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Approved Methods) (EPA, 2016) defines sensitive receptors as locations where people are likely to work or reside and may include a dwelling, school, hospital, office or recreation areas. A review of aerial photography was undertaken to identify nearby sensitive receptors. All residential dwellings are considered sensitive receptors, and sensitive receptors for the project are discussed in Section 2.2.6.

The following receptors, however, were identified to be most sensitive to the works from an air quality perspective:

– 8 Copper Creek Road (adjacent to Rail Loading Area)
– NSW State Emergency Service, Copper Creek Road (north of Rail Loading Area)
– 5 Old Mines Road (north of the Mill Area)

– 44 Old Mines Road (south of the Mill Area)
– 66 Old Mines Road (south of the Mill Area)
– Residents on Foxlow Street
– QPRC Captains Flat Pool
– Colin Winchester Oval
– Captains Flat Public School.

3.2 Water

3.2.1 Surface water

The proposal site is located in the headwaters of the Murrumbidgee catchment, to the west of the Molonglo River and to the east of Copper Creek, a tributary of the Molonglo River. The site is located downstream of the Captain Flat Dam located on the Molonglo River. The Molonglo River is a perennial water course which flows into Lake Burley Griffin in Canberra, ACT, before flowing into the Murrumbidgee River, west of Belconnen. Lake Burley Griffin, in Canberra, ACT, is a key hydrologic feature, acting as a sink for sediment conveyed by the Molonglo River (Caitcheon *et al*., 1988), which could include sediment mobilised from the site.

The Molonglo River and its tributaries form “uncontrolled streams”, within the Murrumbidgee Surface Water Resource Plan Area, of the Murray Darling Basin – and is subject to the Murrumbidgee Unregulated Rivers Water Sharing Plan (WSP) within the Molonglo Water Source. The Captains Flat water supply dam is located just upstream of the site. The dam has a capacity of 820ML at full supply level and is operated by the Queanbeyan-Palerang Regional Council as the water supply source for Captains Flat.

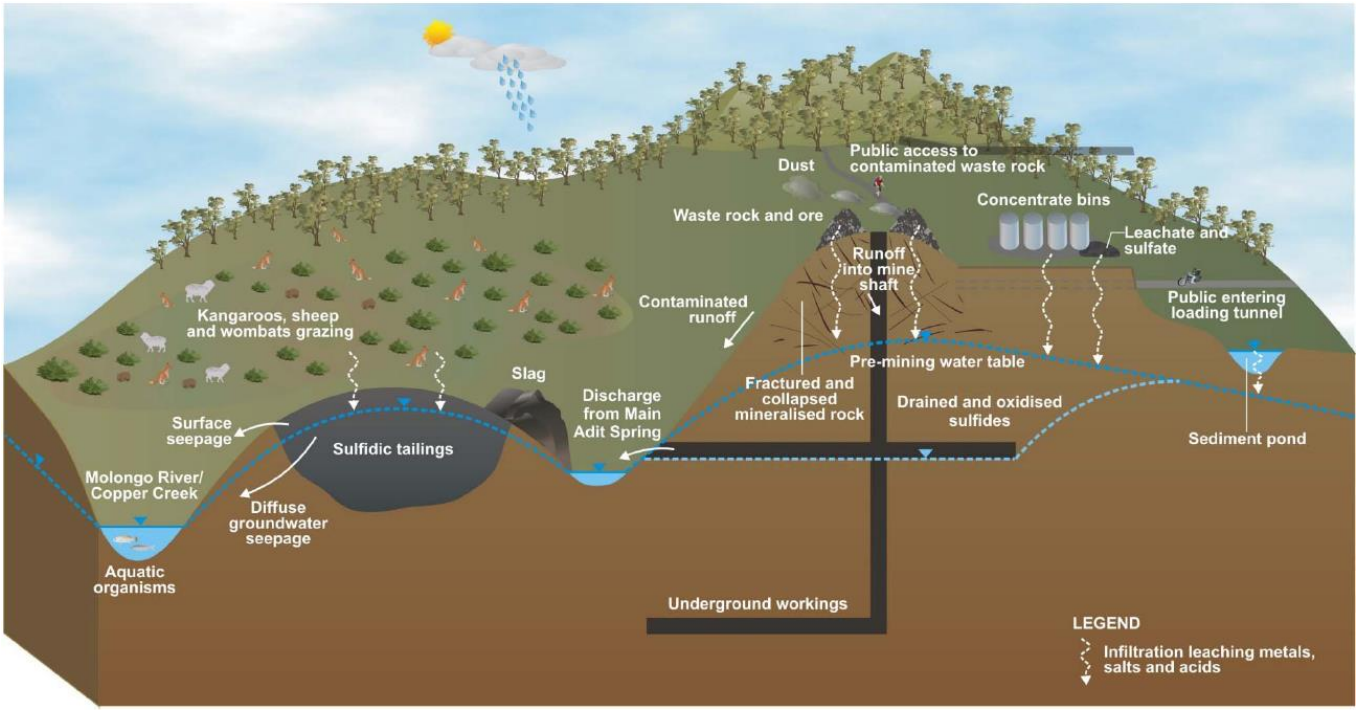
The Molonglo River and Lake George Mine at Captains Flat have been subject to previous water quality studies including Brooks (1980) and GHD (2018). Previous studies have identified that adverse environmental impacts of legacy mining at the Lake George Mine are present within the Molonglo River System, with key contaminants comprising arsenic, cadmium, copper, lead and zinc.

GHD (2018) found that historic mining at the site has left a contamination legacy that continues off-site to the present day for up to 40 kilometres downstream. Previous remediation work has resolved some contamination sources, with the main remaining issues being:

– The Main Adit Spring – contributing around 80 to 90 per cent of dry weather, point source dissolved zinc loads into the Molonglo River and around 99 per cent of dissolved lead loads into the Molonglo River
– Exposed or only partly vegetated contaminated mineral waste and soils in the Rail Loading and Mill Areas (Copper Creek catchment)
– Exposed mine waste and mineralised rock in the Central and Elliot’s Mine Area (Molonglo River and Copper Creek catchment).

3.2.2 Groundwater

Groundwater at Lake George Mine occurs via rainfall infiltrating into the existing ground surface (GHD, 2018). Groundwater at the site ultimately flows to the Molonglo River north of Captains Flat. A conceptual model of this is shown in Figure 3.1.



Source: GHD, 2018

Figure 3.1 Conceptual model of the Lake George Mine including groundwater flow

3.3 Topography, geology and soils

3.3.1 Topography

The Captains Flat area lies in the western slopes of the Great Dividing Range. Captains' Flat township is located within gently sloping areas associated with the alluvial flats of the Molonglo Valley (GHD, 2018). Comparatively, the mountains on either side of Molonglo Valley comprise rugged, more deeply dissected terrain. Lake George Mine is located within these mountains on a ridgeline running north-south, bisected by a saddle (URS, 2004). Lake George Mine has significant local relief of about 100 metres between the high point of the mine ridge at around 940 metres Australian height datum (AHD) and the low point at the Molonglo River to the east at about 840 metres AHD (GHD, 2018). As shown in Figure 2.4, the site contains steep slopes with significant portions of land having slopes over 18 degrees.

The mine's main headworks and processing facilities are located along the ridgeline, with several adits and collapsed areas along the eastern flank (GHD, 2018). The Northern Dumps fills a small valley to the northwest of the mine, abutting the ridge, and the Southern Dumps occupies a small valley confined by two low ridges running parallel to the mine ridge.

3.3.2 Geology

Lake George Mine was a volcanogenic massive sulphide (VMS) zinc-lead-copper deposit located in the Lachlan Fold Belt (GHD, 2018). Local geology comprises tightly folded Middle to Upper Silurian felsic pyroclastics, volcanogenic sediments and shales with key geological units including:

– Copper Creek Shale – 60 to 150 metres of sediments with subordinate tuffs
– Kohinoor Volcanics (this unit hosts the ore body) that comprise porphyritic andesite to dacite to rhyolitic lavas, tuffs and volcanic breccias, tuffaceous shales and volcanic cherts
– Captains Flat Formation (predominantly shales and siltstones with lesser volcanic flow and tuffs).

Ore minerals on site include (in decreasing abundance): pyrite (FeS_2), sphalerite (ZnS), galena (PbS), chalcopyrite ($CuFeS_2$), tennantite ($(Cu, Fe, Zn, Ag)_{12}(SbAs)_4S_{13}$), arsenopyrite (FeAsS) and gold. As noted above, the geology of the site includes sulfides, which are present in high concentrations in the underground ore zone, while in the surrounding host rock, sulfide concentrations range from low to environmentally significant. As a result of the sulfide presence, relatively high metallic sulfide concentrations occur in the tailings and waste rock on site.

Historically, there were three main deposits at the Lake George Mine: the Elliot's, Central and Keating's orebodies. They are all steeply west-dipping (80° to 85°), north-plunging (60° to 70°) lenses. The Keating's Lens within the Keating's orebody reportedly pinches out at 670 metres in depth, the Elliot's Lens within the Elliot's orebody at 960 metres in depth and the Vanderbilt and Copper Creek Lodes at 120 metres and 240 metres in depth respectively. The latter two lodes comprised the Central orebody (Gilligan, 1975).

The primary ore deposit has been oxidised and leached above the palaeo-water table, leaving a near-surface gossan of oxide minerals (GHD, 2018). It is likely that this grades down through a zone of supergene enrichment, where infiltrating water containing sulfate and metals reduces below the water table, re-precipitating as secondary metal sulfides. Leachate from the various sulfide-bearing materials is commonly acidic and metalliferous, with elevated zinc, and to lesser extent, copper, lead and arsenic.

3.3.3 Soils

Generally, surface soils at the Lake George Mine are largely unvegetated due to the presence of elevated metals concentrations, acidity and salinity from oxidised, or oxidising, sulfidic waste rock, low grade ore and/or ore. *In situ* bedrock, mineral waste, low grade ore and ore with visible sulfides in various states of weathering are present, along with slag scattered around areas of exposed mineralised bedrock (GHD, 2018) (refer Figure 3.2).

Figure 3.2 Partially oxidised sulfidic waste rock in Mill Area

Some areas including the Northern and Southern Dumps have undergone capping as a part of previous remediation works. Most of the capped areas have good grass cover, although there are also minor areas of exposed clay capping material where erosion has occurred that will be subject to remediation.

According to field work undertaken by GHD (2018), soil salinity at Lake George Mine range, from very low (<150 μS/cm) to Very High (>35,200 μS/cm). Electrical conductivity was found to be high in the various adit and tailing seeps and moderate in the two sediment dams and in Copper Creek. The highest electrical conductivity values were found in the two seepages from the Southern Dumps. Soil pH values were predominantly acidic, with 14 of 22 samples retuning values below pH 4.5. Very low pH values were generally correlated with high salinity and elevated metal concentrations as may be anticipated given the sulfidic mineral waste scattered across the site.

Background natural sandy clay loam soils over *in situ* weathered schists sampled and analysed by GHD (2018) reported low sodicity and therefore, low dispersion risk and very low salinity (9-18 µS/cm in 1:5 soil:water slurry). They returned low to medium pH values of 5.4 and 5.5 pH units.

The site hosts several areas of highly erodible soils due to the steep topography and largely unvegetated ground cover due to site contamination, including:

– Mill Area
– Rail Loading Area including the Lower Sediment Pond Catchment
– Elliot's Mine
– Central Mine Area
– Areas on the Southern Dumps
– Keating's Collapse and Forster's Creek (the former not subject to this tranche of remediation while the latter hosts the slag heap).

The presence of heavy metals and acidity in contaminated soils at the Lake George Mine pose a potential risk to downstream environments through erosion and increased metal solubility due to acidic solution pH values.

The slag heap located near Forster's Creek west of Jerangle Road has unstable slopes and also is an erosion and contamination risk (refer Figure 3.3).

Source: GHD, 2018

Figure 3.3 Slag Heap on the banks of Forster's Creek, below Jerangle Road opposite the Southern Dumps

3.3.4 Contamination

3.3.4.1 Mineral waste and mine soils

Dobos and Associates (2002), URS (2004) and GHD (2018) previously undertook site assessments to delineate the surficial extent of site contamination. Table 3.1 presents a summary of GHD's results which measured the concentration of metals at the site using portable x-ray fluorescence (XRF) technology and the Geochemical Abundance Index (GAI) (GHD 2018). The GAI method compares elemental concentrations against crustal averages whereby a GAI result of three or greater is considered significantly elevated relative to crustal average. Table 3.1 shows that arsenic (As) and lead (Pb) were both found to have average GAI values above three (n = 154). In addition, all elements assessed had a maximum individual GAI sample value of over three, consistent with the mineralogy of the ore body and mineral waste on site. This suggests contaminated pockets of metal and metalloid-rich mineral waste across the site, while arsenic and lead have broad scale contamination issues across the site.

Table 3.1 Summary GAI statistics from site XRF results

Element	As	Ba	Co	Cu	Mo	Pb	Zn	S
Crustal abundance (ppm)	1.8	425	25	55	1.5	12.5	70	0.04 (%)
Sample Count	154	154	154	154	154	154	154	154
Medium GAI	3.6	0.6	0.3	1.0	2.9	6.2	2.1	2.2
Average GAI	**3.2**	0.5	0.5	1.2	2.8	**5.3**	2.3	1.8
Maximum GAI	**11.1**	**4.4**	**4.0**	**9.3**	**4.1**	**12.9**	**10.9**	**8.0**

Median GAI results from the 22 soil/mineral waste samples analysed at a NATA-accredited laboratory reported by GHD (2018) showed arsenic, lead and antimony returned GAI values greater than 3. This is consistent with the XRF results provided above, however, also includes antimony.

A summary of the combined URS (2004) and GHD (2018) metal and metalloid results from 71 test pits dug on site (URS 2004) and 15 surface soil samples relevant to the remediation (GHD 2018) is provided below in Table 3.2. The data in Table 3.2 indicates that the key metal driving site remediation is lead, with arsenic and zinc also reporting above site assessment criteria, broadly supporting GHD's (2018) site-wide GAI assessment above.

Table 3.2 Summary metals and metalloid statistics (URS 2004)

Site domain	As		Cd		Cu		Pb		Zn	
(all mg/kg)	Ave	Med	Ave	Med	Ave	Med	Ave	Med	Ave	Med
HIL (A) residential (NEPC 2014) mg/kg	100		20		7,000		300		8,000	
HIL C recreational (NEPC 2014) mg/kg	300		100		20,000		600		30,000	
HIL D Comm/Industrial (NEPC 2014) mg/kg	3,000		800		250,000		1,500		400,000	
Rail loading area (n = 22)	34.7	21.0	1.6	1.0	234.6	139.0	1,772.1	623.0	1,171.3	677.5
Central Mine Area (n = 19)	141.2	75.0	5.2	0.3	591.2	273.0	4,156.8	1,880.0	3,806.2	582.0

Site domain	As		Cd		Cu		Pb		Zn	
(all mg/kg)	Ave	Med	Ave	Med	Ave	Med	Ave	Med	Ave	Med
HIL (A) residential (NEPC 2014) mg/kg	100		20		7,000		300		8,000	
HIL C recreational (NEPC 2014) mg/kg	300		100		20,000		600		30,000	
HIL D Comm/Industrial (NEPC 2014) mg/kg	3,000		800		250,000		1,500		400,000	
Creeks Area (n = 4)	8.5	7.5	1.3	1.0	73.3	46.5	259.3	77.0	458.0	428.5
Mill Area (n = 58)	84.2	22.5	16.2	1.0	765.8	117.5	2,958.8	349.0	10,168	2,175.0
Old Mill (n = 8)	114.8	90.5	7.3	1.5	474.0	451.5	8,513.0	1,980.0	2,655.8	763.0

Dobos and Associates (2002), URS (2004) and GHD (2018) report in various levels of detail the specifics of site contamination across the Lake George Mine. Of note, all three reports agreed on the need to cap the exposed mine areas to reduce the off-site risk of windborne and waterborne contamination.

GHD (2018) defined health-based metal contamination indicators using National Environmental Protection Council (NEPC) (NEPC 2013) guidelines. Under these guidelines Health-based Investigation Level A (HIL-A), was defined as the safe contaminant level for residential gardens and accessible soils. These levels were used to assess risk to people from windborne contaminated dust being deposited onto residential gardens in Captains Flat. Health-based Investigation Level C (HIL-C) was defined as safe levels for public open spaces which was used to assess risk from occasional exposure consistent with public recreational access to the site.

GHD (2018) determined that elevated lead levels presented the greatest risk in terms of human health with concentrations in most disturbed areas being above safe levels (300 parts per million (ppm) in residential, 600 ppm in public open spaces) (NEPC, 2013). High lead contamination was persistent across all unvegetated areas of the Lake George Mine, with arsenic and zinc also present at lesser concentrations, though also exceeding the adopted health investigation levels.

The Northern and Southern Dumps had relatively low metal and sulfur concentrations at surface, confirming the capping material is relatively benign when compared to exposed mine surfaces. the soils located within the eucalypt-forested area to the south of the mine area were found not to exceed safe levels of metals for human health.

GHD (2018) concluded that based on XRF testing, soil and mine waste samples within the disturbed mine area (with the exception of the Northern and Southern Dumps), exceeded HIL-A and HIL-C for lead, and to a lesser extent, arsenic and zinc. GHD (2018) concluded that the indicative areas of exposed metal contamination (driven by lead exceedance of HIL-A and HIL-C) that pose potential health risks are:

- Elliot's/Northern Mine Ridge and Old Mill area north of Miners Road
- Mill area, west of the Central Mine Area
- Central Mine headworks area south of Miners Road (Also referred to (URS, 2004) as North Face of Old Mill area)
- Creeks Area
- Rail Loading Area
- Keating's Collapse North
- Minor areas or eroded capping on the Northern and Southern Dumps.

On the basis of the results, *in situ* contamination at the former Central Mine, Mill and Rail Loading Areas is considered to pose an unacceptable risk to human health in the context of the land use types assumed by HIL-A and HIL-C, and the current accessibility of the site to the public. Lead levels are sufficiently high in the exposed soils at the listed locations that dust blown from the site may impact on the town of Captains Flat in addition to on-site ingestion and exposure risk from the public.

With respect to the risk of acid, metalliferous and / or saline drainage from site, the high soil and water salinity and metals results, the XRF sulfur-based modified maximum potential acidity values and low pH values in almost all samples from the mine area indicate that almost all of the exposed waste rock and soil is acid-forming. Some 65 of 149 XRF readings by GHD (2018) returned maximum potential acidity (MPA) readings calculated using total sulfur of over 10 kgH_2SO_4/tonne - an indication of the presence of potentially acid-forming (PAF) material. There is therefore a high risk of ongoing acid, saline, and metalliferous drainage unless key contaminant sources are targeted for remediation.

The above contamination risks drove the capping design; the implementation of which is the subject of assessment in this REF.

3.3.4.2 Asbestos

Given the age and nature of the operations on site at the Lake George Mine, the Captains Flat Railway Precinct and the Lead Abatement Areas in the Captains Flat township, it remains possible that asbestos may present through remedial works.

Where asbestos is identified during remedial works, it will be gathered to a contained centralised location for legal disposal in line with an Unexpected Finds Protocol within the Construction Environmental Management Plan to be prepared by the Principal Contractor.

3.4 Noise

3.4.1 Noise sensitive land uses

A number of sensitive residential, educational, and recreational receivers have been identified in the vicinity of the proposal site. Receivers have been sorted into noise catchment areas defined in Table 2.2. The sensitive receivers relevant for noise are shown in Figure 2.6.

3.4.2 Background noise levels

GHD conducted unattended noise monitoring at the proposal site between the 10 and 24 August 2021. Full details of the method used for this survey can be found in the report in Appendix G.

Noise logger data results are summarised in Table 3.3 and noise monitoring charts are presented in Appendix A of the full acoustic report in Appendix G. This excluded data considered invalid due to adverse weather conditions and extraneous noise sources. Evening wildlife noise, such as noise from insects, has been determined as extraneous noise as the evening noise level is inconsistent across the monitoring period. As such, the minimum rating background level (RBL) for the evening period has been adopted for this assessment.

Table 3.3 Summary of unattended noise monitoring results, dBA

Day	Background noise descriptors[1], $L_{A90(Period)}$,			Ambient noise descriptors[1], $L_{Aeq(15m)}$		
	Day	Evening	Night	Day	Evening	Night
Thurs 12 August 2021	**24**	51	20	**44**	60	50
Fri 13 August 2021	21	55	18	45	61	52
Sat 14 August 2021	19	51	17	45	61	48
Sun 15 August 2021	**17**	**51**	**29**	**41**	**60**	**47**
Mon 16 August 2021	**25**	**19**	17	**44**	**49**	43
Tues 17 August 2021	17	19	16	41	55	34

Day	Background noise descriptors[1], $L_{A90(Period)}$,			Ambient noise descriptors[1], $L_{Aeq(15m)}$		
	Day	Evening	Night	Day	Evening	Night
Wed 18 August 2021	19	26	16	41	56	39
Thur 19 August 2021	19	24	16	40	55	42
Fri 20 August 2021	**21**	**37**	18	**43**	**54**	41
Sat 21 August 2021	**23**	39	19	**43**	56	44
Sun 22 August 2021	**21**	54	35	**44**	61	56
Mon 23 August 2021	**34**	**59**	**34**	**48**	**63**	**40**
Total	35[2] (21)	30[3] (45)	30[2] (18)	44	59	48

Notes:
1. The *Noise Policy for Industry (NPfI)* (EPA, 2017) defines day, evening and night-time periods as:
   - Day: 7am to 6pm Monday to Saturday and 8am to 6pm Sunday
   - Evening: 6pm to 10pm
   - Night: 10pm to 7am Monday to Saturday and 10pm to 8am Sunday.
2. Minimum RBLs as outlined in Table 2.1 of the NPfI have been adopted (EPA, 2017)
3. Due to extraneous noise during the evening period, the rating background level has been adjusted to the minimum RBLs in line with the day and evening periods
4. Values marked in red/bold denote time periods where extraneous noise has been removed.

3.5 Flora and fauna

3.5.1 Flora

Native vegetation throughout the site has been substantially cleared for the mine and impacted by the high levels of contamination on the site. Native vegetation is patchy across the site, and typically occurs as scattered patches of degraded woodland, often with a high proportion of exotic pine trees.

A total of 44 flora species from 16 families were recorded on site, comprising 25 native and 19 exotic species. The Poaceae (grasses, 10 species, three native), Fabaceae (nine species, all native) and Myrtaceae (six species, all native), were the most diverse families recorded.

The plant community types (PCTs) and vegetation zones within the remediation area are listed in Table 3.4.

Table 3.4 Vegetation zones within remediation area

Plant community type (OEH, 2021)	PCT ID	Condition	Area (ha)	BC Act Status [1]	EPBC Act Status[1]
Apple Box - Blakely's Red Gum moist valley and footslopes grass-forb open forest of the NSW South Western Slopes Bioregion	283	Degraded /Medium Condition	0.36	CEEC	CEEC
Broad -leaved Peppermint -Mountain Gum dry open forest of the Central Table lands area of the South Eastern Highlands Bioregion	730	Degraded Pine Forest	3.57	-	-
Broad -leaved Peppermint -Mountain Gum dry open forest of the Central Table lands area of the South Eastern Highlands Bioregion	730	Degraded /Medium Condition	1.72	-	-
Exotic grassland	N/A	Exotic vegetation	24.50		
Cleared/Infrastructure	N/A	Cleared land	16.62		

Note: 1. CEEC – critically endangered ecological community

Five plant species identified as priority weeds for the Southeast region were recorded in the site. The weeds and their management requirements as per the *Biosecurity Act 2015* are listed in Table 3.5. Serrated Tussock (*Nassella trichotoma*) is particularly abundant in grassland areas throughout the site.

Table 3.5 Priority weeds recorded within the site and related management measures

Scientific name	Common name	Requirements
Lycium ferocissimum	African Boxthorn	Prohibition on certain dealings Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Eragrostis curvula	African Lovegrass	Regional Recommended Measure Land managers reduce impacts from the plant on priority assets.
Nassella trichotoma	Serrated Tussock	Prohibition on certain dealings Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Olea europaea subsp. *cuspidata*	African Olive	Regional Recommended Measure An exclusion zone is established for all lands in Blue Mountains City Council LGA and in Penrith LGA west of the Nepean River. The remainder of the region is classified as the core infestation area. Whole region: The plant or parts of the plant are not traded, carried, grown or released into the environment. Exclusion zone: The plant is eradicated from the land and the land kept free of the plant. Core infestation area: Land managers prevent spread from their land where feasible. Land managers reduce impacts from the plant on priority assets.
Rubus fruticosus species aggregate	Blackberry	Prohibition on certain dealings Must not be imported into the state, sold, bartered, exchanged or offered for sale. All species in the *Rubus fruiticosus* species aggregate have this requirement, except for the varietals Black Satin, Chehalem, Chester Thornless, Dirksen Thornless, Loch Ness, Murrindindi, Silvan, Smooth Stem, and Thornfree.

3.5.2 Fauna

3.5.2.1 Fauna and habitat resources

The proposal would be undertaken on land which has been subject to extensive historical modification and land clearing for mining. The proposed remediation areas contain little native vegetation, few habitat resources for native fauna and have low value as a movement corridor, given the patches of canopy vegetation are largely isolated and occur only in small patches.

A moderate diversity of native fauna species was recorded in the site. Species recorded were those capable of persisting in disturbed environments and in fragmented patches of vegetation that lack structural and floristic diversity.

Fifty-five species of fauna were recorded during the survey, comprising 45 birds, five mammals and five frogs. Three introduced species; the House Sparrow (*Passer domesticus*), the Rabbit (*Oryctolagus cuniculus*) and European Goldfinch (*Carduelis carduelis*) were recorded in the study area. Native species recorded were typically common, widespread species, characteristic of disturbed or fragmented habitats but also intact woodlands.

The site contains three broad habitat types for fauna, which are discussed below.

3.5.2.1.1 Fauna habitats of grassy and/or regenerating woodland

Typical fauna species recorded or likely to occur

Common birds, capable of persisting in disturbed environments, and typical of fragmented woodland such as the Australian Magpie (*Cracticus tibicen*), Long-billed Corella (*Cacatua tenuirostris*). Australian King-Parrot (*Alisterus scapularis*) was recorded flying over grassy woodland patches and is likely to forage in adjacent areas of intact native vegetation.

Vegetation provides broadly suitable foraging and shelter resources for small native woodland birds, such as the Spotted Pardalote (*Pardalotus punctatus*) and Silvereye (*Zosterops lateralis*), however none were recorded during surveys.

The vegetation would not provide denning habitat for arboreal mammals, including the Sugar Glider (*Petaurus breviceps*) and Brush-tailed Possum (*Trichosurus vulpecula*), given the absence of hollows.

Microbats are likely to forage above vegetation. Hollows within intact native vegetation outside the site would provide roosting habitat for hollow-dependant microbats in the locality.

A number of reptiles including various skinks (e.g. *Lampropholis* spp.) and snakes are likely to occur here, especially where the understorey is dense. The Southern Dumps contains some embedded rocky outcrop that may also provide shelter for small reptiles.

Threatened and migratory fauna species recorded or likely to occur

Hollow-dependent bats, including the Eastern Coastal Freetail Bat (*Micronomus norfolkensis*), Eastern False Pipistrelle (*Falsistrellus tasmniensis*), Yellow-bellied Sheathtail Bat (*Saccolaimus falviventris*) and Greater Broad-nosed Bat (*Scoteanax rueppellii*) may forage within canopy vegetation but unlikely to roost in the site given the absence of hollows. Southern Myotis would primarily forage over pools of water in creeklines and dams.

Primarily cave-roosting bats including the Eastern Bentwing Bat (*Miniopterus orianae oceanensis*), Little Bentwing Bat (*Miniopterus australis*) may forage on occasion where there are gaps in canopy vegetation that form a natural flyway. The Eastern Bentwing Bat and Little Bentwing Bat would also potentially use man-made structure (e.g culverts and bridges for roosting).

Introduced species recorded

No introduced species were recorded within this broad habitat type. However, species such as the Common Myna (*Acridotheres tristis*) and Rabbit (*Oryctolagus cuniculus*) are likely to occur here.

3.5.2.1.2 Fauna utilisation of non-native vegetation, including areas of exotic grassland and pine forest

Typical fauna species recorded or likely to occur

Only one species, the Australian Pipit (*Anthus novaeseelandiae*) was recorded foraging in exotic grassland, within the Southern Dumps. The Fairy Martin (*Petrochelidon ariel*) was recorded flying overhead on numerous occasions and would forage on flying insects above the exotic grassland.

Sulphur-crested Cockatoo (*Cacatua galerita*) were recorded foraging on cones in the canopy of pine forest east of the Central Mine Area.

Fauna likely to utilise exotic grassland and pine forest in the site, include insectivorous species such as the Magpie-lark (*Grallina cyanoleuca*), Welcome Swallow (*Hirundo neoxema*), and Australian Magpie; granivorous species, including the Red-rumped Parrot *(Psephotus haematonotus*), Long-billed Corella and Eastern Rosella (*Platycercus eximius*).

Raptors including the Black-shouldered Kite (*Elanus axillaris*), Australian Hobby (*Falco longipennis*) and Wedge-tailed Eagle (*Aquila audax*) are also likely to forage in exotic grassland within the site.

Grassland areas provide foraging habitat for larger herbivores, including the Eastern Grey Kangaroo (*Macropus giganteus*), which was recorded within the Northern Dumps in large numbers. Bats typical of open areas such as the White-striped Freetail Bat (*Austronomus australis*) and Gould's Wattled Bat (*Chalinolobus gouldii*) may forage over this habitat type.

Common frogs such as the Common Eastern Froglet (Crinia signifiera) and Brown Striped-frog (*Limnodynastes peronii*) may occur in small soaks within exotic grassland following rain.

Grassland areas with dense grass and areas of pine forest with heavy accumulation of pine needles also provide habitat for a range of reptile species, including common snakes and small lizards.

Threatened and migratory fauna species recorded or likely to occur

No threatened fauna or migratory species were recorded in this habitat type during the field survey.

The Eastern Bentwing Bat (*Minopterus sheirbersii oceanensis*) and Yellow-bellied Sheathtail-bat may forage on occasion over grassland areas. Exotic grassland does not provide roosting habitat for threatened microbats.

Introduced species recorded

Introduced species recorded in the site include the House Sparrow (*Passer domesticus*), European Goldfinch (*Carduelis carduelis*) and Rabbit (*Oryctolagus cuniculus*).

3.5.2.1.3 Cleared areas including man-made structures (derelict surge bin, concentrate bins, loading tunnels and railway culverts)

Typical fauna species recorded or likely to occur

The Central loading tunnel would comprise the best potential roosting habitat for microbats (if roosting in the site in derelict structures). However, the presence of active nests by Fairy Martin is likely to reduce the quality of this habitat, at this point in time.

Microbats with the potential to roost in derelict mine structures include Southern Myotis (*Myotis macropus*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern Bentwing Bat (*Miniopterus oceanensis*) and Chocolate Wattled Bat (*Chalinolobus morio*).

Threatened and migratory fauna species recorded or likely to occur

The Southern Myotis was potentially recorded at the surge bin during emergence period for roosting microbats. Eleven calls recorded over two surveys periods in August and November near the surge bin and central loading tunnel were too short in duration to confirm they were from Southern Myotis (*Myotis macropus*) and as such, the calls were identified to the species guild that includes *Nyctophilus* spp. The species is known to roost with a few hundred metres of foraging resources including creeks or dams.

Other cave roosting bats including the Large Bentwing Bat and Large-eared Pied Bat were not recorded roosting within the Loading Tunnels or Surge Bin, despite targeted harp trap, anabat detector and Echometer Touch surveys. Notwithstanding this, the Concentrate Loading Tunnels and Surge Bin may provide roosting habitat for these species on occasion. While roosting habitat is also present for the Little Bent-wing Bat (*Miniopterus australis*) within these structures, the proposal occurs outside the distribution range of this species.

3.5.3 Threatened species and ecological communities

3.5.3.1 Threatened ecological communities

One TEC was recorded in the construction footprint. Apple Box - Blakely's Red Gum moist valley and footslopes grass-forb open forest of the NSW Southwestern Slopes Bioregion (PCT 283) comprises an occurrence of the White Box - Yellow Box - Blakely’s Red Gum Grassy Woodland and Derived Native Grassland which is listed as a CEEC under the BC and EPBC Act.

This CEEC occurs as a small patch of degraded remnant vegetation adjoining Copper Creek in the west of the site in both private property and in the rail corridor. Some 0.36 hectares of the CEEC occurs within the site and may be impacted by the proposed remediation works. The remediation works are focussed on the contaminated land below the existing rail line.

3.5.3.2 Threatened flora species

No threatened flora species were recorded in the site during the current field surveys and no threatened species have been previously recorded in the locality. A total of 19 threatened flora species are predicted to occur in the locality (within 10 kilometres) of the construction footprint based on the database searches. The full list of species in Appendix A of the biodiversity report in Appendix H.

Table 3.6 identifies the one threatened flora species that has the potential to occur within the construction footprint, based on the presence of suitable habitat. No other threatened species are expected to occur within the subject site, due to lack of suitable habitat on the subject site as a result of historic clearing and mining on the subject site.

Table 3.6 Threatened flora that have potential to occur at Lake George Mine

Species name	Common name	BC Act status	EPBC Act status	Likelihood of occurrence at the site	Level of Impact within indicative disturbance areas
Lepidium hyssopifolium	Aromatic Peppercress	E	E	Possible	Low

3.5.3.3 Threatened fauna species

One threatened fauna species, the Flame Robin (*Petroica phoenicea*), was recorded in the site during the current field surveys. The database searches for rare or threatened species within the site revealed 41 threatened fauna species previously recorded or predicted to occur in the locality of the site. The full list of these species is included in Appendix A of the biodiversity report in Appendix H, including their conservation status, number and date of observations, habitat associations and likelihood of occurring in the site and being impacted by the proposal. Most of these species are not considered likely to occur within the remediation area as it is heavily degraded with large areas of exotic grassland or bare ground and their preferred habitat is not present. Many previous records of threatened species in the locality are associated with habitats associated with Tallaganda State Forest and associated intact native vegetation.

Three Flame Robins (*Petroica phoenicea*) were recorded in the Old Mill area and also off Old Mines Road within the site. Both male and females of this species were recorded during recent surveys in exotic grassland and also adjacent pine forest. The Flame Robin has been recorded east of Jerangle Road within exotic pine forest in 2004 (Lesryk 2012). Potential breeding and known foraging habitat is present for this species within the site. This species and other threatened woodland bird species may forage in patches of native and exotic vegetation at the site on occasion.

Habitat for threatened species also occurs within derelict structures comprising potential roosting habitat for microbats. There are small, fragmented patches of canopy vegetation (primarily degraded pine forest) in the remediation areas which may also provide foraging habitat for threatened microbats in the locality.

A Gang-gang Cockatoo (*Callocephalon fimbriatum*) was recorded adjacent to Lake George Mine off Captains Flat Road in 2017 (EES 2021a). The exact location of this record is unknown due to the large inaccuracy (500 metres) submitted with this record. Gang-gang Cockatoos may forage on occasion in native eucalypt woodland near the railway corridor. There are no suitable breeding hollows for this species within Lake George Mine.

Table 3.7 below identifies threatened fauna species with the potential to occur within the Lake George Mine, noting that the remediation area would only comprise habitat for cave-roosting microbat species and small woodland birds on occasion.

Table 3.7 Threatened fauna that have the potential to occur at Lake George Mine

Scientific name	Common name	BC Act status [1]	EPBC Act status [1]	Potential habitat within the site	Likelihood of occurrence at the site
Anthochaera phrygia	Regent Honeyeater	CE	CE	Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct. No breeding habitat present.	Possible
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V		Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible

Scientific name	Common name	BC Act status [1]	EPBC Act status [1]	Potential habitat within the site	Likelihood of occurrence at the site
Daphoenositta chrysoptera	Varied Sittella	V		Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible
Grantiella picta	Painted Honeyeater	V	V	Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct. No local records.	Possible
Ninox connivens	Barking Owl	V		Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible
Ninox strenua	Powerful Owl	V		Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible
Petroica boodang	Scarlet Robin	V		Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible
Petroica phoenicea	Flame Robin	V		Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present. Recorded adjacent to remediation areas during previous surveys.	Possible
Polytelis swainsonii	Superb Parrot	V	V	Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible
Tyto novaehollandiae	Masked Owl	V		Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	May breed in Fairy Martin mud nests and within derelict loading tunnels on occasion. No foraging habitat is present.	Possible.
Dasyurus maculatus	Spotted-tailed Quoll	V	E	May forage in the site. No breeding habitat is present.	Possible
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		May forage in the site. No breeding habitat is present.	Possible
Miniopterus oceanensis	Eastern Bent-wing Bat	V		May breed in Fairy Martin mud nests and within derelict loading tunnels on occasion. No foraging habitat is present.	Possible
Myotis macropus	Southern Myotis	V		Potential call from surge bin where potential roosting habitat is present. Foraging habitat is present within dam within Central Mill area and Molonglo River	Recorded

Scientific name	Common name	BC Act status [1]	EPBC Act status [1]	Potential habitat within the site	Likelihood of occurrence at the site
Petauroides volans	Greater Glider		V	Broadly suitable but not preferred habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint-Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible
Phascolarctos cinereus	Koala	V	V	Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. Low numbers of records in locality.	Possible
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Broadly suitable habitat in Box-Gum woodland at Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. Low numbers of records in locality.	Possible

Note: 1. CE = critically endangered, E= endangered, V= vulnerable

3.5.3.4 Migratory fauna species

No migratory species were recorded during field surveys. There is only marginal habitat for migratory waders or wetland birds within the site and wider locality.

There is some potential for the following migratory terrestrial bird species to occur on occasion at or above the site, during their migration to breeding habitats elsewhere:

– Fork-tailed Swift (*Apus pacificus*)
– White-throated Needletail (*Hirundapus caudacutus*)
– Rufous Fantail (*Rhipidura rufifrons*)

3.6 Community resources

As a rural township, Captains Flat has few local services. Queanbeyan is the closest larger centre, located 44 kilometres northwest from Captains Flat and provides a range of higher order services and facilities for surrounding rural communities. Braidwood is located 46 kilometres northeast from Captains Flat and contains some rural amenities and lower order community facilities and services. Consultation with key stakeholders (section 6.4.1.2) identified that Captains Flat Residents primarily travel to Queanbeyan to access services as well as the smaller centres of Bungendore and Braidwood.

Facilities located within Captains Flat include the Captains Flat Community Hall, Captains Flat Bowling Club/RSL, Australia Post and Community Centre. Other businesses include the Captains Flat Hotel which according to a local stakeholder is currently closed and on the market for sale. Captains Flat Preschool and Captains Flat Primary School are the only educational facilities in the town. Captains Flat Primary School currently has 50 students enrolled (Department of Education, 2021). There are several sporting fields as well as a pool and tennis courts located in the southern part of the township and which adjoin the western border of the mine site. Foxlow Parklet is a local park with play equipment located in the northern portion of the suburb. The Captains Flat Heritage Trail is a popular historic walking trail, aimed at highlighting the town's rich mining history.

Nearby services include water supply delivered from Captains Flat Dam, sewerage treatment from the Captains Flat Sewerage Treatment Plant and local mains power supply.

3.7 Social

At the time of the 2016 Census, the suburb of Captains Flat had a population of 610 people with a median age of 38 which is consistent with that of the Queanbeyan-Palerang LGA. Captains Flat had a higher proportion of younger age groups with 0-11 year old's comprising 18.2 per cent of the population compared to wider Capital Region which comprises of the ACT and the 17 surrounding LGAs (14.1 per cent) but is consistent with the rest of the Queanbeyan-Palerang LGA. Captains Flat had a higher proportion of Indigenous persons (3.6 per cent) compared to the LGA (3.1 per cent). A detailed social baseline and summary of key demographic indicators is located in Appendix J.

According to consultation with stakeholders and a review of desktop sources (section 6.4.1.2), the community of Captains Flat is tight knit with a strong history associated with the previous mining operations in the area. The Captains Flat community includes residents who have lived in the area for a long time and have a strong understanding of the operations at Lake George Mine, as well as newer residents who have been attracted to live there due to its affordability and lifestyle.

3.8 Economic

A summary of the key economic indicators for the locality is provided below using information from the Australian Bureau of Statistics (ABS) 2016 Census, Economy id (2021) and council resources. A detailed economic baseline is located in Appendix J.

At the time of the 2016 Census, the predominant industry of employment within the social locality was public administration and safety, representing 22.0 per cent of the workforce in Captains Flat, consistent with the broader Queanbeyan-Palerang LGA (14.1 per cent) and Capital Region (25.4 per cent). Construction is also a significant industry in the area, comprising 15.5 per cent of the labour force, higher than the broader Queanbeyan-Palerang LGA (9.4 per cent) and Capital Region (10.1 per cent).

A large proportion of Queanbeyan-Palerang residents (two out of three workers) are employed in the ACT (QPRC, 2018). Queanbeyan-Palerang's economy is centred around construction, public administration and safety and health care and social assistance (QPRC, 2018). In 2019/20 the construction industry had the largest output by industry, generating $865 million (Economy id., 2021). In terms of value add, the public administration and safety industry generated $415 million in 2019/20, consistent with the large proportion of the labour force working in the ACT in the public service (Economy id., 2021).

3.9 Heritage – non-Aboriginal

Lake George Mine has had an important role in the development of Captains Flat. Mining at the site occurred in two distinct periods: small scale mining from 1881 to 1899 and large-scale mining from 1937 to 1962. At the height of its operation Lake George Mine was one of the largest operating mines in NSW and the town of Captains Flat grew alongside the mine. The mined closed in early 1962 and although exploration licences have existed for the site since, no further mining work has been undertaken since.

A detailed history of the mine is provided in Appendix O. This history details the operation and closure of the mine and its accompanying effects on the class conflict and labour relations and Captains Flat town and community (including social, cultural and sporting associations).

There are no World, Commonwealth, National or State heritage-listed items within the proposal site or within 20 kilometres of Lake George Mine (refer to Appendix N).

Two heritage items located within the proposal site are listed under Schedule 5 of the *Palerang Local Environment Plan 2014.* These items include structures associated with Captains Flat Railway Precinct and Lake George Mine. These items are listed in Table 3.8.

Table 3.8 Heritage items within the proposal site listed under the Palerang LEP

Description	Significance	Item No.	Property Description
Captains Flat Railway: goods shed, weighbridge, gantry and turntable	Local	I266	Railway land adjacent to Lots 155, 194, and 319 DP754870; Lot 1 DP189797 and Lot 1 DP36902
Lake George Mine, including smelter site, mine processing sites, railway precinct, Fosters Gully and Keating's Collapse	Local	I267	Lot 2, DP229690; Lot 1, DP222274; Lot C, DP172630; Lot 319, DP 754870; Lot 2, DP 1033184 and adjacent Crown land

In addition, three listings are immediately adjacent to the above sites are also included in Schedule 5 of the Palerang LEP. These items are listed in Table 3.9.

Table 3.9 Heritage items listed under the Palerang LEP adjacent to the site

Description	Significance	Item No.	Property Description
Stationmasters Residence (Former)	Local	I251	Lot 1, DP 572636
Railway Station (Former)	Local	I249	Lot 1, DP 189797 and adjacent land
Roscommon	Local	I252	Lot 2, DP 369062; Lot 192, DP 754870

Impacts to non-Aboriginal heritage are discussed in Section 6.4.3.

3.10 Heritage – Aboriginal

3.10.1 Aboriginal cultural heritage

A search of publicly available databases did not identify any previously recorded Aboriginal cultural heritage items (objects or sites) within the proposal site. In addition, the site is not located within a landscape feature likely to indicate the presence of Aboriginal objects in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010) and the *NSW Minerals Industry Due Diligence Code of Practice* (NSW Minerals Council 2010) (refer to Appendix K).

The proposal site has a past history of extensive disturbance associated with mining activities and subsequent mine rehabilitation works. It is extremely unlikely that unidentified sites and objects could be present within the proposal site.

3.10.2 Native title, indigenous land use agreements, and joint management arrangements

The following publicly available databases were reviewed to determine if the proposal site is subject to native title claims, indigenous land use agreements, or join management arrangements:

– National Native Title Register
– NSW Government Aboriginal Joint Management Agreements Database.

There were no publicly available records of native title claims, indigenous land use agreements, or joint management arrangements at the proposal site identified. Crown Lands are completing the Native Title process internally and will advise LMP if any changes to the works are required.

3.11 Aesthetic

3.11.1 Landscape character

The existing site is predominantly cleared but contains small patches of woodland and grasses. Large patches of the site in the northern investigation area do not contain any vegetation as a result of contamination at Lake George Mine. The hills surrounding Lake George Mine are well vegetated.

The site lies above the township of Captains Flat between 840 to 910 metre above sea level. It has a broadly western to north-western aspect.

Other rural residences and community facilities are scattered across the landscape around the site, connected by local sealed and unsealed roads. The site is bordered by the Molonglo River in the east which flows in a northwest direction to the Queanbeyan River and eventually Lake Burley Griffin (Canberra). Copper Creek intersects the site in the north-west. Copper Creek flows under the railway corridor and into the Molonglo River north of the site.

The wider landscape comprises mainly eucalypt woodland, areas of planted pine woodland and pasture. The topography comprises mainly undulating hills.

3.11.2 Key viewpoints

The proposal site would be visible by the following receivers during both remediation and post remediation, unless otherwise stated:

– Users of local roads including:
  - Captains Flat Road (see Figure 3.4)
  - Copper Creek Road
  - Old Mines Road
  - Miners Road (see Figure 3.5)
  - Braidwood Road
  - Foxlow Street
– Residential properties
  - Multiple residences on the eastern side of Captains Flat township. Closest receivers are located on Foxlow Street (see Figure 3.6)
  - 5 Old Mines Road
  - 44 Old Mines Road
  - 8 Copper Creek Road
  - 2 Copper Creek Road (this property would be vacant during remediation and would therefore only be impacted by post remediation impacts) (see Figure 3.7)
– Commercial/Community facilities
  - NSW State Emergency Service, Copper Creek Road.

Heritage items within and surrounding the proposal site and their setting are discussed in Section 3.9.

Figure 3.4 *View from Captains Flat Road looking south towards the Northern Dumps, Captains Flat Railway Precinct and Miners Road*

Figure 3.5 *Quarry area west of Council's Water Treatment Plant*

Figure 3.6 Foxlow Street looking northeast towards Central Mine Area and Old Mill Area

Figure 3.7 1 Copper Creek Road looking south east towards the Northern Dumps

3.12 Land use

Lake George Mine closed in 1962. The mine was closed as mining activities were no longer considered financially viable at the site. A recent search of the existing mineral licences and titles under the *Mining Act 1992* has been undertaken. One exploration licence application (ELA6441) applies to the proposal site. The licence application is held by Orthosa Pty Ltd targeting Group 1 minerals. The application date was 23 February 2022. No mining activities have taken place at Lake George Mine since its closure.

The site contains areas zoned for Primary Production and Special Infrastructure. However, the contaminated soil at the site prohibits any agricultural activity occurring at Lake George Mine. The Special Infrastructure zoned areas include the following infrastructure:

– Captains Flat Sewerage Treatment Facility (1/DP714087; 2/DP1033184; 1/DP1142954)
– Water Supply System (1/DP222274)
– Captains Flat Rail Infrastructure Facility (no longer operating) (4425//DP1217100; 1//DP542415)
– Electricity Transmission and Distribution (1/DP1103495).

The site also contains some private residences including 5 Old Mines Road (2/DP229690) which spans 37.55 hectares of Lake George Mine and contains some legacy mine infrastructure such as concrete silos, a surge bin, bridges and concentrate loading tunnels. There is also a residence at the Station Masters Cottage adjacent to the disused Captains Flat railway line.

Finally, the site is used for legacy mines tourism. A lookout has been established on Miners Road to observe the surrounding heritage items (discussed in Section 6.4.3). Tourists also used to visit a mural near the lookout, however, access to the mural has been restricted due to the human health risk from contamination. Some interpretive heritage signage has been placed throughout Lake George Mine to aid visitor experience.

3.13 Transportation

3.13.1 Access

The proposal site has two access points: Miners Road, off Captains Flat Road in the north; and Miners Road off Foxlow Street in the south. As both points are located outside the town, vehicles going to/from the proposal site do not need to go through Captains Flat town to access the site.

3.13.2 Traffic volumes

The existing road network in proximity to the proposal site is characterised by low traffic volumes, with average daily traffic ranging from 207 to 795 vehicles per day (equivalent to a Level of Service of “A”, signifying unimpeded flow).

3.13.3 Active and public transport

There is no access to train services or regular bus services in the proposal area. At the time of writing, only school bus services are available within 800 metres from the proposal site.

There are no dedicated footpaths and cycling lanes that provide access to or within the proposal site. Active transport facilities in proximity to the site are limited to the town, located around Captains Flat Public School and Wilkins Park.

3.13.4 Crashes

A review of five-year crash data showed five road crash incidents recorded within a 2.0 kilometre radius from the site, three of which occurred on Captains Flat Road. Captains Flat Road is in a poor condition and upgrading commenced in December 2021. The predominant crash type was off-carriageway right on left bend into object. The location of the crashes suggests that the topography and limited sight distance along the bends on Captains Flat Road contributed to the incidents (TfNSW, 2021).

The majority of recorded crash incidents are not located along identified haulage routes for the proposed remediation works. However, one crash was recorded in 2019 on Foxlow Street. This crash was a non-casualty and resulted when the vehicle was leaving parking.

4. The proposed activity

4.1 Summary of the activity

The proposed remediation works include site preparatory early works, fencing historic mining structures, strategic structural works, remediation earthworks, augmentation of surface water drainage, and revegetation across several key domains in the northern portion of Lake George Mine.

The purpose of the proposed remediation works is to reduce the risk of offsite contamination through airborne dust and surface erosion generating contaminated runoff from the continued oxidation of sulfidic mineral waste at Lake George Mine. The proposed remediation works are required to prevent potential environmental and human health risks to people accessing the site, to residents in the vicinity of the site, and in the township of Captains Flat, and to aquatic ecosystems and downstream users of the Molonglo River.

A summary of the proposed remediation works is provided in Table 4.1.

Table 4.1 Summary of proposed remediation works

Element	Description
Land affected	Approximately 20 hectares within Lake George Mine, Captains Flat NSW, as described in Section 2.1
Landowner	Private land (multiple landowners), Council, Crown Land and TfNSW owned land
Land operator	Not applicable – mine and railway line no longer in operation
Activity type	Remediation works, including site preparatory early works, fencing historic mining structures, strategic structural works, excavation and encapsulation, neutralisation of surface materials, importation of growing media and rock mulch, installation of surface water drainage, and revegetation of remediated areas; other than rock mulched areas
Activity location	Lake George Mine, Captains Flat NSW
Activity duration	Approximately 19 months, with site preparatory early works proposed to commence in June 2022, remedial earthworks in August 2022, with works estimated for completion around December 2023 subject to prolonged weather delays

4.2 Description of the activity

4.2.1 Proposed remediation works

The proposed remediation works include:

– Site preparatory early works
– Fencing historic mining structures (including native fauna fencing where applicable to encourage revegetation and demarcate private property)
– Strategic structural works
– Remediation earthworks
– Augmentation of surface water drainage
– Revegetation.

The proposed remediation works would be undertaken across several key site domains, predominantly in the northern portion of Lake George Mine. These areas are:

– North Mine Ridge/Elliot's
– Old Mill
– Mill Area (west of the Central Mine Area)
– Central Mine Area
– Creeks Area

– Rail Loading Area
– Minor areas of eroded capping on the Northern and Southern Dumps.

In addition, mine waste from the following sources are proposed for relocation to a containment cell that would be located on the Northern Dumps. These include:

A sulfidic waste stockpile located on the junction of Miners Road and the Council wastewater treatment plant access road.

A slag heap located on the western side of Jerangle Road in Forster's Gully, adjacent to the northern end of the Southern Dumps.

TfNSW lead contamination from around the Captains Flat Railway Precinct. TfNSW propose to remediate the Captains Flat Railway Precinct by removing approximately the surface 500 millimetres of contaminated topsoil for encapsulation in the containment cell on the Northern Dumps, before importing railway ballast, sub- and topsoil to site for backfilling. Prior to excavation of the contaminated surface soils, existing railway infrastructure including the railway line, signalling, gantry, signs, posts and fencing would be removed and temporarily stored on, or nearby the site. Once excavation and backfilling had been completed, the railway infrastructure would be replaced into its original location as far as reasonably practicable.

Crown Land / QPRC land within the Captains Flat township. That is, the Captains Flat Lead Management Taskforce is currently undertaking an assessment of the Captains Flat township with the aim to prepare abatement plans for the higher risk public spaces. One option being investigated is moving up to a maximum 20,000 tonnes of contaminated soil from these Crown Land-owned abatement areas into the containment cell on the Northern Dumps. These remediation works would be subject to a separate approval under the *NSW Planning and Assessment Act 1979*.

A summary of the proposed remediation works is provided in Section 4.2.1.2 through Section 4.2.1.7. A detailed description of the remedial earthworks works is provided in *Lake George Mine, Captains Flat Detailed Design Report* (GHD 2020), included as Appendix B.

4.2.1.1 Site preparatory early works

The Principal Contractor proposes to access the Lake George Mine prior to the remedial earthworks commencing for site establishment. The proposed activities include:

– Establishing a site office including ablutions and worker decontamination/washroom facilities at either the NSW State Emergency Services building (the preferred option) and/or at the Mine lookout parking area
– The installation of a truckwash at an existing hardstand in the Mill Area
– The installation of a water tank in the Mill Area
– Preparation of a bunded laydown area on the designated stockpile area on the Northern Dumps and/or the contingency site located on the Creeks and Rail Loading Area
– Importation and stockpiling of approximately one third of imported clean remedial materials (i.e., subsoil, topsoil, lime, alternative liming products etc) onto the bunded laydown area at the designated stockpile area on the Northern Dumps and/or the contingency site located on the Creeks and Rail Loading Area
– Preparation of the Northern Dumps Access track off Miners Road including the addition of a surface treatment for stability as well as drainage works
– Site safety fencing
– Geotechnical investigations around key site features including the main shaft to ensure civil plant and equipment can safely traverse the areas for remedial purposes.
– Install erosion and sediment controls around Copper Creek and the Northern Dumps in accordance with the 'Blue Book' (DECC 2008a and b and Landcom 2008), including de-silting of existing sediment basins.

It is important to note that no remediation of disturbed areas on site are proposed during site establishment, therefore, there is no trigger for issuance of an Environment Protection Licence under Schedule 1 of the NSW *Protection of the Environment Operations Act 1997* prior to undertaking site establishment activities.

4.2.1.2 Fencing historic mining structures

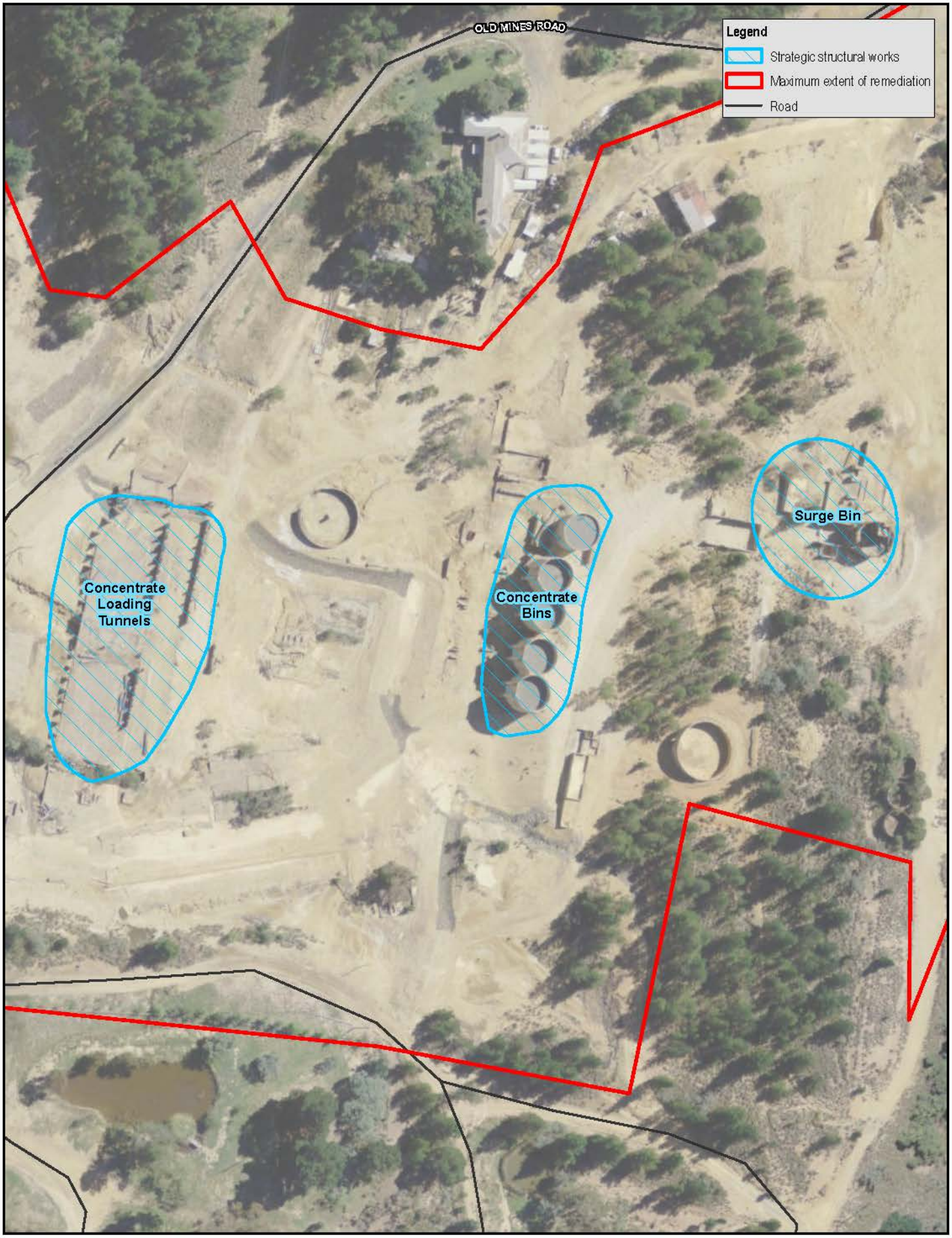
Historic mining infrastructure is present on site, predominantly, though not exclusively, within the Old Mill and Mill Area (west of the Central Mine Area). Historic mining infrastructure is also present on the Northern Dumps. These areas are accessible to the public and, therefore, may present a safety risk. Some of the existing safety fencing around the historic mine infrastructure is in a state of disrepair and other areas are not fenced.

Prior to, during or following (as applicable for safety, access and revegetation purposes) the proposed remediation works, historic structures located within the proposal site would be fenced to prevent public access (to minimise on site safety risk) and to protect the historic structures.

The majority of historic structures would be preserved and fenced, potentially with the exception of the Concentrate Loading Tunnels and the Surge Bin (refer to Section 4.2.1.3). Some historic structures may be fenced as a group for practical reasons.

4.2.1.3 Strategic structural works

The proposal involves undertaking strategic works to the Concentrate Loading Tunnels, Concentrate Bins, Surge Bin and rail infrastructure located within the Captains Flat Railway Precinct (refer to Figure 4.1).



Paper Size ISO A4

0 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA1994
Grid: GDA1994 MGA Zone 55

N

GHD

Department of Regional NSW
Lake George Mine Remediation

Project No. 12551771
Revision No. A
Date 23/03/2022

Proposed strategic structural works within Mill Area

FIGURE 4.1

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Print date: 23 Mar 2022 - 10:16

Data source: General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: elibbertson

4.2.1.3.1 Concentrate Loading Tunnels

Previous site surveys (URS 2004 and GHD 2018) have reported public safety issues associated with the Concentrate Loading Tunnels as their structural integrity may be compromised. The tunnels, and some of the associated hazards, are shown in Figure 4.2, Figure 4.3 and Figure 4.4. As such, the LMP is proposing that the Concentrate Loading Tunnels be either:

– Fenced
– Filled
– Demolished and lawfully disposed of.

The land on which the Concentrate Loading Tunnels are located upon is privately owned and at the time of writing, had recently changed hands. Therefore, the LMP will consult with the new landowner and a decision would be made with respect to a way forward. If the Concentrate Loading Tunnels are demolished, the area would then be remediated consistent with the rest of the Mill Area. For the purposes of assessing impacts, a worst case has been assumed whereby the Concentrate Loading Tunnels would be demolished and lawfully disposed of.

Figure 4.2 Northern Concentrate Loading Tunnel

Figure 4.3 Central Concentrate Loading Tunnel

Figure 4.4 Sulfate efflorescence in central Concentrate Loading Tunnel

4.2.1.3.2 Concentrate and Surge Bins

The Concentrate and Surge Bins were historically used to store ore concentrate prior to load out and off-site transport. The then NSW Derelict Mines Program attempted to remediate the sulfidic ore stored within the Concentrate Bins them during the 2006-2014 tranche of remedial works. These works involved moving the remaining ore to the southern-most bin, filling the emptied bins with local inert rock and covering the sulfidic ore in the southern-most bin with inert gravel. The works also included adding a “funnel type” drainage layer incident rainfall to drain out of the side of the bins, thereby avoiding contact with the residual sulfidic ore.

Despite this, sulfidic efflorescence is forming under the bins from what appears to be groundwater leaching through the retaining wall upslope of the bins, and potentially, also from drainage from residual sulfidic ore despite the previously discussed remedial works (refer Figure 4.5). The secondary mineralisation poses both a public safety and an environmental risk as it is highly soluble relative to the sulfidic ore. A similar scenario is present at the surge bin (refer Figure 4.6).

Two remedial options are proposed for the concentrate bins once the site establishment/early works geotechnical investigation is completed for safety and access purposes:

1. Install a trench on the upslope side of the concentrate bins to a level below the base of the bins and fill with inert rock to create a preferred drainage pathway to redirect the groundwater currently leaching through the retaining wall into the bottom of the concentrate bins around the structure. The diverted drainage would report to a sediment dam.
2. Empty the bins by removing the inert gravel and the sulfidic waste and placing the material into the Northern Dumps encapsulation cell, noting that there may be opportunity to beneficially reuse the inert gravel onsite during the remedial works.

There are currently two options being proposed to remove the rock from the bins:

3. Constructing a temporary earthen bund parallel to the structure to support a long-reach excavator that would excavate the material into dump trucks for relocation to the encapsulation cell.
4. Use of truck-mounted dryvac technology to vacuum the material from the bins for relocation and placement in the encapsulation cell. As the dryvac truck has an internal storage cell for the sulfidic waste, it would simply shuttle between the bins and encapsulation cell, negating the need for an excavator and/or dump trucks. This is the preferred option.

The Surge Bin will likely be removed (or fenced in situ), depending on geotechnical and heritage considerations. The preferred option is to remove the Surge Bin for safety reasons. This would entail removing the metal and timber elements of the Surge Bin with the sulfidic waste ore within the bin relocated to the Northern Dumps encapsulation cell. Following completion of works and pending a safety inspection, it is proposed that the remaining concrete and masonry elements of the Surge Bin precinct will remain in situ, with an earthen bund built around the structure for water management purposes. An engineered concrete slab will be constructed to seal the shaft if required.

The Concentrate Bins will remain onsite. Pending safety and heritage inspections, it is proposed that the emptied Concentrate and Surge Bin (if retained – removal is the preferred option) would be fenced and remain *in situ* as mining heritage items for mining heritage interpretative purposes.

Figure 4.5 Sulfate efflorescence outside fenced area beneath northern Concentrate Bin

Figure 4.6 Aerial view showing weathered ore inside of the Surge Bin, located within the Central Mine Area

4.2.1.3.3 Captains Flat Railway Precinct

TfNSW propose to remediate the Captains Flat Railway Precinct by removing approximately the surface 500 millimetres of contaminated topsoil for encapsulation in the containment cell on the Northern Dumps, before importing railway ballast, sub- and topsoil to site for backfilling. Prior to excavation of the contaminated surface soils, existing railway infrastructure including the railway line, signalling, gantry, signs, posts and fencing would be removed and temporarily stored on, or nearby the site.

Once excavation and backfilling had been completed, the railway infrastructure would be replaced into its original location as far as reasonably practicable. It is understood that the railway turntable located on a short spur line northwest of the Station Master's Cottage, can remain *in situ* during remedial works.

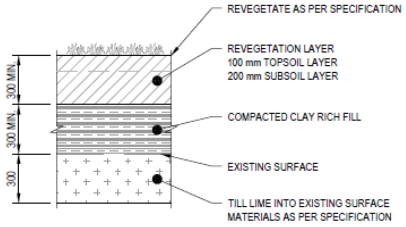
4.2.1.4 Remediation earthworks

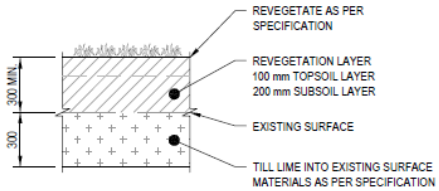
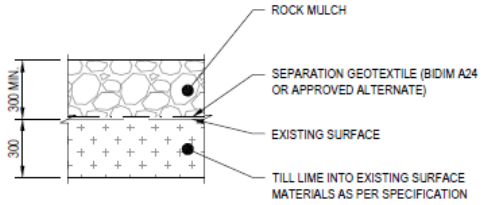
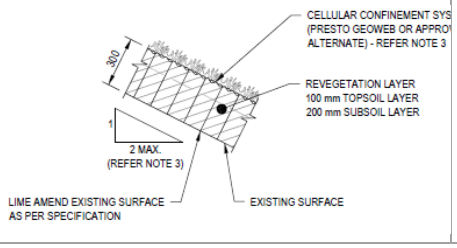
Five different remediation earthworks options are proposed, with the preferred option for each domain dependant on the:

– Volume of contamination present
– Environmental geochemistry of the contaminated material in each domain (i.e. the level of contamination)
– Topography/slope within the individual domain
– Land ownership and aesthetic considerations.

A brief description of the proposed remediation works for each capping option, as it would inform potential environmental impacts through construction, is provided in Table 4.2. The proposed capping option to be used for each site domain at Lake George Mine is listed in Table 4.3.

Table 4.2 Description of proposed remediation works for each capping option

Option	Description	Remedial activity summary
Option 1	*In situ* lime neutralisation overlain with a 300 mm thick, low permeability, natural soil barrier with high clay content, itself overlain with a 300 mm thick (subsoil (200 mm)/growing media or topsoil (100 mm)) layer.  	Option 1 is proposed for use over the Northern Dumps containment cell (minus the in situ liming as described below under Option 5) and to patch eroded areas on the Northern and Southern Dumps based on *in situ* assessment. To patch the eroded areas on the Northern and Southern Dumps, the eroded area will be potholed to assess existing capping. As a minimum, the material will be over excavated by 300 mm and a stoichiometric volume of lime and/or gypsum would be spread over the required area and ripped into the existing surface using a dozer with a tyne fitted. The area would then be compacted using a padfoot roller, before 200 mm of imported subsoil would be spread and lightly tamped with 100 mm of growing media spread and revegetated with grass species as per the Revegetation Plan. If existing clay capping is not observed during potholing, additional over-excavation will be undertaken to allow a 300 mm of imported clay rich material to be spread over the area and also compacted using a padfoot roller, below the subsoil layer. The surface will be finished such that it is free draining and generally in line with the current levels and grades. Excess excavated material will be incorporated into the containment cell.

Option	Description	Remedial activity summary
Option 2	*In situ* lime neutralisation overlain with a 300 mm thick (subsoil (200 mm)/growing media or topsoil (100 mm)) layer. (Note: Where Option 5 (excavate) has first been used, liming may not be required pending the results of soil validation testing for residual acid forming potential; e.g. Mill Area) 	Option 2 is being used across most of the contaminated domains. To complete the capping, a stoichiometric volume of lime would be spread over the required area and ripped into the existing surface using a dozer with a tyne fitted. The area would then be wheel rolled for compaction, before 200 mm of imported subsoil is spread and lightly tamped. A 100 mm depth of growing media would then be spread and revegetated as per the Revegetation Plan.
Option 3	*In situ* lime neutralisation overlain with a 300 mm thick rock mulch layer comprising a hard rock drainage aggregate. 	Option 3 is to be used in the middle of the Central Mine Area to retain the mining/industrial feel of the area as per stakeholders' wishes. Option 3 will also be used in select steep areas across all domains and in the vicinity of some structures in the Mill Area, Captains Flat Railway Precinct (ballast) and potentially along Jerangle Road on the Southern Dumps. To complete the capping, a stoichiometric volume of lime would be spread over the required area and ripped into the existing surface using a dozer with a tyne fitted or excavator. The area would then be wheel rolled for compaction, over which separation geotextile would be installed. A 300 mm layer of imported and inert rock mulch would then be emplaced over the geotextile as the capping option. This area would not be revegetated.
Option 4	An engineered solution for steeper slopes: Surface neutralisation by lime amendment (where practical and as required based on the geochemistry of the surface material). A geosynthetic cellular confinement system. Application of growth media and vegetation (where practical), or hydro-mulching as an alternate solution. 	Option 4 is proposed for use on steeper sections including in the southern portion of the North Mine Ridge/Elliott's, the Old Mill Area, the Central Mine Area, and potentially along Jerangle Road on the Southern Dumps. As described at left, the area would be cut to fill, with the extra overs being hauled to the Northern Dumps containment cell for emplacement as described below under Option 5. The areas would be lime neutralised as far as reasonably practicable, then the geosynthetic cellular confinement system would be installed. The areas would then be revegetated as per the Revegetation Plan. In overly steep areas, hydromulching becomes an alternate revegetation option.

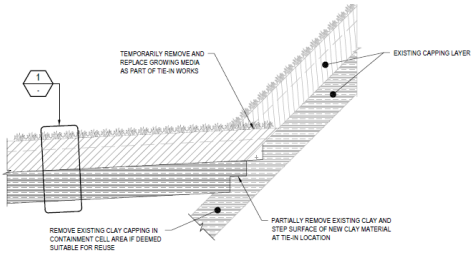
Option	Description	Remedial activity summary
Option 5	Excavate and relocate surface soils/mineral waste for on-site encapsulation at the Northern Dumps. Then apply cap as per Option 2 (without the *in situ* liming component). 	The Northern Dumps containment cell would be opened up by dozing the existing capping materials to the sides into stockpiled windrows using a dozer. Contaminated material would be excavated from the Mill Area and the extra overs from Capping Option 4, most likely using either a 20 tonne or 30 tonne excavator. The material would then be hauled from the respective site domains to the cell using up to three appropriately sized dump trucks (approximately 30 tonne), or 'Moxys'. The material would be placed in lifts ranging from nominally 150 mm to 400 mm, where a stoichiometrically balanced lime volume would be added, ripped or dozed through the material, then compacted using a padfoot roller. The process would be repeated until all contaminated material was emplaced, whereby the stockpiled capping material would be reinstated and/or imported capping material used where a deficit presents.

Table 4.3 Proposed remediation option to be used in each domain to be remediated

Site domain	Remediation option to be used
North Mine Ridge/Elliot's	Option 2 Option 3 and/or 4 for steeper areas – extra overs to be encapsulated in containment cell
Old Mill	Option 2 Option 3 and/or for steeper areas – extra overs to be encapsulated in containment cell. Option 3 around heritage structure and drainage pipe steep areas
Mill Area	Option 5 followed by Option 2, with around 35% Option 3
Central Mine Area	Option 2 around the periphery and Option 3 in the central portion Option 4 for steeper areas – extra overs to be encapsulated in containment cell
Creeks Area	Option 2
Rail Loading Area	Option 2
Captains Flat Railway Precinct	Option 5 followed by Option 2
Minor areas of eroded capping in the Northern and Southern Dumps	Option 1, with Options 3 and 4 along Jerangle Road
Northern Dumps Encapsulation Cell	Option 1
Smaller stockpiles to be relocated	Option 5 followed by one of Options 1 to 4 inclusive as deemed appropriate and as assessed in the REF once the material has been removal (Note that this excludes in channel stabilisation works in Copper Creek and for the Slag Heap capping/stabilisation in Forsters Creek as it has not been assessed in this REF. That is, material removal in channel in Forsters Creek is acceptable from top of bank, however, no channel stabilisation works have been assessed herein).

4.2.1.5 Material volumes

The estimated spatial extent of the proposed remediation works, along with the estimated volumes of mineral waste to be excavated, and imported materials to be brought to site, are summarised in Table 4.4.

As shown in Table 4.4, the maximum remedial disturbance area is approximately 20 hectares, being around 43 per cent of the maximum remediation spatial extent of 46.8 hectares, with around 58,470 m^3 of mineral waste and contaminated soil to be excavated and encapsulated in the Northern Dumps containment cell.

In addition to the totals shown in Table 4.4, the following remedial material would be imported to site:

– Some 44,500 m^2 of separation geotextile
– Around 5,200m^2 of cellular confinement system
– Approximately 100 metres of linear fibre roll for erosion protection above the Quarry Area in the North Mine Ridge/Elliot's domain.

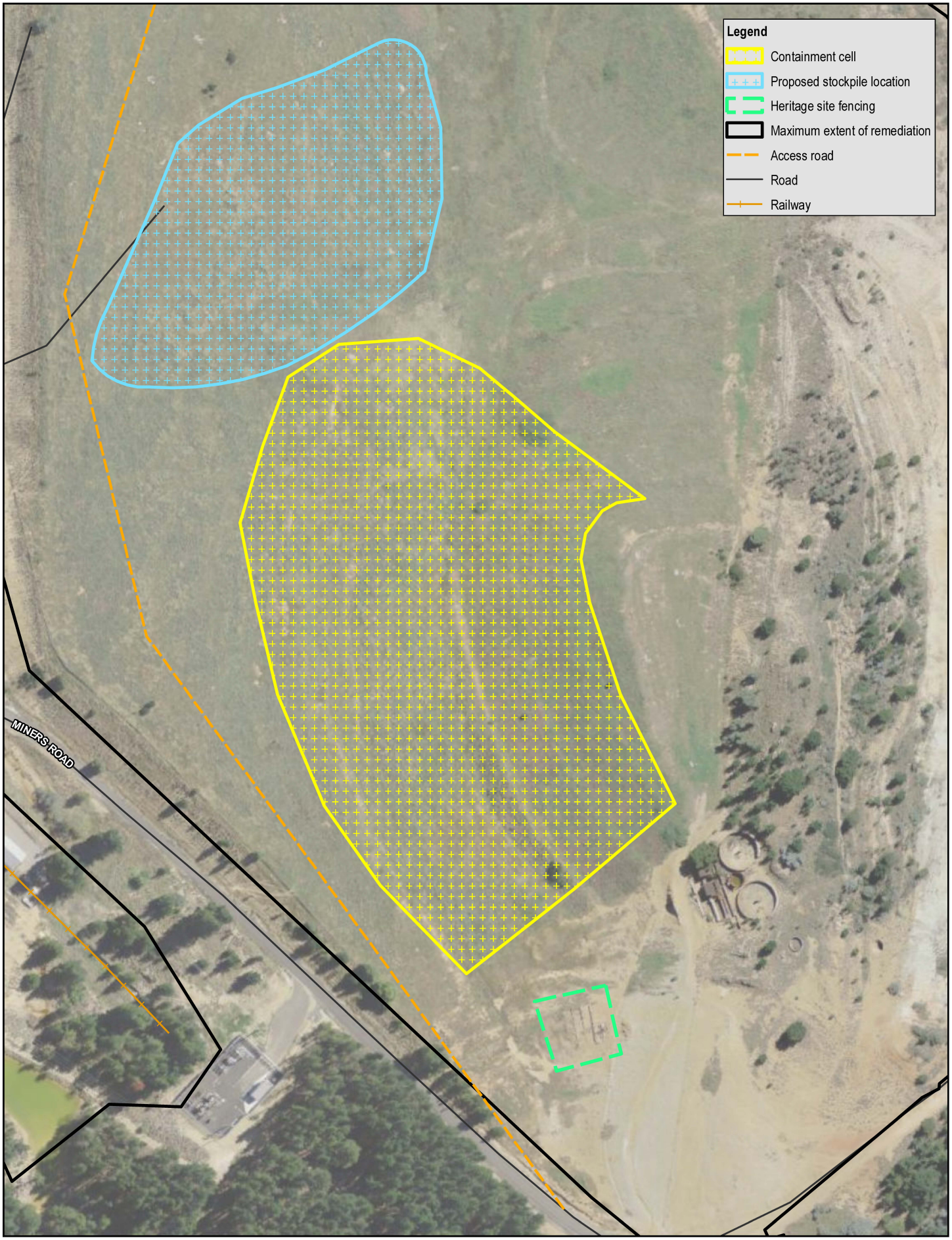
The material volumes have been converted using appropriate bulk densities to inform traffic volumes for imported remedial materials, as described in Section 4.2.6.

It is proposed that around one-third of the imported materials as summarised in Table 4.4 are brought to site during site establishment early works over approximately a two to three-month period and stockpiled predominantly on the Northern Dumps, immediately to the north of the proposed containment cell area, as shown on Figure 4.7 and/or on the contingency stockpile area located in the Creeks/Rail Loading Area, slated as a priority works area in the remedial schedule. The remainder of the imported material would be brought to site throughout the main remedial works.

Table 4.4 Estimated material volumes

Site domain	Estimated remedial area by domain (m^2)	Estimated volumes of mineral waste for relocation to Northern Dumps containment cell (m^3)	Estimated lime volume required (tonnes)	Estimated rock mulch requirement (m^3)	Estimated cellular confinement system requirement (m^2)	Estimated clay requirement (m^3)	Estimated subsoil requirement (m^3)	Estimated topsoil requirement (m^3)
North Mine Ridge/Elliot's	27,100	3,070[4] (includes sulfidic waste stockpile)	194	4,065	0	0	2,710	1,355
Old Mill	17,000	2,900[4]	451	720	500	0	2,920	1,460
Mill Area (west of the Central Mine Area)	34,600	34,600	0[1]	3,633	0	0	4,498	2,249
Central Mine Area	18,100	6,700[4]	365	3,960	800	0	980	490
Creeks and Rail Loading Areas	49,200	0	610	675	0	0	9,390	4,695
Captains Flat Railway Precinct	10,000[2]	5,000	0[1]	0	0	0	4,000	1,000
Minor areas of eroded capping in the Northern and Southern Dumps	20,400	1,200 (includes slag heap)	8	1,335	0	3,450	3,190	1,595
Captains Flat lead abatement areas	Unknown	5,000[5]	282	NA	NA	NA	NA	NA
Northern Dumps Containment Cell	28,700	0 (total estimated volume as below)	6,803[6]	0	0	0 – reuse cut material	0	0
Total	**205,100**	**58,470**	**8,713**	**14,388**	**1,300**	**3,450**	**27,688**	**12,844**

Notes:
1. Subject to successful post-excavation validation re liming requirements for residual sulfidic mineral waste.
2. Area is around 20,000 m^2 however not all area being treated. Backfill to grade using 500 mm subsoil prior to reinstatement of railway infrastructure.
3. Preliminary estimate only.
4. Excess cut to fill material to be relocated to encapsulation cell for areas receiving remedial capping Option 4.
5 Maximum volume driven by POEO Act 1997 EPL constraints.
6 LMP has indicated a preference to use an alternate liming material which will require around 9,071 t as it has a neutralising value approximately 75% that of lime. The 6,803 t shown is the lime equivalence tonnage.
NA Details subject to a separate future development application by a third party.



Paper Size ISO A4

0 10 20 30 40 50

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

GHD

Department of Regional NSW
Lake George Mine Remediation

Proposed imported material primary stockpile location on Northern Dump

Project No. **12551771**
Revision No. **A**
Date **23/03/2022**

FIGURE 4.7

\\ghdnetghd\AU\Sydney\Projects\21\12551771\GIS\Maps\Deliverables\12551771_Z009_ProposedStockpileLocations.mxd
Print date: 23 Mar 2022 - 10:20

Data source: General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: eibbertson

4.2.1.6 Augmentation of surface and sub-surface drainage

The proposed remediation works would involve augmentation of existing surface and sub-surface drainage in some areas, as outlined in Table 4.5. Surface water runoff quantity and quality should decrease and improve respectively following the proposed remediation works due to regrading and stabilisation/revegetation. In total, around 1,000 metres of surface drainage works would be undertaken during site remediation.

Table 4.5 Proposed surface and sub-surface drainage works

Site domain	Existing drainage	Proposed drainage
Central Mine Area Old Mill North Mine Ridge/Elliot's	Runoff is predominantly uncontrolled through informal flow paths/channels.	The existing drainage system would be re-established and formalised to suit the regraded and revegetated surface following the remediation works. If required, the culvert under the access road on the eastern side of the Central Mine Area may need to be cleared or replaced to maintain functionality. .A site inspection is required to confirm its condition.
Mill Area Rail Loading Area Creeks Area Captains Flat Railway Precinct	Runoff managed through a network of engineered drainage lines and on-site sediment storage ponds.	The existing drainage system would be modified, re-established and formalised to suit the regraded and revegetated surface following remediation works. Two sub-surface drains are proposed immediately upslope of the Concentrate Bins and Concentrate Loading Tunnel to redirect groundwater seepage around these structures into the surface water drainage system for management.

4.2.1.7 Revegetation

Each domain slated for remediation would be re-vegetated (or vegetated if currently bare), following neutralisation and capping, with the exception of the central portion of the Central Mine Area, around one-third of the Mill Area and other select areas, which would be remediated using rock mulch (i.e., Capping Option 3). The rock mulch remedial option was agreed upon through stakeholder consultation to retain the industrial feel of the high point in the Central Mine Area as well as being more appropriate on steeper grades.

The purpose of revegetation is to establish a self-sustaining vegetation community that would maintain site stability and reduce erosion risks from both wind and water. Revegetation would also increase the visual amenity of the site. Careful consideration would be given to balancing the management of erosion risk and dust suppression, while maintaining the mining heritage character of the site.

The long-term objective is that the site would naturally revegetate with native species present in the vicinity such as native grasses, herbs and shrub species found in the grassy woodlands and dry sclerophyll forests of surrounding areas (e.g., similar to the Yanununbeyan State Conservation Area located approximately five kilometres west of Captains Flat). Species may include silver wattle (*Acacia dealbata*), green wattle (*Acacia mearnsii*), bitter pea (*Daviesia mimisoides*), dogwood (*Cassinia sp*.), bush pea (*Pultenaea procumbens*), tussock grass (*Poa labillardierer*) and redanther wallaby grass (*Joycea pallida*).

To ensure initial site stabilisation (and reduced erosion and weed colonisation) following neutralisation and capping, a sterile 'nurse' crop of pioneer species, including non-native grasses, would be used. These species may include Japanese millet, oats, couch, tall fescue, and perennial rye grass. As the native vegetation develops, the pioneer species consisting of non-native grasses would decrease or disappear altogether. Monitoring of the vegetation re-establishment will occur in accordance with a Revegetation Plan and will be supplemented if required. Where required, temporary erosion control and protection measures (e.g., erosion control blankets, mats or hydroseeded grass species) may be required during the proposed remediation works. Allowance has been made for these items as described in Section 4.2.1.5

4.2.2 Plant and equipment

The proposed remediation works would be undertaken using conventional earthmoving equipment. The plant and equipment likely to be used includes:

– Excavators – Up to 2 x 20 to 30 tonnes
– Bulldozers – 1 x D8 and up to 2 x D5s
– Dump trucks – up to 3 x 30 tonnes articulated vehicles
– Padfoot roller/compactor – Up to 2
– Water trucks – 2 x water carts fed from an on-site tank supplied by the town reservoir
– Light vehicles – Refer Section 4.2.6.

The exact make of the equipment may vary depending on availability and operational requirements. However, for the purposes of the environmental assessment, it is assumed the above equipment or similar will be used.

4.2.3 Workforce

The proposed remediation works would require an estimated peak workforce of approximately 25 people. It is proposed to use predominantly local sub-contractors under the Principal Contractor, who would likely be sourced from the Queanbeyan/Canberra area.

4.2.4 Work hours

The proposed remediation works would be undertaken as follows, and in accordance with the *Interim Construction Noise Guideline* (DECC 2009):

– Monday to Friday 7:00 am to 6:00 pm
– Saturday 8:00 am to 1:00 pm
– No work on Sundays or Public Holidays.

No work would be undertaken outside of these hours, with the possible exception of environmental mitigation activities in accordance with the approved Construction Environmental Management Plan.

4.2.5 Duration of works

The indicative remediation works schedule is estimated to take up to 19 months from site establishment / early works scheduled for around June 2022 to final site demobilisation around December 2023. A period of 18 months has been assumed for imported material delivery. Material and supply delays, or weather events, may lead to the works being extended over a longer period.

4.2.6 Traffic volumes

The approximate volumes of imported material presented in Table 4.4 have been summarised in Table 4.6 to inform the volume of truck movements over the indicative remediation works schedule. The numbers assume the following densities: topsoil (1.3 tonnes per m^3), subsoil (1.4), clay (2.0) and rock mulch (1.6). No bulking factors have been used. It is assumed that imported material is being supplied using truck and trailers (i.e. truck and dog configuration) with a payload of circa 33 tonnes. Both the number of trucks (for material delivery) and truck movements (return trip for traffic impact considerations) have been provided.

Table 4.6 Estimated truck movements for imported material

Material	m^2	m^3	tonnes	trucks	truck movements (in/out)
Lime	-	-	1,628	49	98
Lime alternate	-	-	9,071	275	550
Subsoil	-	27,688	38,763	1,175	2,350
Topsoil	-	12,844	16,697	506	1,012
Clay	-	3,450	6,900	209	418
Rock mulch	-	14,388	23,020	698	1,396
Cellular confinement system *	1,300	-	-	10	20
Hydromulch	-	-	-	30	60
Geotextile **	47,960	-	-	50	100

Notes: 1. Presto Geoweb at 150 mm depth.

2. Assumes Bidim A24; 74 units of 600 m^2 each at circa 130 kg each.

The above totals 3,002 trucks, for 6,004 truck movements over the materials delivery window of 18 months. Based on standard construction work hours, this is the equivalent of around 79 truck movements per week, being approximately two truck movements every hour. Most material would be delivered from the north, with approximately 10 % of topsoil being delivered from the east.

Light vehicle movements would be commensurate with the maximum estimated workforce of around 25 people. The bulk of light vehicle movements would be ex Queanbeyan/Canberra return, with car-pooling encouraged where possible, and COVID-permitting.

4.3 Stakeholder consultation

4.3.1 Identification of community stakeholders

Community stakeholders were identified as those that may be interested in, or who may be affected by, the proposed remediation works at Lake George Mine. Community stakeholders are listed in Table 4.7.

Table 4.7 Community stakeholders identified to date

Community stakeholder group	Stakeholders
Government agencies	Department of Regional NSW Transport for NSW Health NSW Environment Protection Authority Department of Planning, Industry and Environment, Crown Lands Education NSW
Affected infrastructure authorities	Transport for New South Wales Queanbeyan Palerang Regional Council
Directly adjoining and/or impacted landowners	Maddy and Sean Newman Rebecca and Drew Scott David and Margaret Yarra Heidi Statford and Eric Gallagher Matthew Vankerkoerle and Chey
Community interest groups	Captains Flat Community Association Captains Flat S355 Community Group
Indigenous organisations	Mogo Aboriginal Land Council (consulted through Crown Lands NSW)
General community	Township of Captains Flat

4.3.2 Engagement with community stakeholders

Community stakeholders were engaged using a range of tools and techniques including meetings, phone calls, and information sessions. These were supported by community feedback mechanisms, including a project-specific phone number and email address. A summary of the community engagement undertaken to date is outlined in Table 4.8.

Table 4.8 Community engagement undertaken to date

Engagement method	Targeted community stakeholder group	Purpose
Meetings	Government Community interest groups Directly adjoining and/or impacted landowners	To facilitate detailed discussion about the proposal objectives, justification, and timing; impact on the stakeholder; seek feedback and comments for consideration; and to communicate next steps.
Phone calls	Government Community interest groups Directly adjoining and/or impacted landowners	To facilitate property access for site investigations and set up meetings with key stakeholders.
Emails	Government Community interest groups Directly adjoining and/or impacted landowners	To facilitate ongoing liaison with key project stakeholders; to distribute key project collateral to key stakeholders and encourage discussion; and to enable direct enquiries about the proposal from the general community.
Website updates	All stakeholders	To provide an overview of the proposal; an overview of the environmental impact assessment process and key findings; answers to frequently asked questions; and access to key documents.
Letters	Government Directly adjoining and/or impacted landowners	To make contact with key project stakeholders. Issued to directly impacted landholders to introduce the proposal and request they contact for further discussion with the team.
Letter box drops	All local residents	Issued directly to all local residents to inform them of all activities, including mine site progress.
Information sessions	Directly adjoining and/or impacted landowners General community	To update the community on the proposed remediation works, allow them to see how feedback has influenced the proposal, and to provide an opportunity for further feedback.

4.3.3 Key issues raised during engagement

A number of issues were raised by various community stakeholder groups during the preparation of the REF. The key issues raised, along with a response and the location of where the issue is addressed in the REF, is provided in Table 4.9.

Table 4.9 Summary of issues raised during community engagement

Issue category	Issue raised	Community stakeholder group	Response	Location addressed in REF
Description of proposed activity – remediation earthworks	Planned work for the area around Mogo.	Individual – community	The proposed remediation works include the Rail Loading Area.	Section 1.3 Section 4.2.1
Description of proposed activity – remediation earthworks	Detail required on use of topsoil.	Individual – neighbour	Remediation earthworks will generally involve *in situ* lime neuralisation overlain with a 300 mm thick subsoil/topsoil to support revegetation.	Section 4.2.1.4

Issue category	Issue raised	Community stakeholder group	Response	Location addressed in REF
Description of proposed activity – surface water drainage	Detail required on proposed drainage works.	Individual – community	The existing drainage system would be re-established and formalised to suit the regraded and revegetated surface following remediation works.	Section 4.2.1.6
Impact assessment – water impacts	Flooding of adjoining properties.	Individual – neighbour	The proposed remediation works would reduce runoff and associated flooding of adjoining properties.	Section 6.1.2
Description of proposed activity – rail corridor	Long term plan for the rail corridor (beyond fencing).	Individual – neighbour	The proposed remediation works include remediation of an area around the Captains Flat Railway Precinct, including some of the Rail Loading Area. Long-term plans for the rail corridor are being developed by Transport for NSW and are not part of the proposed remediation works assessed in this REF.	Section 1.3 Section 4.2.1
Description of activity – remediation earthworks	Concurrent timing of mine site and rail corridor remediation.	Individual - neighbour	The proposed remediation works at the mine site and rail corridor would be undertaken in tandem.	Section 1.3 Section 4.2.1
Impact assessment – community impacts	Length of time relocated residents will be out of their properties.	Individual - neighbour	Transport for NSW has accepted the Voluntary Management Proposal (VMP) and has provided details to landholders.	Section 6.4
Impact assessment – community impacts	Priority to move relocated residents back into their properties.	Individual – neighbour	While Transport for NSW had not identified this as a priority, the Department committed to looking at every opportunity to expedite the relocation.	Section 6.4
Description of activity – remediation earthworks and stakeholder consultation	Consultation with landowners regarding remediation of contaminated area around the ore loader at Copper Creek Road.	Individual - neighbour	Investigations will be undertaken by Transport for NSW regarding the remediation of the contaminated area around the ore loader at Copper Creek Road. Adjacent landholders will be consulted as part of this process by Transport for NSW.	N/A
Description of activity – stakeholder consultation	Landholders unhappy that contractors have been coming on site and/or their property without advance notice or consultation.	Individual - neighbour	Ongoing engagement with key stakeholders (including landholders) would continue for the duration of the proposed remediation works.	Section 4.3.4
Description of the activity – duration of works	Sale of mine site and potential delays with the proposed remediation works.	Individual - neighbour	Duration/schedule of works not expected to be held up with sale of mine site. Remediation works anticipated to take up to 19 months, commencing around June 2022.	Section 4.2.5

Issue category	Issue raised	Community stakeholder group	Response	Location addressed in REF
Description of activity – remediation earthworks and justification of activity (need)	Unhappiness at being "stuck with" a contaminated property.	Individual – neighbour	The purpose of the proposed remediation works is to prevent ongoing environmental and human health risks to people accessing the site, to residents in the vicinity of the site, and in the town of Captains Flat, and to aquatic ecosystems and downstream users of the Molonglo River.	Section 1.3 Section 4.2.1 Section 4.6.1
Description of the activity – proposed remediation works and duration of works	Duration and schedule of works and what works will be undertaken.	Individual – neighbour	The proposed remediation works would include fencing historic mining structures, strategic structural works, remediation earthworks, augmentation of surface water drainage, and revegetation in various areas within the mine site. Duration/schedule of works not expected to be held up with sale of mine site. Remediation works anticipated to take up to 19 months, commencing around June 2022.	Section 1.3 Section 4.2.1 Section 4.2.5
Other – overall plan and timeline works at Lake George Mine/Captains Flat	Require overall picture of the rail corridor, sealing of roads, bridge works etc at Lake George Mine/Captains Flat	Individual - neighbour	Not applicable to the proposed remediation works assessed in this REF.	N/A
Other – rail corridor	Contamination of the rail corridor impacting on the potential walking and cycling trail along the rail line.	Individual – community member	Not applicable to the proposed remediation works assessed in this REF.	N/A
Other – contaminated properties, property values and acquisition	Dissatisfaction that current property owners were not informed of contamination risks prior to purchase. Some properties "do not even exist" and "never should have been private property" due to originally being a "mine site building". Government acquisition of the mine.	Individual - neighbour	Not applicable to the proposed remediation works assessed in this REF.	N/A
Other – mine site sale	Requirements the potential new owner will face and if they will have knowledge of the remediation status of the site.	Individual – community member	Not applicable to the proposed remediation works assessed in this REF.	N/A

4.3.4 On-going engagement

Engagement with key stakeholders would continue for the duration of the proposed remediation works. Details of the key methods of engagement that would be used during on-going stakeholder engagement are presented in Table 4.10.

Table 4.10 Methods used during ongoing stakeholder engagement

Engagement method	Purpose
Meetings	To facilitate discussion about construction/operation activities and timing; impact on the stakeholder; and to seek feedback and comments for consideration.
Phone calls	To set up meetings with key stakeholders.
Emails/eDMs/Newsletters	To facilitate ongoing liaison with key project stakeholders and to enable direct enquiries about construction/operation from the general community.
Letters	To make contact with key project stakeholders during construction/operation.
Enquiry lines (phone and email)	To provide community stakeholders with lines of enquiry to the construction/operation team.

4.3.5 Conflict resolution

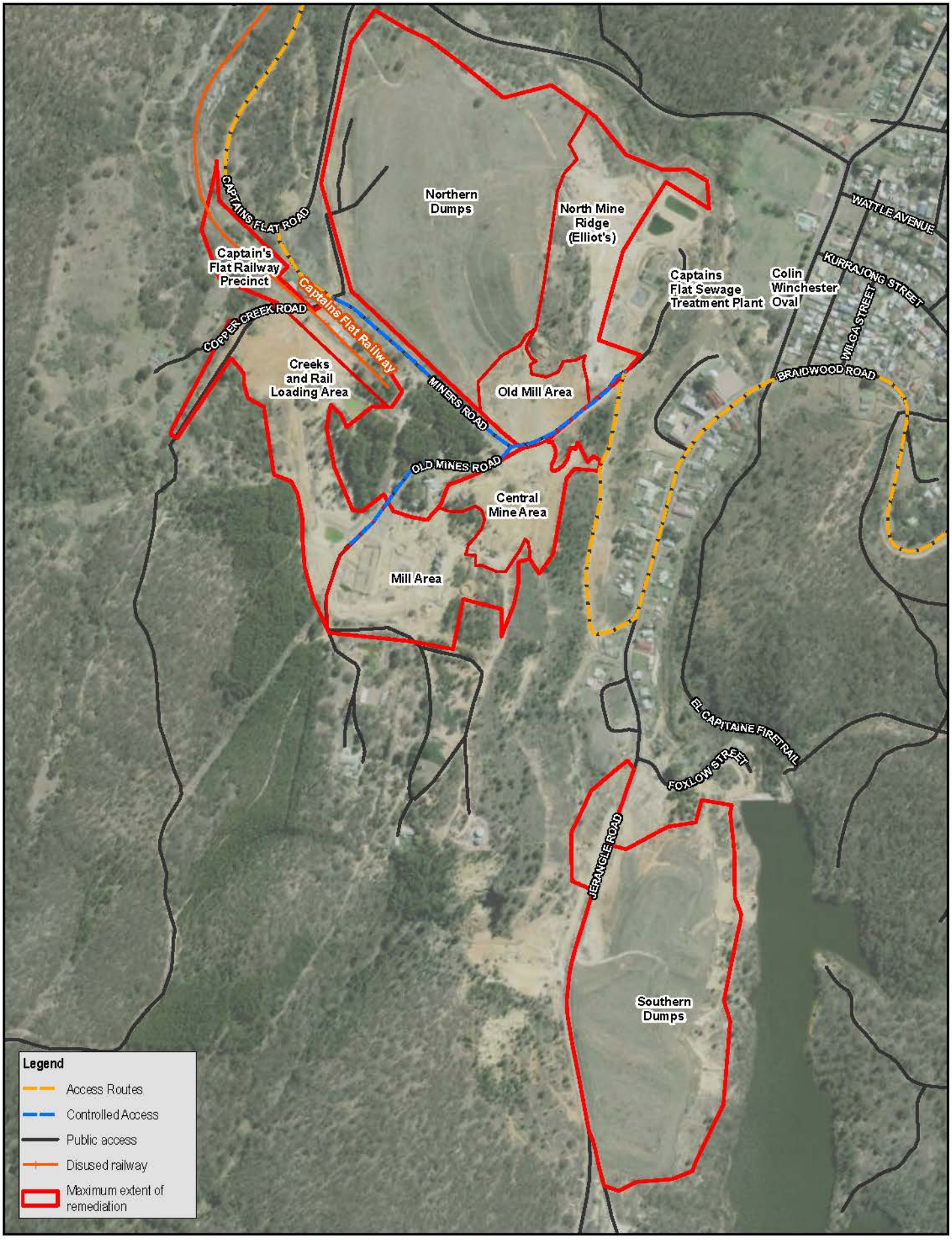
Conflicts would be documented and then progressively worked through to understand the competing nature of the views. The first preference would be to undertake a collaborative approach to resolve the conflict, which usually works by compromising on the issue. If compromising is not possible, a decision would be made, documented, and advised to the conflicting parties.

4.4 Access arrangements

Access to the site is via public roads, specifically from the north via Miners Roads off Captains Flat Road and from the east from Miners Road off Foxlow Street. Most traffic associated with the proposed remediation works would access the proposal site from the north, with traffic coming from the south, where required. This access arrangement would help to reduce traffic movement through Captains Flat.

The proposal site would be a controlled site during the course of the proposed remediation works. As such, internal access roads would be closed off to the public to manage vehicle movements and activities. This arrangement would minimise the movement of through-traffic on Miners Road while maintaining access to the private properties and Council access to infrastructure located within the proposal site. The extent of internal road closures is shown in Figure 4.8.

Further discussion on access arrangements is provided in Section 6.4.7. Council would be consulted prior to the proposed remediation works to manage any cumulative traffic impacts, as discussed in Section 6.6.



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA1994
Grid: GDA1994 MGA Zone 55

N

GHD

Department of Regional NSW
Lake George Mine Remediation

Project No. 12551771
Revision No. A
Date 23/03/2022

Proposed Construction Site Access Arrangements

FIGURE 4.8

4.5 Mitigation strategies

The proposal would be undertaken in accordance with best practice environment management measures to avoid or otherwise minimise environmental impacts associated with the proposed remediation works. Mitigation and management measures that would be implemented during the proposed remediation works are detailed in Section 6 and are summarised in Section 9.

4.6 Justification of activity and analysis of alternatives

4.6.1 Need

As noted earlier, mining operations (for silver, gold, and copper) in the area commenced in the early 1880s with several small operations amalgamating to form Lake George Mine. Mining for copper, lead and zinc continued until Lake George Mine closed in 1962. The site is heavily contaminated with metals and metalloids (including lead, arsenic, copper, and zinc) and sulfur and has undergone a succession of remediation works since 1976.

In 2017, the LMP commissioned a review of previous remediation works to establish the current situation at Lake George Mine. The purpose of the review was to formulate a way forward to reduce the risk of off-site environmental impacts from Lake George Mine. The review document was titled *Lake George Captains Flat Mine Review: Assessment of Remediation Options* (GHD 2018).

Key contaminant sources, pathways and receptors for the site identified by GHD (2018) include those listed in Table 4.11. A conceptual model for the site is provided in Figure 3.1.

The proposed remediation works are required to prevent ongoing environmental and human health risks to people accessing the site, to residents on-site and in the town of Captains Flat, and to aquatic ecosystems and downstream users of the Molonglo River.

Table 4.11 Key contaminant sources, pathways, and receptors

Area	Contaminant(s)	Pathway	Receptor
North Mine Ridge/Elliot's and Old Mill	Pb (main contaminant); As, Cu, Cd, Zn, S (and acidity from S, lowering pH values and making the contaminant metals and metalloids more soluble) (minor contaminants)	Surface runoff Windborne dust Dermal exposure and incidental ingestion	Aquatic ecosystems and downstream users of Molonglo River and Copper Creek[1] Surrounding rural resident and residents of Captains Flat Adults and children accessing the site, including collecting ore samples at the site
Mill Area			
Central Mine Area			
Creeks Area			
Rail Loading Area			
Captains Flat Railway Precinct			
Northern Dumps		Throughflow seepage Surface runoff Windborne dust Dermal exposure and incidental ingestion	Aquatic ecosystems and downstream users of Copper Creek and Molonglo River[1] Surrounding rural resident and residents of Captains Flat Adults and children accessing the site
Southern Dumps			Town water supply dam, aquatic ecosystems, and downstream users of Molonglo River[1] Surrounding rural resident and residents of Captains Flat Adults and children accessing the site

Note: 1. Downstream users include possible potable supply, ingestion by livestock and wildlife, irrigation, and consumption of irrigated crops.

4.6.2 Consideration of ecologically sustainable development

The principals of ecologically sustainable development include:

– Integration – Decision making processes should effectively integrate both long term and short term economic, social, environmental, and equitable considerations.
– The precautionary principle – Where there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
– Inter-generational equity – The present generation should ensure that the health, diversity, and productivity of the environment are maintained or enhanced for the benefit of future generations.
– Conservation of biological diversity and ecological integrity – Conservation of biological diversity and ecological integrity should be a fundamental consideration.
– Improved valuation, pricing, and incentive mechanisms – Includes recognition of the principles that the costs of environmental externalities should be internalised, and that the polluter should bear the costs associated with environmental pollution.
– Public participation – Decisions and actions relating to ecologically sustainable development should provide for broad community involvement on issues which affect them.

The proposed remediation works would be consistent with the principals of ecologically sustainable development, as outlined in Section 4.6.2.1 through Section 4.6.2.5.

4.6.2.1 Integration

The environmental impacts of the proposed remediation works have been assessed. The proposed remediation works would provide both short term and long-term benefits including remediating a highly contaminated site that currently poses environmental and human health risks to site visitors and the residents of Captains Flat.

4.6.2.2 Precautionary principle

Environmental investigations have been undertaken to ensure that the potential impacts of the proposed remediation works are understood with a high degree of certainty. Where a higher degree of risk was identified, this included specialist studies. The assessment of the potential impacts of the proposal is considered to be consistent with the precautionary principle. The assessment undertaken is consistent with accepted scientific methodologies and has taken into account relevant statutory and government agency requirements.

A number of mitigation and management measures have been proposed to minimise the environmental impacts. These mitigation and management measures would be implemented for the duration of the proposed remediation works.

4.6.2.3 Inter-generational equity

The proposal has the potential to lead to some environmental impacts. These include temporary elevated levels of traffic, noise, and dust generated by the proposed remediation works. Implementation of the proposed mitigation and management measures would ensure that there would be reduced impact from the proposed remediation works.

Importantly, the proposal would enhance the health, diversity, and productivity of the environment for present and future generations. The objective of the proposal is to remediate the site and to reduce the environmental and human health risk to the town of Captains Flat, the environment and water users downstream of Captains Flat.

4.6.2.4 Conservation of biological diversity and ecological integrity

A biological assessment has been undertaken to identify potential adverse impacts on biodiversity. The assessment demonstrates that the proposed remediation works would not have a significant impact on any local populations of native biota, including threatened and endangered species, populations, or ecological communities listed under the *Biodiversity Conservation Act 2016* (BC Act) (NSW) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth).

Rather, the intent of the works is to materially improve the site to sustain habitat to enhance biological diversity and ecological integrity.

4.6.2.5 Improved valuation, pricing, and incentive mechanisms

The environmental assessment has identified the environmental and other consequences of the proposed remediation works and identified mitigation and management measures, where appropriate, to manage potential impacts. If approved, the proposed remediation works would be undertaken in accordance with these mitigation and management measures. These requirements would result in an economic cost to the proponent, indicating that environmental resources have been given appropriate valuation in the development of the proposal.

The proposed remediation works have been designed with an objective of minimising potential impacts on the surrounding environment, with the stated aim of enhancing the environmental post-remediation. This indicates that the remediation works have been developed with consideration of environmental outcomes.

4.6.2.6 Public participation

Stakeholder consultation has been undertaken during the development of the proposal and during the preparation of the environmental impact assessment of the proposal. The objective of the stakeholder consultation was to ensure clear, two-way communication by listening, recording, and responding to issues as they arose. The specific objectives were to disseminate information about the proposal and the assessment process to key stakeholders, increase stakeholder awareness and understanding of the proposal and the assessment process, ensure that key stakeholders were provided with opportunities through the consultation process to communicate feedback and to identify issues so that they could be included in the proposal; and to identify stakeholder and community issues and views.

Issues identified during the consultation process were included in the design of the proposal and the mitigation and management measures developed to safeguard the environment from potential impacts during the proposed remediation works.

4.6.3 Alternatives

A range of alternative have been considered to address the contamination risk at Lake George Mine. These alternatives are discussed in Section 4.6.3.1 through Section 4.6.3.3.

4.6.3.1 'Do-nothing' alternative

The consequences of not proceeding with the proposed remediation works would mean that the risks to human health and the environment would remain unchanged, resulting in an unacceptable environmental and human health risk to people accessing the site, to residents on-site and in the town of Captains Flat, and to aquatic ecosystems and downstream users of the Molonglo River. As such the 'do nothing' alternative was not considered a viable option for addressing the contamination risk at Lake George Mine.

4.6.3.2 Alternative remediation options considered

A range of remediation options were considered to address the surficial contamination risk at Lake George Mine. Remediation options are detailed by Dobos and Associates (2002), URS (2004), and GHD (2018), and, depending on the levels of contamination by site domain, included:

– Low contamination – *in situ* liming and re-vegetation
– Medium contamination - *in situ* liming, importation of a growth medium and re-vegetation
– High contamination – the option of:
    - On site capping, importation of sub and topsoil, revegetation
    - Excavation and encapsulation on site, backfill and revegetation
    - Excavation and treatment for stabilisation on-site, backfill and revegetation
    - Excavation, stabilisation and legal disposal off-site, backfill and revegetation.

4.6.3.3 The preferred alternative and justification

The remediation alternatives outlined above were considered and the remediation options described in Table 4.2 and Table 4.3 were selected based on the findings of Dobos and Associates (2002), URS (2004) and GHD (2018). The preferred option was selected based on:

– Stakeholder consultation
– Sustainability
– Geochemistry
– Cost
– Environmental performance
– Waste management
– Practicality.

5. Statutory context

5.1 Legislation – NSW

5.1.1 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 State Environmental Planning Policies (SEPPs) and Local Environmental Planning Policies (LEPs).

The proposed remediation works are 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 Section 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. Section 6 of this REF provides an environmental impact assessment of the proposal in accordance with Clause 171(2), and Appendix D specifically responds to the factors for consideration under Clause 171(2).

5.1.2 Other legislation

Other relevant legislation applicable to the proposed remediation works are considered in Table 5.1.

Table 5.1 Legislation applicable to the proposed remediation works.

Legislation	Description/applicability	Licence / permit required
Protection of the Environment Operations Act 1997 (POEO Act)	Focuses on protecting, restoring, and enhancing the environment within NSW, and reducing potential risks to human health and the environment. Also aims to provide opportunity for increased public involvement and access to information regarding environmental protection. An environment protection licence (EPL) is required for scheduled activities or scheduled development work outlined in Schedule 1 of the POEO Act. Clause 15(2)(b) of Schedule 1 relates to activities requiring an EPL concerning the treatment of contaminated soil. The proposal involves about 20 hectares of area that would be disturbed for remediation works. A licence would, therefore, be required under Clause 15(2)b (iii) due to the proposal disturbing more than three hectares of contaminated soil.	Yes – license
Water Management Act 2000 (WM Act)	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. The proposal is considered a ‘controlled activity' and is proposed on ‘waterfront land', an approval is required under the WM Act (Section 91E). Under the WM Act, ‘waterfront land’ is defined as land within 40 metres of a river, lake, estuary or shoreline. The proposal site is within 40 metres of the Molonglo River and Copper and Forsters Creeks.	No

Legislation	Description/applicability	Licence / permit required
	However, pursuant to Clause 39A (1) of the *Water Management (General) Regulation 2004*, public authorities are exempt from the requirements of Section 91 of the WM Act. As LMP is a public authority, approval is not required under Section 91 of the WM Act.	
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. Impacts of the proposal on non-Aboriginal heritage are discussed in Section 6.4.3. An exemption would not need to be obtained under section 139(4) of the Heritage Act for impacts to local heritage items located within the proposal site. The SoHi, found at Appendix O, provides evidence of the proponent's consideration of the heritage issues and the associated mitigation measures.	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 Section 6.2.2. The Principal Contractor would be responsible for managing biosecurity risks such as spreading of weeds.	No
Biodiversity Conservation Act 2016	Provides legal status for biota of conservation significance in NSW. A Species Impact Statement (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 *Biodiversity Conservation Act 2016.* Impacts of the proposal on biodiversity are discussed in Section 6.2.1. As the impacts to species from the proposal are limited, an SIS will not be required.	No
Fisheries Management Act 1994	Provides a framework for the management of fisheries resources. Impacts of the proposal on biodiversity are discussed in Section 6.2.1. Copper Creek and the Molonglo River are mapped as Key Fish Habitat as part of the Murray Darling Basin South catchment (DPI 2021a). The Molonglo River does not intersect the site but occurs nearby to the east and has the potential to be indirectly impacted by the proposal downstream. A large dam also occurs in the Mill Area. However, no threatened species, endangered populations, endangered ecological communities listed under the FM Act are likely to occur within the proposal site, or would be affected by the proposal and therefore, assessments of significance are not required.	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 Section 6.4.4. No sites of Aboriginal heritage have been identified and are highly unlikely to be uncovered due to the disturbed nature of the site.	No

Legislation	Description/applicability	Licence / permit required
Crown Lands Management Act 2016	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. DPE-Crown lands is represented on the Legacy Mines Steering Committee as a key stakeholder to guide/support proposed works on Crown land sites. The proposal site includes areas of Crown land and Crown reserves. However, The Legacy Mines Program is a state government agency authorised to undertake remediation works on Crown land with DPE-Crown Lands agreement/support; therefore no formal approvals are required to do this work.	No
Mining Act 1992	A search of the existing mineral licences and titles under the *Mining Act 1992* has been undertaken. One exploration licence application (ELA6441) applies to the proposal site. The licence application is held by Orthosa Pty Ltd with the exploration targeting Group 1 minerals. The application date was 23 February 2022.	No

5.1.3 State and Local Environmental Planning Policies

Relevant SEPPs and LEPs applicable to the proposed remediation works are considered in Table 5.2.

Table 5.2 Relevant SEPPs and LEPs and their applicability to the proposal

Policy	Description/applicability	Consideration required
State Environmental Planning Policy (Resilience and Hazards) 2021	Provides a state-wide planning approach to contaminated land remediation. SEPP (Resilience and Hazards) 2021 also promotes the remediation of contaminated land to reduce the risk of harm. Section 4.7 of SEPP (Resilience and Hazards) 2021 provides that 'A person may carry out a remediation work in accordance with this Chapter, despite any provision to the contrary in an environmental planning instrument, except as provided by section 4.16(3).' Section 4.11 defines Category 2 remediation work which does not require consent as work not considered Category 1 remediation work. Category 1 remediation is defined by section 4.8 Part of the proposal site is listed as a heritage item under the Palerang LEP and therefore is considered to be Category 1 remediation work, and therefore, would require development consent. Regardless of the above, section 4.16(3) provides that 'If a provision of another State environmental planning policy or of a regional environmental plan, whether made before or after this Policy, permits a remediation work without development consent, a requirement in this Policy to obtain development consent to carry out the work does not prevail over that provision'. As the proposal is permissible without consent under SEPP (Resources and Energy) 2021 (see below) the requirement for consent under SEPP (Resilience and Hazards) 2021 does not apply to the proposal.	No
State Environmental Planning Policy (Transport and Infrastructure) 2021	Facilitates the effective delivery of infrastructure across the State. Appendix C sets out the consultation requirements set out under Chapter 2 of the *SEPP (Transport and Infrastructure) 2021*. Consultation with Council is required under the Infrastructure SEPP as the proposal is likely to involve: Consequential excavation of a road or adjacent footpath managed by council. Consequential impacts on a heritage item.	Yes – Consultation

Policy	Description/applicability	Consideration required
State Environmental Planning Policy (Planning Systems) 2021	Identifies development that is State significant development, State significant infrastructure and critical State significant infrastructure. The remediation of contaminated land is identified in section 24 of Schedule 1 as development to which the SEPP (Planning Systems) 2021 applies. The Statement and Regional Development SEPP only applies to Category 1 remediation work (as described in SEPP 55, now Chapter 4 of SEPP (Resilience and Hazards) 2021). As discussed above, this proposal is categorised as Category 2 remediation work in accordance with SEPP (Resilience and Hazards) 2021 and therefore the SEPP (Planning Systems) 2021 does not apply to the proposal.	No
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 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.	No
Palerang Local Environmental Plan 2014	The proposal is located within the Queanbeyan-Palerang Local Government Area (LGA) and, therefore, the *Palerang Local Environmental Plan (LEP) 2014* applies to the proposal site. The LEP outlines what land uses are permitted in different land zones. The proposal site includes land which is zoned RU1 Primary Production and SP2 Special Infrastructure. However, Clause 5.12 of the LEP states: *(1) This Plan does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007.* As outlined above, the proposal is considered to be development permissible without consent under the Mining SEPP, and the provisions of the Mining SEPP prevail over the provisions of the LEP. Therefore, the proposed works are permitted without consent.	No

5.2 Legislation – Commonwealth

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cmth) 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 Matters of National Environmental Significance (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
- 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).

Impacts under the EPBC Act are considered in Section 6.2, Section 6.5 and Appendix D of this REF. The proposal is not likely to have a significant impact on MNES, therefore, approval is not required under the EPBC Act.

6. Impact assessment

6.1 Assessment of physical and pollution impacts

6.1.1 Air impacts

6.1.1.1 Introduction

This section assesses the potential impacts on air quality associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential air quality impacts.

6.1.1.2 Methodology

The methodology for the air quality impact assessment is outlined below.

6.1.1.2.1 Relevant guidelines and codes of practice

The air quality impact assessment was undertaken with reference to the following:

– *Protection of the Environment Operations Act* (1997)
– *Protection of the Environment Operations (Clean Air) Regulation* (2010)
– *National Environment Protection (Ambient Air Quality) Measure* (2021) (Air NEPM)
– *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016)
– Guideline Air emissions (Government of Western Australia Department of Water and Environmental Regulation, October 2019, Draft for external consultation) (WA Government guidance)
– *ESG2: Guideline for preparing a Review of Environmental Factors* (Department of Planning and Environment 2015).

6.1.1.2.2 Desktop assessment

The air quality assessment was undertaken to conservatively assess potential worst case air quality impacts from the proposal. The air pollutants assessed in this report include:

– Soil contaminants and metals (from the remediation project earthworks and transfer of contaminated mineral waste material) – quantitative assessment
– Particulate matter (Total Suspended Particulates (TSP) and particulate matter with diameter smaller than 10 microns (PM_{10})) (from the remediation earthworks and materials transfer) – qualitative assessment.

It has been assumed that dust from haul roads and imported fill is not highly contaminated and general site mitigation measures including regular watering outlined in Section 6.1.1.4 (including real time monitoring during remediation) will manage dust impacts in the town of Captains Flat and other sensitive receptors to the works.

Quantitative assessment has been undertaken for the handling and relocation of contaminated soil, with worst-case impacts predicted from eleven remediation locations with highest potential for dust impacts on receptors. The locations where dispersion modelling was undertaken include the Northern Dumps, North Mine Ridge, Central Mine Area, Mill Area, Creeks Area, Rail Loading Area, Rail Precinct and Southern Dumps given their proximity to sensitive receptors.

Soil contamination

Soil contamination data was obtained from an assessment of remediation options review (GHD, 2018) for the site. The sampling program was strategic across the site given the scope of GHD (2018), however is useful to determine what the source contaminants are and gain a high-level understanding of contaminant concentrations in the soil.

In order to determine the likelihood of impacts during remediation, the average of all field XRF results (excluding slag and/or ore samples which would not contribute to dust due to large particle sizes) across the site for each contaminant of concern was used in conservative air dispersion modelling for the Northern Dumps, North Mine Ridge, Central Mine Area, Mill Area, Creeks Area and Southern Dumps.

Review of the GHD (2018) contaminant dataset showed elevated concentrations at the Rail Loading Area and Rail Precinct when compared to the rest of the site (specifically lead, arsenic, cadmium, iron and silver), and therefore, this area has been modelled using sampled data contained specifically within that area. Samples which are attributed to being slag fragments, which are not likely to contribute to dust load due to large particle size were excluded from the emission inventory.

A known limitation of this assessment methodology is that average concentrations are assumed to be uniform across each remediation area; which takes a highly conservative, or worst-case scenario approach to modelling. Another limitation of the assessment is that soil samples may not have captured areas with maximum contaminant concentrations. If any future soil samples are undertaken this assessment can be revised to consider additional contaminated concentration data.

Air quality criteria

The assessment has compared predicted impacts from the proposal with available environmental and health-based criteria. Assessment criteria has been taken from the Approved Methods and the WA Government guidance listed above.

Adoption of air quality assessment criteria specific to NSW was prioritised in this air quality assessment, however where NSW specific guidance was not available, air quality criteria was sourced from the WA Government guidance.

For particulate matter, the criteria are presented as cumulative impacts and should be met at existing or future off-site sensitive receptors. Cumulative impacts are defined as the predicted impact of the proposal (incremental impact) plus the existing levels (background). For metals and contaminants, the criteria are presented as incremental impacts and should be met at and beyond the boundary of the facility.

To determine the level of air quality impacts, emissions from the proposal must be assessed against the assessment criteria as shown in Table 6.1.

The impact assessment modelled metals, metalloids and other contaminants and has not predicted source emissions and concentrations for particulates across the entire site and at sensitive receptors. Particulate matter criteria would still apply during at all offsite receptors during the remediation.

Table 6.1 Air quality impact assessment criteria

Pollutant	Averaging period	Percentile	Assessment criteria (µg/m^3)	Assessment criteria source
Particulate matter (dust)				
TSP (total suspended particulates)	Annual	100th	90	The Approved Methods (2016)
PM_{10}	24-hour	100th	50	The Approved Methods (2016)
	Annual	100th	25	The Approved Methods (2016)
$PM_{2.5}$	24-hour	100th	25	The Approved Methods (2016)
	Annual	100th	8	The Approved Methods (2016)
Metals and contaminants				
Aluminium	24-hour	100th	9.2	WA Government guidance (2019)
Antimony	1 hour	99.9th	9	Approved Methods (2016)
Arsenic	1 hour	99.9th	0.09	Approved Methods (2016)
Barium	1 hour	99.9th	9	Approved Methods (2016)
Cadmium	1 hour	99.9th	0.018	Approved Methods (2016)
Chromium (III+VI)	1 hour	99.9th	0.09	Approved Methods (2016)

Pollutant	Averaging period	Percentile	Assessment criteria (µg/m^3)	Assessment criteria source
Cobalt	24-hour	100th	0.092	WA Government guidance (2019)
Copper	1 hour	99.9th	18	Approved Methods (2016)
Iron	1 hour	99.9th	90	Approved Methods (2016)
Lead	Annual	100th	0.5	Approved Methods (2016)
Magnesium	1 hour	99.9th	180	Approved Methods (2016)
Manganese	1 hour	99.9th	18	Approved Methods (2016)
Molybdenum	24-hour	100th	11	WA Government guidance (2019)
Nickel	1 hour	99.9th	0.18	Approved Methods (2016)
Selenium	1 hour	100th	0.92	WA Government guidance (2019)
Silver	1 hour	100th	0.18	WA Government guidance (2019)
Sulphur (total oxidised as SO_4)	1 hour	99.9th	18	Approved Methods (2016)
Uranium	Annual	100th	0.037	WA Government guidance (2019)
Vanadium	1 hour	100th	0.92	WA Government guidance (2019)
Zinc	1 hour	99.9th	90	Approved Methods (2016)

Estimated emissions

Activities that generate dust include earthworks and the handling and transfer of earth and other material. Dust emissions were identified to occur from the following sources:

– Mechanical movements of soil during excavation activities from use of excavators, front end loaders and bulldozers in the areas being cleared and remediated
– Loading and unloading material into trucks and stockpiles
– Wheel generated dust from haulage truck movements (note it is assumed main haul routes and roads that would receive gravel treatment are not a source of significant contaminated material and therefore these are not incorporated into emissions inventory below for this assessment – dust mitigation for haul roads is provided)
– Haulage trucks dumping soil and use of graders/bulldozers to spread soil material once dumped
– Wind-blown dust emissions from uncovered stockpiles and cleared land.

Dust emission rates were estimated based on assumed emissions factors and anticipated activity rates. Emission factors were taken from the *National Pollutant Emissions Estimation Technique Manual for Mining Version 3.1 (2012)*. Anticipated activity rates are summarised below:

– Total contaminated material for excavation and relocation to the containment cell is 58,470 m^3 (refer Table 4.4)
– Two bulldozers would be operational at any one time, one clearing and one leveling spoil
– Excavators and front-end loaders excavate around 643 tonnes of soil per day which is loaded into trucks
– Trucks relocate and dump material to the northern dump
– Cleared land has a surface area of 5000 m^2 at any one time
– Moisture and silt content of 10 per cent for material being moved.

It has been conservatively assumed in the assessment that these worst-case activities would occur at all assessment locations, even during activities like application of lime into the soil and spreading of topsoil which may not include such heavy earthworks and dust generation.

It is understood that the sulfidic waste stockpile and slag heap contain mostly material with large particle sizes (slag and gravel like material) and that the slag heap would be vitrified in part. The two stockpiles are also small in volume and area compared to other work areas onsite. Therefore, it was assumed that these stockpiles would not contribute to significant offsite dust or contaminant emissions and were not included in modelling scenarios. These areas will include specific dust mitigation as detailed in Section 6.1.1.4.

Table 6.2 shows the emission inventory with calculated particulate emissions for a typical remediation day, no matter where this would occur onsite. This assumes a worst-case day for dust generation could occur at any part of the site during the remediation program.

Table 6.2 Dust emissions from mineral waste

Source	Source type	Active hours[1]	Emission rate (g/s)		Notes[2]
			TSP	PM_{10}	
Excavator/front end loader	Volume	0700 - 1800 (10 hours)	0.0025	0.0012	All material for remediation by encapsulation in the cell excavated and placed in truck
Bulldozer worksite	Volume	0700 - 1800 (10 hours)	0.57	0.12	Clearing, bulk earthworks
Wind erosion from stockpiles and cleared land	Area	24 hours	0.056	0.028	-
Trucks dumping spoil	Volume	0700 - 1800 (10 hours)	0.21	0.077	Contaminated soil dumped at Northern Dumps
Leveling material at Northern Dumps	Volume	0700 - 1800 (10 hours)	0.17	0.076	Emission assumed similar to a grader for levelling of material

This emissions inventory does not include all sources of dust onsite, only emissions from contaminated work areas. Other sources of dust would include trucks travelling on unpaved roads between areas of the site however it is assumed this will be appropriately managed through watering and real time dust sampling as per Section 6.1.1.4 where gravel treatment was not applied.

Metal, metalloids and other compounds are present within the soil and would be released due to the same emission mechanisms as dust (and contribute to TSP). Metals, metalloids and contaminant emissions were scaled off TSP emissions based on maximum measured concentration of each contaminant. It was therefore assumed that the average concentrations will be uniform across the entire remediation area.

The metal and other contaminant emission inventory (provided as a per centage of TSP emissions) is provided in Table 6.3. The table includes emissions from Rail Loading Area and Rail Precinct Area, as well as an average use for the rest of the site, noting that no contaminated material would be removed from the Rail Loading Area, rather, it would be treated *in situ*.

Table 6.3 Contaminant emission inventory

Contaminant	Rail loading and Rail Precinct areas		Average for rest of site	
	Average measured concentration (mg/kg)	Corresponding percentage of TSP emissions	Average measured concentration (mg/kg)	Corresponding percentage of TSP emissions
Aluminium	9920	0.99%	9638	0.96%
Antimony	64.1	0.0064%	42.8	0.0043%
Arsenic	37	0.004%	73	0.0073%
Barium	641	0.06%	927	0.093%
Cadmium	7.3	0.0007%	9.90	0.0010%

[1]Source were modelled as active from 0700 – 1800 excluding a 1 hour break in the middle of the day totalling 10 hours of emissions each day.
[2] Any Level 1 watering of 2 litres per metre squared per hour ($L/m^2/h$) could further reduce dust emissions by 50% in accordance with *National Pollutant Emissions Estimation Technique Manual for Mining Version 3.1 (2012)* guidance

Contaminant	Rail loading and Rail Precinct areas		Average for rest of site	
	Average measured concentration (mg/kg)	Corresponding percentage of TSP emissions	Average measured concentration (mg/kg)	Corresponding percentage of TSP emissions
Chromium (III+VI)	4.46	0.00045%	37.5	0.0038%
Cobalt	44.6	0.0045%	25.8	0.0026%
Copper	292	0.029%	240	0.024%
Iron	46289	4.6%	36670	3.7%
Lead	14985	1.5%	2704	0.27%
Magnesium	6.67	0.00067%	530	0.053%
Manganese	150	0.015%	282	0.028%
Molybdenum	3.57	0.00036%	1.53	0.00015%
Nickel	49.1	0.0049%	53.8	0.0054%
Selenium	0.0	0.0000%	2.21	0.00022%
Silver	112	0.011%	88.6	0.0089%
Sulphur (total oxidised as SO_4)	4829	0.48%	2704	0.27%
Uranium	0	0%	1.23	0.00012%
Vanadium	60.1	0.0060%	51.9	0.0052%
Zinc	405	0.04%	1828	0.18%

Meteorology

Local meteorology including long term wind speed and direction, as well as atmospheric stability, influence how air pollutants are dispersed into the local environment. Local weather observations are not available, apart from rainfall. Therefore, meteorological modelling was undertaken for the site in order to gain an understanding of potential wind speed and direction and atmospheric stability.

Site specific meteorology was created using the TAPM and CALMET models in accordance with guidance contained within the Approved Methods. A wind rose from the CALMET model extract at the site is provided in Figure 6.1. This shows most stronger winds (greater than 7.5 m/s) come from the south and west, however winds above 5 m/s which are also attributed to dust lift off are evenly spread across all directions except from the north.

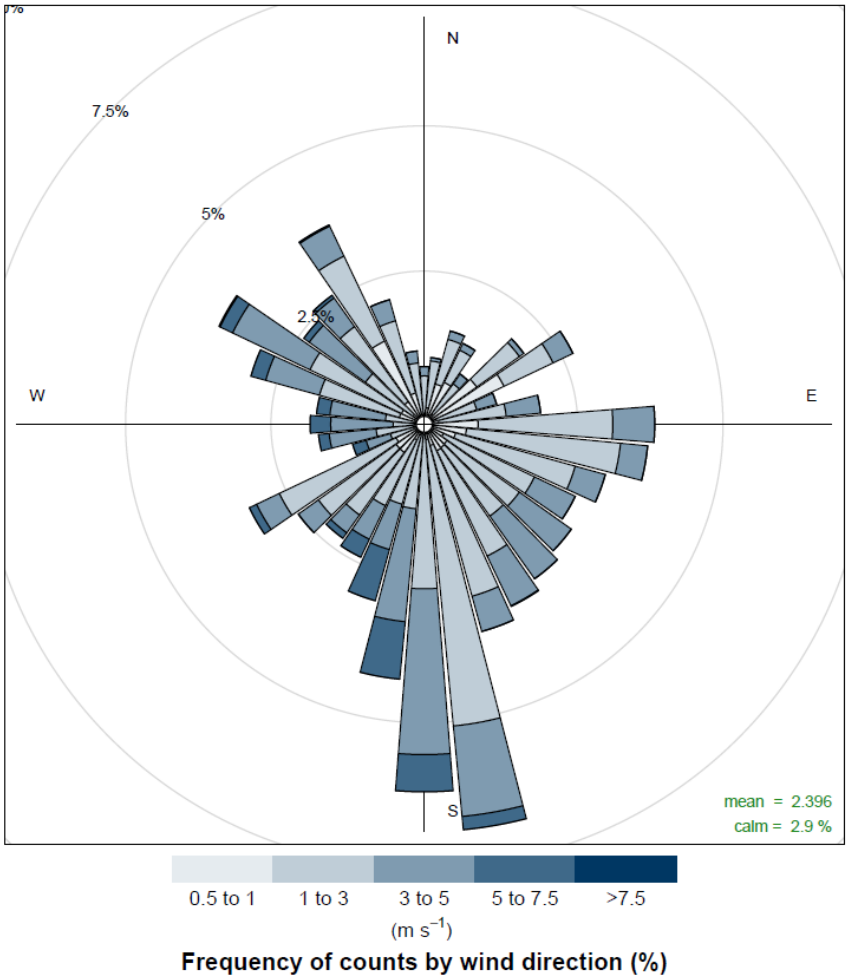


Figure 6.1 CALMET wind rose at proposed remediation works location (01/01/2017 – 0/1/01/2018)

Dispersion modelling

Predicted air quality impacts were modelled in accordance with the Approved Methods using an approved computer software model CALPUFF. All CALPUFF model settings were selected based on the recommendations provided in the *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia* (J Barclay and J Scire, Atmospheric Studies Group TRC Environmental Corporation, 2011) except for the MDISP parameter which was chosen as the model default value.

The CALPUFF dispersion model utilised a meteorological dataset of one year in duration in accordance with the Approved Methods.

Dispersion modelling was undertaken for Eleven scenarios, which assessed active remediation works occurring in the following locations:

– Northern Dumps
– North Mine ridge
– Central Mine Area
– Mill Area
– Creeks Area
– Rail Loading Area
– Rail Precinct Area
– Southern Dumps.

All scenarios, except for the Rail Loading Area scenario, assumed material would be transported to the Northern Dump Containment cell for remediation. No relocation is proposed for the Rail Loading Area scenario (i.e. all material would be remediated *in situ*). The modelled scenario assumes that a worst-case day for dust generation could occur at any part of the site during the remediation program.

The dispersion model predicts contaminant concentrations at identified sensitive receptor locations and at a sampling grid of 50 metre spacing centred over the site. Sampling grid receptors were assigned to be either 'on-site' or 'off-site' based on inspection of site boundaries provided in Figure 1-2 within *NSW Planning and Environment Division of Resources and Geoscience Lake George Captains Flat Mine Review Assessment of remediation options* (GHD, 2018). The sampling grid was used to determine the predicted maximum contaminate concentrations at and beyond site boundary. A figure showing the allocation of sampling grid receptors is provided in Appendix E.

6.1.1.2.3 Field survey

No site assessment was undertaken.

6.1.1.3 Assessment of impacts

Dispersion modelling was undertaken to predict potential worst-case air quality impacts from the proposal in accordance with the methodology and assumptions outlined above.

Modelling results are presented for the following two cases:

– Rail Loading Area and Rail Precinct Area (calculated as the maximum predicted impact from these two locations as they were identified as worst case with regard to exceeding the assessment criteria)
– Rest of site scenarios (calculated as the maximum predicted impact from all other locations).

The averaging period and percentile presented for each air quality species was chosen to align with assessment criteria (refer Table 6.1) for that particular contaminant. Model predictions are presented as maximums at and beyond the site boundary (for comparison against the assessment criteria) and maximum concentrations at sensitive receptor locations (for informational and comparative purposes only).

Predicted contaminant concentrations for the Rail Loading Area and Rail Precinct Area scenario and the maximum for the rest of site scenarios are provided in Table 6.4 and Table 6.5 respectively.

There was a predicted exceedance of the assessment criteria for silver at the NSW State Emergency Service building (Copper Creek Road) for the Rail Loading Area scenario. This receptor falls within the site boundary and is understood to be rarely occupied (and if occupied, it is typically used outside of normal construction hours). Exceedances at and beyond the site boundary were predicted for lead and silver for the Rail Loading Area and Rail Precinct Area scenarios.

Exceedances at and beyond the site boundary (but not at sensitive receptor locations) were predicted for arsenic, cadmium, chromium (III+VI) and silver for the worst-case rest of site scenarios. These offsite exceedances were predicted when active remediation works were modelling directly adjacent to or on the site boundary (worst case location). A review of the predicted pattern of dispersion indicated that exceedances could occur up to 70 metres from the site boundary when active remediation works occur on the site boundary.

Therefore, appropriate mitigation measures should be implemented whenever active remediation works are scheduled to occur near (within 70 metres) sensitive receptors or the site boundary.

It is noted that a significant portion of lands immediately beyond the boundary of the site are classified as crown land. Therefore, there is greater opportunity to control emissions (i.e. using crown land as a buffer exclusion zone) and it is less likely that impacts would occur at sensitive receptors locations. Mitigation measures are recommended in Section 6.1.1.4.

Table 6.4 Predicted contaminant concentrations from Rail Loading Area and Rail Precinct Area

Contaminant	Criteria (ug/m^3)	Maximum predicted at and beyond site boundary		Maximum predicted at receptor	
		Concentration (ug/m^3)	Percentage of assessment criteria	Concentration (ug/m^3)	Percentage of assessment criteria
Aluminium	9.2	2.4	26%	1.4	15%
Antimony	9	0.11	1%	0.060	1%
Arsenic	0.09	0.066	74%	0.034	38%
Barium	9	1.1	13%	0.60	7%
Cadmium	0.018	0.013	73%	0.0068	38%
Chromium (III+VI)	0.09	0.0080	9%	0.0042	5%
Cobalt	0.092	0.011	12%	0.0061	7%
Copper	18	0.52	3%	0.27	2%
Iron	90	83	92%	43	48%
Lead	0.5	0.64	127%	0.16	32%
Magnesium	180	0.0	0%	0.0062	0%
Manganese	18	0.27	1%	0.14	1%
Molybdenum	11	0.00085	0%	0	0%
Nickel	0.18	0.088	49%	0.046	25%
Selenium	0.92	0	0%	0	0%
Silver	0.18	0.27	151%	0.19	108%
Sulphur (total oxidised as SO_4)	18	8.6	48%	4.5	25%
Uranium	0.037	0	0%	0	0%
Vanadium	0.92	0.15	16%	0.10	11%
Zinc	90	0.73	1%	0.38	0%

Table 6.5 Predicted contaminant concentrations from rest of site scenarios (maximum shown)

Contaminant	Criteria (ug/m^3)	Maximum predicted at and beyond site boundary		Maximum predicted at receptor	
		Concentration (ug/m^3)	Percentage of assessment criteria	Concentration (ug/m^3)	Percentage of assessment criteria
Aluminium	9.2	5.6	61%	1.1	12%
Antimony	9	0.11	1%	0.041	0%
Arsenic	0.09	0.18	200%	0.070	77%
Barium	9	2.3	25%	0.89	10%
Cadmium	0.018	0.024	136%	0.0095	53%
Chromium (III+VI)	0.09	0.09	103%	0.036	40%
Cobalt	0.092	0.015	16%	0.0030	3%
Copper	18	0.59	3%	0.23	1%
Iron	90	90	100%	35	39%
Lead	0.5	0.30	61%	0.036	7%
Magnesium	180	1.3	1%	0.51	0%

Contaminant	Criteria (ug/m^3)	Maximum predicted at and beyond site boundary		Maximum predicted at receptor	
		Concentration (ug/m^3)	Percentage of assessment criteria	Concentration (ug/m^3)	Percentage of assessment criteria
Manganese	18	0.69	4%	0.27	1%
Molybdenum	11	0.00090	0%	0	0%
Nickel	0.18	0.13	74%	0.051	29%
Selenium	0.92	0.0073	1%	0.0024	0%
Silver	0.18	0.29	163%	0.10	54%
Sulphur (total oxidised as SO_4)	18	6.7	37%	2.6	14%
Uranium	0.037	0	0%	0	0%
Vanadium	0.92	0.17	19%	0.057	6%
Zinc	90	4.5	5%	1.7	2%

6.1.1.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on air quality during the proposed remediation works are listed in Table 6.6. While the assessment focussed on contaminants in the soil only, it was assumed there will be a high level of dust mitigation applied on all areas which can be a source of dust including haul roads in between areas onsite.

Real time air quality monitoring stations shall be used to help the management of dust and when to apply additional dust mitigation. Dust deposition gauges should also be installed around the site to ensure dust and contaminants are not being deposited at high levels over the remediation program.

Additional mitigation should apply to the remediation activities at the rail loading area and any remediation activities undertaken on the site boundary near (within 70 metres) sensitive receptors.

Table 6.6 Mitigation measures – air quality

No.	Outcome	Mitigation measure
AQ1	Clear controls and mitigation for contractors	Prepare a dust management plan, with specific management measures for all remediation areas.
AQ2	Real-time dust sampling for management of dust	Prepare a dust monitoring plan, which is to include at least two real time particulate samplers to assist proactive management of dust. Real-time samplers should be placed at the two nearest receptors to the current remediation area. The plan should include triggers and alerts to reduce or stop works based on measured dust concentrations.
	Dust deposition sampling	Install a network of dust deposition gauges including the following: – One at receptor adjacent to rail loading area – One at nearest receptor south of the mill area – One to the east of central mine area in Captains Flat – One to the east of the north mine ridge, potentially the sports field or swimming pool.
	Reduce potential exposure	SES is located directly adjacent to remediation works. This SES site should not be used by non-construction workers when remediation works are directly adjacent unless in the case of an emergency.

No.	Outcome	Mitigation measure
	Reduce the potential for dust	Undertake watering (2 L/m^2/h) of haul truck access routes, the remediation zones and stockpiles (including sulfidic and slag stockpiles). Additional watering should be applied if any visible dust plumes are observed leaving the work area or site boundary.
AQ3	Rail loading and Rail precinct area dust and any remediation activities undertaken on the site boundary	Additional watering should be applied to the rail loading and rail precinct areas and any remediation activities undertaken on the site boundary within 70 metres of sensitive receptors due to a higher risk of exceedances of the criteria. Watering can reduce emissions by up to 70 per cent
	Reduce the potential for dust	Aim to minimise the size of excavated stockpiles where possible
	Reduce the potential for dust	Limit clearing areas of land and clear only when necessary to reduce fugitive wind-blown dust emissions.
	Reduce the potential for dust	Control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 25 kilometres per hour.
	Reduce the potential for dust	All trucks hauling material should be covered on the way to and from the proposal site and should maintain a reasonable amount of vertical space between the top of the load and top of the trailer to prevent the escape of dust or other material while in transit.
	Reduce the potential for dust	During stockpile loading and unloading the drop height of the excavator should be minimised to prevent unnecessary dust emissions.
	Reduce the potential for dust	If dust generation is evident, measures such as increased water application, minimising vehicle movements and reducing vehicle speed limits will be carried out to minimise dust impacts.
	Reduce the potential for dust	On high wind days, or when real-time dust sampling trigger alerts, increase watering, reduce activity or stop works.
	Ensure combustion emissions are minimised	All construction plant and machinery will be fitted with emission control devices complying with the Australian Design Standards.
	Ensure combustion emissions are minimised	All vehicles, plant and machinery will be maintained and serviced in accordance with manufacturer's specifications.
	Ensure combustion emissions are minimised	Machinery will be turned off when not in use and not left to idle for prolonged periods.

6.1.1.5 Conclusion

Assessment of potential air quality impacts from remediation of the site was undertaken using the dataset of contaminants from mineral waste and soil samples reported in GHD (2018) to inform potential emission estimation based on proposed remediation activities.

The assessment estimated particulate emissions from equipment and remediation activities and dispersion modelling predicted worst-case concentrations surrounding the site.

Based on the assumptions, an exceedance of the silver criteria was predicted at the NSW State Emergency Service building (Copper Creek Road) and exceedances at and beyond the site boundary were predicted for lead and silver for the Rail Loading Area and Rail Precinct Area scenarios.

Exceedances at and beyond the site boundary (but not at sensitive receptor locations) were predicted for arsenic, cadmium, chromium (III+VI) and silver for the worst-case rest of site scenarios.

Modelling was not undertaken for site-wide dust impacts (only contaminated soil) however dust mitigation measures and real-time dust sampling during remediation are recommended to manage any potential impacts.

A summary of the potential impacts to air quality is provided in Section 7.

Mitigation measures would be implemented to reduce the potential impacts on air quality during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.1.2 Water impacts

6.1.2.1 Introduction

This section assesses the potential impacts on water associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential water impacts. This section draws upon a water impact assessment provided in Appendix F.

6.1.2.2 Methodology

The methodology for the water impact assessment is outlined below, with further detail provided in Appendix F.

6.1.2.2.1 Relevant guidelines and codes of practice

The water impact assessment was undertaken with reference to the following guidelines and codes of practice:

– *Water Quality Guidelines* (ANZG, 2008)
– *Manual Managing Urban Stormwater: Soils and Construction – Volume 1* (4th Edition) (Landcom, 2004)
– *Manual Managing Urban Stormwater: Soils and Construction – Volume 2* (DECC, 2008a)
– *Manual Managing Urban Stormwater: Soils and Construction – Volume 2E, Mines and quarries* (DECC, 2008b)
– *ESG2: Guideline for preparing a Review of Environmental Factors* (Department of Planning and Environment 2015).

6.1.2.2.2 Desktop assessment

The water impact assessment aims to identify impacts from the proposed remediation works, including ancillary works, and potential long-term benefits associated with the site's remediation. The assessment considered if the proposal would impact the following:

– Surface or groundwater use
– Water storage
– The hydrological network (waterbodies, runoff, riverine flows, etc.)
– Groundwater-related impacts
– Impacts arising from hydraulic fracturing
– Changes to the flooding or tidal regime
– Changes to water quality.

If likely impacts have not been identified, no further assessment was identified as necessary.

Following the initial issue identification, further assessment was undertaken to understand potential impacts on water quality from the proposed remediation works. Further assessment of the potential impacts to water quality involved the following methodology:

– Identifying existing water quality conditions and risks associated with the proposal
– Qualifying potential long-term changes to water quality
– Identifying additional risks during the proposed remediation works, including surface water management measures which may need to be implemented to manage risk
– Identifying potential mitigation and management measures, including monitoring to eliminate or reduce risks to water.

6.1.2.3 Assessment of impacts

6.1.2.3.1 Preliminary assessment

The results of the initial issue identification are presented in Table 6.7. Of the issues considered, water quality was deemed to require additional assessment (refer to Section 6.1.2.3.2).

Table 6.7 Initial water issue identification

Potential impact	Initial assessment	Further assessment required
Water sourcing		
Impacts arising from surface or groundwater use	Water would be sourced externally or from the existing/ temporary basins required to manage sedimentation. No licenced surface or groundwater would be used for the proposed remediation works or following the works. Water sourced from existing basins would only be utilised for environmental outcomes such as dust control and vegetation establishment. No water would be injected or used to stimulate fractures.	No
Water storage		
Impacts associated with water storage	Storage of water at the site occurs within environmental basins, designed to manage sedimentation in accordance with the *Protection of the Environment Operations Act 1997* (NSW). During the proposed remediation works, additional temporary basins may be required to capture runoff from disturbed areas in accordance with *Managing Urban Stormwater* (Landcom, 2004).and any environmental protection requirements specified by the NSW Environment Protection Authority or other relevant authority. No significant impacts are anticipated.	No
Hydrology		
Protect natural water levels in pools of creeks and rivers and wetlands during periods of no flows.	No change to river flow objectives, as changes to runoff patterns are not anticipated to affect regional hydrology. Works proposed in proximity to Forsters Creek are to remove previously stockpiled material which has spilled over the natural surface. This work is to involve exposing the natural surface by removing historically emplaced material. To minimise disturbance mobile plant will not operate on the bank or within the waterway, and the works are anticipated to improve long-term management. Disturbance of the existing unnatural surface may pose a risk to water quality associated with sedimentation, however, is not anticipated to influence river flow objectives. No-instream works are to be undertaken within Copper Creek. In summary, works are on a minor scale compared to the downstream system overall such that measurable change to river flow objectives is not anticipated. Furthermore, works restore conditions closer to those of a natural state which is consistent with the objectives. On that basis, no significant impacts are anticipated with relation to these objectives, and no further assessment was undertaken. No significant impacts are anticipated.	No
Protect natural low flows.		
Protect or restore a proportion of moderate flows ('freshes') and high flows		
Maintain or restore the natural inundation patterns and distribution of floodwaters supporting natural wetland and floodplain ecosystems		
Mimic the natural frequency, duration, and seasonal nature of drying periods in naturally temporary waterways		
Maintain or mimic natural flow variability in all streams		
Groundwater		
Groundwater related impacts	Capping of surfaces may reduce infiltration of rainwater into groundwater which flows through to the Molonglo River. However, runoff at the site also flows to the Molonglo River meaning no ultimate loss in water quantity to the Molonglo River. Molonglo River inflows are less likely to be of poor water quality. No significant impacts are anticipated.	No
Hydraulic fracturing		
Impacts arising from hydraulic fracturing	Hydraulic fracturing will not be used in the proposal. No impacts.	No
Changes to the flooding or tidal regime	Limited changes to the site's topography are proposed.	No

Potential impact	Initial assessment	Further assessment required
	Lower permeability capping material are being installed only in areas at higher elevations than rivers and current flood pathways. Lake George Mine is located above 1 in 100 AEP flood depths (Cardno, 2015). No significant impacts are anticipated.	
Water quality		
Changes to water quality	The proposal may have incremental water quality impacts during the proposed remediation works. The proposal may have long-term water quality benefits associated with the site's remediation.	Yes – Refer to Section 6.1.2.3.2.

6.1.2.3.2 Water quality

Remediation works impacts

During the proposed remediation works, there is an elevated risk associated with water quality associated with:

– Mobilisation of excess soil above existing rates into Forsters and Copper Creeks, and the Molonglo River, resulting in water quality impacts associated with suspended sediment and / or leaching of contaminants of concern
– Over application of liming products resulting in alkaline runoff, including other potential impacts associated with storing and handling this material on site.

These risks are considered moderate and are generally associated with the short-term potential risks during the 19 months of remediation works. Mitigation measures are proposed to eliminate or reduce these risks (refer to Section 6.1.2.4). As the site is progressively neutralised and vegetated through the remediation works, the identified risks to water quality would decrease.

Work areas in proximity to natural waterways, including remediation of the slag heap near and in Forsters Creek, shall include removal of any existing waste material that may has spilled into the natural waterway over the site's history. Within these areas, mobile plant shall operate on the top of bank only and shall not enter the bed or the banks of water courses. These works shall include removal of surficial waste to expose the natural surface, no additional cut or emplacement of material shall be permitted.

Where remediation works are completed on existing watercourse batters to expose the natural surface, the surface should be made stable. Where instabilities of the natural surface occur, i.e. landslips, tension cracking, slumping, etc. guidance shall be sought from the designer on additional engineering controls – this may include vegetation and/or geosynthetics and/or rock armouring.

Importantly, it is noted that even moderate changes to local runoff water quality associated with sediment loads are unlikely to pose a significant risk to downstream water quality compared to other point sources on the site, such as the Main Adit. The Main Adit contributes a very high proportion of existing zinc and lead loads into the downstream environment.

Post-remediation impacts

The proposed remediation works are expected to result in a significant improvement to water quality. No significant negative impacts are predicted when compared to the site's current (pre-remediation) water quality impacts.

A key aspect of the proposal is to improve environmental outcomes by reducing risks associated with contaminated runoff and sediment loading from exposed contaminants and disturbed soils at the proposal site.

Improvements to water quality and reduced mobilisation of soils is anticipated to occur through treating and capping; acting to stabilise the existing surface and isolate potentially contaminated materials from rainfall derived runoff and/or infiltration.

Contamination pathways associated with exposed material are anticipated to be significantly reduced, providing a post-remediation improvement in water quality. No significant negative impacts are anticipated.

6.1.2.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on water during the proposed remediation works are listed in Table 6.8. These mitigation measures are discussed in further detail in Appendix F.

Table 6.8 Mitigation measures – water

No.	Outcome	Mitigation measure
Construction mitigation measures		
W1	Provide specific guidance on the contractor's proposed water management strategy	A Construction Environmental Management Plan (CEMP) will be prepared by the Contractor, including a Surface Water Management Plan (SWMP) based upon the detailed design to provide specific further guidance on the Contractor's proposed water management strategy. The Surface Water Management Plan should be developed in accordance with Managing Urban Stormwater – Volume 1 (Landcom, 2004), Managing Urban Stormwater – Volume 2 (DECC, 2008a) and Managing Urban Stormwater – Volume 2E, Mines and quarries (DECC, 2008b), informally known as the 'Blue Book', this document, as well as any condition of consent and relevant agency requirements.
W2	Manage the erosion and sediment risk during the remediation works	To manage the erosion and sedimentation risk during the works, a system of engineered erosion and sedimentation controls. These controls should be implemented in accordance with the CEMP and the Surface Water Management Plan.
W3	Use of a lower risk liming product is not expected to have any significant water quality impacts	Use a lower-risk liming product, such as a calcium carbonate based agricultural lime on areas not subject to clay capping.
W4	Enable identification of any potential deficits at previous monitoring locations	Implement a water quality monitoring program to identify potential deficits in the site's environmental management during construction at previous monitoring locations, including key upstream and downstream locations, using similar analytes to allow for comparison to historical observations.
W5	Provide an action plan to resolve potential water quality issues	Implement a Trigger Action Response Plan (TARP) to identify trigger values and criteria and provide appropriate response actions if impacts during the remediation works are identified through the monitoring program.
Post-remediation mitigation measures		
W6	Confirm long-term benefits to water quality and identify any ongoing maintenance required for the capping system	Post remediation, monitor of water quality to identify any acute changes to water quality (anticipated benefits) arising from implementation of the remediation works, as well as any long-term trends following remediation. Post-remediation water monitoring will be included as part of the Long-Term Environmental Management Plan.
W7	Reduced sedimentation	Monthly inspections of vegetation establishment, including monitoring and rectification of any deficiencies (or as required in accordance with the Technical Specification of the works) for a minimum of 12 months.
W8	Channel stability	Quarterly visual stability inspections of Forsters Creek in proximity to the remediated slag heap.

6.1.2.5 Conclusion

The proposed remediation works is expected to result in a significant improvement to water quality. No significant negative impacts are predicted when compared to the site's current (pre-remediation) water quality impacts. A summary of the potential impacts to water is provided in Section 7. Mitigation measures would be implemented to reduce the potential impacts on water. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.1.3 Soil and stability impacts

6.1.3.1 Introduction

This section assesses the potential impacts on soil and stability associated with the proposed remediation works. Soil and stability impacts can include issues around soil degradation, erosion, loss of soil integrity, subsidence, and increased ground movements. The proposal will result in positive post-remediation impacts, as this is one of the stated aims of the proposed remedial works. Mitigation measures are identified to eliminate or otherwise reduce potential soil and stability impacts.

6.1.3.2 Methodology

The methodology for the soil and stability assessment is outlined below.

6.1.3.2.1 Relevant guidelines and codes of practice

The soil and stability impact assessment was undertaken with reference to the following guidelines and codes of practice:

- Landcom (2004). Manual Managing Urban Stormwater: Soils and Construction – Volume 1 (4th Edition)
- *Manual Managing Urban Stormwater: Soils and Construction – Volume 2,* (DECC, 2008a)
- *Manual Managing Urban Stormwater: Soils and Construction – Volume 2E, Mines and quarries* (DECC 2008b)
- AMIRA (2002). *Project P387A Prediction & Kinetic Control of Acid Mine Drainage – ARD Test Handbook.* April 2002. AMIRA International Limited, Melbourne
- INAP (2009). *Global Acid Rock Drainage Guide* (GARD Guide) http://www.inap.com.au/GARDGuide.htm The International Network for Acid Prevention
- Commonwealth Department of Foreign Affairs and Trade (DFAT) (2016a). *Preventing Acid and Metalliferous Drainage.* Canberra. Leading Practice Sustainable Development for the Mining Industry Series
- Commonwealth Department of Foreign Affairs and Trade (DFAT) (2016c). *Mine Rehabilitation.* Canberra. Leading Practice Sustainable Development for the Mining Industry Series
- Standards Australia, AS1726 – 2017, *Geotechnical Site Investigation*, 2017
- Standards Australia, AS1289, *Methods of Testing Soils for Engineering Purposes.*

6.1.3.2.2 Desktop assessment

Prior work undertaken by Dobos and Associates (2002), URS (2004) and GHD (2018) was used to establish the existing soil and stability condition at the proposal site. Existing conditions were used to understand:

- Prior disturbance to the site's ground surface
- Land features
- Erosion prone areas
- Areas with steeps slopes
- Soil physical and chemical characteristics
- Soil contamination
- Any other potential soil and stability matters.

The proposed remedial works were then considered to determine if they are likely to result in any significant impacts on soil quality of land stability including:

- Any degradation of soil quality, including contamination, salinisation or acidification
- Any loss of soil from wind or water erosion
- Any loss of structural integrity of the soil

– Any increased land instability with high risks from landslides or subsidence
– Any induced seismicity or ground movements associated with fracture stimulation or injection or extraction of groundwater.

6.1.3.2.3 Field survey

6.1.3.2.3.1 Geotechnical survey

In addition, geotechnical field surveys were undertaken by GHD in August and October 2021. These investigations involved a targeted fieldwork program comprising of Cone Penetrometer Testing with porewater pressure measurements (CPTu), borehole drilling and test pitting at selected sites in the vicinity of the proposed structures, to assess the sub-surface conditions and to provide geotechnical information for areas on the Northern Dumps scheduled to be affected by remedial works and/or be the site of a future Water Treatment Plant.

An example of the test pitting is shown in Figure 6.2. Dynamic Cone Penetrometer Tests (DCP) were conducted adjacent to the test pits to assess capping/tails consistency and provide a strength correlation. The work was undertaken to ensure the Northern Dumps had suitable strength to accommodate remediation plant and equipment, stockpiles and the containment cell.

The geotechnical surveys also involved cone penetration testing and shear strength, the results of which were also used to determine the geotechnical engineering properties of the soil and delineating soil stratigraphy. These tests are used to gain an understanding of the subsurface condition and geotechnical soil properties as being fit for purpose for hosting the proposed activities. The geotechnical survey confirmed the thickness and permeability of the existing clay capping on the Northern Dumps, the suitability of the Northern Dumps to host a proposed Water Treatment Plant and that the proposed access road can be safely trafficked by the proposed remediation plant and equipment.

Figure 6.2 Test pits on Northern Dumps

6.1.3.2.3.2 Biological survey

In addition, field surveys were conducted as a part of the biological impact assessment in August 2021 (refer Section 6.2). The survey assisted with spatial validation of disturbed soil areas.

6.1.3.3 Assessment of impacts

6.1.3.3.1 During remediation

Erosion and sediment impacts

The proposal would result in earthworks which have the potential to mobilise sediment at Lake George Mine, which has the potential to enter nearby watercourses which is discussed further is Section 6.1.2. Similarly, earthworks activity could mobilise contaminated material. Mobilisation of sediment could occur if stockpile areas are not managed appropriately.

Impacts from spills and leaks

There is potential for impacts to soil and water quality due to spills and leaks of hydrocarbons from the operation of plant and equipment. Such impacts would be minimised through the implementation of standard safeguards and management measures to ensure spills are contained and removed.

Asbestos

Given the age and nature of the operations on site at the Lake George Mine, the Captains Flat Railway Precinct and the Lead Abatement Areas in the Captains Flat township, it remains possible that asbestos may present through remedial works.

Where asbestos is identified during remedial works, it will be gathered to a contained centralised location for legal disposal in line with an Unexpected Finds Protocol within the Construction Environmental Management Plan to be prepared by the Principal Contractor.

6.1.3.3.2 Post-remediation

The purpose of the proposal is to contain key contaminant sources on the proposal site that are contributing to reduced soil quality in the receiving environment. The remediation works would significantly reduce the likelihood of contaminants entering the surrounding off-site environment. This would significantly improve general soil condition, which is currently impacted by contaminants, thereby allowing native vegetation to be reinstated, further reducing erosion risk whilst also providing biodiversity and habitat. The removal of sulfidic mineral waste and the laying of non-saline subsoils will likely reduce the salinity levels of the soil at the proposal site.

6.1.3.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on soil and stability during the proposed remediation works are listed in Table 6.9.

Table 6.9 Mitigation measures – soil and stability

No.	Outcome	Mitigation measure
Construction impacts		
SS1	Controls would minimise the amount of material which would enter the surrounding environment	Erosion and sediment controls would be implemented in accordance with Volume 1, 2C and 2E of *Managing Urban Stormwater: soils and construction* (Landcom 2004; DECC NSW, 2008a; DECC NSW 2008b). These should not extend across waterways as this may interrupt fish passage (as applicable given the ephemeral and degraded condition of Copper and Forster's Creeks).
SS2	Ensures control measures are maintained.	Erosion and sediment control measures would be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality.

No.	Outcome	Mitigation measure
SS3	Minimises time period that surfaces will have higher risk of sediment mobilisation.	Stabilised surfaces would be rehabilitated as quickly as practicable after construction.
SS4	Reduced potential of material to be mobilised from stockpile.	Stockpiled material would be stabilised / covered where feasible / bunded and contained, as required, during extended periods of time; such as when heavy rainfall is forecast.
SS5	Reduces potential contamination of soil from hydrocarbon spills.	Measures to minimise the potential for hydrocarbon spills or release of contaminated material and associated impacts on natural environments adjacent to, and downstream, of the proposal site.
SS6	Reduced movement of contaminated soil onto roads	The CEMP would include controls to limit the transfer of contaminated soil onto public roads such as a truck wash for example.
SS7	Asbestos management	Develop and implement an Unexpected Finds Protocol for asbestos within the CEMP

6.1.3.5 Conclusion

A summary of the potential impacts to soil and stability is provided in Section 7.

Mitigation measures would be implemented to reduce the potential impacts on soil and stability during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.1.4 Noise and vibration impacts

6.1.4.1 Introduction

This section assesses the potential noise and vibration impacts associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential impacts. This section draws upon a noise and vibration impact assessment provided in Appendix G.

6.1.4.2 Methodology

The methodology for the noise and vibration assessment is outlined below, with further detail provided in Appendix G.

6.1.4.2.1 Relevant guidelines and codes of practice

The noise and vibration assessment was undertaken with reference to the following guidelines and codes of practice:

– *Interim Construction Noise Guideline* (DECC, 2009)
– *Road Noise Policy* (DECCW, 2011)
– *Assessing Vibration: A Technical Guideline* (DEC, 2006)
– *ESG2: Guideline for preparing a Review of Environmental Factors* (Department of Planning and Environment 2015).

6.1.4.2.2 Noise and vibration criteria

Criteria were adopted for construction noise, road traffic noise, and vibration impacts at the proposal site based on the guidelines/codes of practices listed in Section 6.1.4.2.1. The criteria are outlined in Table 6.10 through Table 6.13.

Table 6.10 Project-specific noise management levels

Sensitive receiver type	Construction Noise Management Level ($L_{Aeq,15min}$)	
	Noise affected level	Highly noise affected level
Residential	45	75
Educational institutions	45	
Active recreation	65	
Passive recreation	60	

Table 6.11 Human comfort intermittent vibration limits (BS 6472-1992)

Receiver type	Period	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day (7 am to 10 pm)	0.2	0.4
	Night (10 pm to 7 am)	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8

Table 6.12 Transient vibration guide values – minimal risk of cosmetic damage

Type of building	Peak component particle velocity in frequency range of predominant pulse		Adopted criteria
	4 Hz to 15 Hz	15 Hz and above	
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s	50 mm/s	25 mm/s
Unreinforced or light framed structures. Residential or light commercial type building	15 mm/s	20 mm/s increasing to 50 mm/s at 40 Hz and above	7.5 mm/s

Table 6.13 Road traffic noise criteria, dBA

Development type	Relevant road	Noise criteria (standard hours)
Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	Captains Flat Road	$L_{Aeq,15hr}$ 60 (external)
Existing residences affected by additional traffic on existing local roads generated by land use developments	Braidwood Road Foxlow Road Miners Road	$L_{Aeq,1hr}$ 55 (external)

6.1.4.2.3 Sensitive receivers

A number of sensitive residential and recreational receivers have been identified in the vicinity of the proposal site. Receivers have been sorted into noise catchment areas, as mapped in Figure 6.3. Receivers isolated from other buildings (e.g. 8 Copper Creek Road, Catchment Area 4) were given individual catchment areas to avoid unnecessarily large catchment areas close to the proposal site. A full list of addresses associated with each catchment area is provided in Table 2.2.

Predicted noise levels were calculated at the worst affected point for each catchment area.

6.1.4.2.4 Construction modelling methodology

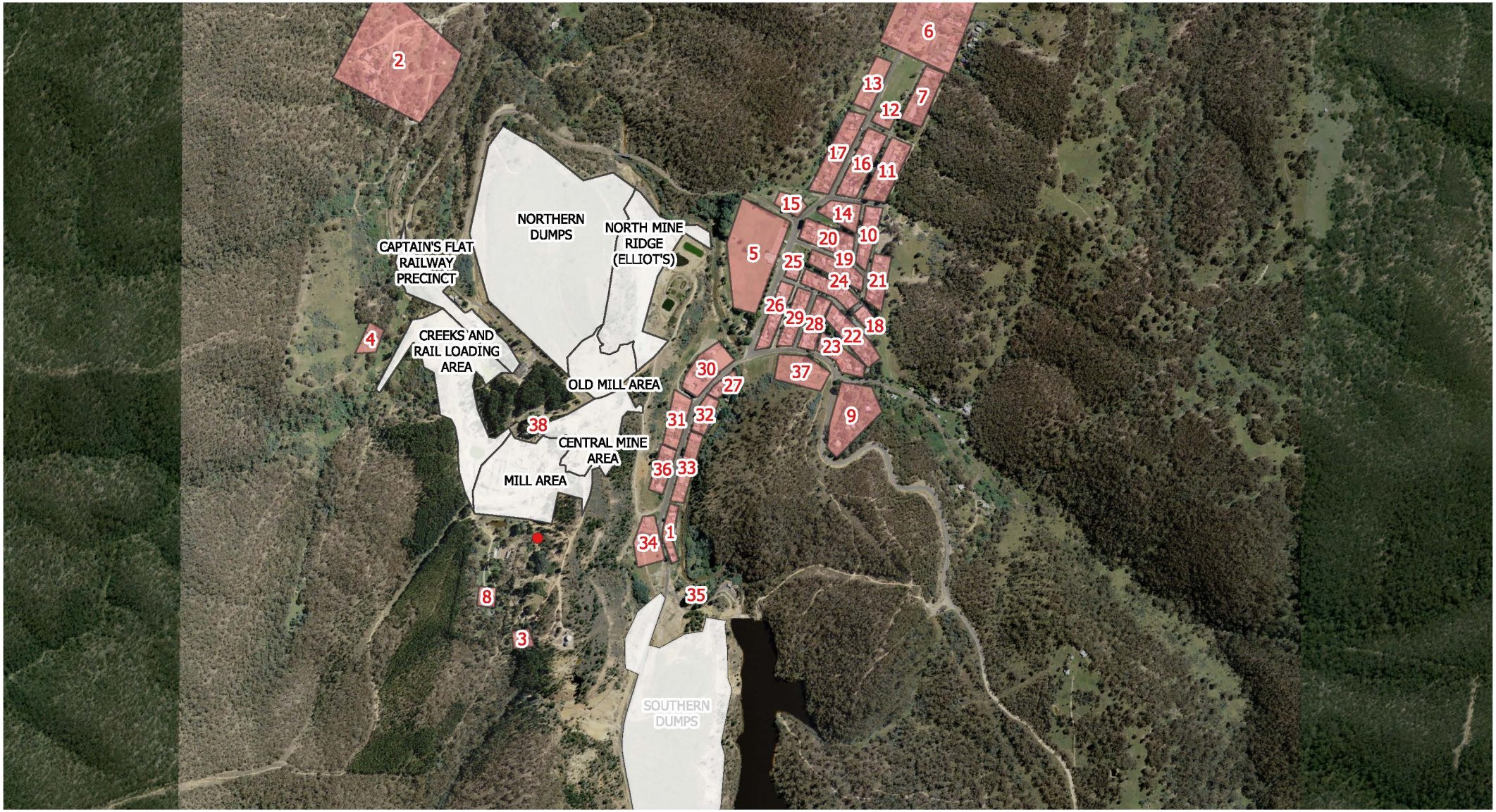
Noise modelling for construction noise impacts was conducted using *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'* in CadnaA 2021 noise modelling software. A summary of modelling assumptions is provided in Appendix G. The proposed remediation works were assumed to take place in five major stages, as summarised in Table 6.14.

Table 6.14 Work stage - noise

Stage	Activity outline	Noise sources	Total Sound Power Level (SWL), dBA
1	Site preparation	Two loudest machines operating simultaneously; assuming: – One grader at SPL 115dBA – One water cart at SPL 109dBA.	115
2	Fencing of historic structures	Two light trucks at SPL 84dBA One water truck at SPL 109dBA One person speaking at SPL 76dBA.	109
3	Remediation earthworks & structural works	Two loudest machines operating simultaneously; assuming: – One bulldozer at SPL 109dBA – One excavator at 108dBA.	112
4	Drainage augmentation	Two loudest machines operating simultaneously; assuming: – One excavator at 108dBA – One compactor at 111dBA.	112
5	Revegetation	Two light trucks at SPL 84dBA One water truck at SPL 109dBA One person speaking at SPL 76dBA.	109

Safe working distances for vibratory intensive equipment were sourced from the TfNSW Construction Noise and Vibration Guideline (CNVG) and were compared to receiver distances from the proposal site for all catchment areas (RMS, 2016).

Two haulage routes are anticipated in relation to the proposed works, a route to the north purely on Captains Flat Road south of Hoskinstown Road, and an eastern traffic route including Captains Flat Road south of George Street and Foxlow Street north of Miners Road. Noise from traffic generated during the proposed remediation works was modelled using the RMS Construction noise estimator tool which utilised existing traffic volumes obtained from daily traffic counts. Miners Road is included in the haulage routes; however, the closest residences are over 200 metres from this road and noise levels from additional traffic are not anticipated to exceed the controlling criteria at these properties.



Legend

- Proposal site
- Noise monitoring location
- Noise catchment areas

Paper Size ISO A4

0 . 0.5 km

N

Map Projection: Transverse Mercator
Horizontal Datum: GDA2020
Grid: GDA2020 MGA Zone 55

GHD

Dept of Regional NSW

LAKE GEORGE MINE REMEDIATION

Proposal site, noise catchment areas, and noise monitoring locations

Project No. **12551771**
Revision No. **-**
Date. **15/03/2022**

FIGURE 6.3

Document Path: \\ghdnet\ghd\AU\Sydney\Projects\21\12551771\Tech\Noise\Modelling\Updated boundaries\mapping.qgz
Print Date: 15/03/2022

Data Source:Google Earth Imagery 2021.
Created By: smullins2

6.1.4.2.5 Field survey

Unattended noise monitoring was undertaken at the proposal site between 10 and 24 August 2021. The data collected by the noise loggers was downloaded and analysed to exclude data considered invalid due to adverse weather conditions (periods of time where average wind speeds were greater than 5 m/s, or when rainfall occurred). Noise logger data results are summarised in Table 6.15 and noise monitoring charts are presented in Appendix G.

Noise levels surrounding the proposal site are very low, as such, the minimum noise levels outlined in the Noise Policy for Industry (NPfI, EPA 2017) were adopted for the noise and vibration assessment.

Table 6.15 Summary of unattended monitoring results, dBA - noise

Day	Background noise descriptors[1], $L_{A90(Period)}$,			Ambient noise descriptors[1], $L_{Aeq(15m)}$		
	Day	Evening	Night	Day	Evening	Night
Thurs 12th August 2021	24	51	20	44	60	50
13th August 2021	21	55	18	45	61	52
14th August 2021	19	51	17	45	61	48
Sun 15th August 2021	17	51	29	41	60	47
16th August 2021	25	19	17	44	49	43
17th August 2021	17	19	16	41	55	34
18th August 2021	19	26	16	41	56	39
19th August 2021	19	24	16	40	55	42
20th August 2021	21	37	18	43	54	41
21st August 2021	23	39	19	43	56	44
Sun 22nd August 2021	21	54	35	44	61	56
23rd August 2021	34	59	34	48	63	40
24th August 2021	30			42		
Total	**35[2] (21)**	**30[3] (45)**	**30[2] (18)**	**44**	**59**	**48**

Notes: 1. The *Noise Policy for Industry (NPfI)* defines day, evening and night-time periods as:
- Day: 7am to 6pm Monday to Saturday and 8am to 6pm Sunday
- Evening: 6pm to 10pm
- Night: 10pm to 7am Monday to Saturday and 10pm to 8am Sunday.

2. Minimum RBLs as outlined in Table 2.1 of the NPfI have been adopted.
3. Due to extraneous noise during the evening period, the rating background level has been adjusted to the minimum RBLs in line with the day and evening periods.
4. Values marked in red denote time periods where extraneous noise has been removed.

6.1.4.3 Assessment of impacts

6.1.4.3.1 Construction noise impacts

All five work stages shown in Table 6.14 would result in the potential for an exceedance of the residential Noise Management Level (NML) for at least one receiver in the vicinity of Captains Flat. These exceedances are only predicted to occur for worst-case scenario works in particular areas of the proposal site. In particular, Work Scenario 3 has the potential to result in an exceedance of the NML for the educational receiver at 14 Montgomery Street within Noise Catchment Area 11, and for the passive and active recreational receivers in Noise Catchments 30 and 5 respectively.

A summary of predicted noise levels at each catchment area for each work stage is provided in Table 6.16. Detailed results are provided in the noise and vibration assessment in Appendix G.

Table 6.16 Maximum construction noise exceedances – noise and vibration

Catchment ID	Criteria	Maximum potential predicted noise levels of any receivers (L_{Aeq}, dBA)				
		Site Establishment	Fencing	Excavation	Drainage	Revegetation
1	45	62	58	69	64	58
2	45	60	50	61	56	50
3	45	52	52	63	58	52
4	45	66	52	63	58	52
5	65	70	52	63	58	52
6	45	37	55	66	61	55
7	45	46	49	60	55	49
8	45	56	50	62	57	50
9	45	44	48	59	54	48
10	45	47	47	59	53	47
11	45	46	43	54	49	43
12	45	44	42	53	48	42
13	45	39	41	53	47	41
14	45	52	40	51	46	40
15	45	54	47	58	53	47
16	45	49	45	56	51	45
17	45	53	43	54	49	43
18	45	52	41	53	47	41
19	45	53	36	47	42	36
20	45	57	47	59	53	47
21	45	46	44	55	50	44
22	45	50	41	53	48	41
23	45	51	42	54	48	42
24	45	55	39	50	45	39
25	45	57	36	47	42	36
26	45	57	36	48	43	36
27	45	58	29	40	35	29
28	45	52	33	45	39	33
29	45	53	35	47	41	35
30	45	65	26	37	32	26
31	45	62	34	45	40	34
32	45	60	46	57	52	46
33	45	59	42	53	48	42
34	45	60	50	61	56	50
35	45	67	61	72	67	61
36	45	61	57	68	63	57
37	45	55	45	57	51	45
38	45	77	67	78	73	67

The majority of noise catchment areas are anticipated to experience exceedances of the Residential Noise Management Level; of these, catchments 35 and 38 are expected to be worst impacted, with anticipated noise levels exceeding the Highly Affected Noise Level for residential receivers during Construction Scenario 3. A number of recommendations for noise mitigation measures have been given in the report in Appendix G, and are also listed in Section 9.

With appropriate mitigation and management measures implemented (as outlined in Section 6.4.1.4), the predicted noise impacts on affected receivers could be reduced. The application of mufflers / silencers on relevant machinery, as advised in the mitigation measures, could be expected to reduce received noise levels by 5-10dB. This would likely be sufficient to eliminate the Highly Affected Noise Level exceedance at catchments 35 and 38 and the exceedances at educational and recreational receivers in catchments 5, 11, and 30, but would not be sufficient to prevent exceedances of the NML at other residential receivers in the vicinity of the site. Therefore, even with mitigation and management measures in place, a medium adverse impact could still be expected at the worst affected noise catchment areas in the vicinity of the proposed works.

6.1.4.3.2 Vibration impacts

There are no sensitive receivers within the cosmetic damage zones for any vibratory roller types available for use at the proposal site. However, a number of sensitive receivers / catchment areas fall wholly or partially within 100 metres of the proposed work areas and may experience vibration levels above the human comfort criteria. These sensitive receivers/catchment areas and their distance to the proposal site boundary are listed in Table 6.17.

Table 6.17 Potentially affected residences, vibration impacts – noise and vibration

Catchment ID	Address	Distance to proposal site boundary (m)
1	6-18 Foxlow Street	73
5	73 Foxlow Street	57
30	51-59 Foxlow Street	90
34	15-19 Foxlow Street	81
35	2 Foxlow Street	36
38	5 Old Mines Road	11

The mitigation and management measures (as outlined in Section 6.4.1.4) include recommendations to select plant and equipment with smaller safe work distances of only 40 metres for human comfort. This would exclude the majority of the receivers noted in Table 6.17, with the exception of catchments 35 and 38. Due to the distance of catchment 35 from the proposed site, and the limited time over which any works would take place within the radius of effect for this receiver, a low adverse impact is expected for these works. However, significant care would be required to avoid the potential for human comfort exceedances or cosmetic damage to the residential receiver at noise catchment 38.

6.1.4.3.3 Road traffic noise impacts

Predicted noise impacts for an increase in road traffic are given below in Table 6.18. At all assessed roads, noise increase due to additional traffic to and from the site is below the trigger level of 2dBA. As such, no significant traffic noise impacts are anticipated at any residential receivers as a result of the proposed remediation works. Vehicle movements along Beverley Hills Road and Railway Crescent have not been included in this assessment as no vehicle movements are planned directly on these routes as part of the proposed works; however, the receivers on these roads fall under the assessment of the northern haulage route (Captains Flat Road south of Hoskinstown Road).

Table 6.18 Predicted road traffic noise impacts – noise and vibration

Scenario	Road	Road type	Distance to nearest receiver (m)	Increase in road noise (dBA)	Noise level at nearest receiver (dBA)
1 – Light traffic only	Captains Flat Road south of Hoskinstown Road	Sub-arterial	45	0.1	46.9
2 – Delivery stage	Captains Flat Road south of Hoskinstown Road	Sub-arterial	45	0.7	47.6
3 – Lime deliveries	Captains Flat Road south of George Street	Sub-arterial	18	0.3	48
	Foxlow Street north of Miners Road	Local	8	1.0	49.6

With the relevant mitigation and management measures in place, road traffic noise is expected to have a low adverse impact on the receivers in the vicinity of the proposal site.

6.1.4.4 Construction noise management and mitigation

It is predicted that construction activities could exceed the construction noise management levels for the proposal in a number of locations. Mitigation measures proposed to eliminate or otherwise reduce potential noise impacts during the proposed remediation works are listed in Table 6.19.

Table 6.19 Mitigation measures – noise

Number	Outcome	Mitigation measure
NV1	Ensure awareness of potential noise impacts by all employees and contractors	Ensure employees, contractors and subcontractors receive an environmental induction. The induction must include: – All proposal-specific and relevant standard noise and vibration mitigation measures – Relevant licence and approval conditions – Permissible hours of work – Any limitations on high noise generating activities – Location of nearest sensitive receivers – Construction employee parking areas – Designated loading/unloading areas and procedures – Site opening/closing times (including deliveries) – Environmental incident procedures.
NV2	Avoid noise impacts during sensitive time periods	Confine activities on site between the hours: daytime hours of 7:00 am to 6:00 pm from Monday to Friday and 8:00 am to 1:00 pm on Saturday, with the exception of the following activities: – The delivery of oversized plant of structures – Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm. The need for additional works required to be undertaken outside of standard construction hours (ICNG) should be justified in the CEMP for the proposed remediation works and assessed against the noise requirements of the ICNG. Consult with affected neighbours about scheduling activities to minimise noise impacts. Schedule work generating high noise and/or vibration levels during less sensitive time periods.
NV3	Avoid noise-generating behaviours	– Avoid the use of radios or stereos outdoors where neighbours can be affected. – Avoid shouting and minimise talking loudly and slamming vehicle doors. – Reduce throttle setting and turn off equipment when not being used. – Avoid use of reversing alarms by designing site layout to avoid reversing, such as by including drive- through for parking and deliveries.

Number	Outcome	Mitigation measure
		– Install where feasible and reasonable less-annoying alternatives to the typical 'beeper' alarms, taking into account the requirements of any relevant Occupational Health and Safety legislation (in particular, the Interim Construction Noise Guideline); examples are multifrequency alarms that emit noise over a wide range of frequencies.
NV4	Construction Noise and Vibration Management Plan (CNVMP)	Prepare a CNVMP. Include a review of the construction noise predictions assessed during the environmental impact assessment phase based on the methodology and revise accordingly to include a detailed examination of feasible and reasonable work practices and noise mitigation measures to manage sensitive receivers that are predicted to be 'noise affected'. The CNVMP should also include: – Details of the construction methodology – Feasible and reasonable mitigation measures to be implemented – Updated noise predictions at sensitive receivers – A noise monitoring procedure for the duration of works – A community consultation plan to liaise with the noise affected receivers.
NV5	Minimise noise impacts from tonal alarms	Fit and use non-tonal reversing beepers (or an equivalent mechanism) on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
NV6	Ensure use of less impactful equipment	Use quieter and less vibration emitting construction methods, where feasible and reasonable.
NV7	Minimise noise from plant and equipment	Select, where feasible and reasonable, the most effective mufflers. Always seek the manufacturer's advice before making modifications to plant to reduce noise. Silencers/mufflers are required on the following mobile plant: – Dozers – Graders – Backhoe – Loaders – Concrete trucks – as applicable – Rollers – Asphalt pavers – as applicable – Excavators – Trucks – Water carts – Bobcats – Scrapers.
NV8	Alter direction of noise emission	Orient equipment with directional noise characteristics away from noise sensitive receivers.
NV9	Reduced equipment power	Use only the necessary size and power.
NV10	Minimise disturbance arising from delivery of goods to construction sites.	– Ensure loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. – Select site access points and roads as far as possible away from sensitive receivers. – Shield dedicated loading/unloading areas if close to sensitive receivers. – Fit delivery vehicles with straps rather than chains for unloading, wherever possible. – Avoid or minimise out of hours movements, where possible.
NV11	Avoid noise from compression braking	– Limit the use of engine compression brakes in proximity to residences. – Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.

Number	Outcome	Mitigation measure
NV12	Block noise between source and receiver	– Use temporary site buildings and materials stockpiles as noise barriers. – Use natural landform as noise barrier – place fixed equipment in cuttings, or behind earth berms.
NV13	Compliance noise and vibration monitoring	Ensure a noise monitoring procedure is developed and carried out for the duration of works in accordance with the CNVMP and any approval or licence conditions. Monitoring reports should be prepared in accordance with the requirements of the noise monitoring procedures.
NV14	Minimise complaints	Compliance monitoring should be undertaken to investigate complaints.

6.1.4.5 Vibration impact management and mitigation

Vibration impacts are anticipated for works including the use of a vibratory roller of type VR4 or greater (7 or more tonnes). Mitigation measures proposed to eliminate or otherwise reduce potential vibration impacts during the proposed remediation works are listed in Table 6.20.

Table 6.20 Mitigation measures – vibration

Number	Outcome	Mitigation Measure
NV15	Avoid use of impactful machinery	Where vibratory rollers may be required, use plant types of type VR3 or lower (i.e. 6 tonnes or less) if works are within the buffer distances (100 metres from sensitive receivers).
NV16	Community engagement	Notify residents in potentially affected catchment zones prior to use of any vibratory within the human response zones outlined in Section 6.1.4.3.2.
NV17	Area avoidance	Wherever possible, avoid the use of any vibrating roller within 15 metres of the residential building at 5 Old Mines Road.

6.1.4.6 Road traffic noise management and mitigation

No significant exceedances to noise criteria are predicted from road traffic due to the proposed remediation works. However, a number of mitigation strategies are outlined below to ensure compliance with the relevant criteria.

Number	Outcome	Mitigation Measure
NV18	Limit traffic volumes	Ensure delivery truck movements not exceed the following hourly volumes: – Day period 7am* to 6 pm – 6 in and 6 out – Evening period 6 pm to 9 pm – 2 in and 2 out – Night period – 6 am to 7* am - 1 in and 1 out. *8 am on Sundays and public holidays. No truck deliveries should occur between 9 pm and 6 am.
NV19	Minimise noise from delivery trucks	– Ensure all trucks are in good working order and comply with the relevant noise emissions standards by checks and regular inspection. – Operations should be designed to minimise reversing on site. – Keep to speed limits on public roads and onsite. – Where possible, driving of trucks should minimise: • Heavy acceleration and braking • Engine/compression braking (especially during the evening and night) • Reversing using tonal alarms, where feasible.

6.1.4.7 Conclusion

The proposed works are expected to impact nearby receivers from the perspective of construction noise (medium adverse impact), construction vibration (low adverse impact), and road traffic noise (low adverse impact). A summary of the potential noise and vibration impacts is provided in Section 7.

Mitigation measures would be implemented to reduce potential noise and vibration impacts during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.1.5 Other physical or pollution impacts

6.1.5.1 Introduction

This section assesses any other potential physical or pollution impacts that may be associated with the proposed remediation works. Other physical or pollution impacts include those impacts not already covered in Section 6.1. These include impacts to coastal areas and impacts associated with waste generation. Mitigation measures are identified to eliminate or otherwise reduce other potential physical or pollution impacts.

6.1.5.2 Methodology

6.1.5.2.1 Relevant guidelines and codes of practice

The assessment of other physical and pollution impacts was undertaken with reference to the following guidelines and codes of practice:

– *Waste Classification Guidelines – Part 1: Classification of waste.* (EPA 2014)
– *ESG2: Guideline for preparing a Review of Environmental Factors* (Department of Planning and Environment 2015).

6.1.5.2.2 Desktop assessment

A desktop assessment of publicly available information was undertaken to assess other physical and pollution impacts. The assessment of other physical and pollution impacts was also informed by the results of the technical studies undertaken for the REF.

6.1.5.3 Assessment of impacts

This section addresses other potential physical and pollution impacts, including an assessment of:

– Coastal processes and coastal hazards
– Use, generation, storage, and transportation of hazardous substances/chemicals
– Generation and disposal of waste.

6.1.5.3.1 Coastal processes and coastal hazards

The proposed remediation works would not impact on coastal processes or coastal hazards as the proposal site is not located on a coastline. The proposal site is located approximately 80 kilometres to the west of the NSW coastline.

6.1.5.3.2 Use, generation, storage, and transportation of hazardous substances/chemicals

Use and storage

The proposed remediation works involve applying a liming product to neutralise acidic soils. Over application of liming products has the risk to result in alkaline runoff. Storing and handling these materials similarly can pose a risk to soil and water quality. This risk may be higher if non-calcium carbonate-based products, such as oxide or hydroxide-based products, are used. Therefore, as discussed in Section 6.1.2, a lower-risk liming product (a calcium carbonate based agricultural lime) should be used when broadacre liming the *in situ* surface soils. These lower risk liming products are not anticipated to have a significant impact on water quality.

The LMP is proposing to beneficially use an industrial waste derived alternative alkaline product in the Northern Dumps containment cell to mitigate the risk of acidity generation from oxidising sulfides in the relocated mineral waste. The use of the alkaline product would be made permissible under a Resource Recovery Order and Exemption issued by the NSW EPA under the *Protection of the Environment Operations (Waste) Regulation 2014*. It is proposed that around 9,000 tonnes of the alkaline material would be imported to site, with a portion of that to be transported and stockpiled on the bunded laydown area at the designated stockpile area on the Northern Dumps and/or the contingency site located on the Creeks and Rail Loading Area during site preparatory early works. The material is effectively a more saline carbonate product than traditional agricultural lime. Appropriate stockpile management techniques would therefore be employed to mitigate surface water quality impacts through

appropriate bunding and drainage works in accordance with the Erosion and Sediment Control Plan within the CEMP developed using Landcom (2004), DECC NSW (2008a and b).

Hydrocarbons such as oils and fuel will be used by plant and equipment during the proposed remediation works. Any spills of oils and fuels have the potential to report to nearby creeks. Such impacts would be minimised through the implementation of safeguards and management measures to ensure spills are contained and removed. The incorrect storage of fuel and oils could also result in impacts on water quality.

Generation

There would be no generation of hazardous substances / chemicals on site during the proposed remediation works.

Transportation

Some of the proposed remediation works would require on-site transportation of contaminated mineral waste and soil to the containment cell on the Northern Dumps. There therefore remains the potential for accidental spill of contaminated soil and/or mineral waste resulting in potential impacts to soil and/or water quality. Mitigation measures would be implemented to reduce the impact associated with accidental spills of soil and/or mineral waste as outlined in Section 6.1.5.4. There would be no transportation of contaminated soil off-site.

Generation and disposal of waste

The proposed works would generate excavated spoil, structural waste, and general waste. The waste types and proposed waste disposal methods are listed in Table 6.21.

Structural and general waste would be removed from site at time intervals appropriate to maintain the work areas in a tidy and litter-free condition. Waste would be transported and disposed of in accordance with the *Waste Classification Guidelines* (EPA 2014) and the *Protection of the Environment Operations Act 1997* (NSW). At the completion of proposed remediation works, a check would be made to ensure that no waste has been left from the remedial works.

No waste related to the proposal would be generated on site following completion of the proposed remediation works.

Table 6.21 Estimated waste generation

Waste	Disposal	Responsibility
Excavated soil / fill	To be encapsulated on site at Northern Dumps	Remediation contractor
Structural waste	Removed for licenced off-site disposal	Remediation contractor
General and food waste	To be disposed of off-site as domestic waste	Remediation contractor
Existing domestic refuse currently located on site	To be disposed of off-site as domestic waste	Remediation contractor
General construction waste such as oils and oily rags	Removed for licenced off-site disposal	Remediation contractor
Human effluent from the on site ablutions facility used by remediation contractors on site	Removed for licenced off-site disposal	Remediation contractor

6.1.5.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce other physical or pollution impacts during the proposed remediation works are listed in Table 6.22.

Table 6.22 Mitigation measures – other physical or pollution impacts

No.	Outcome	Mitigation measure
Hazardous substances / chemicals		
OPP1	Use of a lower risk liming product is not expected to have significant water quality impacts	Use a lower-risk liming product, such as a calcium carbonate based agricultural lime except in the containment cell which would remain an enclosed and controlled environment.
OPP2	Reduced risk of impacts from hydrocarbon spills	Measures to minimise the potential for hydrocarbon spills or release of contaminated material and associated impacts on natural environments adjacent to, and downstream, of the proposal site.
OPP3	Spillage that occurs during transportation of contaminated waste would be removed	Ensure that contaminated soil spilled during transportation on site is collected and appropriately contained at the Northern Dumps.
OPP4	Safer transportation of contaminated material	Trucks would be covered when transporting contaminated material between the Slag Heap and the Northern Dumps containment cell.
Waste		
OPP5	Waste shall be disposed of according to best practice	Ensure waste that is to be disposed of off-site is classified in accordance with the *Waste Classification Guidelines* (EPA, 2014) and that it is removed and disposed of at a facility that can lawfully accept the waste in accordance with the POEO Act and POEO Waste Regulation.
OPP6	Waste practice dictated by clear instruction	Document and implement waste mitigation and management strategies in accordance with the CEMP. This shall include: – Waste management facilities on-site including their set-up, use, management removal and waste tracking documentation. Enclosed waste bins should be made available on site for domestic waste including light weight plastic to ensure it remains secure. – Waste hierarchy application including information demonstrating the reduction of the amount of waste produced and the maximised reuse and recycling opportunities utilised. – Appropriate waste management across all possible waste items produced.
OPP7	Waste managed appropriately throughout the proposed remediation work and all waste removed from site	Remove waste on a weekly basis, or as soon as reasonably practicable. At the completion of works, a check shall be made to ensure that all waste has been removed from site.
OPP8	Waste removed by appropriately qualified contractors	Ensure waste is removed by an appropriately licenced contractor.

6.1.5.5 Conclusion

Other physical and pollution impacts are assessed as being low adverse impacts. The proposal would involve the transportation of hazardous, contaminated soil; however, all soil would be disposed of on-site and would be appropriately remediated. The proposal would temporarily generate other wastes associated with construction. Volumes of waste would be small-scale and would be transported and disposed of by appropriately licenced contractors in accordance with the *Waste Classification Guidelines* (EPA 2014) and the *Protection of the Environment Operations Act 1997* (NSW).

A summary of the other potential physical and pollution impacts is provided in Section 7. Mitigation measures would be implemented to reduce other potential physical and pollution impacts during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.2 Assessment of biological impacts

6.2.1 Flora and fauna impacts

6.2.1.1 Introduction

This section assesses the potential impacts on flora and fauna impacts associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential impacts. This section draws on a biodiversity assessment report provided as Appendix H.

6.2.1.2 Methodology

The methodology for the biodiversity assessment is outlined below, with further detail provided in Appendix H

6.2.1.2.1 Relevant guidelines and codes of practice

The biodiversity assessment was undertaken with reference to the following guidelines and codes of practice:

– *Matters of National Environmental Significance, Significant Impact Guidelines 1.1* (DoE 2013)
– *Policy and guidelines for fish habitat conservation and management* (DPI 2013a)
– *Bat Roosts, private native forestry advisory note 7* (DECC 2007).

6.2.1.2.2 Desktop assessment

A database search was carried out to create a list of threatened flora and fauna species, populations and ecological communities (threatened biota) listed under the *NSW Biodiversity Conservation Act 2016* (BC Act) and *Fisheries Management Act 1994* (FM Act), and Matters of National Environmental Significance (MNES) listed under the Commonwealth Environmental Protection and *Biodiversity Conservation Act 1999* (EPBC Act) that could be expected to occur in the locality based on previous records, known distribution ranges, and habitats present. Biodiversity databases and existing literature and information pertaining to the site and locality (i.e. within a 10 kilometres radius of the site) that were reviewed prior to conducting field investigations included:

– NSW Department of Planning, Industry and Environment (DPIE) BioNet Atlas for records of threatened biota previously recorded in the locality (website for the Atlas of NSW Wildlife) (EES 2021a) and Threatened Biodiversity Data Collection (TBDC) profiles of threatened species listed under the BC Act (EES 2021b)
– DPIE Threatened biodiversity profile search online database for threatened ecological communities and species listed under the BC Act (EES 2021b)
– Department of Agriculture, Water and the Environment (DAWE) EPBC Act Protected Matters Search Tool – for a 10 kilometre radius around the study area (DAWE 2021a)
– DAWE online Species profiles and threats database (SPRAT) (DAWE 2021b)
– NSW BioNet Vegetation Classification (EES 2021c) to identify matching plant community types (PCTs) in the site
– DPI Fisheries NSW Spatial Data Portal
– NSW Department of Primary Industries (DPI) priority weed declarations – South East region (DPI 2021)
– Aerial photographs and satellite imagery of the site
– Available regional-scale vegetation mapping of the South East and South Coast Region (DPIE 2011a, DPIE 2011b, DPIE 2010).

6.2.1.2.3 Field survey

Field survey was conducted on the 12 to 13 August 2021 to assess the presence of flora, fauna and hollow-bearing trees, and to identify areas of biodiversity constraint for proposed remediation. Survey included:

– Site stratification and vegetation mapping
– Sampling of vegetation integrity plot/transects
– Habitat assessments

– Targeted surveys for threatened flora
– Targeted surveys for threatened fauna.

Supplementary microbat surveys were conducted on 22 to 23 November 2021. These surveys were conducted to identify microbat and diurnal bird species presence. These surveys included:

– Habitat assessment
– Diurnal bird surveys
– Call playback
– Spotlighting
– Ultrasonic call recording targeting microbats at derelict man-made structures
– Harp trapping
– Roost watch at derelict man-made structures.

6.2.1.2.4 Consultation with stakeholders

Biodiversity consultation with stakeholders was limited to those undertaken by the Proponent more broadly relating to the REF activities.

6.2.1.3 Assessment of impacts

Direct impacts of rehabilitation

The remediation of contamination land at Lake George Mine would require the neutralisation of contaminated soils with *in situ* lime, ripping and/or capping with 30 centimetres thick soil and / or rock mulch layer. The remediation would occur within denuded areas, as well as transitional zones between contaminated, denuded and also vegetated areas, where the Principal Contractor would define the spatial extent of vegetation clearance for remediation of the underlying soil in 'real time' to improve the potential for vegetation growth following remediation. Direct impacts to native vegetation would mainly comprise clearing of degraded understorey vegetation on the edges of bare areas, and impacts to small, fragmented patches of degraded woodland and pine forest. The majority of the vegetation that would be removed or modified would be exotic grassland. Some native forbs and grasses occurring within exotic grassland would also be removed.

The area of vegetation within the maximum extent of remediation is shown in Table 6.23, comprising a conservative upper limit of vegetation clearing for the proposal. The actual extent of vegetation removal is likely to be less than the areas shown in Table 6.23. The majority of the Northern and Southern Dumps do not require vegetation remediation works as they have undergone previous capping and comprise large areas of exotic grassland. Minor areas that were observed to be eroded or bare do not sustain vegetation and are proposed for remediation. Exotic grassland on the edges of these eroded and denuded areas would require vegetation removal as part of the remediation works. As such, while all vegetation on the Northern and Southern Dumps has been included when calculating vegetation clearance, in reality, only a small fraction of unvegetated areas within these domains will be remediated and require additional vegetation removal (nominally ~5-10 per cent).

Direct impacts to small areas of native vegetation communities may be required. The impacts are restricted to the edge of patches of degraded native vegetation. The removal of mature trees from Apple Box - Blakely's Red Gum moist valley open forest adjacent to the Captains Flat Railway Precinct may be required, with the actual extent of removal likely to be ~only 0.04 hectares (in contrast to the 0.36 hectares anticipated for potential removal within the maximum remediation extent, based on the level of contamination previously recorded (Ramboll 2022). Vegetation removal in the North Mine Ridge / Elliot's area would occur within the transition zone on the western edge of Broad-leaved Peppermint-Mountain Gum dry open forest (degraded pine forest) and adjacent bare areas in exotic grassland, where contamination is present. Again, this patch of vegetation would be largely retained with only slight disturbance at its edges.

A summary of the areas of vegetation types to be removed is provided in Table 6.23. As discussed above, vegetation removal would be largely restricted to exotic grassland on the edges of contaminated areas, and it is likely that the majority of native vegetation occurring in the maximum spatial extent of remediation areas would be retained during the remediation works. However, for the purposes of impact calculations, it is assumed that all vegetation within the maximum spatial extent of remediation areas will be impacted and that vehicle access, work

compounds, stockpiles and any additional earthworks required to facilitate removal of contaminated material would be restricted to cleared land and exotic vegetation. This approach was adopted to retain flexibility for the Principal Contractor on site, and therefore, is deemed a conservative approach that represents a worst-case scenario.

Table 6.23 Vegetation within remediation area

Vegetation type	Condition	BC Act Status [1]	EPBC Act Status [1]	Area (ha) of Vegetation within indicative disturbance area
Apple Box - Blakely's Red Gum moist valley and footslopes grass-forb open forest (PCT 283)	Medium	CEEC	CEEC	0.36
Broad-leaved Peppermint – Mountain Gum dry open forest (PCT 730)	Degraded Pine Forest			3.57
Broad-leaved Peppermint – Mountain Gum dry open forest (PCT 730)	Degraded/medium condition			1.72
Non-Native	Exotic grassland			24.50
Total native vegetation				**5.66**

Note: 1. CEEC – Critically endangered ecological community

Rehabilitation works within the site would remove a small number of individuals of non-threatened native mid and understorey plants and noxious and environmental weeds and degraded pine. Provided the weed management measures proposed herein are adopted, the proposal is likely to result in some positive impacts on retained native vegetation by reducing the abundance of exotic plants in the site. Additional planting of native plants in indicative remediation areas would also improve condition of the vegetation at Lake George Mine, although the natural ingress of native plants from the surrounding environment will provide the long-term transition to native plants across the remediated sites.

The clearing of predominantly exotic grassland would remove a very small proportion of foraging resources, shelter and nesting habitat for local populations of native fauna. Alternative habitat resources and refuge from remediation and rehabilitation works is available in native vegetation adjoining the site.

Remediation and rehabilitation works may result in the injury or mortality of small terrestrial fauna that may be sheltering in vegetation at the site, such as the frogs and reptiles, as well as nesting birds or nestlings. There are substantial areas of habitat outside the site that would provide refuge and alternative resources for fauna. More mobile native fauna such as native birds, bats, and arboreal mammals are highly unlikely to be affected by the remediation and rehabilitation activities. Removal of the Surge Bin and Loading Tunnels would injure roosting microbats or lead to mortality if present. However, survey results suggest that these structures are not used frequently or by a large number of microbats. Derelict mine structures at the site are unlikely to contain a maternity colony or substantial numbers of roosting microbats. Demolition of these structures is only likely to harm a small proportion of any locally occurring microbat populations (if any).

Indirect impacts of rehabilitation

Indirect effects on flora and fauna during remediation and rehabilitation works could potentially include the following:

– Edge effects: vegetation removal can affect adjoining or adjacent areas of vegetation and habitat through increased weed growth, increased noise and light or erosion and sedimentation at the interface of vegetation and cleared areas. Edge effects can result from vegetation clearance, where a new edge is created between vegetation and cleared areas, or from widening or extending of access tracks through existing vegetation. Given the existing degree of fragmentation present on the study site, the proposal is unlikely to substantially increase this indirect impact.
– Noise: there is likely to be limited, temporary impacts on fauna utilising adjacent areas of habitat during remediation and rehabilitation works associated with noise. Human activities (including agricultural activities and road traffic) already occur within the locality. Remediation and rehabilitation works would temporarily increase noise and potentially disturb resident fauna in the area. Any Southern Myotis or other cave-roosting

bats roosting within the Surge Bin would be indirectly impacted by the noise and vibration impacts associated with conventional earthmoving equipment such as dozers and excavators. Remediation and rehabilitation works impacts would be short term and limited to standard working hours. Some fauna may move out of areas proximal to high levels of noise but would then likely move back once works are completed.

– Erosion and sedimentation: Clearing of vegetation may increase erosion and sedimentation within ephemeral creeks including Copper Creek. Uncontrolled erosion of topsoil from excavated areas and exposed soils and corresponding deposition into native vegetation, Copper Creek or the Molonglo River can cause weed problems and stifle plant growth. Remediation and rehabilitation work also has the potential to further expose contaminated soils and result in additional mobilisation of these soils, which could result in further contamination of surrounding areas. Sediment runoff to waterways from exposed soils due to riparian vegetation clearing and/or earthworks can adversely affect aquatic life by altering water quality and filling aquatic habitat with fine sediment. As the site currently comprises mostly bare, contaminated ground with a high potential for erosion, the proposed works are unlikely to increase the risk of erosion and sedimentation. In fact, the planned revegetation of these bare, contaminated areas is expected to have a positive impact in the medium to long term.
– Dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), workers' shoes and clothing and through construction vehicles. Although weed species are already present on the site, there is a possibility that more invasive or otherwise damaging environmental weeds may be introduced or further spread during construction. Depending upon the weeds introduced to the sites, this could result in a decline in native vegetation and associated native fauna habitats. However, the planting of an appropriate sterile cover crop will assist in the reduction of weeds.
– Potential spread of soil-borne pathogens of native plants (e.g. *Phytophthora cinnamomi*) or water-borne pathogens of frogs (*chytrid fungus*) spread via workers' shoes and clothing and via construction vehicles. Spread of soil and water-borne pathogens could continue to occur following rehabilitation works through visits from the general public.
– Accidental spills of oils or other chemicals during the remediation and rehabilitation works, resulting in a decline in flora and fauna habitat and potential mortality to individuals.

A discussion on biosecurity issues is provided in Section 6.2.2.

Impacts on threatened and migratory biota

Removal of contaminated material from the Captains Flat Rail Line has the potential to directly impact the adjoining patch of Box Gum Woodland. The area has been previously cleared for the rail line and comprises regenerating vegetation subject to edge effects. The clearing would likely be limited to shrubs and groundcover, although some mature trees may be impacted once the extent of contamination is fully delineated. The remediation and rehabilitation work has the potential to result in disturbance of sediments including contaminants, which could affect surrounding native vegetation. This native vegetation is already likely to be subject to erosion of contaminated soils and associated sedimentation from the decommissioned mine. The potential for contamination or increased sediment inputs during remediation and rehabilitation works can be avoided or minimised through the implementation of appropriate mitigation measures.

The proposal is unlikely to result in a significant impact on Box Gum Woodland, pursuant to Section 7.3 of the BC Act given:

– Up to 0.36 hectares of Box Gum Woodland would be impacted by the proposal, mainly comprising degraded edge vegetation adjacent to a heavily contaminated decommissioned mine and railway line.
– The proposal will not isolate any stands of this community in the locality.
– The proposal will not threaten the persistence of the local occurrence of the community.
– In the medium to long term rehabilitation works at Captains Flat Mine are likely to improve the condition of adjoining vegetation.

A separate assessment of significance was prepared in accordance with the EPBC Act significant impact guidelines (see Appendix H). The proposal is unlikely to result in a significant impact on the local or regional occurrence of Box Gum Woodland listed under the EPBC Act, given:

– The small area of vegetation that may be impacted along a disturbed and contaminated edge or a larger tract of vegetation.
– The proposal would result in negligible fragmentation of the community.
– No stands would become isolated.
– There will be no modification to abiotic factors necessary for the community's survival.
– The proposal is unlikely to result in a substantial negative change in the species composition of the community.
– There is unlikely to be a substantial reduction in the quality or integrity of the community through the introduction of invasive species or the regular mobilisation of pollutants or chemicals which will kill or inhibit the community.

The removal of exotic pine forest and patchy eucalypt woodland in the site and intact eucalypt forest in the surrounds would reduce breeding and foraging habitat for Flame Robin (recorded in the site) in addition to other woodland birds. An assessment of the likely significance of potential impacts on small woodland birds has been prepared and is presented in Appendix H. The proposal is unlikely to have a significant impact on small woodland birds as:

– No Flame Robin nests were identified despite targeted surveys around locations where both male and female Flame Robins were recorded.
– A negligible area of foraging habitat for woodland birds would be removed and the extent of foraging and shelter habitat would increase following revegetation works.
– Given the limited extent and quality of vegetation to be removed it is unlikely to comprise important habitat for these species in the locality.

There is the potential for direct injury or mortality of cave-roosting microbats (including Southern Myotis, Large Bent-winged Bat and Large-eared Pied Bat), if present within the Surge Bin, loading tunnels and concentrate bins during demolition. The remediation and rehabilitation work have the potential to indirectly disturb microbats if roosting within the surge bin. Low levels of bat activity were revealed by Anabat detectors, and no bats were revealed by dusk monitoring of the derelict mine structures or captured in harp traps suggesting that these structures are not used frequently or by a large number of microbats. Derelict mine structures at the site are unlikely to contain a maternity colony or substantial numbers of roosting microbats. Demolition of these structures is only likely to harm a small proportion of any locally occurring populations of threatened microbat species (if any).

An assessment of the likely significance of potential impacts on cave-roosting microbats has been prepared and is presented in Appendix H. The proposal is unlikely to have a significant impact on cave-roosting microbats as:

– No direct evidence that a local population of these species occurs at the site or that derelict mine structures comprise important habitat for a local population of these species.
– A negligible area of foraging habitat for Large-eared Pied Bat and Large Bent-winged Bat would be removed and the extent of foraging habitat would increase following revegetation works.
– No foraging habitat for the Southern Myotis would be removed or modified.
– The potential roosting habitat that would be removed in the Surge Bin, loading tunnel and concentrate bins would comprise a small proportion of the potential roosting habitat associated with hollow-bearing trees and caves within the adjacent Tallaganda National Park, Tallaganda State Forest and Yanunbeyan National Parks.

A species impact statement is not likely to be required.

The proposal would not result in a significant impact on any threatened aquatic biota listed under the FM Act as none are likely to occur within the site or be impacted by the proposal.

No migratory species were recorded during the survey. The Fork-tailed Swift (*Apus pacificus*), White-throated Needletail (*Hirundapus caudacutus*) and Rufous Fantail (*Rhipidura rufifrons*) may occur on occasion. The proposal would not remove any important habitat for these species and would not affect an ecologically significant proportion of a population of these species as defined in the significant impact guidelines (DoE 2013). The proposal would not result in significant impact on any migratory species.

Operational impacts

Following remediation and rehabilitation works, the above-ground areas of Lake George Mine would continue to remain open to the public. Sporadic visits from the general public occur currently, and this would continue in the future. The fencing of derelict mine structures as part of the remediation process is likely to prevent human disturbance to roosting microbats if present.

6.2.1.4 Mitigation measures

The site is located in a highly modified environment, with substantial clearing of native vegetation having occurred historically. Adjoining patches of Box-Gum Woodland and degraded patches of Broad-leaved Peppermint – Mountain Gum dry open forest contain fauna habitat and are sensitive receptors for indirect impacts.

The derelict structures and abandoned mine workings within the mine site may provide habitat for cave-dependent microbats. If bats are roosting in the structures, the removal of these structures may result in impacts to a local population of cave roosting bats. The extent of remediation has been revised through the design process to avoid direct impacts to abandoned mine workings where possible. Specific mitigation measures are proposed for these species to minimise potential impacts as far as possible.

The overall remedial strategy for the Captains Flat Capping Project is to improve the condition of the contaminated areas on site such that they sustain native vegetation, whilst retaining the mining heritage feel of the site. Areas slated for remediation using Capping Options 1, 2 and 4 (see Table 4.3) would be re-vegetated following neutralisation and capping. Areas being remediated using Capping Options 3 would not be revegetated, although vegetation may become established in these rock mulch areas over time. To ensure initial site stabilisation, and therefore, reduced erosion and weed colonisation following remediation, a sterile 'nurse' crop of pioneer species, including non-native grasses, would be used (see Table 6.24). As noted above, the long-term objective of the remedial works is to remediate the land so that native vegetation from surrounding areas can re-establish.

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on biodiversity during the proposed remediation works are listed in Table 6.24.

Table 6.24 Mitigation measures – flora and fauna

No.	Outcome	Mitigation measure
FF1	General	A Construction Environmental Management Plan (CEMP) will be prepared, including the specific mitigation measures and sub plans listed below along with work methods, contingencies, roles and responsibilities. The mitigation measures included in the CEMP and sub-plans would be implemented during remediation and rehabilitation works. All workers must be provided with an environmental induction prior to starting remediation and rehabilitation works on site. This would include information on the ecological values of the site and protection measures to be implemented to protect biodiversity during remediation and rehabilitation. This would focus particularly on measures to avoid or minimise disturbance of roosting microbats and minimising impacts on the adjacent Box Gum Woodland EEC.
FF02	Vegetation	To reduce the potential for adverse impacts on ecologically sensitive areas the following measures would be implemented: – Confirmation of the final spatial extent of vegetation clearance required for remediation of the underlying soil. – A site inspection prior to the commencement of vegetation clearing to clearly demarcate vegetation protection areas and clearing limits with a particular focus on minimising clearing of Box-Gum Woodland with reference to Figure 4.1 of this report. – Hygiene protocols would be followed to prevent the introduction and spread of pathogens. All machinery and plant should be cleaned prior to work on site.

No.	Outcome	Mitigation measure
		– Weed control mitigation and management strategies shall be documented and implemented in accordance with the CEMP and *Biosecurity Act 2015*. This shall include procedures to reduce the spread of weeds via vehicles and machinery with particular focus on weeds of concern such as Serrated Tussock, which is particularly abundant in grassland areas throughout Lake George Mine. – Post remediation rehabilitation of disturbed or exposed surfaces should include planting of a cover crop to minimise the erosion risk in line with the *Lake George Mine Capping and revegetation works technical specification* (App B). This will include: • Grass seed sown in accordance with the supplier's requirements and/or achieve a minimum 70 per cent cover per square metre • Lightly raking the topsoil surface after sowing and watering the area immediately • Regular watering through the establishment period in accordance with the suppliers requirements • Protection of revegetated areas from pedestrians and animals until the grass has established, and from vehicles or heavy plant at all times • Maintenance of revegetation areas for a period of 12 months. It is noted that the initial ground cover will be a sterile exotic cover crop.
FF03	Fauna	To reduce the potential for adverse impacts on fauna and fauna habitat the following measures will be implemented: – Fencing of retained derelict structures to avoid disturbance to potential microbat roosting habitat within Lake George Mine – Retention and relocation of woody debris within the mine site which provide important habitat components for small woodland birds. – A local vet or wildlife carer should be identified as a contact during clearing operations and contacted if wildlife is injured during clearing operations. – Demolition of derelict mine structures should not occur during the breeding seasons for cave-roosting microbats. Breeding season occurs from approximately October to February.
FF04	Water Quality	The following measures should be incorporated into the CEMP to manage impacts on aquatic habitats and water quality: – Measures to minimise the potential for chemical spills or release of contaminated material and associated impacts on natural environments adjacent to and downstream of the site. – Erosion and sediment controls would be implemented in accordance with Volume 1, 2 and 2E of Managing Urban Stormwater: soils and construction (Landcom 2004; DECC 2008a, 2008b). – Erosion and sediment control measures would be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality. – Stabilised surfaces would be rehabilitated as quickly as practicable after construction. – All stockpiled material would be stored in bunded areas and kept away from waterways to avoid sediment entering the waterway. – Dust suppression techniques such as water spraying and covering stockpiles would be implemented, where necessary. – Vehicles would follow appropriate speeds to limit dust generation. – Specific measures will be incorporated to minimise the potential for chemical spills and associated impacts on natural environments adjacent to and downstream of the site.

6.2.1.5 Conclusion

Overall, the potential impacts to flora and fauna from the remediation works that may occur during remedial activities and post-remediation would be minor. A summary of the potential impacts to flora and fauna is provided in Section 7.

Mitigation measures would be implemented to reduce the potential impacts on biodiversity during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.2.2 Ecological and biosecurity impacts

6.2.2.1 Introduction

This section assesses the potential impacts on biosecurity matters associated with the proposed remediation works. Ecological issues are addressed in Section 3.5 and Section 6.2.1. Mitigation measures are identified to eliminate or otherwise reduce potential impacts. This section draws on the biodiversity assessment report provided as Appendix H.

6.2.2.2 Methodology

The methodology for the biosecurity assessment is outlined in Section 6.2.1, with further detail provided in the biodiversity assessment report provided in Appendix H.

6.2.2.3 Assessment of impacts

Biosecurity matters

Biosecurity issues were considered during the biodiversity impact assessment. This assessment considered the potential for the proposal to introduce or increase the risk from vertebrate animal pests, plant pests and diseases, noxious weeds, and animal diseases that pose risks to animal and human health. Impacts from genetically modified organisms is not a risk from this proposal.

Edge effects in adjoining or adjacent areas of vegetation and habitat include the potential for increased weed growth, at the interface of vegetation and cleared areas. Edge effects can result from vegetation clearance, where a new edge is created between vegetation and cleared areas, or from widening or extending of access tracks through existing vegetation. Given the existing degree of fragmentation present on the study site, the proposal is unlikely to substantially increase this indirect impact.

Clearing of vegetation and groundworks may increase erosion. Uncontrolled erosion of topsoil from excavated areas and exposed soils and corresponding deposition into native vegetation, Copper Creek or the Molonglo River may cause weed problems. Dispersal of weed propagules (seeds, stems and flowers) could be via wind or water erosion, workers' shoes and clothing and through construction vehicles. Although weed species are already present on the site, there is a possibility that more invasive or otherwise damaging environmental weeds may be introduced or further spread during construction. Depending upon the weeds introduced to the sites, this could result in a decline in native vegetation and associated native fauna habitats. As the site currently comprises mostly bare, contaminated ground with a high potential for erosion, the proposed works are unlikely to increase the risk of erosion.

Potential spread of soil-borne pathogens of native plants (e.g. *Phytophthora cinnamomi*) or water-borne pathogens of frogs (chytrid fungus) spread via workers' shoes and clothing and via construction vehicles. Spread of soil and water-borne pathogens could continue to occur following rehabilitation works through visits from the general public.

A number of key threatening process as defined under the BC Act relate to biosecurity matters. These are summarised in Table 6.25.

Table 6.25 Key threatening processes

Key Threatening Process	Status	Comment
Weeds		
Invasion of plant communities by perennial exotic grasses	BC Act	There is the potential for perennial exotic grasses to invade adjacent native vegetation through disturbance during remediation and rehabilitation works. The proposal would include environmental management measures, including weed management and specific consideration of potential impacts on soil, water and native vegetation.

Key Threatening Process	Status	Comment
Disease		
Infection of native plants by *Phytophthora cinnamomi*	BC Act; EPBC Act	Construction activities have the potential to introduce *Phytopthora* into the site, through the transport and movement of plant, machinery and vehicles, as well as through any landscaping works following construction. The proposal would include environmental management measures, including specific consideration of measures to reduce potential impacts on soil, water and native vegetation.
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	BC Act	Construction activities have the potential to introduce Myrtle Rust to the site. The proposal would include environmental management measures, including specific consideration of measures to reduce potential impacts on soil, water and native vegetation.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	BC Act; EPBC Act	Construction activities have the potential to introduce amphibian chytrid to the site, which could lead to death of local frogs. The proposal would include environmental management measures including specific consideration of measures to reduce potential impacts on soil, water and native vegetation.

Bushfire risk

The area around Lake George Mine is all classified as bushfire prone land and is categorised as Vegetation Category 1 according to the NSW Government planning portal (Figure 6.4). Category 1 vegetation is the highest hazard classification for bush fire hazard and includes vegetation formations such as forest, woodland, and tall heath/shrublands. It has the highest combustibility and likelihood of forming fully developed fires including heavy ember production.

The proposal site, on the basis of its existing degraded vegetation cover, is presently categorised as Vegetation Category 3. This is considered to comprise medium bush fire risk vegetation. However, following remediation of surface soil profiles in the proposed remediation areas, revegetation works involving the establishment of a self-sustaining vegetation communities is proposed to be undertaken. The long-term objective is that the site is dominated by native grasses, herbs and shrub species found in the grassy woodlands and dry sclerophyll forests of surrounding areas. Species may include silver wattle (*Acacia dealbata*), green wattle (*Acacia mearnsii*), bitter pea (*Daviesia mimisoides*), dogwood (*Cassinia sp*.), bush pea (*Pultenaea procumbens*), tussock grass (*Poa labillardierer*) and redanther wallaby grass (*Joycea pallida*). The remediated surface soil profile is also likely to provide a suitable seedbed for natural recolonisation of tree and shrub species from adjacent native forest areas. Accordingly, under the proposed revegetation works it can reasonably be expected that the remediated site areas will transition from Category 3 vegetation to Category 1 vegetation in the remediation Option 2 areas where revegetation is proposed (Figure 6.4), with a commensurate increase in bushfire risk.

Additionally, during the juvenile periods of tree and shrub species utilised in the revegetation works, the revegetating areas will be highly vulnerable to bushfire damage. The proposed species to be used in revegetating the site are comprised principally of obligate seeder species and in their juvenile life stage are readily killed by bushfire. These species will require protection from bushfire until they have matured and have been able to establish a viable seedbank from which they can regenerate if impacted by fire.

Large areas of the Lake George Mine site will retain their existing grassy cover or bare unvegetated condition, including the extensive Northern and Southern Dumps and Quarry Area adjacent to the Council Sewage Treatment Facility. However, in the remediation areas along the outer boundaries of the Northern Dumps in particular, it is expected there will be a transition of vegetation cover from Category 3 to Category 1 vegetation hazard. Substantial areas where revegetation is proposed are west of the Northern Dumps, more than 600 metres from the western edge of Captains Flat township and are already classified as Category 1 vegetation. However, revegetation works in the more eastern areas including the Central Mine, Old Mill, and North Mine Ridge/Elliotts areas will have the effect of expanding Category 1 vegetation cover closer to Captains Flat township. Bushfire prone land mapping (sourced from NSW Government ePlanning spatial viewer 23/9/2021) applying to the Captains Flat/Lake George Mine site locality has been reproduced as Figure 6.4.

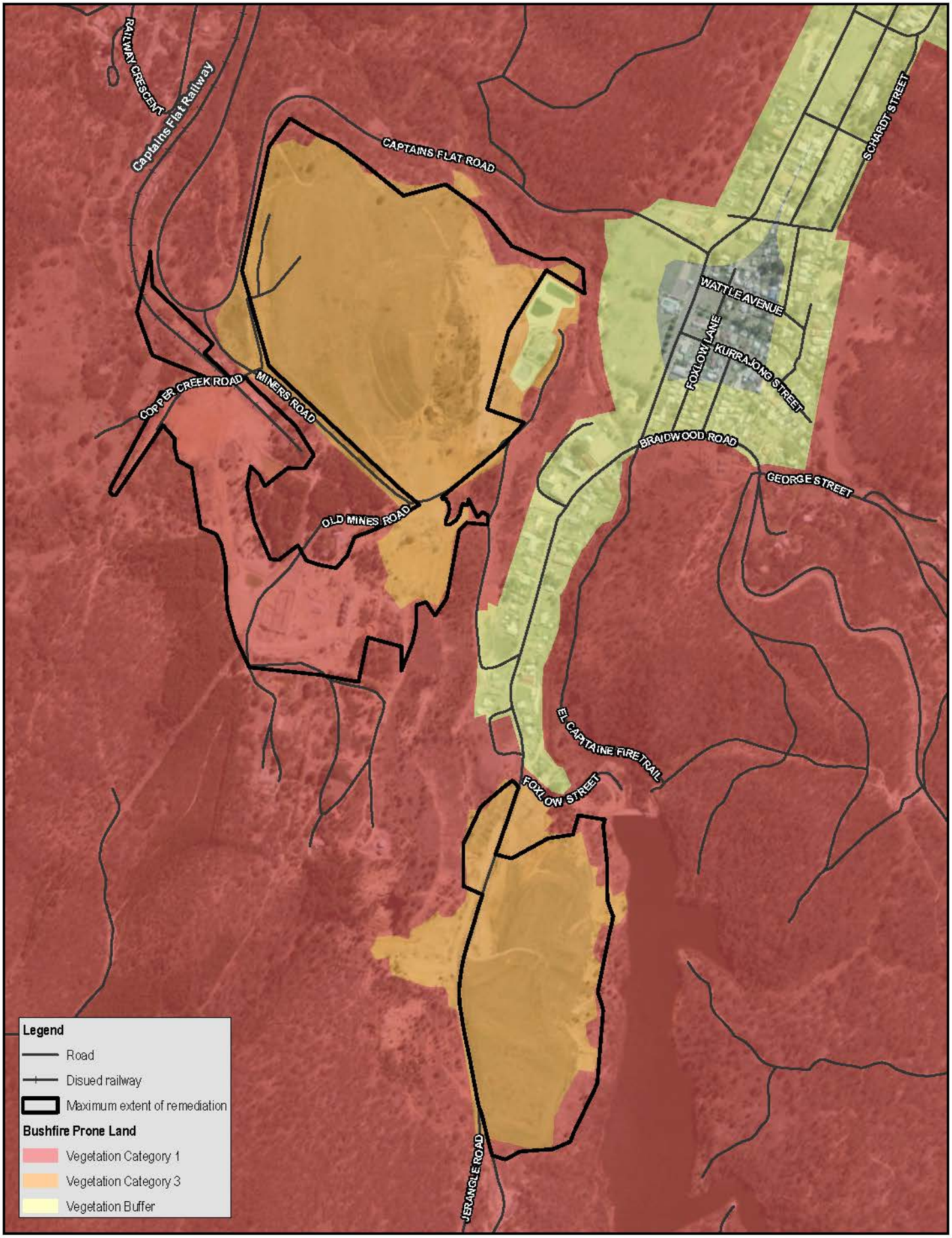
The areas depicted in orange in Figure 6.4 are the Category 3 vegetation areas corresponding generally to the Northern and Southern Dumps areas of the Lake George Mine site area. These extensive dump areas can be expected to remain as Category 3 vegetation, however, other areas where revegetation works occur will become Category 1 vegetation, thus expanding the extent of Category 1 vegetation near the western edge of Captains Flat township, from where the most adverse fire weather typically prevails during the bushfire danger period.

Accordingly, for the reasons outlined above, it will be important for a bushfire risk management plan to be developed as part of the proposed remediation project and be captured in the Long Term Management Plan to be implemented post remedial works. The bushfire risk management plan will need to be developed in conjunction with revegetation planning to avoid incompatibilities between revegetation works and bushfire risk management requirements. Ideally, the bushfire risk management plan will need to cover:

– Identification of the spatial areas proposed to be vegetated, and the particulars of the vegetation to be established;
– Assessment of the vegetation hazard category attributable to the re-established vegetation areas;
– Identification of the fire-vulnerable period for the vegetation communities proposed to be established;
– The locations of firebreaks and trails necessary to enable protection of the establishing vegetation during its vulnerable establishment period;
– Identification of any areas adjacent to the rehabilitation area where it would be desirable to undertake fuel reduction burning to mitigate bushfire risk to the rehabilitation area during its fire-vulnerable period;
– The locations and dimensions of fire breaks and trails between the western edge of Captains Flat township and the rehabilitated areas to ensure adequate bushfire risk mitigation for the Captains Flat township/community (to be undertaken in consultation with NSW Rural Fire Service and the Captains Flat Rural Fire Brigade);
– Details of fire and emergency service access to the Lake George Mine site area for fire preparedness and response operations; and
– Risk assessment and control measures for the prevention of bushfire ignition and spread from construction phase activities associated with the remediation project (see further context below).

During the remediation project, activities which have the highest accidental fire ignition risk would comprise the use of plant and equipment and from general construction activities. Construction methodology would be developed by the contractor and could include grinding and cutting. These activities which could cause sparks from metal on metal or rock friction during ground works to move materials. In addition, discarded cigarette butts from smokers are also a risk.

Bushfire risk will be included as part of site-specific hazard and risk management assessment and management measures.



Paper Size ISO A4

0 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA1994
Grid: GDA1994 MGA Zone 55

N

GHD

Department of Regional NSW
Lake George Mine Remediation

Project No. 12551771
Revision No. A
Date 23/03/2022

Bushfire prone land mapping – Captains Flat area

FIGURE 6.4

Data source: General topography - Sixmaps via SSNSW © Department of Customer Service 2020. Created by: eibbertson

6.2.2.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on biosecurity matters and from bushfire risk during the proposed remediation works are listed in Table 6.26.

Table 6.26 Mitigation measures – biosecurity

No.	Outcome	Mitigation measure
BS1	Manage biosecurity issues and bushfire risk.	A Construction Environmental Management Plan (CEMP) will be prepared, including the specific mitigation measures and sub plans listed below along with work methods, contingencies, roles and responsibilities. The mitigation measures included in the CEMP and sub-plans would be implemented during remediation and rehabilitation works. Ensure all workers are provided with an environmental induction prior to starting remediation and rehabilitation works on site. This would include information on the ecological values of the site and protection measures to be implemented to prevent biosecurity issues during remediation and rehabilitation. The CEMP will include a bushfire risk assessment and management protocol.
BS2	Minimise impacts to biosecurity	To reduce the potential for adverse impacts to biosecurity the following measures would be implemented: – Hygiene protocols would be followed to prevent the introduction and spread of pathogens. All machinery and plant should be cleaned prior to work on site. – Weed control mitigation and management strategies shall be documented and implemented in accordance with the CEMP and Biosecurity Act 2015. This shall include procedures to reduce the spread of weeds via vehicles and machinery with particular focus on weeds of concern such as Serrated Tussock, which is particularly abundant in grassland areas throughout Lake George Mine.
BS3	Minimise risk from Bushfire	Measures to mitigate and manage bushfire risk will be developed and included as part of site-specific hazard and risk management measures for the proposal. Measures will include the maintenance of ancillary facilities in a tidy and orderly manner and the storage and management of dangerous goods and hazardous materials in a safe location.
BS4	Incident response	An incident response management plan will be developed and implemented. This plan will include bushfire risks. The response to incidents will be managed in accordance with the requirements of NSW Rural Fire Service, NSW Fire Brigade and other emergency services.

6.2.2.5 Conclusion

Overall, the potential impacts to biosecurity from the remediation works that may occur during construction and operation would be minor with the incorporation of the proposed mitigation measures. A summary of the potential risks from biosecurity matters and bushfire is provided in Section 7.

Mitigation measures would be implemented to reduce the potential impacts on biosecurity during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

A Bushfire Risk Management Plan would be developed and implemented as a sub-plan to the long-term post remediation Environmental Management Plan for the site.

6.3 Assessment of resource use impacts

6.3.1 Community resources

6.3.1.1 Introduction

This section assesses the potential impacts on community resources associated with the proposed remediation works. No mitigation measures are proposed.

6.3.1.2 Methodology

The methodology for the assessment of impacts on community resources is outlined below.

6.3.1.2.1 Relevant guidelines and codes of practice

The community resources impact assessment was undertaken with reference to the following guidelines and codes of practice:

– ESG2: Guideline for preparing a Review of Environmental Factors.

6.3.1.2.2 Desktop assessment

The following tasks were undertaken to gain an understanding of the local area and potential community resources that could be impacted by the proposal:

– Review ArcGIS maps to understand the location of the proposal site and surrounds in relation to Captains Flat
– Review various online sources including Google maps, Queanbeyan-Palerang Regional Council website and reports, and other websites to understand the provision and location of community infrastructure and businesses in Captains Flat.

6.3.1.2.3 Consultation with stakeholders

As detailed in Section 4.3, the Department of Regional NSW has been engaging with community and stakeholders throughout the proposal planning, scoping and design process.

Representatives from Queanbeyan-Palerang Regional Council and Department of Regional NSW were also consulted via telephone interviews in August 2021. The purpose of these interviews was to validate and gather additional information to inform the understanding of the local area, including the location and capacity of community infrastructure and businesses located in Captains Flat, identification of potential social benefits and impacts, and development of recommended mitigation and management measures.

The outcomes of the consultation activities outlined in Section 4.3, along with the targeted stakeholder interviews, have informed the desktop assessment (Section 3.8), assessment of impacts (Section 6.4.2.3) and mitigation measures (Section 6.4.2.4).

6.3.1.3 Assessment of impacts

The REF must assess whether the activity is likely to result in a significant change in the level of demand for community resources, including community facilities, community services and labour force.

The proposed remediation works would require an estimated peak workforce of approximately 25 people. As outlined in Section 4.2.3, the proposal intends to utilise predominantly local sub-contractors under the Principal Contractor, who would likely be sourced from the Queanbeyan LGA and surrounds (e.g. Canberra).

It is anticipated that the workforce will primarily comprise local and regional residents who would drive in and-out from the site as required. There is potential for workers to visit local services at times, such as the bowling club, or local pub when it reopens. However, given the workforce is 25 people at peak, the increase in demand is expected to be relatively minor. It is therefore anticipated that a local workforce of 25 people over the proposed 12-month remediation works period, are not anticipated to result in a change of demand for community resources, including community facilities and community services. The potential economic benefits for local businesses are discussed in Section 6.4.2.

6.3.1.4 Mitigation measures

The assessment of impacts to community resources had identified no negative impacts to community resources, community facilities, community services or the labour force of Captains Flat. No mitigation measures have been identified to reduce impacts on community resources as community resource impacts have been assessed to be negligible or positive.

Table 6.27 Mitigation measures – community resources

No.	Outcome	Mitigation measure
CR1	Potential for local and regional businesses to participate in procurement opportunities during construction. Local businesses may also benefit from construction workers spending money in town.	N/A

6.3.1.5 Conclusion

Overall, the assessment has not identified any potential negative impacts to community resources as a result of the proposed remediation works.

6.3.2 Natural resources

6.3.2.1 Introduction

This section assesses the potential impacts on natural resources associated with the proposed remediation works. Natural resources include land and soil, water, air, and minerals. Further discussion of potential impacts to land is provided in Section 6.4.6. Impacts to soil is provided in Section 6.1.3 and impacts to water is provided in Section 6.1.2. Potential impacts to air quality are provided in Section 6.1.1.

6.3.2.2 Methodology

6.3.2.2.1 Relevant guidelines and codes of practice

The natural resources assessment was undertaken with reference *ESG2: Guideline for preparing a Review of Environmental Factors (REF) for exploration activities* and is subject to Part 5 of the Environmental Planning and Assessment Act 1979 (Department of Planning and Environment 2015).

6.3.2.2.2 Desktop assessment

A desktop assessment of publicly available information was undertaken to assess impacts to natural resources. This information included a review of publicly available databases for sensitive land and a review of the Palerang LEP. The assessment of impacts to natural resources was also informed by the results of the technical studies undertaken for the REF.

6.3.2.3 Assessment of impacts

This section addresses potential impacts to natural resources, including:

– Disruption, depletion, or destruction natural resources
– Disruption of existing activities or reduction in options for future activities
– Degradation of areas reserved for conservation purposes.

6.3.2.3.1 Disruption, depletion or destruction of natural resources

Natural resources estimated to be consumed during the proposed remediation works are listed in Table 6.28. The quantities of materials used would be negligible and would not impact other users or future generations' use of these natural resources.

In addition, the proposed remediation works would involve remediating contaminated soils and revegetating cleared areas of the mine site. This will would have positive impacts on catchment water quality as well as local biodiversity values with an increased area of native vegetation established within the proposal site will increase vegetated area. This will would have a positive impact on natural resource availability in the future.

Table 6.28 Estimated natural resources required by the proposed works

Material	Quantity (tonnes)
Lime	1,628
Lime alternate (beneficial reuse of industrial waste)	9,071
Subsoil	27,688
Topsoil	12,844
Clay	3,450
Rock mulch	14,388
Water	No licenced surface or groundwater. Contractor responsibility.
Wood	0

6.3.2.3.2 Disruption of existing activities/reduction in options for future activities

The proposal site is currently a legacy mine and does not have any current or future natural resource uses. The contaminated and unvegetated nature of the site renders it inhospitable for agriculture or forestry uses. There is a recently expired mining exploration licence (23016) held by Ironbank Zinc over the proposal site, however, extractive industry has not been considered financially viable at the site since its closure in 1962. Regardless, the proposed remediation works would not restrict future mining at the site. Therefore, remediating the site would not disrupt any existing or future activities that rely on natural resources.

Potential impacts to non-natural resource-related land uses are discussed in Section 6.4.6.

6.3.2.3.3 Degradation of areas reserved for conservation purposes

There would be no impact to land reserved for conservation purposes, as none occurs within the proposal site (refer to Section 2.2.5). The proposed remediation works would be confined to the proposal site and, as such, there would be no impact to conservation areas located in the general vicinity of the site including the Tallaganda National Park, the Yanununbeyan National Park and the Yanununbeyan State Conservation Area.

There would be no impact to heritage items listed under the Palerang LEP (refer to Section 6.4.3).

6.3.2.4 Mitigation measures

No mitigation measures have been identified to reduce impacts on natural resources as natural resource impacts have been assessed to be negligible or positive.

6.3.2.5 Conclusion

Impacts to natural resources have been assessed as negligible or positive. The natural resources used would not significantly reduce stores of those natural resources or impact stores for future generations. The proposed remediation works would not disrupt any existing or future activities that rely on natural resources, nor would they degrade any areas reserved for conservation purposes.

A summary of the potential impacts on natural resources is provided in Section 7. No mitigation measures have been identified to reduce natural resource impacts as impacts have been assessed as negligible or positive.

6.4 Assessment of community impacts

6.4.1 Social impacts

6.4.1.1 Introduction

This section assesses the potential social impacts associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential impacts.

6.4.1.2 Methodology

The methodology for the social impact assessment is outlined below.

6.4.1.2.1 Relevant guidelines and codes of practice

The social impact assessment was undertaken with reference to the following guidelines and codes of practice:

– ESG2: Guideline for preparing a Review of Environmental Factors.

6.4.1.2.2 Desktop assessment

A social locality was identified based on the location of the proposal site and the communities most likely to experience impacts or benefits as a result of the proposal. The social locality is outlined in Table 6.29 below.

Table 6.29 Social locality

Area (ABS Census area)	Interaction with proposal
Captains Flat state suburb	The proposal site is located within Captains Flat state suburb. Local residents, businesses and users of social infrastructure in Captains Flat are most likely to experience the social impacts and benefits during construction and operation of the proposal.
Queanbeyan-Palerang LGA	Captains Flat is located within Queanbeyan-Palerang LGA. Communities across the LGA may experience some indirect impacts and benefits during construction and operation of the project.
Capital Region	Queanbeyan-Palerang LGA is located within Capital SA4. SA4 catchments are considered because the ABS provides frequent updates to employment and economic data at this level, unlike at the LGA (SA2) level, where all demographic and economic data is updated at every census.

Characteristics of the social locality have been analysed and are described in Section 3.7 and a demographic baseline of key indicators is located in Appendix J.

The following characteristics have been considered to provide the baseline for the social impact assessment:

– Overview of place, including key features, amenity and access and connectivity
– Demographic characteristics of the community
– Economic and employment profile
– Community facilities and services
– Indicators of community vulnerability.

The purpose of this analysis is to identify defining characteristics of the communities in the social locality and any vulnerable groups, communities, or stakeholders. Data used to inform this analysis include:

– Australian Bureau of Statistics (ABS) Census 2016
– Australian Bureau of Statistics (ABS) Socio-Economic Indexes for Areas (SEIFA) 2016
– NSW Government Population Projections 2019
– Australian Government, Small Area Labour Markets 2021
– Local government websites and publications
– Various online sources.

6.4.1.2.3 Consultation with stakeholders

As detailed in Section 4.3, the Department of Regional NSW has been engaging with community and stakeholders throughout the proposal planning, scoping and design process.

The social impact assessment team also consulted with representatives from Queanbeyan-Palerang Regional Council and Department of Regional NSW via telephone interviews in August 2021.

The purpose of these interviews was to validate and gather additional information to inform the understanding of the social baseline, identification of potential social benefits and impacts, and development of recommended mitigation and management measures.

The outcomes of the consultation activities outlined in Section 4.3, along with the targeted stakeholder interviews, have informed the desktop assessment (Section 3.7), assessment of impacts (Section 6.4.1.3) and mitigation measures (Section 6.4.1.4).

Potential social impacts and benefits were assessed based on the findings of the social baseline research, outcomes of the consultation activities, understanding of the proposed construction and operation activities, and findings of other technical assessments outlined in this report. Appropriate mitigation and enhancement measures have been recommended for identified social impacts and benefits, taking into consideration other mitigation measures outlined in this report.

6.4.1.3 Assessment of impacts

Is the activity likely to result in a change to the demographic structure of the community?

The proposed remediation works would require an estimated peak workforce of approximately 25 people. As outlined in Section 4.2.3, the proposal intends to utilise predominantly local sub-contractors under the Principal Contractor, who would likely be sourced from the Queanbeyan LGA and surrounds (e.g. Canberra). This is supported by the baseline which indicates there is an existing skills base in the local and regional areas, with the construction industry representing 15.5 per cent of the Captains Flat labour force, and 9.4 per cent in the Queanbeyan-Palerang LGA. It is therefore anticipated that the workforce will primarily comprise local and regional residents who would drive in and out from the mine site as required. A small drive-in, drive-out workforce is not expected to result in changes to the demographic structure of Captains Flat.

Is the activity likely to have any environmental impact that may cause substantial change or disruption to the community?

As detailed in Section 4.2.6, during construction, the proposed remediation activities are anticipated to generate around 6,0002 heavy vehicle truck movements over the 19-month materials delivery window, equalling to about one truck for two truck movements per hour. In addition, around 50 light vehicle movements, generated by site personnel accessing the site, equivalent to 25 light vehicle movements during the peak hour (AM and PM maximum hourly traffic volume).

As identified in the *Traffic Impact Assessment* (GHD, 2021) located in Appendix M, Captains Flat Road is a regional road that provides inter-town connectivity and direct access to Queanbeyan/Canberra in the north. Due to the absence of any alternative routes, the road is shared by cars, freight, and school buses. Increased construction traffic and changed access to the proposal site may lead to minor delays for people traveling along Captains Flat Road to Canberra or Queanbeyan for work, school or to access community services and facilities. These delays may cause some frustration for the local community, particularly as the impacts would be experienced over a six-month timeframe. The community would also have experienced disruptions and delays due to the bridge replacement and road upgrade works (discussed in Section 6.6) which may contribute to feelings of frustration.

There are a number of residential properties within the vicinity of the proposed remediation works.

The proposed 19-month construction phase of the remediation work may result in changes to local amenity (e.g. noise, dust, vibration, odour and visual changes) for people located close to construction activities. There is potential for people living adjacent to the site to experience increased noise, dust and odour dust, which may disturb daily activities for some people, such as closing doors and windows whilst inside their property or spending less time outdoors. As outlined in Section 6.1.1 and 6.1.4, during the proposed works, it is predicted that the air quality criteria will be exceeded as a result of the remediation, for three residential properties. It is also predicted that noise criteria levels are expected to be exceeded at eight noise catchment areas and the greatest impact will be at two residential properties. This has the potential to affect some individual's quality of life at times. Proposed mitigation measures detailed in Section 6.1.1.4 and 6.1.4.4 are expected to reduce impacts to amenity for the sensitive receptors impacted by the proposed works. The potential amenity impacts are expected to affect a small number of residents and are therefore not expected to cause substantial change or disruption to the community.

Consultation and aerial imagery of the Lake George Mine site indicated that there are vast areas of exposed, unvegetated ground where contamination exists. Once the proposed works are complete, each area proposed for remediation would be re-vegetated (or vegetated if currently bare, with the exception of the centre portion of the Central Mine Area), resulting in an improved environmental condition of the landscape, an increase in the amount of vegetation on site and improving the overall safety of the area (Section 6.4.5). This is expected to result in an increase in the enjoyment of the site and surrounds for adjacent landholders, as well as visitors. As discussed in Section 3.7, the site already attracts visitors with an interest in mining heritage, particularly due to the Heritage Trail which is a popular historic walking trail, aimed at highlighting the towns rich mining history.

Is the activity likely to result in some individuals or communities being significantly disadvantaged?

While some individuals living adjacent to the site may experience reduced amenity and disruptions at times during construction, these effects are not expected to significantly disadvantage these residents. However, the Department of Regional NSW would continue to consult with these residents, and would notify them about potential impacts in line with the communication management plan to manage potential impacts to wellbeing.

The community of Captains Flat is not expected to be significantly disadvantaged by construction or operation of the proposal.

Is the activity likely to result in any impacts on the health, safety, privacy or welfare of individuals or communities?

The proposed remediation works are located across private and Crown lands. There are several residential properties located adjacent to the site, and there is potential for some residents to experience reduced privacy due to remediation workers accessing areas close to their properties.

Consultation outcomes outlined in Table 4.9 show that a local resident has raised existing concerns about privacy due to contractors and workers accessing and undertaking work on the site to undertake maintenance. The communication management plan would include procedures to ensure adjacent residents are notified about remediation activities, as well as a complaints procedure. This is expected to help reduce actual and perceived privacy concerns.

The proposed remediation works are expected to reduce contamination and associated effects on local waterways and soil. This is expected to contribute to overall improved health and safety outcomes for the Captains Flat community.

Is the activity likely to result in a change in the level of demand for community resources?

The potential for the proposal to result in a change to the level of demand for community resources is assessed in Section 6.4.1.3.

6.4.1.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential social impacts during the proposed remediation works are listed in Table 6.30.

Table 6.30 Mitigation measures – social

No.	Outcome	Mitigation measure
S1	Manage impacts to local residents and communities	Implement a communication management plan to manage impacts to community stakeholders. This would include: – Protocols to keep the community updated on the progress of the proposal – Protocols to inform the community of potential impacts (traffic/access, noise, air quality impacts) – Inform the community about companies involved in truck movements so the community is aware of the contracting vehicles associated with the proposal – Protocols to respond to complaints received.
S2	Potential for reduced privacy	The communication management plan which would include procedures to ensure adjacent residents are notified about remediation activities, as well as a complaints procedure.

6.4.1.5 Conclusion

Overall, the potential social impact of the remediation works that may occur during construction and operation would be minor.

Mitigation measures would be implemented to reduce the potential social impacts during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.4.2 Economic impacts

6.4.2.1 Introduction

This section assesses the potential economic impacts associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential impacts.

6.4.2.2 Methodology

The methodology for the economic impact assessment is outlined below.

6.4.2.2.1 Relevant guidelines and codes of practice

The economic impact assessment was undertaken with reference to the following guidelines and codes of practice:

– ESG2: Guideline for preparing a Review of Environmental Factors.

6.4.2.2.2 Desktop assessment

Relevant economic indicators were analysed according to the study area described in Section 6.4.1.2.2, and are detailed in Appendix J. The purpose of the qualitative assessment was to understand the existing economic profile for the study area as relevant to the proposal.

6.4.2.2.3 Consultation with stakeholders

Representatives from Queanbeyan-Palerang Regional Council and Department of Regional NSW via telephone interviews in August 2021. The purpose of these interviews was to validate and gather additional information to inform the understanding of the economic baseline, identification of potential economic benefits and impacts, and development of recommended mitigation and management measures.

The outcomes of the consultation activities outlined in Section 4.3, along with the targeted stakeholder interviews, have informed the desktop assessment (Section 3.8), assessment of impacts (Section 6.4.2.3) and mitigation measures (Section 6.4.2.4).

6.4.2.3 Assessment of impacts

Any impacts which may affect economic activity (positive or negative), particularly impacts which result in a decrease to net economic welfare

As discussed in Section 6.4.1.3, some local businesses such as the service station, pub (when it reopens) and bowling club may benefit from workers spending wages on meals and supplies. This is also expected to be a minor, short term benefit for these businesses.

As discussed in Section 6.4.1.3, the improved safety and visual amenity of the site and surrounds may encourage more visitors to Captains Flat and enhance the current tourism offering, being the Heritage Trail (Section 3.8). This could be a minor contribution to the overall economic activity of Captains Flat; however, this is not able to be quantified.

Any impacts which may result in a decrease in the economic stability of the community

The proposed remediation works are not expected to result in a reduction in the economic stability of the community.

Any impacts which may result in a change to the public sector revenue or expenditure base

The proposed remediation works are not expected to result in a change to the public sector revenue or expenditure base.

6.4.2.4 Mitigation measures

The assessment of economic impacts had identified no negative impacts to the economic activity, economic welfare or economic stability of Captains Flat and surrounds. No mitigation measures have been identified to reduce economic impacts as economic impacts have been assessed to be negligible or positive as listed in Table 6.31.

Table 6.31 Mitigation measures – economic

No.	Outcome	Mitigation measure
E1	Opportunities for local and regional businesses to participate in procurement opportunities or benefit from construction workers spending money in town.	N/A
E2	Enhancement of current tourist offering.	N/A

6.4.2.5 Conclusion

Overall, the potential economic impact of the remediation works would be positive.

The assessment of economic impacts had identified no negative impacts to the economic activity, economic welfare or economic stability of Captains Flat and surrounds. No mitigation measures have been identified to reduce economic impacts as economic impacts have been assessed to be negligible or positive.

6.4.3 Heritage impacts (non-Aboriginal)

6.4.3.1 Introduction

This section assesses the potential impacts on non-Aboriginal heritage associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential impacts. This section draws on the Statement of Heritage Impact provided in Appendix O.

6.4.3.2 Methodology

The methodology for the non-Aboriginal impact assessment is outlined below, with further detail provided in Appendix O.

6.4.3.2.1 Relevant guidelines and codes of practice

The impact assessment was undertaken in accordance with NSW Heritage Office's *Statement of Heritage Impact Guidelines* (Heritage NSW, 2002). The criteria employed to assess the heritage significance of the historic mining heritage sites at Captains Flat are those specified in the *Heritage Act 1977*. The assessment also considered the following guidelines and codes of practice:

– Australia ICOMOS (1999) Australia ICOMOS Burra Charter
– Heritage NSW (2001) Assessing Heritage Significance, NSW Heritage Manual.

6.4.3.2.2 Desktop assessment

The assessment of potential heritage impacts included a desktop search of the following registers to determine if there is any additional information on places of heritage significance in or near to the proposed activity area:

– NSW State Heritage Inventory to identify sites listed in:
  - The State Heritage Register
  - An Interim Heritage Order
– The *Palerang Local Environment Plan 2014*, Schedule 5

– Australian Heritage Database, to identify sites listed upon:
    - National Heritage List
    - Commonwealth Heritage List
    - Register of the National Estate.

6.4.3.2.3 Field survey

A physical assessment of the proposal site was carried out at site-based assessment undertaken on 27 October 2021 to visually assess key heritage locations on site.

6.4.3.2.4 Consultation with stakeholders

Refer to the consultation section of this REF.

6.4.3.3 Assessment of impacts

A summary of the statement of heritage impacts and consideration of Palerang LEP 2014 requirements are discussed below for Lake George Mine (I267) and Captains Flat Railway (I266) sites located within the proposal site. Predicted impacts are also discussed for the Stationmasters Residence (Former) (I251), Railway Station (Former) (I249) and Roscommon (I252) which are located adjacent to the proposal site.

Lake George Mine (I267) and Captains Flat Railway (I266)

Elements of the mining infrastructure that remains at the site is in a derelict or partially demolished state. As these features are accessible to the public, there is a safety risk. In some cases, existing safety fencing is in a state of disrepair and other areas are not fenced. Prior to the proposed remediation works, the heritage fabric would be secured with temporary fencing to restrict access, minimise on site safety risk, and to protect the historic structures from inadvertent mechanical damage.

The remediation strategy for the Captains Flat Railway Precinct (including the weigh station, railway lines, gantry, platform and turntable) is to excavate and remove lead contaminated soil and relocate the contaminated material into the containment cell to be located on the Northern Dumps. This would involve temporary removal and relocation of selected heritage fabric elements including signs, posts, signals, fencing and the rail tracks. Once the contaminated soil has been removed and replaced with clean fill, all heritage fabric elements would be reinstated in their original position.

The Concentrate Loading Tunnels that form part of the Flotation Mill contain hazardous material and are an ongoing source of contamination. An assessment undertaken by GHD (2018) also identified evidence to suggest that their structural integrity may be compromised. It is proposed that the Concentrate Loading Tunnels be either:

– Fenced;
– Filled; or
– Demolished.

If the Concentrate Loading Tunnels are demolished, mineral waste material associated with the Tunnels would be relocated to the containment cell at the Northern Dumps and the area would then be remediated consistent with the rest of the Mill Area.

To remediate the Concentrate Bins, one option proposed is that the sulfidic waste within the bins be removed and placed in the Northern Dumps encapsulation cell, with the inert gravel within the bins potentially being beneficially reused; if not, it would also be placed in the containment cell. It is proposed that this will take place either by:

– Constructing a temporary earthen bund parallel to the bins that would support a long-reach excavator that would remove the material into dump trucks for relocation to the encapsulation cell.
– Use of a dryvac excavation truck to remove the material for relocation and placement in the encapsulation cell. As the dryvac truck has an internal storage cell for the sulfidic waste, it would shuttle between the bins and encapsulation cell, negating the need for an excavator and/or dump trucks.

In addition, a deep excavated trench is planned to be installed upslope of the Bins to divert groundwater around the structure to prevent seepage.

The Surge Bin is severely corroded; therefore it is proposed that the metal and timber elements of the structure be removed with the sulfidic waste ore within the bin relocated to the Northern Dumps encapsulation cell.

Following completion of works and pending a safety inspection, it is proposed that the remaining concrete elements of the Surge Bin precinct will remain *in situ*, with an earthen bund built around the structure for water management purposes. An engineered concrete slab will be constructed to seal the shaft if required. Removal will permanently change the visual appearance of the Surge Bin precinct, however, the remaining concrete footers are of a size and proportion sufficient to retain its existing identified heritage values.

Some trees may be removed as part of the proposed remediation works. None of the trees within the proposed activity footprint have been identified as having heritage value or contributing to significant aesthetic values.

Potential archaeological deposits may be associated with the Lake George Mine entrance, workshop and change rooms and at the processing site, the significance of which remain unknown. They would be protected from disturbance with physical barriers whilst remediation works are underway. If the mitigative actions are taken, the proposed works would not impact on the identified heritage values of the site.

Some minor alterations to the fabric of Lake George Mine are required to control the spread of contamination and make structures safe, potentially including blocking or filling of loading tunnels, removal of fabric that could cause harm.

The proposed works are the most sympathetic solution to addressing the significant health risks associated with mine site contamination, that does not involve physical impact upon the heritage fabric of the Lake George Mine and Captains Flat Railway Precinct. In addition, interpretive heritage signage would be considered as part of the ongoing management of the site. Overall, the proposed works can be implemented without impacting on the heritage significance of the site, its fabric, settings, or views.

The proposed works would enhance the amenity of the Lake George Mine and Captains Flat Railway sites as the removal and/or containment of contaminated soil would make the sites safer for public visitation. Revegetation work would contribute to stabilising the site and augment proposed signage and interpretive material designed to help visitors gain an understanding and appreciation of the mining history and heritage of Captains Flat.

The improved amenity and safety resulting from the proposed works may potentially make the Lake George Mine and Captains Flat rail precinct a more attractive destination for visitors, and with that the attendant increased potential for inadvertent or deliberate damage to listed items.

Stationmasters Residence (Former) (I251), Railway Station (Former) (I249) and Roscommon (I252)

The proposed works are the most sympathetic solution to addressing the significant health risks associated with mine site contamination. The proposed works would not impact the views to or from the heritage items, once complete and would not encroach upon or interfere with the heritage items curtilage. The proposal would enhance the amenity of the Stationmasters Residence and Railway Station (Former). The proposal would neither enhance nor be of any detriment to the Roscommon site.

The proposed works would have no impact on the heritage significance of the items.

The proposed works would improve the ability of the public and other users to access, view or appreciate the significance of all three sites. The improved amenity and safety resulting from the proposed works may potentially make the proposal site a more attractive destination for visitors, and with that the attendant increased potential for inadvertent or deliberate damage to listed items.

6.4.3.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on heritage (non-Aboriginal) during the proposed remediation works are listed in Table 6.32.

Table 6.32 Mitigation measures – heritage (non-Aboriginal)

No.	Outcome	Mitigation measure
NAH1	Protection of neighbouring and adjacent heritage sites	The proposed activity must be confined to the proposed works footprint. This would ensure that neighbouring and adjacent heritage sites (Captains Flat Railway Station and Roscommon) are not impacted upon.
NAH2	Prevent unintended harm to the Railway Precinct and former Stationmasters Residence	To mitigate any unintended harm the following measures must be taken: – A detailed geospatial survey of the site must be prepared that identifies all elements subject to removal and temporary relocation. Drone footage and GIS mapping should be used to identify the location of each element in order to return items to their original position once the remediation works have been completed. – A detailed photographic record must be prepared of each element subject to removal and temporary relocation – Elements subject to removal and temporary relocation will be securely stored at an appropriate location at, or near, the site – Reinstatement of elements subject to removal and temporary relocation must occur as soon as practicable following completion of the remediation works – Fabric elements associated with the rails including rail spikes, fishplates and ties must be salvaged and, where that is not possible, they must be replaced with like components – Replacement timbers (including rail sleepers) should be like items, where possible – The rail ballast and sub-grade is to be replaced with new material. As the Captains Flat railway is no longer operating, the reinstatement of railway tracks may not require engineering and construction to meet operational railway standards. Advice should be obtained from Transport for NSW on this matter.
NAH3	Protection of potential archaeological deposits	Potential archaeological deposits are likely to be associated with the mine entrance, workshop and change rooms and at the Processing Site (Kohinoor & Elliots). These sites will be remediated using hand tools and must be protected from unintended disturbance with physical barriers whilst works are underway. The positioning of barrier fencing should be determined in consultation with an archaeologist with experience of the Lake George Mine site. The application of lime to surface deposits at the Processing Site (Kohinoor & Elliots) will be undertaken by hand and without disturbance to surface deposits to avoid any impact to potential archaeological deposits.
NAH4	Protection of the Flotation Mill during removal of Concentrate Loading Tunnels	If the Concentrate Loading Tunnels are to be removed, the following measures would be taken before the proposed activity commences in order to mitigate the impact – A detailed archival recording of the Concentrate Loading Tunnels will be prepared including site plans and measured drawings – A detailed archival photographic record of the Concentrate Loading Tunnels will be prepared.
NAH5	Protection of the Concentrate Bins during removal of contaminated material	To mitigate any unintended harm to the Concentrate Bins, the following measures would be taken before the proposed activity commences: – A detailed archival recording of the Concentrate Bins will be prepared – A detailed archival photographic record of the Concentrate Bins will be prepared. If removal of the inert gravel and the sulfidic waste causes the structural integrity of one or more of the Concentrate Bins to be compromised, additional heritage assessment will be required to determine the most appropriate future management of the structure(s).
NAH6	Removal of metal and timber elements and contaminated material	To mitigate the proposed impacts to the Surge Bin associated with removing the metal and timber elements and the contaminated ore inside the existing structure, the following measures would be taken before the proposed activity commences: – A detailed archival recording of the Surge Bin will be prepared – A detailed archival photographic record of the Surge Bin will be prepared.

No.	Outcome	Mitigation measure
		If removal of the sulfidic waste causes the structural integrity of the remaining concrete elements of the Surge Bin to be compromised, additional heritage assessment will be required to determine the most appropriate future management of the structure
NAH7	Protective Temporary Fencing – Processing Site (Kohinoor & Elliots)	Prior to the commencement of the proposed remediation works, the Processing Site (Kohinoor & Elliots) should be secured with temporary fencing to restrict access, minimise on site safety risk, and to protect the historic structures from inadvertent damage during the works.
NAH8	Protective permanent Safety Fencing	At the completion of construction works, the following heritage elements should be secured with appropriate permanent safety fencing to restrict access. Final barrier design would be determined based on site specific conditions and the relevant Australian Design Standards. – Flotation Mill – Storage Bins, Sulphur Plant & Ball Mills – Surge Bin concrete footers.

6.4.3.5 Conclusion

Overall, the potential impacts to non-Aboriginal heritage from the remediation works that may occur during construction and operation would be minor. A summary of the potential impacts to non-Aboriginal heritage is provided in Section 7.

Mitigation measures would be implemented to reduce the potential impacts on non-Aboriginal heritage during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.4.4 Heritage impacts (Aboriginal)

6.4.4.1 Introduction

This section assesses the potential impacts on Aboriginal heritage associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential Aboriginal heritage impacts. This section draws upon an Aboriginal Heritage Due Diligence Report provided in Appendix L.

6.4.4.2 Methodology

The methodology for the Aboriginal heritage impact assessment is outlined below, with further detail provided in Appendix L.

6.4.4.2.1 Relevant guidelines and codes of practice

The Aboriginal Heritage Due Diligence Assessment was prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010) and the *NSW Minerals Industry Due Diligence Code of Practice* (NSW Minerals Council 2010).

6.4.4.2.2 Desktop assessment

The following publicly available databases were reviewed to determine if previously recorded cultural heritage items are located within or in the vicinity of the proposal site:

– Aboriginal Heritage Information Management System (AHIMS)
– NSW State Heritage Inventory
– National Heritage List
– Commonwealth Heritage List
– Register of the National Estate.

A review was also undertaken of the *Palerang Local Environment Plan 2014*.

The results of previous archaeological research were reviewed and used to develop a predictive model of the proposal site and surrounds.

A physical assessment of the proposal site was not considered necessary given that the proposed remediation works would be restricted to locations that have already sustained repeated significant disturbance associated with past activities at the site including:

– Mining
– Construction, operation and maintenance of mining infrastructure
– Removal and relocation of contaminated deposits
– Ongoing surface erosion and deflation.

The assessment, therefore, consisted of a detailed review of the most recent aerial photography of the proposal site and surrounds and available historic images of the proposal site.

The following publicly available databases were reviewed to determine if the proposal site is subject to native title claim(s), indigenous land use agreement(s), or join management arrangement(s):

– National Native Title Register
– NSW Government Aboriginal Joint Management Agreements Database.

6.4.4.3 Assessment of impacts

This section outlines impacts to cultural heritage during the proposed remediation works at Lake George Mine, with further detail provided in Appendix L A summary of impacts is provided in Section 7.

6.4.4.3.1 Impacts to ground surface and culturally modified trees

The proposed remediation works would disturb the ground. This disturbance would be restricted to areas that have already sustained considerable past disturbance from mining and mine site remediation activities. The original ground surface has been heavily modified or removed completely.

There would be no impact to culturally modified trees as none are present within the proposal site.

6.4.4.3.2 Impacts to known objects or places

The proposed remediation works would not pact to known heritage objects or places as none are located within or in proximity to the proposal site.

6.4.4.3.3 Impacts to previously unrecorded objects or places

A review of available archaeological literature enabled the development of a predictive model for the proposal site and surrounds. It identified that drainage lines and elevated level to gently sloping landforms above drainage lines are potentially archaeologically sensitive. These landforms are not present within the proposal site. It is extremely unlikely that unidentified heritage objects or places could be present in the proposal site. Given this, it would be extremely unlikely that the proposed remediation works would impact previously unrecorded heritage objects or places.

6.4.4.3.4 Native title, indigenous land use agreements, joint management arrangements

The proposal site is not subject to a native title claim, indigenous land use agreement, or joint management arrangement. Native title may exist on unalienated Crown Land if it has not been extinguished. If a claim emerges over the proposal site, then the proponent will be required to forward a notice of the works to the native title claimants' representative body. Crown Lands is also working through their Native Title process and will advise the LMP if there are any required changes to the planned work.

6.4.4.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on Aboriginal heritage during the proposed remediation works are listed in Table 6.33.

Table 6.33 Mitigation measures – heritage (Aboriginal)

No.	Outcome	Mitigation measure
AH1	Protection of previously unrecorded heritage objects and sites.	Implement unanticipated finds protocol. If unforeseen Aboriginal objects/sites are uncovered during the proposed remediation works, work would cease in the vicinity of the find and next step would be co-ordinated by LMP. This would likely involve consultation with an archaeologist, the Department of Planning, Industry and Environment (DPIE) and the Local Aboriginal Land Council.
AH2	Protect	Implement unanticipated skeletal remains protocol. If human remains are found during the proposed remediation works, work would cease, the site would be secured, and the NSW Police and DPIE would be notified.
AH3	Consent for works if a native title claim is declared	If a native title land claim is declared this will be investigated and a notice of the works will be forwarded to the native title claimants' representative body.

6.4.4.5 Conclusion

No previously recorded Aboriginal cultural heritage items occur within the proposal site. In addition, the proposal site is not located within a landscape feature likely to indicate the presence of Aboriginal objects. The proposal site has a past history of extensive disturbance associated with mining activities and subsequent mine rehabilitation works. It is extremely unlikely that unidentified sites and objects could be present within the proposal site.

Given the above, the proposed remediation works would have a negligible impact on Aboriginal heritage. A summary of the potential impacts to Aboriginal heritage is provided in Section 7.

Mitigation measures would be implemented to reduce the potential impacts on Aboriginal heritage during the proposed remediation works. These include implementing protocols for unanticipated finds. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.4.5 Aesthetic impacts

6.4.5.1 Introduction

This section assesses whether the activity is likely to cause significant impacts on the visual or scenic landscape, associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise

6.4.5.2 Methodology

The methodology for the aesthetic impact assessment included a desktop assessment supported by observations from site visits, to determine the visibility of the proposal site from sensitive visual receptors and viewpoints. This allowed an assessment to be made of the potential aesthetic impacts during the proposed remediation works and post the remediation works. This assessment has considered:

– The viewshed of the activity (i.e. from what area will the activity be able to be seen)
– Whether there are any particular points within the viewshed of the activity which may cause concern (e.g. lookouts, popular walking tracks, neighbours)
– Whether there are any impacts such as loss of privacy, glare or overshadowing of members of the community
– Whether the design of the activity is visually sympathetic to the surrounding environment and blends in, or whether it will stand out as an obvious feature.

6.4.5.3 Assessment of impacts

This section assesses the potential aesthetic impacts during the proposed remediation works and post the remediation works at Lake George Mine. A summary of impacts is provided in Section 7.

6.4.5.3.1 During remediation

During the proposed remediation works, aesthetic impacts would generally be associated with:

– The presence of construction vehicles and equipment such as excavators, bulldozers, dump trucks, roller/compactors and water trucks
– The presence of construction traffic and workers
– The storage of construction equipment and plant
– Materials stockpiling
– Fencing of historic structures.

The duration of the proposed remediation works would be longer-term, lasting approximately 19 months.

During remediation impacts to aesthetics to the majority of receivers would generally be associated with the presence of work and construction equipment. The visual impacts of plant and equipment being operated within the disturbance areas are considered low as views of the site area are distant and minimised through surrounding vegetation. Views from the local roads including Miners Road, Old Mines Road and Foxlow Street would be brief and intermittent by road user. The majority of the residences in Captains Flat township, particularly along Foxlow Street, see Figure 3.6, would be around 150 metres at the closest point, from the disturbance areas and views would be intermittent between other buildings and existing vegetation. Minimal additional vegetation clearing would be required, and therefore, existing views of the site would not be extended further.

The receivers where the viewshed of the works is more substantial and likely to cause a noticeable impact to the visual or scenic landscape are:

– 5 Old Mines Road
– 44 Old Mines Road
– 8 Copper Creek Road.

These receivers are located close to the works and there is limited existing vegetation to screen the works. These receives will be close to haul routes and work areas and it is likely that the level of impact will be medium negative. Due to the nature of the area and topography, hoarding would not provide feasible screening.

Overall, the potential aesthetic impact of the proposed remediation works would be low to medium negative. Impacts would be reduced with the mitigation measures outlined in Section 6.4.5.4.

6.4.5.3.2 Post remediation

Each domain slated for remediation would be re-vegetated (or vegetated if currently bare) following neutralisation and capping to increase site stability and reduce erosion risk, except for the central portion of the Central Mine Area, around a third of the Mill Area and other small and steeper areas, which would be remediated using rock mulch. The rock mulch remedial option was agreed upon through stakeholder consultation to retain the industrial feel of the high point in the Central Mine Area.

The proposed removal of the Surge Bin will have an impact on the aesthetic of Lake George Mine. The Surge Bin sits atop a large hill overlooking the town at its southern end and was once visible from almost all directions. In recent years some of the badly corroded metal elements have collapsed reducing the height of the structure to the extent that it is no longer visible from the township. In plan aspect, it is circular in shape and constructed primarily of riveted iron plates in three sections. The concrete elements are largely intact, however the riveted iron elements are severely corroded to the extent that the structural integrity of the bin appears to be compromised.

The Surge Bin is partially filled with sulfidic ore and as a result it is a source of sulfate-rich leachate emanating from the ore. In its present condition the Surge Bin poses both a public safety and an environmental risk. Therefore, it is considered necessary to remove the structure. This would entail removing the metal and timber elements of the Surge Bin with the sulfidic waste ore within the bin relocated to the Northern Dumps encapsulation cell. Following completion of works and pending a safety inspection, it is proposed that the remaining concrete and masonry elements of the Surge Bin precinct will remain in situ, with an earthen bund built around the structure for water management purposes. An engineered concrete slab will be constructed to seal the shaft if required.

Removal of the Surge Bin will reduce the industrial atmosphere of Lake George Mine. This impact will be limited nearby viewpoints as the structure has been eroded to the extent that it is no longer visible from the township.

However, the remaining concrete footers are of a size and proportion sufficient to retain its existing identified aesthetic values. To mitigate the impact of removal of the Surge Bin is it proposed that a detailed archival photographic record of the Surge Bin be prepared prior the proposed works commencing. Other historic mining structures would remain *in situ* after the proposed works and therefore, the proposal site would maintain its overall mining heritage character. Post remediation, the proposal site would have a more natural appearance and blend into the existing landscape while also retaining the mining heritage character of the site. Overall, the potential aesthetic impact of the post remediation works would be positive.

6.4.5.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on aesthetics during the proposed remediation works are listed in Table 6.34.

Table 6.34 Mitigation measures – aesthetic

No.	Outcome	Mitigation measure
A1	Minimise aesthetic impacts associated with the proposed remediation works.	Ensure construction plant, equipment, waste and excess materials are contained within the designated boundaries of the site and are removed following the completion of the proposed remediation works.
A2	Minimise aesthetic impacts associated with the proposed remediation works.	Keep work areas tidy at all times.
A3	Minimise aesthetic impacts associated with the proposed remediation works.	Keep vegetation clearance to a minimum.
A4	Enhance aesthetic appearance of the proposal site.	Ensure the proposal site is revegetated as per a Revegetation Plan.
A5	Successful revegetation of the proposal site.	Monitor revegetation to ensure successful re-establishment.
A6	Maintain historic records of the Surge Bin's aesthetic.	A detailed archival photographic record of the Surge Bin will be prepared prior to the works commencing.

6.4.5.5 Conclusion

The proposal site would be visible from the receivers listed in Section 3.11.2 which includes residents and road users. The duration of the proposed remediation works would be longer term, lasting approximately 19 months. Overall, the potential aesthetic impact of the proposed remediation works would be low to medium adverse.

Post remediation, removal of the Surge Bin would have an impact on the industrial atmosphere of the mine given its position on a high point. However, with the installation of vegetation and retention of other historic mining structures, the proposal site would have a more natural appearance and blend into the existing landscape while also retaining the mining heritage character of the site. Overall, the potential aesthetic impact of the post remediation works would be positive. A summary of the potential impacts to aesthetics is provided in Section 7.

Mitigation measures would be implemented to reduce the potential aesthetic impacts during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.4.6 Land use impacts

6.4.6.1 Introduction

This section assesses the potential impacts on land use associated with the proposed remediation works. Land uses of the site include residencies and legacy mine tourism. Impacts to these land uses will be positive to marginally negative. Mitigation measures are identified to eliminate or otherwise reduce potential land use impacts.

6.4.6.2 Methodology

The methodology for the land use impact assessment is outlined below. The land use impact assessment assesses whether the proposal is likely to significantly disrupt or change current land uses, including curtailing of other beneficial land uses.

6.4.6.2.1 Relevant guidelines and codes of practice

The land use impact assessment was undertaken with reference to the *Guideline for preparing a review of Environmental Factors.* Section 4.4.6 of these guidelines pose questions concerning land use impacts that could occur as a result of the proposal. This assessment addresses those questions to ensure land use impacts have been considered.

The land use impact assessment was also undertaken with reference to the following guideline and code of practice:

– *NSW Strategic Regional Land Use Policy* (DP&I, 2012).

6.4.6.2.2 Desktop assessment

Existing land uses of the site were identified through land zoning maps, previous reports and consultation with Legacy Mines NSW. Further, Strategic Agricultural Land (SAL) maps were used to identify if any land at the site has been assigned a SAL status under the *NSW Strategic Land Policy* (DPI, 2013b). The proposed works were then analysed to determine if any of the activities would interfere with current or future land uses.

The land use impact assessment also involves addressing how proposed works may impact property values. Desktop information on Captains Flat property and stakeholder engagement documents were used to assess local property prices.

6.4.6.2.3 Consultation with stakeholders

Learnings from previously conducted stakeholder engagement documents in URS (2004) were used to inform the land use assessment. In addition, information gleaned from the LMP was used to identify land use concerns concerning heritage.

6.4.6.3 Assessment of impacts

6.4.6.3.1 Changes to land use and curtailment of other beneficial land uses

The proposed remediation works will not curtail any beneficial land uses and will have positive impacts for some land uses. As discussed above in Section 6.4.6.3.1, the contamination at the site prohibits it for an any agricultural use. An inspection of the SAL Map 36 revealed that the site is not considered to be SAL (DP&I, 2012).

The proposed work will not impact on the land reserved for Special Infrastructure. The Captains Flat Railway line is not in operation and consultation will be carried out with Special Infrastructure to minimise construction impacts. The Special Infrastructure zoned areas will continue to operate for their intended purposes.

The proposed works will not impact on residential uses of the Lake George Mine. Residential land holders have advised previous project teams that their preference is for all contaminated materials to be removed from their properties and be landfilled at the Northern Dumps (URS, 2004). Further, land uses in the adjacent Captains Flat town will have reduced impacts from contaminated material from the Lake George Mine.

Crown Lands managed land within the Northern Dumps area is considered the most appropriate location for the proposed containment cell and will not significantly impact future land use potential. The proposed containment cell will again produce a positive impact on the surrounding land uses. The Northern Dumps is considered to be a highly modified/developed section of the historic mine footprint and offers extremely limited land use options.

In June 2021, Captains Flat Preschool had to be moved after NSW EPA surface soil testing found elevated lead levels along Foxlow Street and at the Captains Flat preschool (EPA, 2021). NSW EPA testing found that the preschool contained significant lead contamination and it has been reported that more lead was deposited at the preschool from the mine during every high rainfall event (Lucas, 2021). The proposed works will reduce contamination risk to Captains Flat town and therefore enabling a wider range of land uses possible on lots near the mine, particularly in the southern portion of Captains Flat town.

However, revegetation that will occur as a part of the proposed remediation work may act to reduce the industrial aesthetics of the legacy mine. This may reduce the site's value as a legacy mine tourism location. Consultation has occurred with stakeholder groups to manage this impact. To reduce this impact rock mulch, instead of vegetation, will be used as the top layer for proposed remediation works occurring at the central portion of the Central Mine Area, around one third of the Mill Area and in other select areas around the mine site. This will help maintain an industrial look of the mine to help the site maintain heritage value. In addition, contaminated soil around the lookout will be remediated to protect the health of tourism visitors.

6.4.6.3.2 Property value impacts

Decreased contamination resulting from the proposed works are likely to have negligible, or positive impacts on nearby property values. Increases in property values near mine sites that have undergone remediation have been observed at other sites (Hanginger *et al*., 2016). Increased property values are unlikely to result in changes in land use as the most of the site's surrounding areas are zoned for agricultural use.

6.4.6.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on land use during the proposed remediation works are listed in Table 6.35.

Table 6.35 Mitigation measures – land use

No.	Outcome	Mitigation measure
LU1	Some areas of the mine will maintain an industrial atmosphere to support legacy mine tourism	Rock mulch instead of topsoil will be used as the top layer for remediation works occurring in the central part of the Central Mine Area, around one third of the Mill Area and in other select areas to promote mining infrastructure aesthetics.

6.4.6.5 Conclusion

The proposed remediation works will have a negligible to positive impacts on the current land uses of the site. The decreased contaminated that will result from the proposed works will have a positive impact on nearby residencies and other land uses that experience contamination from the site.

The proposed will reduce the industrial atmosphere at Lake George Mine due to large areas become revegetated. This may impact legacy tourism land use. However, this will be mitigated be the use of rock mulch in the central part of the Central Mine Area to give an indication of previous use. Further, the health of visitors will be protected through reduced contamination.

A summary of the potential impacts to land use is provided in Section 7. Mitigation measures would be implemented to reduce the potential impacts on land use during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.4.7 Transportation impact

6.4.7.1 Introduction

This section assesses the potential impacts on traffic and transport associated with the proposed remediation works. Mitigation measures are identified to eliminate or otherwise reduce potential impacts to the road network and existing road users. This section draws on the traffic impact assessment (TIA) provided as Appendix M

6.4.7.2 Methodology

The general methodology for the traffic impact assessment is outlined below, with further detail provided in Appendix M.

6.4.7.2.1 Relevant guidelines and codes of practice

The traffic impact assessment was undertaken with reference to the following guidelines and codes of practice:

– *ESG2: Guideline for preparing a Review of Environmental Factors* (NSW DPE, 2015)
– *Guide to Road Design Part 3: Geometric Design, Edition 3.4, AGRD03-16* (Austroads, 2021)
– *Guide to traffic generating developments, version 2.2* (RTA, 2002)
– *Heavy Vehicle National Law* (NSW, 2013)
– *NSW Interim Construction Noise Guideline* (DECC, 2009)
– *NSW Planning Guidelines for Walking and Cycling* (NSW Government, 2004)
– *Palerang Development Control Plan 2015* (Palerang Council, amended 2020).

6.4.7.2.2 Desktop assessment

A desktop assessment was conducted to gain an understanding of the existing road network and traffic conditions in study area. Information on road classification, road characteristics, transport services, active transport infrastructure, and road crash information were collected and documented. Traffic volume counts in the area were also obtained from Queanbeyan-Palerang Regional Council to establish the existing traffic conditions in the network.

The amount of traffic likely to be generated by the remediation works were estimated based upon the volume of imported materials (to inform truck movements) and the number of site personnel (to inform light vehicle movements). Traffic impacts on the immediate road network were quantified by taking the traffic generation (vehicle movement) of the proposal site and adding it to the existing traffic on the affected roads. Mid-block analysis was carried out to analyse impacts on road capacity. Traffic and transport implications arising from the additional vehicle movements was also assessed.

6.4.7.3 Assessment of impacts

Key findings of the TIA are presented in the following sections. Further details are provided in Appendix M.

6.4.7.3.1 Traffic Generation

The proposed remediation works is anticipated to generate 6,004 around truck movements (heavy vehicle movements, in and out) over the 19-month materials delivery window, equalling to about two truck movements per hour. In addition, around 50 light vehicle movements (in and out) are expected to be generated by site personnel accessing the site, equivalent to 25 light vehicle movements during the peak hour.

The proposed remediation works is anticipated to generate the following total vehicle movements during the peak hour:

–	LV	25 vehicle movements	per hour	access off Captains Flat Road (north)
–	HV	2 vehicle movements	per hour	access off Captains Flat Road (north)
–	HV	1 vehicle movement	per hour	access off Foxlow Street (south).

6.4.7.3.2 Traffic Implications

The following traffic implications were derived from the traffic assessment:

– There is adequate capacity in the surrounding existing local road network to accommodate the traffic generated by the remediation works. Based on the assessment, LoS A would be maintained on the affected roads even with the additional vehicle movements associated to the works.
– Traffic that would be rerouted from the partial closure of Miners Road is expected to be very minimal and would not affect the LoS of existing roads or adversely impact circulation in the road network.
– Opportunities to reduce light vehicle movements by encouraging carpooling or providing coach services from Queanbeyan to Captains Flat would also potentially reduce the expected traffic generation from the remediation works.

– A parking area for site personnel's vehicles would be allocated within site premises (location yet to be determined) and would not impact on-street and other public parking in the town of Captains Flat.
– The proposal would not impact on public transport movements or property access.

6.4.7.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential impacts on traffic and transport during the proposed remediation works are listed in Table 6.36.

Table 6.36 Mitigation measures – traffic and transport

No.	Outcome	Mitigation measure
T1	General increase in traffic volumes	A Traffic Management Plan (TMP) shall be prepared by the contractor prior to commencement of remediation works. The TMP shall form part of the CEMP and shall include specific traffic, transportation, and access mitigation and management strategies to facilitate the safety of all workers and road users within, including access to, the proposal site.
T2	General increase in traffic volumes	Protection shall be provided to workers and road users through advance warning of roadworks, speed changes, safety barriers with adequate offsets and deflection allowance, where necessary.
T3	Increase in light vehicle traffic during peak periods associated with ingress and egress of site personnel	Opportunity for carpooling and/or the provision of coach/shuttle services for site personnel shall be explored, subject to government guidelines around COVID-19, to minimise light vehicle movements.
T4	Increase in heavy vehicles	All deliveries shall be scheduled and coordinated to facilitate the organised arrival of trucks. Ample space and time shall be allotted for the safe loading and unloading of materials. All parking and queueing (if any) shall be contained within the proposal site.

6.4.7.5 Conclusion

A summary of the potential impacts to traffic and transport is provided in Section 7.

Based on the assumptions and findings of the TIA, it is considered that the proposal satisfies the planning requirements on traffic engineering grounds and is not anticipated to have adverse traffic impacts on the surrounding road network.

Mitigation measures would be implemented to further minimise potential impacts on traffic and transport during the proposed remediation works. These mitigation measures are compiled into a Statement of Commitments in Section 9.

6.5 Assessment of national impacts

6.5.1 Introduction

This section assesses the potential impacts associated with the proposed remediation works on MNES listed under the EPBC Act.

MNES include:

– World heritage areas
– National heritage places
– Wetlands of international importance (i.e. Ramsar wetlands)
– Nationally listed threatened species and ecological communities
– Listed migratory species
– Commonwealth marine areas
– The Great Barrier Reef Marine Park

– Nuclear actions
– A water resource, in relation to coal seam gas development and large coal mining development.

Impacts on nationally listed threatened species and ecological communities are discussed in Section 6.2. The need for a referral under the EPBC Act is discussed in Section 5.2.

6.5.2 Methodology

6.5.2.1 Relevant guidelines and codes of practice

The assessment of impacts to MNES was undertaken with reference to *Matters of National Significance: Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation 1999* (Commonwealth of Australia, 2013).

6.5.2.2 Desktop assessment

A search of the EPBC Act protected matters search tool was undertaken on 19 August 2021 to determine the presence of any MNES in the vicinity of the proposal site. The results of the search are provided in Appendix I.

6.5.2.3 Field survey

Biodiversity field surveys were undertaken from 12 to 13 August 2021 and 23 to 23 November 2021. The methods and results of these surveys are discussed in Section 6.2 and detailed in Appendix H. These surveys were undertaken to identify the presence and/or likelihood of occurrence of threatened species and ecological communities listed under the EPBC Act at the proposal site.

6.5.3 Assessment of impacts

The EPBC Act protected matters search tool suggested that Commonwealth Land used by the Australian Telecommunication Commission may be present within the proposal site. However, a search of the Australian Government Commonwealth Owned Land data set shows there is no Commonwealth Land present within post code 2623 - Captains Flat (Department of Finance, 2021). No other MNES occur, or are likely to occur, within the proposal site (refer to Section 6.2, Appendix D, Appendix O and Appendix H).

A summary of potential impacts on MNES from the proposed remediation works is provided in Table 6.1. There would be no impacts from the proposed remediation works to MNES.

6.5.4 Mitigation measures

As there would be no impacts on MNES, no specific mitigation measures are proposed to manage impacts on MNES.

6.5.5 Conclusion

There are no MNES identified to occur within the proposal site. Therefore, there would be no impacts from the proposed remediation works on MNES. No mitigation measures have been proposed to address impacts on MNES.

6.6 Assessment of cumulative impacts

6.6.1 Introduction

This section assesses the potential cumulative impacts associated with the proposed remediation works. A cumulative impact assessment assesses whether the proposed remediation works are likely to have any significant cumulative impacts by identifying and taking into account interactions with existing and proposed activities in the immediate locality and the region. Mitigation measures are identified to eliminate or otherwise reduce potential cumulative impacts.

6.6.2 Methodology

6.6.2.1 Relevant guidelines and codes of practice

The cumulative impact assessment was undertaken with reference to the *Impact Assessment Guidelines for State Significant Projects* (CIA Guidelines) (DPIE 2021). Although this proposal is not considered a State Significant project these guidelines can provide insight into the cumulative impact assessment process. These guidelines recommend that cumulative impact assessments should:

– Be proportionate to the scale and potential significance of the cumulative impacts of the project combined with the impacts of other relevant future projects.
– Only focus on the key matters that are within the immediate geographical area of influence of the project (i.e. within proximity to the proposal site) and within the relevant strategic context.

6.6.2.2 Desktop assessment

To determine the cumulative impacts of the proposal, a search of the DPE Planning Portal was conducted on 23 March 2022 to identify any major nearby projects that may interact with the proposal. This search did not identify any nearby major projects.

In additional, a search of the Queanbeyan-Palerang Council 'Works and Projects' list was also searched on 23 February 2022 to identify nearby works. This search identified the projects listed in Table 6.37. A meeting with the Queanbeyan-Palerang Council was used to verify the nearby local works and determine when they would occur.

The identified projects were then assessed to ascertain if any impacts from nearby projects would likely compound the impacts from the proposal.

6.6.3 Assessment of impacts

The projects identified through the desktop assessment search are listed in Table 6.37.

Table 6.37 Works and projects listed on the Queanbeyan–Palerang Council

Project name	Distance from proposal	Works type	Project value	Project Start Date	Project End Date	Does the project cross over with the proposal construction period?
MR270 – Captains Flat Road	Adjacent	Capital works	$281,840	December 2021	About December 2023	Yes

Road works are scheduled to begin on Captains Flat Road between Captains Flat and Queanbeyan from late 2021 to December 2023. Road works on Captains Flat Road in the vicinity of the proposal are anticipated to begin in 2022 to 2023. Road works will include patching and updating sections of road requiring maintenance. These road works will be ongoing for a couple of years, and some of the works are anticipated to coincide with the proposal activities. Increased construction traffic and changed access to the proposal site may lead to minor

delays for people traveling along Captains Flat Road to Canberra or Queanbeyan for work, school or to access community services and facilities. These delays may cause some frustration for the local community. However, the cumulative impacts on Captains Flat are seen to be minimal since the proposed remediation works will be taking place on a closed construction site within Lake George Mine with associated traffic movements taking place within the site.

Regardless, the mitigation measures proposed in Section 6.6.4 suggest consulting with Council to coordinate the timing and duration of any road closures and project activities that will impact road capacity, noise levels or air quality. Scheduling should occur so that noise levels and air quality Mine are not further impacted by concurrent works in the vicinity of Lake George Mine.

To manage the lead contamination issue present in the Captains Flat Township, the Department of Regional NSW has established the multi-agency Captains Flat Lead Management Taskforce. The Captains Flat Taskforce is currently carrying out surface soil testing and other data collection activities within Captains Flat. The Taskforce is developing a lead management lead plan for Captains Flat. One option being investigated is moving up to some of the contaminated soil from Crown Land-owned abatement areas in Captains Flat township into the containment cell on the Northern Dumps, as required. Approval under the NSW Planning and Assessment Act 1979 for the abatement area remediation would be undertaken as a separate approval to this REF. It is proposed the Captains Flat Taskforce be consulted during the proposed remediation works to manage any cumulative impacts that may occur as a result of concurrent works.

6.6.4 Mitigation measures

Mitigation measures proposed to eliminate or otherwise reduce potential cumulative impacts during the proposed remediation works are listed in Table 6.38.

Table 6.38 Mitigation measures – cumulative impacts

No.	Outcome	Mitigation measure
C1	Reduced cumulative traffic impacts from nearby projects	Consult with Council to coordinate the timing and duration of any road closures and project activities that will impact road capacity. As necessary, alternative route options and (truck) delivery schedules will be planned with council to minimise impact (e.g. delays) to other road users.
C2	Reduced cumulative noise and air impacts from multiple nearby projects	Consult with Council to coordinate the timing and duration of any project activities that will impact noise levels and air quality in the vicinity of Lake George Mine.
C3	Increased community understanding of planned works across concurrent projects	Notify residents of planned construction works in the Captains Flat area as well as when they are expected to start and finish. Notifications will provide community with a complaints mechanism.
C4	Reduced cumulative impacts form Captains Flat Taskforce works occurring during the proposed remediation work	Consult with the Captains Flat Taskforce to coordinate concurrent remediation works that may result from the Lead Management Plan.

6.6.5 Conclusion

Concurrent works from the proposed remediation works and other proposed projects in the vicinity of the proposal site may create cumulative construction traffic, noise and air impacts. Council and the Captains Flat Taskforce will be consulted in relation to managing impacts during the proposed remediation works to eliminate or otherwise reduce cumulative impacts. In addition, the Captains Flat community should be notified of the works and provided a mechanism to make complaints. A summary of the potential cumulative impacts is provided in Section 7. The mitigation measures used to reduce cumulative impacts are included as part of the mitigation measures compiled into a Statement of Commitments in Section 9.

7. Summary of impacts

A summary of the likely consequence and significance of predicted impacts is provided in Table 7.1.

Table 7.1 Summary of potential impacts

Impacts	Size	Scope	Intensity	Duration	Level of confidence in predicting impacts	Resilience of environment to cope with impacts	Level of reversibility of impacts	Ability to manage or mitigation impacts	Ability of the impacts to comply with standards, plans or policies	Level of public interest	Requirement for further information on the impacts of the activity or mitigation	Ranking of potential significance
Physical or pollution impacts (refer to Section 6.1)												
Air	Small scale size/volume	Localised	Small impact dispersed over a short period	Short term (several hours)	Low confidence, numerous uncertainties and unknowns	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available	Uncertain or part compliance	High interest and uncertain impacts on community	Low level of information on and understanding of key issues	Low adverse
Water	Small scale size/volume	Localised	Large impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available	Uncertain compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Temporary low adverse Long term positive
Soil and stability	Large scale size / volume	Extensive	Large impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available	Uncertain compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Positive
Noise and vibration (construction noise)	Large scale size / volume	Extensive	Large impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available Refer to Section 6.1.4.	Uncertain or part compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Low adverse
Noise and vibration (construction vibration)	Small scale size/volume	Localised	Small impact dispersed over a short period	Medium term (maximum 9 months)	High confidence / knowledge and past experience	Medium resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available Refer to Section 6.1.4.	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Low adverse
Noise and vibration (road traffic noise)	Small scale size/volume	Localised	Small impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available Refer to Section 6.1.4.	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Low adverse
Coastal processes and hazards	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hazardous substance sand chemicals	Small scale size/volume	Localised	Small impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available Refer to Section 6.1.1.4.	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Low adverse

Impacts	Size	Scope	Intensity	Duration	Level of confidence in predicting impacts	Resilience of environment to cope with impacts	Level of reversibility of impacts	Ability to manage or mitigation impacts	Ability of the impacts to comply with standards, plans or policies	Level of public interest	Requirement for further information on the impacts of the activity or mitigation	Ranking of potential significance
Wastes	Small scale size/volume	Localised	Small impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available Refer to Section 6.1.1.4.	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Low adverse
Biological impacts (refer to Section 6.2)												
Flora and fauna	Small scale size/volume	Localised	Small impact dispersed over a short period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Not possible	Effective mitigation measures available	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Temporary low adverse Long term positive
Biosecurity and bushfire	Medium scale size / volume	Localised	Small impact dispersed over a short period	Long term (19 months)	High confidence / knowledge and past experience	Medium resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available Refer to Section 6.2.2.4.	Total compliance	High interest and predictable impacts on community	High level of understanding and information on the impact	Low adverse
Resource use impacts (refer to Section 6.3												
Community resources	Small scale size/volume	Localised	Small impact dispersed over long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Not applicable	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Negligible
Natural resources	Small scale size/volume	Localised	Small impact dispersed over long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Not appliable	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Negligible
Community impacts (refer to Section 6.4)												
Social factors	Small scale size/volume	Localised	Small impact dispersed over long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Negligible
Economic factors	Small scale size/volume	Localised	Small impact dispersed over long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Not applicable	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Negligible
Non-Aboriginal heritage impacts	Small	Localised	Minor	Short term	High	NA	Not Possible	High	High compliance	Moderate	Impacts are identifiable and understood	Low adverse
Aboriginal heritage impacts	Small scale size/volume	Localised	Small impact dispersed over long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available (refer to Section 6.4.4.4)	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Negligible
Aesthetic impacts	Medium scale size / volume	Localised	Large impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available (refer to Section 6.4.5.4)	Total compliance	High interest and predictable impacts on community	High level of understanding and information on the impact	Temporary medium adverse Long term positive

Impacts	Size	Scope	Intensity	Duration	Level of confidence in predicting impacts	Resilience of environment to cope with impacts	Level of reversibility of impacts	Ability to manage or mitigation impacts	Ability of the impacts to comply with standards, plans or policies	Level of public interest	Requirement for further information on the impacts of the activity or mitigation	Ranking of potential significance
Land use	Small scale size/volume	Localised	Small impact over a long period	Long term	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available (refer to Section 6.4.6.4)	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Positive
Transportation	Small scale size/volume	Localised	Small impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available (refer to Section 6.4.7.4)	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Negligible
National and cumulative impact												
National	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Negligible
Cumulative	Small scale size/volume	Localised	Small impact dispersed over a long period	Long term (19 months)	High confidence / knowledge and past experience	High resilience	Impacts are reversible and rehabilitation likely to be successful	Effective mitigation measures available (refer to Section 6.6.4)	Total compliance	Low interest and predictable impacts on community	High level of understanding and information on the impact	Low adverse
Ranking of the activity as a whole												
Positive / Negligible / Low adverse / Medium adverse / High adverse Construction (i.e. remediation) – Low adverse Operation (i.e. post-remediation) – Positive												

8. 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 proposal would meet the proposal objectives, which are outlined in Section 4. The proposal would primarily assist with significantly reducing the risk of off-site contaminant migration through windborne dust, sediment and surface water migration to the surrounding environment, in addition to reducing on site human health and safety risks.

The proposal would result in some minor temporary environmental impacts, including minor vegetation clearing, potential minor sedimentation impacts during the remedial works, decreased air and aesthetic quality and an increase in noise and traffic during construction. Implementation of the safeguards and management measures detailed in this REF would ameliorate or minimise these minor temporary impacts.

The REF proposal would be unlikely to cause a significant impact on the environment. Indeed, the aim of the remedial works is to improve the condition of the environment at, and downstream of, the Lake George Mine, including the township of Captains Flat. The assessment found that a species impact statement is not required and that an environmental impact statement does not need to be prepared. No approval is required to be sought from the Minister for Planning under Part 5.1 of the EP&A Act.

In addition, the REF proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*. Therefore, a referral to the Australian Department of Agriculture, Water and the Environment is not required.

On balance, the proposal is considered justified as the environmental impacts would be outweighed by the improvement of water quality leaving Lake George Mine, the reduction of windborne dust risk, the improvements to public health and safety and increased aesthetic and tourism value of the site.

9. Statement of commitments

Table 9.1 Statement of commitments

Item	Commitment
Activity type	The Legacy Mines Program (LMP) within the Department of Regional NSW propose to undertake remediation works at the legacy Lake George Mine, located immediately west of the township of Captains Flat, New South Wales (NSW).
Activity location	Lake George Mine, immediately west of the township of Captains Flat NSW, about 50 kilometres south-east of Canberra. Activities will occur on the land listed within Appendix A.
Activity scope (including any ancillary activities)	The proposed remediation works include site preparatory early works, fencing historic mining structures, strategic structural works, remediation earthworks, augmentation of surface water drainage, and revegetation across several key domains in the northern portion of Lake George Mine. The purpose of the proposed remediation works is to reduce the risk of offsite contamination through airborne dust and surface erosion generating contaminated runoff from the continued oxidation of sulfidic mineral waste at Lake George Mine. The proposed remediation works are required to prevent potential environmental and human health risks to people accessing the site, to residents in the vicinity of the site, and in the township of Captains Flat, and to aquatic ecosystems and downstream users of the Molonglo River. The proposed remediation works include: – Site preparatory early works – Fencing historic mining structures – Strategic structural works – Remediation earthworks – Augmentation of surface water drainage – Revegetation. The proposed remediation works would be undertaken across several key site domains, predominantly in the northern portion of Lake George Mine. These areas are: – North Mine Ridge/Elliot's – Old Mill – Mill Area (west of the Central Mine Area) – Central Mine Area – Creeks Area – Rail Loading Area – Minor areas of eroded capping on the Northern and Southern Dumps. In addition, mine waste from the following sources are proposed for relocation to a containment cell that would be located on the Northern Dumps. These include: – A sulfidic waste stockpile located on the junction of Miners Road and the Council wastewater treatment plant access road – A slag heap located on the western side of Jerangle Road in Forster's Gully, adjacent to the northern end of the Southern Dumps. – TfNSW lead contamination from around the Captains Flat Railway Precinct – Crown Land / QPRC land within the Captains Flat township. That is, The Captains Flat Lead Management Taskforce is currently undertaking an assessment of the Captains Flat township with the aim to prepare abatement plans for the higher risk public spaces. One option being investigated is moving up to a maximum of 20,000 tonnes of contaminated soil from these Crown Land-owned abatement areas into the containment cell on the Northern Dumps. These remediation works would be subject to a separate approval under the NSW Planning and Assessment Act 1979.
Hours of operation	– Monday to Friday 7:00 am to 6:00 pm – Saturday 8:00 am to 1:00 pm – No work on Sundays or Public Holidays
Activity duration	Estimated at 19 months from commencement

Item	Commitment
Proposed commencement date	Estimated June 2022 (pending approvals)
Proposed completion date	Estimated December 2023
Maximum area of disturbance	– Maximum spatial extent of remedial domains: 46.8 ha – Maximum area of disturbance as defined by clearing and grubbing for remedial works: 20.5 ha
Air quality	AQ1: Prepare a dust management plan, with specific management measures for all remediation areas.
	AQ2: Prepare a dust monitoring plan, which is to include at least two real time particulate samplers to assist proactive management of dust. Real -time samplers should be placed at the two nearest receptors to the current remediation area. The plan should include triggers and alerts to reduce or stop works based on measured dust concentrations. Install a network of dust deposition gauges including the following: – One at receptor adjacent to rail loading area – One at nearest receptor south of the mill area – One to the east of central mine area in Captains Flat – One to the east of the north mine ridge, potentially the sports field or swimming pool. SES is located directly adjacent to remediation works. This SES site should not be used by non-construction workers when remediation works are directly adjacent unless in the case of an emergency. Undertake watering (2 L/m2/h) of haul truck access routes, the remediation zones and stockpiles, as required. Additional watering should be applied if any visible dust plumes are observed leaving the work area or site boundary
	AQ3: Additional watering should be applied to the Rail Loading Area and any remediation activities undertaken on the site boundary within 70 metres of sensitive receptors due to a higher risk of exceedances of the criteria. Watering can reduce emissions by up to 70 per cent. Aim to minimise the size of excavated stockpiles where possible. Limit clearing areas of land and clear only when necessary to reduce fugitive wind-blown dust emissions. Control on-site traffic by designating specific routes for haulage and access and limiting vehicle speeds to below 25 kilometres per hour. All trucks hauling material should be covered on the way to and from the proposal site and should maintain a reasonable amount of vertical space between the top of the load and top of the trailer to prevent the escape of dust or other material while in transit. During stockpile loading and unloading the drop height of the excavator should be minimised to prevent unnecessary dust emissions. If dust generation is evident, measures such as increased water application, minimising vehicle movements and reducing vehicle speed limits will be carried out to minimise dust impacts. On high wind days, or when real-time dust sampling trigger alerts, increase watering, reduce activity or stop works. All construction plant and machinery will be fitted with emission control devices complying with the Australian Design Standards. All vehicles, plant and machinery will be maintained and serviced in accordance with manufacturer's specifications. Machinery will be turned off when not in use and not left to idle for prolonged periods.
Water	W1: A Construction Environmental Management Plan (CEMP) will be prepared by the Contractor, including a Surface Water Management Plan (SWMP) based upon the detailed design to provide specific further guidance on the Contractor's proposed water management strategy. The Surface Water Management Plan should be developed in accordance with Managing Urban Stormwater – Volume 1 (Landcom, 2004), Managing Urban Stormwater – Volume 2 (DECC, 2008a) and Managing Urban Stormwater – Volume 2E, Mines and quarries (DECC, 2008b), informally known as the 'Blue Book', this document, as well as any condition of consent and relevant agency requirements.

Item	Commitment
	W2: To manage the erosion and sedimentation risk during the works, a system of engineered erosion and sedimentation controls. These controls should be implemented in accordance with the CEMP and the Surface Water Management Plan.
	W3: Use a lower-risk liming product, such as a calcium carbonate based agricultural lime on areas not subject to clay capping.
	W4: Implement a water quality monitoring program to identify potential deficits in the site's environmental management during construction at previous monitoring locations, including key upstream and downstream locations, using similar analytes to allow for comparison to historical observations.
	W5: Implement a Trigger Action Response Plan (TARP) to identify trigger values and criteria and provide appropriate response actions if impacts during the remediation works are identified through the monitoring program.
	W6: Post remediation, monitor water quality to identify any acute changes to water quality (anticipated benefits) arising from implementation of the remediation works, as well as any long-term trends following remediation. Post-remediation water monitoring will be included as part of the long-term Environmental Management Plan.
	W7: Monthly inspections of vegetation establishment, including monitoring and rectification of any deficiencies (or as required in accordance with the Technical Specification of the works) for a minimum of 12 months.
	W8: Quarterly visual stability inspections of Forsters Creek in proximity to the remediated slag heap.
Erosion and sediment controls	SS1: Erosion and sediment controls would be implemented in accordance with Volume 1, 2C and 2E of *Managing Urban Stormwater: soils and construction* (Landcom 2004; DECC NSW, 2008a; DECC NSW 2008b). These should not extend across waterways as this may interrupt fish passage (as applicable).
	SS2: Erosion and sediment control measures would be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality.
	SS3: Stabilised surfaces would be rehabilitated as quickly as practicable after construction.
	SS4: Stockpiled material would be stabilised / covered where feasible / bunded and contained as required, during extended periods of time, such as when heavy rainfall is forecast.
	SS5: Measures to minimise the potential for hydrocarbon spills or release of contaminated material and associated impacts on natural environments adjacent to, and downstream, of the proposal site.
	SS6: The CEMP would include controls to limit the transfer of contaminated soil onto public roads such as a truck wash for example.
	SS7: Develop and implement an Unexpected Finds Protocol for asbestos within the CEMP.
Noise and vibration	NV1: Ensure employees, contractors and subcontractors receive an environmental induction. The induction must include: – All proposal-specific and relevant standard noise and vibration mitigation measures – Relevant licence and approval conditions – Permissible hours of work – Any limitations on high noise generating activities – Location of nearest sensitive receivers – Construction employee parking areas – Designated loading/unloading areas and procedures – Site opening/closing times (including deliveries) – Environmental incident procedures.

Item	Commitment
	NV2: Confine activities on site between the hours: daytime hours of 7:00 am to 6:00 pm from Monday to Friday and 8:00 am to 1:00 pm on Saturday, with the exception of the following activities: – The delivery of oversized plant of structures – Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm. The need for additional works required to be undertaken outside of standard construction hours (ICNG) should be justified in the CEMP for the proposed remediation works and assessed against the noise requirements of the ICNG. Consult with affected neighbours about scheduling activities to minimise noise impacts. Schedule work generating high noise and/or vibration levels during less sensitive time periods.
	NV3: – Avoid the use of radios or stereos outdoors where neighbours can be affected – Avoid shouting and minimise talking loudly and slamming vehicle doors – Reduce throttle setting and turn off equipment when not being used – Avoid use of reversing alarms by designing site layout to avoid reversing, such as by including drive- through for parking and deliveries – Install where feasible and reasonable less-annoying alternatives to the typical 'beeper' alarms, taking into account the requirements of any relevant Occupational Health and Safety legislation (in particular, the Interim Construction Noise Guideline); examples are multifrequency alarms that emit noise over a wide range of frequencies.
	NV4: Prepare a CNVMP. Include a review of the construction noise predictions assessed during the environmental impact assessment phase based on the methodology and revise accordingly to include a detailed examination of feasible and reasonable work practices and noise mitigation measures to manage sensitive receivers that are predicted to be 'noise affected'. The CNVMP should also include – Details of the construction methodology – Feasible and reasonable mitigation measures to be implemented – Updated noise predictions at sensitive receivers – A noise monitoring procedure for the duration of works – A community consultation plan to liaise with the noise affected receivers.
	NV5: Fit and use non-tonal reversing beepers (or an equivalent mechanism) on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.
	NV6: Use quieter and less vibration emitting construction methods, where feasible and reasonable.
	NV7: Select, where feasible and reasonable, the most effective mufflers. Always seek the manufacturer's advice before making modifications to plant to reduce noise. Silencers/mufflers are required on the following mobile plant: – Dozers – Graders – Backhoe – Loaders – Concrete trucks – as applicable – Rollers – Asphalt pavers – as applicable – Excavators – Trucks – Water carts – Bobcats – Scrapers.
	NV8: Orient equipment with directional noise characteristics away from noise sensitive receivers.
	NV9: Use only the necessary size and power.

Item	Commitment
	NV10: – Ensure loading and unloading of materials/deliveries is to occur as far as possible from sensitive receivers. – Select site access points and roads as far as possible away from sensitive receivers. – Shield dedicated loading/unloading areas if close to sensitive receivers. – Fit delivery vehicles with straps rather than chains for unloading, wherever possible. – Avoid or minimise out of hours movements, where possible.
	NV11: – Limit the use of engine compression brakes in proximity to residences – Ensure vehicles are fitted with a maintained Original Equipment Manufacturer exhaust silencer or a silencer that complies with the National Transport Commission's 'In-service test procedure' and standard.
	NV12: – Use temporary site buildings and materials stockpiles as noise barriers – Use natural landform as noise barrier – place fixed equipment in cuttings, or behind earth berms.
	NV13: Ensure a noise monitoring procedure is developed and carried out for the duration of works in accordance with the CNVMP and any approval or licence conditions. Monitoring reports should be prepared in accordance with the requirements of the noise monitoring procedures.
	NV14: Compliance monitoring should be undertaken to investigate complaints.
	NV15: Where vibratory rollers may be required, use plant types of type VR3 or lower (i.e. 6 tonnes or less) if works are within the buffer distances (100 metres from sensitive receivers).
	NV16: Notify residents in potentially affected catchment zones prior to use of any vibratory within the human response zones outlined in Section 6.1.4.3.2.
	NV17: Wherever possible, avoid the use of any vibrating roller within 15 metres of the residential building at 5 Old Mines Road.
	NV18: Ensure delivery truck movements not exceed the following hourly volumes: – Day period 7am* to 6 pm – 6 in and 6 out – Evening period 6 pm to 9 pm – 2 in and 2 out – Night period – 6 am to 7* am - 1 in and 1 out. *8 am on Sundays and public holidays. No truck deliveries should occur between 9 pm and 6 am.
	NV19: Ensure all trucks are in good working order and comply with the relevant noise emissions standards by checks and regular inspection. – Operations should be designed to minimise reversing on site – Keep to speed limits on public roads and onsite – Where possible, driving of trucks should minimise: • Heavy acceleration and braking • Engine/compression braking (especially during the evening and night) • Reversing using tonal alarms, where feasible.
Use of chemical, fuels and lubricants	OPP1: Use a lower-risk liming product, such as a calcium carbonate based agricultural lime except in the containment cell which would remain an enclosed and controlled environment.
	OPP2: Measures to minimise the potential for hydrocarbon spills or release of contaminated material and associated impacts on natural environments adjacent to, and downstream, of the proposal site.
	OPP3: Ensure that any contaminated soil that is spilled during transportation on site is collected and appropriately landfilled and remediated at the Northern Dumps.
	OPP4: All trucks would be covered when transporting contaminated material between the Southern Dumps and the Northern Dumps containment cell.
Waste	OPP5: Ensure waste that is to be disposed of off-site is classified in accordance with the *Waste Classification Guidelines* (EPA, 2014) and that it is removed and disposed of at a facility that can lawfully accept the waste in accordance with the POEO Act and POEO Waste Regulation.

Item	Commitment
	OPP6: Document and implement waste mitigation and management strategies in accordance with the CEMP. This shall include: – Waste management facilities on-site including their set-up, use, management removal and waste tracking documentation – Waste hierarchy application including information demonstrating the reduction of the amount of waste produced and the maximised reuse and recycling opportunities utilised – Appropriate waste management across all possible waste items produced.
	OPP7: Remove waste on a weekly basis, or as soon as reasonably practicable. At the completion of works, a check shall be made to ensure that all waste has been removed from site.
	OPP8: Ensure waste is removed by an appropriately licenced contractor.
Flora and fauna	FF1: A Construction Environmental Management Plan (CEMP) will be prepared, including the specific mitigation measures and sub plans listed below along with work methods, contingencies, roles and responsibilities. The mitigation measures included in the CEMP and sub-plans would be implemented during remediation and rehabilitation works. All workers must be provided with an environmental induction prior to starting remediation and rehabilitation works on site. This would include information on the ecological values of the site and protection measures to be implemented to protect biodiversity during remediation and rehabilitation. This would focus particularly on measures to avoid or minimise disturbance of roosting microbats and minimising impacts on the adjacent Box Gum Woodland EEC.
	FF2: To reduce the potential for adverse impacts on ecologically sensitive areas the following measures would be implemented: – Confirmation of the final spatial extent of vegetation clearance required for remediation of the underlying soil. – A site inspection prior to the commencement of any vegetation clearing to clearly demarcate vegetation protection areas and clearing limits with a particular focus on minimising clearing of Box-Gum Woodland with reference to Figure 4-1 of this report. – Hygiene protocols would be followed to prevent the introduction and spread of pathogens. All machinery and plant should be cleaned prior to work on site. – Weed control mitigation and management strategies shall be documented and implemented in accordance with the CEMP and *Biosecurity Act 2015*. This shall include procedures to reduce the spread of weeds via vehicles and machinery with particular focus on weeds of concern such as Serrated Tussock, which is particularly abundant in grassland areas throughout Lake George Mine. – Post remediation rehabilitation of disturbed or exposed surfaces should include planting of a cover crop to quickly reduce the erosion risk in line with the *Lake George Mine Capping and revegetation works technical specification* (GHD 2020). This will include: • Grass seed sown in accordance with the supplier's requirements and/or achieve a minimum 70% cover per square metre • Lightly raking the topsoil surface after sowing and watering the area as possible • Regular watering through the establishment period in accordance with the suppliers requirements • Protection of revegetated areas from pedestrians and animals until the grass has established, and from vehicles or heavy plant at all times • Maintenance of revegetation areas for a period of 12 months. – It is noted that the initial ground cover will be a sterile exotic cover crop.
	FF3: To reduce the potential for adverse impacts on fauna and fauna habitat the following measures will be implemented: – Fencing of retained derelict structures to avoid disturbance to potential microbat roosting habitat within Lake George Mine. – Retention and relocation of woody debris within the mine site which provide important habitat components for small woodland birds. – A local vet or wildlife carer should be identified as a contact during clearing operations contacted if wildlife is injured.

Item	Commitment
	– Demolition of derelict mine structures should not occur during the breeding seasons for cave-roosting microbats. Breeding season occurs from approximately October to February.
	FF4: The following measures should be incorporated into the CEMP to manage impacts on aquatic habitats and water quality: – Measures to minimise the potential for chemical spills or release of contaminated material and associated impacts on natural environments adjacent to and downstream of the site. – Erosion and sediment controls would be implemented in accordance with Volume 1, 2 and 2E of Managing Urban Stormwater: soils and construction (Landcom 2004; DECC 2008a, 2008b). – Erosion and sediment control measures would be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality. – Stabilised surfaces would be rehabilitated as quickly as practicable after construction. – All stockpiled material would be stored in bunded areas and kept away from waterways to avoid sediment entering the waterway. – Dust suppression techniques such as water spraying and covering stockpiles would be implemented, where necessary. – Vehicles would follow appropriate speeds to limit dust generation. – Specific measures will be incorporated to minimise the potential for chemical spills and associated impacts on natural environments adjacent to and downstream of the site.
Ecological and biosecurity	BS1: A Construction Environmental Management Plan (CEMP) will be prepared, including the specific mitigation measures and sub plans listed below along with work methods, contingencies, roles and responsibilities. The mitigation measures included in the CEMP and sub-plans would be implemented during remediation and rehabilitation works. Ensure all workers are provided with an environmental induction prior to starting remediation and rehabilitation works on site. This would include information on the ecological values of the site and protection measures to be implemented to prevent biosecurity issues during remediation and rehabilitation. The CEMP will include a bushfire risk assessment and management protocol as a sub-plan.
	BS2: To reduce the potential for adverse impacts to biosecurity the following measures would be implemented: – Hygiene protocols would be followed to prevent the introduction and spread of pathogens. All machinery and plant should be cleaned prior to work on site. – Weed control mitigation and management strategies shall be documented and implemented in accordance with the CEMP and Biosecurity Act 2015. This shall include procedures to reduce the spread of weeds via vehicles and machinery with particular focus on weeds of concern such as Serrated Tussock, which is particularly abundant in grassland areas throughout Lake George Mine.
	BS3: Measures to mitigate and manage bushfire risk will be developed and included as part of site-specific hazard and risk management measures for the proposal. Measures will include the maintenance of ancillary facilities in a tidy and orderly manner and the storage and management of dangerous goods and hazardous materials in a safe location.
	BS4: An incident response management plan will be developed and implemented. This plan will include bushfire risks. The response to incidents will be managed in accordance with the requirements of NSW Rural Fire Service, NSW Fire Brigade and other emergency services.
Community resources	CR1: Potential for local and regional businesses to participate in procurement opportunities during construction. Local businesses may also benefit from construction workers spending money in town.
Social	S1: Implement a communication management plan to manage impacts to community stakeholders. This would include: – Protocols to keep the community updated on the progress of the proposal – Protocols to inform the community of potential impacts (traffic/access, noise, air quality impacts) • Inform the community about companies involved in truck movements so the community is aware of the contracting vehicles associated with the proposal. – Protocols to respond to complaints received.
	S2: The communication management plan which would include procedures to ensure adjacent residents are notified about remediation activities, as well as a complaints procedure.

Item	Commitment
Non-Aboriginal Heritage	NAH1: The proposed activity must be confined to the proposed works footprint. This would ensure that neighbouring and adjacent heritage sites (Captains Flat Railway Station, Stationmasters Residence (Former) and Roscommon) are not impacted upon.
	NAH2: To mitigate any unintended harm the following measures must be taken: – A detailed geospatial survey of the site must be prepared that identifies all elements subject to removal and temporary relocation – A detailed photographic record must be prepared of each element subject to removal and temporary relocation – Elements subject to removal and temporary relocation will be securely stored at an appropriate location at, or near, the site – Reinstatement of elements subject to removal and temporary relocation must occur as soon as practicable following completion of the remediation works – Fabric elements associated with the rails including rail spikes, fishplates and ties must be salvaged and, where that is not possible, they must be replaced with like components – Replacement timbers (including rail sleepers) should be like items, where possible – The rail ballast and sub-grade is to be replaced with new material. As the Captains Flat railway is no longer operating, the reinstatement of railway tracks may not require engineering and construction to meet operational railway standards. Advice should be obtained from Transport for NSW on this matter.
	NAH3: Potential archaeological deposits are likely to be associated with the mine entrance, workshop and change rooms and at the Processing Site (Kohinoor & Elliots). These sites must be protected from disturbance with physical barriers whilst works are underway. The positioning of barrier fencing should be determined in consultation with an archaeologist with experience of the Lake George Mine site. The application of lime to surface deposits at the Processing Site (Kohinoor & Elliots) will be undertaken by hand and without disturbance to surface deposits to avoid any impact to potential archaeological deposits.
	NAH4: If the Concentrate Loading Tunnels are to be removed, the following measures would be taken before the proposed activity commences in order to mitigate the impact – A detailed archival recording of the Concentrate Loading Tunnels will be prepared including site plans and measured drawings; and – A detailed archival photographic record of the Concentrate Loading Tunnels will be prepared.
	NAH5: To mitigate any unintended harm to the Concentrate Bins, the following measures would be taken before the proposed activity commences: – A detailed archival recording of the Concentrate Bins will be prepared including site plans and measured drawings; and – A detailed archival photographic record of the Concentrate Bins will be prepared. If removal of the inert gravel and the sulfidic waste causes the structural integrity of one or more of the Concentrate Bins to be compromised, additional heritage assessment will be required to determine the most appropriate future management of the structure(s).
	NAH6: To mitigate any unintended harm to the Surge Bin, the following measures would be taken before the proposed activity commences: – A detailed archival recording of the Surge Bin will be prepared including site plans and measured drawings; and – A detailed archival photographic record of the Surge Bin will be prepared. If removal of the sulfidic waste causes the structural integrity of the Surge Bin to be compromised, additional heritage assessment will be required to determine the most appropriate future management of the structure.
	NAH7: Prior to the commencement of the proposed remediation works, the Processing Site (Kohinoor & Elliots) should be secured with temporary fencing to restrict access, minimise on site safety risk, and to protect the historic structures from inadvertent damage during the works.

Item	Commitment
	NAH8: At the completion of construction works, the following heritage elements should be secured with appropriate permanent safety fencing to restrict access. Final barrier design would be determined based on site specific conditions and the relevant Australian Design Standards. – Flotation Mill – Storage Bins, Sulphur Plant & Ball Mills – Surge Bin concrete footers.
Aboriginal Heritage	AH1: Implement unanticipated finds protocol. If unforeseen Aboriginal objects/sites are uncovered during the proposed remediation works, work would cease in the vicinity of the find and next step would be co-ordinated by LMP. This would likely involve consultation with an archaeologist, the Department of Planning, Industry and Environment (DPIE) and the Local Aboriginal Land Council.
	AH2: Implement unanticipated skeletal remains protocol. If human remains are found during the proposed remediation works, work would cease, the site would be secured, and the NSW Police and DPIE would be notified.
	AH3: If a native title land claim is declared this will be investigated and a notice of the works will be forwarded to the native title claimants' representative body.
Aesthetic	A1: Ensure construction plant, equipment, waste and excess materials are contained within the designated boundaries of the site and are removed following the completion of the proposed remediation works
	A2: Keep work areas tidy at all times
	A3: Keep vegetation clearance to a minimum
	A4: Ensure the proposal site is revegetated as per a Revegetation Plan
	A5: Monitor revegetation to ensure successful re-establishment
	A6: A detailed archival photographic record of the Surge Bin will be prepared prior to the works commencing.
Land use	LU1: Rock mulch instead of topsoil will be used as the top layer for remediation works occurring in the central part of the Central Mine Area, around one third of the Mill Area and in other select areas of the site to promote mining infrastructure aesthetics.
Transport	T1: A Traffic Management Plan (TMP) shall be prepared by the contractor prior to commencement of remediation works. The TMP shall form part of the CEMP and shall include specific traffic, transportation, and access mitigation and management strategies to facilitate the safety of all workers and road users within, including access to, the proposal site.
	T2: Protection shall be provided to workers and road users through advance warning of roadworks, speed changes, safety barriers with adequate offsets and deflection allowance, where necessary.
	T3: Opportunity for carpooling and/or the provision of coach/shuttle services for site personnel shall be explored, subject to government guidelines around COVID-19, to minimise light vehicle movements.
	T4: All deliveries shall be scheduled and coordinated to facilitate the organised arrival of trucks. Ample space and time shall be allotted for the safe loading and unloading of materials. All parking and queueing (if any) shall be contained within the proposal site.
Cumulative	C1: Consult with Council to coordinate the timing and duration of any road closures and project activities that will impact road capacity. As necessary, alternative route options and (truck) delivery schedules will be planned with council to minimise impact (e.g. delays) to other road users.
	C2: Consult with Council to coordinate the timing and duration of any project activities that will impact noise levels and air quality in the vicinity of Lake George Mine.
	C3: Notify residents of planned construction works in the Captains Flat area as well as when they are expected to start and finish. Notifications will provide community with a complaints mechanism.
	C4: Consult with the Captains Flat Taskforce to coordinate any concurrent remediation works that may result from the Lead Management Plan.
Rehabilitation commitments and timeframes	Not applicable as the proposal works are remediation works

Item	Commitment
Other regulatory approvals required	– *Protection of the Environment Operations Act 1997 (POEO Act)* licence. – *State Environmental Planning Policy (Transport and Infrastructure) 2021* requires consultation with Council as the project involves consequential excavation of a road for which the council is the roads authority.
Community consultation	– To be engaged using a range of tools and techniques including meetings, phone calls, and information sessions. – To be supported by community feedback mechanisms, including a project-specific phone number and email address.
Compliant management	– A Complaints Management Procedure will be established and information provided to all landholders of properties where activities will take place. – Landholders will be provided with relevant contact details to be able to contact a staff member.
Incident management	– An Incident Management Procedure will be established and utilised in the event of an environmental or safety incident. – The Department will be notified of all incidents
Monitoring	Monitoring of the long-term impacts of the remediation works will be undertaken in accordance with the water quality monitoring program and potentially, the forward site Environmental Management Plan.
Continuous improvement	No additional measures identified
Reporting	Reporting to the Department will occur as required
Other (as applicable)	No additional measures identified

10. References

AMIRA (2002). *Project P387A Prediction & Kinetic Control of Acid Mine Drainage - ARD Test Handbook.* April 2002. AMIRA International Limited, Melbourne.

Australian Bureau of Meteorology (2021). *Monthly rainfall Captains Flat (Foxlow St)*. Accessed online at: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=070016

Australian Bureau of Statistics. 2017a. *2016 Census*. Australian Bureau of Statistics. 2017. http://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016 Census Community Profiles.

Australian Bureau of Statistics. 2017b. *2016 Census of Population and Housing. General Community Profile. Catalogue Number 2001.0*. https://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016 Census Community Profiles.

Australian Bureau of Statistics. 2019. *6291.0.55.001 - RM1 - Labour Force Status by Age, Labour Market Region (ASGS) and Sex, October 1998 Onwards*. https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6291.0.55.001Dec 2016?OpenDocument.

Australian Bureau of Statistics. 2016. *Technical Paper: Socio-Economic Indexes for Areas (SEIFA)*. http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/756EE3DBEFA869EFCA258259000BA746/$File/SEIFA 2016 Technical Paper.pdf.

Australian Department of Finance. 2021. *Commonwealth Owned Land.* Accessed online at: https://data.gov.au/dataset/ds-dga-abf537fa-fbd5-44a3-bff2-a39580face9a/details?q=

Australian Government Department of Agriculture, Water and the Environment (2012). Emission estimation technique manual for mining Version 3.1

Australia ICOMOS (1999). *Australia ICOMOS Burra Charter*.

Australian Government Labour Market Information Portal, 2021. *Small Area Labour Markets Data*. Accessed online at: https://lmip.gov.au/default.aspx?LMIP/Downloads/SmallAreaLabourMarketsSALM

Australian and New Zealand Governments (ANZG). (2018) *Water Quality Guidelines.* Accessed online at: waterquality.gov.au/anz-guideline

Austroads (2021). *Guide to Road Design Part 3: Geometric Design, Edition 3.4,* AGRD03-16, Austroads, Sydney, NSW.

Brooks, K. 1980. *Mine Waste Pollution of the Molonglo River: An Investigation into the Effect of Remedial Measures Carried Out in 1976 at Captains Flat*. Sydney: Chemical Laboratory New South Wales Department of Mineral Resources, 1980.

Cardno (2015). Captains Flat Floodplain Risk Management Study and Plan

Caitcheon, G., Hammond, R., Wasson, R., Wild, B. & Willet, I. (1988). The Lake Burley Griffin study: its implications for catchment management.

Commonwealth of Australia. 2013. *Matters of National Environmental Significance – Significant impact guideline 1.1 Environmental Protection and Biodiversity Conservation Act 1999*. Accessed online at: http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

Commonwealth Department of Foreign Affairs and Trade (DFAT) (2016a). *Preventing Acid and Metalliferous Drainage.* Canberra. Leading Practice Sustainable Development for the Mining Industry Series.

Commonwealth Department of Foreign Affairs and Trade (DFAT) (2016c). *Mine Rehabilitation.* Canberra. Leading Practice Sustainable Development for the Mining Industry Series.

Department of Agriculture, Water and the Environment (DAWE) (2021a). Protected Matters Search Tool. Accessed at https://www.environment.gov.au/epbc/pmst/index.html

DAWE (2021b) Species Profile and Threats Database. Department of the Environment and Energy. Accessed at: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Department of Environment (DoE) (2013) *Matters of National Environmental Significance. Significant Impact Guidelines 1.1.* Accessed at: https://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

Department of Environment and Conservation (DEC) (2006) *Assessing Vibration: a technical guideline*

Department of Environment and Climate Change (DECC) NSW (2008a). *Manual Managing Urban Stormwater: Soils and Construction – Volume 2C.* Department of Environment and Climate Change

DECC NSW (2008b). *Manual Managing Urban Stormwater: Soils and Construction – Volume 2E, Mines and quarries.* Department of Environment and Climate Change

DECC. NSW (2009). *Interim Construction Noise Guideline*

Department of Environment, Climate Change and Water (DECCW) (2011). *NSW Road Noise Policy*

DECCW (2010). Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.

Department of Finance (2021). *Commonwealth Owned Land*. Accessed at: https://data.gov.au/data/dataset/abf537fa-fbd5-44a3-bff2-a39580face9a

Department of Planning and Environment (2015). *ESG2: Guideline for preparing a Review of Environmental Factors*.

Department of Planning and Infrastructure (DPI) (2021). *Priority weed declarations – South East region.* Accessed at: https://weeds.dpi.nsw.gov.au/WeedBiosecurities?AreaId=10

DPI (2013a) Policy and guidelines for fish habitat conservation and management. 2013 Update

Department of Planning, Industry and Environment, 2019. *Population Projections*. Accessed online at: https://www.planning.nsw.gov.au/Research-and-Demography/Population-projections/Projections

DPI (2013b). *Strategic Agricultural Land Map 36.* Accessed at: https://www.planning.nsw.gov.au/Policy-and-Legislation/Mining-and-Resources/Safeguarding-our-Agricultural-Land.

DPI (2012). *Strategic Land Use Policy.*

DPIE (2021a) DPI Fisheries NSW Spatial Data Portal. Accessed at: https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal

DPIE (2021b). *Impact Assessment Guidelines for State Significant Projects.* Accessed at: https://www.planning.nsw.gov.au/-/media/Files/DPE/Guidelines/Policy-and-legislation/GD1259-RAF-Assessing-Cumulative-Impacts-Guide-final.pdf

DPIE (2011a) Forest Ecosystems: Native Vegetation of the Southern Forests: South-east Highlands, Australian Alps, South-west Slopes, and SE Corner bioregions. Pre-1750. VIS ID 3859.

DPIE (2011b) Forest Ecosystems: Vegetation of the Southern Forests. VIS ID 3858.

DPIE (2010) Forest Ecosystems, South Coast Sub-region VIS_ID 3786.

Dobos and Associates. 2002. *Risk Assessment and Remedial Action Plan Derelict Lake George Mine Captains Flat*.

EES (2021a). BioNet Species Sighting Search. NSW Office of Environment and Heritage. Accessed via the licenced BioNet site: http://www.bionet.nsw.gov.au/

EES (2021b). Threatened biodiversity profile search. Accessed: https://www.environment.nsw.gov.au/threatenedspeciesapp/

EES (2021c). NSW BioNet Vegetation Classification. Accessed at https://www.environment.nsw.gov.au/research/Visclassification.htm

Economy id community n.d, Queanbeyan-Palerang*, economic profile*. Accessed online at: https://profile.id.com.au/queanbeyan-palerang

GHD (2018). *Lake George Captains Flat Mine Review: Assessment of Remedial Options*.

GHD (2020). *Lake George Mine, Captains Flat Detailed Design Report.*

GHD (2021). *Lake George Mine AMD Functional Design: Geotechnical Investigation Factual Report.*

Gilligan, L. B. (1975). *Canberra 1:250 000 Metallogenic Map Part 1. Mine Data Sheets to accompany Metallogenic map.* 1975.

Glasson, K R and Paine, V R. (1965). *Lead-zinc-copper deposits of Lake George Mines, Captains Flat*. [book auth.] J McAndrew. Geology of Australina Ore Depoits. Melbourne : Australasian Institute of Mining and Metallurgy, 1965, pp. 423-431.

Government of Western Australia Department of Water and Environmental Regulation (October 2019), Guideline Air emissions Draft for external consultation)

Haninger, K., Ma, L., & Timmins, C. (2017). The Value of Brownfield Remediation. *Journal of the Association of Environmental and Resource Economists*, *4*(1), 197–241. https://doi.org/10.1086/689743

Heritage NSW (2001). *Assessing Heritage Significance. NSW Heritage Manual.*

Hogg, D. 1990. *Evaluation of Remedial Works at Captains Flat Mine*. Maquarie, ACT: David Hogg Pty Ltd, 1990.

Landcom (2008). *Managing Urban Stormwater: Soils and construction - Volume 2B.* Department of Environment and Climate Change

Landcom (2004). *Manual Managing Urban Stormwater: Soils and Construction – Volume 1 (4th Edition).* Department of Environment and Climate Change

INAP (2009). *Global Acid Rock Drainage Guide* (GARD Guide) http://www.inap.com.au/GARDGuide.htm The International Network for Acid Prevention.

Lucas, Freya (2021). *Captains Flat preschool to be relocated after lead found onsite is declared unsafe.* The Sector. Accessed from: https://thesector.com.au/2021/06/10/captains-flat-preschool-to-be-relocated-after-lead-found-onsite-is-declared-unsafe/

National Environment Protection Council (NEPC) (2013). National Environment Protection (Assessment of Site Contamination) Measure *1999 As Amended.* Canberra.

NEPC. (2013). *National Environment Protection (Assessment of Site Contamination) Measure 1999 As Amended.* National Environment Protection Council, Canberra.

NSW (2013). *Heavy Vehicle National Law.*

NSW Government (2004). *NSW Planning Guidelines for Walking and Cycling*.

NSW Department of Environment and Climate Change (DECC), 2009, 'NSW Interim Construction Noise Guideline'. Accessed online at: https://www.epa.nsw.gov.au/~/media/EPA/Corporate%20Site/resources/noise/09265cng.ashx

NSW Environment Protection Agency (EPA) (2021). *Captains Flat surface soil testing report.*

NSW EPA (2017). *The Noise Policy for Industry.*

NSW EPA (2016). *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*.

NSW EPA (2014). *Waste Classification Guidelines – Part 1: Classification of waste.*

NSW Government (2004). *NSW Planning Guidelines for Walking and Cycling.*

NSW Department of Planning and Environment (DPE) (2015). *ESG2: Guideline for preparing a Review of Environmental Factors.* DPE, Sydney, NSW.

NSW Department of Education, 2021, *Captains Flat Public School.* Accessed online at: https://captainsfl-p.schools.nsw.gov.au/about-our-school.html

NSW Minerals Council (2010). *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects*.

Office of Environment and Heritage (OEH) (2021) NSW BioNet *Vegetation Classification.* Accessed online at: http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx

Palerang Council (2020). *Palerang Development Control Plan 2015,* with amendments to Part E Notification. Palerang Council. QPRC, Australia.

Queanbeyan-Palerang Regional Council, 2018. *QPRC Regional Economic Development Strategy 2018-2022.*

Ramboll (2021). CAPTAINS FLAT AIR QUALITY MONITORING REPORT JUNE TO AUGUST 2021

Roads and Maritime Services (RMS) (2016). *Construction Noise and Vibration Guideline*. Transport for NSW.

Roads and Traffic Authority (RTA) (2002). *Guide to traffic generating developments*, *version 2.2*, RTA, Sydney, NSW.

Standards Australia, AS1726 – 2017, *Geotechnical Site Investigation*, 2017

Standards Australia, AS1289, Methods of Testing Soils for Engineering Purposes

Stinton, Dylan, Larissa Schneider, Sara Beavis, Janelle Stevenson, William A Maher, Olha Furman, Simon Haberle, and Atun Zawadzki (2020). The Spatial Legacy of Australian Mercury Contamination in the Sediment of the Molonglo River. *Elementa: Science of the Anthropocene* 8 (August). https://doi.org/10.1525/elementa.440.

Transport for NSW (TfNSW) (2021). *Centre for Road Safety.* https://roadsafety.transport.nsw.gov.au/

URS. 2004. *Environmental Site Assessment and Remediation Action Plan for the Ore Processing and Loading Area at the Lake George Mine at Captain's Flat*. North Sydney : URS Australia Pty Ltd, 2004.