Appendix G

Noise and vibration impact assessment

Lake George Mine Remediation

Noise and Vibration Impact Assessment

Department of Regional NSW (Legacy Mines Program)

March 2022

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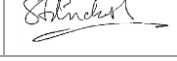
S4	0	S Mullins	E Milton	On file	S Winchester		25/03/2022

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Abbreviations and acronyms

Term	Definition
AS	Australian Standards
CNVG	Construction Noise and Vibration Guideline (TfNSW, 2016)
DECC	Department of Environment and Climate Change NSW
DECCW	Department of Environment, Climate Change, and Water NSW
DPIE	Department of Planning, Industry, and Environment
EPA	Environmental Protection Agency
HAL	Highly Affected (Noise) Level
ICNG	Interim Construction Noise Guideline (DECC, 2009)
NML	Noise Management Level
NPfI	Noise Policy for Industry (EPA, 2017)
NSW	New South Wales
RBL	Rating Background Noise Level
RNP	Road Noise Policy (DECCW, 2011)

Glossary of terms

Term	Definition
A Weighting	The human ear responds more to frequencies between 500 Hz and 8 kHz and is less sensitive to very low-pitch or high-pitch noises. The frequency weightings used in sound level measurements are often related to the response of the human ear to ensure that the meter better responds to what you actually hear.
Adverse weather	Weather conditions affecting background noise monitoring. Periods in which precipitation is present or wind speeds are greater than 5 m/s at ground level should be excluded.
Noise-enhancing weather conditions	Weather effects that enhance noise (i.e. wind and temperature inversions) that occur at a site for a significant period of time (i.e. light winds, up to and including 3 m/s, occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources, both near and far. This is described using the Leq descriptor.
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L90 descriptor.
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build. 'Reasonable' relates to the application of judgement in arriving at a decision, taking into account the following factors: – Noise mitigation benefits (amount of noise reduction provided, number of people protected) – Cost of mitigation (cost of mitigation versus benefit provided) – Community views (aesthetic impacts and community wishes) – Noise levels for affected land uses (existing and future levels, and changes in noise levels).
Maximum noise event	The loudest event or events within a given period of time. This is generally described using the Lmax descriptor.
Meteorological conditions	Wind and temperature inversion conditions.
Minimum rating background noise level	Minimum background levels are threshold values for rating background noise levels used to avoid a situation where applying a very low background noise level would not improve the level of protection but may impose very strict requirements on a new development.
Most-affected location	Location(s) that experience (or will likely experience) the greatest noise impact from the construction works under consideration. In determining these locations, existing background noise levels, noise source location(s), distance and any shielding between the construction works (or proposed works) and the residences and other sensitive land uses need to be considered.
Noise management level	The NML as defined as the ICNG. To be measured and assessed at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the residential property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most affected point within 30 m of the residence.
Noise sensitive land use	Land uses that are sensitive to noise, such as residential areas.

Term	Definition
Non-compliance	Development is deemed to be in non-compliance with its noise consent/ licence conditions if the monitored noise levels exceed its statutory noise limit (exceptions may be given if the noise level exceeds by less than 2 dB).
Octave	A division of the frequency range into bands, the upper frequency limit.
One third-octave	Single octave bands divided into three parts.
Project noise trigger level	Target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. Which of the two criteria is the most stringent is determined by measuring the level and nature of existing noise in the area surrounding the actual or propose noise generating facility.
Proponent	Department of Regional NSW
Rating Background Level	The RBL is defined by the Noise Policy for Industry (NPfI) as the overall, single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). This is the level used for assessment purposes.

1. Introduction

1.1 Purpose of this report

The purpose of this report is to consider the potential noise and vibration impacts of the proposed remediation of the Lake George Mine located near the town of Captains Flat, NSW, within the Queanbeyan-Palerang Regional Council Area. Where required, recommendations for mitigation strategies have been provided to ensure compliance with the requirements of the NSW EPA.

The proposed remediation works include 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 of historic mining structures (including native fauna fencing where applicable to encourage revegetation and demarcate private property)
- 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 pile 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 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 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.

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 on-site and in the town of Captains Flat, and to aquatic ecosystems and downstream users of the Molonglo River.

1.2 Scope and limitations

This report has been prepared by GHD for Department of Regional NSW (Legacy Mines Program) and may only be used and relied on by Department of Regional NSW (Legacy Mines Program) for the purpose agreed between GHD and Department of Regional NSW (Legacy Mines Program) as set out in Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Department of Regional NSW (Legacy Mines Program) arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

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

1.3 Assumptions

GHD has made the following assumptions when assessing the potential impacts of noise and vibration from the proposed works at Lake George Mine:

– The works will be completed over the course of approximately 19 months, and will take place entirely within the site boundary outlined in Section 2.
– Works will be completed in five primary stages (being site preparatory early works, fencing, excavation/earthworks, drainage augmentation, and revegetation).

2. Existing environment

2.1 Site location

The proposal site is located near Captains Flat, in the Queanbeyan-Palerang Local Government Area (LGA), NSW. Figure 2.1 shows the site in relation to nearby noise catchment areas and the noise monitoring location used to determine background noise levels (referred to in Section 2.3).

2.2 Noise sensitive land uses

Noise and vibration sensitive receivers are defined based on the type of occupancy and the activities performed in the land use. Noise and vibration sensitive land uses include:

– Residential dwellings
– Classrooms at schools and other educational institutes
– Hospital wards and operating theatres
– Places of worship
– Passive and active recreational areas such as parks, sporting fields, golf courses. Note that these recreational areas are only considered sensitive when they are in use or occupied
– Community centres
– Hotels, motels, caretaker's quarters, holiday accommodation and permanent resident caravan parks.

Offices, retail outlets and other business such as theatres and childcare centres could be considered noise sensitive. However, typically industrial and commercial premises are not considered particularly noise sensitive and have a relatively high noise criteria.

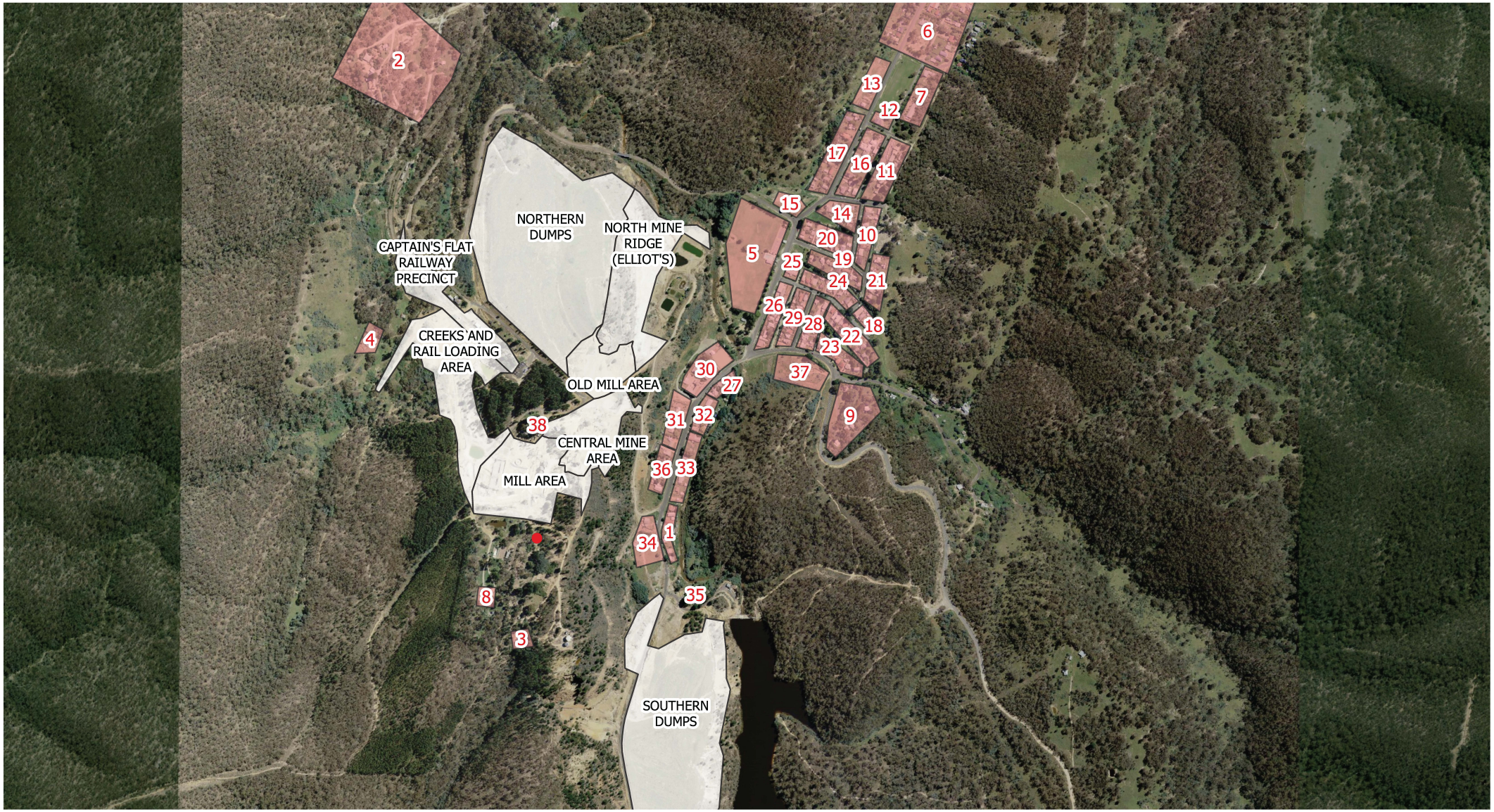
The existing environment in the vicinity of the proposal site is a mix of rural and commercial land uses, primarily zoned as Primary Production (RU1) or Village (RU5) as defined in the Palerang Local Environment Plan 2014.

A number of sensitive residential and recreational receivers have been identified in the vicinity of the site. Receivers have been sorted into noise catchment areas by location and distance to the construction footprint and are defined in Table 2.1. 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. Predicted noise levels are calculated at the worst affected point for each catchment area.

Note that the noise catchment at 5 Old Mines Road (catchment ID 38) is currently unoccupied, and its occupation status during the proposed works is unknown. For the purposes of this report, it has been assessed a residential receiver.

Table 2.1 Noise catchment areas

Catchment ID	Location	Receiver Types
1	6-18 Foxlow Street	Residential
2	Railway Cres, Beverley Hills Road	Residential
3	66 Old Mines Road	Residential
4	8 Copper Creek Road	Residential
5	73 Foxlow Street	Active Recreation
6	Spring Street, Beazley Street, Blatchford Street, Foord Street, 119-274 Foxlow Street	Residential
7	1-15 Schardt Street	Residential
8	44 Old Mines Road	Residential
9	4-8 Lewis Street, 39-43 George Street	Residential
10	2-20 Mulga Street	Residential
11	14 Montgomery Street	Educational
12	200 Foxlow Street	Residential
13	101-115 Foxlow Street	Residential
14	178 Foxlow Street, 1-11 Mulga Street	Residential
15	Corner Captains Flat Road and Foxlow Street	Residential
16	12 Montgomery Street, 180-196 Foxlow Street	Residential
17	6-10 Montgomery Street, 79-99 Foxlow Street	Residential
18	25-31 Kurrajong Street	Residential
19	4-22 Wattle Avenue	Residential
20	168-172 Foxlow Street, 1-13 Wattle Avenue	Residential
21	2-18 Willow Road	Residential
22	16-36 Kurrajong Street	Residential
23	1-15 Braidwood Road, 38 George Street	Residential
24	1-23 Kurrajong Street	Residential
25	150 Foxlow Street	Residential
26	106-130 Foxlow Street	Residential
27	70-90 Foxlow Street	Residential, Commercial
28	2-14 Wilga Street, 8-12 Kurrajong Street	Residential
29	1-17 Wilga Street, 2-6 Kurrajong Street	Residential
30	51-59 Foxlow Street	Passive Recreation, Residential
31	39-49 Foxlow Street	Residential
32	54-68 Foxlow Street	Residential
33	20-42 Foxlow Street	Residential
34	15-19 Foxlow Street	Residential
35	2 Foxlow Street	Residential
36	27-37 Foxlow Street	Residential
37	2 Braidwood Road	Residential
38	5 Old Mines Road	Residential



Legend

- Proposal site
- Noise monitoring location
- Noise catchment areas

Paper Size ISO A4

0 0.25 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 2.1

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

2.3 Background noise monitoring

2.3.1 Unattended noise monitoring methodology

GHD conducted unattended noise monitoring at Captains Flat between 10 and 24 of August 2021. Noise data was collected using a RION NL-52 environmental noise logger; details of the noise monitoring equipment are provided in Table 2.2. A calibration check was performed on the noise monitoring equipment using a sound level calibrator. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of ±1 dBA. All noise monitoring activities were undertaken and processed in accordance with the *Noise Policy for Industry* (NPfI, EPA 2017) long-term monitoring method. All noise logger settings and descriptors used were based on this method.

Table 2.2 Unattended noise monitoring details

Location	Equipment details	Equipment settings	Logger photo
60 Old Mines Road, Captains Flat 35.595573 S, 149.440945 E	Rion NL-52 Type 1 SN: 131629 1.5 m above ground level Free-field conditions IEC 61672-3:2013 Compliant Manufactured prior 2019 Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	A-Weighted Fast time response 15 minute interval Pre to post calibration variance: 0.2 dB	

2.3.2 Results

The data collected by the noise loggers was downloaded and analysed to exclude data considered invalid due to adverse weather conditions. Invalid data refers to periods of time where average wind speeds were greater than 5 m/s, or when rainfall occurred with meteorological data sourced from the Bureau of Meteorology. Weather data was sourced from the nearest Bureau of Meteorology weather station, Braidwood Racecourse AWS (SN: 069132) which is approximately 36 kilometres from proposal site. Noise logger data results are summarised in Table 2.3 and noise monitoring charts are presented in Appendix A. The NPfI defines extraneous noise as noise that is not a usual feature of the area. Increased evening noise levels are assumed to be the result of local wildlife activity. Wildlife noise at this site has been determined as extraneous noise as the evening noise level is inconsistent across the monitoring period. As such, the minimum RBL for the evening period has been adopted for this assessment.

Table 2.3 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
Wed 18 August 2021	19	26	16	41	56	39
Thurs 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)* 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.

2.4 Local meteorology

Wind has the potential to increase noise levels at a receiver when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases, the noise produced by the wind will mask noise from most industrial and transport sources. Wind effects need to be considered when predicting the long-term noise levels during the operation of the proposal.

2.4.1 Noise Policy for Industry requirements

The NPfI requires assessment of noise under standard and noise enhancing weather conditions. The NPfI defines these as follows:

– Standard meteorological conditions: defined by stability categories A through to D with wind speeds up to 0.5m/s at 10 m above ground level (AGL) for day, evening and night periods; and
– Noise-enhancing meteorological conditions: defined by stability categories A through to D with light winds (up to 3 m/s at 10 m AGL) for the day and evening periods; and/or stability category F with winds up to 2 m/s at 10 m AGL.

The NPfI specifies the following two options to consider meteorological effects:

1. Adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receiver wind vectors for all receivers and F class temperature inversions with wind speeds up to 2 m/s at night; or

2. Determine the significance of noise-enhancing conditions. This involves assessing the significance of light winds up to and including 3 m/s for all assessment periods during stability categories other than E, F or G. Significance is based on a threshold of occurrence of 30 per cent determined in accordance with the provisions in this policy. Where noise-enhancing meteorological conditions occur for less than 30 per cent of the time, standard meteorological conditions may be adopted for the assessment.

When modelling conditions at the proposal site, the more conservative first modelling option was used when estimating meteorological effects.

2.4.2 Atmospheric conditions

Temperature and humidity affects how sound is absorbed by the atmosphere. With a fixed temperature at 10ºC, a decrease in relative humidity from 90 per cent to 30 per cent can decrease the sound level at a listener standing 800 metres from the noise source by 3 dB (at 1000 Hz). Fixing the relative humidity at 90 per cent and increasing the temperature from 10 ºC to 25 ºC can decrease the sound level 800 metres from the noise source by 3 dB (at 1000 Hz).

Adopting an average temperature of 10°C and average humidity of 70 per cent is representative of the atmospheric conditions for environmental noise propagation at the proposal site and is considered conservative for the purposes of this assessment.

3. Regulatory requirements

3.1 Construction noise

Construction noise for this proposal has been considered with reference to the EPA's *Interim Construction Noise Guideline* (ICNG) (DECC, 2009).

3.1.1 Construction hours

Standard construction hours are defined in the ICNG as the following:

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

All works at the Captains Flat sites are expected to be conducted during standard hours; no out-of-hours works are planned.

3.1.2 Noise Management Levels (NMLs)

Construction noise management levels for residential premises and other sensitive land uses are provided in Table 12 and Table 13 of ICNG. Relevant noise management levels for residential and other sensitive land uses are outlined in Table 3.1. These noise management levels apply only when properties are in use and are relevant to all works conducted during standard construction hours.

Table 3.1 Noise Management Levels, standard hours

Receiver Type	Noise Management Level ($L_{Aeq,15min}$)	Application notes
Residential	Noise affected: RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as provide contact details.
	Highly noise affected: 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: – Times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residences) – Whether the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Educational	45dBA	Classrooms at schools and other educational institutions
Active recreation	65dBA	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion
Passive recreation	60dBA	Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion; for example, reading, meditation

3.1.3 Project specific construction noise management levels

The project specific noise management levels for the proposed works are based on the unattended noise monitoring presented in Section 2.3 and the methods outlined in Table 3.1 above, and are outlined in Table 3.2.

Table 3.2 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	

3.1.4 Sleep disturbance

As no works are planned outside of standard construction hours, sleep disturbance impacts are not anticipated at any sensitive receivers in the vicinity of the proposal site.

3.2 Construction vibration criteria

3.2.1 Human comfort

Acceptable vibration levels for human comfort have been set with consideration to *Assessing Vibration: a technical guideline* (DEC, 2006) which is based on the guidelines contained in British Standard *BS 6472 – 1992, Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)*.

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3.3 for sensitive receivers.

Table 3.3 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

Whilst the assessment of response to vibration in BS 6472:1992 is based on vibration dose value and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of a peak value, since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard, *BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration* and are shown below in Table 3.4.

Table 3.4 Guidance on effects of vibration levels for human comfort

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

3.2.2 Guidelines for general structures

The effects of transient vibration on structures is considered in *BS 7385 Part 2 – 1993 Evaluation and measurement for vibration in buildings*. The criteria provided in BS 7385 are presented in Table 3.5.

Table 3.5 Transient vibration guide values – minimal risk of cosmetic damage

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

The guide values in Table 3.5 relate predominantly to transient vibration which does not give rise to resonant responses in structures and low-rise buildings. Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at lower frequencies, then the guide values may need to be reduced by up to 50 per cent.

The predominant vibration for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers and excavators occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). On this basis, a conservative vibration damage screening level per receiver type is given below:

– reinforced or framed structures: 25.0 mm/s
– unreinforced or light framed structures: 7.5 mm/s.

3.3 Road traffic noise

The NSW Road Noise Policy (RNP) (DECCW, 2011) provides traffic noise target levels for residential receivers in the vicinity of existing roads subject to increased road traffic. The RNP road types and the relevant roads used for the proposal are outlined below in Table 3.6.

Table 3.6 RNP road type categories

Road type	Description	Relevant roads in proposal area
Freeways or motorways/arterial roads	Support major regional and inter-regional traffic movement. Freeways and motorways usually feature strict access controls via grade separated interchanges.	-
Sub-arterial roads	Provide connection between arterial roads and local roads. May support arterial roads during peak periods. May have been designed as local streets but can serve major traffic-generating developments or support non-local traffic.	Captains Flat Road

Road type	Description	Relevant roads in proposal area
Local roads	Provide vehicular access to abutting property and surrounding streets. Provide a network for the movement of pedestrians and cyclists, and enable social interaction in a neighbourhood. Should connect, where practicable, only to sub-arterial roads.	Braidwood Road Foxlow Street Miners Road

The application notes for the RNP state that “for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.”

If the road traffic noise increase from the construction work is within 2 dBA of current levels, then the objectives of the RNP are met and no specific mitigation measures are required. In the event of an exceedance greater than 2dBA, the controlling noise criterion are to be applied at the façade of relevant receivers; in the event of an exceedance of these criteria, mitigation should be applied.

Table 3.7 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)

4. Noise and vibration impacts

4.1 Construction noise impacts

4.1.1 Construction staging

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

– Excavators: Up to 2 vehicles weighing 20-30 tonnes
– Bulldozers: 1 D8 and up to 2 D5 vehicles
– Dump trucks: up to 3 30-tonne articulated vehicles
– Padfoot roller/compactor: Up to 2
– Water trucks: 2 water carts fed from an on-site 1100,000 litre tank supplied by the town reservoir
– Light vehicles: enough to support an estimated working crew of around 25 people.

Remediation works have been divided into five primary stages. For each stage, a 'worst-case' noise scenario has been modelled as described in in Table 4.1 below. All sound power levels are referenced from the Transport for NSW Construction Noise and Vibration Guideline (TfNSW, 2016).

Table 4.1 Modelling assumptions for proposed works

Scenario no.	Activity outline	Worst case scenario + sound power levels	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

4.1.2 Noise modelling methodology

Noise modelling was undertaken using CadnaA 2021. CadnaA is a computer program for the calculation, assessment and prognosis of noise exposure. CadnaA calculates environmental noise propagation according to *ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'.*

The following noise modelling assumptions were made:

– Surrounding land was modelled assuming mostly soft ground with a ground absorption coefficient of 0.5.
– Atmospheric absorption was based on an average temperature of 10°C and an average humidity of 70 per cent.

– Atmospheric propagation conditions were modelled with noise enhancing wind conditions for noise propagation (downwind conditions) or an equivalently well-developed moderate ground-based temperature inversions.
– Modelled scenarios take into account the shielding effect from surrounding buildings and structures on and adjacent to the site.
– Scenarios incorporated ground slope and elevation into calculations for noise propagation.
– Noise sources for each scenario are in some cases modelled at different locations. As such the noise modelling assesses the noise source at multiple locations and takes the maximum L_{Aeq} received noise level.

4.1.3 Predicted noise impacts

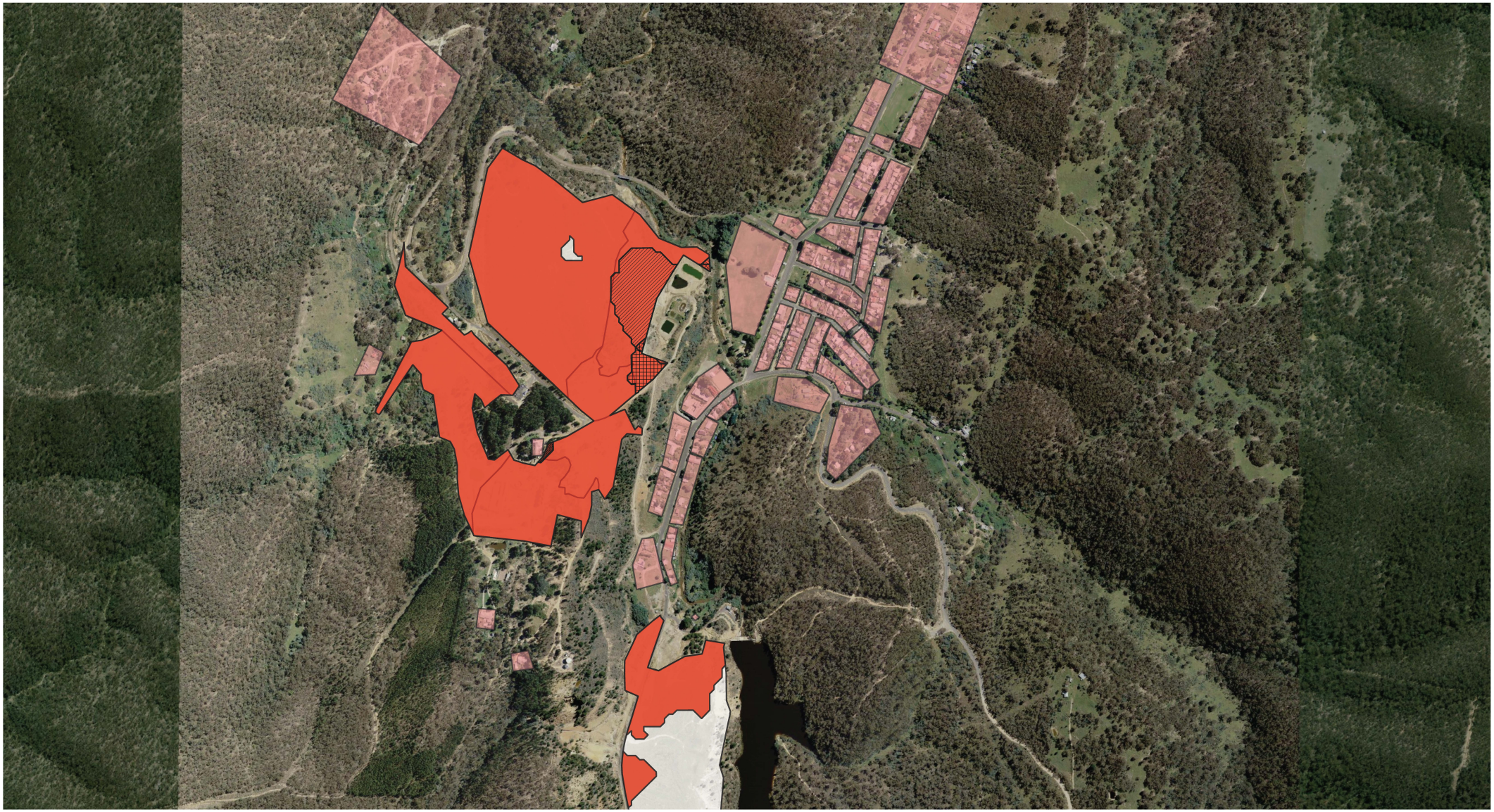
All four work scenarios outlined in Section 4.1.1 result in the potential for an exceedance of the residential Noise Management Level (NML) for at least one receiver in the vicinity of Captains Flat. These exceedances are only predicted to occur for worst-case scenario works in particular areas of the proposal site; the areas of potential impact are shown on Figure 4.2, Figure 4.3, Figure 4.4 and Figure 4.5. Work scenario 2 (Earthworks & structural works) has the potential to result in an exceedance of the NML for the educational receiver at 14 Montgomery Street (noise catchment area 11), the active recreational receiver at 73 Foxlow Street (noise catchment area 5), and the passive recreational receiver at 51-59 Foxlow Street (noise catchment area 30). The impact area for these exceedances is outlined in Figure 4.3. Without mitigation, an exceedance to the 75dB Highly Affected Noise Level for residential receivers is expected for work scenario 2 (Earthworks & structural works). This exceedance is anticipated at noise catchment 38.

Table 4.2 gives a summary of maximum potential noise levels for each work scenario at all receivers.

Table 4.2 Predicted maximum potential noise levels at receivers, all work scenarios

Catchment ID	Location	Criteria	Maximum potential predicted noise levels of any receivers (L_{Aeq}, dBA)				
			Site Establishment	Fencing	Excavation	Drainage	Revegetation
1	6-18 Foxlow Street	45	62	58	69	64	58
2	Railway Cres, Beverley Hills Road	45	60	50	61	56	50
3	66 Old Mines Road	45	52	52	63	58	52
4	8 Copper Creek Road	45	66	52	63	58	52
5	73 Foxlow Street	65	70	52	63	58	52
6	Spring Street, Beazley Street, Blatchford Street, Foord Street, 119-274 Foxlow Street	45	37	55	66	61	55
7	1-15 Schardt Street	45	46	49	60	55	49
8	44 Old Mines Road	45	56	50	62	57	50
9	4-8 Lewis Street, 39-43 George Street	45	44	48	59	54	48
10	2-20 Mulga Street	45	47	47	59	53	47
11	14 Montgomery Street	45	46	43	54	49	43
12	200 Foxlow Street	45	44	42	53	48	42
13	101-115 Foxlow Street	45	39	41	53	47	41

Catchment ID	Location	Criteria	Maximum potential predicted noise levels of any receivers (L_{Aeq}, dBA)				
			Site Establishment	Fencing	Excavation	Drainage	Revegetation
14	178 Foxlow Street, 1-11 Mulga Street	45	52	40	51	46	40
15	Corner Captains Flat Road and Foxlow Street	45	54	47	58	53	47
16	12 Montgomery Street, 180-196 Foxlow Street	45	49	45	56	51	45
17	6-10 Montgomery Street, 79-99 Foxlow Street	45	53	43	54	49	43
18	25-31 Kurrajong Street	45	52	41	53	47	41
19	4-22 Wattle Avenue	45	53	36	47	42	36
20	168-172 Foxlow Street, 1-13 Wattle Avenue	45	57	47	59	53	47
21	2-18 Willow Road	45	46	44	55	50	44
22	16-36 Kurrajong Street	45	50	41	53	48	41
23	1-15 Braidwood Road, 38 George Street	45	51	42	54	48	42
24	1-23 Kurrajong Street	45	55	39	50	45	39
25	150 Foxlow Street	45	57	36	47	42	36
26	106-130 Foxlow Street	45	57	36	48	43	36
27	70-90 Foxlow Street	45	58	29	40	35	29
28	2-14 Wilga Street, 8-12 Kurrajong Street	45	52	33	45	39	33
29	1-17 Wilga Street, 2-6 Kurrajong Street	45	53	35	47	41	35
30	51-59 Foxlow Street	45	65	26	37	32	26
31	39-49 Foxlow Street	45	62	34	45	40	34
32	54-68 Foxlow Street	45	60	46	57	52	46
33	20-42 Foxlow Street	45	59	42	53	48	42
34	15-19 Foxlow Street	45	60	50	61	56	50
35	2 Foxlow Street	45	67	61	72	67	61
36	27-37 Foxlow Street	45	61	57	68	63	57
37	2 Braidwood Road	45	55	45	57	51	45
38	5 Old Mines Road	45	77	67	78	73	67



Legend

- Proposal site
- Noise catchment areas

Criteria exceedances

- Active Recreation
- Education
- Residential HAL
- Residential NML
- Passive Recreation

Paper Size ISO A4

0 0.25 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

Work area exceeding relevant noise criteria, Work Scenario 1 (Site preparation works)

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

FIGURE 4.1

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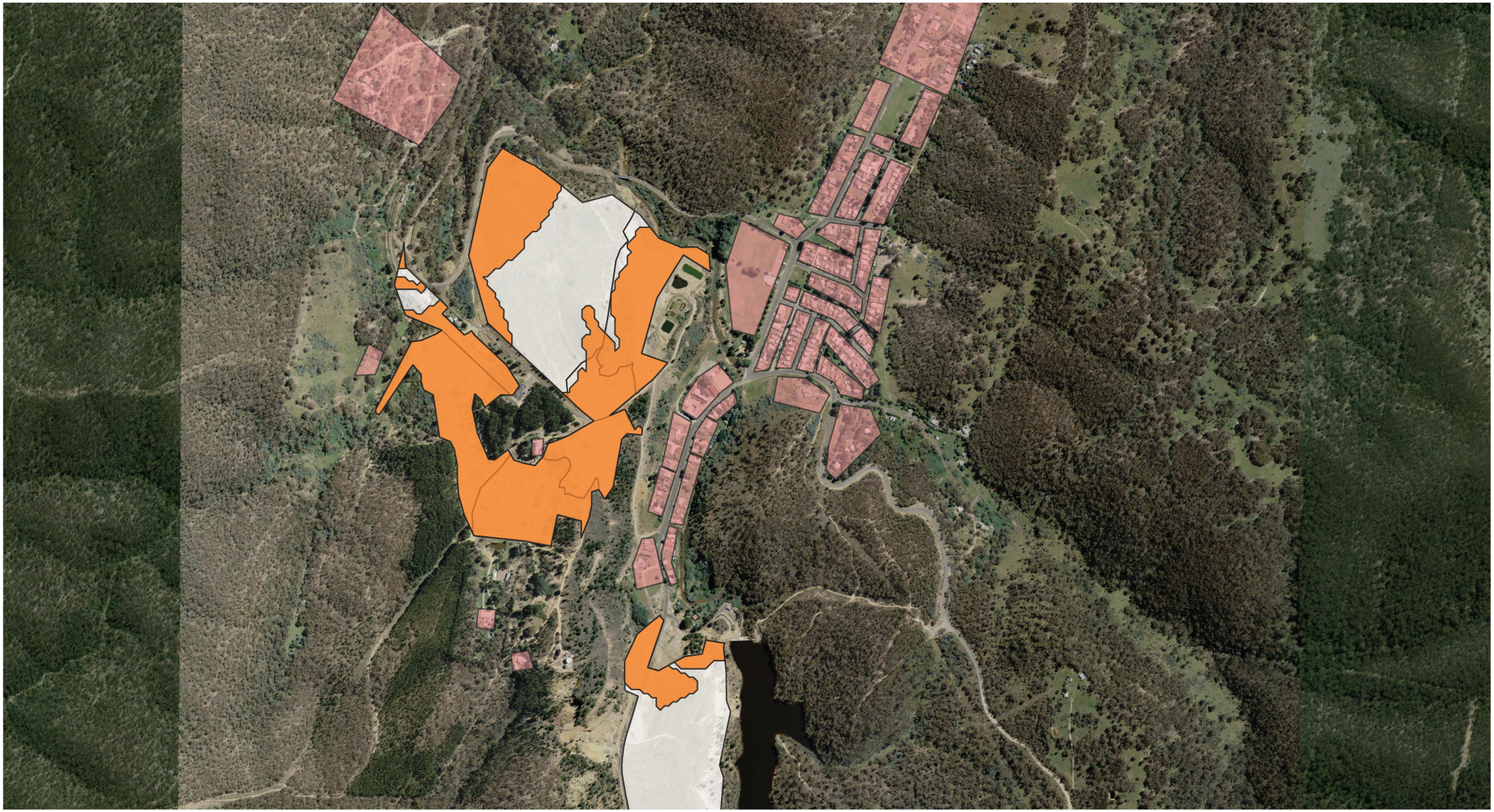
Print Date: 23/03/2022

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



Legend

- Noise catchment areas
- Proposal site
- Criteria exceedances
- Residential NML

Paper Size ISO A4

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

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Dept of Regional NSW

LAKE GEORGE MINE REMEDIATION

Work area exceeding relevant noise criteria, Work Scenario 2 (Fencing of historic mining structures)

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

FIGURE 4.2

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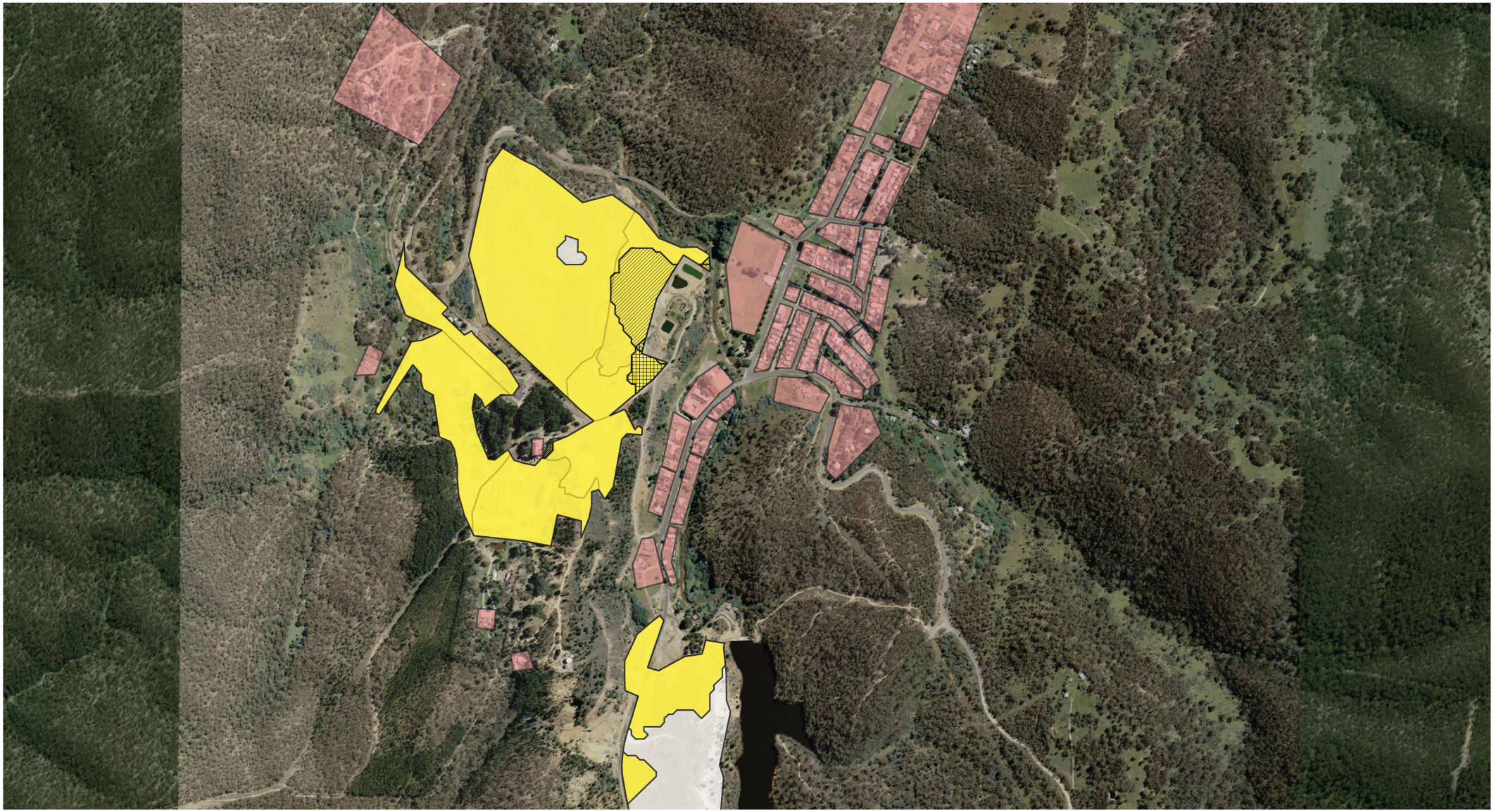

Legend

- Proposal site
- Noise catchment areas

Criteria exceedances

- Active Recreation
- Education
- Residential HAL
- Residential NML
- Passive Recreation

Paper Size ISO A4

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

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Dept of Regional NSW

LAKE GEORGE MINE REMEDIATION

Work area exceeding relevant noise criteria, Work Scenario 3 (Remediation earthworks and structural works)

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

FIGURE 4.3

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Print Date: 23/03/2022

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

Legend

- Noise catchment areas
- Proposal site

Criteria exceedances

- Active Recreation
- Education
- Residential HAL
- Residential NML
- Passive Recreation

Paper Size ISO A4

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

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Dept of Regional NSW

LAKE GEORGE MINE REMEDIATION

Work area exceeding relevant noise criteria, Work Scenario 4 (Drainage augmentation)

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

FIGURE 4.4

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Print Date: 23/03/2022

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

Legend

- Proposal site
- Noise catchment areas
- Criteria exceedances
- Residential NML

Paper Size ISO A4

0 0.25 0.5 km

N

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

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Dept of Regional NSW

LAKE GEORGE MINE REMEDIATION

Work area exceeding relevant noise criteria, Work Scenario 5 (Revegetation)

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

FIGURE 4.5

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Print Date: 23/03/2022

Data Source:Google Earth Imagery 2021.
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4.2 Construction vibration impacts

4.2.1 Assessment methodology

Transport for NSWs *Construction Noise and Vibration Guideline* (CNVG) (RMS, 2016) provides safe working distances for plants and equipment anticipated to cause vibration impacts during use. These safe working distances are outlined in Table 4.3. To assess the greatest potential impact, the largest roller option was chosen when considering exclusion zones. Buildings within the safe working distances have been identified for consideration of management measures.

4.2.2 Vibration safe working distances

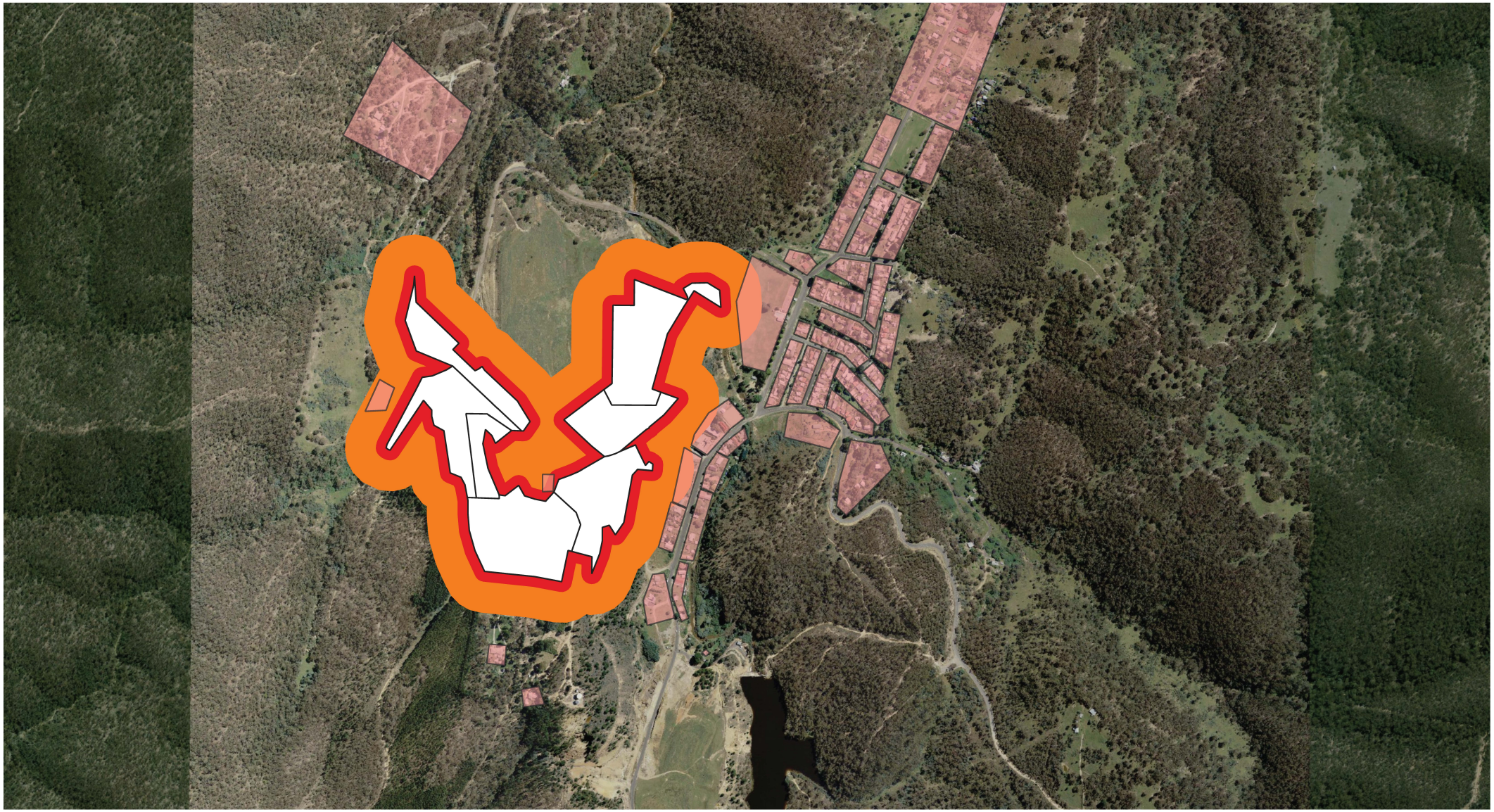
Safe working distances for vibratory intensive equipment has been sourced from the CNVG and are shown in Table 4.3.

Table 4.3 Vibration safe working distances

Equipment	Human comfort (OH&E Vibration guideline)	Cosmetic damage (BS 7385)
Piling rig – Bored <800 mm	N/A	2 m (nominal)
Piling rig–Hammer (12 t down force)	50 m	15 m
Piling rig – Vibratory (sheet piles)	20 m	2 m to 20 m
Vibratory roller (>18 tonnes)	100 m	25 m
Vibratory roller (13-18 tonnes)	100 m	20 m
Vibratory roller (7-13 tonnes)	100 m	15 m
Vibratory roller (4-6 tonnes)	40 m	12 m
Vibratory roller (2-4 tonnes)	20 m	6 m
Vibratory roller (1-2 tonnes)	15 m	5 m
Small hydraulic hammer 300 kg (5-12t excavator)	7 m	2 m
Medium hydraulic hammer 900 kg (12-18t excavator)	23 m	7 m
Large hydraulic hammer 1600 kg (18-34t excavator)	73 m	22 m
Jackhammer (handheld)	Avoid contact with structure	1 m (nominal)

4.2.3 Predicted vibration impacts

A number of noise 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 catchment areas are listed below in Table 4.4. Additionally, one catchment area (catchment 38, 5 Old Mines Road) sits within the cosmetic damage exclusion zone for any vibratory roller above approximately 4 tonnes. Vibration impact buffers for an 18 tonne vibratory roller (assumed as a conservative worst-case scenario) are shown in Figure 4.6. In this scenario, the Northern and Southern dumps are excluded from the anticipated area of works, as no vibratory rollers are expected to be used in these areas.



Legend

- Noise catchment areas
- Proposal area
- 25m cosmetic damage zone
- 100m human comfort zone

Paper Size ISO A4

0 0.25 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

Vibration safe working distances

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

FIGURE 4.6

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Print Date: 23/03/2022

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

Table 4.4 Potentially affected residences, vibration impacts

Catchment ID	Address	Distance to proposal site boundary (m)
4	8 Copper Creek Road	50
5	73 Foxlow Street	39
30	51-59 Foxlow Street	84
31	39-49 Foxlow Street	64
36	27-37 Foxlow Street	96
38	5 Old Mines Road	2

For the use of any vibratory roller, there is the potential for an exceedance of the human comfort criteria during use in the vicinity of noise catchment area 38. For vibratory rollers larger than 4 tonnes, there is also a risk of cosmetic damage in a small radius in the vicinity of catchment 38. For use of a vibratory roller greater than 6 tonnes, there is a potential for the exceedance of the human comfort criteria at a number of other sensitive receivers in the vicinity of the proposal site. Mitigation and management measures to minimise the impact of vibratory rollers at the proposal site are outlined in Section 5.2.

4.3 Road traffic noise

4.3.1 Traffic generation

It is estimated that during the 19-month 'delivery' phase of the proposed works, around 6,004 truck movements will be required to deliver imported material to the site. The majority of these truck movements will be to and from the north via Captains Flat Road, and will average 16 vehicle movements each day, or slightly under two per hour during work hours.

Of these vehicle movements, around 10 per cent of topsoil deliveries, totalling two per cent of overall deliveries, will be made along an eastern route along Captain's Flat Road moving through the residential area of Captain's Flat. This amounts to around 120 truck movements in total during the delivery period. To consider a worst-case scenario, it is assumed that these deliveries are concentrated over a one-month period, averaging slightly more than four truck movements per day, assuming a maximum of two in any given hour.

Light vehicles are also expected as part of the traffic in and out of the proposal site. These vehicles will be the transport in and out of Captains Flat for an estimated 25 workers. The majority of these workers will be arriving from the Canberra and Queanbeyan regions, and it is therefore assumed that all light vehicle movements will enter the site via the northern road. Assuming between 2 and 3 workers per vehicle gives a total of 20 light vehicle movements in and out of the site via the northern road each day, for all days of operation (i.e. over the full 19-month period of works).

4.3.2 Modelling methodology

Table 4.5 below summarises the three main 'groups' of vehicle movements expected over the course of the anticipated works. This can be organised into three modelling scenarios, which are described in Table 4.6. All vehicle movements are anticipated to occur within standard working hours.

Table 4.5 Vehicle movement groups

Vehicle type	Movements per day	Route	Time period
Heavy	16	Northern	19 months
Heavy	4	Eastern	1 month
Light	20	Northern	19 months

Table 4.6 Vehicle movement scenarios

Scenario	Description	Increase in light vehicle movements per day	Increase in heavy vehicle movements per day	Duration	Route
1	Light traffic only	20	0	6 months	Northern
2	Delivery stage	20	16	6 months	Northern
3	Topsoil deliveries	0	4	1 month	Eastern

The northern traffic route in the scenarios above occurs purely on Captains Flat Road south of Hoskinstown Road. The eastern traffic route includes Captains Flat Road south of George Street and Foxlow Street north of Miners Road. 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. Average daily traffic counts for these roads are presented in Table 4.7.

Table 4.7 Average daily traffic, relevant roads

Road name	Road classification	Vehicle movements per day	% heavy vehicles	Total light vehicles per day	Total heavy vehicles per day	Mitigation level during standard hours (dBA)
Captains Flat Road south of Hoskinstown Road	Sub-arterial	795	15.6	671	124	60 ($L_{Aeq15hr}$)
Captains Flat Road south of George Street	Sub-arterial	207	22.1	161	46	60 ($L_{Aeq15hr}$)
Foxlow Street north of Miners Road	Local	282	16.5	235	47	55 (L_{Aeq1hr})

4.3.3 Road traffic noise impacts

Predicted noise impacts for an increase in road traffic for the three scenarios outlined above are given below in Table 4.8 An exceedance of the 2 dBA trigger for further assessment occurs for Captains Flat Road south of George Street.

Table 4.8 Predicted road traffic noise impacts

Scenario	Road	Road type	Distance to nearest receiver (m)	Increase in road noise (dBA)	Noise level at nearest receiver (dBA)
1	Captains Flat Road south of Hoskinstown Road	Sub-arterial	45	0.1	46.9
2	Captains Flat Road south of Hoskinstown Road	Sub-arterial	45	0.7	47.6
3	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

At all modelled traffic scenarios, the total increase in road traffic noise is below 2 dBA, meaning no further assessment is required. Additionally, noise levels due to traffic are below the mitigation level of 50dBA at all nearby receivers. As such, no significant traffic noise impacts are anticipated at any residential receivers as a result of the proposed works.

5. Mitigation recommendations

5.1 Construction noise mitigation

It is predicted that construction activities could exceed the construction noise management levels for the project in a number of locations. The measures provided below should be implemented for any works in areas identified as having potential impacts on nearby receivers, as per Figure 4.2 to Figure 4.5.

Table 5.1 Mitigation strategies, construction noise

Control	Description	Responsibility	Timing
Site inductions	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: – All project 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.	Contractor	On-site work
Schedule activities to minimise noise impacts	All activities on site should be confined 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 Construction Environmental Management Plan (CEMP) from the project and assessed against the noise requirements of the ICNG. Consult with affected neighbours about scheduling activities to minimise noise impacts. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.	Contractor	Pre-work/on-site work
Behavioural practices	– 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.	Contractor	On-site work

Control	Description	Responsibility	Timing
Construction Noise and Vibration Management Plan (CNVMP)	A CNVMP should be prepared post approval, after the construction contractor has been engaged and prepared their construction methodology. The CNVMP would include a review of the construction noise predictions 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.	Contractor	Post approval
Non-tonal and ambient sensitive reversing alarms	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used 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.	Contractor	On-site work
Equipment selection	Use quieter and less vibration emitting construction methods where feasible and reasonable.	Contractor	Pre-work/on-site work
Silencers on mobile plant	When purchasing, 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.	Contractor	On-site work
Direction of equipment	Orient equipment with directional noise characteristics away from noise sensitive receivers.	Contractor	On-site work
Reduced equipment power	Use only the necessary size and power	Contractor	On-site work
Minimise disturbance arising from delivery of goods to construction sites.	– 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. – Dedicated loading/unloading areas to be shielded if close to sensitive receivers. – Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. – Avoid or minimise these out of hours movements where possible.	Contractor	On-site work

Control	Description	Responsibility	Timing
Engine compression brakes	– 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.	Contractor	On-site work
Maintain equipment	– 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.	Contractor	On-site work
Compliance noise and vibration monitoring	A noise monitoring procedure should be developed and carried out for the duration of works in accordance with the Construction Noise and Vibration Management Plan and any approval or licence conditions. Monitoring reports should be prepared in accordance with the requirements of the noise monitoring procedures.	Contractor	On-site work
Complaints	Compliance monitoring should be undertaken to investigate complaints.	Contractor	On-site work
Routine monitoring	Regular routine monitoring should be undertaken for high-risk activities, including activities undertaken outside recommended standard hours, to quantify noise, vibration or blasting emissions.	Contractor	On-site work

Australian Standard AS2436:2010 (Guide to construction and vibration control on construction, demolition, and maintenance sites) suggests that the use of silencers on all mobile plants typically reduces site noise by 5-10dB. Therefore, it can be assumed that at the absolute minimum, the management and mitigation strategies outlined above will reduce noise generated by the proposed activities by 5dB.

5.2 Vibration impact mitigation

Significant vibration impacts are anticipated for works including the use of a vibratory roller of type VR4 or greater (seven or more tonnes). Potential mitigation strategies are outlined in Table 5.2.

Table 5.2 Mitigation strategies, vibration impacts

Control	Description	Responsibility	Timing
Equipment selection	Where vibratory rollers may be required, use plant types of type VR3 or lower (i.e. 6 tonnes or less).	Contractor	Pre-work/on-site work
Community engagement	Notify residents in potentially affected catchment zones prior to use of any vibratory rollers within the human response zones outlined in Section 4.2.3.	Contractor	Pre-work/on-site work
Area avoidance	Wherever possible, avoid the use of any vibratory roller within 15 metres of the residential building at 5 Old Mines Road.	Contractor	On-site work

With the appropriate implementation of the above measures, the human comfort impact of the use of a vibratory roller is limited to only noise catchment areas 35 and 38, with no cosmetic damage predicted at either receiver.

5.3 Road traffic noise mitigation

No significant exceedances to noise criteria are predicted from road traffic due to the proposed site operations. However, a number of mitigation strategies are outlined below to ensure compliance with the criteria considered in Section 3.3.

Table 5.3 Mitigation strategies, road traffic noise

Control	Description	Responsibility	Timing
Maximum truck movements	During operation, delivery truck movements should not exceed the following hourly volumes: – Day period 7* am 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	Contractor	On-site work
Delivery truck operations	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.	Contractor	On-site work

6. Evaluation and conclusion

This assessment has been undertaken to consider the potential noise and vibration impacts of remediation of the Lake George Mine in Captains Flat.

The existing noise environment has been characterised and the ambient and background noise levels used to assess the potential noise impacts associated with the proposed works. The assessment included noise and vibration associated with construction works and noise from increased traffic levels on the local transport network, with respect to the following guidelines:

– *Interim Construction Noise Guideline* (ICNG) (DECC, 2009)
– *Road Noise Policy* (RNP) (DECCW, 2011)
– *Assessing Vibration: a technical guideline* (DEC, 2006).

An assessment of potential noise impacts during the proposed works has been undertaken against the ICNG noise management level (NML) during standard hours. The RBL for the area surrounding the proposal site was obtained via unattended long-term noise monitoring. Noise levels during works are predicted to exceed the residential NML in up to seven noise catchment areas and residences in two noise catchment areas are predicted to be highly noise affected, where no mitigation has been applied. Some exceedances to the NMLs for educational, passive recreational, and active recreational land use are predicted for work scenario 2 (earthworks and structural works).

Six noise catchment areas have been identified as potentially impacted by vibration during work scenario 2 (earthworks and structural works). Of these, one sensitive receiver has been identified within the safe working distances for cosmetic damage during vibratory intensive work.

3D noise modelling was undertaken using CadnaA 2021 to predict operational noise levels at sensitive receivers.

Mitigation measures to reduce noise levels and the risk of the noise impacts during construction have been recommended in Section 5. Based on the advice provided in *Australian Standard AS2436:2010*, it is anticipated that these mitigation measures will reduce perceived noise by 5-10dB at all sensitive receivers. With the implementation of these mitigation and management measures, no or minimal (i.e. <2dB) exceedances to the residential Highly Affected Noise Level or the Noise Management Levels for educational, passive recreational, and active recreational land uses are anticipated.

Mitigation measures to reduce the impact of vibration on nearby sensitive receivers have also been identified. With the appropriate implementation of these measures, no exceedances of the vibration limits for cosmetic structural damage are anticipated at any receiver, and exceedances of the human comfort criteria are limited to two sensitive receivers. Management of impacts at these receivers includes active community engagement and warning prior to works in the vicinity of the relevant noise catchment areas.

7. References

DEC (2006) *Assessing Vibration: a technical guideline*

DECC (2009). *Interim Construction Noise Guideline*

DECCW (2011). *NSW Road Noise Policy*

EPA (2021). *Draft Construction Noise Guideline*

EPA (2017). *Noise Policy for Industry*

GHD (2020). *Lake George Mine, Captains Flat Detailed Design Report*

Palerang Council. (2014) *Palerang Local Environment Plan*

Roads and Maritime Services. (2016). *Construction Noise and Vibration Guideline*

Appendix A

Noise monitoring data

Statistical Ambient Noise Levels
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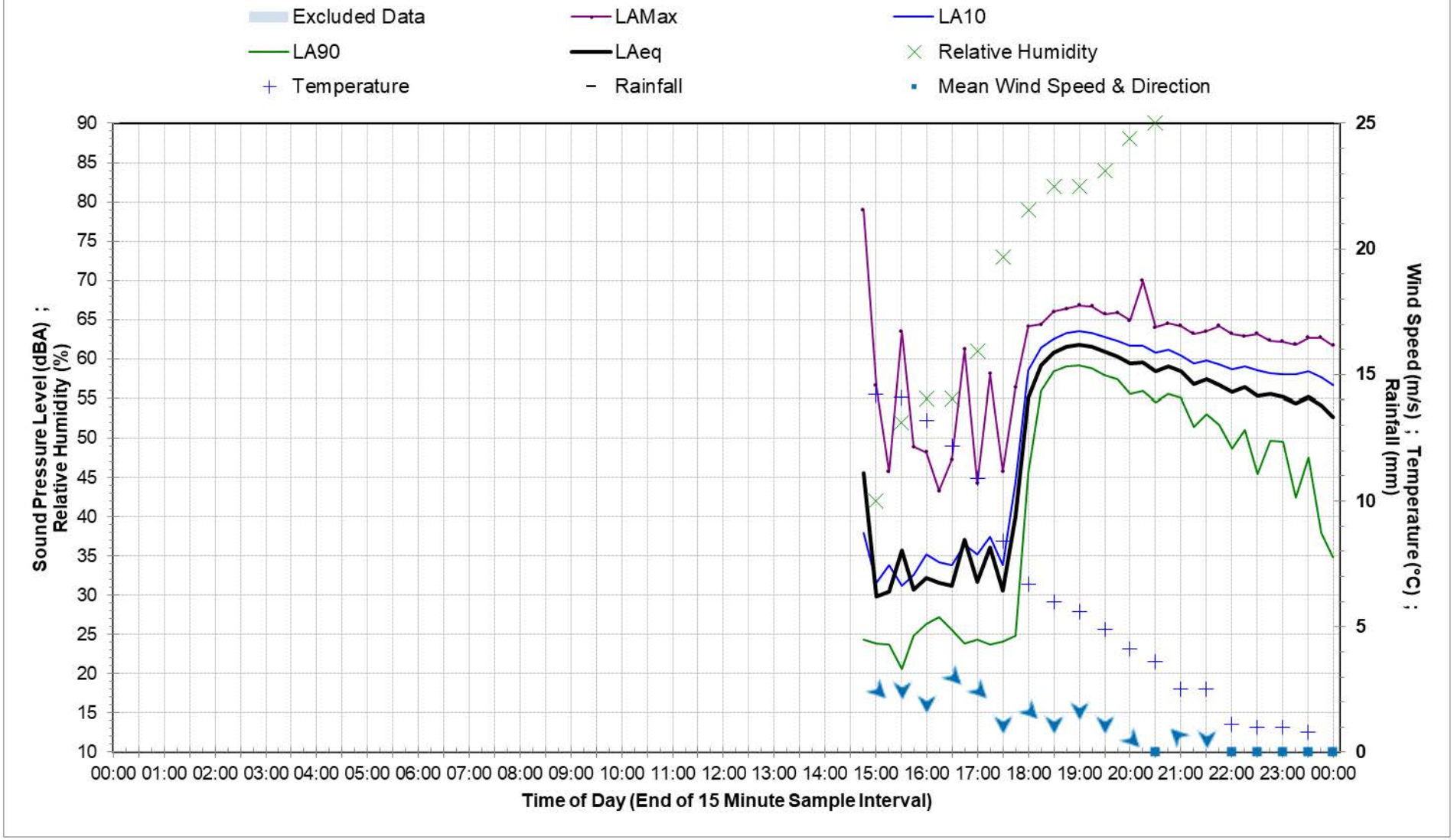

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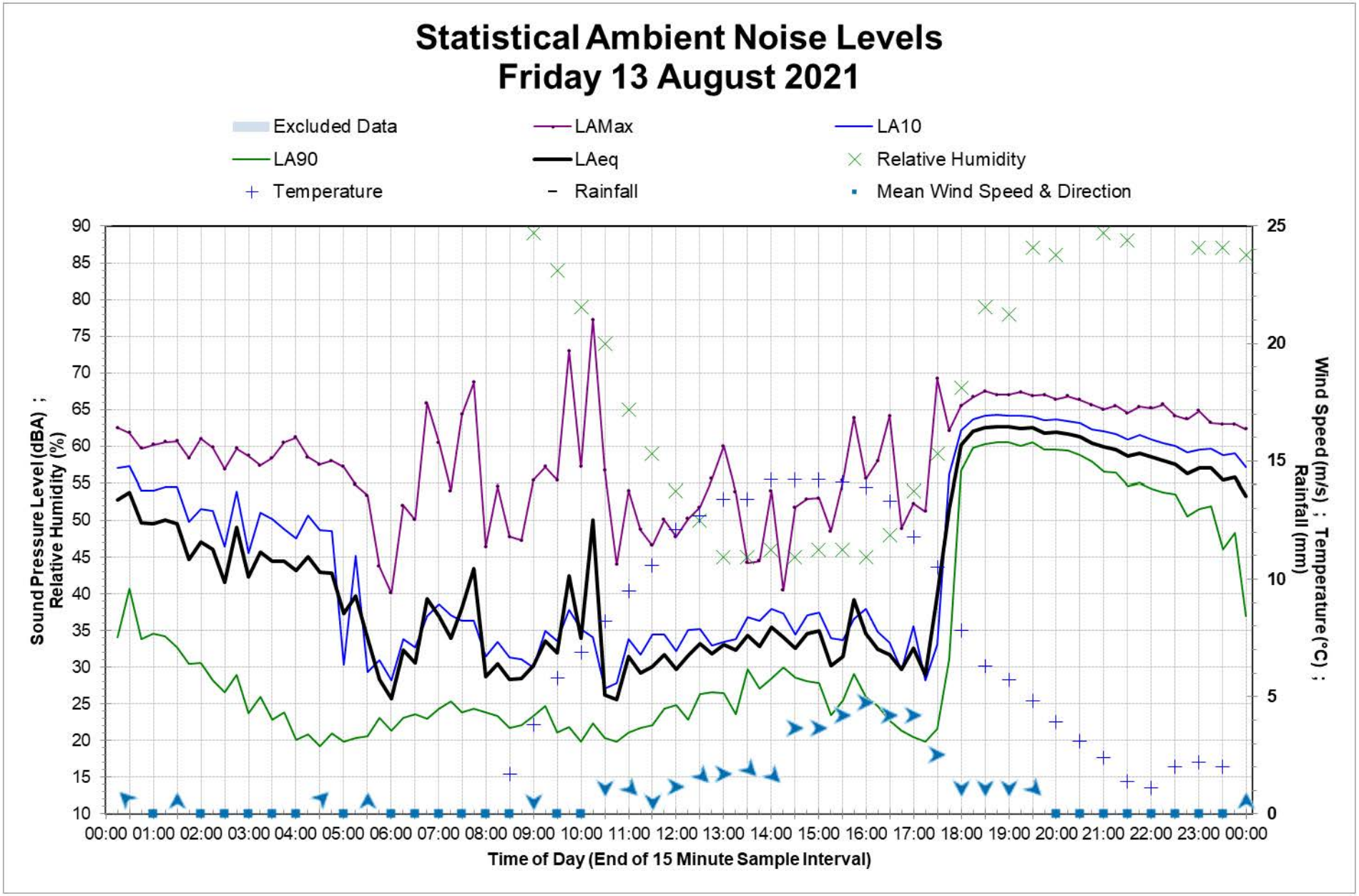

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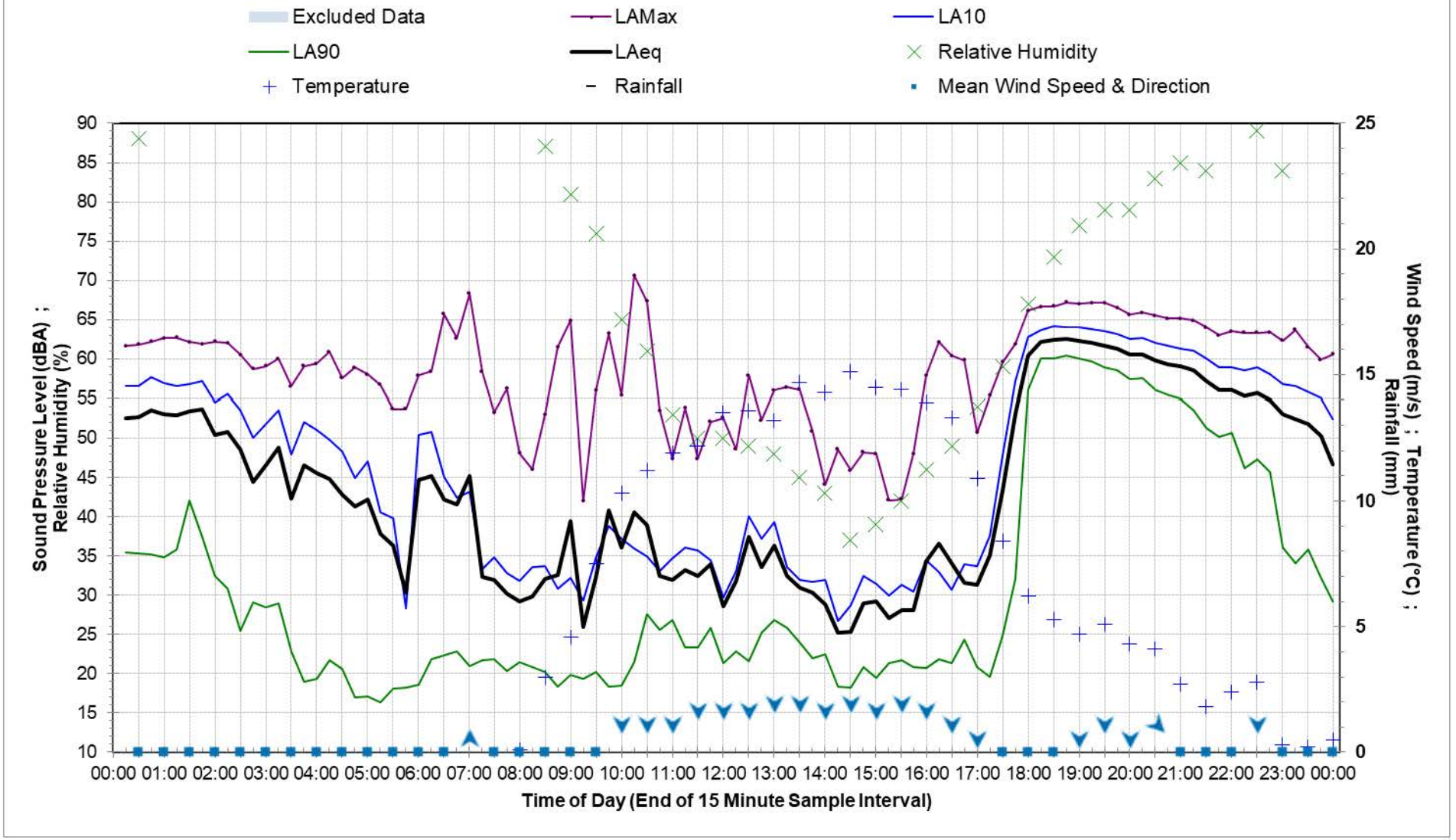

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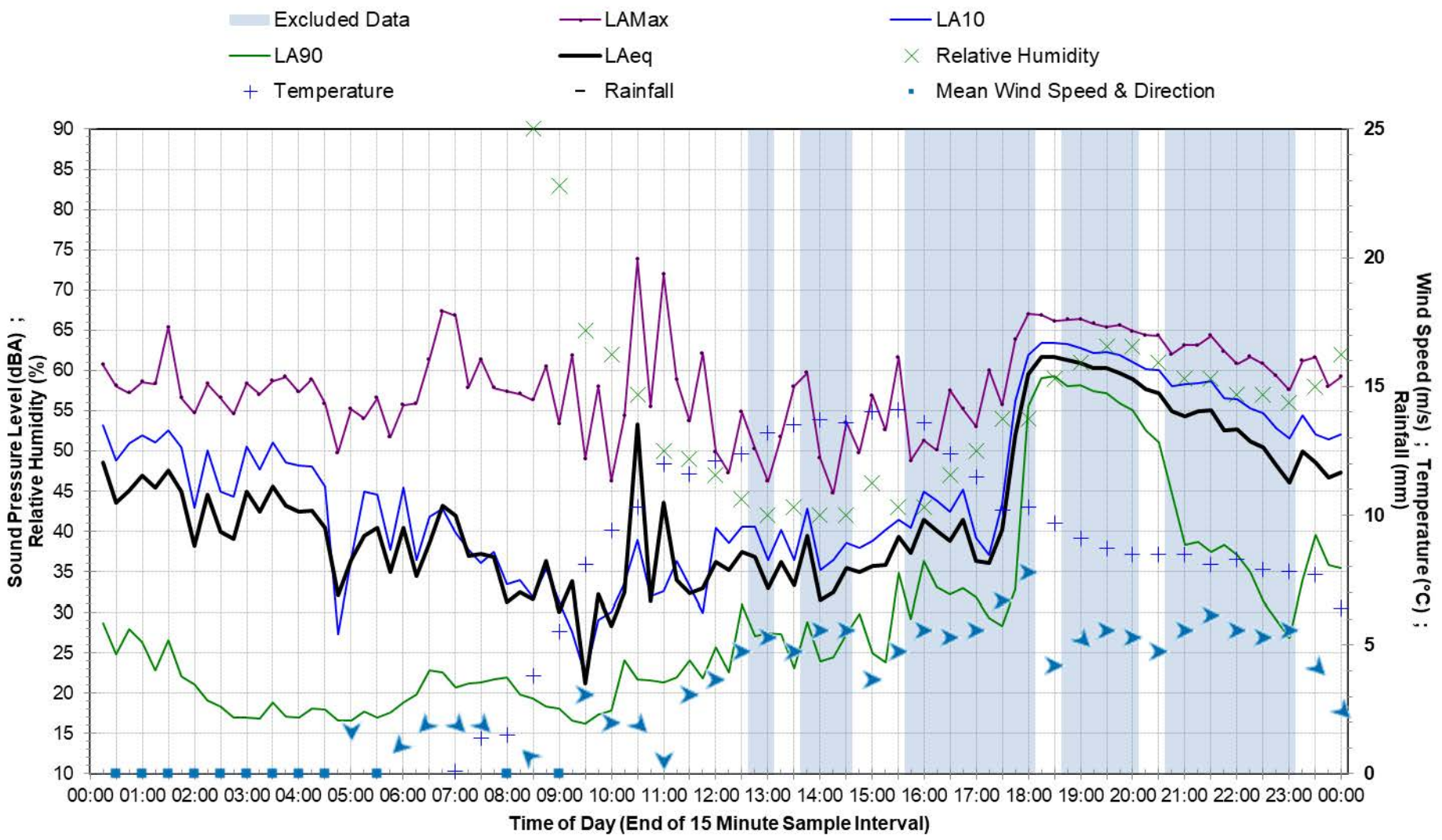

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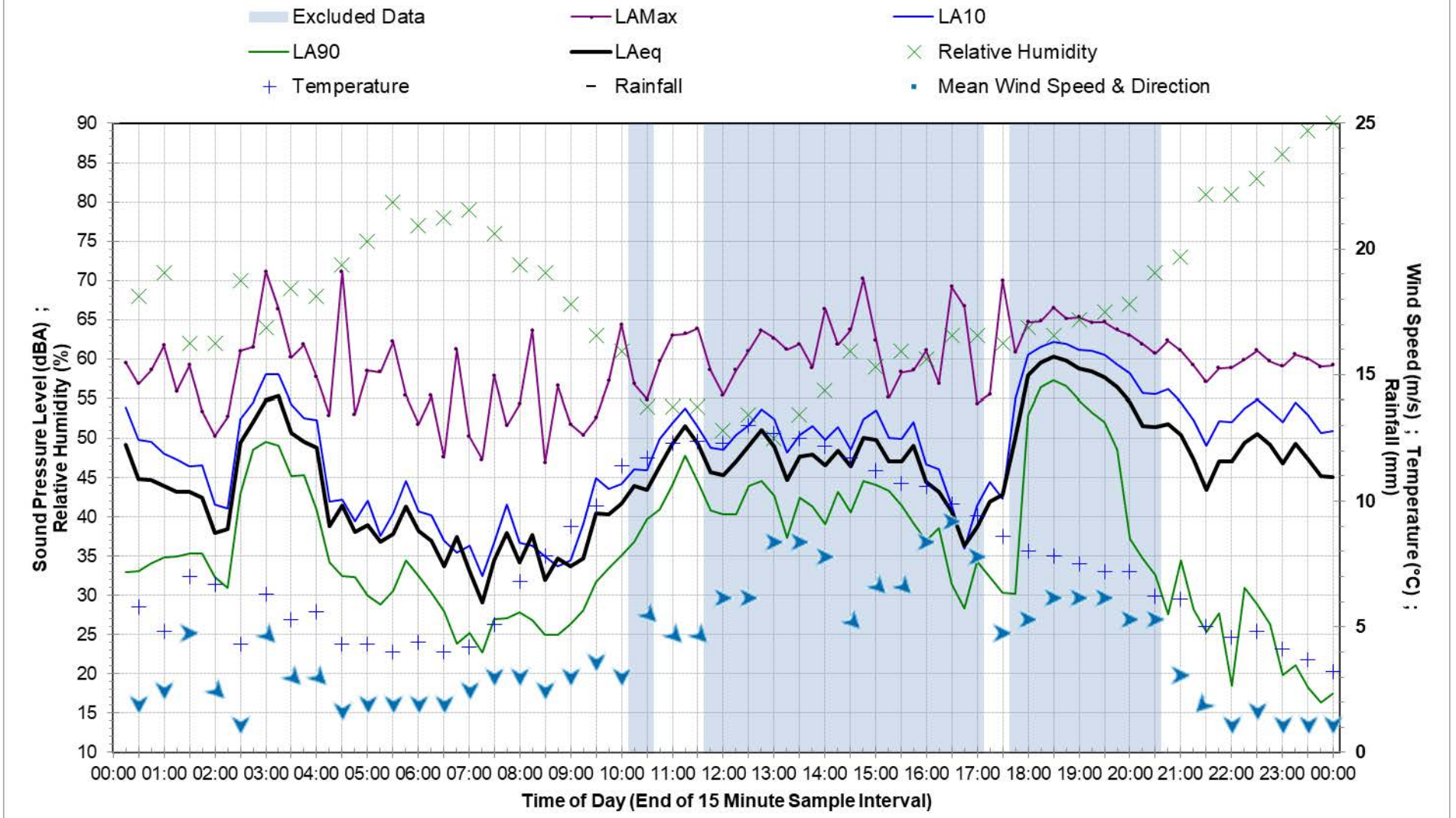

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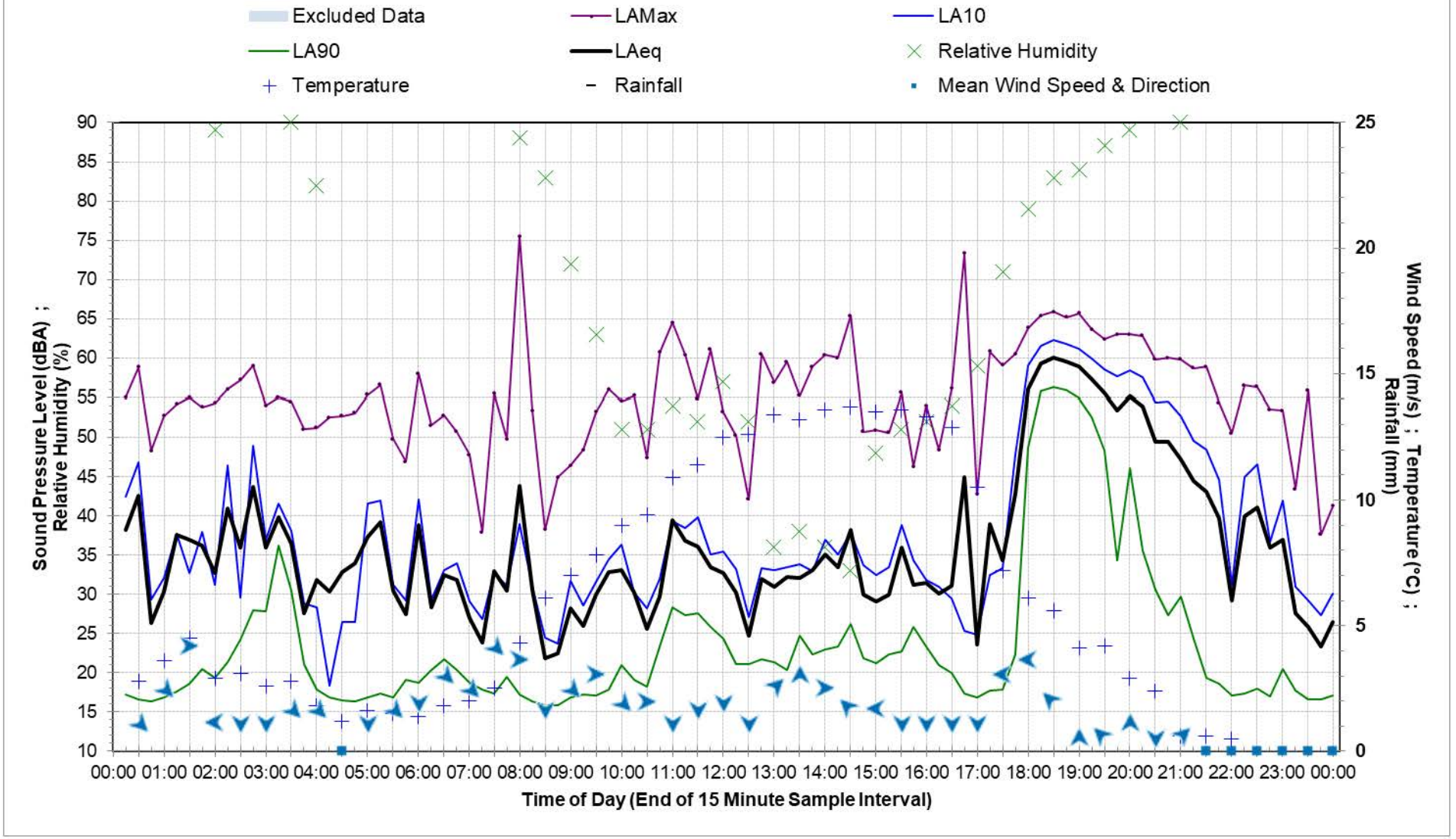

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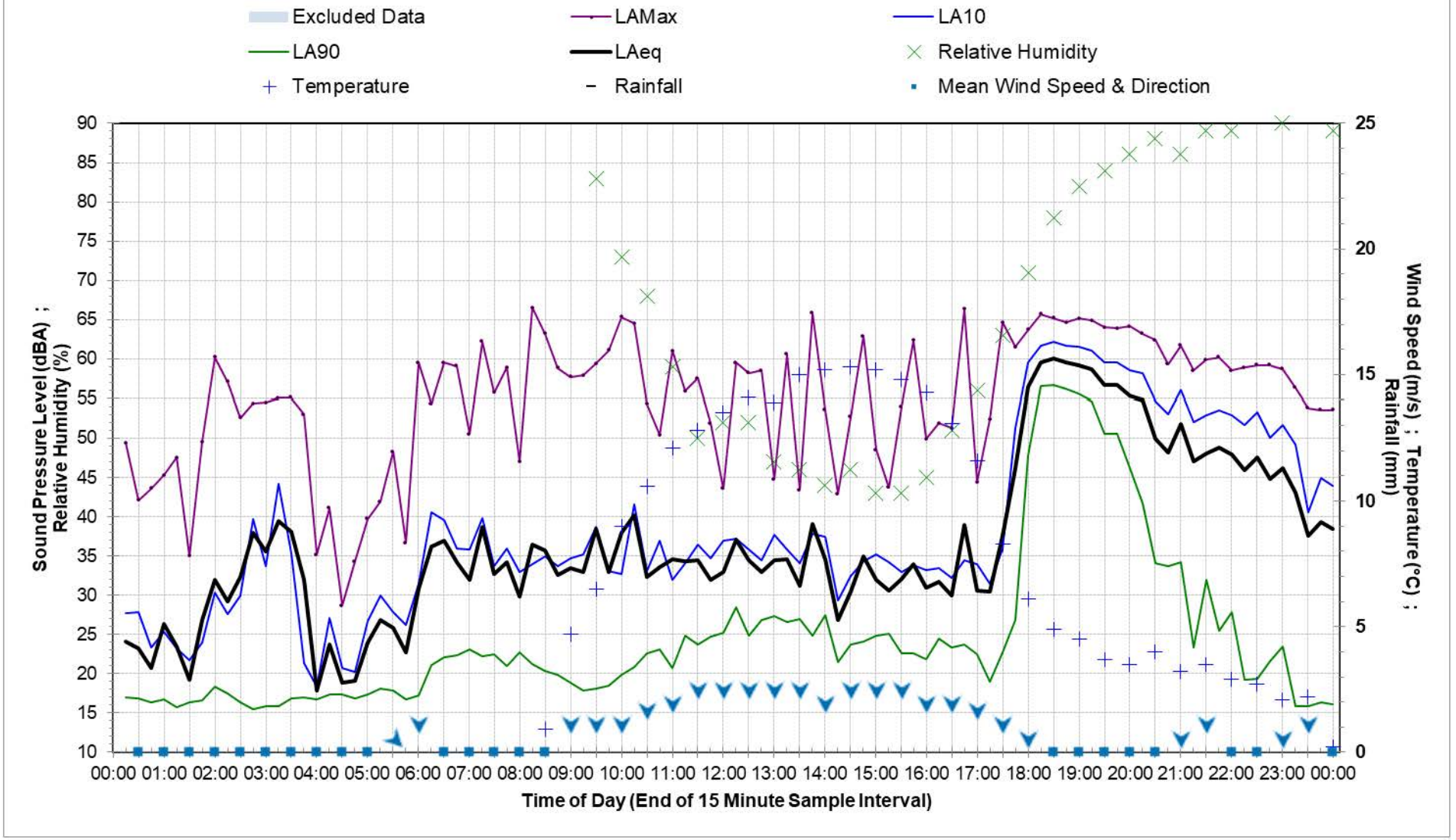

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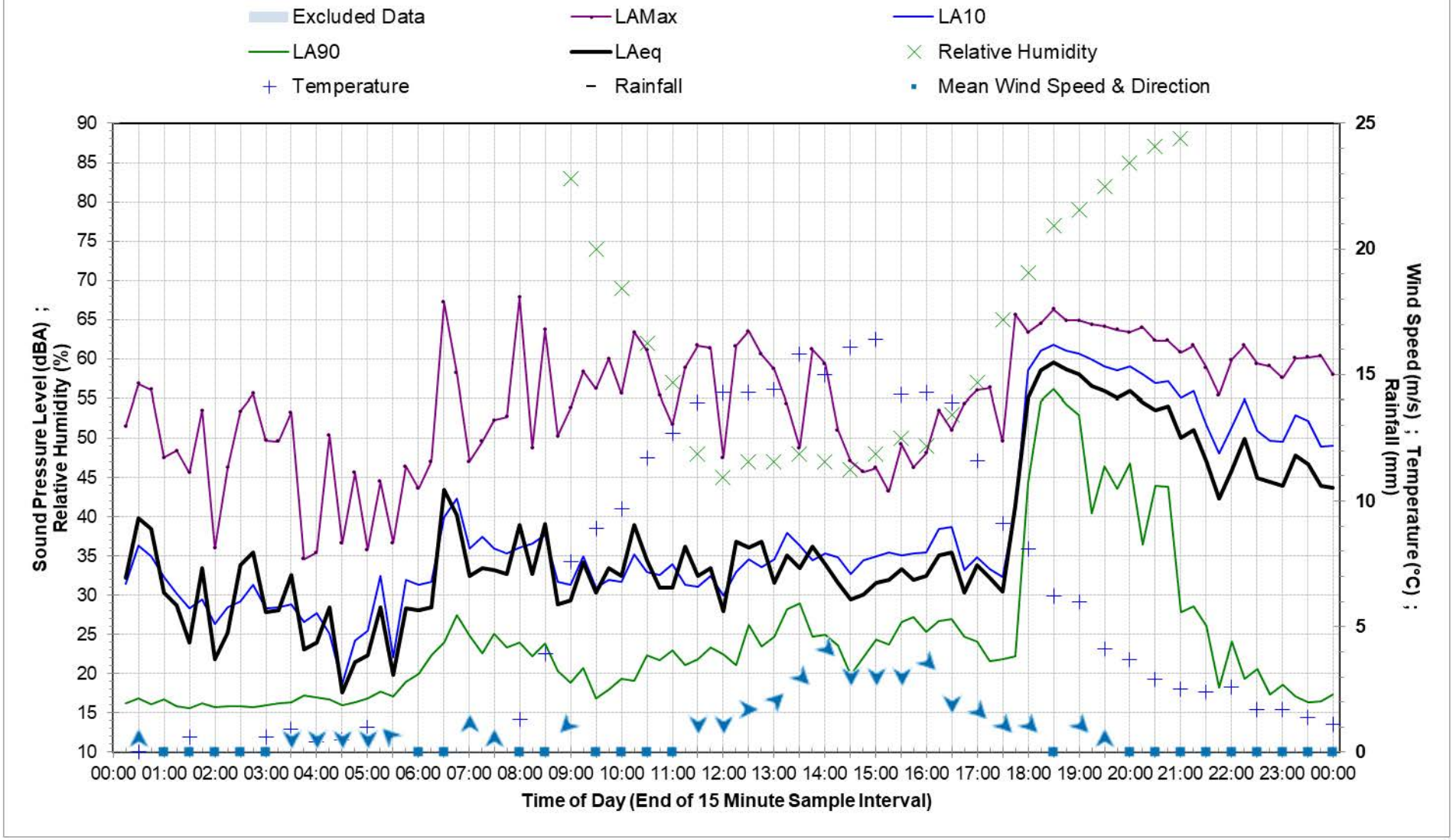

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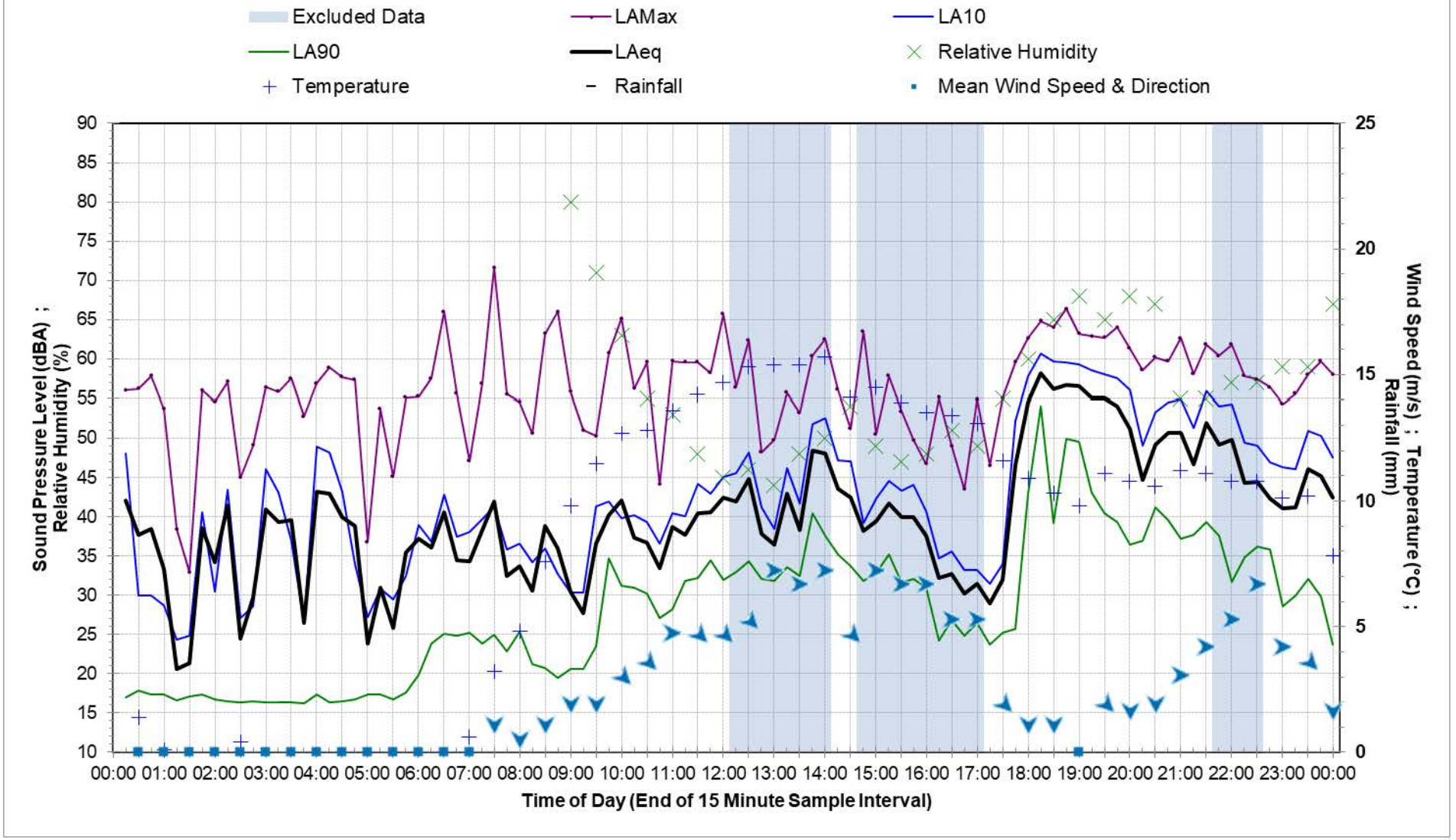

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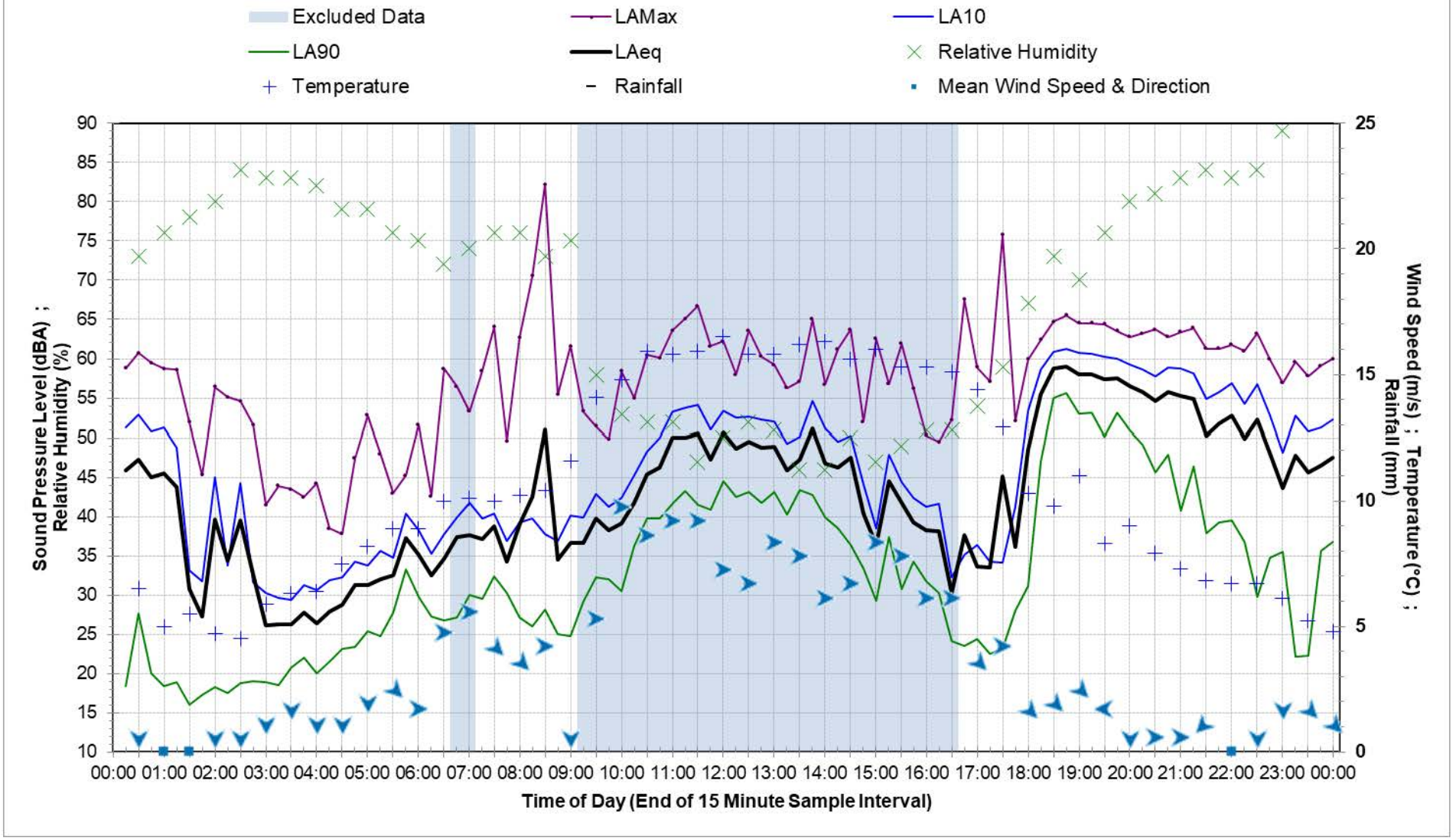

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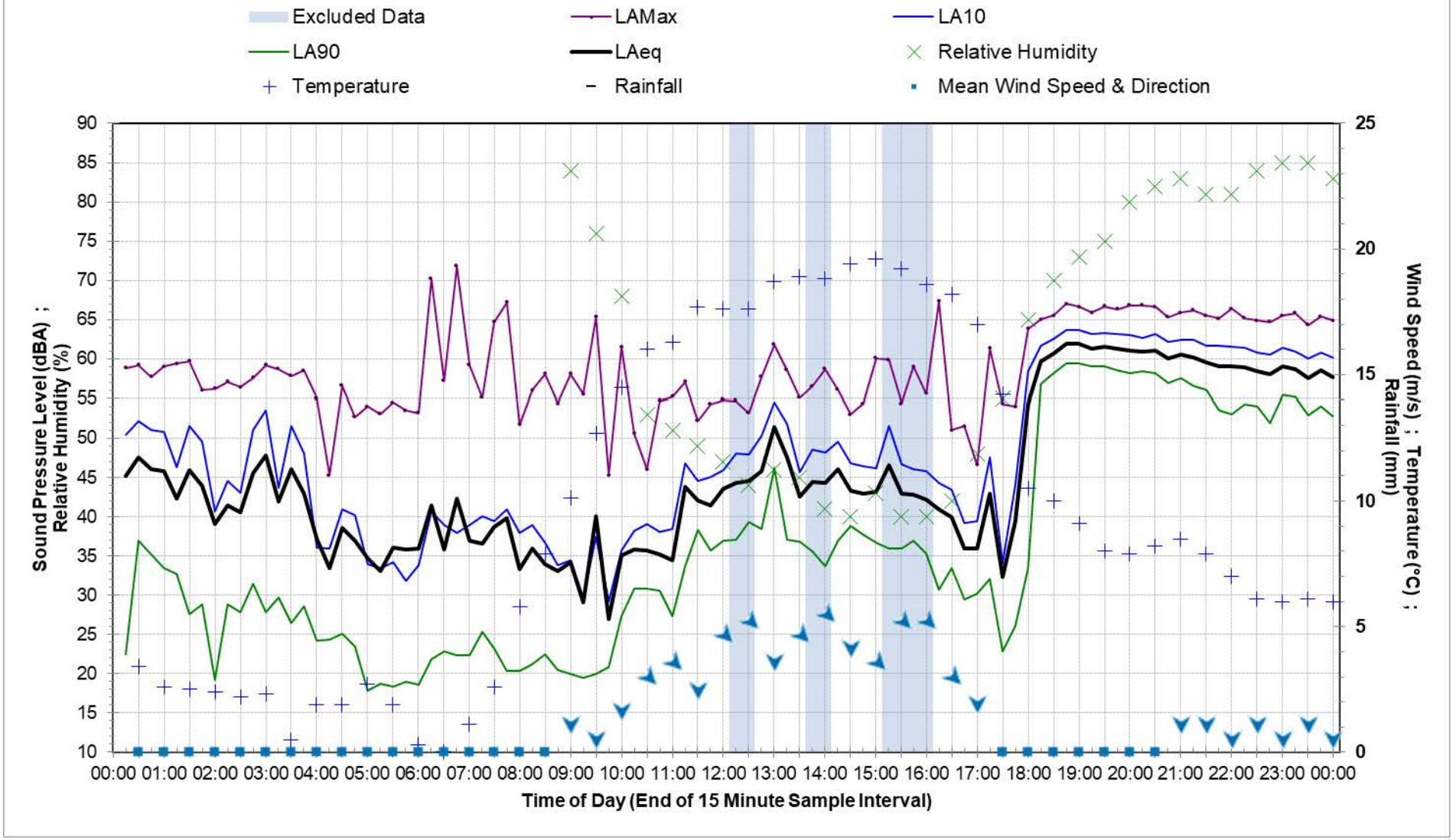

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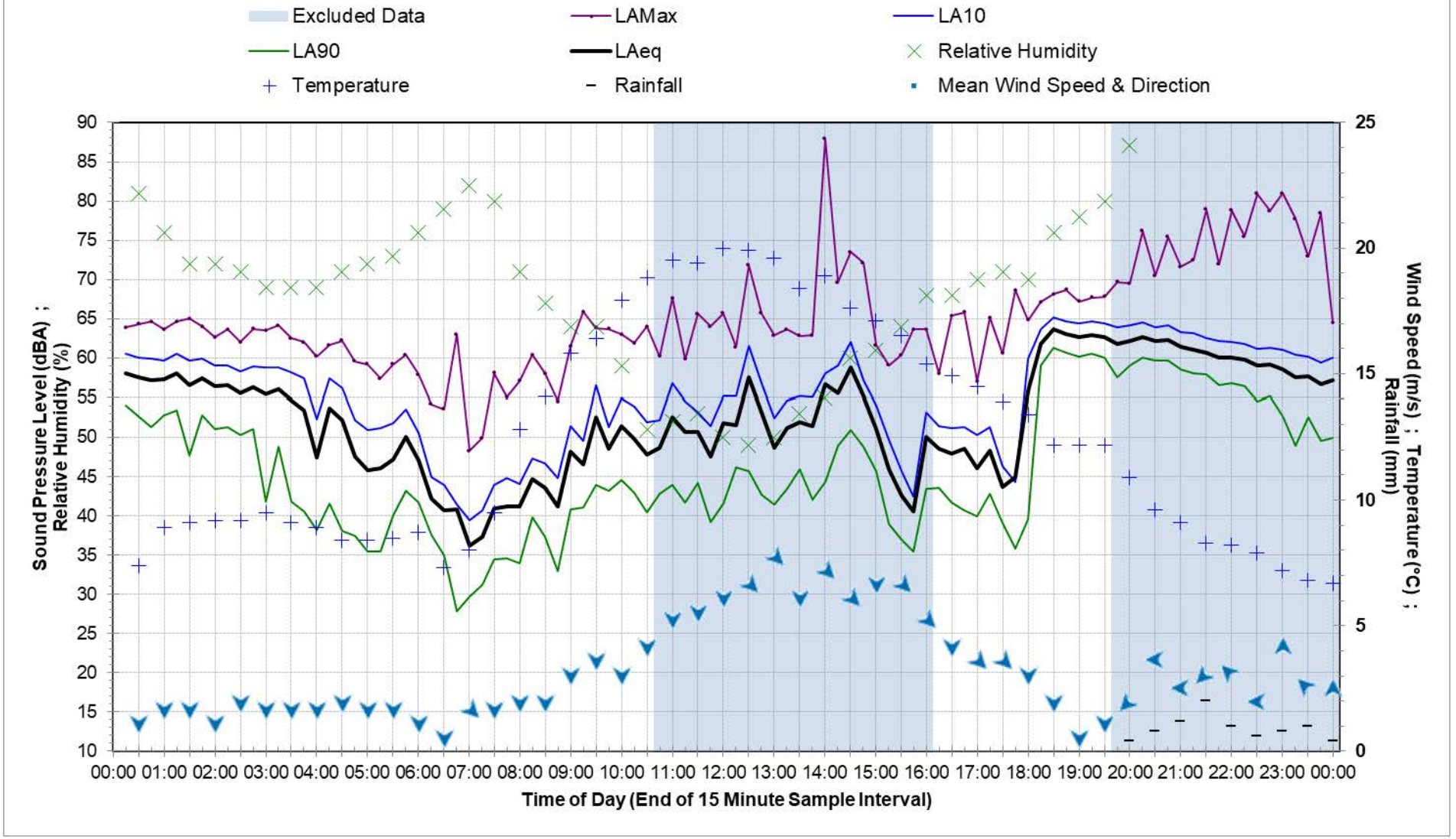

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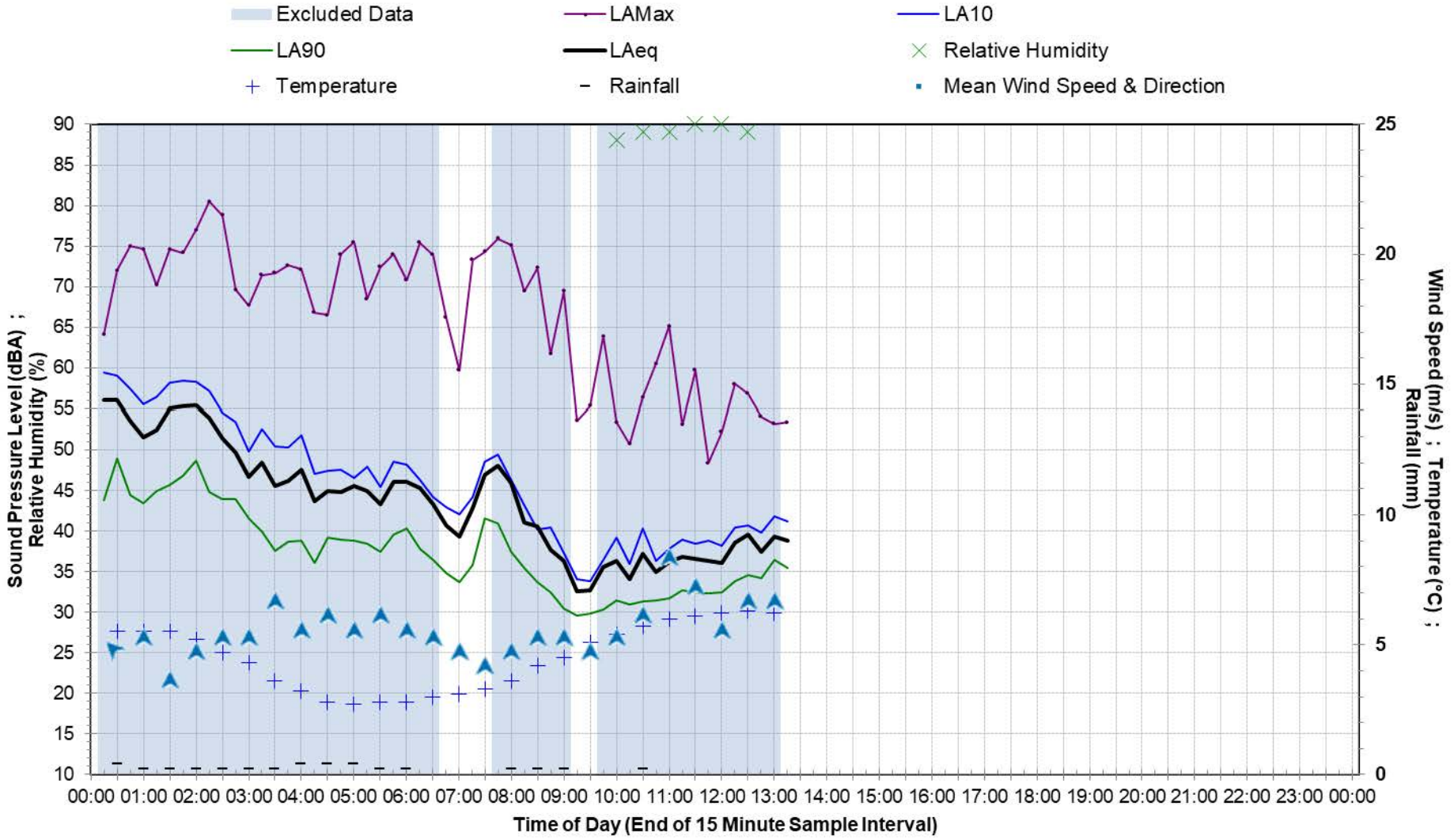

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The Power of Commitment

Appendix H

Biodiversity impact assessment report

Lake George Mine Rehabilitation

Biodiversity Assessment

Department of Regional NSW (Legacy Mines Program)

March 2022

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File name	https://projectsportal.ghd.com/sites/pp15_03/lakegeorgemineremedi/ProjectDocs/Technical Reports/12551771_REP_Lake George Mine Remediation_Biodiversity Assessment.docx
Author	Mal Weerakoon, Maddy Young
Project manager	Karen Yale
Client name	Department of Regional NSW (Legacy Mines Program)
Project name	Lake George Mine Remediation REF
Document title	Lake George Mine Rehabilitation | Biodiversity Assessment
Revision version	Rev 0
Project number	12551771

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S4	0	M Weerakoon M Young	B Harrington		S Winchester		25/03/2022

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Abbreviations

Abbreviation	Definition
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BCD	Biodiversity Conservation Division (formerly OEH)
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offsets Scheme
CEEC	Critically endangered ecological community
CEMP	Construction environmental management plan
DAWE	Department of Agriculture, Water and the Environment
DECCW	Department of Environment, Climate Change and Water (now BCD)
DotEE	Commonwealth Department of the Environment and Energy (now DAWE)
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EEC	Endangered ecological community
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
FM Act	*Fisheries Management Act 1994* (NSW)
GIS	Geographic information system
ha	Hectare
KTP	Key threatening process
LGA	Local Government Area
m	Metre
mm	Millimetre
MNES	Matter of national environmental significance
NSW	New South Wales
OEH	Office of Environment and Heritage (now BCD)
PCT	Plant community type
PMST	Protected Matters Search Tool
REF	Review of Environmental Factors
SIS	Species Impact Statement
TEC	Threatened ecological community
TSC Act	The former *NSW Threatened Species Conservation Act 1995*
VIS	NSW Vegetation Information System

1. Introduction

1.1 The proposal

The Legacy Mines Program (LMP) within the Department of Regional NSW propose to undertake remediation works at the legacy Lake George Mine, located immediately to the west of the township of Captains Flat, New South Wales (NSW) (the proposal). The location of the site for the proposal is shown on 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 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 are subject to the environmental impact assessment and planning approval requirements of Division 5.1 of the of the *Environmental Planning and Assessment Act 1979* (EP&A Act). A Review of Environmental Factors (REF) is to be submitted to LMP for assessment for the proposal as proponent and also as the determining authority.

The REF examines the statutory context of the proposal and assesses the potential impact to the environment. Mitigation measures are proposed to minimise any identified impacts. This Biodiversity Assessment Report (BAR) has been prepared to support the REF and provides an assessment of the potential biodiversity impacts of the proposed works, with particular focus on threatened ecological communities, populations and species listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

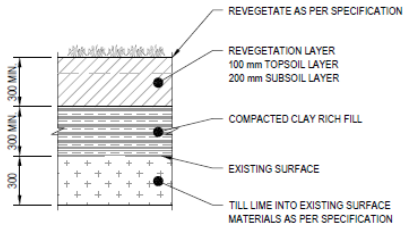
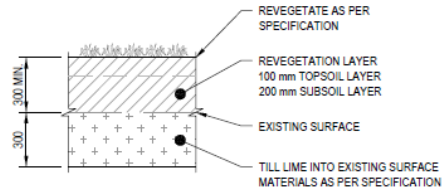
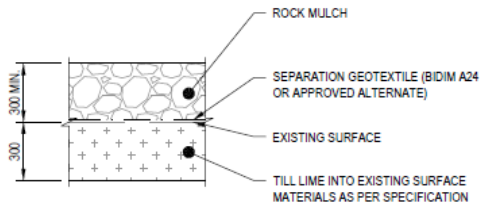
1.2 Key features of the proposal

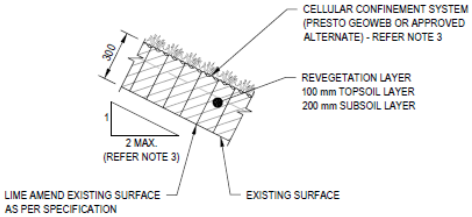
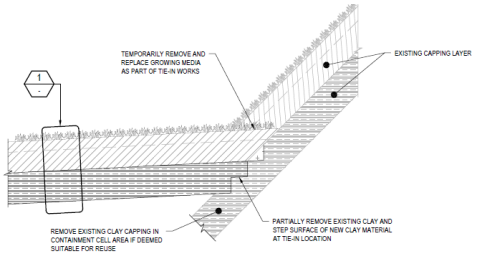
The key features of the proposal include proposed remediation works at across several sites across the Lake George Mine (see Figure 1.2). These rehabilitation works would include:

- Site preparatory early works
- Fencing historic mining structures
- Strategic structural works including fencing, filling or demolishing the concentrate loading tunnels and also removing inert gravel and sulfidic waste from concentrate bins and surge bin into the encapsulation cell
- Remediation earthworks including a series of capping options such as the neutralisation of contaminated land with in-situ lime. A detailed description of each capping option is included in Table 1.1 below and the maximum spatial extent of remediation assessed for the REF is shown in Figure 1.2. Remediation requiring vegetation removal would generally only occur in transitional zones between contaminated, denuded areas and well-vegetated areas, where the Principal Contractor would make a ‘real time’ decision of the actual extent of vegetation requiring removal for remediation of the underlying soil
- Augmentation of surface and subsurface drainage including regrading and revegetation works to decrease runoff and improve surface water quality
- Revegetation including the establishment a self-sustaining vegetation community that would maintain site stability, reduce erosion risks from both wind and water and improve visual amenity of the site.

The overall remedial strategy for the Captains Flat Capping Project would improve the condition of the contaminated areas on site such that they sustain native vegetation, whilst retaining the mining heritage feel of the site.

Table 1.1 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 (excluding 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 300 mm of imported clay rich material was spread over the area and also 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 was 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 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, 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. To complete the capping, 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, 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	Description	Remedial activity summary
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 and the Central Mine Area. 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 would be an appropriate alternative revegetation option.
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 'Moxy's'. The material would be placed in lifts ranging from nominally 150 mm to 400 mm of nominal 300 mm to 500 mm lifts, 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.

1.3 Purpose of this report

The purpose of this report is to assess the potential impacts of the proposed remediation at the derelict Lake George Mine on biodiversity values by:

- Outlining the methods used for the biodiversity assessment
- Describing the existing environment of the site, including the results of the desktop assessment and site surveys
- Identifying the presence or likely presence of threatened species, populations and ecological communities and their habitats listed under the BC Act and FM Act
- Assessing the potential for any MNES listed under the EPBC Act to occur within the site and/or to be affected by the proposal
- Identifying the potential impacts of the proposal on threatened biota and migratory species and their habitats
- Recommending mitigation and environmental management measures to avoid or minimise adverse impacts on threatened biota and other biodiversity values
- Assessing the likely significance of impacts on threatened biota listed under the BC Act and FM Act that would be affected by the proposal and determine whether a biodiversity development assessment report (BDAR) or species impact statement (SIS) would be required
- Assessing the likely significance of impacts on MNES that would be affected by the proposal to determine whether any additional assessment or approval under the EPBC Act would be required.

1.4 Scope and limitations

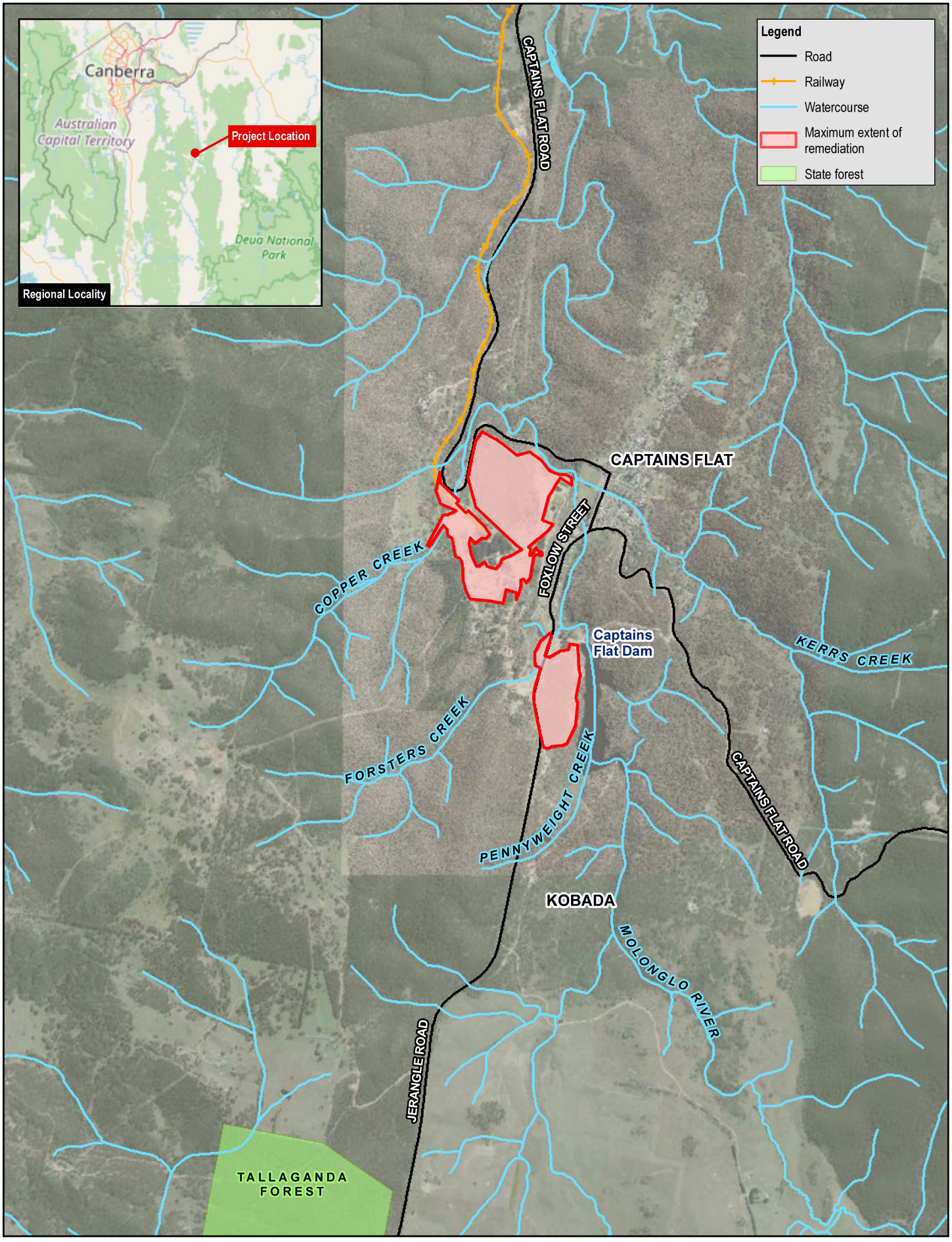
This report has been prepared by GHD for Department of Regional NSW (Legacy Mines Program) and may only be used and relied on by Department of Regional NSW (Legacy Mines Program) for the purpose agreed between GHD and Department of Regional NSW (Legacy Mines Program) as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Department of Regional NSW (Legacy Mines Program) arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

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



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Kilometres

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Grid: GDA 1994 MGA Zone 55

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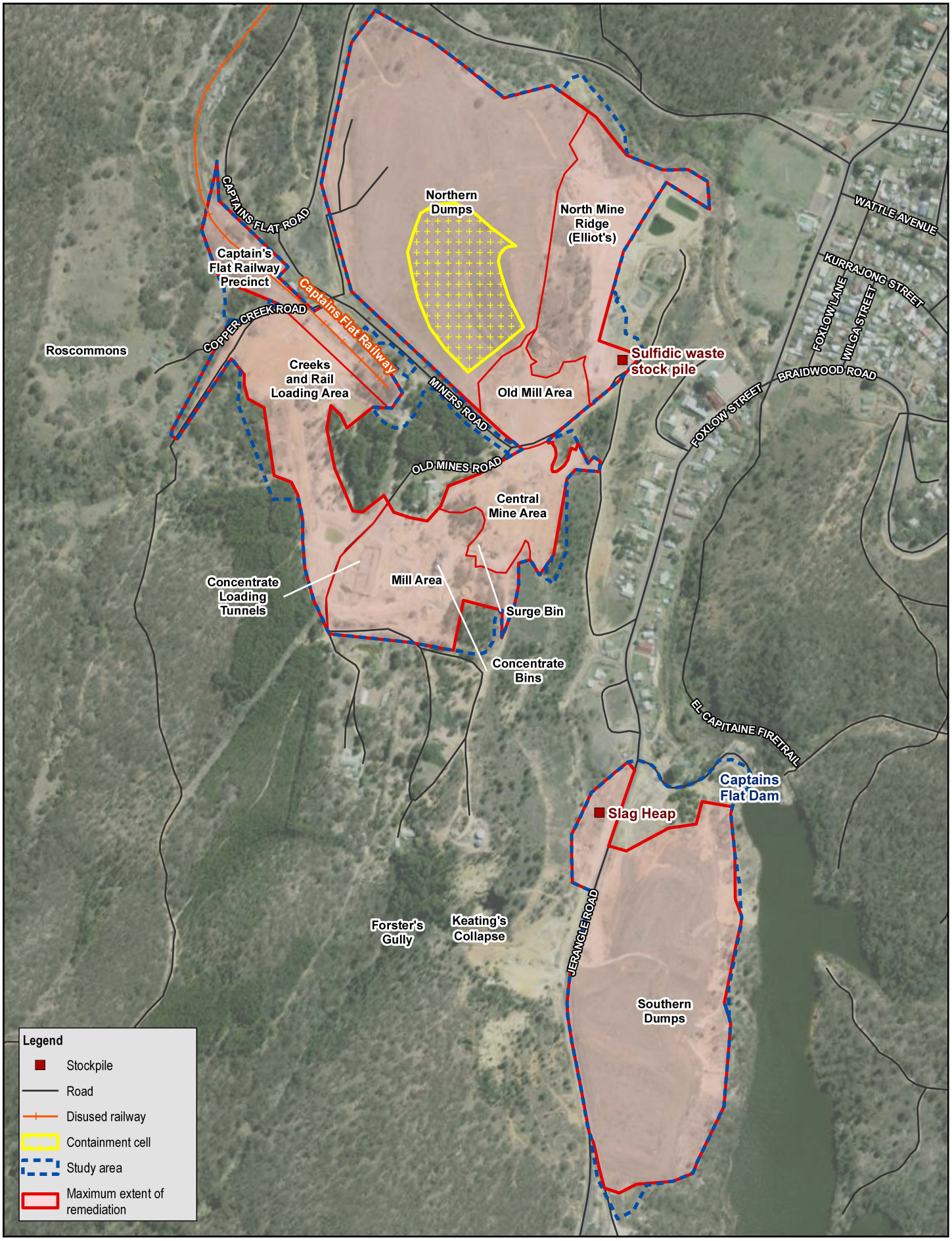
GHD

Department of Regional NSW
Lake George Mine Remediation

Project No. **12551771**
Revision No. **-**
Date **A**

Site location

FIGURE 1.1



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GHD

Department of Regional NSW
Lake George Mine Remediation

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

Key features of the proposal

FIGURE 1.2

2. Legislative context

2.1 NSW State legislation

2.1.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) forms the legal and policy platform for proposal assessment and approval in NSW and aims to, amongst other things, 'encourage the proper management, development and conservation of natural and artificial resources'. All development in NSW is assessed in accordance with the provisions of the EP&A Act and the *Environmental Planning and Assessment Regulation 2000*.

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.

Under section 1.7 of the EP&A Act, the provisions of Part 7 of the *Biodiversity Conservation Act 2016* (BC Act) (the 'five-part test') and Part 7A of the *Fisheries Management Act 1994* (FM Act) requires that the significance of the impact on threatened species, populations and endangered ecological communities is assessed using an assessment of significance (see sections below).

2.1.2 Biodiversity Conservation Act 2016

The BC Act provides legal status for biota of conservation significance in NSW. The BC Act aims to, amongst other things, 'maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development'. It provides for the listing of threatened species and communities, establishes a framework to avoid, minimise and offset the impacts of proposed development (the Biodiversity Offsets Scheme, BOS), and establishes a scientific method for assessing the likely impacts on biodiversity values and calculating measures to offset those impacts (the Biodiversity Assessment Method, BAM).

Section 7.3 of the BC Act lists five factors that must be taken into account when determining the significance of potential impacts of a proposed activity on threatened species, populations or ecological communities (or their habitats) listed under the BC Act. The 'five part test' or 'assessment of significance' is used to assist in the determination of whether a proposal is 'likely' to impose 'a significant effect' on threatened biota. Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the Secretary's Environmental Assessment Requirements, or a biodiversity development assessment report (BDAR) in accordance with the Biodiversity Offsets Scheme and Biodiversity Assessment Method. The BC Act has been addressed in this assessment through:

- Desktop review to determine the threatened species, populations or ecological communities (referred to collectively as threatened biota) and migratory species that have been previously recorded within the locality and hence could occur in the site subject to the habitats present
- Field surveys for threatened biota
- Identification, assessment and mapping of threatened biota (or their habitat)
- Assessment of potential impacts on listed threatened biota and migratory species
- Identification of suitable impact mitigation and environmental management measures to minimise potential impacts on threatened biota and migratory species, where required.

Threatened biota and migratory species recorded or likely to occur in the site are detailed further in Section 5 and Section 6.5 and potential impacts are identified in Section 6. Five-part tests have been prepared for threatened biota that would be impacted or are likely to be impacted by the proposal and are provided in Appendix C.

2.1.3 Fisheries Management Act 1994

The objectives of the *Fisheries Management Act* (FM Act) are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It provides for the listing of threatened species, populations and ecological communities, key threatening processes and requirements or otherwise for the preparation of a SIS. One of the objectives of the FM Act is to 'conserve key fish habitats' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. To assist in the protection of key fish habitats, DPI has produced the Policy and guidelines for fish habitat conservation and management (DPI 2013).

The FM Act has been addressed in this assessment through undertaking:

– A desktop review to determine the threatened species, populations or ecological communities that have been previously recorded within the locality of the proposal and hence could occur in the construction footprint, subject to the habitats present
– Assessment of potential impacts on aquatic habitats, including identification of key threatening processes of relevance to the proposal, impacts on key fish habitat and fish passage
– Assessment of the potential for impacts on listed threatened species, populations and ecological communities and the requirement or otherwise for an SIS
– Identification of suitable impact mitigation and environmental management measures to avoid or mitigate impacts on the aquatic environment.

Aquatic habitat is discussed in Section 4.3.3, and potential impacts are identified in Section 6.2.2.

2.1.4 Biosecurity Act 2015

The *Biosecurity Act 2015* provides for risk-based management of biosecurity in NSW. It provides a statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds.

The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

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

Priority weeds recorded in the site during site surveys are identified in Section 4.2.3.

2.2 Commonwealth legislation

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the EPBC Act is to, among other things, provide for the protection of the environment, especially matters of national environmental significance (MNES) and to conserve Australian biodiversity values. Under the EPBC Act, an action includes a proposal, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that ‘has, will have or is likely to have a significant impact’ on a MNES or a significant impact to the environment of Commonwealth land is deemed to be a ‘controlled action’ and may not be conducted without prior approval from the Australian Minister for the Environment.

Potential MNES of relevance to this assessment include:

– Threatened species and ecological communities
– Migratory species.

The EPBC Act has been addressed in this assessment through:

– Desktop review to determine the listed biodiversity matters that are predicted to occur within the locality of the proposal and hence could occur, subject to the habitats present
– Field surveys to identify the presence of potential habitat for listed threatened biota and migratory species
– Assessment of potential impacts on threatened and migratory biota
– Identification of suitable impact mitigation and environmental management measures for threatened and migratory biota, where required.

An assessment of significance was prepared to assess impacts to the occurrence of White Box-Yellow Box-Blakely's Red Gum Woodland and Large-eared Pied Bat in accordance with the EPBC Act significant impact guidelines 1.1 (DoE 2013) and is presented in Appendix D.

3. Methodology

3.1 Desktop assessment

A desktop assessment was carried out to compile a list of threatened flora and fauna species, populations and ecological communities (threatened biota) listed under the BC Act and FM Act, and MNES listed under the EPBC Act that could be expected to occur in the locality based on previous records, known distribution ranges, and habitats present. The assessment also assisted with focusing field survey techniques and effort. Biodiversity databases and existing literature and information pertaining to the site and locality (i.e. within a 10 kilometre 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 2021a)
– 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).

Dependence (or interaction) of the vegetation communities identified within the study area on groundwater was determined by searching the Atlas of Groundwater Dependent Ecosystems (BOM 2021a). The Atlas predicts the occurrence of groundwater dependent ecosystems (GDEs) and ecosystems that potentially use groundwater. It shows ecosystems that interact with the subsurface expression of groundwater (including vegetation ecosystems) or the surface expression of groundwater (such as rivers and wetlands). The Atlas also shows the likelihood that landscapes are accessing water in addition to rainfall, such as soil water, surface water or groundwater.

A review of assessments relevant to biodiversity in the site at Lake George mine and also the local government area was undertaken prior to the commencement of fieldwork. These include:

– *Review of Environmental Factors for the derelict Lake George Mine Ore processing and loading area* (URS 2004)
– *Review of Environmental Factors for revegetation and rehabilitation works at the Lake George Mine* (Lesryk 2012)
– *Biodiversity Study Findings Report of the Queanbeyan Local Government Area* (Bushfire and Environmental Services 2008).

Following collation of database records, consideration of records from other studies and species and community profiles, a ‘likelihood of occurrence’ assessment was prepared with reference to the broad habitats at the study area. This was further refined following field surveys and assessment of habitats present to inform the impact assessment. The results of this assessment are presented in Appendix A.

3.2 Site survey

3.2.1 Survey overview

Site surveys included:

– Site stratification and vegetation mapping
– Sampling of vegetation integrity plot/transects
– Habitat assessments
– Targeted surveys for threatened flora
– Targeted surveys for threatened fauna.

Survey effort was formally stratified across the study area in accordance with the BAM. Survey effort that has directly contributed to this BAR is summarised in Table 3.1 and is described in detail below.

Table 3.1 Survey techniques and timing

Stage	Date	Survey Technique
Biodiversity assessment survey within Lake George Mine	12-13 August 2021	Vegetation mapping Vegetation integrity plot/transects Habitat assessment Hollow-bearing tree survey Call playback Spotlighting Active searches Ultrasonic call recording targeting microbats at derelict man-made structures Roost watch at derelict man-made structures
Supplementary microbat surveys	22-23 November 2021	Ultrasonic call recording targeting microbats at derelict man-made structures Harp trapping Roost watch at derelict man-made structures Habitat assessment Diurnal bird surveys Call playback Spotlighting

3.2.2 Vegetation mapping

Existing vegetation mapping of the site (DPIE 2010) was ground-truthed in the field via systematic walked transects across the site and by walking the boundary of vegetation units. Necessary adjustments were made by hand on aerial photographs of the study area with reference to a handheld Global Positioning System (GPS) unit. Native vegetation in the site was initially assigned a vegetation community name based on observed floristic and structural characteristics. Intact native vegetation communities were defined into plant community types (PCTs) based on vegetation structure, species composition, soil type and landscape position with reference to the BioNet Vegetation Classification (EES 2021c). PCTs were further split into vegetation zones according to the following broad condition classes:

– Good – featuring natural vegetation structure and predominantly native understorey
– Degraded / Medium Condition – featuring natural vegetation structure but predominantly exotic or cleared understorey, or regenerating vegetation
– Degraded / Pine Forest – dominated by exotic pine trees with occasional native canopy trees.

3.2.3 Vegetation integrity survey plot/transects

Plot/transect surveys were conducted on site with reference to the BAM given its value as a consistent and prescribed method for survey. The site value was determined by assessing ten attributes used to assess function, composition and structure of vegetation within a 50 metre by 20 metre plot centred on a 50 metre transect. These attributes were then assessed against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement and are set for PCTs at the Vegetation Class level (EES 2021c). The overall condition of vegetation was assessed through general observation and comparison against the PCT condition benchmark data as well as using parameters such as species diversity, history of disturbance, weed invasion and canopy health.

All flora species within a 20 metre by 20 metre quadrats nestled within the 50 metre by 20 metre plot were identified according to the current nomenclature of PlantNet (Royal Botanic Gardens and Domain Trust (2021). Each species identified was allocated a growth form group and designated as either native, exotic or high threat exotic in accordance with lists provided by EES.

The plots were stratified between vegetation zones across the site to ensure all PCTs present with varying composition and condition were sampled. The location of survey plots is shown on Figure 4.1.

3.2.4 Targeted threatened flora surveys

Targeted surveys were undertaken for threatened flora species with the potential to occur within the study area given known distributions, previous records in the locality and habitat requirements for each species (refer to the threatened species assessment in Section 6.5.2).

Targeted searches were completed by random meanders through areas of suitable habitat. The majority of the site comprises bare ground, is highly contaminated and as such not suitable habitat for threatened flora species.

3.2.5 Terrestrial fauna survey

Fauna habitat assessment

Fauna habitat assessments were undertaken throughout the site, including observation of potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources were noted.

Indicative habitat criteria for targeted threatened species (i.e., those determined as having the potential to occur within the study area following the desktop review) were identified prior to fieldwork. Habitat criteria were based on information provided in EES and DAWE threatened species profiles, field guides, and the knowledge and experience of GHD field ecologists.

Habitat assessments included searches for resources of potential value to threatened fauna including:

– Trees with bird nests, hollows or other potential fauna roosts with a particular focus on suitable habitat for threatened forest owls, parrots or cockatoo hollows and threatened raptor nest trees
– Rock outcrops, caves or overhangs providing potential shelter sites for fauna
– Burrows, dens and warrens
– Distinctive scats or latrine sites, owl white wash and regurgitated pellets under roost sites
– Tracks or animal remains
– Evidence of activity such as feeding scars, scratches and diggings
– Specific food trees and evidence of foraging (for example chewed *Allocasuarina* cones).

The locations and quantitative descriptions of habitat features were captured with a handheld GPS unit and photographed where appropriate.

Spotlighting and call playback

Spotlighting for nocturnal birds and arboreal mammals including Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*), Barking Owl (*Ninox connivens*) and Greater Glider (*Petauroides volans*) was conducted for 1.5 person-hours on one night and involved two ecologists conducting a walking transect through areas of potential habitat around the Old Mines Road and the Mill Area. Nocturnal birds and arboreal mammals were targeted during the spotlight period by systematically scanning native vegetation.

Call playback was undertaken along formed tracks and involved broadcasting calls for threatened fauna species with the potential to occur, based on the habitats present. Calls were played for two minutes each, followed by five minutes of silence. Species targeted included the Powerful Owl, Masked Owl, Barking Owl and Green and Golden Bell Frog (*Litoria aurea*).

Active searches

Active searches targeting reptile and amphibian species were conducted in areas of potential habitat, including patches of woody debris, rocky outcrops and rocky habitat in woodland and other ground litter within the remediation areas at the Southern Dumps where embedded rocky outcrop and some partially embedded rock in grassland was present. These searches included active hand searches by flipping partially embedded rocks.

Diurnal bird surveys

Dedicated bird surveys were conducted at four locations across the site. Surveys generally consisted of area searches of 30 minutes to one hour, depending on patch size and habitat values. Birds were identified by sight and call.

Microchiropteran bat surveys

Microbat ultrasonic echolocation call recordings (Anabat surveys) were undertaken using three Anabat units over one night in August 2021 and a further two Anabats over two consecutive nights in November 2021 targeting potential roost sites within derelict loading tunnels and surge bins (see Figure 4.1).

The methodology for analysis and identification of microbat calls is provided in Appendix B. No reference calls were collected during the survey. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating as summarised in Table 3.2. Due to the absence of reference calls from the site, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Derelict loading tunnels, concentrate bins, mine shafts, surge bins and railway culverts were visually inspected for evidence of use by microbats, such as the presence of guano (bat droppings) and for roosting microbats where possible. The central loading tunnel and the surge bin were monitored for the presence of emerging roosting microbats with a spotlight prior to and after dusk. Harp traps were installed at the northern loading tunnel, central loading tunnel and surge bin for two consecutive nights during the typical emergence period for bats and were open for up to four hours following dusk and regularly checked (noting the potential for lactating females during the November survey round).

Table 3.2 Confidence ratings applied to calls

Identification	Description
D – Definite	Species identification not in doubt.
PR – Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG – Species Group	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species, for example: – *Chalinolobus gouldii* /*Mormopterus ozimops sp* – Nyctophilus sp. The calls of *Nyctophilus geoffroyi* / *gouldi* cannot be distinguished during the analysis process and are therefore lumped together – Nyctophilus sp./*Myotis macropus*. The calls of these species can be easily confused during the analysis process and are therefore often lumped together.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. This included a conscious focus on suitable areas of habitat during flora surveys, for instance fallen timber was scanned and/or turned for reptiles and mature trees and stags were scanned for roosting birds.

3.2.6 Aquatic habitat assessment

A rapid assessment was conducted on aquatic habitat comprising qualitative assessments of the substrata and water channel and an on-site assessment of habitat features and suitability for threatened taxa identified from the database and literature searches. The sensitivity of key fish habitat and the functionality of the creek was classified according to the *Policy and guidelines for fish habitat conservation and management* (DPI 2013).

3.3 Survey conditions

Conditions during field surveys were mild during morning surveys, with mild to warm temperatures during daytime surveys. Survey conditions were cold during the August nocturnal survey with little to no wind. No rainfall was experienced during surveys.

Diurnal weather conditions were generally suitable for the detection of most species.

Temperatures during the August 2021 nocturnal surveys were 7°C which is unlikely to have adversely affected the likelihood of detection of forest owls and arboreal mammals and microbat activity in the early evening. Temperatures fell to ~-4°C minimum overnight, which may have inhibited activity levels of microbats in the later evening and before dawn and as such limited the likelihood of detection if present and roosting within adjacent derelict structures. Approximately 50 Anabat sequence files were obtained from 33 hours of recording from three sites during the August surveys, with just three bat call sequences identified, indicating very low activity levels. The log files from all detectors were examined and all detectors operated for the entire night, however low temperatures during the August surveys may account for the low bat activity.

Supplementary surveys were conducted in November 2021, which a particular focus on potential microbat roosting habitat in derelict man-made structures during warmer months when microbats are more likely to be active as prescribed in the survey guidelines for threatened microbats (OEH 2018). Weather conditions during the November survey remained relatively warm and humid, with overnight minimum temperatures above 8.1°C. Up to 343 Anabat sequence files were obtained from 20 hours of recording from two sites during the November surveys, with nine bat calls identified. Noting the warm overnight temperatures, these November results can be considered a more reliable indicator of the presence or absence of bat species and the likely use of potential roost sites.

Weather observations during the survey period (refer Table 3.3) were taken from Braidwood All Weather Station (station 069132) ~35 kilometres from the study area (BOM 2021a). The rainfall detected at the weather station was not experienced at the site during the August and November survey period.

Table 3.3 Daily weather observations during the survey period

Date	Minimum temp (Degrees Celsius)	Max temp (Degrees Celsius)	Rainfall (mm)
12/08/2021	3.0	14.5	1.8
13/08/2021	-4.4	14.6	0.2
22/11/2021	8.1	16.4	1.0
23/11/2021	9.7	19.8	0.0

3.4 Geographical Information System (GIS) analysis

GIS was used to:

– Plot the study area on a high-resolution aerial photo base and to map PCTs, survey effort, habitat resources and biodiversity values across the study area and areas investigated in the site
– Calculate the extent of native vegetation to be impacted
– Confirm the relevant IBRA bioregion, IBRA subregion and Mitchell Landscape for the site.

Native vegetation cover, extent and connectivity were assessed using aerial photography. Air photo interpretation was used to identify and record distinct vegetation patches, determine the broad condition state of vegetation types and the location and extent of vegetated habitat corridors.

3.5 Likelihood of occurrence of threatened and migratory biota

Following collation of database records, consideration of records from other studies and review of species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the habitats contained within the study area. Identification of potential habitat for threatened and migratory species was based on information provided in the species profiles (DAWE 2021b), recovery plans, journal articles, and the field staffs' knowledge of species habitat requirements. The likelihood of occurrence assessment was further refined following field surveys. The likelihood of threatened and migratory biota occurring in the study area was assessed based on presence of records from the locality for the last 20 years (since 2000), species distribution and habitat preferences, and the suitability of potential habitat present in the study area. The results of this assessment are provided in Appendix A.

Table 3.4 provides a key to the likelihood of occurrence in the study area of threatened biota known or likely to occur in the locality. Following completion of a likelihood of occurrence assessment, the likely impact of the proposal on those species with a 'likely', 'possible', 'unlikely' or 'recorded' likelihood of occurrence were considered (refer to Appendix A). Species and communities that were considered to have a 'recorded' or 'possible' likelihood of occurrence in the remediation area and that had potentially significant habitat features that would be impacted were the focus of assessments of significance, as outlined in Section 6.5.

Table 3.4 Key to the likelihood of occurrence of threatened species

Likelihood	Definition
Recorded	The species was observed in the study area during the current survey.
Likely	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (within 10 kilometres) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Possible	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however, may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Unlikely	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (within 10 kilometres). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Nil	Suitable habitat is absent from the study area

3.6 Survey effort considerations and limitations

Flora and fauna surveys were conducted by GHD in the site for two days in August 2021 and two days in November 2021. Some fauna species that may occur in the locality or region on a seasonal basis, use habitats periodically (as part of a wider home range) or become active at different times of the year may not have been recorded. Similarly, some flora species that are difficult or impossible to locate or identify at certain times of year due to a lack of reproductive material and/or their seasonal nature may also have not been observed.

For the above reasons, the impact assessment and conclusions of this report draw upon information obtained from a variety of sources in addition to the field survey data. An assessment of the likelihood of occurrence of threatened species has been provided, on the basis of known distributional ranges and previous records in the locality and the habitats present in the site. The assessment of impacts includes those threatened species not detected but considered likely to occur or to be impacted by the proposal based on the results of the desktop review and field surveys.

There is generally a low cover of groundcover species across the study area, with the density of species not high enough as to prevent or inhibit identification of species of conservation significance. There was minimal flowering of flora species observed across the site and surrounding site.

4. Existing environment

4.1 Landscape context

4.1.1 Site description

The site lies above the township of Captains Flat between 840 to 910 metres above sea level and occurs in two separate investigation areas. The southern investigation area occurs between Jerangle Road and the Molonglo River to the south of the township and comprises the Southern Dumps in its entirety. The northern investigation area occurs to the west of the township and includes the Mill Area and Rail Loading Area with derelict mine infrastructure still on-site and the Northern Dumps. Portions of the northern investigation area and associated historic mining infrastructure are freely accessible for viewing by the public from Miners Road.

The site is predominantly cleared, but contains small patches of pine woodland and regenerating *Acacia* spp. Where vegetation is present, this is likely to comprise planted species as part of previous rehabilitation works including Tussock grasses (*Poa* spp.) which are the result of previous revegetation works undertaken in the site (Lesryck 2002) or regenerating woodland, where soil contamination is less prevalent.

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. Common tree species comprising Brittle gum (*Eucalyptus mannifera*), Scribbly gum (*Eucalyptus rossii*), Candlebark (*Eucalyptus rubida*) and Apple Box (*Eucalyptus bridgesiana*) with a midstorey of Wild Cherry (*Exocarpos cupressiformis*), Red-stemmed Wattle (*Acacia rubida*) and Silver wattle (*Acacia dealbata*) are present in the surrounding landscape.

The entirety of the site is mapped as disturbed terrain, with the original soil removed, greatly disturbed or buried and associated with mining activities. The Captains Flat Dumps are known to contain large quantities of heavy metals such as lead, zinc and copper (Craze 1977). Prior to mining activities in the site, very shallow Lithosols and shallow to moderately deep Red Podzolic soils on crests and sideslopes associated with the Bennison soil landscape would have originally occurred (Craze 1977).

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) ~70 kilometres from Captains Flat. Water from Lake Burley Griffin then flows into the Murray River. 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.

4.1.2 Historical activities

The historic operation of the Lake George Mine has had a detrimental impact to environmental values at Captains Flat. Disturbances to the environment from historic mining activities include:

– Smelting impacts, including the release of sulfur dioxide emissions, leading to acid rain and acidic runoff.
– Surface water impacts, including changes to natural geomorphology and location of drainage lines and contaminated runoff such as particulate lead, zinc and copper from loading areas, and from seepages at dams and adits. This includes a breach in the Northern Dumps in 1933 resulting in tailings and slime entering the Molonglo River and collapse of tailings stored in the Southern Dumps resulting in the dumping of ~30,000 m^3 of tailings into the water reservoir (Dobos and Associates 2002).
– Vegetation impacts from large-scale vegetation clearing and the release of sulfur dioxide emissions causing a general dieback in vegetation.

Most vegetation at the Lake George Mine today represents either assisted revegetation or regrowth, with some degraded remnant vegetation also present in the riparian corridor of Copper Creek. Historic remedial work at Lake George Mine includes the remediation of tailings dump and Foster's Creek diversion in 1976 (Brooks 1980). Other various site works to remediate the mine since the preparation of a Remedial Action Plan (URS 2004) have included:

– Capping of slag on the uphill (east) side of the Jerangle Road, immediately south of Captains Flat
– 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
– Additional fencing and sealing of some shafts
– Rehabilitating the northern face of the Southern Dumps where previous remedial works had eroded
– Weather-proofing the sulfidic ore in the ore bins in the historic ore processing area
– Installing additional diversion drains to reduce runoff over contaminated areas, primarily in the Creek and Rail Loading areas in the Copper Creek catchment.

4.2 Vegetation

4.2.1 Flora species

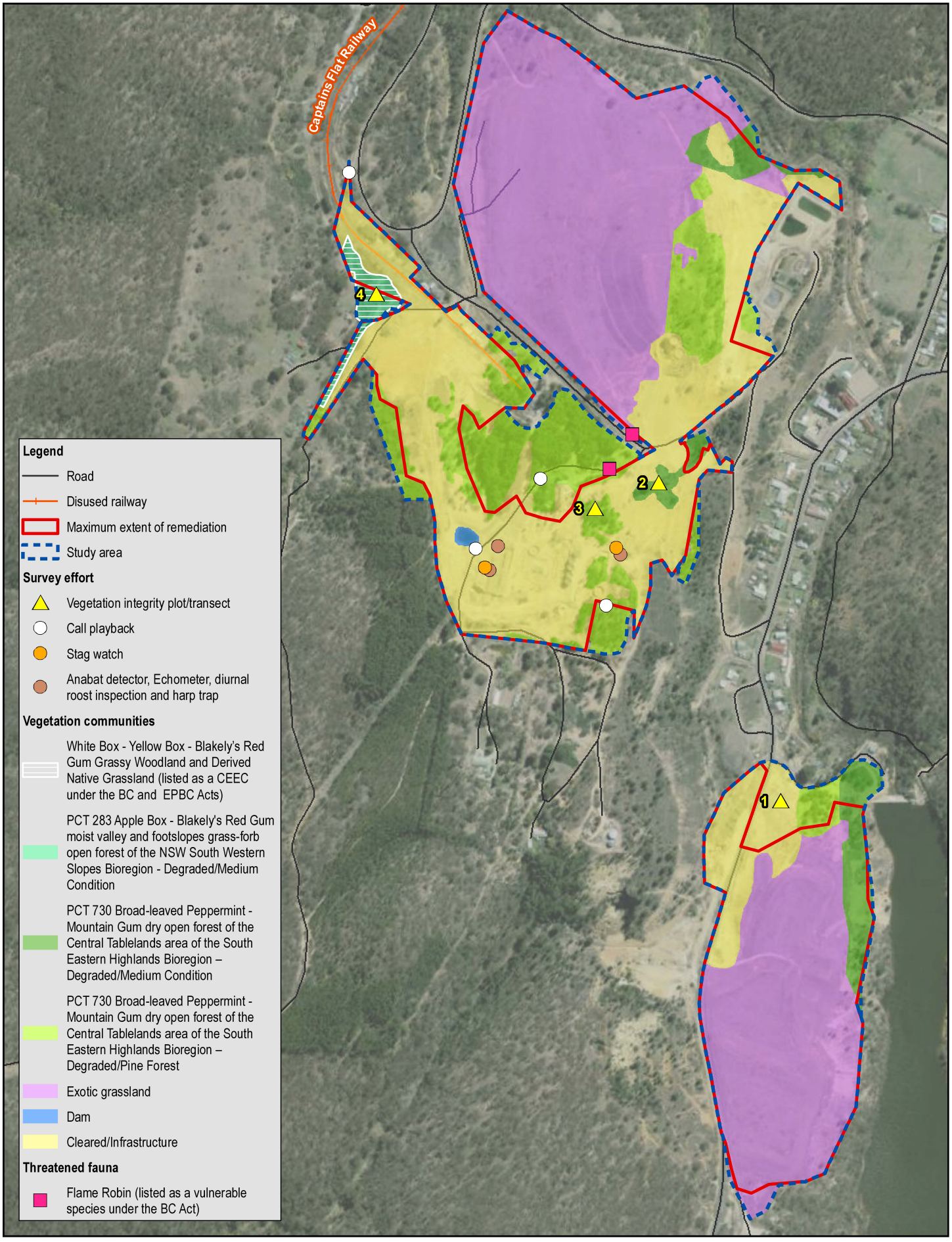
A total of 44 flora species from 16 families were recorded within the site, comprising 25 native and 19 exotic species. The Poaceae (grasses, 10 species, three native), Fabaceae (nine species, all native) and Myrtaceae (six species, all native), were the most diverse families recorded. A full list of flora species recorded within the site is provided in Appendix B. Characteristic plant species are discussed below in relation to the vegetation zones occurring in the site.

4.2.2 Vegetation zones

The site contains a range of degraded vegetation types, including degraded woodland, exotic grassland and cleared, contaminated ground. The vegetation within the site is described below and shown on Figure 4.1.

Native vegetation throughout the site has been substantially cleared for the mine and impacted by the high levels of contamination in 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.

PCTs and vegetation zones within the site are shown on Figure 4.1 and summarised in Table 4.1.



Paper Size ISO A4

0 50 100 150 200

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

Survey effort, vegetation and threatened biota

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

FIGURE 4.1

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

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Print date: 24 Mar 2022 - 15:46

Table 4.1 Vegetation zones within study area

Plant community type (OEH, 2021)	PCT ID	Condition	Area within study area (ha.)	BC Act Status	EPBC Act Status	Vegetation integrity plot sampled
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	0.48	CEEC*	CEEC*	Plot 4
Broad-leaved Peppermint-Mountain Gum dry open forest of the Central Table lands area of the South Eastern Highlands Bioregion	730	Degraded/ Pine Forest	7.83	-	-	Plot 3
Broad-leaved Peppermint-Mountain Gum dry open forest of the Central Table lands area of the South Eastern Highlands Bioregion	730	Degraded/ Medium Condition	2.35	-	-	Plot 2
Exotic grassland	N/A	Exotic vegetation	25.06			Rapid observations
Cleared/Infrastructure	N/A	Cleared land	18.04			Plot 1

*CEEC = critically endangered ecological community.

Table 4.2 Vegetation zone descriptions

Apple Box Blakely's Red Gum moist valley and footslopes grass forb open forest degraded/medium condition		
PCT (EES 2021c)	Apple Box - Blakely's Red Gum moist valley and footslopes grass-forb open forest of the NSW South Western Slopes Bioregion	
PCT ID	283	
Conservation significance	Comprises an occurrence of a critically endangered ecological community (CEEC) listed under the BC Act and EPBC Act: *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions*	
Condition	Degraded/Medium Remnant and regrowth native vegetation with a patchy to near-intact over storey, with a midstorey and understorey dominated by exotic species. There are occasional native midstorey and understorey species, but many patches have a midstorey dominated by woody weeds. Community structure is variable, probably due to proximity to the rail line and decommissioned mine. This vegetation zone has high intrinsic value. It supports potential habitat for threatened fauna species and contains fauna habitat resources such as fallen timber.	
Evidence used to define vegetation unit	Forest vegetation structure with an open midstorey. Characteristic canopy species that are consistent with the VIS (EES 2021c).	
Landscape position	Occurs along Copper Creek and Captains Flat Rail Line	
Structure	Open woodland with a disturbed and weedy mid storey and understorey.	
Over storey	Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*Eucalyptus melliodora*) and Argyle Apple (*Eucalyptus cinerea*)	
Mid storey	Black Wattle (*Acacia mearnsii*), Broad-leaved Hickory (*Acacia falciformis*), Native Broom (*Viminaria juncea*), and A Hopbush (*Dodonaea* sp.)	
Groundcover	Predominantly exotic. Native species include Two-colour Panic (*Panicum simile*) and Climbing Saltbush (*Einadia nutans*).	
Exotic species	Radiata Pine (*Pinus radiata*), shrubs including African Boxthorn (*Lycium ferocissimum*) and Blackberry complex (*Rubus fruticosus* sp. agg.) and grasses such as Lesser Canary Grass (*Phalaris minor*) and Serrated Tussock (*Nassella trichotoma*).	

Broad leaved Peppermint Mountain Gum dry open forest of the Central Table lands area of the South Eastern Highlands Bioregion degraded/medium condition		
PCT (OEH, 2021)	Broad -leaved Peppermint - Mountain Gum dry open forest of the Central Table lands area of the South Eastern Highlands Bioregion	
PCT ID	730	
Conservation significance	Native vegetation. Does not comprise an occurrence of a threatened ecological community (TEC).	
Condition	Degraded/Medium A mixture of sparse moderate to advanced regrowth. The vegetation zone supports a low to moderate species richness across the midstorey and canopy stratum, with a midstorey and understorey dominated by exotic species. Community structure is variable, as a result of surrounding disturbance and land use. The low cover and species diversity is probably also a function of the high level of contamination in the landscape. This vegetation zone has moderate intrinsic value. It contains potential habitat for threatened flora and fauna species and contains fauna habitat resources such as fallen timber.	
Evidence used to define vegetation unit	Open forest vegetation structure with patchy midstorey. The dominant plant species described below are consistent with the VIS (EES 2021c).	
Landscape position	It occurs as small, fragmented patches throughout the site.	
Structure	Patchy open woodland with a sparse midstorey dominated by a mix of exotic and native shrubs and sparse understorey dominated by exotic perennial grasses.	
Over storey	Apple Box (*Eucalyptus bridgesiana*), Argyle Apple (*Eucalyptus cinerea*) and Mountain Gum (*Eucalyptus dalrympleana*)	
Mid storey	Black Wattle (*Acacia decurrens*), *Acacia mearnsii,* Broad-leaved Hickory (*Acacia falciformis),* and Wedge-leaved Wattle (*Acacia pravissima)*	
Groundcover	Generally low species richness. Includes groundcover species such as *Lachnagrostis* spp., Blue Flax-lily (*Dianella caerulea),* Lovegrass (*Eragrostis* spp.) and Spiny-headed Mat-rush (*Lomandra longifolia*).	
Exotic species	Radiata Pine (*Pinus radiata*), Blackberry complex (*Rubus fruticosus* sp. agg.), African Lovegrass (*Eragrostis curvula),* Common vetch (*Vicia sativa*), Cudweed (*Gamochaeta calviceps*), Haresfoot Clover (*Trifolium arvense*), Lamb's Tongues (*Plantago lanceolata*), and Serrated Tussock (*Nassella trichotoma*).	

Broad leaved Peppermint Mountain Gum dry open forest of the Central Table lands area of the South Eastern Highlands Bioregion degraded pine forest		
PCT (OEH, 2021)	Broad -leaved Peppermint - Mountain Gum dry open forest of the Central Table lands area of the South Eastern Highlands Bioregion	
PCT ID	730	
Conservation significance	Native vegetation. Does not comprise an occurrence of TEC.	
Condition	Degraded / Pine Forest Dominated by exotic pine trees with occasional native canopy trees. Low richness across the canopy, midstorey and understorey dominated by exotic species. This vegetation zone has low intrinsic value. It contains potential habitat for threatened flora and fauna species.	
Evidence used to define vegetation unit	Open forest vegetation structure with patchy midstorey. The dominant plant species described below and in adjoining better condition patches of the PCT, are consistent with the VIS (EES 2021c).	
Landscape position	It occurs as large patches throughout the site.	
Structure	Woodland dominated by pine trees with mostly absent midstorey with a groundcover dominated by exotic perennial grasses.	
Over storey	Sporadic occurrence of Brittle Gum (*Eucalyptus mannifera*)	
Mid storey	Wedge-leaved Wattle (*Acacia pravissima)* and Cootamundra Wattle (*Acacia baileyana*) and *Acacia longifolia*	
Groundcover	Generally low species richness. Includes groundcover species such as Brown's Lovegrass (*Eragrostis brownii)* and Spiny-headed Mat-rush (*Lomandra longifolia*).	
Exotic species	Dominated by Radiata Pine (*Pinus radiata*above a groundcover of Brome (*Bromus* sp.), Buddleja (*Buddleja davidii*), Mouse-ear Chickweed (*Cerastium glomeratum*), Perennial Ryegrass (*Lolium perenne*), Serrated Tussock (*Nassella trichotoma*), and Tall fleabane (*Conyza sumatrensis)*	

Exotic grassland		
PCT (OEH, 2021)	N/A	
PCT ID	N/A	
Conservation significance	Exotic vegetation	
Condition	Exotic vegetation	
Landscape position	It occurs as large patches throughout the site.	
Structure	Absent canopy and midstorey with a groundcover dominated by exotic perennial grasses.	
Over storey	Absent	
Mid storey	Mostly absent, with occasional Blackwood (*Acacia melanoxylon*) and Wedge-leaved Wattle (*Acacia pravissima*)	
Groundcover	Generally low species richness. Includes groundcover species such as Brown's Lovegrass (*Eragrostis brownii)* and Spiny-headed Mat-rush (*Lomandra longifolia*).	
Exotic species	Dominated by Serrated Tussock (*Nassella trichotoma*), Common vetch (*Vicia sativa*), Cudweed (*Gamochaeta calviceps*), Lamb's Tongues (*Plantago lanceolata*), Spear Thistle (*Cirsium vulgare*), Lesser Canary Grass (*Phalaris minor*) and Tall fleabane (*Conyza sumatrensis)* with occasional exotic shrubs such as Buddleja (*Buddleja davidii*),	

4.2.3 Priority weeds

Five plant species identified as priority weeds for the South East region were recorded in the site. The weeds and their management requirements as per the *Biosecurity Act 2015* are listed in Table 4.3 below. Serrated Tussock (*Nassella trichotoma)* is particularly abundant in grassland areas throughout the site.

Table 4.3 Priority weeds recorded within the site and 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.

4.3 Fauna and habitat resources

4.3.1 Fauna species

A moderate diversity of native fauna species was recorded in the site (refer to Appendix B). Species recorded were those capable of persisting in disturbed environments and in fragmented patches of vegetation that lack structural and floristic diversity. The majority of the total species recorded were observed in areas where eucalypts were present, including adjacent to the Molonglo Rover and in the Railway Precinct, with a lower diversity noted in portions of the site with lower native vegetation cover.

Fifty-five species of fauna were recorded during the survey, comprising 45 birds, five mammals and five frogs (refer to Appendix B). 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.

4.3.2 Terrestrial fauna habitats

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.

The site contains the following broad habitat types for fauna:

– Grassy and/or regenerating woodland
– Non-native vegetation, including areas of exotic grassland and pine forest
– Cleared areas including man-made structures (derelict surge bin, concentrate bins and loading tunnels and railway culverts).

The various habitats and their biodiversity value are discussed in the following tables.

Table 4.4 Fauna habitat descriptions

Grassy and/or regenerating woodland		
Description	Occur off Old Mines Road where a viewing platform is present, on the eastern sideslope of the Southern Dumps, off Copper Creek and in the Northern Dumps. Generally in poorer condition with only occasional eucalypts present and missing one or more vegetation stratum. The exception is grassy woodland off Copper Creek that adjoins intact native vegetation. A dense shrubby stratum of Acacia spp. was present in grassy woodland in the Northern Dumps however no canopy was present. Habitat resources include canopy trees, nectar, fruits and leaves as well as foraging substrate and some fruiting and flowering small trees and shrubs, such as Acacia spp. Sparse fallen timber and leaf litter provides limited areas of broadly suitable shelter habitat for small reptiles, snakes and small mammals. The majority of this vegetation within the site is immature regrowth, with no hollow-bearing trees recorded. It occurs as fragmented patches surrounding by exotic grassland, pine forest or cleared land. Habitat value is limited by the immaturity of the canopy stratum. Native species using grassy woodland within the site may use these isolated patches as 'stepping stones' as part of their wider home range that includes the larger, more intact and better condition tracts of vegetation in the locality and associated with Tallagenda State Forest.	
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. 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. 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	Three introduced species were recorded in the study area. The House Sparrow (*Passer domesticus*) and European Goldfinch (*Carduelis carduelis*) was recorded in the Southern Dumps & Keatings Collapse. The Rabbit (*Oryctolagus cuniculus*) was recorded in the Northern Dumps and at the Molonglo River (downstream). All three species are likely to occur in these habitats.	
Photos	 Grassy woodland adjoining viewing platform in Central Mine Area	 Grassy woodland adjoining Copper Creek in the Captains Flat Railwat Precinct. Note intact native vegetation

Grassy and/or regenerating woodland		
	 Grassy woodland in the Southern Dumps, noting embedded rocky fragments and occasional eucalypt present	 Regrowth grassy woodland in the Northern Dumps, noting dense midstorey of Acacia spp. and absence of canopy

Non native vegetation, including areas of exotic grassland and pine forest	
Description	Exotic grassland is the most common fauna habitat type. Exotic grassland is unmaintained and restricted to the Northern and Southern Dumps. Bare areas devoid of vegetation within exotic grassland are likely to contain high levels of contaminants which would restrict their occupation by most fauna. These areas would have historically supported native woodland vegetation, which has been cleared to stockpile the mines' tailings. Exotic grassland contains few habitat resources of relevance to most native fauna species due to its low structural and floristic diversity. Foraging resources for relatively mobile and opportunistic native fauna species include seed, nectar and invertebrates. Pine Forest occurs as fragmented and isolated patches within the Rail Loading Area, Mill Area and North Mine Ridge. *Pinus* species would have little value as foraging habitat for native fauna given the scarcity of flowering shrubs, a dense understorey and eucalypts within pine forest, they also comprise low habitat value for local fauna.
Typical fauna species recorded or likely to occur	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. 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. 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 here. 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. The Eastern Bentwing Bat (*Minopterus sheirbersii oceanensis*), Little Bentwing Bat (*Miniopterus australis*) 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	The Rabbit (*Oryctolagus cuniculus*) was recorded in the Northern Dumps and at the Molonglo River (downstream). The House Sparrow (*Passer domesticus*) and European Goldfinch (*Carduelis carduelis*) are likely to occur in these habitats.

Non native vegetation, including areas of exotic grassland and pine forest		
Photos	 Exotic grassland in the Southern Dumps. Note bare areas devoid of vegetation in background	 Pine Forest in the Mill Area
	 Small seep in the Southern Dumps	 Pine Forest in the Northern Dumps

Cleared areas and infrastructure	
Description	Associated with the Rail loading area, Mill Area, Old Mill and Central mine Area containing mine infrastructure such as derelict surge bin, concentrate bins, loading tunnels and railway culverts. Generally devoid of all vegetation however scattered Acacia spp. and tussock grasses are present between derelict mine infrastructure, which present minimal fauna habitat. The existing mine infrastructure is in various stages of collapse, but still comprises potential roosting habitat for microbats. **Central loading tunnel** The central loading tunnel has remained intact, and is primarily supported by wooden girders under a concrete slab. This loading tunnel would only receive low levels of light to the front of the tunnel during the day. The far reaches of the tunnel (at least up to 25 m deep) would remain in darkness throughout the day. There is potential for microbats to roost between or along the wooden girders on the sides and also the ceiling of this structure Microbats are also known to use disused Fairy Martin nests (Hopkins 2015, Schultz 1998, DECC 2007), which occur in abundance within this particular loading tunnel. A bat call was recorded in the vicinity of the Central loading tunnel around dusk suggesting that an individual or a few individuals may have used the tunnel as a diurnal roost in November 2021. However, the call recording data to date and the fact that no bats were revealed by dusk monitoring of the tunnel entrance or captured in harp traps suggests that the tunnel is not used frequently or by a large number of bats. **Northern loading tunnel** The northern loading tunnel is partially collapsed but comprises the same structural support as the central loading tunnel. The northern tunnel is exposed to greater levels of sunlight during the day, however there are areas of low-light at the back of the tunnel. There is potential for microbats to roost between or along the wooden girders on the sides and also the ceiling of this structure however no direct evidence of microbat occupation was recorded despite targeted survey. **Surge bin** The western side of the Surge bin has been boarded up by wooden planks to prevent further collapse. Several small concrete hollows ~5 cm have been drilled into the concrete above the boarded wooden planks which may provide habitat for roosting microbats. There is also the potential for microbats to roost behind the wooden planks, particularly if these concrete holes also occur behind these wooden planks. Bat calls recorded in the vicinity of the surge bin around dusk suggesting that an individual or a few individuals may have used the structure as a diurnal roost in August and November 2021. However the call recording data to date and the fact that no bats were revealed by dusk monitoring of potential roost sites or captured in harp traps suggests that the surge bin is not used frequently or by a large number of bats.

<table>
<tr><th colspan="3">Cleared areas and infrastructure</th></tr>
<tr><td></td><td colspan="2">Concentrate bins
The underside of the derelict concrete bins contain multiple small holes within hardened sulfidic waste. The depth of these holes is unknown however they appear to go deep into the structure itself, given the low level of light observed within these holes. While some of these holes are leaking a watery substance, the holes which are dry may contain potential low quality roosting habitat for microbats on occasion.
Culvert under rail corridor
The box culvert under the rail corridor does not contain crevices, cracks or fissures for microbats to roost in. However, some disused Fairy Martin nests were recorded, which may provide some limited roosting habitat.
An upwards facing mine shaft, and the rock slide at Keatings Collapse were also noted as potential roosting habitat for microbats during the survey. These areas would not be directly impacted by the remediation works.</td></tr>
<tr><td>Typical fauna species recorded or likely to occur</td><td colspan="2">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 Fairy Martins in their nests may reduce the quality of this habitat resource, 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) and Chocolate Wattled Bat (Chalinolobus morio).</td></tr>
<tr><td>Threatened and migratory fauna species recorded or likely to occur</td><td colspan="2">The Southern Myotis was potentially recorded at the surge bin and central loading tunnel during emergence period for roosting microbats. Calls were identified to species guild level with Nyctophilus spp. due to low number and short duration of calls. The species is known to roost with a few hundred metres of foraging resources including creeks or dams.
Large Bentwing Bats were potentially recorded at the surge bin and central loading tunnel during emergence period for roosting microbats. Calls were identified to species guild level with Vespadelus spp. due to low number and short duration of calls. This species is known to roost in derelict mine structures including adits and mine shafts. The call recording data to date and the fact that no bats were revealed by dusk monitoring of the structures or captured in harp traps suggests that the derelict structures are not used frequently or by a large number of bats.</td></tr>
<tr><td rowspan="3">Photos</td><td> 
Cleared areas in the Mill area</td><td> 
Cleared areas in the Old Mill area</td></tr>
<tr><td> 
Potential microbat roosting habitat within derelict surge bin</td><td> 
Potential microbat roosting habitat within collapsed northern loading tunnel</td></tr>
<tr><td> 
Potential microbat roosting habitat within intact central loading tunnel</td><td> 
Derelict concentrate bins with sulfidic waste and water seepage</td></tr>
</table>

4.3.3 Aquatic habitat

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. Aquatic habitats are described in Table 4.5.

Table 4.5 Aquatic habitats

Aquatic habitats	
Description	Copper Creek is a slow-flowing perennial creek which flows into the Molonglo River. It comprises a rocky bottom with a 1 m wide channel in the site. It has defined banks and was very shallow at the time of the survey, despite nearly 15 mm of rain in the preceding 24 hrs. No instream emergent aquatic vegetation was recorded within Copper Creek, but terrestrial grasses and shrubs directly above the creek bank. Overhanging canopy vegetation shade large parts of this creek throughout much of the day. Water flows from Copper Creek and exits through a concrete-lined box culvert in the site. It comprises Class 3 minimal key fish habitat as it is a named third order stream with likely intermittent flow and sporadic refuge, breeding and feeding area for aquatic fauna and would not comprise a fish habitat sensitivity ranking (DPI 2013). A freshwater fish community status has not been mapped for this waterway (DPI 2021a). The Molonglo River occurs to the east and north of the site and is a major river in the Queanbeyan-Palerang region. The bedrock underlying the Molonglo River mostly comprises Silurian and Ordovician sedimentary and volcanic rock and Quaternary alluvial deposits (NSW Department of Planning and Environment 2019). The damming of the Molonglo River at Captains Flat has greatly changed the physical attributes of this river downstream of the dam. The Molonglo River is considered Class 1 Major key fish habitat upstream of the Captains Flat dam, as it is a waterway or permanently flowing or flooded freshwater waterway. The Molonglo River upstream of the Captains Flat dam would comprise Type 1 highly sensitive key fish habitat (DPI 2013). The Molonglo River upstream of the Captains Flat dam is very wide (up to 100 m) and does not contain any emergent aquatic vegetation adjacent to the site). Downstream of the dam, the Molonglo River comprises Type 2 Fish habitat (DPI 2013); moderately sensitive key fish habitat including freshwater habitats and brackish wetland, lakes and lagoons and including freshwater aquatic vegetation. Molonglo River downstream of the dam is also classified as Class 2 for fish passage (DPI 2013) which comprises moderate key fish habitat; non-permanently flowing stream, creek or waterway with clearly defined bed and banks. The Molonglo River downstream of the Captains Flat dam becomes narrow (up to 25 m wide) and contains large patches of emergent aquatic vegetation adjacent to the site, which slow the flow of water further downstream. Also includes a dam located in the Mill Area. This dam is devoid of any emergent aquatic vegetation and is surrounded by bare ground with scattered tussock grasses
Typical fauna species recorded or likely to occur	No fish were observed in any of the creeks, dams or the Molonglo River. The presence of fish in these waterways is highly dependent on the level of contamination in these locations. The collapse of mine tailings dams in Captains Flat between 1930-1960 has historically resulted in the loss of fish from the Molonglo River (Lintermans 2002). The Captains Flat dam is known to contain Murray Cod (*Maccullochella peelii*), Golden Perch (*Macquaria ambigua*), Silver Perch (*Bidyanus bidyanus*), Brown Trout (*Salmo trutta*), Rainbow Trout (*Oncorhynchus mykiss*) and European Carp (*Cyprinus carpio*) (Sweetwater Fishing 2021). A large number of Common Eastern Froglet (*Crinia signifera*) were heard in chorus within the dam in the Mill area. A chorus of Common Eastern Froglet, Eastern Banjo Frog (*Limnodynastes dumerilii*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), Verreaux's Frog (*Litoria verreauxii*) and Brown-striped Frog (*Limnodynastes peronii*) was recorded calling within the Molonglo River at Colin Winchester Oval downstream of the site.
Threatened fauna species recorded or likely to occur	The Southern Myotis may forage over pools in the site comprising the dam at the Mill Area. Foraging habitat for the species is present in the locality within the Molonglo River and other creeks. Aquatic habitat in the site would not provide habitat for threatened fish or threatened frogs recorded in the locality.

Aquatic habitats		
Photos	 Molonglo River downstream of the proposal	 Molonglo River adjacent to the Southern Dumps and upstream of the dam
	 Molonglo River east of the Northern Dumps at Kerrs Creek intersection and downstream of the dam	 Copper Creek at the intersection of the rail corridor
	 Dam in the Mill Area. Note the absence of any emergent aqautic vegetation.	

5. Conservation significance

5.1 Threatened ecological communities

One TEC was recorded in the site. Apple Box - Blakely's Red Gum moist valley and footslopes grass-forb open forest of the NSW South Western 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. 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. Direct impacts to the CEEC associated the remediation will be restricted to the degraded edge vegetation adjoining the rail line.

5.2 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.

Table 5.1 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 5.1 Threatened flora that have potential to occur at Lake George Mine

Species name	BC Act status	EPBC Act status	Likelihood of occurrence at the site	Level of Impact within remediation areas
Lepidium hyssopifolium	E	E	Possible	Low

Notes: V = vulnerable; E = endangered

5.3 Threatened fauna species

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 C, 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 small number of potential calls from the Anabat detectors targeting the surge bin and central loading tunnel was recorded within a window of time around dusk when microbats are known to emerge from their roost. The eleven calls recorded in these locations over two survey periods in August and November were too short in duration to confirm they were from Southern Myotis (*Myotis macropus*) and as such, the calls were identified to species guild which include *Nyctophilus* spp. which have similar calls. The wooden slats and concrete crevices and drill holes in the Surge bin in addition to the wooden girders and dark crevices in the central loading tunnel would provide potential roosting habitat for the Southern Myotis. The Southern Myotis is known to roost in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (EES 2021b). The adjacent upper sediment dam (~200 metres to the west) and Molonglo River (<500 metres to the east and north) would provide suitable foraging habitat for the species. Cave-roosting bats including the Large Bentwing Bat (*Miniopterus oceanensis*) and Large-eared Pied Bat (*Chalinolobus dwyeri*) were not recorded roosting within the Loading Tunnels or surge bin, despite targeted harp trap, anabat detector and Echometer Touch surveys. 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. An assessment of significance has been prepared for cave-roosting microbats, given the moderate potential for impacts to this guild (see 6.5.3 and Appendix C.

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 m) 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.

The remediation area does not contain any substantial rock outcrops, sandstone escarpment country, beaches, rocky shorelines or marine environments and does not contain any habitat resources for threatened fauna of these environments.

Table 5.2 below identifies threatened fauna species with the potential to occur within the Lake George mine site, noting that the remediation area would only comprise habitat for cave-roosting microbat species and small woodland birds on occasion.

Copper Creek and the Molonglo River are mapped as Key Fish Habitat as part of the Murray Darling Basin South (DPI 2021a) and have historically provided habitat for the Silver Perch and Murray Cod.

Table 5.2 Threatened fauna that have the potential to occur at Lake George Mine

Scientific name	Common name	BC Act status	EPBC Act status	Potential habitat within the site	Likelihood of occurrence at the site	Level of impact within remediation areas
Anthochaera phrygia	Regent Honeyeater	CE	CE	Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct. No breeding habitat present.	Possible	Very low. Removal of mature trees in Box-gum woodland may be required on the edges of remediation areas.
Callocephalon fimbriatum	Gang-gang Cockatoo	V		Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V		Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.
Daphoenositta chrysoptera	Varied Sittella	V		Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.
Grantiella picta	Painted Honeyeater	V	V	Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct. No local records.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.
Ninox connivens	Barking Owl	V		Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas. No potential breeding habitat impacted.
Ninox strenua	Powerful Owl	V		Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas. No potential breeding habitat impacted.

Scientific name	Common name	BC Act status	EPBC Act status	Potential habitat within the site	Likelihood of occurrence at the site	Level of impact within remediation areas
Petroica boodang	Scarlet Robin	V		Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Moderate. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.
Petroica phoenicea	Flame Robin	V		Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No known breeding habitat recorded. Recorded within and also adjacent to remediation areas.	Recorded	Moderate. Removal of a small amount of native woodland comprising known foraging habitat is anticipated on the edges of remediation areas.
Polytelis swainsonii	Superb Parrot	V	V	Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.
Tyto novaehollandiae	Masked Owl	V		Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas. No potential breeding habitat impacted.
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	Moderate. Loading tunnels and other derelict mine structures comprising potential roosting habitat would be removed by the proposal.
Dasyurus maculatus	Spotted-tailed Quoll	V	E	May forage in the site. No breeding habitat is present.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		May forage in the site. No breeding habitat is present.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.
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	Moderate. Loading tunnels and other derelict mine structures comprising potential roosting habitat would be removed by the proposal.

Scientific name	Common name	BC Act status	EPBC Act status	Potential habitat within the site	Likelihood of occurrence at the site	Level of impact within remediation areas
Myptis macropus	Southern Myotis	V		Potential call from surge bin and central loading tunnel where potential roosting habitat is present. Foraging habitat is present within dam within Central Mill Area and Molonglo River	Possible	Moderate. Loading tunnels and other derelict mine structures comprising potential roosting habitat would be removed by the proposal.
Petauroides volans	Greater Glider		V	Broadly suitable but not preferred habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.
Phascolarctos cinereus	Koala	V	V	Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. Low numbers of records in locality.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Broadly suitable habitat in Box-Gum woodland in the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. Low numbers of records in locality.	Possible	Very low. Removal of a small amount of native woodland is anticipated primarily on the edges of remediation areas.

Notes: CE = critically endangered, E= endangered, V= vulnerable.

5.4 Migratory fauna species

No migratory species were recorded during field surveys. A full list of migratory fauna species recorded in the locality or predicted to occur is provided in Appendix A, together with their habitat requirements and likelihood of occurrence.

There is only marginal habitat for migratory waders or wetland birds within the site and wider locality. The Molonglo River upstream of the Captains Flat dam is a substantial water body but is deep and steep sided. The Captains Flat dam impoundment does not contain fringing macrophyte beds, shallow water or mudflats that would comprise important migratory bird habitat.

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*).

Important habitat for migratory birds is defined in the significance criteria for listed migratory species (DoE 2013) as follows:

– Habitat utilised by a migratory species occasionally or periodically within the region that supports an ecologically significant proportion of the population of the species
– Habitat that is of critical importance to the species at particular life-cycle stages
– Habitat utilised by a migratory species which is at the limit of the species range
– Habitat within an area where the species is declining.

Habitat in the remediation area is not important habitat as defined in the significance criteria (DoE 2013) for migratory species as it is highly fragmented and has been subject to substantial disturbance from previous mining activities and would not support an ecologically significant proportion of the population, is not critical to the lifecycle of these species and is not at the limit of these species' range. While these species may occur on occasion, they would not rely on the habitats present for their survival in the locality.

The proposal would not involve the creation of any structures or any substantial gaps in habitat that would increase the risk or energy cost of movement of migratory birds.

6. Potential impacts

6.1 Direct impacts of rehabilitation

6.1.1 Vegetation clearing

By way of background, 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. Therefore, it is not the intention of the Proponent to remove vegetation, rather, to enhance it. Remediation would generally require the neutralisation of contaminated soils with *in situ* lime, and generally, ripping and/or capping with 30 cm thick soil and/or a rock mulch layer. The remediation would occur within denuded areas, as well as transitional zones between contaminated, denuded and also vegetated areas, where the final spatial extent of vegetation clearance for remediation of the underlying soil would be determined in 'real time' for agreement by the Principal to improve the potential for vegetation growth following remediation. Given this approach, a conservative upper estimate of possible, rather than likely, vegetation clearance has been assessed herein. Direct impacts to native vegetation would likely 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 may also be removed.

The area of vegetation within the maximum extent of remediation is shown in Table 6.1, comprising a conservative upper limit of vegetation clearing for the proposal, with the actual extent of vegetation removal is likely to be less than the areas shown in Table 6.1. 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 therefore proposed for remediation. Exotic grassland on the edges of these eroded and denuded areas would require minor vegetation removal for tie in 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%).

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 in prep). 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 (Figure 4.1). Again, this patch of vegetation would be largely retained with only slight disturbance at its edges for tie in to degraded areas proposed for remediation.

A summary of the areas of vegetation types to be removed is provided in Table 6.1. 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.

As shown on Figure 4.1, the remediation area could be accessed via adjoining areas of exotic grassland, cleared land or infrastructure. There is minimal risk of additional impacts to native vegetation and threatened species habitat beyond the remediation areas.

Table 6.1 Vegetation within the remediation area

Vegetation type	Condition	BC Act Status	EPBC Act Status	Maximum Area of Vegetation Removal (ha)
Apple Box - Blakely's Red Gum moist valley and footslopes grass-forb open forest (PCT 283)	Degraded / 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			1.72
Total native vegetation				**5.66**
Exotic grassland	Non-native			24.50

The proposal 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 in Section 7.2 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 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.

6.1.2 Removal of terrestrial fauna habitats

The proposal would remove a very small proportion of foraging resources and shelter and nesting habitat for local populations of native fauna associated with up to 5.66 hectares of degraded native vegetation. The majority of the remediation area is exotic grassland with very little value for native fauna. The removal of some mature trees within the patch of Apple Box - Blakely's Red Gum forest at the Captains Flat Railway Precinct and a small amount of native midstorey vegetation on the edges of bare areas devoid of vegetation is unlikely to comprise an impact to an important habitat resource for local fauna. As noted above, much of the areas to be disturbed for remediation are already highly modified and have lower habitat value for those native fauna species that require more intact vegetation.

The remediation of the Loading Tunnels and surge bin would remove potential roosting habitat for cave-roosting microbats. The northern loading tunnel is partially collapsed and provides low quality habitat for roosting microbats. The central loading tunnel provides good potential habitat for roosting microbats, is still intact, has low light levels and has numerous crevices and gaps for roosting. The central loading tunnel also contains a large number of Fairy Martin nests, which may be used as roosting habitat. Other abandoned mine workings and derelict structures may be used by cave-roosting microbats but would be retained as part of the proposal. No direct evidence of roosting microbats was recorded despite echolocation call recording surveys, harp trapping and dusk monitoring of the central Loading Tunnel, however based on the extent and depth of shelter provided by the tunnels, roosting populations of microbats may be present at other times.

Subterranean roosts are used at different times of the year according to the specific microclimate they can provide for daily, maternity, winter and staging roosts. Disturbance of a roost at critical times can result in the abandonment or death of a high proportion of the colony (Gration 2006). Disturbance of hibernating colonies during winter months is potentially damaging because the loss of energy reserves caused by arousal from torpor can lead to starvation (NPWS 2001). Disturbance of roosting colonies in mines can result from the following activities:

– Non-deliberate closure (e.g. collapse through natural weathering processes)
– Deliberate closure of mines during remediation and rehabilitation or other purposes
– Re-opening of previously collapsed collars or portals so that the mine micro-environment is changed
– Indirect disturbance by visitors (noise, lights etc – especially during torpor)
– Deliberate, direct interference by visitors (by shooting, for example)
– Direct interference (lighting of fires, burning plastic, for example)

– Increased accessibility of predators (snakes, raptors, foxes, cats etc.)
– Above-ground operations which might cause mine collapse or other underground disturbance (e.g. vibrations).

Alternative habitat resources and refuge from remediation and rehabilitation works is available in native vegetation adjoining the site. Mitigation measures recommended in Section 7 would minimise impacts on fauna species.

6.1.3 Injury and mortality

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. The potential injury or mortality of individuals within the very small areas of understorey vegetation to be removed is highly unlikely to affect an ecologically significant proportion of any local populations. More mobile native fauna such as native birds, bats, and arboreal mammals are highly unlikely to be affected by the remediation and rehabilitation activities. The risk of injury is substantially lower than if the proposal included removal of intact native vegetation and mature or hollow-bearing trees that may harbour young or nocturnal fauna.

The removal of the Loading Tunnels and the Surge Bin would injure roosting microbats or lead to mortality if present during the demolition of these structures. 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 microbat populations (if any). Potential indirect impacts on roosting microbat species as a result of remediation and earthworks at Lake George Mine are discussed further in Section 6.2.

Mitigation measures including pre-clearing inspections of the site and measures for the safe management of native fauna are recommended in Section 7.

6.2 Indirect impacts of rehabilitation

6.2.1 Terrestrial impacts

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 works also have 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.

– 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 mitigating the risk of weed infestation.
– 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.

Mitigation measures to reduce the likelihood of these indirect impacts occurring are described in Section 7.

6.2.2 Aquatic impacts

The Molonglo River and Copper Creek are already highly modified and disturbed waterways, subject to substantial levels of contamination from historic mine workings and activities. The aim of the remediation and rehabilitation works is to reduce the amount of exposed contaminated soils present, cap contaminated areas where possible, and thus improve water quality in these creeks.

This creek has been subject to impacts from erosion and sedimentation and leaching of contaminated material associated with historic operation of Lake George Mine. Contaminated runoff currently enters the creek from the rail loading area. Remediation and rehabilitation works would occur adjacent to Copper Creek and should improve water quality in the creek in the future.

The Molonglo River flows to the east and north of Lake George Mine and may be indirectly impacted by the proposal. As discussed above, potential impacts that could cause a decline in aquatic habitat value include alterations to catchment hydrology and reduced water quality through heavy metal contamination and/or through increased sediment inputs. As described in Section 4.1.2, the Molonglo River is already highly contaminated from the existing mine due to collapse of tailings stored in the Southern Dumps. Given the extent of existing modifications to the local catchment the proposal would comprise a minor change to hydrology and would be highly unlikely to further adversely affect any aquatic habitats. The remediation of contaminated material from the Lake George Mine and in the Southern Dumps, is likely to improve water quality in the Molonglo River.

The potential for hydrocarbon contamination or increased nutrient or sediment inputs during rehabilitation works can be avoided or minimised through the implementation of appropriate mitigation measures as outlined in Section 7.

6.3 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 in human disturbance to roosting microbats if present.

Mitigation measures to minimise impacts on the colony are described in Section 7.

6.4 Key threatening processes

A key threatening process (KTP) is defined under the BC Act (DEC 2005) as an action, activity or proposal that:

– Adversely affects two or more threatened species, populations or ecological communities
– Could cause species, populations or ecological communities that are not currently threatened to become threatened.

A number of KTPs are listed under more than one Act. Those potentially relevant to this proposal are listed in Table 6.2 below. Mitigation measures to limit the impacts of these KTPs are discussed in Section 7.2.

Table 6.2 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 (see Section 7.2).
Native vegetation		
Clearing of native vegetation	BC Act	Construction activities may occur on the edges of small patches of fragmented native woodland and forest. The proposal would include the clearing of 5.66 ha within remediation areas. This small area of clearing is highly unlikely to affect the viability of remnant vegetation in the locality or reduce the extent of habitat below a minimum size required for any fauna species. The proposal would include environmental management measures including specific consideration of measures to reduce potential impacts on native vegetation (see Section 7.2).
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 (see Section 7.2).
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 (see section 7.2).
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 (see Section 7.2).
Waterways		
The degradation of native riparian vegetation along NSW water courses	FM Act	Remediation and rehabilitation works could potentially have indirect impacts on riparian vegetation downstream of the site associated with Copper Creek and the Molonglo River through the mobilisation of contaminated waste. Mitigation measures are recommended to limit the potential for adverse impacts on riparian vegetation (see Section 7.2). The aim of the remediation and rehabilitation is to improve soil quality and water quality in the site.
Climate change		
Human-caused climate change	BC Act FM Act EPBC Act	Combustion of fuels associated with construction and operation of the proposal would contribute to anthropogenic emissions of greenhouse gases. The proposal will add to cumulative increases in greenhouse gases, however direct impact on the local environment is likely to be negligible.

6.5 Impacts on threatened and migratory biota

6.5.1 Threatened ecological communities

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 could be impacted. 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 as outlined in Section 7.

An assessment of the likely significance of impacts of the proposed remediation and rehabilitation activities on Box Gum Woodland as listed under the BC Act has been prepared and is presented in Appendix C.

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

– Only 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.

Rehabilitation works are likely to have positive impacts through the removal of contaminants and seeding/encouragement of regeneration after remediation. Mitigation measures are proposed to limit the potential for indirect impacts on Box Gum Woodland vegetation adjacent to the area of impact.

A separate assessment of significance was prepared in accordance with the EPBC Act significant impact guidelines and is presented in Appendix D. 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.

6.5.2 Threatened flora species

No threatened flora species were recorded during the survey. The remediation is mostly limited to previously cleared areas with low degrees of regeneration due to the high level of contamination in the soil. As such it is unlikely that any threatened flora species occur in the areas of disturbance. The proposal would not result in a significant impact on any threatened flora species.

6.5.3 Threatened fauna species

A Flame Robin was recorded at the Old Mill and also off Old Mines Road. The exotic pine forest and patchy eucalypt woodland in the site and intact eucalypt forest in the surrounds would provide breeding and foraging habitat for this species. While both males and females of the species were recorded in close proximity to each other during surveys, a nesting location was unable to be identified. Other woodland birds including the functionally similar Scarlet Robin, are also likely to inhabit these areas.

An assessment of the likely significance of potential impacts on small woodland birds has been prepared and is presented in Appendix C. 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 the species in the locality.

Potential calls from the Southern Myotis were recorded from a Surge bin and Central loading tunnel in the Mill Area. None of the call sequences could be definitely identified to the species due to call duration and quality but some were able to be attributed to Species Guild (SG), which includes Southern Myotis. A call attributed to the *Myotis macropus/Nyctophilus* species group was recorded from the Central loading tunnel approximately 5 or so minutes post sunset in the November survey round, suggesting that the call may have originated from within or in close proximity to the tunnel. It is possible that an individual or a few individuals may be using the tunnel as a temporary diurnal roost, however the call recording data to date (e.g. small number of calls during August and November, and all other November calls occurring at least 30 mins post sunset) and the fact that no bats were captured in harp traps suggests that the tunnel is not used frequently or by a large number of bats.

The Surge Bin and other derelict mine structure which contain potential roosting habitat for Southern Myotis are proposed for removal. The proposal would not remove any waterbodies that would comprise foraging habitat for this species.

The Large-eared Pied Bat and Large Bent-winged Bat were not recorded during surveys but may occupy potential roost sites within derelict mine infrastructure. The proposal would remove potential roost habitat for these species within the loading tunnels and concentrate bins.

There is the potential for direct injury or mortality of cave-roosting microbats, if present within the loading tunnels and concentrate bins and the Surge Bin during demolition. The remediation and rehabilitation work have the potential to indirectly disturb microbats if roosting within the derelict mine structures. Disturbance of a roost at critical times can result in the abandonment or death of a high proportion of the colony (Gration 2006). Additional disturbance of a roosting colony could occur as a result of indirect noise disturbance by adjacent excavation plant and machinery which would be used to remediate adjoining areas. 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). Impact mitigation measures, such as conducting works outside of the breeding season for these species would reduce the chance of an adverse effect.

An assessment of the likely significance of potential impacts on cave-roosting microbats has been prepared and is presented in Appendix C. 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 (see Section 4.3.3) or be impacted by the proposal(see Section 6.2.2).

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.

7. Mitigation and management measures

7.1 Introduction

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 1.1) 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 7.1). 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.

7.2 Mitigation measures

The proposal would affect a small area of native vegetation comprising areas of a TEC, and potential habitat for threatened flora and fauna species. In order to minimise the potential impacts of the proposal on biodiversity, the mitigation measures outlined in Table 7.1 are recommended.

Table 7.1 Recommended mitigation measures

Impact	Mitigation
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.
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 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.

Impact	Mitigation
	– 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 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.
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.
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.

8. Conclusion

The Lake George Mine has been subject to significant levels of contamination as a result of its mining history. Open heap roasting of ore, pyritic smelting and the dumping of mining waste has led to the release of sulfur into the atmosphere killing most of the surrounding vegetation and contamination of the soils and the Molonglo River. Most of the vegetation within Lake George Mine is pine forest, exotic grassland or small patches of poorly regenerating native vegetation.

The proposal would involve the remediation of contaminated soils through in-situ lime infiltration either superficially or blended into the overlying material to reduce the risk of airborne dust, erosion, and contaminated runoff generated from the continued oxidation of sulfidic mineral waste. Some contaminated material would also be excavated and dumped into a containment cell within the Northern Dumps. Remediation areas would be re-seeded with local vegetation to rehabilitate the area with the exception of the Central Mill Area which would be rock-mulched. Derelict mining structures including the Surge Bin and the Loading Tunnel would also be removed as part of the remediation process. The overall remedial strategy for the Captains Flat Capping Project would improve the condition of the contaminated areas on site such that they sustain native vegetation, whilst retaining the mining heritage feel of the site.

Remediation works may impact a small area of Box Gum Woodland, which is listed as a critically endangered ecological community under the BC Act and EPBC Act. Direct impacts are likely to be minimal and would be restricted about 0.36 hectares of degraded vegetation immediately adjacent to the Captains Flat Rail Line. Vegetation condition should improve in the future as a result of the removal of the contaminated soil. The proposal would not have a significant impact on the local or regional occurrence of the community.

Flame Robins were recorded in the Old Mill area and off Old mines Road. The species is known to forage and may also breed within or adjacent to the mine site. The proposal would result in the direct removal of pine forest and patch eucalypt woodland which provide habitat for this species and other small woodland birds. An assessment of significance for small woodland birds concluded there was unlikely to be a significant impact due to the small amount of vegetation removal and the amount of alternate and better quality habitat which would be retained in the locality.

Potential calls from the threatened Southern Myotis were recorded at the Surge bin and central loading tunnel. The Large-eared Pied Bat and Large Bent-winged Bat were not recorded during surveys but may occupy potential roost sites within derelict mine infrastructure. The proposal would result in direct and indirect impacts on these threatened cave-roosting microbat species if present within derelict mine Structures at the site. Impact mitigation, such as conducting works outside of the breeding season for these species would reduce the chance of an adverse effect.

Direct impacts on habitat for most other threatened fauna species are likely to be minimal. Up to 5.66 hectares of native vegetation communities would be removed as part of these works. Native vegetation removal would be restricted to the edges of degraded patches of vegetation adjoining exotic grassland and bare ground where contamination levels are likely to be high. The risk of injury and mortality of threatened species is very low, given the small area and quality of habitat that is likely to be removed.

No threatened flora species were recorded during surveys; given the level of disturbance and contamination on the site, it is unlikely that any threatened flora species would occur in the remediation area.

The proposal is unlikely to result in a significant impact on any threatened biota listed under the BC Act or EPBC Act. No threatened biota listed under the FM Act are likely to occur or be impacted by the proposal. A species impact statement is not required for threatened biota listed under the BC Act. The proposal would not require further assessment or approval under the EPBC Act. These conclusions should be re-assessed following supplementary microbat surveys and consideration of the presence of local populations of threatened cave-roosting microbat species and usage of potential roost sites in derelict mine structures.

A CEMP would be required for the remediation and rehabilitation works. In particular, this would include mitigation measures to minimise potential for indirect impacts to Box-gum Woodland, downstream aquatic habitat and potential colonies of roosting microbats.

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Appendix A

Likelihood of occurrence assessment

Likelihood of occurrence of threatened flora species known or predicted to occur in the locality

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Baloskion longipes	Dense Cord-rush	V	V	Species or species' habitat known to occur within 10 km (DoE 2021a)	Occurs in small populations between the Kanangra-Boyd area to the Southern Tablelands. Commonly found in swamps or depressions in sandy alluvium, sometimes growing with sphagnum moss. It also occurs in swales within tall forest, and in *Eucalyptus aggregata* woodland.	Nil. Suitable habitat not present onsite.	Nil.
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Species or species' habitat likely to occur within 10 km (DoE 2021a)	Occurs from Central Coast NSW to southern Victoria. Mostly coastal but extends inland to Braidwood in southern NSW. In NSW grows in grassy dry sclerophyll woodland on clay loam or sandy soils, and less commonly in heathland on sandy loam soils. Flowers between September and November.	Nil. Suitable habitat not present onsite.	Nil.
Calotis glandulosa	Mauve Burr-daisy	V	V	Species or species habitat known to occur within 10 km (DoE 2021a)	The distribution of the Mauve Burr-daisy is centred on the Monaro and Kosciuszko regions. There are three known sites in the upper Shoalhaven catchment. There are old and possibly dubious records from near Oberon, the Dubbo area and Mt Imlay. Found in montane and subalpine grasslands in the Australian Alps. Found in subalpine grassland (dominated by Poa spp.), and montane or natural temperate grassland dominated by Kangaroo Grass (*Themeda australis*) and Snow Gum (*Eucalyptus pauciflora*) Woodlands on the Monaro and Shoalhaven area.	Nil. Suitable habitat not present onsite.	Nil.
Commersonia prostrata	Dwarf Kerrawang	E	E	Species or species habitat likely to occur within 10 km (DoE 2021a)	In NSW occurs as individual plants at Penrose State Forest and Tallong with populations at Rowes Lagoon near the Corang and the Thirlmere lakes area, and at the Tomago sand beds near Newcastle. Grows on sandy, sometimes peaty soils in a variety of habitats.	Nil. Suitable habitat not present onsite.	Nil.
Diuris aequalis	Buttercup Doubletail	E	E	Species or species habitat likely to occur within 10 km (DoE 2021a)	Occurs in higher areas of the tablelands between Braidwood and Kanangra-Boyd NP. Grows in forest, low open woodland with grassy understorey and secondary grassland on the higher parts of the Southern and Central Tablelands. Recorded from gravelly clay-loam soils, often on gentle slopes.	Nil. Suitable habitat not present onsite.	Nil.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Diuris ochroma	Pale Golden Moths	E	V	Species or species habitat may occur within 10 km (DoE 2021a)	Restricted to a single population in the Kybeyan area, Monaro Tableland. The population occupies about 6 ha of freehold pasture and adjacent road easement at an elevation of 975-1000 metres above sea level. The habitat comprises grassland and open woodland with few remaining trees on brown loam over shale.	Nil. Suitable habitat not present onsite.	Nil.
Dodonaea procumbens	Trailing Hop-bush	V	V	Species or species' habitat likely to occur within 10 km (DoE 2021a)	Creeping Hop-bush is found in the dry areas of the Monaro, between Michelago and Dalgety. Here it occurs mostly in Natural Temperate Grassland or Snow Gum Eucalyptus pauciflora Woodland. Grows in open bare patches where there is little competition from other species. Found on sandy-clay soils, usually on or near vertically-tilted shale outcrops.	Nil. Suitable habitat not present onsite.	Nil.
Eucalyptus aggregata	Black Gum	V	V	24 records within 10 km (EES 2021a), Species or species' habitat known to occur within 10 km (DoE 2021a)	Occurs on the central and southern tablelands of NSW, and in a small disjunct population in Victoria. In NSW it occurs in the South Eastern Highlands Bioregion and on the western fringe of the Sydney Basin Bioregion. Black Gum grows in the lowest parts of the landscape, on grassy woodlands on alluvial soils in moist sites along creeks on broad, cold and poorly-drained flats and hollows. Commonly occurs with Candlebark, Ribbon Gum, and White Sally with a grassy understorey of Tussock. Also occurs as isolated paddock trees in modified native, exotic pastures or travelling stock reserves.	Nil. Suitable habitat not present onsite.	Nil.
Lepidium hyssopifolium	Basalt Pepper-cress	E	E	Species or species' habitat likely to occur within 10 km (DoE 2021a)	Currently known near Bathurst and Bungendore, with historic records near Armidale. Grows on light to heavy, often friable clay loams, often in highly modified environments amongst exotic pasture grasses and weeds. Requires bare ground to establish.	Possible. Areas of exotic grassland and disturbed bare ground may provide habitat, however the soil on site is highly contaminated and mostly void of vegetation.	Low.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Leucochrysum albicans var. tricolor	Hoary Sunray		E	Two records within 10 km, last recorded 2008 (EES 2021a), Species or species' habitat known to occur within 10 km (DoE 2021a)	In NSW it currently occurs on the Southern Tablelands adjacent areas in an area roughly bounded by Albury, Bega and Goulburn, with a few scattered localities know from beyond this region. Occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. The species is highly dependent on the presence of bare ground for germination and can occur in modified habitats such as semi-urban areas and roadsides.	Unlikely. Small area of degraded woodland in areas mapped as PCT 282 and PCT 730 is unlikely contain this threatened flora species given the history of disturbance	Low.
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	Species or species' habitat likely to occur within 10 km (DoE 2021a)	Disjunct distribution including the Nungatta area, Tumut, the Tantawangalo area, near Tallong, the Yerranderie area, the Canyonleigh area and Ettrema Gorge. Found in wide range of habitats, including forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs.	Nil. Suitable habitat not present onsite.	Nil.
Pomaderris pallida	Pale Pomaderris	V	V	Species or species' habitat known to occur within 10 km (DoE 2021a)	Currently only recorded from near Kydra Trig, Tinderry Nature Reserve, the Queanbeyan River, the Shoalhaven River (between Bungonia and Warri), the Murrumbidgee River west of the ACT and the Byadbo area in Kosciuszko NP. This species usually grows in shrub communities surrounded by Brittle Gum (*Eucalyptus mannifera*) and Red Stringybark (*E. macrorhyncha*) or *Callitris* spp. woodland, or in open forest.	Nil. Suitable habitat not present onsite.	Nil.
Prasophyllum petilum	Tarengo Leek Orchid	E	E	Species or species' habitat known to occur within 10 km (DoE 2021a)	Occurs at 4 sites in NSW (Captains Flat Cemetery, Ilford Cemetery, Steves TSR at Delegate and Tarengo TSR near Boorowa). Also at Hall in ACT. Grows on relatively fertile soils in grassy woodland or natural grassland. Occurs in relatively moist, poorly drained areas.	Nil. Suitable habitat not present onsite.	Nil.
Rhizanthella slateri	Eastern Underground Orchid	V	E	Species or species habitat may occur within 10 km (DoE 2021a)	Currently known only from 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The species grows in eucalypt forest but no informative assessment of the likely preferred habitat for the species is available. Flowers September and November.	Unlikely. Small area of degraded woodland in areas mapped as PCT 282 and PCT 730 is unlikely contain this threatened flora species given the history of disturbance	Low.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Rutidosis leptorrhynchoides	Button Wrinklewort	E	E	Species or species' habitat known to occur within 10 km (DoE 2021a)	Local populations at Goulburn, the Canberra – Queanbeyan area and at Michelago. Occurs in Box-Gum Woodland, secondary grassland derived from Box-Gum Woodland or in Natural Temperate Grassland; and often in the ecotone between the two communities.	Unlikely. Small area of degraded woodland in areas mapped as PCT 282 and PCT 730 is unlikely contain this threatened flora species given the history of disturbance	Low.
Senecio macrocarpus	Large-fruit Fireweed		V	Species or species habitat likely to occur within 10 km (DoE 2021a)	Found in woodland, grassland, and sedgeland. Tablelands east and north of the ACT. Flowers Aug.–Oct.	Unlikely. Small area of degraded woodland in areas mapped as PCT 282 and PCT 730 is unlikely contain this threatened flora species given the history of disturbance	Low.
Swainsona recta	Small Purple-pea	E	E	Species or species' habitat known to occur within 10 km (DoE 2021a)	Current populations exist in the Queanbeyan and Wellington-Mudgee areas, previous populations thought extinct include Carcoar, Culcairn and Wagga Wagga. Also known from ACT and Victoria. Inhabits grassy woodlands and open-forests dominated by Blakely's Red Gum, Yellow Bloodwood, Candlebark and Long-leaved Box and in association with understorey dominants that include *Themeda australis*, *Poa* spp. and *Austrostipa* spp. Flowers throughout spring, with a peak in October.	Unlikely. Small area of degraded woodland in areas mapped as PCT 282 and PCT 730 is unlikely contain this threatened flora species given the history of disturbance	Low.
Thesium australe	Austral Toadflax	V	V	Species or species' habitat known to occur within 10 km (DoE 2021a)	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.	Unlikely. Small area of degraded woodland in areas mapped as PCT 282 and PCT 730 is unlikely contain this threatened flora species given the history of disturbance	Low.
Xerochrysum palustre	Swamp Everlasting		V	Species or species habitat likely to occur within 10 km (DoE 2021a)	Found in Kosciuszko National Park and the eastern escarpment south of Badja. Grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils.	Nil. Suitable habitat not present onsite.	Nil.

Notes: CE= critically endangered, E= endangered, V= vulnerable

Likelihood of occurrence of threatened fauna species known or predicted to occur in the locality

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Birds							
Anthochaera phrygia	Regent Honeyeater	CE	CE	Species or species' habitat known to occur within 10 km (DoE 2021a)	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct. No breeding habitat present.	Very low. Removal of only up to two trees in Box-gum woodland is anticipated on the edges of remediation areas.
Artamus cyanopterus	Dusky Woodswallow	V		3 records within 10 km, last recorded 2004 (EES 2021a)	The Dusky Woodswallow is widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. The nest is an open shallow untidy cup frequently built in an open hollow, crevice or stump. Although Dusky Woodswallows have large home ranges, individuals may spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Dusky Woodswallows prefer larger remnants over smaller remnants. Competitive	Unlikely. No large remnants of habitat preferred by this species are present in the site.	Nil.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
					exclusion by Noisy Miners (*Manorina melanocephala*) is a significant threat to this species.		
Botaurus poiciloptilus	Australasian Bittern	E	E	Species or species' habitat known to occur within 10 km (DoE 2021a)	Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west. The species favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.), it hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. The species may construct feeding platforms over deeper water from reeds trampled by the bird; platforms are often littered with prey remains.	Unlikely. No suitable habitat present. No dense tall aquatic vegetation is present in the dam in the Mill Area.	Nil.
Callocephalon fimbriatum	Gang-gang Cockatoo	V		22 records within 10 km (EES 2021a)	In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee. In spring and summer the species is generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas.	Likely. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present. Bionet record adjacent to site.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V		6 records within 10 km, last recorded 2008 (EES 2021a)	The western boundary of the range of the Brown Treecreeper runs approximately through Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell and along this line the subspecies intergrades with the arid zone subspecies of Brown Treecreeper which then occupies the remaining parts of the state. The species is often found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.
Daphoenositta chrysoptera	Varied Sittella	V		3 records within 10 km, last recorded 2008 (EES 2021a)	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The species inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.
Falco hypoleucos	Grey Falcon	E	V	Species or species' habitat likely to occur within 10 km (DoE 2021a)	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The species is usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. It also occurs near wetlands where surface water attracts prey.	Unlikely. Broadly suitable habitat but not known from the locality.	Nil.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Grantiella picta	Painted Honeyeater	V	V	Species or species' habitat known to occur within 10 km (DoE 2021a)	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. The species inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests. It is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct. No local records.	Very low. Removal of only up to two trees in Box-gum woodland is anticipated in remediation areas
Lathamus discolor	Swift Parrot	E	CE	Species or species' habitat known to occur within 10 km (DoE 2021a)	The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. On the mainland the species occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Their favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta)*, Spotted Gum (*Corymbia maculate*), Red Bloodwood (*C. gummifera*), Forest Red Gum (*E. tereticornis*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*).	Unlikely. Favoured food trees absent from remediation areas.	Nil.
Ninox connivens	Barking Owl	V		1 record within 10 km, last recorded 2004 (EES 2021a)	The Barking Owl is found throughout continental Australia except for the central arid regions. The owls sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. Extensive wildfires in 2019-20 reduced habitat quality further, burnt many old, hollow-bearing trees needed as refuge by prey species and reduced the viability of some regional owl populations. The species inhabit woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
					cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils. The species typically roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as *Acacia* and *Casuarina* species.		
Ninox strenua	Powerful Owl	V		7 records within 10 km (EES 2021a)	The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine (*Syncarpia glomulifera*), Black She-oak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angophora floribunda*), Cherry Ballart (*Exocarpus cupressiformis)* and a number of eucalypt species.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Pachycephala olivacea	Olive Whistler	V		5 records within 10 km (EES 2021a)	The Olive Whistler inhabits the wet forests on the ranges of the east coast. It has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to Victoria. In the south it is found inland to the Snowy Mountains and the Brindabella Range. The species mostly inhabit wet forests above about 500 m. During the winter months they may move to lower altitudes.	Unlikely. Suitable habitat is not present.	Nil.
Petroica boodang	Scarlet Robin	V		11 records within 10 km (EES 2021a)	In NSW, the Scarlet Robin from the coast to the inland slopes. After breeding, some Scarlet Robins disperse to the lower valleys and plains of the tablelands and slopes. Some birds may appear as far west as the eastern edges of the inland plains in autumn and winter. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. The species habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Moderate. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.
Petroica phoenicea	Flame Robin	V		6 records within 10 km, last recorded 2009 (EES 2021a)	In NSW, the Flame Robin breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. The species breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes, it prefers clearings or areas with open understoreys.	Recorded. Broadly suitable habitat in Box-Gum woodland at the 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.	Moderate. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Petroica rodinogaster	Pink Robin	V		1 record within 10 km, last recorded 2010 (EES 2021a)	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. The species inhabit rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies.	Unlikely. Suitable habitat is not present.	Nil.
Polytelis swainsonii	Superb Parrot	V	V	Species or species' habitat known to occur within 10 km (DoE 2021a)	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. The species inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.
Rostratula australis	Australian Painted-snipe	E	E	Species or species' habitat likely to occur within 10 km (DoE 2021a)	In NSW many records of the Australian Painted Snipe are from the Murray-Darling Basin including the Paroo wetlands, Lake Cowal, Macquarie Marshes, Fivebough Swamp and more recently, swamps near Balldale and Wanganella. Other important locations with recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. The species prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Unlikely. No suitable habitat present. No dense tall aquatic vegetation is present in the dam in the Mill Area.	Nil.

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Tyto novaehollandiae	Masked Owl	V		1 record within 10 km (EES 2021a)	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. Lives in dry eucalypt forests and woodlands from sea level to 1100 m and often hunts along the edges of forests, including roadsides. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. No breeding habitat present.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.
Tyto tenebricosa	Sooty Owl	V		3 records within 10 km (EES 2021a)	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Found in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roost by day in the hollow of a tall forest tree or in heavy vegetation and nest in very large tree hollows.	Unlikely. Suitable habitat is not present.	Nil.
Fish							
Bidyanus bidyanus	Silver Perch		CE	Translocated population known to occur within 10 km (DoE 2021a)	In NSW now absent from much of their former range across the Murray-Darling. Most abundant remaining natural population occurs in the central Murray River downstream of Yarrawonga Weir as well as several of its anabranches and tributaries including the Edward River – an anabranch of the Murray River that flows through Deniliquin, and the Murrumbidgee River. Prefer fast-flowing, open waters, especially where there are rapids and races, however they will also inhabit warm, sluggish water with cover provided by large woody debris and reeds. Information on habitat preferences is scarce for this species.	Nil. Historically known from the Molonglo River. Recent catches in the Molonglo River Fish due to stocking from Googong Dam. Molonglo River does not form part of its known or indicative distribution (DPI 2021).	Nil. Remediation of the mine will further reduce contamination into the Molonglo River.
Maccullochella macquariensis	Trout Cod		E	Species or species habitat may occur within 10 km (DoE 2021a)	The Trout Cod is endemic to the Murray-Darling Basin (MDB). Once widespread in the southern tributaries of the MDB, Trout Cod have declined dramatically in both abundance and distribution and are now known only from scattered localities. The last remaining natural populations in the wild are in the Murray River between Yarrawonga, Barmah and Seven Creeks. The species occurs in a range of habitats but is strongly associated with the presence of woody debris and snags.	Nil. Molonglo River does not form part of its known or indicative distribution (DPI 2021).	Nil. Remediation of the mine will further reduce contamination into the Molonglo River.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Maccullochella peelii	Murray Cod	V (FM Act)	V	Species or species' habitat may occur within 10 km (DoE 2021a)	The Murray Cod is endemic to river systems of the Murray–Darling Basin in south-eastern Australia, including South Australia, Victoria, New South Wales, the Australian Capital Territory and Queensland. Once widespread throughout the Murray-Darling system, the Murray Cod is now uncommon in much of its range and is more restricted to the lower Murray-Darling. Murray Cod live in a variety of habitats ranging from clear, rocky streams to slow flowing turbid rivers, lakes and billabongs and are more common in waterways with large rocks, snags and undercut banks with overhanging vegetation.	Nil. Historically known from the Molonglo River. Recent catches in the Molonglo River Fish due to stocking from Googong Dam. Molonglo River does not form part of its known or indicative distribution (DPI 2021).	Nil. Remediation of the mine will further reduce contamination into the Molonglo River.
Macquaria australasica	Macquarie Perch	E (FM Act)	E	Species or species' habitat may occur within 10 km (DoE 2021a)	The Macquarie Perch is known only from scattered localities in the cool upper reaches of the Murray-Darling system of New South Wales, including the Hawkesbury-Nepean and Shoalhaven catchments, Victoria and the Australian Capital Territory. Also found in man-made lakes on the NSW coast. The species inhabits cool, clear freshwaters of rivers with deep holes and shallow riffles. They are also found in lakes and reservoirs, where adults aggregate in small shoals during the spawning season.	Nil. Molonglo River does not form part of its known or indicative distribution (DPI 2021).	Nil. Remediation of the mine will further reduce contamination into the Molonglo River.
Prototroctes maraena	Australian Grayling		V	Species or species' habitat may occur within 10 km (DoE 2021a)	The Australian Grayling occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The species is found in fresh and brackish waters of coastal lagoons, from Shoalhaven River in NSW to Ewan Ponds in South Australia	Nil. Molonglo River does not form part of its known or indicative distribution (DPI 2021).	Nil. Remediation of the mine will further reduce contamination into the Molonglo River.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Frogs							
Heleioporus australiacus	Giant Burrowing Frog	V	V	Species or species' habitat known to occur within 10 km (DoE 2021a)	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. It is found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	Unlikely. No suitable sandstone habitat present.	Nil.
Litoria aurea	Green and Golden Bell Frog	E	V	Species or species' habitat known to occur within 10 km (DoE 2021a)	Since 1990 there have been approximately 50 recorded locations of Green and Golden Bell Frog in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. The species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimal habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. At some sites the species has been recorded in, occur in highly disturbed areas.	Unlikely. Only marginal quality habitat present noting absence of aquatic vegetation in the dam in the Mill Area. Extant population is known from adjacent Captains Flat (BES 2008), however location remains confidential and not listed in Bionet records. Individuals (if present at Captains Flat) are unlikely to move through work area.	Nil.

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Litoria castanea	Yellow-spotted Tree Frog	CE	CE	Species or species habitat likely to occur within 10 km (DoE 2021a)	There is a single known population of Yellow-spotted Tree Frog on the Southern Tablelands, near Yass. The species require large permanent ponds or slow flowing 'chain-of-ponds' streams with abundant emergent vegetation such as bulrushes and aquatic vegetation.	Unlikely. No suitable habitat present. No dense tall aquatic vegetation is present in the dam in the Mill Area.	Nil.
Litoria raniformis	Southern Bell Frog	E	V	Species or species' habitat may occur within 10 km (DoE 2021a)	Currently, the Growling Grass Frog is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. A few yet unconfirmed records have also been made in the Murray Irrigation Area in recent years. The species is usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat. Breeding occurs during the warmer months and is triggered by flooding or a significant rise in water levels. The species has been known to breed anytime from early spring through to late summer/early autumn	Unlikely. No suitable habitat present. No dense tall aquatic vegetation is present in the dam in the Mill Area.	Nil.
Insects							
Synemon plana	Golden Sun Moth	E	CE	Species or species habitat known to occur within 10 km (DoE 2021a)	The Golden Sun Moth's NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. The species' historical distribution extended from Bathurst (central NSW) through the NSW Southern Tablelands, through to central and western Victoria, to Bordertown in eastern South Australia. The species occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses *Austrodanthonia* spp.	Unlikely. Box Gum Woodland at Captains Flat does not have the preferred Austrodanthonia spp.-dominated understorey.	Nil.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Mammals							
Cercartetus nanus	Eastern Pygmy-possum	V		2 records within 10 km, last recorded 2003 (EES 2021a)	The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extents from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. The species is found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. It feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes and is an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable.	Unlikely. Box Gum Woodland at Captains Flat does not contain heath or an abundance of myrtaceous shrubs or trees. No breeding habitat present.	Nil.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Species or species' habitat likely to occur within 10 km (DoE 2021a)	The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. The species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. It is found in well-timbered areas containing gullies.	Possible. May breed in Fairy Martin mud nests and within derelict loading tunnels on occasion. Limited foraging habitat is present.	Moderate. Loading tunnels and other derelict mine structures comprising potential roosting habitat would be removed.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Dasyurus maculatus	Spotted-tailed Quoll	V	E	13 records within 10 km (EES 2021a), Species or species' habitat known to occur within 10 km (DoE 2021a)	The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. Only in Tasmania is it still considered relatively common. The species has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges of 200-500 ha, while males occupy very large home ranges from 500 to over 4000 ha. Are known to traverse their home ranges along densely vegetated creeklines.	Possible. May forage in the site. No breeding habitat is present.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		7 records within 10 km, last recorded 2004 (EES 2021a)	The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. The species prefer moist habitats, with trees taller than 20 m.	Possible. May forage in the site. No breeding habitat is present.	Very low. Removal of a small amount of native woodland, and no hollow-bearing trees, is anticipated on the edges of remediation areas.
Miniopterus australis	Little Bentwing-bat	V	-	Not recorded during database searches	Occurs along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Prefers moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day. Forages for small insects beneath the canopy of densely vegetated habitats.	Unlikely. Remediation areas occur outside the known distribution for the species.	Nil.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Miniopterus orianae oceanensis	Large Bentwing-bat	V	-	Not recorded during database searches	Occurs along the east and north-west coasts of Australia. Uses caves as the primary roosting habitat, but also uses derelict mines, storm-water tunnels, buildings and other man-made structures. Hunts in forested areas, catching moths and other flying insects above the tree tops.	Possible. Potential roosting habitat is present within surge bins and loading tunnels. Foraging habitat is present within timbered and grassland areas throughout the site. The species is likely to roost within derelict mine structures in the region.	Moderate. Loading tunnels and other derelict mine structures comprising potential roosting habitat would be removed.
Myptis macropus	Southern Myotis	V		Not recorded during database searches	The Southern Myotis is mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water.	Possible. Potential call from surge bin where potential roosting habitat is present. Foraging habitat is present within dam within Central Mill area and Molonglo River	Moderate. Loading tunnels and other derelict mine structures comprising potential roosting habitat would be removed.
Petauroides volans	Greater Glider		V	179 records within 10 km (EES 2021a), Species or species' habitat known to occur within 10 km (DoE 2021a)	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Possible. Broadly suitable but not preferred habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint-Mountain Gum forest in Central Mine Area. No breeding habitat present.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Petaurus australis	Yellow-bellied Glider	V		1 record within 10 km (EES 2021a)	The Yellow-bellied Glider is found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. The species occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Vegetation preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	Unlikely. Tall mature forest is absent in the remediation area.	Nil.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Species or species' habitat likely to occur within 10 km (DoE 2021a)	In NSW the Brush-tailed Rock-wallaby occurs from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. The species occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. It typically shelters or basks during the day in rock crevices, caves and overhangs and are most active at night when foraging.	Nil. No suitable habitat present.	Nil.
Phascolarctos cinereus	Koala	V	V	1 record within 10 km (EES 2021a), Species or species' habitat known to occur within 10 km (DoE 2021a)	The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In New South Wales, koala populations are found on the central and north coasts, southern highlands, southern and northern tablelands, Blue Mountains, southern coastal forests, with some smaller populations on the plains west of the Great Dividing Range. The species inhabit eucalypt woodlands and forests, and feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. Low numbers of records in locality.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.

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Potorous tridactylus	Long-nosed Potoroo (SE Mainland)	V	V	Species or species habitat may occur within 10 km (DoE 2021a)	The long-nosed potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm. It inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature.	Nil. No suitable habitat present.	Nil.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	1 record within 10 km (EES 2021a), Foraging, feeding or related behaviour known to occur within 10 km (DoE 2021a)	Grey-headed Flying-foxes are generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. The species occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	Possible. Broadly suitable habitat in Box-Gum woodland at the Captains Flat Railway Precinct and Broad-leaved Peppermint- Mountain Gum forest in Central Mine Area. Low numbers of records in locality.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas.

Scientific Name	Common Name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Reptiles							
Aprasia parapulchella	Pink-tailed Worm-lizard	V	V	Species or species' habitat known to occur within 10 km (DoE 2021a)	The Pink-tailed Legless Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. There is a concentration of populations in the Canberra/Queanbeyan Region. Other populations have been recorded near Cooma, Yass, Bathurst, Albury and West Wyalong. This species is also found in the Australian Capital Territory. It's found to inhabit sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (Themeda australis), The sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. They are commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small black ants and termites.	Unlikely. Not known to occur in the area. Closest records known from Googong near Queanbeyan. There are no native grassy groundlayers preferred by this species within woodland at the site. Not recorded despite targeted surveys under partially buried rocks.	Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas. Disturbance of some partially embedded rock may occur as a result of the proposal.
Delma impar	Striped Legless Lizard	V	V	Species or species' habitat likely to occur within 10 km (DoE 2021a)	The Striped Legless Lizard occurs in the Southern Tablelands, the South West Slopes, the Upper Hunter and possibly on the Riverina. Populations are known in the Goulburn, Yass, Queanbeyan, Cooma, Muswellbrook and Tumut areas. Individuals are found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. they are also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland.	Unlikely. Not known to occur in the area. Native grassy groundlayers preferred by this species is absent within open woodland and grassy areas. Not recorded despite targeted surveys under partially buried rocks.	Very low. Very low. Removal of a small amount of native woodland is anticipated on the edges of remediation areas. Disturbance of some partially embedded rock may occur as a result of the proposal.

Notes: CE= critically endangered, E= endangered, V= vulnerable

Likelihood of occurrence of migratory species known or predicted to occur in the locality

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Actitis hypoleucos	Common Sandpiper			Species or species habitat may occur within 10 km (DoE 2021a)	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	Nil. No suitable habitat is present.	Nil
Apus pacificus	Fork-tailed Swift			Species or species habitat known to occur within 10 km (DoE 2021a)	The Fork-tailed Swift is almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. The sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines.	Possible. May forage above the remediation areas on occasion.	Very low.
Calidris acuminata	Sharp-tailed Sandpiper			Species or species habitat may occur within 10 km (DoE 2021a)	Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia.	Nil. No suitable habitat is present.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Calidris ferruginea	Curlew Sandpiper	CE	CE,C,J,K	Species or species' habitat may occur within 10 km (DoE 2021a)	The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration. The Curlew Sandpiper breeds in Siberia and migrates to Australia (as well as Africa and Asia) for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April. It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed.	Nil. No suitable habitat is present.	Nil
Calidris melanotos	Pectoral Sandpiper			Species or species habitat may occur within 10 km (DoE 2021a)	Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire.	Nil. No suitable habitat is present.	Nil
Gallinago hardwickii	Latham's Snipe			Species or species habitat likely to occur within 10 km (DoE 2021a)	Latham's Snipe is a non-breeding migrant to the south east of Australia including Tasmania, passing through the north and New Guinea on passage. Latham's Snipe breed in Japan and on the east Asian mainland. Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.	Nil. No suitable habitat is present.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Hirundapus caudacutus	White-throated Needletail		V,C,J,K	1 record within 10 km, last 24innamom 2004 (EES 2021a), Species or species' habitat known to occur within 10 km (DoE 2021a)	White-throated Needletails often occur in large numbers over eastern and northern Australia. White-throated Needletails are aerial birds and for a time it was commonly believed that they did not land while in Australia. It has now been observed that birds will roost in trees, and radio-tracking has since confirmed that this is a regular activity.	Possible. May forage above the remediation areas on occasion.	Very low.
Monarcha melanopsis	Black-faced Monarch			Species or species' habitat known to occur within 10 km (DoE 2021a)	The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. It is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Possible. May forage on the edges of fragmented woodland during migration.	Very low.
Motacilla flava	Yellow Wagtail		C,J,K	Species or species' habitat may occur within 10 km (DoE 2021a)	The Yellow Wagtail breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	Possible. May forage in exotic grassland on occasion.	Very low.
Numenius madagascariensis	Eastern Curlew		CE,C,J,K	Species or species' habitat may occur within 10 km (DoE 2021a)	The Eastern Curlew is widespread in coastal regions in the north-east and south of Australia, including Tasmania, and scattered in other coastal areas. It is rarely seen inland. It breeds in Russia and north-eastern China. On passage, they are commonly seen in Japan, Korea and Borneo. Small numbers visit New Zealand. The Eastern Curlew is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons.	Nil. No suitable habitat is present.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Likelihood of occurrence in remediation areas	Potential for impact
Pandion haliaetus	Osprey			Species or species habitat may occur within 10 km (DoE 2021a)	Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. The species favour coastal areas, especially the mouths of large rivers, lagoons and lakes. The species breeds in NSW from July to September.	Unlikely. However broadly suitable habitat is present adjacent to the Molonglo River.	Very low.
Rhipidura rufifrons	Rufous Fantail			Species or species' habitat known to occur within 10 km (DoE 2021a)	The Rufous Fantail is found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas.	Possible. May forage on the edges of fragmented woodland during migration.	Very low.

Notes: CE= critically endangered, E= endangered, V= vulnerable, C= listed under the Chinese-Australia Migratory Bird Agreement, J= listed under the Japan-Australia Migratory Bird Agreement, K= listed under the Korea-Australia Migratory Bird Agreement

Appendix B

Field survey results

Flora species recorded at the site

Family	Scientific name	Common name	Exotic	Growth form
Asteraceae	*Cirsium vulgare*	Spear Thistle	*	EX
Asteraceae	*Conyza sumatrensis*	Tall fleabane	*	EX
Asteraceae	*Gamochaeta calviceps*	Cudweed	*	EX
Buddlejaceae	*Buddleja davidii*	Buddleja	*	EX
Caryophyllaceae	*Cerastium glomeratum*	Mouse-ear Chickweed	*	EX
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush		FG
Fabaceae (Faboideae)	*Trifolium arvense*	Haresfoot Clover	*	EX
Fabaceae (Faboideae)	*Vicia sativa*	Common vetch	*	EX
Fabaceae (Faboideae)	*Viminaria juncea*	Native Broom		SG
Fabaceae (Mimosoideae)	*Acacia baileyana*	Cootamundra Wattle		SG
Fabaceae (Mimosoideae)	*Acacia decurrens*	Black Wattle		TG
Fabaceae (Mimosoideae)	*Acacia falciformis*	Broad-leaved Hickory		SG
Fabaceae (Mimosoideae)	*Acacia longifolia*	0		SG
Fabaceae (Mimosoideae)	*Acacia mearnsii*	Black Wattle		SG
Fabaceae (Mimosoideae)	*Acacia melanoxylon*	Blackwood		TG
Fabaceae (Mimosoideae)	*Acacia obliquinervia*	Mountain Hickory		SG
Fabaceae (Mimosoideae)	*Acacia pravissima*	Wedge-leaved Wattle		SG
Fabaceae (Mimosoideae)	*Acacia verniciflua*	Varnish Wattle		SG
Lomandraceae	*Lomandra glauca*	Pale Mat-rush		GG
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush		GG
Loranthaceae	*Amyema spp.*	Mistletoe		OG
Myrtaceae	*Eucalyptus blakelyi*	Blakely's Red Gum		TG
Myrtaceae	*Eucalyptus bridgesiana*	Apple Box		TG
Myrtaceae	*Eucalyptus cinerea*	Argyle Apple		TG
Myrtaceae	*Eucalyptus dalrympleana*	Mountain Gum		TG
Myrtaceae	*Eucalyptus mannifera*	Brittle Gum		TG
Myrtaceae	*Eucalyptus melliodora*	Yellow Box		TG
Phormiaceae	*Dianella caerulea*	Blue Flax-lily		FG
Pinaceae	*Pinus radiata*	Radiata Pine	*	HT
Pinaceae	*Pinus* spp.	0	*	HT
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*	EX
Poaceae	*Bromus* spp.	A Brome	*	GG
Poaceae	*Dactylis glomerata*	Cocksfoot	*	EX
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		GG
Poaceae	*Eragrostis curvula*	African Lovegrass	*	HT
Poaceae	*Eragrostis* spp.	A Lovegrass	*	GG
Poaceae	*Lachnagrostis* spp.	0		GG
Poaceae	*Lolium perenne*	Perennial Ryegrass	*	EX
Poaceae	*Nassella trichotoma*	Serrated Tussock	*	HT

Family	Scientific name	Common name	Exotic	Growth form
Poaceae	*Panicum simile*	Two-colour Panic		GG
Poaceae	*Phalaris minor*	Lesser Canary Grass	*	EX
Rosaceae	*Rubus fruticosus* sp. agg.	Blackberry complex	*	HT
Sapindaceae	*Dodonaea* spp.	A Hopbush		SG
Solanaceae	*Lycium ferocissimum*	African Boxthorn	*	HT

Notes: Growth form- EX= exotic, HT= high threat exotic, GG= grass and grasslike, TG = tree group, SG= shrubs, FG= forbs, OG= other (mistletoe in this instance)

Fauna species recorded in the site

Common name	Scientific name	Mine site	Southern Dumps & Keatings Collapse	Northern Dumps	Railway Precinct	Molonglo River (downstream)
Birds						
Australian King-Parrot	*Alisterus scapularis*	X				
Australian Magpie	*Cracticus tibicen*	X	X	X	X	
Australian Pipit	*Anthus novaeseelandiae*	X	X			
Australian Raven	*Corvus coronoides*	X	X			
Australian Wood Duck	*Chenonetta jubata*	X				
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		X			
Brown Thornbill	*Acanthiza pusilla*			X		
Brown-headed Honeyeater	*Melithreptus brevirostris*				X	
Buff-rumped Thornbill	*Acanthiza reguloides*				X	
Crimson Rosella	*Platycercus elegans*				X	
Eastern Spinebill	*Acanthorhynchus tenuirostris*		X		X	
European Goldfinch	*Carduelis carduelis*		X			
Fairy Martin	*Petrochelidon ariel*	X				
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	X	X			
Flame Robin	*Petroica phoenicea*	X		X		
Galah	*Eolophus roseicapillus*				X	
Golden Whistler	*Pachycephala pectoralis*		X			
Grey Butcherbird	*Cracticus torquatus*	X	X			

Common name	Scientific name	Mine site	Southern Dumps & Keatings Collapse	Northern Dumps	Railway Precinct	Molonglo River (downstream)
Grey Fantail	*Rhipidura albiscapa*				X	
Grey Shrike-thrush	*Colluricincla harmonica*	X	X			
House Sparrow	*Passer domesticus*		X			
Laughing Kookaburra	*Dacelo novaeguineae*		X		X	
Long-billed Corella	*Cacatua tenuirostris*	X				
Magpie-lark	*Grallina cyanoleuca*		X			
Noisy Friarbird	*Philemon corniculatus*		X		X	
Peregrine Falcon	*Falco peregrinus*		X			
Pied Currawong	*Strepera graculina*					X
Red Wattlebird	*Anthochaera carunculata*				X	
Rufous Songlark	*Cincloramphus mathewsi*		X			
Rufous Whistler	*Pachycephala rufiventris*				X	
Silvereye	*Zosterops lateralis*				X	
Southern Boobook	*Ninox novaeseelandiae*	X				
Spotted Pardalote	*Pardalotus punctatus*		X			
Sulphur-crested Cockatoo	*Cacatua galerita*	X	X			
Superb Fairy-wren	*Malurus cyaneus*	X			X	
Superb Lyrebird	*Menura novaehollandiae*		X			
Wedge-tailed Eagle	*Aquila audax*		X			
Welcome Swallow	*Hirundo neoxena*	X	X	X	X	X
White-browed Scrubwren	*Sericornis frontalis*			X		
White-eared Honeyeater	*Nesoptilotis leucotis*		X			
Willie Wagtail	*Rhipidura leucophrys*	X	X	X	X	
Yellow Thornbill	*Acanthiza nana*				X	
Yellow-faced Honeyeater	*Caligavis chrysops*		X			
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*				X	

Common name	Scientific name	Mine site	Southern Dumps & Keatings Collapse	Northern Dumps	Railway Precinct	Molonglo River (downstream)
Yellow-tailed Black-cockatoo	*Calyptorhynchus funereus*				X	
Amphibians						
Brown-striped Frog	*Limnodynastes peronii*					X
Common Eastern Froglet	*Crinia signifera*	X		X		X
Eastern Banjo Frog	*Limnodynastes dumerilii*					X
Spotted Grass Frog	*Limnodynastes tasmaniensis*	X		X		X
Verreaux's Frog	*Litoria verreauxii*	X				X
Mammals						
Common Brushtail Possum	*Trichosurus vulpecula*				X	
Common Wombat	*Vombatus ursinus*					X
Eastern Grey Kangaroo	*Macropus giganteus*			X		
Rabbit	*Oryctolagus cuniculus*			X		X
Short-beaked Echidna	*Tachyglossus aculeatus*				X	
	Myotis Macropus / Nyctophilus species [1]	X				

Note: 1. Possible call from this species.

Anabat/Echometer analysis – 1251771

Analysis method

Bat calls were recorded during field surveys using Anabat Express Zero Crossing detectors (Titley Scientific) and a Full Spectrum Echo Meter EM3+ (Wildlife Acoustics).

The zero crossing analysis file (zca file) recorded using the Anabat detector was converted to zc sequence files using Anabat Insight (version 1.9.9) for analysis and in order to add metadata (e.g. species label etc). During the conversion process the standard 'all bats' filter was applied to identify candidate bat sequences and remove noise files, and converted to a 10 second maximum file length. Noise files were moved to a separate folder for later checking. Raw .wav files produced by the Echo Meter were viewed in Anabat Insight without modification.

Calls were identified by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material. Species specific filters were also used to discriminate candidate threatened species bat calls from other non-candidate bat calls for further manual review and analysis of call parameters.

The *Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (Pennay et al. 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for potential species (BatMap 2021; Pennay et al 2011; Churchill 2008; Van Dyck et al. 2013) and records from BioNet (August 2021). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000 for similar process) as summarised in Table B.1. Due to the absence of reference calls from the study area, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows van Dyck et al. (2013) and Reardon et al (2104).

Table B.1 Confidence ratings applied to calls

Identification	Description
D – Definite	Species identification not in doubt.
PR – Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG – Species Group	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species e.g. *Chalinolobus gouldii /Ozimops sp.* *Nyctophilus sp.* The calls of *Nyctophilus geoffroyi / gouldi* cannot be distinguished during the analysis process and are therefore lumped together. *Nyctophilus sp/Myotis Macropus.* The calls of these species can be easily confused during the analysis process and are therefore often lumped together.

Summary of results

August 2021

Approximately 50 Anabat sequence files were recorded from 33 hours of recording from 3 sites. From the 50 files, 3 bat call sequences were identified. None of the 24 species known to occur in the locality were definitively identified to species level, however four were identified as part of a species group. None of the call sequences could be definitely identified to species due to call duration and quality. The log files from all detectors were examined and all detectors operated for the entire night, however low temperatures (< 8 dc) were recorded from 7:45 pm which may account for the low bat activity.

The majority of pulses from one call recorded at 5:58 pm, 12/8/2021 from Anabat #3 were characteristic of the *Biodiversity Conservation Act 2016* (BC Act) listed *Myotis 7innamom*. The Anabat #3 detector was deliberately placed near potential roosting habitat, therefore the early time that this call was recorded is noteworthy (e.g. during the mergence period when bats leave the roost). However the short duration of the call and lack of additional calls prevented definitive identification to species level. There is also a possibility that this call could belong to one of the two long-eared bat species (*Nyctophilus*) that occur in the area.

Table B.2 provides a summary of the species and groups identified for each site/night during the survey.

Table B.2 Summary of bat analysis for each site

Species / group name	Surge bin Anabat 3# sn542859 12/8/21	Central loading tunnel Dracula sn434272 12/8/21	Northern loading tunnel Nosferatu sn507312 12/8/21
Myotis 7innamom/Nyctophilus species	SG	-	-
Number of species	0	0	0
Number of files	10	39	1
Number of bats calls	3	0	0
Approx. survey effort (hrs:min)	11	11	11

Table Notes:
Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one Nyctophilus species where recorded.
See Table B.1 for confidence rating e.g. D or Pr
ce, e, v – species listed under the *NSW Biodiversity Conservation Act 2016*.
CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
Number of files: total number of Anabat sequence files recorded for each night and survey period.
Number of bat calls: the number of Anabat sequence files identified as a bat call of any type including SG, PR and D calls, and files with poor quality calls and sometimes multiple species within the same sequence file.
Survey effort: estimate of time between sunset and sunrise for a successful night of Anabat detection.

November 2021

Approximately 343 Anabat sequence files and 11 .wav files were recorded from approximately 20 hours of recording from 3 sites. Approximately 9 bat call sequences (all species groups) were identified. None of the 24 species known to occur in the locality were definitively identified to species level. None of the call sequences could be definitely identified to species due to call duration and quality. An inspection of the call times revealed that the earliest call was at 8:16 pm from the Central loading tunnel (*Myotis 7innamom/Nyctophilus* species group) approximately 5 or so minutes post sunset suggesting that the call may have originated from within or in close proximity to the tunnel. It is possible that an individual or a few individuals may be using the tunnel as a temporary diurnal roost, however the data to date (e.g. small number of calls during August and November, and all other November calls occurring at least 30 mins post sunset) and the lack of harp trap success suggests that tunnel is not being used by a large number (e.g. a colony) of bats. The log files from all detectors were examined and all detectors operated as expected.

Table B.3 provides a summary of the species and groups identified for each site/night during the survey.

Table B.3 Summary of bat analysis for each site

Species / group name	Echo Meter 3 / Surge Bin/Central loading tunnel/Northern loading tunnel	Surge bin Dracula sn434272 22/11 and 23/11	Central loading tunnel Nosferatu sn507312 22/11 and 23/11
Miniopterus orianae oceanensis/Vespadelus species	SG[1]	-	SG
Myotis macropus/Nyctophilus species	-	-	SG
Number of species	0	0	0
Number of files	11	229	114
Number of bats calls	1	0	8
Approx. survey effort (hrs:min)	4 hours	4 hours each night for 2 nights	4 hours each night for 2 nights

Table Notes:
Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one Nyctophilus species where recorded.
See Table B.1 for confidence rating e.g. D or Pr
ce, e, v – species listed under the *NSW Biodiversity Conservation Act 2016*.
CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
Number of files: total number of Anabat sequence files recorded for each night and survey period.
Number of bat calls: the number of Anabat sequence files identified as a bat call of any type including SG, PR and D calls, and files with poor quality calls and sometimes multiple species within the same sequence file.
Survey effort: estimate of time between sunset and sunrise for a successful night of Anabat detection.
1 Calls recorded from the Central loading tunnel

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Appendix C

Assessments of significance – BC Act

Threatened ecological communities

Box Gum woodland

PCT 283 Apple Box – Blakely's Red Gum moist valley and footslopes grass-forb open forest of the NSW South Western Slopes Bioregion mapped in the site are commensurate with White Box-Yellow Box-Blakely's Red Gum Woodland which is listed as a critically endangered ecological community under the BC Act. The vegetation occurs along a degraded and contaminated edge of a larger tract of adjoining the decommissioned Captains Flat rail line. As the patch is highly disturbed, not all of the vegetation is likely to be commensurate with this community, although Blakely's Red Gum and Yellow Box does occur in the adjoining patch of vegetation. For the purposes of this assessment, all areas mapped as Box Gum Woodland area have been assessed on a precautionary basis.

BC Act Assessment: Box Gum Woodland
a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
Not relevant to this community.
b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction**
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Up to 0.36 ha of Box Gum Woodland would be impacted as a result of the proposed remediation of the contaminated soil below the existing rail infrastructure. Vegetation that may be impacted is in a modified state and occurs along the south-western edges Captains Flat Rail Line. Remediation works would require removal of groundcover vegetation and potential removal of some mature trees along the edge of the rail line. This vegetation has been exposed to historical disturbance associated with the rail line, as well as the influence of contamination from the mine site. In the medium to long term the proposal would result in the overall improvement of the site, through rehabilitation and revegetation. Extensive areas mapped as Box Gum Woodland would be retained throughout the surrounding locality. The vegetation that may be impacted by the proposal comprises a minor proportion of the local extent of the community. Any vegetation removal as a result of the proposal would not threaten the viability or persistence of the community or any of its component species in the region, however, may result in a very small reduction in the extent of the local occurrence, as described below. The proposal may result in a minor reduction in the extent of the local occurrence of this community, however, is unlikely to threaten its viability or persistence, since the area to be impacted is in a highly modified environment, located on a contaminated decommissioned mine site, is generally in poor condition, prone to edge effects, weed invasion and previous disturbances for maintenance activities. Vegetation management measures would be included in the CEMP for the proposal to avoid direct and indirect impacts on native vegetation adjoining the proposal area, including this community. Within NSW, Box Gum Woodland EEC occurs in the tablelands and western slopes from the Queensland border in the north, to the Victorian border in the south. The proposal would require the removal of small areas of vegetation commensurate with this community. Given the widespread distribution of Box Gum Woodland within NSW, and the mapped extent of this community in the study area and locality, it is considered unlikely that any works associated with the proposal would result in the local occurrence being placed at risk of extinction.
c) in relation to the habitat of a threatened species or ecological community: **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed**
The proposal would require the removal of 0.36 ha of groundcover Box Gum Woodland in the remediation area. The area of the community to be removed occurs along the edges of Captains Flat Rail Line and is in a modified state. There are no mature, hollow-bearing trees within the vegetation that would be impacted. This vegetation has been exposed to historical land management practices as well as likely influences from the contamination of the Captains Flat Mine. In the medium to long term the proposal would result in the overall improvement of the site, through rehabilitation and revegetation.

BC Act Assessment: Box Gum Woodland
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity
The proposal would result in the removal of up to 0.36 ha of Box Gum woodland vegetation from along a disturbed, contaminated and degraded edge, along the edge of a highly contaminated decommissioned mine and rail line. The proposal would not involve the creation of any structures that would impede ecological processes or increase the risk or energy cost of movement of component species within the community. There will be negligible additional fragmentation and no isolation as a result of the proposed works.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
Given the minimal (0.36 ha) area and degraded condition of the community to be removed, the mapped extent of the community within the locality, and the distribution of the community throughout NSW, the habitat to be removed is of low importance to the long-term survival of the community within the locality
d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity values (either directly or indirectly)
There is no area of outstanding biodiversity value at or near the site.
e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process
The proposal would result in the operation of the following KTP: – Clearing of native vegetation – up to 0.36 ha of Box Gum Woodland and a total of 5.49 ha of native vegetation would be removed or disturbed. This vegetation is mainly regrowth and is dominated by weeds. Given the minimal area and degraded condition of the vegetation to be removed the proposal would result in a negligible increase in the impact of this KTP Mitigation measures to minimise direct impacts on this community would be included in the CEMP (see Section 7). The proposal has the potential to introduce or increase the operation of the following KTPs within this community through soil disturbance and increased visitation to the area: – Infection of native plants by *Phytophthora cinnamonii* and Myrtle Rust – Invasion and establishment of weeds – Removal of dead wood and dead trees; the proposal may require the removal of dead wood to carry out the rehabilitation works. Native vegetation is already subject to weed invasion from adjoining disturbed areas. The proposal is unlikely to influence the introduction or further spread of exotic species, given the disturbed condition of the vegetation. Mitigation measures to minimise indirect impacts would be included in the CEMP (see Section 7).
Conclusion of Assessment of Significance
The proposal is unlikely to result in a significant impact on Box Gum Woodland, pursuant to s.7.3 of the BC Act given: – Only up to 0.36 ha of Box Gum Woodland would be impacted by the proposal, 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. Rehabilitation works are likely to have positive impacts through the removal of contaminants and seeding/encouragement of regeneration after remediation. Mitigation measures are proposed to limit the potential for indirect impacts on Box Gum Woodland vegetation adjacent to the area of impact.

Threatened fauna

Cave-roosting microbats

The Southern Myotis is listed as a vulnerable species under the BC Act. Potential calls from the Southern Myotis were recorded from a Surge bin and Central Loading Tunnel in the Mill Area, however the species was not trapped despite harp trap surveys at the entrance of these structures. The Surge Bin and other derelict mine structure including the concentrate bins and the loading tunnels, which contain potential roosting habitat for Southern Myotis are proposed for removal. The proposal would not remove any waterbodies that would comprise foraging habitat for this species.

Additional cave roosting species were not recorded during surveys but may occupy potential roost sites within derelict mine infrastructure:

– The Large-eared Pied Bat, which is listed as a vulnerable species under the BC Act and EPBC Act
– The Large Bent-winged Bat (*Miniopterus orianeae oceanensis*), which is listed as a vulnerable species under the BC Act.

The proposal would remove potential roost habitat for the Large-eared Pied Bat and Large Bent-wing Bat within the loading tunnels and concentrate bins. Potential foraging habitat for these species would also be temporarily removed, with revegetation works to increase the extent of vegetated foraging habitat in the longer term.

Cave roosting microbats
a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Potential Southern Myotis calls were recorded within a potential roost from within the Surge Bin and Central loading tunnel located in the Mill Area. There is the potential that this species and other cave-roosting species such as the Large-eared Pied Bat and Large Bent-wing Bat may also roost within the loading tunnels, concentrate bins and also under the culvert in the railway corridor. Neither species has been recorded in the locality in recent times (EES 2021a). The proposal will involve the removal of the surge bin, loading tunnels and concentrate bins.. Removal of the these structures will remove potential roosting and breeding habitat for these species and could result in mortality of individuals if undertaken without appropriate mitigation. 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). If works are undertaken during the breeding season, there is the potential to impact the lifecycle of these species through disturbance of females when pregnant or when there are dependant young. The removal of occupied roosting habitat would prevent breeding at this location, which would have the potential to have an adverse effect on the life cycle of a viable local population of the species (if present). Due to the historic land-clearing and contamination, the site does not contain hollow-bearing trees which might comprise alternative roosting habitat for the Southern Myotis. Hollow-bearing trees however are likely to be present in the adjacent vegetation associated with the Molonglo River, Tallaganda National Park, Tallaganda State Forest and Yanunbeyan National Park and may provide suitable roosting habitat for this species. Caves and other habitat, known to provide roosting habitat for the Large-eared Pied Bat, Large Bent-wing Bat and Southern Myotis, may also occur on the steep undulating hills adjoining the Molonglo River and provide roosting resources in the locality, however no cave habitat was noted immediately adjacent to the site. No known maternity caves for the Large-eared Pied Bat, Large Bentwing Bat or Southern Myotis are known to occur in the locality. Foraging habitat for the Southern Myotis is present within the sediment dams of the Mill Area and also the adjacent Molonglo River. These areas would continue to provide foraging habitat following the proposed remediation works. Foraging habitat for the Large-eared Pied Bat and Large Bent-wing Bat in the site comprising up to 24.50 ha of exotic grassland and 5.66 ha of edge woodland vegetation would be temporarily removed as part of the remediation works, but then re-instated as part of revegetation works. This would comprise a negligible impact on the extent and quality of foraging habitat for the Large-eared Pied Bat in the locality and is unlikely to affect the life cycle of the species. Taking these considerations into account, the removal of roosting habitat would have the potential to put a viable local population at risk, without suitable management. However, supplementary, seasonally appropriate surveys were completed in November 2021 and did not record any evidence to suggest that microbats are present and roosting at the site. The proposed works will be conducted outside of the breeding season for these species, and there is no evidence that the structures to be removed are important roosting habitat that would be occupied by large numbers of individuals during remediation. Overall there is a minimal risk that the proposal would put a viable local population at risk of extinction.

Cave roosting microbats
b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
Not applicable to these threatened species.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable to these threatened species.
c) In relation to the habitat of a threatened species, population or ecological community:
(i) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity and
The proposal would result in the removal of the surge bin, loading tunnels and concentrate bins that may provide potential roosting habitat for the Southern Myotis, Large Bentwing Bat and Large-eared Pied Bat. The proposal may also indirectly impact a cave-roosting microbats, if present, through noise disturbance from excavation plant and equipment. Up to 24.50 ha of exotic grassland and 5.66 ha of degraded woodland vegetation would be temporarily removed as part of the remediation works, but then re-instated as part of revegetation works. Following revegetation works, the extent of Large-eared Pied Bat foraging habitat at the site is likely to increase.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
Native vegetation to be removed comprises disturbed edges of small patches, within the mine site. Vegetation clearing has occurred historically throughout the area. The proposal would comprise a minor increase in the degree of habitat fragmentation in the local area and would not create gaps in habitat that could not be traversed by these mobile species. The proposal would not isolate any areas of habitat within the site or at a landscape scale, due to the high mobility of these threatened microbat species and the limited extent of the works. The proposal would not involve the creation of any structures that would increase the risk or energy cost of movement of these species. Given the highly mobile nature of these species, the removal of a small area (up to 5.66 ha) of native vegetation and 24.50 ha of exotic grassland from along the edges of patches will not result in a substantial increase in fragmentation and no areas of habitat will be isolated from any other areas of habitat as a result of the proposal.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
The demolition and removal of the surge bin, loading tunnels and concentrate bins would result in a loss of potential roosting habitat for the Southern Myotis, Large Bent-wing Bat and Large-eared Pied Bat. 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. There is no direct evidence that these derelict mine structures comprise important habitat for a local population of these species, however suitable roosting habitat is, in general, an important resource in the life cycle of microbat species. The proposal would not remove or modify any Southern Myotis foraging habitat. Works would be restricted to daylight hours and would not affect use of foraging habitat for the Southern Myotis within the sediment dams of the Mill Area or nearby reaches of the Molonglo River. The proposal would remove foraging habitat for the Large-eared Pied Bat and Large Bent-wing Bat associated with up to 24.50 ha of exotic grassland and 5.66 ha of degraded woodland vegetation. Given the limited extent and quality of foraging in the remediation area it would have little value for a local population of these species. This habitat would be temporarily removed as part of the remediation works, but then re-instated as part of revegetation works. Following revegetation works, the extent of Large-eared Pied Bat and Large Bent-wing Bat foraging habitat at the site is likely to increase.
d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
There are no areas of outstanding biodiversity value in the locality. The proposal will not have an impact on areas of outstanding biodiversity value.
e) Whether the proposed development or activity constitutes or is part of a key threatening process or is likely to increase the impact of, a key threatening process
The proposal would directly contribute to the operation of the following KTPs: – Clearing of native vegetation – 5.66 ha of degraded native vegetation comprising poor quality shelter and foraging habitat for these species would be removed.

Cave roosting microbats
Other KTPs which require consideration, include: – Invasion and establishment of exotic perennial grasses – the proposal has the potential to increase the incidence of weeds through ground disturbance and potentially spread of propagules on plant and vehicles during construction. Establishment of plants has the potential to affect the condition of habitat for these species. – Infection of native plants by *Phytophthora cinnamomi* and Myrtle Rust – the proposal would disturb soil within and adjoining native vegetation and potentially transfer or introduce pathogens via infected boots, equipment and machinery during excavation. Mitigation measures to minimise the potential for increase in the operation of these KTPs would be included in the CEMP (see Section 7).
Conclusion of test of significance
The demolition and removal of the Surge Bin, loading tunnels and concentrate bins would result in a loss of potential roosting habitat for the Southern Myotis, Large Bentwing Bat and Large-eared Pied Bat. There is no direct evidence that a local population of these species occurs at the site or that these derelict mine structures comprise important habitat for a local population of these species. However suitable roosting habitat is, in general, an important resource in the life cycle of microbat species. Impact mitigation, such as conducting works outside of the breeding season for these species would reduce the chance of an adverse effect. The potential roosting habitat that would be removed in the surge bin, loading tunnel and concentrate bins would comprise a small proportion of the habitat available in the locality. Hollow-bearing trees are abundant in the locality and are associated with Tallaganda National Park, Tallaganda State Forest and Yanunbeyan National Park and would provide alternate roosting habitat for the Southern Myotis. Small caves and cliffs associated with the undulating and steep terrain of the Molonglo River is likely to provide roosting habitat for the Southern Myotis, Large Bentwing Bat and Large-eared Pied Bat in the locality. Based on consideration of the above criteria, the proposal is unlikely to have a significant impact on a local population of the Southern Myotis, Large Bent-wing Bat or Large-eared Pied Bat pursuant to Section 7.3 of the BC Act. A species impact statement is not likely to be required.

Small woodland birds

The Flame Robin is listed as a vulnerable species under the BC Act. Three Flame Robins were recorded in the Mill Area and off Old Mines Road in pine forest. The proposal would remove small areas of pine forest and eucalypt woodland that comprises foraging habitat and potential nesting habitat for the species within the mine site prior to remediation activities.

The Scarlet Robin is listed as a vulnerable species under the BC Act. The species was not recorded during surveys but may occur on occasion. The pine forest and eucalypt forest within and adjacent to the site contain woody debris which is an important habitat component for the species.

Small woodland birds
a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Three Flame Robins were recorded within or adjacent to pine forest within the site during recent surveys. The species has also been previously been recorded off Jerangle Road (Lesryck 2004). There is the potential that this species and other small woodland birds such as the Scarlet Robin may also breed and forage within the site. The Flame Robin and Scarlet Robin have been recorded in the locality six and eleven times respectively within the last 20 years (EES 2021a). The proposal will involve the removal of small eucalypt patches and also pine forest within the site. The vegetation to be removed comprises potential breeding and known foraging habitat for small woodland birds. Foraging and potential breeding habitat for woodland birds comprising 5.66 ha of vegetation at the edge of woodland patches would be temporarily removed as part of the remediation works, but then re-instated as part of revegetation works. This would comprise a negligible impact on the extent and quality of foraging and breeding habitat for woodland birds in the locality. If works are undertaken during the breeding season, there is the potential to impact the lifecycle of these species through disturbance of females when dependant young are present within nests. The removal of foraging habitat is unlikely to affect the life cycle of these species as they are mobile and have access to alternative nest sites in better quality habitats present in the locality including along the Molonglo Rover and associated with Tallaganda National Park, Tallaganda State Forest and Yanunbeyan National Park.

Small woodland birds
b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
Not applicable to these threatened species.
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable to these threatened species.
c) In relation to the habitat of a threatened species, population or ecological community:
(i) The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity and
The proposal would result in the removal of pine forest and small patches of isolated eucalypt forest that provide foraging and breeding habitat for the Flame Robin and Scarlet Robin. Up to 5.66 ha of degraded woodland vegetation would be temporarily removed as part of the remediation works, but then re-instated as part of revegetation works. Following revegetation works, the extent of Flame Robin and Scarlet Robin foraging habitat at the site is likely to increase. Mitigation measures including the relocation and reinstatement of woody debris from remediation areas is proposed to retain important habitat components for these species.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
Native vegetation to be removed comprises disturbed edges of small patches, within the mine site. Vegetation clearing has occurred historically throughout the area. The proposal would comprise a minor increase in the degree of habitat fragmentation in the local area and would not create gaps in habitat that could not be traversed by these mobile species. The proposal would not isolate any areas of habitat within the site or at a landscape scale, due to the high mobility of these threatened woodland birds and the limited extent of the works. Given the highly mobile nature of these species, the removal of a very small area (5.66 ha) of native vegetation from along the edges of patches will not result in a substantial increase in fragmentation and no areas of habitat will be isolated from any other areas of habitat as a result of the proposal.
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
The removal of pine forest and patchy eucalypt forest from the site would result in a loss of foraging and potential breeding habitat for small woodland birds. There is no direct evidence that these areas comprise important habitat for a local population of these species. No nests were recorded despite targeted surveys in the location where both male and female Flame Robins were recorded. Suitable foraging habitat which comprises an abundance of woody debris, is in general, an import resource in the life cycle of these species and was recorded in the site. The proposal would remove or modify woodland bird foraging and breeding habitat associated with up to 24.50 ha of exotic grassland and up to 5.66 ha of degraded woodland vegetation. Given the limited extent and quality of foraging in the remediation area it would have little value for a local population of the species. This habitat would be temporarily removed as part of the remediation works, but then re-instated as part of revegetation works. Following revegetation works, the extent of woodland bird foraging habitat at the site is likely to increase, if mitigation measures such as the relocation and reinstatement of woody debris are applied.
d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
There are no areas of outstanding biodiversity value in the locality. The proposal will not have an impact on areas of outstanding biodiversity value.
e) Whether the proposed development or activity constitutes or is part of a key threatening process or is likely to increase the impact of, a key threatening process
The proposal would directly contribute to the operation of the following KTPs: – Clearing of native vegetation – 5.66 ha of degraded native vegetation comprising known foraging and potential breeding habitat for small woodland birds would be removed. – Other KTPs which require consideration, include: Invasion and establishment of exotic perennial grasses – the proposal has the potential to increase the incidence of weeds through ground disturbance and potentially spread of propagules on plant and vehicles during construction. Establishment of plants has the potential to affect the condition of habitat for these species.

Small woodland birds
– Infection of native plants by *Phytophthora cinnamomi* and Myrtle Rust – the proposal would disturb soil within and adjoining native vegetation and potentially transfer or introduce pathogens via infected boots, equipment and machinery during excavation. Mitigation measures to minimise the potential for increase in the operation of these KTPs would be included in the CEMP (see Section 7).
Conclusion of test of significance
The removal of patches of pine forest and eucalypt forest within the site would result in a loss of known foraging habitat and potential breeding habitat for the Flame Robin and Scarlet Robin. The remediation and revegetation works may indirectly impact habitat for these species through noise and vibration impacts and result in the temporary avoidance of foraging habitat within the mine site until construction words have concluded. There is no direct evidence that pine and patch eucalypt forest at the site comprise important habitat for a local population of these species. The known foraging and potential breeding habitat that would be removed in the site would comprise a small proportion of the habitat available in the locality. Eucalypt and pine forests are abundant in the locality and are associated with Tallaganda National Park, Tallaganda State Forest and Yanunbeyan National Park and would provide alternate habitat for small woodland birds. Based on consideration of the above criteria, the proposal is unlikely to have a significant impact on a local population of the Flame Robin and Scarlet Robin pursuant to Section 7.3 of the BC Act. A species impact statement is not likely to be required.

Appendix D

Assessments of significance – EPBC Act

EPBC Act Assessment: Box Gum Woodland
According to the DotE (2013) 'significant impact criteria' for endangered or critically endangered ecological communities, an action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:
Reduce the extent of an ecological community
The proposal would result in the removal of up to 0.36 ha of degraded Box Gum Woodland within the site from along a degraded and contaminated edge of a larger tract of vegetation. Impacts would primarily involve the removal of disturbed patch of woodland surrounding existing railway infrastructure. The area has been previously disturbed during operation of the mine, with regrowth occurring since the decommission of the mine. Within NSW, Box Gum Woodland occurs in the tablelands and western slopes from the Queensland border in the north, to the Victorian border in the south. Given the widespread distribution of Box Gum Woodland within NSW, and the mapped extent of this community within the site and locality, the potential loss of a small area of modified vegetation from within the site will not result in a significant impact to the extent of the community throughout its range. Rehabilitation works are likely to improve the condition of the community in the long-term.
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
The proposal may result in the removal of a small area of Box Gum woodland vegetation from along a disturbed, contaminated and degraded edge, adjacent to a highly contaminated decommissioned mine site and railway line. There will be no isolation of this vegetation or any other native vegetation as a result of the proposed works.
Adversely affect habitat critical to the survival of an ecological community
The National Recovery Plan for the community notes that: "in very broad terms, habitat critical to the survival of Box-Gum Grassy Woodland is on the moderate to highly fertile soils of the western slopes of NSW and Queensland, the northern slopes of Victoria, and the tablelands of the Great Dividing Range from southern Queensland through NSW and the ACT. Given the currently highly fragmented and degraded state of this ecological community, all areas of Box-Gum Grassy Woodland which meet the minimum condition criteria outlined in Section 3 [of the recovery plan] should be considered critical to the survival of this ecological community. In addition, degraded woodland areas not considered part of the listed ecological community may also be essential to the long-term conservation of Box-Gum Grassy Woodland, by virtue of their landscape setting (e.g., providing connectivity) or remaining flora/fauna habitat features (e.g., occurrence of rare or threatened species, tree hollows), and should also be considered as potential habitat critical to the survival of this ecological community. The importance of degraded areas to the survival of the listed ecological community should therefore be assessed on a site-by site basis" Using this guidance, it is considered that the proposal is unlikely to adversely affect habitat critical to the survival of the community, given: – Vegetation that may be impacted is already modified and exists as a degraded, contaminated edge of a larger tract of vegetation. – There are no tree hollows within vegetation that may be removed. – The vegetation that may be impacted does not contribute to connectivity within the landscape. The proposed works entail rehabilitation of a highly contaminated mine and railway line, which may require the removal of a small area of vegetation from adjacent areas. The long-term effects of these works will be positive and will not result in any long-term adverse impacts to the community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
The proposal will involve the removal of highly contaminated material from within a mine site and rail line adjacent to vegetation commensurate with Box Gum Woodland. In the process of removing this material, there may be some need for impacts to or removal of vegetation immediately adjacent to the rail line to enable access and rehabilitation works. Modification of the mine and rail line will entail removal of contaminants from the environment and will not modify or destroy any abiotic factors necessary for the survival of the community.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
Any individual plants and animals affected by the works are unlikely to be an ecologically significant proportion of any of the individual species that make up the broader occurrence of the community in the locality or region. The areas of floristically similar vegetation in the locality and region are likely to be sufficient to maintain viable local populations of the species that comprise the community.

EPBC Act Assessment: Box Gum Woodland
The proposal is unlikely to result in a substantial negative change in the species composition of an occurrence of the community. The proposal will involve removal of contaminated material from a decommissioned mine site and rail line adjacent to vegetation commensurate with Box Gum Woodland. Following this rehabilitation, there is potential for a number of species that are sensitive to contaminants to establish within the site, which may result in a positive change in the species composition of the community with greater floristic diversity.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
The recovery plan for the community notes that "some weed species are particularly threatening to Box Gum Woodland as they are highly competitive and actively exclude locally indigenous species". Invasive species that are known to affect Box Gum Woodland include Blackberry (*Rubus fruticosus*) which is known to occur in the area. A range of grasses, herbs and other woody weeds are also known to affect this community. A number of animals are also noted to threaten Box Gum Woodland. These include herbivores that may impact the vegetation or soil stability, such as rabbits, hares, goats and deer and pigs, as well as foxes, dogs and feral cats which can threaten native fauna that occurs within the community. Further to these species, bees and introduced birds can lead to ecosystem imbalances. The proposal is unlikely to result in any of these species becoming established at the site. Existing weed management measures as well as mitigation measures outlined in Section 7 would be implemented the limit the potential for the spread or establishment of any exotic species likely to threaten the community.
– **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**
The proposal will involve the rehabilitation of a contaminated mine site and rail line immediately adjacent to the patch of Box Gum Woodland. The proposed works will involve the removal of contaminated material from the site and relocation to an alternative area. There may be some temporary mobilisation of pollutants during the works, however the long-term prognosis for the site will be improved significantly through the removal of the contaminants.
Interfere with the recovery of an ecological community
A National Recovery Plan has been published for this community; National Recovery Plan White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland – a critically endangered ecological community (DECCW 2011). The overall objective of this recovery plan is to promote the recovery and prevent the extinction of the critically endangered ecological community, known as Box-Gum Grassy Woodland. The specific objective to be achieved within the lifespan of this recovery plan is to minimise the risk of extinction of the ecological community through: – Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution; – Increasing protection of sites with high recovery potential; – Increasing landscape functionality of the ecological community through management and restoration of degraded sites; – Increasing transitional areas around remnants and linkages between remnants; and – Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland. While the proposal would result in the removal of up to 0.36 ha of Box Gum Woodland from along a degraded and contaminated edge of a larger tract of vegetation, the proposal will result in an overall improvement to the local environment through the proposed rehabilitation works. This is likely to improve the long-term viability and health of the vegetation and any fauna species that utilise the area. Given that the proposal will involve rehabilitation works to lessen the degree of contamination in the locality, and the small area of vegetation that may be impacted, it is considered unlikely that the proposal would significantly interfere in the recovery of the Box Gum Woodland community.
Conclusion
The proposal is unlikely to result in a significant impact on the local or regional occurrence of Box Gum Woodland, 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.

EPBC Act Assessment: Box Gum Woodland
EPBC Act Assessment: Large-eared Pied Bat
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:
Lead to a long-term decrease in the size of an important population of a species
There is no evidence of a population of the Large-eared Pied Bat at Lake George Mine. There are no important populations in the vicinity of the site. There is no direct evidence that derelict mine structures at the site comprise important habitat for a local population of these species. The demolition and removal of the surge bin, loading tunnels and concentrate bins, providing potential roosting habitat for the species, would not lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population
There is no evidence of a population of the Large-eared Pied Bat in the site and is unlikely to comprise an important population of the species. Potential roosting and breeding habitat is present within the the surge bin, loading tunnels and concentrate bins proposed for removal. However, no Large-eared Pied Bat was recorded in the site, or were recorded on Anabat surveys targeting derelict mine structures. There are no important populations in the vicinity of the site. The removal and demolition of the surge bin, loading tunnels and concentrate bins is unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations
No important populations occur in or near the site. The removal and demolition of the loading tunnels and concentrate bins and temporary removal of potential foraging habitat in exotic grassland and disturbed woodland edges would not fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species
Habitat critical to the survival of the species includes diurnal roosts for shelter, maternity roosts during the breeding season and the presence of foraging habitat in close proximity to these features (DERM 2011). Sandstone cliffs and fertile wooded valley habitat within close proximity of each other should be considered habitat critical to the survival of the Large-eared Pied Bat (DECC 2007). The structure of maternity roosts appears to be very specific (arch caves with dome roofs). Caves need to be high and deep enough to allow juvenile bats to learn to fly safely inside and have indentations in the roof. Roosting bats cluster in these indentations, presumably to allow the capture of heat. These physical characteristics are very uncommon in the landscape and their scarcity presumably poses an important limiting factor in the distribution of the Large-eared Pied Bat (Pennay 2008, DERM 2011). The proposal would remove and demolish the surge bin, loading tunnels and concentrate bins in the Mill area. There is no evidence that these structures provide a maternity roost or diurnal roost for this species. The species has not been recorded in the locality. As such, the proposal would not adversely affect habitat critical to the survival of this species.
Disrupt the breeding cycle of an important population
Females have been recorded raising young in maternity caves (c. 20-40 females) from November through to January. The structure of maternity roosts appears to be very specific (arch caves with dome roofs). Females remain loyal to the same cave over many years (DERM 2011). Disused mine shafts and Fairy Martin nests also comprise potential breeding and roosting habitat for this species (Schulz 1998), particularly where natural roosts are uncommon or absent. Given the absence of records of these species in the locality, and the lack of evidence that these species are using the mines derelict structures for roosting or breeding, the proposal would not impact any known maternity caves or roost sites, and is unlikely to impact the movement of this species between breeding, roosting and foraging areas. As such, the proposal is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
Lake George Mine does not contain known maternity or diurnal roosts for the species. Potential foraging habitat is present within fertile lands adjacent to the Molonglo River, with potential roosting habitat present nearby in Tallaganda National Park, Tallaganda State Forest and Yanunbeyan National Park. Caves and clifflines, associated with roosting habitat for the Large-eared Pied Bat was not recorded directly adjacent to the mine site.

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The demolition and removal of the surge bin, loading tunnels and concentrate bins would decrease potential roosting and breeding habitat in the locality. The remediation of the mine would result in the temporary clearing of predominantly grassland vegetation which may provide foraging habitat for the species, with the edges of small patches of native vegetation likely to be also impacted. This vegetation would comprise low quality foraging habitat for this species as it does not occur in close proximity to sandstone cliffs or caves, that provide natural roosting and breeding habitat for this species. Post remediation revegetation works would increase the amount of potential foraging habitat within the mine site.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
It is possible that introduced predators such as cats, foxes and invasive rats could contribute to the mortality of the Large-eared Pied Bat where roosts occur close to the ground (DERM 2011). The proposal would not increase the incidence of these invasive species or further contribute to mortality of the Large-eared Pied Bat.
Introduce disease that may cause the species to decline
The proposal is unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species
The overall objective of the recovery plan for the Large-eared Pied Bat is to ensure the persistence of viable populations throughout its geographic range. Important actions comprise protection of maternity roosts (DERM 2011). The proposal would not impact known breeding or roosting habitat for the species, if present within derelict mine infrastructure. The proposal would not remove any natural roosting habitat for the species, given the absence of caves and cliffs in the site. The proposal would increase the amount of potential foraging habitat following revegetation works at Lake George Mine. As a result, the proposal is unlikely to interfere substantially with the recovery of the species.
Conclusion
The proposal is unlikely to result in a significant impact on the Large-eared Pied Bat as: – There is no evidence that the species occurs in the locality, or that it is roosting within derelict mine infrastructure at Captains Flat. – Alternative roosting habitat would be present in small caves and cliffs associated with the undulating and steep terrain of the Molonglo River. – Vegetation proposed for removal is low quality foraging habitat and do not comprise fertile valleys and floodplains preferred by the species. – The removal of derelict mine infrastructure would not affect movement between foraging and breeding and roosting habitat. – The amount of potential foraging habitat present at the site would increase following revegetation works.

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