peel mining LIMITED

Review of Environmental Factors

for the

Mallee Bull Exploration Project

Prepared by:

RWCorkery&co

February 2023

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Contents

Page

Contents

Page

Contents

APPENDICES

FIGURES

Contents

Page

TABLES

Contents

List of Acronyms

AEP	annual exceedance probability
AHIP	Aboriginal Heritage Impact Permit
AIP	*Aquifer Interference Policy*
ANL	Amenity Noise Level
AQIA	Air Quality Impact Assessment
AREA	AREA Environmental and Heritage Consultants Pty Ltd
AWS	Automated Weather Station
BAM	Biodiversity Assessment Methodology
BAM-C	BAM Credit Calculator
BC Act	*Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BOM	Bureau of Meteorology
DECCW	Department of Environment, Climate Change and Water
DP	Deposited Plan
EC	electrical conductivity
EL	Exploration Licence
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDE	groundwater dependent ecosystem
GHD	GHD Pty Ltd
GSV	Ground Surface Visibility
KPI	key performance indicator
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan

LOR	limit of reporting
MAC	Muller Acoustic Consulting Pty Ltd
MGA	map grid of Australia
MIC	Maximum Instantaneous Charge
NAF	Non-acid-forming
NPI	Noise Policy for Industry
NVIA	Noise and Vibration Impact Assessment
PAF	Potentially acid forming
PANL	Project Amenity Noise Level
PCT	Plant Community Type
PINL	Project Intrusiveness Noise Level
PNTL	Project Noise Trigger Level
RAP	Registered Aboriginal Parties
RBL	Rating Background Level
REF	Review of Environmental Factors
SDS	Safety Data Sheets
SVM	State Vegetation Map
TAPM	The Air Pollution Model
TEC	Threatened Ecological Community
TRC	TRC Environmental Corporation
TSP	Total Suspended Particulate
WAL	water access licence

Foreword

This *Review of Environmental Factors* (REF) has been prepared by R. W. Corkery & Co. Pty Limited on behalf of Peel Mining Limited (Peel Mining) to assess the likely environmental impacts of the proposed Mallee Bull Exploration Project (the "Project"). The Project is proposed within Exploration Licence (EL) 7461 and is located at Gilgunnia approximately 100km south of Cobar, New South Wales (**Figure 1**).

For the purposes of this document, the following areas are identified (**Figure 1**).

- Exploration Licence 7461 boundary.
- Mining Lease 1361 boundary.
- Mallee Bull "REF Area" – includes all areas of proposed disturbance associated with the proposed Exploration Decline Program.

The proposed Exploration Decline Program would include the following.

- Construction of a box cut, exploration decline, including associated surface infrastructure.
- Drilling of the Mallee Bull deposit from underground.
- Storage of waste rock extracted during decline development. Non-acid forming (NAF) waste rock will be stored within the NAF Stockpiling Area and potentially acid forming (PAF) waste rock will be stored within the PAF Stockpiling Area. All PAF waste rock would be transported underground or placed within the Box Cut and capped with NAF.
- Rehabilitation of the REF Area.

The Mallee Bull Project comprises a high grade copper deposit, featuring classic 'Cobar-style' Cu-Ag-Au-Zn-Pb mineralisation. Mineralisation commences at ~60m below surface and has been defined to at least 800m below surface and remains open along strike and depth. A maiden Mineral Resource Estimate was released in May 2014 and was subsequently upgraded in July 2017. The 2017 model comprises 6.76 million tonnes at 1.8% copper, 31 g/t silver, 0.4 g/t gold, 0.6% lead and 0.6% zinc containing approximately 119,000 tonnes of copper, 6.6 million ounces silver, 83,000 ounces gold, 38,000t lead and 38,000t zinc.

Peel Mining Limited is an Australian Securities Exchange listed exploration mining company based in Perth. Peel Mining is managed by an experienced Board.

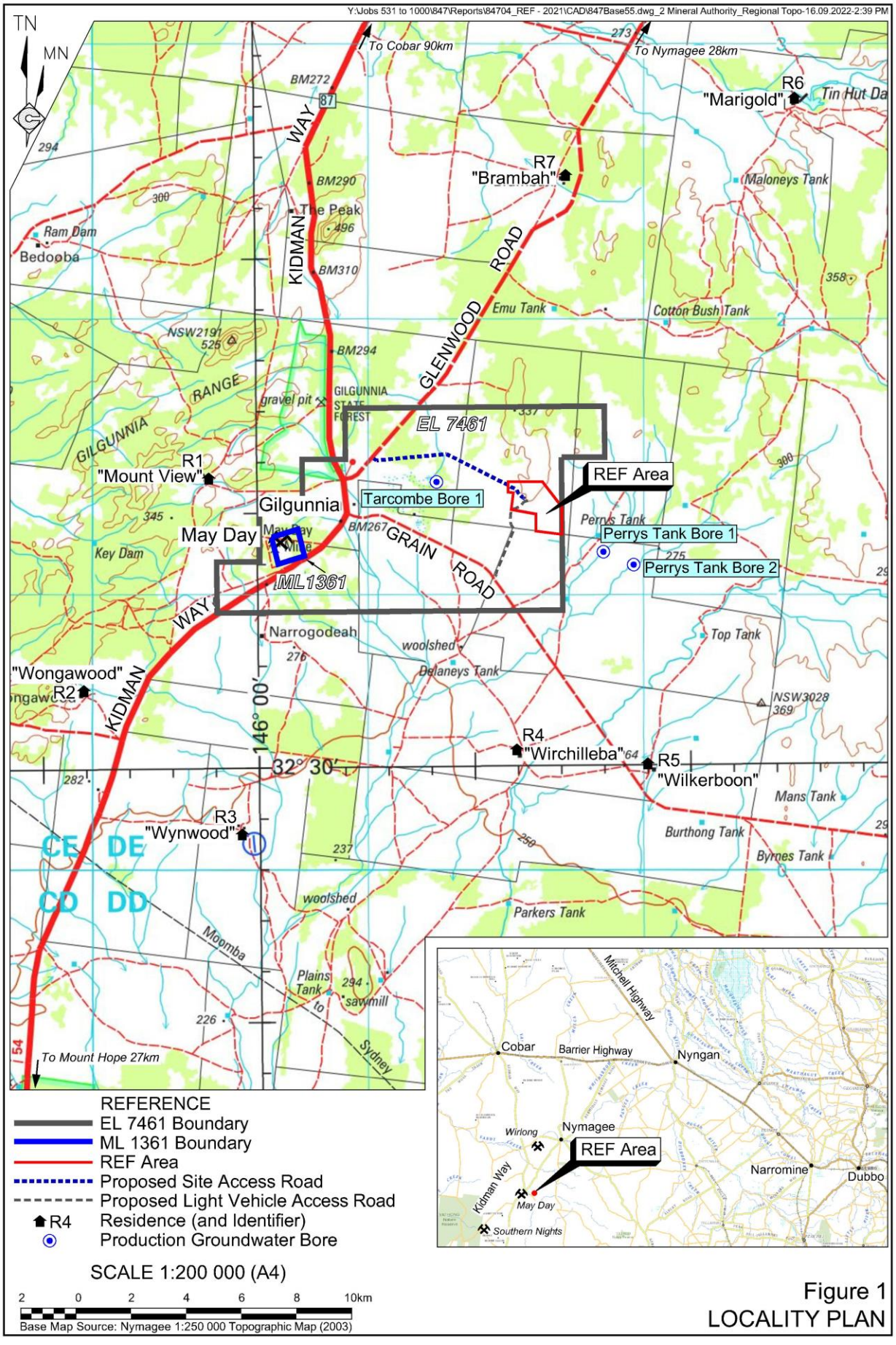

Figure 1
LOCALITY PLAN

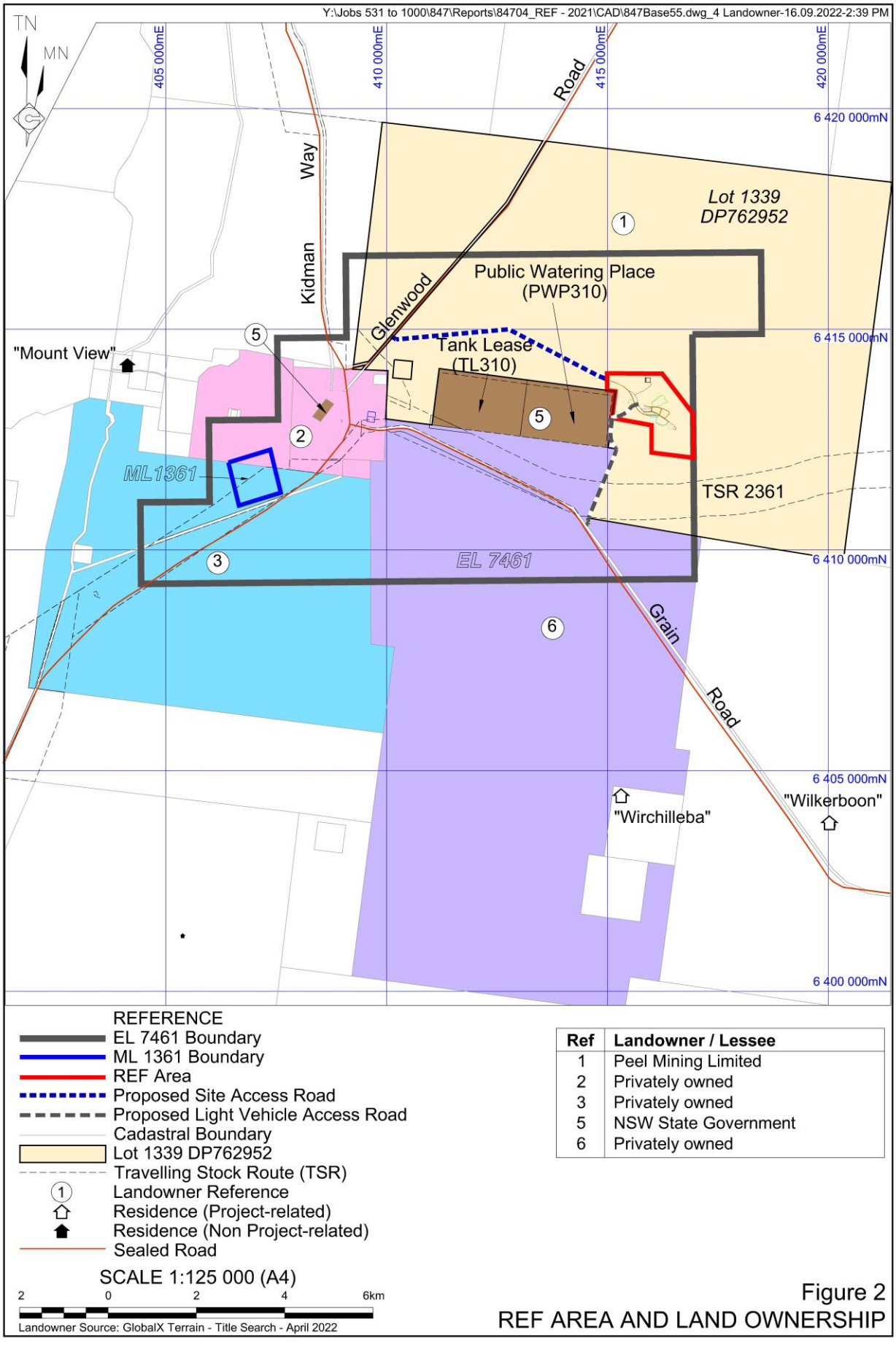

Figure 2
REF AREA AND LAND OWNERSHIP

Peel Mining is currently exploring the following other prospects within the Cobar Basin.

- May Day, located 105km south of Cobar, accessed via Kidman Way.
- Wirlong, located 30km southwest of Nymagee and 80km south-southwest of Cobar.
- Southern Nights / Wagga Tank, located 130km south of Cobar, covering an area of 87km^2.

Peel Mining holds tenements in the Cobar region containing prospects under current exploration and development.

Peel Mining acquired the Exploration Licence 7461 in 2009, encompassing Mining Lease 1361, the historic township of Gilgunnia, 4-Mile Goldfields, and May Day, a Peel Mining project.

Section 23A of the *Mining Act 1992* requires that:

> "the holder of the licence must not carry out an assessable prospecting operation on land over which the licence is granted unless an activity approval has been obtained for the carrying out of the assessable prospecting operation in relation to that land."

The document *ESG5: Assessment Requirements for Exploration Activities* published by the Resources Regulator dated May 2018 identifies a range of thresholds for exempt, complying and non-complying exploration activities. The proposed exploration activities are classified as Non-complying Exploration Activities and the application for approval is to be supported by a Guideline REF (this document).

This document has been prepared generally in accordance with *ESG2: Guideline for Preparing a Review of Environmental Factors* published by the NSW Department of Planning and Environment, Resources Regulator, last updated in May 2018. The information in this document is provided in sufficient detail to allow the NSW Resources Regulator to assess the proposed mineral exploration activities in accordance with Part 5 of *Environmental Planning and Assessment Act 1979*. **Appendix 1** presents a copy of *ESF4 – Exploration Activities Application Form* and **Appendix 2** presents a copy of the Rehabilitation Cost Estimate for the proposed activities, incorporating those activities proposed as part of the exploration program.

1. The Site

1.1 Site Description

The REF Area (**Figure 2**) encompasses all exploration activities for which approval is sought. Landholders within and immediately surrounding the REF Area are shown on **Figure 2**. Peel Mining is the only landholder within the REF Area. **Table 1** lists the lot included within the REF Area and the MGA coordinates of the REF Area (see Guideline).

Table 1
Lot within the REF Area

Lot	DP
1339	762952
Source: MinView (accessed 26 November 2021).	

1.2 Site Plan

Table 2 presents the reference to the figures where key information is presented within this document.

Table 2
Key Requirements and Where Addressed

Requirement	Where Addressed
Boundaries of the title(s)	**Figure 2**
Lot/Deposited Plan (DP) numbers and boundaries	**Table 1**
Topographic contours	**Figure 4**
Location of the proposed activity	**Figures 1** to **18**
Layout of the proposed activity	**Figure 12**
Major regional features	**Figure 4**
Existing and proposed access tracks	**Figure 3**
Existing structures and infrastructure	**Figure 5**
Location of identified sensitive land	Not Applicable
Nearby sensitive receptors (residences, schools, hospitals, etc.)	**Figure 1**
Coal seam gas exclusion zones	Not Applicable
Location of threatened species, populations or ecological communities, or their habitats	**Figure 10**
Location of Aboriginal and historic cultural heritage sites	**Figure 11**

2. The Existing Environment

2.1 General Description

2.1.1 Climate and Weather

Meteorological data were sourced from the Bureau of Meteorology (BOM) Cobar MO (Station number 048027) open station (1962 – present), located approximately 100km to the northwest of the Mallee Bull REF Area. Wind data has been sourced from the Hera Mine Automated Weather Station (AWS) located approximately 100km north of the Mallee Bull REF Area. All climate data related to rainfall, temperature and evaporation are presented in **Table 3**.

Table 3
Monthly Climate Data

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Temperature (°C)													
Mean maximum temperature	34.5	33.4	30.1	25.4	20.1	16.5	16.0	18.1	22.2	26.3	29.6	32.7	25.4
Mean minimum temperature	20.8	20.2	17.2	13.0	9.0	6.2	5.1	6.2	9.1	12.8	16.0	18.8	12.9
Rainfall (mm)													
Mean rainfall	43.7	42.5	35.2	27.8	32.7	28.8	27.4	26.4	25.0	35.5	37.2	35.0	396.1
Highest rainfall	233.8	188.9	217.6	201.4	144.0	107.6	102.4	76.3	104.6	183.4	157.1	151.6	710.2
Lowest rainfall	0.6	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.4	0.8	101.6
Highest daily rainfall	102.2	89.7	108.8	71.4	59.4	38.8	44.6	56.9	44.4	44.6	56.6	74.8	108.8
Evaporation (mm)[1]													
Mean daily Evaporation	11.4	10.0	8.0	5.3	3.1	2.1	2.3	3.4	5.4	7.5	9.4	11.1	6.6
Mean monthly Evaporation[1]	353.4	280	248	159	96.1	63	71.3	105.4	162	232.5	282	344.1	2,397
Note 1: Calculated from daily average evaporation.													
Source: Bureau of Meteorology Stations – Cobar MO NSW (Station No:048027) – accessed 23/01/2023													

The Cobar area experiences hot summers, with a mean maximum temperature of 34.5ºC in January, and relatively mild winters, with a mean maximum temperature of 16ºC and a mean minimum temperature of 5.1ºC in July.

Rainfall is relatively low, averaging 389.5mm per annum, but can be highly variable with the highest maximum recorded monthly rainfall between 3 and 5 times the mean monthly rainfall. The highest recorded daily rainfall is between 2 and 3.5 times the mean monthly rainfall.

Mean monthly evaporation exceeds mean monthly rainfall in all months, resulting in a substantial water deficit within the Mallee Bull REF Area and surrounds.

The wind roses from the Hera Mine AWS show that winds from the south-southwest direction are prevalent year round, with northeast and east winds common during Summer (**Figure 3**).

2.1.2 Topography and Drainage

The topography and drainage surrounding and within the REF Area is presented in **Figures 4** and **5**.

The area immediately surrounding the REF Area is typically flat to gently undulating with isolated small hills and peaks. Elevations range from approximately 250m AHD to the south of the REF Area to approximately 524m AHD at Gilgunnia Hill, to the northwest of the REF Area.

The REF Area topography is typically flat. Two topographical features on the eastern side of the REF Area form rises of approximately 317m AHD with a general east to west slope.

Surface water drainage within the REF Area is characterised by sheet wash with mapped drainage features limited to indistinct, discontinuous ephemeral watercourses. It is likely that surface water within these watercourses would, with the exception of extreme rainfall, not flow into the Darling River.

The REF Area occupies two small sub-catchments labelled the Western Catchment and the Eastern Catchment. Surface water from the REF Area flows to the west then south, and to the east and south and is dominated by overland flows and sheet wash (**Figure 5**).

2.1.3 Soils and Land Capability

Figure 6 displays the soil type and landscape capability within and surrounding the REF Area.

One soil landscape system, namely the Yackerboon Land System, has been identified within the REF Area. Walker (1991) identifies the Yackerboon Land System as occurring on slightly undulating country on Silurian and Siluro-Devonian siltstones and sandstone. It comprises Red Earths and some Lithosols.

The NSW Government SEED database identifies that land within the REF Area is classified as Land Capability Class 5 (**Figure 6**). This class is defined as follows.

- Class 5 – Moderate – low capability land with high limitations for high-impact land uses. Land uses largely restricted to grazing, some horticulture (orchards), forestry and nature conservation.

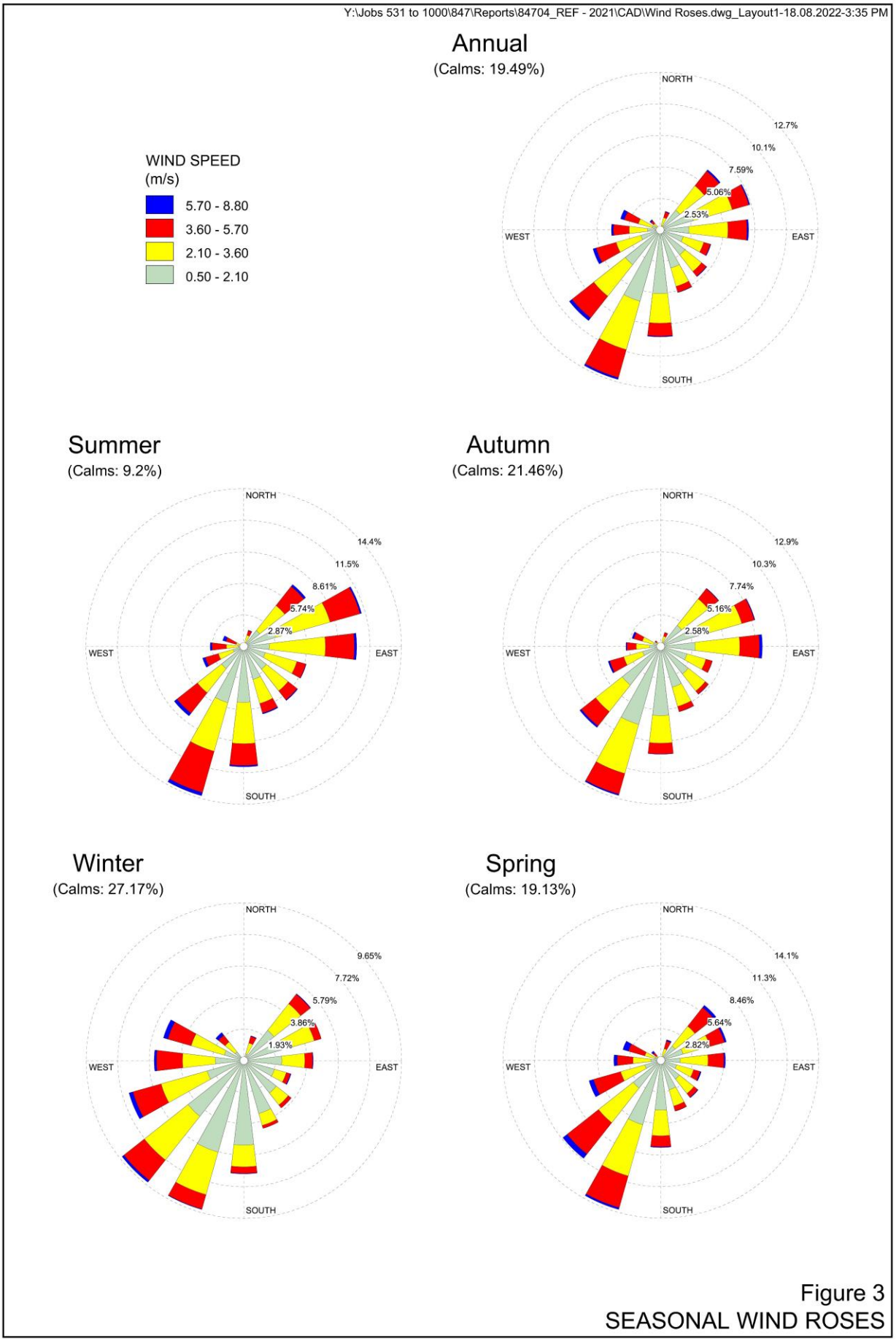

Figure 3
SEASONAL WIND ROSES

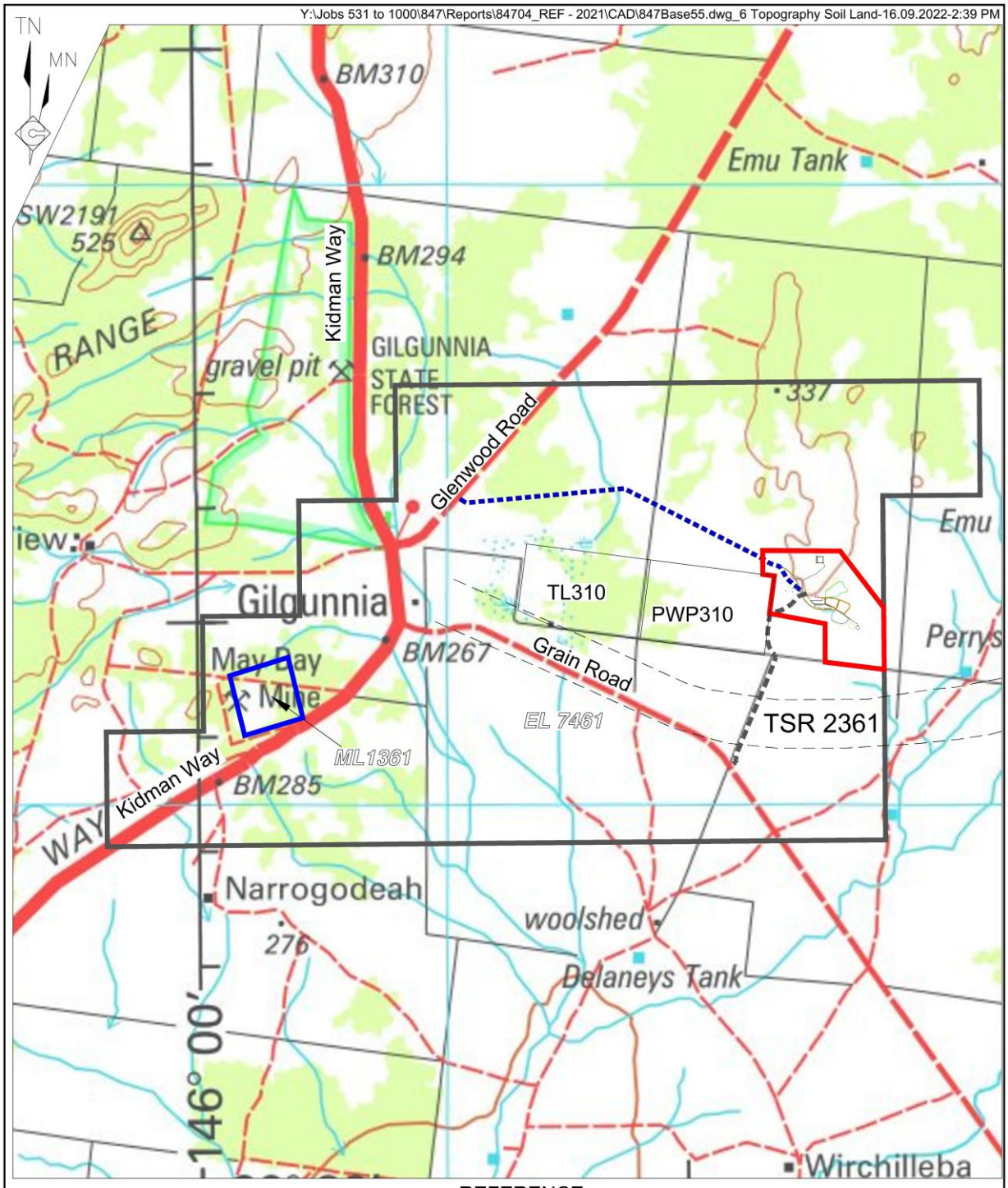

Figure 4
LOCAL TOPOGRAPHY AND DRAINAGE

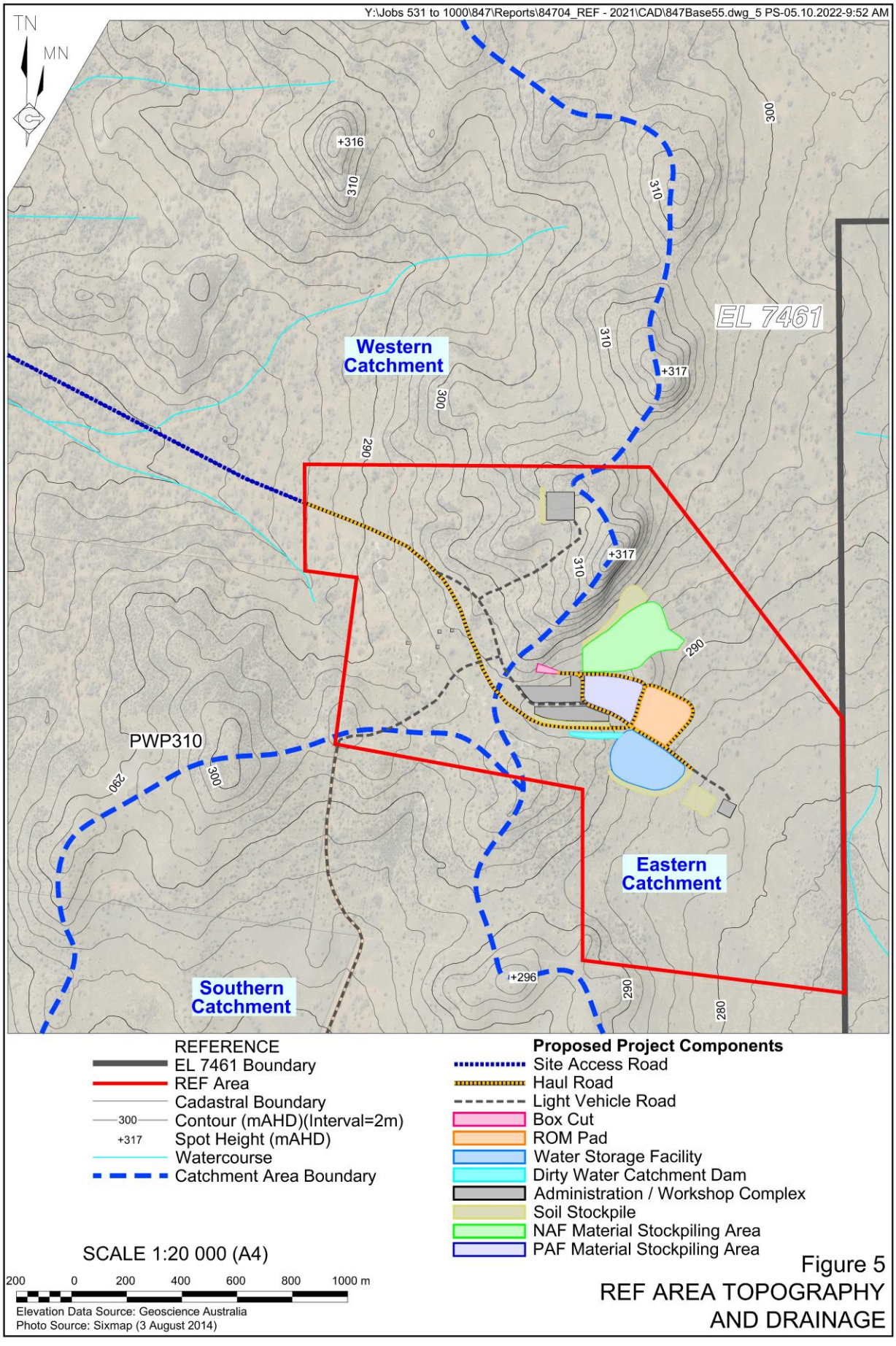

Figure 5
REF AREA TOPOGRAPHY AND DRAINAGE

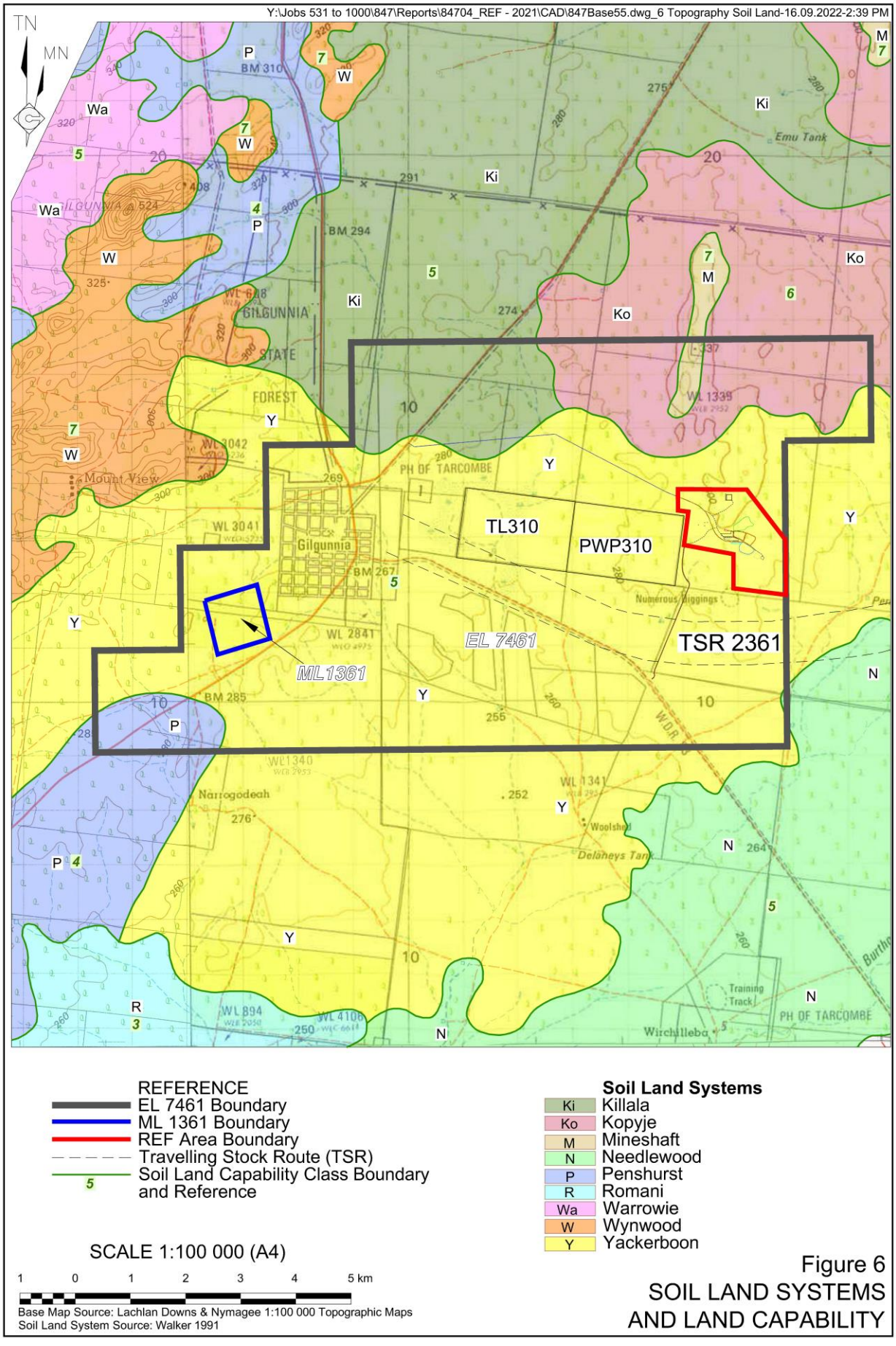

Figure 6
SOIL LAND SYSTEMS
AND LAND CAPABILITY

2.1.4 Existing Land Uses

Land uses, as defined by the NSW Land Use and Management database within and adjacent to the REF Area include the following (**Figure 7**).

Grazing native vegetation – typically low intensity, intermittent grazing.

- Other minimal use - areas of land that are largely unused, likely as a result of steep slopes or dense vegetation.
- Tank Lease 310, Public Watering Place 310 and Travelling Stock Route 2361.

Other surrounding land uses include the following.

- Transportation – including the Kidman Way, Grain Road and Glenwood Road.
- Residential – Widely spaced homesteads and other rural infrastructure.
- Mineral exploration and mining – the former Mayday Mine is located in the western section of the Exploration Licence Area, within ML 1361.
- Nature conservation – associated with Gilgunnia State Forest.

2.1.5 Services and Public Infrastructure

Infrastructure services available near the REF Area include Kidman Way and other local roads. Power infrastructure exists within the area to support existing land uses, including existing residences.

Human services such as medical and government services are available in Cobar.

2.2 Description of Sensitive Land

Table 4 presents the status of sensitive land within or surrounding the REF Area.

2.3 Description of Sensitive Receivers

Figure 2 presents the location of the closest sensitive receivers. The REF Area is located a minimum of 11km from the closest non-project related residence “Mount View”.

2.4 Description of Coal Seam Gas Exclusion Zones

The proposed activities do not relate to coal seam gas exploration.

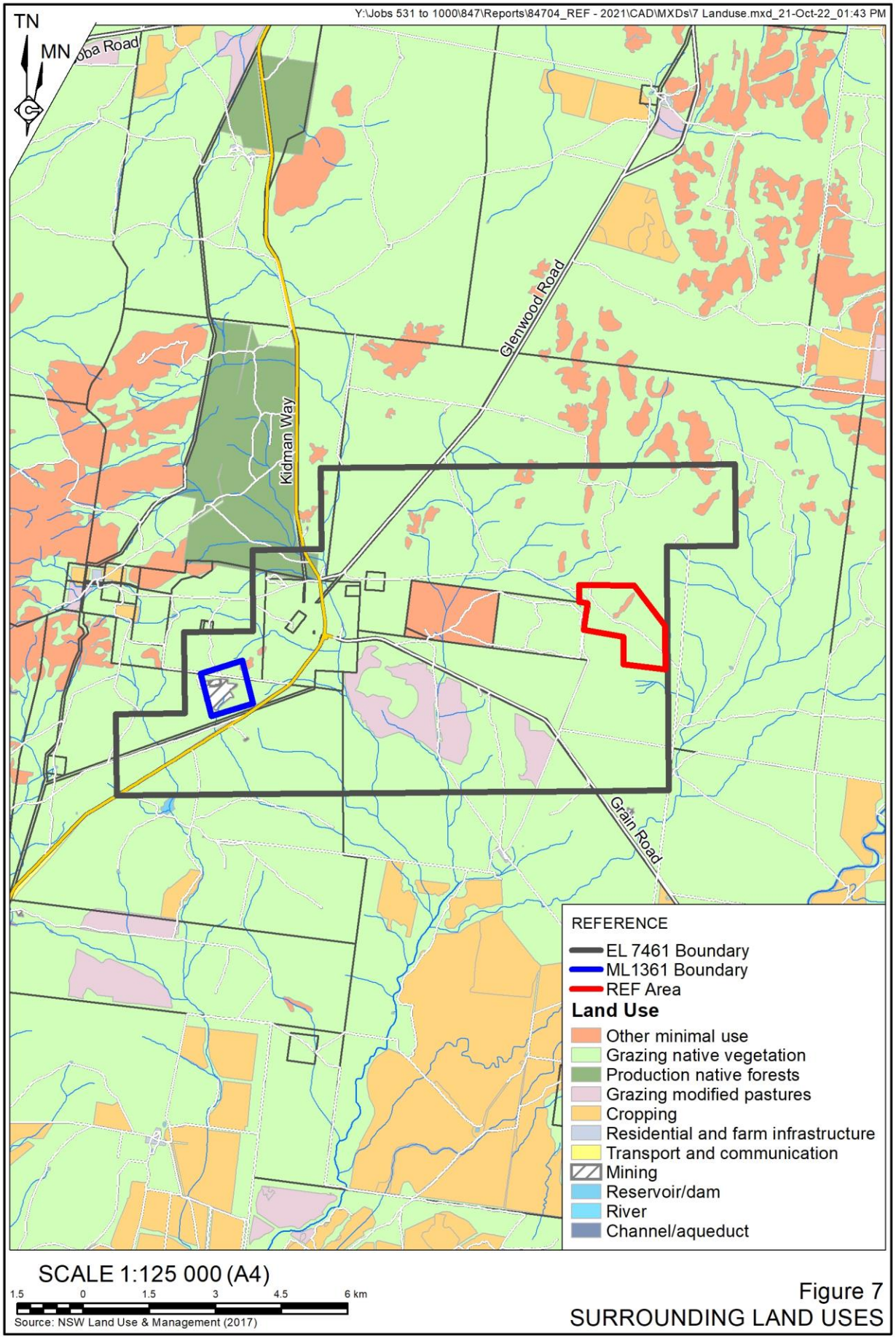

Figure 7
SURROUNDING LAND USES

Table 4
Status of Sensitive Land Within and Surrounding the REF Area

Sensitive Land	Status within or surrounding the REF Area
Conservation Areas	
Land reserved under the *National Parks and Wildlife Act 1974*.	None present
Land acquired by the Minister for the Environment under the *National Parks and Wildlife Act 1974*.	None present
Land subject to a 'conservation agreement' under the *National Parks and Wildlife Act 1974*.	None Present
Land declared as an aquatic reserve under the *Marine Estate Management Act 2014*.	None present
Land declared as a marine park under the *Marine Estate Management Act 2014*.	None present
Land within a State Forest set aside under the *Forestry Act 2012* for conservation values including Flora Reserves, or Special Management (and other) Zones.	None present[1]
Land reserved or dedicated under the *Crown Lands Act 1989 / Crown Lands Management Act 2016* for the preservation of flora, fauna, geological formations or for other environmental protection purposes.	None present
Land identified as wilderness or declared a wilderness area under the *Wilderness Act 1987*.	None present
Land subject to a 'biobanking agreement' under the *Biodiversity Conservation Act 2016* or *Threatened Species Conservation Act 1995*.	None present
Drinking Water Catchment Protection Areas	
Land declared to be a controlled area' or a 'special area' under the *Water NSW Act 2014* or a 'special area' under the *Water Management Act 2000 or Hunter Water Act 1991.*	None present
Environmentally Sensitive Areas	
Land declared as areas of outstanding biodiversity value under *the Biodiversity Conservation Act 2016* or Part 7A of the *Fisheries Management Act 1994*.	None present
Land designated as a wetland of international significance under the Ramsar Convention on Wetlands.	None present
Land designated as a nationally important wetland in the Directory of Important Wetlands of Australia.	None Present
Land identified as Coastal Wetlands under *State Environmental Planning Policy (Coastal Management) 2018.*	None present
Land identified as Littoral Rainforests under *State Environmental Planning Policy (Coastal Management) 2018.*	None present
Land within the coastal zone as defined in the *Coastal Management Act 2016*.	None present
Land identified in an environmental planning instrument as being of biodiversity significance or zoned for environmental conservation.	None present
Waterfront land as defined under the *Water Management Act 2000*.	None Present
Land with a slope greater than 18 degrees measured from the horizontal.	None Present
Land with Potential for Soil and Water Contamination	
Land with potential acid sulfate soils or actual acid sulfate soils as defined by the OEH Acid Sulfate Soils Risk Maps.	None present
Aboriginal Heritage Protection Areas	
Land declared as an Aboriginal place under the *National Parks and Wildlife Act 1974*.	None present
Land identified in an environmental planning instrument as being of Aboriginal cultural significance.	None present

Table 4 (Cont'd)
Status of Sensitive Land Within and Surrounding the REF Area

Sensitive Land	Status within or surrounding the REF Area
Historic or Natural Heritage Protection Areas	
Land identified on the World Heritage List, National Heritage List or Commonwealth Heritage List.	None present
Land, places, buildings or structures listed on the State Heritage Register.	None present
Land identified in an environmental planning instrument as being of heritage significance.	None present
Biophysical Strategic Agricultural Land and Critical Industry Clusters	
Land identified as a Critical Industry Cluster Land under *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*.	None present
Community Land	
Public land classified as community land under *the Local Government Act 1993*.	None present
Other Areas	
Land identified as environmentally sensitive land by the title.	None present
Note 1: The Gilgunnia State Forest is located to the north west of the Mallee Bull REF Area and would not be impacted by the proposed activities	

2.5 Description of Surface and Groundwater Resources

2.5.1 Surface Water Environment

The REF Area is located within the area covered by the *Water* Sharing Plan for the Lachlan Unregulated River Water Source 2012, within the Mount Hope Area Water Source. The proposed exploration activities would not trigger the requirements of this water sharing plan. The REF Area is not located within a drinking water catchment, and the local community does not rely upon surface water flows from the REF Area for drinking water supply.

Typically, surface water drainage within the locality is intermittent and responds to infrequent intense rainfall events that occur sporadically. The closest river intersects the southernmost extent of Nombinnie Nature Reserve, approximately 80km south of the REF Area.

Surface water drainage within EL7461 involves a number of 1st order and 2nd order ephemeral streams, generally flowing to the south, however they are not located within the REF Area. Surface water drainage within the REF Area is largely dominated by sheet wash, with mapped drainage features limited to a single 1st order watercourse immediately adjacent to the northwest of the REF Area and terminating at a soak. There are no watercourses traversing the REF Area and there are no riparian corridors within the REF Area.

2.5.2 Groundwater Environment

2.5.2.1 Introduction

The REF Area lies within the area covered by the *NSW Murray Darling Basin Fractured Rock Groundwater Sources (2012) Water Sharing Plan* within the Western Management Area. More specifically, the REF Area is located within the Lachlan Fold Belt Murray Darling Basin groundwater source.

GHD Group Pty Ltd (GHD) undertook a Groundwater Impact Assessment in support of the Project to assess the potential impacts on groundwater resources associated with the construction and exploration drive. The resulting report, hereafter referred to as GHD (2023), is presented as **Appendix 3**. The following subsections describe the existing groundwater environment in the REF Area, as outlined by GHD (2023).

2.5.2.2 Monitoring and Production Bores

Table 5 and **Figure 8** present eight groundwater monitoring bores established within the REF Area. Three of these monitoring bores, MBGW01, MBGW02 and MBGW05, were drilled following the preparation of GHD (2023).

Table 5
Groundwater Monitoring Bores

Bore	Easting	Northing	Depth (m bgl)	Installation Date
Established Groundwater Monitoring Bores				
MBGW03	415,114	6,412,812	240	13/06/2021
MBGW04	417,639	6,417,224	240	06/06/2021
MBGW06	418,159	6,412,210	204	17/06/2021
MBGW07	414,695	6,410,747	204	17/06/2021
MBGW08	411,018	6,412,917	180	18/05/2021
New Groundwater Monitoring Bores[1]				
MBGW01	414,450	6,415,051	210	4/12/2021
MBGW02	416,580	6,413,711	204	28/11/2021
MBGW05	420,696	6,413,205	300	10/12/2021
Note 1: Groundwater monitoring bores drilled following the preparation of GHD (2023).				
Source: GHD (2023) – modified after Tables 4.1 and 4.2				

Figure 8 also presents the locations of the Perry's Tank Bore (1 & 2) (MBWRC002) and Tarcombe Bore (MBWRC003) production bores owned by Peel Mining.

2.5.2.3 Groundwater Levels

Groundwater levels were recorded at the monitoring bores within the REF Area following the installation of the bores in May 2021. Levels were also recorded in the new groundwater monitoring bores by drillers when the bores were installed in December 2021 and by Peel Mining personnel during January 2022 monitoring rounds. The results are presented in **Table 6**.

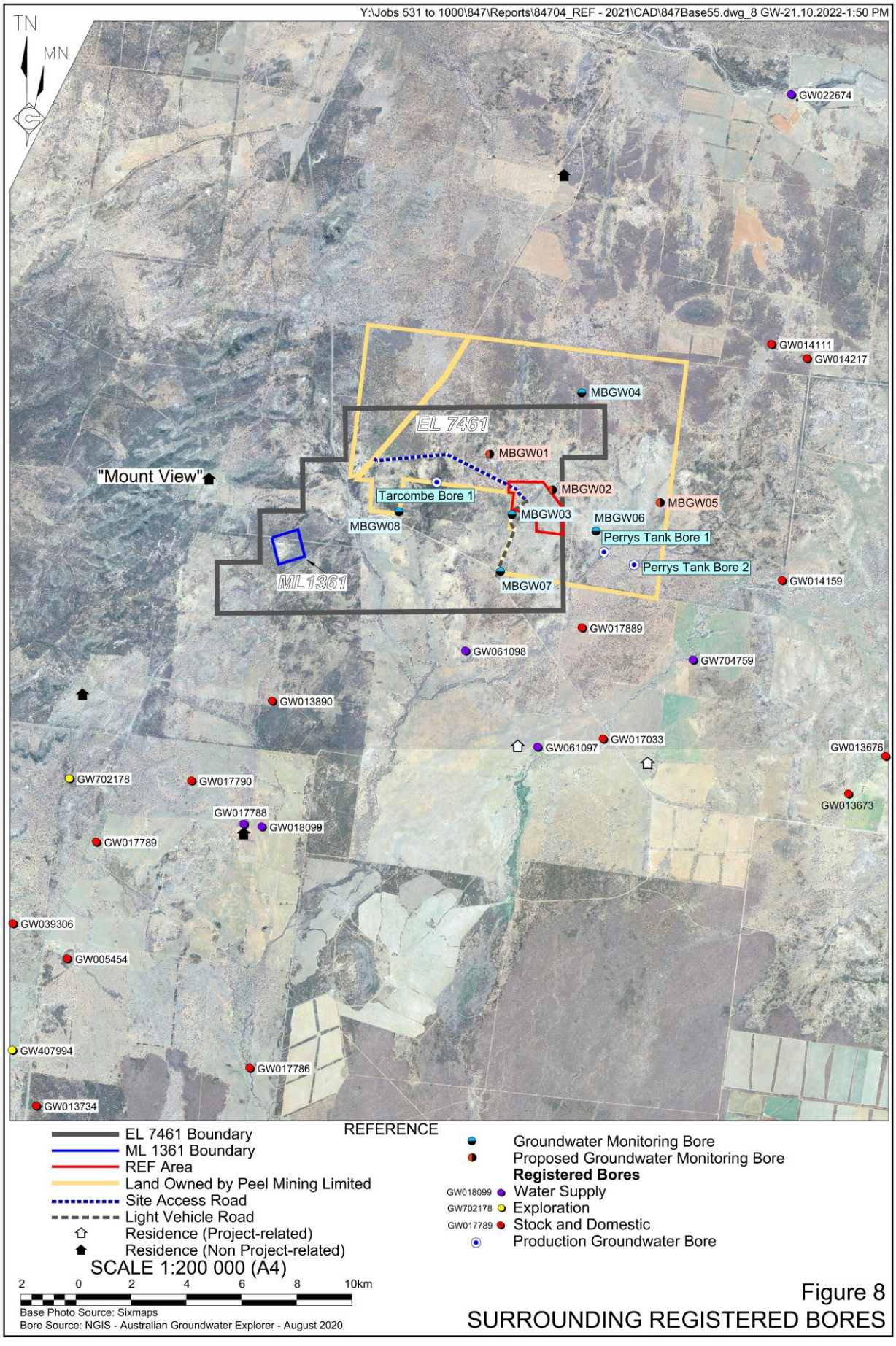

Figure 8
SURROUNDING REGISTERED BORES

Table 6
Groundwater Levels in Monitoring Bores

Monitoring Bore	Depth to Groundwater (m btoc)[1]			
	June 2021	November 2021	December 2021[3]	January 2022[4]
Established Groundwater Monitoring Bores				
MBGW03	NM	77.15	NM	29.61
MBGW04	NM	77.20	NM	75.34
MBGW06	NM	24.61	NM	18.40
MBGW07	26.4	24.96	NM	26.10
MBGW08	34.7	NM	NM	18.10
New Groundwater Monitoring Bores[2]				
MBGW01	NM	NM	71.4	NM
MBGW02	NM	NM	57.4	NM
MBGW05	NM	NM	33.8	NM

Note 1: m btoc - metres below top of casing.
Note 2: Groundwater monitoring bores drilled following the preparation of GHD (2023).
Note 3: Water levels recorded by drillers during installation of new groundwater monitoring bores.
Note 4: Water levels recorded by Peel Mining personnel.

Source: GHD (2023) – after Table 4.3.

Recorded groundwater levels vary between approximately 18.10m below top of casing and 77m below top of casing, with MBGW06, MBGW07 and MBGW08 groundwater levels indicating potentially or partially confined aquifer conditions (GHD, 2023). Analysis of the groundwater levels indicate the flow is from south to north. This direction is not correlated with topography, where ground surface levels generally decrease to the south.

2.5.2.4 Groundwater Quality

Table 7 presents groundwater quality results of the monitoring bores from sampling undertaken in June 2021, and the Tarcombe and Perry's production bores from sampling undertaken in May 2018 and March 2020, and March 2020, respectively.

The groundwater within the REF Area is saline (8,680µS/cm to 33,300µS/cm), slightly basic (7.73pH units to 8.98pH units), and the alkalinity is primarily in the form of bicarbonate (GHD, 2023). Concentrations of dissolved metals are generally low, however dissolved antimony concentrations are variable (between 0.004mg/L and 0.019mg/L). Concentrations of dissolved boron were recorded between 0.7mg/L and 1.6mg/L, and concentrations of molybdenum and nickel were recorded above the limit of reporting (LOR) across the monitoring bores with two exceptions (see **Table 7**) (GHD, 2023).

GHD (2023) also recorded dissolved metals concentrations above the LOR at monitoring bore MBGW03 for arsenic (0.002mg/L) and chromium (0.048mg/L), and at monitoring bore MBGW07 for zinc (0.007mg/L).

Table 7
Monitoring and Production Bore Groundwater Quality Results

Analyte	Unit	LOR	Monitoring Bore				Production Bore		
			MBGW03	MBGW04	MBGW06	MBGW07	Tarcombe Bore (2018)	Tarcombe Bore (2020)	Perry's Bore (2020)
Physiochemical									
pH	pH units	0.01	8.98	7.77	7.73	7.74	7.34	NS	NS
EC	µS/cm	1	8680	29700	33300	12800	8860	NS	NS
TDS[1]	mg/L	10	6640	25200	34100	10500	5760	NS	NS
TSS[2]	mg/L	5	NS	NS	NS	NS	8	NS	NS
Alkalinity (as $CaCO_3$)									
Hydroxide	mg/L	1	<1	<1	<1	<1	<1	<1	<1
Carbonate	mg/L	1	45	<1	<1	<1	<1	<1	<1
Bicarbonate	mg/L	1	36	628	546	387	504	477	522
Total Alkalinity	mg/L	1	81	628	546	387	504	477	522
Ions									
Calcium	mg/L	1	198	526	654	512	327	292	997
Magnesium	mg/L	1	265	966	1940	580	272	300	1200
Sodium	mg/L	1	1410	6650	7310	1950	1460	1670	3690
Potassium	mg/L	1	43	81	48	43	30	28	38
Chloride	mg/L	1	2490	9120	9260	3870	1990	3080	8670
Sulfate	mg/L	1	1020	4150	10100	1800	1420	1320	3540
Nutrients									
Nitrate as N	mg/L	0.01	NS	NS	NS	NS	0.26	0.06	0.18
Nitrite as N	mg/L	0.01	NS	NS	NS	NS	<0.01	<0.01	<0.01
Nitrite plus Nitrate as N (NOx)	mg/L	0.01	NS	NS	NS	NS	0.26	0.06	0.18

Table 7 (Cont'd)
Monitoring and Production Bore Groundwater Quality Results

Analyte	Unit	LOR	Monitoring Bore				Production Bore		
			MBGW03	MBGW04	MBGW06	MBGW07	Tarcombe Bore (2018)	Tarcombe Bore (2020)	Perry's Bore (2020)
Dissolved Metals									
Aluminium	mg/L	0.001	NS	NS	NS	NS	0.01	NS	NS
Antimony	mg/L	0.001	0.004	<0.010	0.019	<0.001	NS	NS	NS
Arsenic	mg/L	0.001	0.002	<0.01	<0.01	<0.001	<0.001	0.002	<0.001
Boron	mg/L	0.05	0.71	1.54	1.03	1.02	0.82	NS	NS
Cadmium	mg/L	0.0001	<0.0001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	0.048	<0.01	<0.01	<0.001	<0.001	0.004	<0.001
Copper	mg/L	0.001	<0.001	<0.01	<0.01	<0.001	0.002	<0.001	<0.001
Fluoride	mg/L	0.1	NS	NS	NS	NS	0.7	NS	NS
Iron	mg/L	0.05	<0.05	<0.1	<<0.1	<0.05	0.11	NS	NS
Lead	mg/L	0.001	<0.001	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	NS	NS	NS	NS	0.290	NS	NS
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	NS	NS
Molybdenum	mg/L	0.001	0.002	<0.01	0.02	0.002	<0.001	NS	NS
Nickel	mg/L	0.001	<0.001	0.012	0.03	0.015	0.002	<0.001	0.002
Silver	mg/L	0.001	<0.001	<0.01	<0.01	<0.001	<0.001	NS	NS
Thallium	mg/L	0.001	NS	NS	NS	NS	<0.001	NS	NS
Tin	mg/L	0.001	<0.001	<0.01	<0.01	<0.001	NS	NS	NS
Vanadium	mg/L	0.01	NS	NS	NS	NS	<0.01	NS	NS
Zinc	mg/L	0.005	<0.005	<0.05	<0.05	0.007	0.042	0.022	1.04

Note 1: TDS - Total Dissolved Solids
Note 2: TSS - Total Suspended Solids
NS: Not Sampled

Source: GHD (2023) – modified after Tables 4.4 and 4.5.

Groundwater quality across all monitoring bores is similar. The monitoring bores MBGW03, MBGW04 and MBGW07 are sodium chloride water type, and MBGW06 is sodium chloride/sulfate water type (GHD, 2023). This similarity is indicative of the fractured rock aquifer being connected across all the monitoring bores within the REF Area (GHD, 2023).

The groundwater at the Tarcombe Bore was also recorded as saline (8,860µS/cm) and circumneutral (7.34pH units). In 2018, concentrations of dissolved metals were generally low or below the LOR at this bore, with the exception of barium (0.007mg/L), boron (0.82mg/L), iron (0.11mg/L), manganese (0.290mg/L) and zinc (0.042mg/L) (GHD, 2023). Electrical conductivity (EC) and pH were not recorded in 2020, however alkalinity and major ion results are comparable to concentrations recorded in 2018. Dissolved metal concentrations recorded in 2020 were below the LOR with the exception of arsenic (0.002mg/L), chromium (0.004mg/L) and zinc (0.022mg/L) (GHD, 2023).

Dissolved metal concentrations recorded at Perry's Bore were low or below the LOR, with the exception of zinc (1.04mg/L), however major ion concentrations are significantly higher than that recorded at the Tarcombe Bore (GHD, 2023).

2.5.2.5 Aquifer Hydraulic Parameters

Aquifer hydraulic parameters have been determined through a review of previous groundwater studies at surrounding mining operations as no aquifer testing was undertaken within the REF Area (GHD, 2023). The studies included the Wirlong Exploration Project, Avoca Tank, the New Cobar Complex and the Federation Exploration Decline.

Wirlong Exploration Project

The Wirlong Exploration Project, owned by Peel Mining, is located 34km north of the REF Area. In 2021, a pumping test was undertaken by AquaWest and observed by Peel Mining personnel. GHD (2021) analysed the results and found that transmissivity was projected to be 81m^2/day. The transmissivity was measured from the top of an uncased section of the bore, meaning it likely represents the upper section of the aquifer which is expected to have the highest transmissivity, therefore transmissivity is expected to decrease with depth as overburden pressure would tend to close and tighten fractures (GHD, 2023).

Avoca Tank

Pumping tests at the Girilambone Mine determined the aquifer parameters for the Avoca Tank Groundwater Assessment (GHD, 2023). Multiple values were reported for hydraulic conductivity (0.483m/day and 0.781m/day) and specific storage (4.563x10-6 1/m and 1.565x10-6 1/m). which matched to close and distant observation wells (GHD, 2023).

New Cobar Complex

Results of slug testing at monitoring bores at the New Cobar Complex suggest the effective hydraulic conductivity is between $1.2x10^{-4}$m/day and $5.4x10^{-4}$m/day (GHD, 2023). **Table 8** presents the modelled aquifer parameters from the calibrated numerical groundwater model for the New Cobar Complex (GHD, 2023).

Table 8
New Cobar Complex Modelled Aquifer Properties

Hydrostratigraphic Unit	Horizontal Hydraulic Conductivity (m/day)	Specific Storage (1/m)
Weathered fractured rock	0.015	1.3×10^{-5}
Fractured rock	7.39×10^{-4}	1.3×10^{-5}
Fractured rock -500 to -1,000m AHD	1×10^{-5}	1.3×10^{-5}
Fractured rock below -1,000m AHD	1×10^{-6}	1.3×10^{-5}
Source: GHD (2023) – after Table 3.5.		

Federation Exploration Decline

A review of the groundwater inflows into the existing Hera Mine indicate that groundwater inflows were low, less than 0.3ML/day.

Mallee Bull REF Area Hydraulic Parameters

Based on hydraulic parameters correlated from groundwater assessments in the surrounding region, GHD (2023) assumed the following hydraulic parameters in order to predict potential groundwater inflow rates and impacts associated with dewatering.

- Aquifer hydraulic conductivity (k, m/day) – to address uncertainties, a range of transmissivity values (T)[1] (T = k x L), including 0.01, 0.1, 0.15 and 1, were adopted for modelling purposes.
- Aquifer thickness (L) – a thickness of 650m was adopted based on:
  - an average surface water level of 50m below ground level based on water strike and groundwater monitoring data; and
  - an assumed based of the transmissive portion of Palaeozoic rocks at 700m.
- Drawdown required (H) – as the base of the decline would be up to 400m below ground level and the average surface water level is assumed to be 50m below ground level, drawdown of 350m was adopted.
- Radius at which drawdown is required – as the outer diameter of the decline would be 50m, a radius of 100m was assumed.
- Elapsed time (t, days) – estimated decline construction time of 2 years (730 days).
- Storage coefficient (S, m/m) – a conservative storativity of 1 x 10^{-5} was adopted based on aquifer storage for fractured rock aquifers and adopted aquifer storage values from groundwater assessments for surrounding mining operations.

2.5.2.6 Registered Bores

Figure 8 and **Table 9** present nine registered bores within approximately 15km of the REF Area, with six listed as "Stock" and three as "Stock and Domestic". Three unregistered landholder bores were also identified within 20km of the REF Area during a site visit undertaken by GHD on 8 December and 9 December 2021.

[1] Transmissivity: T = k x L.

Table 9
Registered Bores within 15km of the REF Area

Bore ID	Bore Depth (m)	Distance (km)	Purpose
GW017889	54.9	4.9	Stock
GW017033	36.6	9.0	Stock
GW013890	43.3	11.5	Stock
GW014159	108.8	9.3	Stock
GW014111	54.3	10.3	Stock
GW014217	55.5	11.1	Stock
GW061097	151	8.9	Stock and Domestic
GW061098	103	5.8	Stock and Domestic
GW704759	96	8.1	Stock and Domestic
Source: GHD (2023) – modified after Table 3.6.			

2.5.2.7 Groundwater Dependent Ecosystems

A groundwater dependent ecosystem (GDE) is an ecosystem that requires access to groundwater to meet all of some of their water requirements to maintain their communities of plants and animals, ecological processes, and ecosystem services (GHD, 2023).

GHD conducted a search of the Groundwater Dependent Ecosystem Atlas to identify GDEs within 20km of the REF Area, which determined no known GDEs are recorded within 20km the REF Area. A review of the Murray-Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan was also conducted, and no high priority GDEs were identified within or near the REF Area.

Table 10 presents the potential aquatic and terrestrial GDEs identified within 20km of the REF Area. The closest of these potential terrestrial GDEs is within approximately 4km of the REF Area.

Table 10
Potential Aquatic and Terrestrial GDEs within 20km of the REF Area

GDE	GDE Type	Potential
Burthong Creek	Aquatic	Potential
Crowl Creek	Aquatic	Potential
Thule Creek	Aquatic	Potential
Poplar Box – Mulga – Ironwood woodland	Terrestrial	Moderate Potential
Belah/Black Oak – Western Rosewood – Leopardwood low open woodland	Terrestrial	Moderate Potential
Black Bluebush low open shrubland	Terrestrial	Moderate Potential
Chenopod low open shrubland	Terrestrial	High Potential
River Red Gum – Black Box woodland wetland	Terrestrial	High Potential
Source: GHD (2023)		

While there are potential aquatic and terrestrial GDEs within 20km of the REF Area, the deep groundwater levels and the ephemeral nature of the watercourses make it unlikely that these communities are GDEs (GHD, 2023).

2.6 Description of Threatened Species, Populations and Ecological Communities

2.6.1 Introduction

Peel Mining engaged AREA Environmental & Heritage Consultants Pty Ltd (AREA) to complete a Biodiversity Development Assessment Report (BDAR) for the Project. The resulting report, referred to hereafter as AREA (2022a) is presented as **Appendix 4**.

AREA (2022a) was prepared in accordance with the *Biodiversity Assessment Methodology* (BAM, 2020). It is noted that as an application to be assessed under Part 5 of the EP&A Act, a full BDAR was not required for the Project. Notwithstanding this, given that the likely subsequent application to be prepared to mine the Mallee Bull Deposit would be classified as a State Significant Development and that a BDAR would be required for such an application, Peel Mining determined that the biodiversity assessment should be undertaken as a full BDAR. The preparation of a BDAR also enables Peel Mining to determine the biodiversity offsets required for the proposed vegetation disturbance.

The BDAR was certified by Mr Phil Cameron, NSW Biodiversity Assessment Method Assessor: accreditation number BAAS17082.

For the purposes of this document and in accordance with BAM (2020), the following areas are defined.

- The development footprint – comprising the proposed limit of disturbance within the Mallee Bull REF Area.
- The Biodiversity Survey Area – referred to by AREA (2022a) as the "study area", comprising all land assessed by AREA (2022a).

2.6.2 Survey Methodology

AREA (2022a) undertook initial desktop assessments using Central West Lachlan State Vegetation Map (SVM) aerial imagery, which was ground truthed during field surveys undertaken in May, October and December 2021. The field surveys included the following.

- Twenty-five nested 20m x 20m plots within larger 20m x 50m plots, referred to hereafter as BAM plots (**Figure 9**). Within each plot the following data was recorded in accordance with BAM (2020).
  - Species composition and abundance for each layer (including upper/canopy, mid-storey/shrub stratum, and groundcover/ orbs and grasses).
  - Plant composition or floral biodiversity.
  - Function analysis including size classes of trees and tree hollows, ground logs and amount of leaf litter.

- Targeted surveys, including the following.
  - Bat echolocation call analysis.
  - Call playback and spotlighting over one night.
  - Two bioacoustics recorders set to collect data for five minutes in every hour from 21 May 2021 to 6 August 2021.
  - Two ultrasonic bat monitors in place for three nights.
  - Scat detection and spot assessment technique.
  - Threatened species search transects throughout the development footprint.
  - Mapping and observation of hollows.

The BDAR assessed approximately 52.44ha, comprising approximately 15.5ha of existing Site Access Roads and 36.94ha of native vegetation. As the existing Site Access Roads have already been cleared, they have not been considered in the development footprint for the purposes of the BDAR.

2.6.3 Plant Community Types

AREA (2022a) mapped the following three Plant Community Types (PCTs) as occurring within the development footprint. The PCTs were further delineated into vegetation zones for entry into the BAM Credit Calculator (BAM-C) (**Figure 10**).

- PCT 103 – Poplar Box – Gum Coolabah – White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
- PCT 104 – Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
- PCT 176 – Green Mallee – White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion

No *Biodiversity Conservation Act 2016* (BC Act) listed Threatened Ecological Communities (TECs), or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed Ecological Communities are associated with any of the PCTs identified in **Table 11**.

AREA (2022a) also state that no Areas of Outstanding Biodiversity Value under the BC Act occur within the previously not introduced.

2.6.4 Threatened Flora and Fauna

A total of 30 ecosystem credit species listed under the BC Act and EPBC Act were identified by AREA (2022a) as predicted to occur within the Biodiversity Survey Area. Two predicted species were excluded due to habitat constraints not present within the Biodiversity Survey Area. The remaining 28 species did not require further survey and the potential impact of the Project to these species was calculated using the BAM-C.

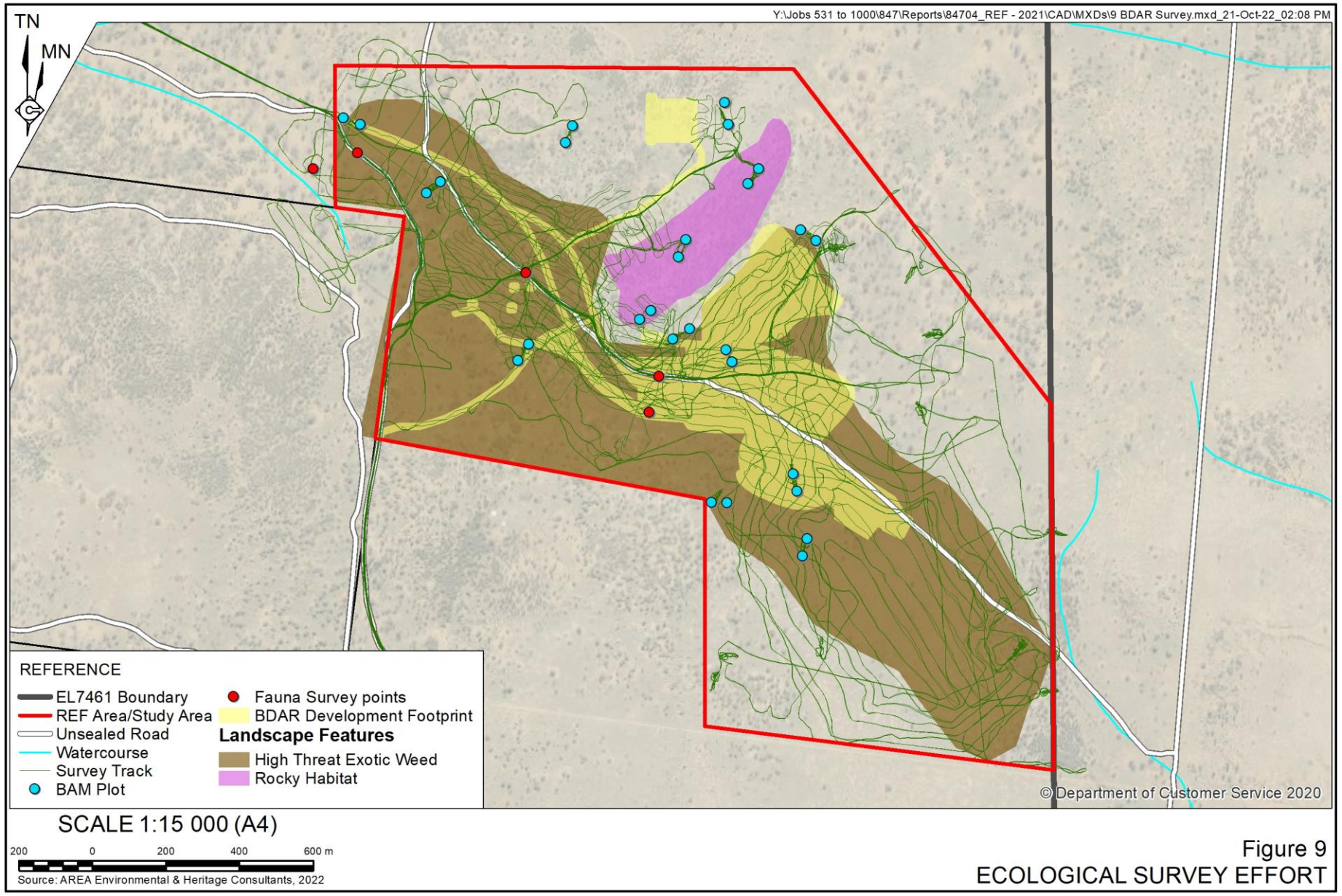

Figure 9
ECOLOGICAL SURVEY EFFORT

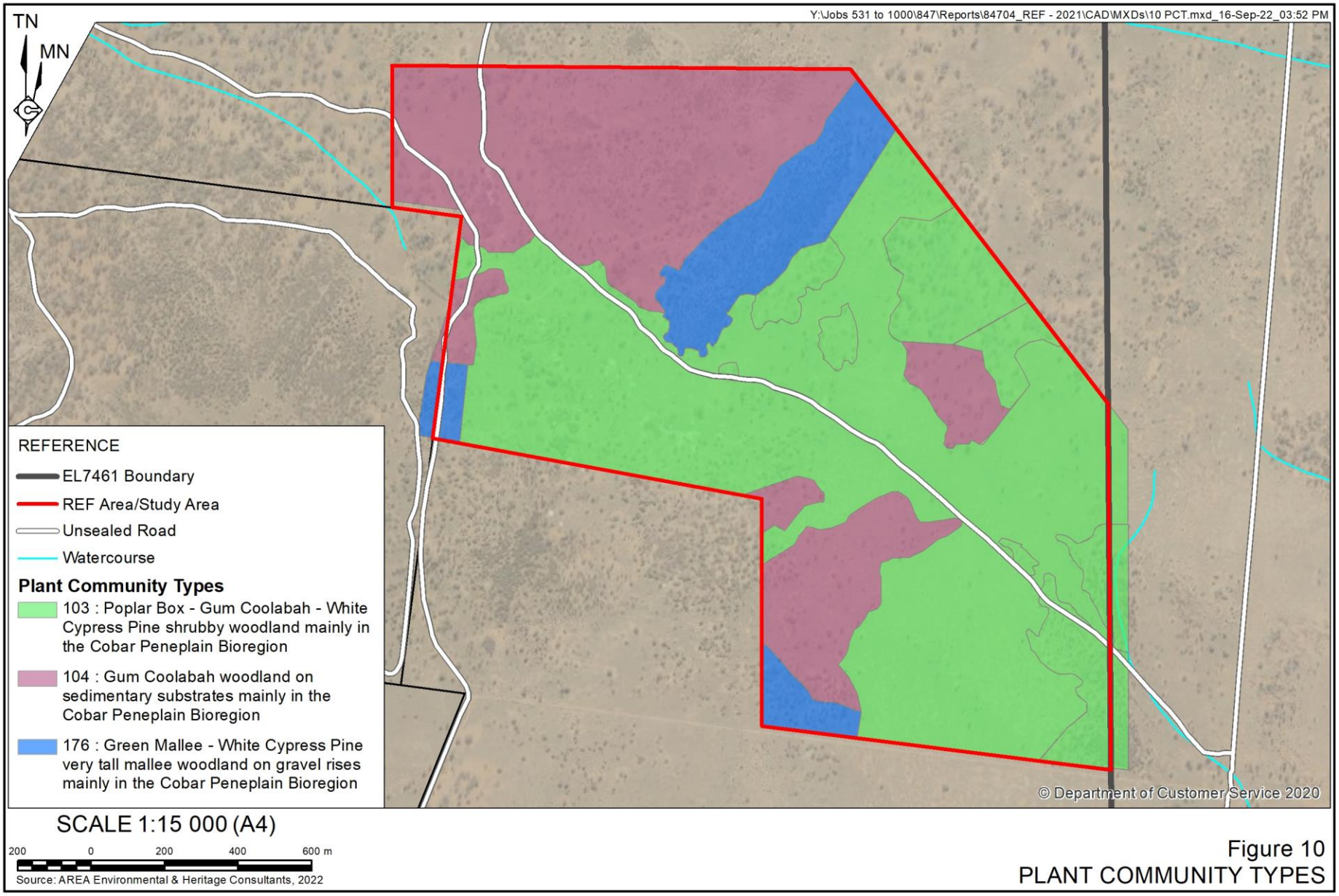

Figure 10
PLANT COMMUNITY TYPES

AREA (2022a) identified 16 species credit species listed under the BC Act and EPBC Act as predicted to occur within the Biodiversity Survey Area. Of these, four flora species and seven fauna species credit species were retained as candidate species credit species, whereby their presence was determined through targeted threatened species surveys. Tables 10 and 11 of AREA (2022a) provide the justifications for the exclusion of the other 5 species credit species.

Table 11 presents a summary of the candidate species credit species predicted to occur.

Table 11
Threatened Species Predicted to Occur

Species		BC Act Listing	EPBC Act Listing	Method to Determine Presence	Present?	Further Assessment Required?[1]
Common Name	Scientific Name					
Flora						
Curly-bark Wattle	*Acacia curranii*	Vulnerable	Vulnerable	Targeted threatened species survey	No	No
Pine Donkey Orchid	*Diuris tricolor*	Vulnerable	Not listed	Targeted threatened species survey	No	No
Holly-leaf Grevillea	*Grevillea ilicifolia subsp. ilicifolia*	Critically Endangered	Not listed	Targeted threatened species survey	No	No
Greenhood Orchid	*Pterostylis cobarensis*	Vulnerable	Not listed	Targeted threatened species survey	No	No
Fauna						
Bush Stone-curlew	*Burhinus grallarius*	Endangered	Not listed	Targeted threatened species survey	No	No
Glossy Black-Cockatoo, Riverina population	*Calyptorhynchus lathami – endangered population*	Endangered Population	Not listed	Targeted threatened species survey	No	No
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	Vulnerable	Not listed	Targeted threatened species survey	No	No
Barking Owl	*Ninox connivens*	Vulnerable	Not listed	Targeted threatened species survey	No	No
Koala	*Phascolarctos cinereus*	Endangered	Endangered	Targeted threatened species survey	No	No
Superb Parrot	*Polytelis swainsonii*	Vulnerable	Vulnerable	Targeted threatened species survey	No	No
Masked Owl	*Tyto novaehollandiae*	Vulnerable	Not listed	Targeted threatened species survey	No	No
Note 1: Further assessment required under BAM Subsections 5.2.5 and 5.2.6.						
Source: AREA (2022a) – After Tables 12 and 13						

Targeted field surveys undertaken following the requisite assessment guidelines did not identify any of the candidate species to be present, and therefore no species credit species are generated by the Project.

No threatened flora species listed under the BC Act or EPBC Act were identified within the development footprint (AREA, 2022a). The following three listed threatened fauna species were identified within the development footprint during field surveys.

- Little Eagle – *Hieraaetus morphnoides*
- Grey-crowned Babbler (eastern subspecies) – *Pomatostomus temporalis*
- Little Pied Bat – *Chalinolobus picatus*

AREA (2022a) have accounted for Little Eagle and Grey-crowned Babbler as ecosystem species credit species, and Little Pied Bat was added to the BAM-C.

2.7 Description of Aboriginal Cultural Heritage

Peel Mining engaged AREA to undertake an archaeological survey of the REF Area for the Project. The resulting report, referred to hereafter as AREA (2022b) is presented as **Appendix 5** of this document.

AREA (2022b) undertook a search of relevant databases and previous archaeological studies for records of registered Aboriginal objects within or surrounding the REF Area. Four registered sites adjacent to the western boundary of the REF Area were identified.

The REF Area is within the registered native title application NC2012/001 – Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan. All land within the REF Area is under Western Lands Lease and, as a result, Native Title has been extinguished.

The fieldwork component of the assessment was undertaken over two survey periods on 4 to 6 February 2022 and 12 and 13 February 2022. The surveys were undertaken by Anna Darby and Mel Hancock of AREA. Peter Harris, Janine Ohlsen, Krista Masaarna, and Jarhen Kennedy who represented the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants were in attendance to provide cultural knowledge. The Study Area that was surveyed by AREA included the entire boundary of the REF Area and the Site Access Road (**Figure 1**).

The field methods used follow those described in the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010).

Table 12 and **Figure 11** present the results of the field surveys. A total of 41 Aboriginal sites were identified within the Study Area and Site Access Road, including the following.

- 12 stone artefacts
- 5 isolated stone artefacts
- 20 culturally modified trees (scarred)
- 2 grinding groves sites
- 2 hearths

AREA (2022b) concluded that one Aboriginal site (Mallee Bull AS05) would be partially impacted by the Project, impacts to twelve sites within 100m of the development footprint were avoided, however mitigation measures are required to reduce the likelihood of indirect impacts. The remaining 28 sites are more than 100m away from the development footprint and would be avoided by the Project.

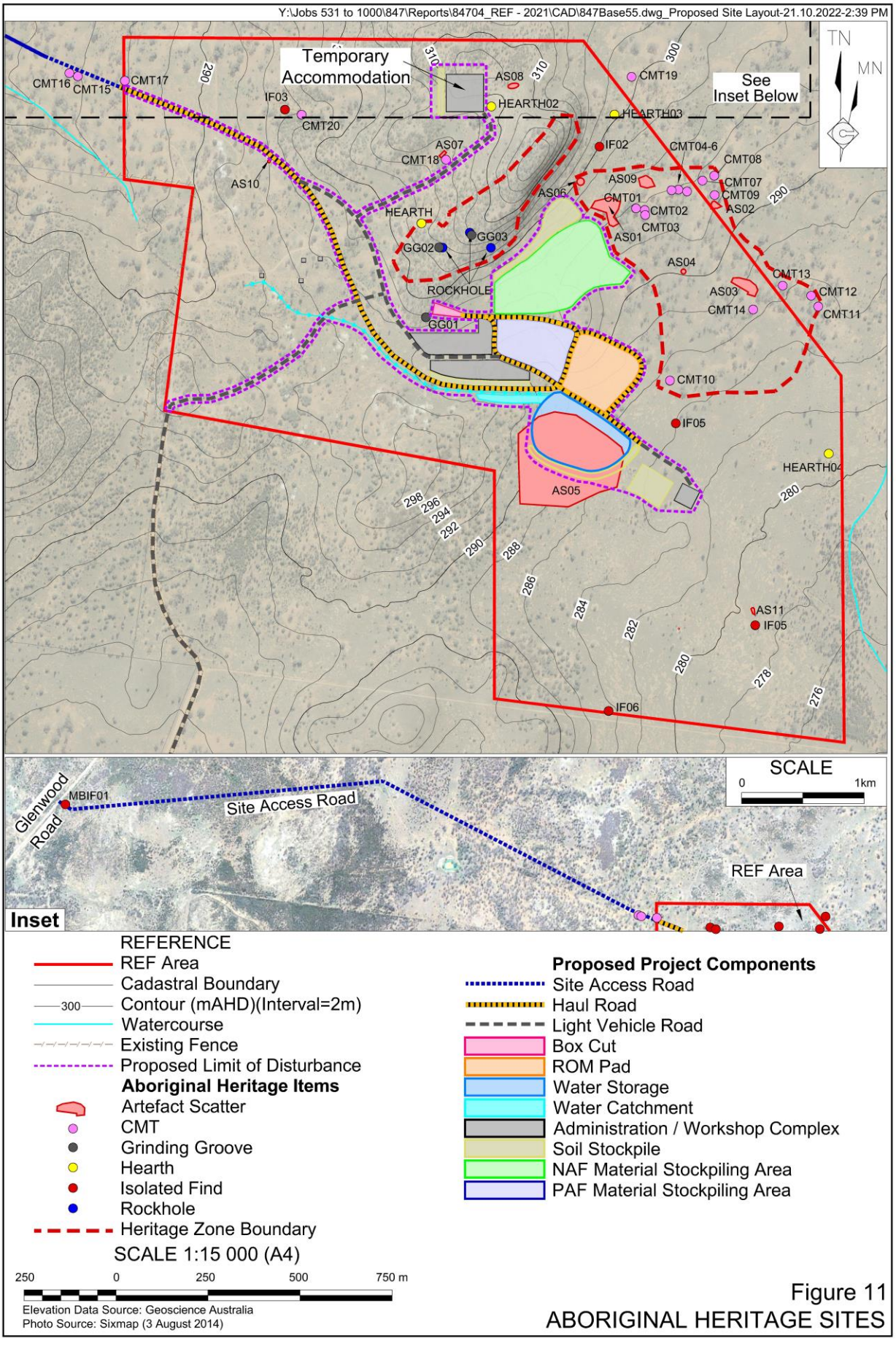

Figure 11
ABORIGINAL HERITAGE SITES

Table 12
Aboriginal Heritage Survey Results

Site	Description
Artefact Scatters	
Mallee Bull AS01	Mallee Bull AS01 is a stone artefact scatter located on mid-slope within a large ground surface exposure either side of an unsealed track. Twenty stone artefacts were observed which included complete flakes, flake fragments, and cores. Approximately 10% of the artefacts possessed cortex, ranging from 5% to 10% of its surface area.
Mallee Bull AS02	Mallee Bull AS02 is located on the northeastern boundary of the study area, 13 stone artefacts were observed within the scatter, and include flakes, cores, and a retouched scrapper. Raw materials include basalt, chert, and silcrete. A hearth was observed within the Aboriginal site, containing hard clumps of baked clay. Ground Surface Visibility (GSV) varied from high to moderate across the site.
Mallee Bull AS03	Mallee Bull AS03 is located in the northeast section of the study area within a large exposure and is comprised of five artefacts, including flakes and a core, made of silcrete and chert. All artefacts have been retouched with one dark grey chert flake retouched into a scrapper along the distal edge. Mallee Bull AS03 is within a drainage line running in a northwest to southeast direction.
Mallee Bull AS04	Mallee Bull AS04 is located 120m west of Mallee Bull AS03 and is located within a small exposure with high GSV (90%) on a flat landform. Three small stone artefacts are recorded within the site, due to low GSV outside the exposure there is a potential for further artefacts to be recorded. The artefacts are simple flakes of pale brown silcrete.
Mallee Bull AS05	Mallee Bull AS05 is a large stone artefact scatter comprising of hundreds of artefacts located south of an unsealed track, in the central portion of the study area. The Aboriginal site measures 300m north-south and 400m east-west. Many of the artefacts are flakes and cores with a number of stone tools including a hammer stone, a ground edges stone axe, and possible stone chisels. A variety of the raw materials were observed including quartz, quartzite, silcrete, mudstone, and sandstone. The site is located within a series of exposures of various sizes, on a flat plain. Low GSV outside the exposures mean there is a potential for more artefacts to occur within the grass.
Mallee Bull AS06	Mallee Bull AS06 is a small artefact scatter located within a small drainage line sloping gently towards the east. The recorded site extent is the exposure were GSV is high, but it is likely that the site extends to the east where artefacts could have washed downhill. Three stone artefacts were recorded at the site. Artefacts are made from pale red silcrete, no use wear or retouch was noted on the flakes. Soils are deflated across the site.
Mallee Bull AS07	Mallee Bull AS07 is located 12m northwest of Mallee Bull CMT 18 within a section of a dried creek bed. The artefact scatter is comprised of nine flakes made of either silcrete or mudstone. No artefacts were observed along the banks of the 1st order drainage line suggesting that the artefacts have washed into the waterway or were exposed by erosion.
Mallee Bull AS08	Mallee Bull AS08 is located within an exposure on a small crest in the northern section of the study area. The artefact scatter is comprised of two artefacts, a large basalt flake with retouch along two of the three edges and a small chert core.
Mallee Bull AS09	Mallee Bull AS09 is located on a flat landform within a large exposure measuring 50m north to south and 35m east to west. The artefacts within the scatter are comprised of 12 chert flakes and cores some with retouch. A sandstone hammerstone or possible axe head was also observed within the scatter.

Table 12 (Cont'd)
Aboriginal Heritage Survey Results

Site	Description
Artefact Scatters (Cont'd)	
Mallee Bull AS10	Mallee BullAS10 is located on the southwestern side of an exposure 60m north of an unsealed access track in the central portion of the study area. Three possible artefacts were observed in an area of high GSV (90%) and comprised of basalt. AREA (2022b) determined these fragments are not Aboriginal objects but are crushed basalt/blue metal left behind by exploration drilling practices as definitive lithic attributes were not present. The stone pieces observed were recorded as an Aboriginal site by requested of the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants.
Mallee Bull AS11	Mallee Bull AS11 is located on a series of soil surface exposures on an undulating plain in the southeast portion of the study area. The Aboriginal site is comprised of a least eight stone artefacts of the same brown material, possibly indurated mudstone. Cortex was observed on the flakes, no backing or retouch was noted. Due to the dense grass outside the exposures, there is a potential for more artefacts. The likelihood of intact subsurface artefacts is low based on the landform and shallow thin deflated soils.
Mallee Bull AS12	Mallee Bull AS12 is located within an exposure on flat landform context. The northern side of the exposure contains a Budda Bush. This bush is used for men's business and smoking ceremonies (pers. Coms Peter Harris). The Aboriginal site contains two pale pink basalt artefacts, a flake and possible core.
Isolated Artefacts	
Mallee Bull IF01	Mallee Bull IF01 is an isolated stone artefact located on an exposure on the northern verge of an unsealed vehicle track, approximately 50m east of Glenwood Road. The track extents from Glenwood Road eastward towards the study area, the track will be upgraded for the proposed haul road. The artefact is likely an arapia (woodworking tool) made of white sandstone, it measures 11.5cm long, 7.5cm wide and 3cm thick.
Mallee Bull IF02	Mallee Bull IF02 is an isolated stone artefact located on the southern bank of a drainage line in the northeastern portion of the study area. The artefact is a stone flake comprised of possibly basalt or chert.
Mallee Bull IF03	Mallee Bull IF03 is located in the eastern portion of the study area and approximately 500m northeast of Mallee Bull AS05. A flake was observed within the site. A rectangular block of white basalt was also observed approximately one metre south of the flake. AREA (2022b) believed the sandstone block was not Aboriginal in origin (i.e. a grinding dish or the like) due to the square shape the block and tools used to cut it and therefore, should not be recorded as part of the Aboriginal site. The Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants believed that the block was used for cultural purposes and should be recorded. Archaeologically the flake has been recorded as an isolated find with the white basalt block noted as part of its listing.
Mallee Bull IF04	Mallee Bull IF04 is located on a small top slope in the southeast portion of the study area. Several Warrior Bushes were surrounding the site. Soils were stone and shallow with fragments of sandstone protruding from the soil. The artefact is a large flake or possible core made of pale brown basalt.
Mallee Bull IF05	Mallee Bull IF05 is an isolated stone artefact located on a slight mid slope at the southern end of the study area. The artefact is a degraded sandstone tool, possibly an *arapia*, a woodworking tool.

Table 12 (Cont'd)
Aboriginal Heritage Survey Results

Site	Description
Culturally Modified Trees	
Mallee Bull CMT 01	Mallee Bull CMT01 is located within a grove of Bimble Box trees in the northeast section of the study area. It is within immediate proximity to Culturally Modified Trees 2,3,4,5 and 6. The scar is located on the southern face of a large Bimble Box tree and measures 2.5m long by 0.7m wide and with 0.55m of regrowth. The scar 55cm above the ground level and contains axe marks, possibly stone, in a horizontal linear dash pattern not unlike ring barking across the top and bottom of the scar face.
Mallee Bull CMT 02	Mallee Bull CMT02 is located within a grove of Bimble Box trees in the northeast section of the study area. The tree is a large Bimble Box with multiple trunks, with at least one epicormic trunk resulting from the scar itself. The scar is located on the main trunk and on the western side of the tree. The scar measures 1.5m long and 0.4m at the widest point. The majority of the bottom of the scar has been covered over by the epicormic growth. It is within immediate proximity to Culturally Modified Trees 1,3,4, 5 and 6.
Mallee Bull CMT 03	Mallee Bull CMT 03 is located approximately 15m south of Mallee Bull CMT 02 and is a Bimble Box tree. The scar is located on the eastern side of the tree and has been mostly grown over by epicormic growth. The visible scar measures 0.2m wide, 0.87m long and with 0.15m of regrowth. Discussions with Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants site officers thought the bark from this scar could have been used for a coolamon. It is within immediate proximity to Culturally Modified Trees 1,2,4,5 and 6.
Mallee Bull CMT 04	Mallee Bull CMT04 is located within the same grove of vegetation as Culturally Modified Trees (scarred) 1 to 3 and 5 and 6. The tree is a mature Bimble Box and contains two cultural scars on the northern and western sides on the main trunk. The scar on the northern side extends into the ground and is mostly covered by epicormic growth. The scar measures 0.55m long, 0.2m wide and with a depth of 0.2m. The scar on the western side of the tree measures 1.3m long and 0.35m wide, with a large epicormic growth at the base of the scar. The bark from the scar on the western side was probably used for shelters.
Mallee Bull CMT 05	Mallee Bull CMT05 is located within the same grove as Culturally Modified Trees 1 to 4 and 6. The tree is a large Bimble Box with two trunks. The largest truck on the south side contains two scars (scar 1 and scar 2) and the second possibly older trunk contains a third scar. Scar 1 on the southern side of the trunk is 0.2m above the ground and measures 1.56m long, 0.45m wide, with irregular regrowth around the edges. The face of scar 1 is very weathered and damaged. Scar 2 is located on the same truck as the scar 1, on the western side. This scar is 10cm above ground, 47cm long, 16cm wide and containing 15cm of regrowth. The possibly older trunk has been broken off just above the third scar and is very weathered and damaged. The third scar measures 2.6m in length and 0.45m wide with 0.1m of regrowth. The scar face is extremely weathered and mostly gone.
Mallee Bull CMT 06	Mallee Bull CMT 06 is located on a flat landform context within the grove of Bimble Boxes and bushes. It is within immediate proximity to Culturally Modified Trees 1,2,3,4 and 5. The scar on the eastern side of the tree has mostly closed over with 15cm of regrowth and the face of the scar measures 104cm long and 23cm wide.
Mallee Bull CMT 07	Mallee Bull CMT 07 is located on a flat landform context within Bimble Box grassy woodland. The tree is a Bimble Box with a small, mostly grown over cultural scar on the eastern side of the trunk. The scar is 0.5m above the ground, 0.55m long, 0.14m wide and with 0.2m of regrowth.

Table 12 (Cont'd)
Aboriginal Heritage Survey Results

Site	Description
Culturally Modified Trees (Cont'd)	
Mallee Bull CMT 08	Mallee Bull CMT 08 is located within a patch of Bimble Box trees and Wilga shrubs with moderate to low GSV due to the leaf litter and native grasses. A 1st order drainage line lies five metres southwest of Mallee Bull CMT 08. The scar is located on the southwest side of Bimble Box possessing epicormic trunks. The scar measures 1.93m long, 0.40m wide and with 0.20m of regrowth. The face of the scar is weathered and broken.
Mallee Bull CMT 09	Mallee Bull CMT 09 is a large Bimble Box containing two scars on the southwest and northeast sides of the tree. The southwest facing scar is the largest and measures 2.0m long, by 0.28m wide and with 0.2m of irregular regrowth which bows in the middle. The smaller scar on the northeast side of the tree measures 1.46m long, 0.29m wide and with 0.24m of regrowth.
Mallee Bull CMT 10	Mallee Bull CMT 10 is located within a clump of Bimble box trees and Wilga shrubs with moderate to low GSV due to the leaf litter and grasses. The scar is located on the eastern side of a Bimble Box tree and measures 70cm long, 23cm wide and with 7cm of regrowth. The tree also contains two scars that are not of cultural origin, these a potentially Branch tears or other natural phenomena.
Mallee Bull CMT 11	Mallee Bull CMT 11 is located within a clump of Bimble box trees and Wilga shrubs with moderate to low GSV due to the leaf litter and grasses. The scar is located on the main trunk of a Bimble Box tree with two epicormic growths caused by the scaring are located at the base of the scar. The visible section of the scar measures 150cm long, 30cm wide and with 10cm of regrowth. Steel axe marks were observed along the top of the scar face.
Mallee Bull CMT 12	Mallee Bull CMT 12 is located outside the northeast boundary of the study area, 34m northwest of Mallee Bull CMT11 and 83m southeast of Mallee Bull CMT13. The site is comprised of a large scar on a Bimble Box. The scar is located on the main trunk of the tree measures 2.1m long, 0.8m wide and with 0.2m of regrowth. The other trunk is epicormic growth caused by scarring of the tree. Mallee Bull CMT 12 is outside the study area and will not impacted by the Project.
Mallee Bull CMT 13	Mallee Bull CMT 13 is located outside the northeast boundary of the study area, on a flat plain within Bimble Box grassy woodland. The tree is a mature Bimble Box with three trunks (main trunk, the scarred one and two epicormic trunks likely caused by scarring) within a small cluster of other box trees and Wilga shrubs. The scar is on the western trunk, is weathered and degraded and measures 0.7m long and 0.15m wide.
Mallee Bull CMT 14	Mallee Bull CMT 14 is located within the northeastern portion of the study area and 40m south of Mallee Bull AS03. The mature Bimble Box tree has with multiple epicormic trunks caused by initial scarring on the main trunk. The scar measures 1.2m long, 0.60m wide and with 0.3m of regrowth. The scar is slightly damaged by natural weathering at the base.
Mallee Bull CMT 15	Mallee Bull CMT 15 is located 15m south of the eastern end of the proposed haul road, a second unsealed track is located approximately 10m south of this site. The scar is located on the western side of the mature Bimble box with multiple trunks. The scar measures 1.75m long, 0.8m wide and with 0.9cm of regrowth.

Table 12 (Cont'd)
Aboriginal Heritage Survey Results

Site	Description
Culturally Modified Trees (Cont'd)	
Mallee Bull CMT 16	Mallee Bull CMT 16 is located 20m south of the eastern end of the proposed haul road, a second unsealed track is located approximately 10m south of the site. The site is located approximately 30m west of Mallee Bull CMT 15. Mallee Bull CMT 16 contains a single large scar on the main trunk of a mature living Bimble Box, the other trunks are epicormic growth from the scar. The scar is on the northeast side of the tree, is rectangular in shape and measures 2.0m long, 0.67m wide, and with 0.15m of regrowth. The size of the scar suggests that the bark would have been used as a shelter. Given the location of the tree near historic mining activity in the 1800s, it cannot be determined if the scaring was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin.
Mallee Bull CMT 17	Mallee Bull CMT 17 is located 13m north of proposed haul road and unsealed track at the western edge of the study area. The tree is large living Gum-barked Coolabah with the scar located on the main trunk. The other trunks are epicormic growth as a result of the scar. The scar is located on the south side of the tree and measures 3.1m long, 0.65m wide and with 0.25m of regrowth. Due to the large size of the scar the bark was potentially used to construct a shelter. Given the location of the tree near historic mining activity in the 1800s, it cannot be determined if the scaring was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin.
Mallee Bull CMT 18	Mallee Bull CMT 18 is located within a valley 10m east of a 1st order drainage line and 30m west of an unsealed track that accesses the weather station for Mallee Bull. Within the drainage line is Mallee Bull AS 07. The tree is a tall Gum-barked Coolabah with the scar located on the eastern side. The scar measures 2.1m long, 0.5m wide and with 0.15m of regrowth. The large size of the scar suggests that the bark would have been used for a shelter. Given the location of the tree near historic mining activity in the 1800s, it cannot be determined if the scaring was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin.
Mallee Bull CMT 19	Mallee Bull CMT 19 is located on a flat landform context within close proximity of a 1st order drainage line. The scar is located on the southern side of an old growth living Bimble Box tree. The scar measures 1.2m long, 0.40m at its widest point and with 0.3m of regrowth.
Mallee Bull CMT 20	Mallee Bull CMT 20 is located 10m south of a 1st order drainage line within the northern section of the study area. The scar is located on the southeastern side of the living Bimble box tree and measures 1.6m long by 0.28m wide and with 0.9m of regrowth. An epicormic growth is growing at the base of the scar and the top of the scar contains a hatching pattern made by a steel axe.
Grinding Grooves	
Mallee Bull GG01	Mallee Bull GG01 is located on a toe slope on the southern side of a hill dominated by Green Mallee in the central section of the study area. The slope contains an outcropping of sandstone rocks and fragments, two of the sandstone fragments contain several grinding grooves. The term 'Grinding Groove' has been used as it reflects discussions with the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants during the fieldwork. This artefact could also be called a 'Whetstone' where some have a grinding grove on both sides while others just on one surface. The principle use for Whetstones was for grinding and resharpening the blades of axes, chisels and knives. The grooves measure on average 15cm long, 5cm wide and 3cm deep, and have a U-shaped bottom.

Table 12 (Cont'd)
Aboriginal Heritage Survey Results

Site	Description
Grinding Grooves (Cont'd)	
Mallee Bull GG02	Mallee Bull GG02 is located on a mid-slope on the southern side of a hill dominated by Green Mallee in the central section of the study area. The crest and mid slope contain an outcropping of sandstone rocks. Approximately five metres downhill from the outcropping a sandstone fragment with a partial grinding groove was observed. The term 'Grinding Groove' has been used as it reflects discussions with the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants during the fieldwork. This artefact could also be called a 'Whetstone' where some have a grinding grove on both sides while others just on one surface. The principle use for Whetstones was for grinding and resharpening the blades of axes, chisels and knives. The groove covers the top of the fragment and measures 20cm long by 20cm wide.
Hearths/Fireplaces	
Mallee Bull Hearth 01	Mallee Bull Hearth 01 is located on the mid-slope on the western side of the ridgeline and contains a hearth of burnt clay and charcoal. The hearth is eroding out of the surface soil and is surrounded by quartz fragments of possible cultural origin. Given the location of the hearth near historic mining activity in the 1800s, it cannot be determined if the fireplace was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin. The hearth covers approximately one metre square.
Mallee Bull Hearth 02	Mallee Bull Hearth 02 is a circular grouping of stones within a large exposure at the head of a drainage line in the northern section of the study area. The stones would have been used in place of clay balls when cooking food in a hearth (pers. Comms Peter Harris). The rocks are rectangular in shape and range in size from five centimetres to approximately 15cm. The site is 190m northeast of Mallee Bull CMT18 and 70m southwest of Mallee Bull AS08. GSV within the site and around the drainage line was high (95%). Given the location of the hearth near historic mining activity in the 1800s, it cannot be determined if the fireplace was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin.
Source: AREA (2022b)	

The field survey also Identified water and cultural resources within the REF Area, including the following.

- Outcroppings of sandstone rocks and boulders used for water storage.
- Budha bush used for medicinal purposes.
- Rosewood used in smoking ceremonies.
- Belah trees.

Tangible and intangible Aboriginal cultural heritage values are contained within the Bimble Box grassy woodland in the eastern section of the Study Area, and the ridgeline, referred to as "Heritage Zones" (**Figure 11**). AREA (2022b), in consultation with the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title claimants over the two areas, state that these Heritage Zones should be avoided and fenced off. The Registered Native Title claimants have requested that other Aboriginal sites identified during the assessment to be avoided, however, where this is not possible, a surface collection of Aboriginal objects at risk of direct or indirect harm would be conducted and the artefacts placed within one of the Heritage Zones under an approved Aboriginal Heritage Impact Permit (AHIP).

2.8 Description of Historic Cultural or Natural Heritage

The following databases were searched on 18 July 2022 to identify heritage-listed items within or in close proximity to the REF Area.

- National Heritage List
- NSW State Heritage Inventory
- Cobar Local Environmental Plan (LEP) 2012

No items of historic, cultural or natural heritage were identified within or in close proximity to the REF Area.

3. The Proposed Activity

3.1 Summary of the Activity

Table 13 presents a brief summary of the proposed activity.

Table 13
Summary of the Proposed Activity

Mineral Authorities:	EL7461
Licence Holder:	Peel Mining Ltd
Operator:	Peel Mining Ltd
Activity Type:	Exploration decline
Activity Location:	Mallee Bull Project Site, Four Mile Station, 629 Grain Road, Gilgunnia, NSW.
Activity Duration:	Approximately 4 years from the approval of the REF

3.2 Description of the Activity

3.2.1 Overview

The objectives of the proposed exploration project are as follows.

- Define the mineral resources associated with the deeper portions of the Mallee Bull Prospect, located in the vicinity of Gilgunnia, NSW.
- Provide drill core samples for metallurgical, geotechnical and associated test work.

The proposed exploration program would involve the following activities.

- Construction of a box cut to a maximum depth of approximately 25m below ground level (mbgl).
- Construction of an exploration decline to a maximum depth of approximately 400mbgl.
- Construction of associated surface infrastructure including a:
  - workshop;
  - administration buildings (site office, ablutions facility);
  - core yard and geology block;
  - magazine;
  - potentially acid forming (PAF) waste rock stockpiling area;
  - non-acid-forming (NAF) waste rock stockpiling area;
  - water storage facility;

  - site access road and internal roads; and
  - other ancillary infrastructure (e.g. fuel storage area, water management infrastructure).
- Rehabilitation of the development footprint within the REF Area.

3.2.2 Site Establishment

Figure 12 presents the proposed Site Layout, which would include the following.

- A Site Access Road.
- An administration / workshop complex.
- A temporary accommodation building for mine employees to reside while working in the REF Area.
- A haul road, box cut, portal and decline.
- Material storage areas, including for NAF material, PAF material and the ROM Pad.
- Ancillary infrastructure areas, including:
  - an explosive storage magazine;
  - ventilation rises and surface fans;
  - an escapeway; and
  - soil stockpiles.
- Surface water infrastructure, including:
  - sediment basins to collect sediment laden water;
  - a lined water storage facility to collect water pumped from the decline and potentially low pH water from the PAF Stockpile Area and ROM Pad;
  - a water catchment area to collect clean water runoff from within the REF Area; and
  - clean and dirty water diversions to ensure that clean water does not flow into disturbed areas and that dirty or sediment-laden water is retained within the surface water management system.

Site establishment would include the following.

- Marking out by a qualified surveyor of all areas of approved disturbance, as displayed on **Figure 12**.
- Establishment of the Site Access Road. The site access road would be an unsealed, two lane access suitable for use by heavy vehicles. Roadside drainage would be installed in accordance with *Managing Urban Stormwater – Volume 2C (Unsealed Roads)* (also known as the Blue Book).

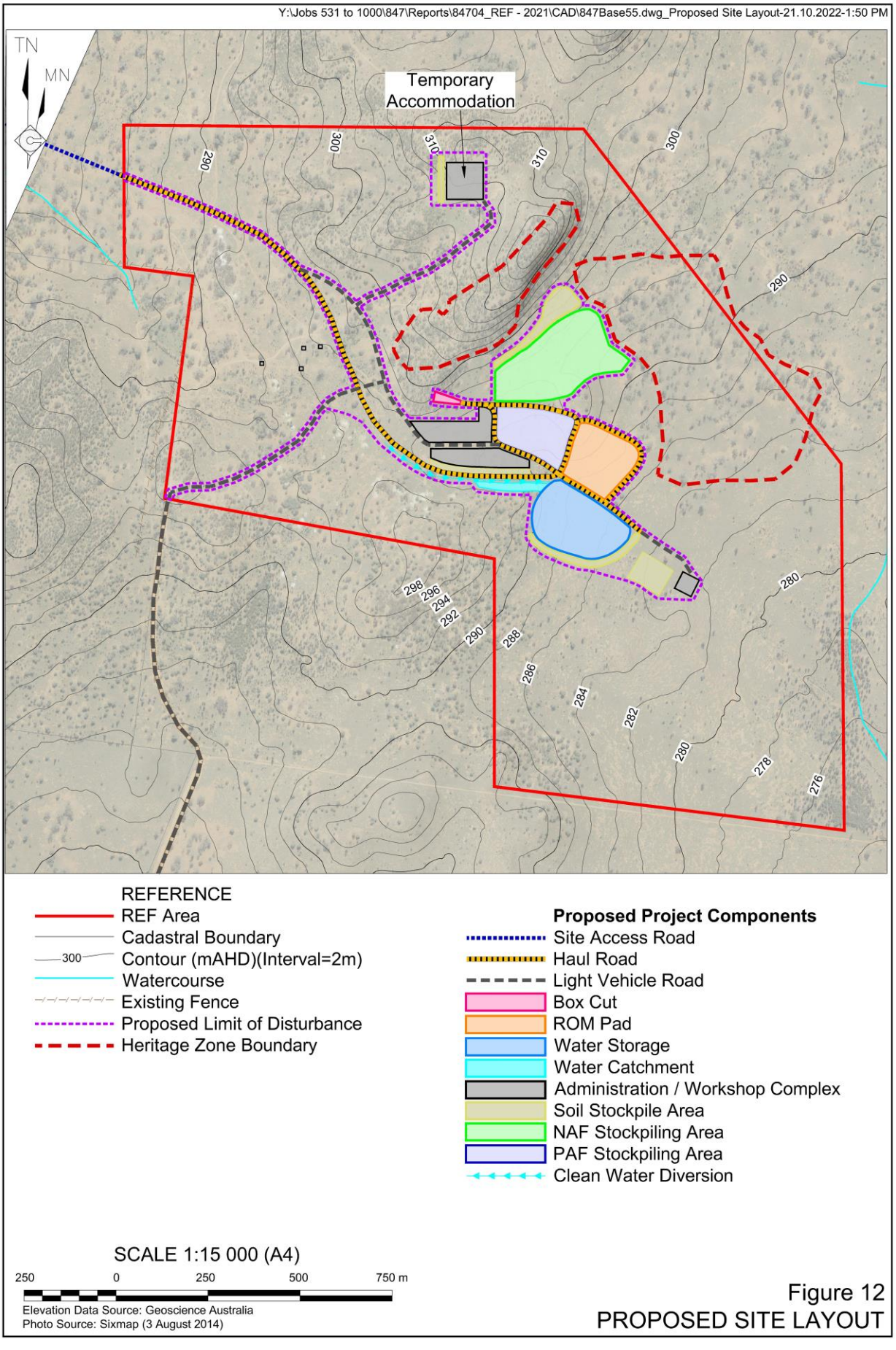

Figure 12
PROPOSED SITE LAYOUT

- Establishment of all required surface water infrastructure prior to the commencement of land preparation activities in accordance with *Managing Urban Stormwater – Volume 2C.*
- Fencing of sections of the REF Area, including the Site Access Road and proposed disturbance area.
- Progressive establishment of all required surface infrastructure.

All vehicles entering the REF Area would be appropriately cleaned prior to arrival to ensure that weeds, pathogens or other pests are not transported to site.

Peel Mining would initially remove vegetation from the proposed areas of disturbance generally in accordance with the following.

- All hollow-bearing trees would be inspected prior to removal and any nesting or roosting fauna would be encouraged to escape or would be relocated, as required.
- Larger vegetation would be removed using a bulldozer with its blade positioned just above the ground surface.
- Tree trunks would be retained for use in rehabilitation activities. Smaller vegetation would be mulched and similarly used for rehabilitation activities.
- Ground cover vegetation would be removed with the topsoil to maximise the retention of the seed bank and nutrients within the soil, as well as to minimise opportunities for erosion and dust lift-off between removal of the larger vegetation and soil stripping.

Soils would be removed generally in accordance with the following.

- Separately strip each soil type within the proposed disturbance areas
- Maintain soil material in a slightly moist condition during stripping. Material would not be stripped in either an excessively dry or wet condition.
- Ensure that all machinery brought onto the site for soil stripping must comply with weed management and biosecurity protocols.
- Minimise handling and rehandling soil as far as possible.
- Establish separate topsoil and subsoil stockpiles, with maximum side slopes not exceeding 1:4 (V:H) and heights not exceeding 2m for topsoil and 4m for subsoil.
- Ensure that the surfaces of soil stockpiles are left in a rough condition to promote water infiltration rather than runoff.
- Install sediment controls at the toe or on the downslope side of all soil stockpiles.
- Seed stockpiles immediately following construction with appropriate grasses and forbs to stabilise the surface, limit dust generation, minimise erosion and minimise weed growth and propagation.
- Exclude machinery and vehicle access to soil stockpiles, once established.

- Record soil stockpiles, including soil types and volumes, on site maps to identify them so that they are protected from disturbance and documented when required for rehabilitation activities.
- Monitor soil stockpiles for the establishment of weeds and implement control programs implemented as required.

3.2.3 Box Cut Development

The proposed box cut would have the following design criteria.

- Maximum length .....approximately 300m
- Maximum width .....approximately 100m
- Maximum depth .....approximately 25m
- Volume ..... approximately 86,000m^3

Following the removal of vegetation and soil material, underlying material would be removed initially using free dig techniques, with an excavator, working with a bulldozer, loading haul trucks. Because the entire box cut would be within the oxidised zone, the material would not contain sulphides and would be transported to the NAF Stockpile Area. Once the material within the box cut becomes too hard to extract using free dig techniques, Peel Mining would use standard drill and blast techniques to fragment the remaining material within the box cut. The Maximum Instantaneous Charge (MIC), namely the quantity of explosives initiated at the same time, for blasting within the box cut would be approximately 122kg. Fragmented material would also be transported to the NAF Stockpile Area using off-road haul trucks.

Once suitably competent material for a portal has been intersected, the walls of the box cut would be scaled to remove loose material and the face of the box cut would be prepared for portal construction, including installation of ground support.

Box cut development, including development of the portal, is expected to require approximately two months.

3.2.4 Exploration Decline Development

The proposed exploration decline would have the following design criteria. It is noted that the following criteria are indicative only and may be revised during the exploration depending on results of other studies, e.g. geotechnical studies.

- Height (with arched back) .....approximately 5.8m
- Width .....approximately 5.5m
- Depth .....approximately 400mbgl
- Length (incl. ventilation, drilling) .....approximately 4.5km
- Material excavated .....approximately 360,000t

The exploration decline would be constructed using typical underground mining methods of jumbo drill and blast, with broken material loaded into underground dump trucks and transported to the NAF or PAF Stockpiling Areas where the PAF stockpile would be stored prior to transportation back into the underground decline upon completion of exploration activities.

It is expected that approximately 35,000t of PAF and 325,000t of NAF material would be generated from the construction of the exploration decline. Peel Mining would undertake PAF/NAF testing as waste rock is extracted from the exploration decline to ensure appropriate classification of the extracted material. PAF would be stored temporarily within the PAF Stockpiling Area for the duration of exploration activities, and NAF would be stored in the NAF Stockpiling Area.

Should a subsequent mining operation not be developed as an outcome of the proposed exploration activities, all waste rock within the PAF Stockpiling Area would be removed and transported back underground for final storage within the exploration decline and the box cut within approximately 12 months following the cessation of diamond drilling. An alternative timeline for rehabilitation activities would be proposed in the event that Peel Mining proceeds with an application to undertake mining operations within the REF Area.

The decline would be developed to a maximum design depth of approximately 400m below surface. The decline would include a number of cross drives for the purposes of ventilation, accessing the mineralised areas for establishment of drill drives for drilling of the deposit laterally and at depth.

Ventilation would initially be provided using a ventilation fan installed within the box cut and ventilation duct from the portal. Once the decline has progressed sufficiently far, the initial ventilation rise would be established as an exhaust air rise before being converted to a fresh air intake later in the life of the exploration decline (see Section 3.2.5).

Services, including communications, power, water and compressed air, would be progressively established as the decline is developed. Accumulated water comprising water pumped into the decline to support exploration operations and groundwater that is expected to seep into the workings, would be pumped from the decline and stored within the lined water storage facility (see Section 3.5.1).

3.2.5 Ventilation Rise and Escapeway Development

During the initial stages of decline development, ventilation of the workings would be achieved through the use of a temporary ventilation fan within the box cut which would transfer fresh air to the face of the proposed decline via ventilation duct that would be installed along the roof of the decline. However, ventilation via this method is suitable for only the initial section of the decline, after which a ventilation rise to surface would be required.

As a result, Peel Mining proposes to install a ventilation rise and a smaller escape way to support the exploration decline (**Figure 12**). **Table 14** presents the design criteria for the ventilation rise and escape way.

Table 14
Ventilation Rise and Escapeway Design Criteria

	Southern Ventilation Rise	Escapeway
Indicative diameter	5.0m	2.0m
Anticipated air flow rate	180m^3/s	10m^3/s
Surface infrastructure	1 x ventilation fans	Ladderway and lockable grate
Purpose	Principal exhaust air rise	Emergency egress from the workings and fresh air intake

Initially a suitable access track would be constructed, and surface infrastructure installed to permit construction of the ventilation rise. This would be followed by excavation of the rise using a raise borer. A small diameter pilot hole would be drilled from surface to intersect with a ventilation drive underground. A drill string would then be lowered down the pilot hole and a drill head would be attached to the lower end of the string. The drill string would then be progressively pulled back to the surface, reaming out the pilot hole to the required diameter. This process may be undertaken in a single pass or multiple passes. The raise borer would be installed at surface and would be powered by silenced generators.

The escapeway would permit workers to exit the workings in the event of an incident such as a fire or a fall of ground that rendered the exploration decline unusable for any reason.

Drill cuttings would fall to the base of the rise and would be transported to the surface via the decline. This material would be classified and managed as either NAF or PAF waste rock and would be stored within the NAF or PAF Stockpiling Area until exploration is completed and the PAF is transported back underground into the decline.

3.2.6 Installation and Operation of Ancillary Infrastructure

Peel Mining would install the following ancillary infrastructure to support the exploration decline.

Hardstand Area

An unsealed hardstand area would be installed and would include the following.

- A workshop and store, including laydown and mobile plant parking areas. The workshop would be used to maintain equipment required for site establishment and box cut and decline development.
- A power station comprising one or more silenced, diesel-powered generators and associated electricity transmission infrastructure.
- A compressor area comprising one or compressors that would provide compressed air to the underground workings.
- An office, crib room, car parking and associated ablutions facilities, including toilets and showers. Wastewater from the ablutions facilities would be treated using a suitable waste water treatment facility in accordance with the requirements of Cobar Shire Council (Council). Alternatively waste water may be stored in pump-out septic tanks and removed from the REF Area by a suitably licenced contractor.

- Water tanks for delivery of water to the underground and potable water tanks for the offices and ablution facilities.
- A fuel farm comprising one or more self-bunded diesel storage tanks and concrete sealed refuelling area.

Materials Storage Area

The Materials Storage Area would comprise three component areas as follows.

- NAF Stockpiling Area. Waste rock from the box cut would be stored within this area. As all material within the box cut is within the oxidised zone, sulphides are not present, and this material would be classified as non-acid forming and would be used for backfilling of the box cut during rehabilitation operations should a subsequent mining operation not be developed. Waste rock from the decline and underground workings which is classified as NAF would be either stockpiled in the NAF Stockpiling Area or used for construction of site roads, underground roads and potentially water storage construction.
- PAF Stockpiling Area. Waste rock from the decline and underground workings would be stored within this area. A proportion of the material extracted from the decline and underground workings would be PAF and with classification protocols in place, this material would be managed as PAF. The PAF Stockpile Area would be constructed to ensure that all surface water drainage flows to a lined leach pond.
- The Soil Stockpile Area. Soil material stripped from surface disturbance activities would be stored in the Soil Stockpile Area. The soil would be retained in this area until required for rehabilitation activities.
- The ROM Pad would be constructed adjacent to the PAF Stockpile Area and would be used to store waste rock material and drill cuttings. As waste rock material and drill cuttings are likely to be PAF, this stockpile area would also be constructed in a manner that would ensure that all surface water drainage would flow to the lined water storage facility.

Water Management Infrastructure

Peel Mining would prepare and implement an *Erosion and Sediment Control* Plan for the REF Area to ensure that surface water runoff, as well as water generated by the dewatering of the exploration decline, would be appropriately managed. It is anticipated that the following water management infrastructure would be constructed within the REF Area.

- The water storage facility would receive water from the ROM Pad, PAF Stockpile Area and the exploration decline, with a catchment of approximately 6.9ha. The material stored within those areas may potentially have a low pH and elevated concentration of metals or other contaminants. the water storage facility would be HDPE lined and water within the water storage facility would not be permitted to flow to natural drainage.

  - The water storage facility would have a minimum combined capacity of approximately 7.7ML and would be designed to contain runoff equivalent to a 1 in 100-year annual exceedance probability (AEP) rainfall event (i.e. 140mm over 72 hours).

- Sediment basins and sumps would receive water from other disturbed sections of the REF Area, with a catchment of approximately 19.3ha. Surface water from these areas may contain elevated concentrations of sediment, but would not contain salts, chemicals or have a low pH.
  - The sediment basins and sumps would have a minimum combined capacity of approximately 21.4ML and would be designed to contain runoff equivalent to a 1 in 100-year AEP rainfall event (i.e. 140mm over 72 hours).
  - The capacity of the sediment basins and sumps would substantially exceed the minimum required capacity for a sediment basin under *Managing Urban Stormwater – Volume 2E (Mines and Quarries).* The sediment basins would include stabilised spillway in the unlikely event of rainfall that exceeds the 1 in 100-year AEP rainfall event.
  - Water within the sediment basins and sumps would be used for exploration-related purposes. Water would only be permitted to flow from the sediment basins in the event that a rainfall event exceeding the 1 in 100-year AEP design criterion occurs.
- Clean and dirty water diversions would be installed generally in accordance with the requirements of *Managing Urban Stormwater – Volume 2E*. The structures would divert clean water away from disturbed sections of the REF Area and would direct potentially dirty or sediment-laden from disturbed areas to sediment basins and sumps.

Magazine

A explosives storage magazine would be established to the north of the ROM Pad. The magazine would comprise two or more transportable structures designed in accordance with the relevant Australian Standard to safely store explosive materials.

3.2.7 Underground Drilling Operations

Peel Mining would undertake exploration drilling operations from drill cuddies or drives constructed off the exploration decline. Drilling operations would be standard underground diamond drilling operations, utilising an underground diamond drill rig. Drilling platforms would be established progressively down the maximum decline to a depth of approximately 400mbgl. Underground drilling operations are currently planned to continue for a period of approximately 24 months following completion of decline development operations.

3.2.8 Bulk Sample Operations

Peel Mining would not collect a bulk sample as part of the proposed exploration activities.

3.2.9 Blasting Operations

Blasting operations would be consistent with standard underground blasting operations. In particular, the most likely maximum instantaneous charge to be used during exploration activities would be as follows.

- Exploration decline / drive development..... Approximately 152kg
- Decline development (drill platforms)..... Approximately 120kg

3.2.10 Transportation Operations

Peel Mining does not propose to extract and transport bulk sample material as part of the proposed exploration activities. Consequently, traffic generation associated with the proposed activities would be limited to:

- mobilisation and demobilisation of equipment (heavy and oversize vehicles) at the beginning and end of exploration activities respectively;
- infrequent deliveries of equipment and supplies to the REF Area during exploration activities (heavy and oversize vehicles);
- regular light vehicle movements associated with employee arrival and departure; and
- final rehabilitation works in the event that further mining operations are not applied for an granted

3.2.11 Equipment

3.2.11.1 Surface Equipment

Table 15 presents the anticipated equipment that would be used during the development of surface activities.

Table 15
Anticipated Surface Equipment

Item	Number	Purpose
Raise borer drill rig	1	Construction of ventilation rises and escapeway
Hydraulic excavator	1	Excavation of portal box cut
25t crane	1	Installation and removal of raise borer drill rig
Service truck	1	Supply fuel, water and servicing for drill rig
Bulldozer	1	Site preparation
Front-end loader	1	Site preparation
Grader	1	Grading roads
Bobcat	1	Minor earthworks
Water cart	1	Dust suppression
Light vehicles	4-6	Transport of personnel and materials around site
500 KVA generator	1-2	Power generation
Source: Peel Mining Limited		

3.2.11.2 Underground Equipment

Table 16 presents the anticipated exploration equipment that would be used during underground development and exploration operations.

Table 16
Anticipated Underground Equipment

Item	Number	Purpose
Diamond drill rigs	1-2	Resource definition drilling
Drill jumbos	1	Drill and blast, ground support installation
Shotcreting unit	1	Shotcrete application
Agitator	1	For shotcrete
Integrated tool carrier	1	For charge up and other services
Haul trucks	1-2	Transport waste rock to surface
Front-end loader	1	Loading dump trucks and misc. works
Grader	1	Surface and underground grading
Light vehicles	3-4	Transport to and from decline
Source: Peel Mining Limited		

3.2.12 Hours of Operation

Table 17 presents the proposed hours of operation.

Table 17
Proposed Hours of Operation

Activity	Proposed Days of Operation	Proposed Hours of Operation
Site establishment	7 days per week	7:00am – 6:00pm
Box cut excavation		
Exploration decline development	7 days per week	24 hours
Underground exploration / drilling		
Rehabilitation		
Maintenance Activities		
Source: Peel Mining Limited		

It is anticipated that the above activities, excluding rehabilitation, would be undertaken over a period of approximately 4 years.

3.2.13 Exploration Personnel

Table 18 presents the anticipated personnel requirements during site construction and exploration decline campaigns. Note these numbers reflect the anticipated maximum number of people on site at one time. During the exploration decline work the number of personnel employed by the project could be up to 50 people, however the anticipated maximum number on site at one time is expected to be 30.

Table 18
Anticipated Exploration Personnel

Personnel	Number
Site construction	15
Exploration decline	30
Source: Peel Mining Limited	

3.2.14 Decommissioning and Rehabilitation

There are two options for rehabilitation of disturbed areas within the REF Area, namely:

1. if the application process for a full scale operational mine has commenced or is intended to proceed, no disturbed areas required for future mining operations would be rehabilitated; or
2. if a future mining operation is not planned or approved is not granted, full rehabilitation of the disturbed areas would occur.

Rehabilitation activities for Option 2 would comprise the following.

- Backfilling the box cut with waste rock material and blocking the entrance to prevent access.
- Ensuring all final landforms are safe, stable and non-polluting.
- Removing all site infrastructure.
- Backfilling and re-contouring disturbed areas (e.g. water storage facility) to connect with adjacent topography and re-establish natural drainage.

Table 19 presents rehabilitation objectives and completion criteria for all surface activities.

3.2.15 Ancillary Activities

No ancillary activities for which approval is required are proposed.

3.3 Stakeholder Consultation

3.3.1 Guideline Consultation

Table 20 presents an assessment of the activity impacts in accordance with Table 2 of the *Exploration Code of Practice: Community Consultation.* In summary, with an Activity Impact Assessment score of 10, the proposed exploration activities be classified as a **medium impact**.

Table 19
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 1 – Decommissioning				
Box Cut and Portal				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Entry portal to the decline blocked.	Install concrete plug to the entry of the portal to block the decline.	Plug consistent with relevant NSW Resources Regulator Guidelines	Engineering report.	Single occurrence following decommissioning (unless follow up actions are identified).
Box cut backfilled with waste rock material	Backfill the box cut with waste rock material. Preference given to placing any remaining PAF waste rock in the deeper parts of the box cut and NAF waste rock in the upper layers.	Backfill consistent with relevant NSW Resources Regulator Guidelines.	Engineering report.	Single occurrence following decommissioning (unless follow up actions are identified).
Mine Rock Storage				
Nil required				
PAF Storage				
PAF waste rock stored separately from NAF waste and used to backfill the decline and box cut	PAF material directed underground placed below the groundwater level to reduce likelihood of oxidation.	Backfill consistent with relevant NSW Resources Regulator Guidelines.	Engineering report.	Single occurrence following decommissioning (unless follow up actions are identified).
Ventilation Rise and Escapeway				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Ventilation rise capped and sealed	Shaft capped and sealed to prevent inadvertent access and ensure long-term stability of the shaft	Cap and seal consistent with relevant NSW Resources Regulator Guidelines	Engineering report	Single occurrence following decommissioning (unless follow up actions are identified).
Prevent inadvertent access	Security fence with lockable gate installed	Security fence with lockable gate installed	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).

Table 19 (Cont'd)
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 1 – Decommissioning (Cont'd)				
Workshop and Administration Area Infrastructure				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Fuel Storage Tanks, Generators, Laydown Areas and Carparks				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Remove concrete pads and footings.	Broken up concrete buried within water storage facility or box cut prior to that facility being backfilled.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Ore Stockpile				
All ore removed from the stockpile pad and processed off site prior to completion of operations.	Ore removed from ROM pad.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Exploration Infrastructure				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
All drill core and collected cuttings removed from the site.		All relevant infrastructure, drill core and cuttings removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Water Storage Facility (including Settling Pond) and Surface Water Diversion Channel				
All infrastructure and services not suitable for a lawful final land use will be removed.	HDPE liner removed from water storage facility. Water storage facility backfilled, and diversion structures removed from around the site. Backfill will be mounded to account for subsidence.	Backfill consistent with relevant NSW Resources Regulator Guidelines.	Engineering report.	Single occurrence following decommissioning (unless follow up actions are identified).
Water Abstraction Bores				
Nil required. Existing water bores will remain post closure of the site.				

Table 19 (Cont'd)
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 1 – Decommissioning (Cont'd)				
Haul and Access Roads				
All infrastructure and services not suitable for a lawful final land use will be removed.	Bund removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Phase 2 – Landform Establishment				
Box Cut and Portal				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
NAF Stockpiling Area				
Free draining, stable and non-polluting landform established.	Stockpiled material remaining at surface is NAF material only. Free draining landform reshaped to have outer batter slopes of 18° or less and a final height of 10m. Batters contour ripped and topsoil placed on top.	No pooling of water observed within landform. Water quality is consistent with natural runoff.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
PAF Stockpiling Area				
Free draining, stable and non-polluting landform established.	If additional area is required for final NAF stockpile outside of NAF Stockpiling Area, then indicator is same as outlined for NAF Stockpiling Area. If not required for NAF stockpile, area is free draining and shaped to match natural / surrounding contours.	No pooling of water observed within landform. Water quality is consistent with natural runoff.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Ventilation Rise and Escapeway				
Nil required	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).

Table 19 (Cont'd)
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 2 – Landform Establishment (Cont'd)				
Workshop and Administration Area Infrastructure				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Fuel Storage Tanks, Generators, Laydown Areas and Carparks				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Ore Stockpile				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform. Water quality is consistent with natural runoff.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Exploration Infrastructure				
Nil required.				
Water Storage Facility (including Settling Pond) and Surface Water Diversion Channel				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform. Water quality is consistent with natural runoff.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Haul and Access Roads				
Nil required.				
Phase 3 – Growth Medium Development				
All Domains				
Growth medium suitable for establishment of pasture communities present.	Compacted surfaces deep ripped along contour.	Photographs of ripped areas.	Inspection and report, including photographs.	Following deep ripping.
	Growth medium placed where required.	Photographs of covered areas.	Inspection and report, including photographs.	Following growth medium placement.

Table 19 (Cont'd)
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 4 – Ecosystem and Land Use Establishment				
All Domains				
Establish pasture communities	Species assemblages consistent with landholder requirements	Landholder confirms species assemblages acceptable	Inspection and report, including photographs.	Following the revegetation program.
Phase 5 – Ecosystem and Land Use Sustainability				
All Domains				
Land capability and vegetation community similar to pre-mining capability.	Species assemblages consistent with landholder requirements	Landholder confirms species assemblages and survival rate acceptable	Inspection and report, including photographs.	Annually following the initial revegetation program until compliance is demonstrated.
Phase 6 – Land Relinquishment				
All Domains				
Demonstrated compliance with all performance indicators for Phases 1 to 5.	Demonstrated compliance with all completion criteria for Phases 1 to 5.	Demonstrated compliance with all completion criteria for Phases 1 to 5.	Inspection and report, including photographs.	Prior to relinquishment of EL.

Table 20
Activity Impact Assessment for Community Consultation

Issue	Assessment	Score
What is the level of community interest in the activity or broader project?	Low level of community concern with no relevant, local community interest groups identified.	0
What is the activity type?	Petroleum Exploration, Coal and Mineral Non-Common Exploration Activities that do not meet the CEA criteria (as set out in ESG5: Assessment Requirements for Exploration Activities)	8
What is the population density of statistical local area?	Sparsely populated area (activity within a statistical local area with <10,000 population)	0
How far is the activity from inhabited dwellings?	Activity within 2km of cluster <100 dwellings	0
How far is the activity from known sensitive receivers (excluding dwellings)?	Activity > 2km of a sensitive receiver.	0
Are there any other extractive industries, mining or petroleum production projects nearby?	Activity further than 5km from other extractive industries, mining or petroleum production.	0
How long will the activity last?	More than 12 months	2
	Total	**10**
Source: Peel Mining Limited		

Table 4 of the Code identifies the range of consultation activities that are required to be undertaken for medium impact exploration activities. The following provides a description of each of consultation activities undertaken during preparation of this document.

Landholders and residents/tenants of the site of the activity

The Mallee Bull REF Area is situated wholly within Four Mile Station which is owned by Peel Mining. As such, there are no non-project related residents/tenants of the site of the activity.

Native title holders or claimants

A Native Title claim (NC2012/001) by the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Native Title Claimants has been accepted for registration over land that includes the REF Area. Representatives of the Claimants completed the archaeological survey for the Project (see Section 2.7). As a component of that process, the claimants were briefed on the proposed activities. The Claimants requested that Peel Mining avoid and fence off the "Heritage Zones" discussed in Section 2.7. The Registered Native Title claimants would also like other Aboriginal sites identified during the archaeological survey avoided, however, where this is not possible, a surface collection of Aboriginal objects at risk of direct or indirect harm would be conducted and the artefacts placed within one of the 'Heritage Zones' under an approved Aboriginal Heritage Impact Permit (AHIP).

Local government

The proposed exploration activities are located entirely within the Cobar Council Government Area. A meeting was held at the Cobar Shire Council with Jane Yelland (Peel Mining Manager Environment, Social and Sustainability, Peter Vlatko (Cobar Shire Council General Manager)

and Garry Ryman (Cobar Shire Council Director of Planning and Environmental Services) on 14th December 2022. During the meeting the Council staff advised that they had not yet had the opportunity to review and provide comment on the Mallee Bull REF. They communicated that the following would be requirements for the Council;

- Section 138 applications for Grain Road/Light Vehicle Road Intersection.
- Section 138 application for Glenwood Road/Heavy Vehicle Site Acccess Road Intersection;
- Accommodation buildings to comply with the Buildings Code of Australia; and
- Infrastructure such as management of effluent waste would need to be checked by Council.

A further meeting has been scheduled in January 2023 to discuss the details required from Cobar Shire Council for the Section 138 applications.

Relevant local community and environment groups

Peel Mining has not identified any local community or environmental groups with an interest in the proposed exploration activities.

Landholders, residents and businesses within 5km of the operational area

There are no residents or businesses within 5km of the operational area.

Local Aboriginal Land Council

The REF Area is located in unincorporated land outside of established Local Aboriginal Land Council (LALC) areas.

3.3.2 Additional Consultation

A formal Briefing Note was prepared and submitted to the following agencies on 3 June 2022, requesting responses outlining each agencies requirements for matters to be addressed in this REF. **Table 21** presents an overview of all responses received from the consulted agencies.

- Environment Protection Authority
- Cobar Shire Council
- Crown Lands
- Natural Resources Access Regulator
- Heritage New South Wales
- Biodiversity, Conservation and Sciences Directorate
- Department of Planning and Environment – Water
- Transport for New South Wales

Table 21
Government Agency Requested Information

Government Agency	Response	Where addressed
Resources Regulator	ESG5: Assessment requirements for exploration activities.	This document generally.
	Guide: Prospecting – Extracting a bulk sample.	Bulk sample extraction no longer proposed.
	Application to be accompanied by a Rehabilitation Cost Estimate.	**Appendix 2**
	Development consent for construction of surface infrastructure.	Council to be consulted.
Transport for NSW	Traffic Impact Assessment.	Section 3.5.6 and **Appendix 8**
Crown Lands	Details of the strategies to manage high sulphide deposits including waste emplacements, pad details, site water management and schedule of testing and ore stockpiles. The rehabilitation plan would aim to return the site to a low ongoing maintenance site, suitable for grazing.	Sections 3.2.4, 3.2.6, 3.2.1, 3.5.2,3.2.14
	Crown Lands will require a complete analysis of the water quality from the decline. Storage requirements for the prevention of seepage/damage to the soils will need to be addressed to identify issues that may present in ongoing rehabilitation for the use of grazing prior to the proposed developments. We ask that the REF addresses the risk that the decline may pose to the environment and the long-term management strategies.	Section 3.5.2
	Waste rock emplacements and general rehabilitation strategies must be addressed, as minimal topsoil clays are identified. What are the strategies proposed for erosion management in the long term? Historic drought events demonstrate that vegetation stabilisation methods may not guarantee erosion control. Please detail proposed slope angles.	Sections 3.2.14, 3.5.11
	Long-term management and maintenance strategies must be addressed when the Crown Land is no longer required for the proposal. Any ongoing maintenance needs to be expressly mentioned with a plan on who will be completing these works and what is involved with a risk matrix if the works are not completed for each aspect.	Section 3.2.14
Biodiversity, Conservation and Sciences Directorate	BSC required the proposal to include an adequate assessment of: 1. Impacts on flora, fauna, threatened species, populations, communities and their habitats. 2. Flooding impacts.	 Sections 2.6, 3.5.11, 4.2 Section 4.1.2

A final draft of this REF was provided to each of the above agencies on 21 October 2022, with a request to provide feedback in relation to matters relevant to each agency's area of responsibility within 4 weeks, by 18 November 2022. **Table 22** presents an overview of responses received from Transport for NSW, and the Biodiversity, Conservation and Sciences Directorate. No other agency responses were received.

Table 22
Government Agency Feedback on Draft REF

Feedback	Where addressed
Agency (date)	
Transport for NSW	Section 3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.2.6, 3.2.10, 3.2.12, 3.5.6, 4.4.7 Appendix 8
Biodiversity, Conservation and Sciences Directorate	Section 2.6.3, 2.6.4, 3.5.11
Crown Lands	No comment.
Heritage NSW	Response confirming that a response will not be provided.
Environment Protection Authroity Natural Resources Access Regulator DPE – Water Cobar Shire Council	No response.

3.4 Access Arrangements

The Mallee Bull REF Area is situated wholly within Four Mile Station which is owned by Peel Mining. As such, no third-party access arrangements would be required.

3.5 Mitigation Strategies

3.5.1 Surface Water Management Strategy

Peel Mining would implement the following surface water management strategy to prevent impacts upon surface water resources and ensure compliance with the requirements of the *Water Management Act 2000*.

- Prepare and implement an *Erosion and Sediment Control Plan* for the REF Area.
- Ensure that surface water within the ROM Pad and PAF Stockpiling Area are directed to the lined water storage facility.
- Maintain a minimum of 30cm freeboard within the water storage facility to prevent discharge.
- Ensure that surface water from all other disturbed areas is directed to sediment basins and that all diversions and the sediment basins themselves are constructed in accordance with *Managing Urban Stormwater – Volume 2E*.
- Ensure that clean water from undisturbed sections of the REF Area is diverted away from disturbed areas.
- Preferentially use water from dirty water storages (e.g. sediment basins) for dust suppression and other exploration operations.
- Ensure, where practicable, that water within on-site water storages is tested prior to discharge.
- Store all hydrocarbons and other chemicals in a bunded container or on a self-bunded pallet.
- Ensure hydrocarbon spill kits are available at each active work site, as appropriate.

3.5.2 Groundwater and Produced Water Management Strategy

Peel Mining would implement the following groundwater management strategy to minimise impacts upon groundwater resources and ensure compliance with the requirements of the *Water Management Act 2000*.

- Ensure that all water removed from the exploration decline is pumped to the lined water storage facility.
- Cease to pump water from the exploration decline to the water storage facility in the event that the water level in the pond is less than 30cm from the pond invert.
- Ensure that all water pumped into and out of the exploration decline, as well material movements and ventilation rates are recorded to enable a robust assessment of groundwater inflows to the proposed exploration decline.
- Continue monitoring groundwater levels and quality within the existing monitoring bores.
- Engage with surrounding landholders, including the owner of bore GW017889, to ensure that groundwater impacts are appropriately managed and mitigated.
- Obtain a works approval for the exploration decline and a water access licence (WAL) for 183 ML/year from the Lachlan Fold Belt MDB groundwater sources of the Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources.

3.5.3 Hydraulic Fracturing (well simulation)

Hydraulic fracturing is not proposed.

3.5.4 Vibration Management Strategy

Blasting would be required during all stages of development and potentially during drilling operations. As all blasting activities would be conducted underground, the potential impacts of flyrock or overpressure would be eliminated. The only potential impact at the surface would relate to ground vibration. Potential blasting-related impacts as assessed by Muller Acoustic Consulting (MAC, 2022) are detailed in Section 4.1.4.

The following management measures would be implemented to ensure that the relevant vibration criteria are not exceeded at surrounding receivers or infrastructure.

- Ensure that all blasts are designed and supervised by a suitable qualified shot firer and that all appropriate blast exclusion zones are complied with.
- Ensure that monitoring is undertaken at an appropriate location between the proposed box cut and decline and the closest residential receiver to demonstrate compliance with relevant blasting criteria.
- Review all monitoring data and develop and refine blasting site laws to reflect blast monitoring data.

3.5.5 Waste and Chemical Management Strategy

Table 23 identifies the waste management strategy that would be implemented during the proposed activity. Management of waste rock is described in Section 3.2.4.

Table 23
Waste Management Strategy

Waste Type	Storage	Estimated Volume	Removal
General waste (including food scraps)	A lidded bin would be located at the box cut area during development of the box cut and ventilation rise vent. A second bin would be located within the office area for the collection of general wastes during operations.	Variable	All waste will be collected from site and transported to a licenced waste facility.
Recyclables	A recycling bin and/or storage area would be located at the Administration / Workshop Complex and at the Temporary Accommodation area for the collection of recyclables.	Variable	All recyclable waste will be collected from site and transported to a licenced recyclable waste facility.
Waste oils and greases	Placed within bunded storage container within the drilling site footprint.	Variable	Wastes would be collected as required by a suitably licenced contractor and transported to a licensed facility for recycling or reuse.
Mining waste, including packaging, vent bags, etc.	All mining waste would be stored in suitable skip bins	Unknown	Wastes would be collected and transported as required by a suitably licensed contractor.

Table 24 presents the hydrocarbons and chemicals that Peel Mining would use during the proposed activity. These would be stored in self-bunded tanks, on bunded pallets or within storage units.

Table 24
Hydrocarbons and Chemicals

Product	Use	Hazardous Yes/No	Biodegradable Yes/No
Diesel	Mobile plant	No	No
Oils and grease	Plant maintenance	No	No
Explosives	Underground blasting operations	Yes	No

Peel Mining would implement the following mitigation strategies to manage the risk of contamination or inappropriate chemical or waste management.

- Ensure all equipment is regularly inspected and maintained, including scheduled replacement of hydraulic hoses to minimise the risk of hydrocarbon spills.
- Ensure that all personnel are trained and aware of the procedures and requirements of hydrocarbon and chemical materials management prior to the proposed activities commencing.
- Ensure that all personnel are trained and aware of waste storage and disposal requirements.

3.5.6 Traffic and Transport Management Strategy

A Traffic Impact Assessment has been completed by TTPP. The report is presented in **Appendix 8**. The Company would implement the following surface transportation-related management strategies.

- Obtain required permits for over-weight or over-size vehicles on the public road network.
- Ensure Dangerous goods are transported in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail.
- Ensure that all loads are covered prior to leaving the REF Area.
- widen the Site Access Road at its approach to Glenwood Road to reflect the swept paths of the heavy vehicles expected to use it;
- flatten the existing dip at the edge of Glenwood Road at the Site Access Road to provide adequate ground clearance for vehicles, and to ensure the angle of articulation of articulated vehicles remains satisfactory;
- construct the Site Access Road to a desirable standard of two 3.5m travel lanes with 1.0m wide shoulders, and the Light Vehicle Access Road to a desirable standard of two 3.0m wide travel lanes with 0.5m wide shoulders;
- provide signage on Glenwood Road and Grain Road to alert drivers to the presence of the Site Access Road and Light Vehicle Access Road;
- develop a Traffic Management Plan (TMP) and Driver Code of Conduct for the heavy vehicle transport associated with the Project. The TMP would form part of the employee contract or transport contractual arrangements, and would be prepared in consultation with Cobar Shire Council prior to commencement of construction of the Project, to address such matters as:
  - compliance with access routes and travel restrictions that may be applicable during or following wet weather;
  - compliance with road rules, laws and regulations, including those relating to OSOM vehicles and dangerous good transport;
  - maintaining safe following distances between vehicles, and increasing separation in poor visibility (e.g. dusty conditions on unsealed roads);
  - reporting of any unsafe driving practices or incidents; and
  - driver behaviour expectations at any specific locations including in the vicinity of any school bus during bus operating hours.

3.5.7 Noise Management Strategy

Peel Mining anticipates that the potential for noise-related impacts would be negligible considering that the majority of exploration activities would be undertaken underground and the distance to the nearest sensitive receiver.

Noise impacts would be largely restricted to the site establishment and operation of the ventilation fans. The following mitigation measures would be implemented to reduce potential impacts on sensitive receivers.

- Maintain vehicles, plant equipment and generators to system requirements and relevant standards to retain appropriate sound power level.
- Promptly respond to any complaints relating to noise.

3.5.8 Air Quality Management Strategy

The following management and mitigation measures would be adopted by Peel Mining to ensure activities associated with the Project have a minimal effect on the surrounding environment and the surrounding residential sensitive receivers.

- An Air Quality Management Plan would be developed to assist with the management of dust emissions. It would include aspects such as key performance indicators (KPIs), monitoring methods, response mechanisms, compliance reporting and complaints management.
- Where reasonable levels of dust cannot be maintained due to adverse weather conditions, operations would be modified or cease until reasonable levels of dust are returned.
- The weather forecast would be checked prior to undertaking material handling or processing.
- On-site vehicles and plant engines would be switched off when not in use.
- Vehicles would be serviced according to manufacturer's specifications and fitted with pollution reduction devices where practicable.
- Visual monitoring of activities would be undertaken to identify dust generation.
- The extent of exposed surfaces and stockpiles would be kept to a minimum and would be dampened with water as far as is practicable if dust emissions are visible or there is potential for dust generation to occur outside of operating hours.
- Drop heights from loading and handling equipment would be reduced, where practicable.
- Haul roads would be regularly inspected to remove potholes or depressions. Hardstand areas would be cleaned regularly.
- Vehicle traffic would be restricted to designated routes, where speed limits would be enforced. Vehicle loads would be covered when travelling off-site.

The air emission controls adopted for the Project would be regularly assessed to ensure they are working effectively, and in turn would be modified where required. Any modifications or adjustments required would be documented in an updated Air Quality Management Plan.

3.5.9 Bush Fire Management Strategy

Peel Mining would implement the following management strategies in the vicinity of the ventilation rise to manage the risk of bush fire.

- Maintain and operate machinery in a manner that would minimise the potential to start a fire. This would include ensuring that spark-free exhausts are fitted and that all fuel, electrical and braking systems are maintained in good order.
- Permit smoking only within designated, cleared areas.
- Ensure appropriate fire extinguishers and other firefighting equipment is fitted on all Company vehicles to manage any fire-related incidents associated with the proposed ventilation rise.
- Ensure all employees are aware of fire risk and mitigation, and Company representatives are trained in the proper use of firefighting equipment.
- Modify on-site activities during high fire danger periods.
- Prepare an evacuation plan in the event of a bush fire.

3.5.10 Aboriginal Cultural and Historic Heritage

Peel Mining would implement the following Aboriginal heritage-related management measures.

- The Registered Aboriginal Parties (RAPs) identified during the consultation process would be consulted in determining the management of Aboriginal objects.
- An Aboriginal Heritage Impact Permit (AHIP) would be applied for prior to any impact to the recorded sites.
- Should the AHIP be issued, removal of artefacts would include salvage/surface collection and may include relocation of impacted items to a suitable location in accordance with the *Code of Practice of archaeological Investigation of Aboriginal Objects in NSW.*
- Create an exclusion zone around the Heritage Zones to avoid indirect or inadvertent impact.
- Aboriginal sites outside the Heritage Zones would be avoided and fenced off. The sites would be re-identified with the assistance of a qualified archaeologist and the Aboriginal community.
- Aboriginal sites within 100m of proposed impacts would be fenced off using standard farm fencing with a buffer of 10m from the trunk of the Culturally Modified Trees and 5m from the boundaries of the Open Stone Artefact Sites.
- Induct all personnel on the presence, significance and management of the cultural heritage sites documented in AREA (2022b).
- Locations of the cultural heritage sites would be provided to the relevant supervisors responsible for the construction and operation of the Project and be documented on project maps and documents such that it is clear where Aboriginal sites are located, and that they are to remain unharmed by work.

- Relevant supervisors would be informed that cultural heritage sites are protected under the *National Parks and Wildlife Act 1974* and no harm is to come to them.
- If any objects of suspected Aboriginal heritage origin are encountered during the Project, work in the area of the find would cease and the unexpected finds protocol (Appendix B of **Appendix 5**) would be implemented.
- If suspected human remains are located during any stage of the Project, work must stop immediately, and the NSW police must be notified.

3.5.11 Ecological Management Strategy

Peel Mining would implement the following biodiversity-related management and mitigation measures.

- Induct all personnel in environmental procedures (i.e. vegetation management, sediment and erosion control, protective fencing, ethical procedures for handling fauna, etc).
- Clearly mark out and ensure that surface disturbance is limited to the proposed limit of disturbance presented on **Figure 12**.
- Undertake pre-clearance surveys prior to any vegetation clearing.
- Avoid, where practicable, clearing native vegetation in Spring.
- Implement staged habitat removal to allow fauna to vacate, if present. Habitat trees would be felled carefully using equipment that allows habitat trees to be lowered to the ground with minimal impact and hollows inspected.
- Assign a spotter/catcher during removal of hollow-bearing trees.
- Salvage and relocate tree hollows from trees cleared and affected as part of the Project.
- Use nest-boxes or prune remaining trees to create hollows to compensate for the loss of large hollows as a result of the Project.
- Develop and implement a Biodiversity Management Strategy and a Biosecurity Management Strategy prior to construction.

3.6 Justification of the Activity

3.6.1 Justification of the Activity

3.6.1.1 Introduction

Sustainable practices by industry, all levels of government and the community are recognised to be important for the future prosperity and well-being of the global environment.

Throughout the planning of the proposed activities, Peel Mining has endeavoured to address each of the principles of Ecologically Sustainable Development. Section 3.2 describes the proposed activities in detail, while the following subsections draw together the features of the proposed activities that reflect the four principles of sustainable development, namely:

- the precautionary principle;
- the principle of intergenerational equity;
- the principle of the conservation of biodiversity and ecological integrity; and
- the principle for the improved valuation, pricing and incentive mechanisms.

3.6.1.2 Precautionary Principle

Examples of matters relating to the precautionary principle that were considered during the planning of the proposed activities are listed below.

- All surface disturbance would be limited to areas that have been previously disturbed by agriculture (i.e. grazing), thereby ensuring that potential adverse biodiversity impacts are minimised to the maximum extent practicable.
- Heritage impacts would be avoided by inspection and, if necessary, relocation of all areas of disturbance.
- Engagement of specialist consultants to assess the anticipated impacts relating to noise and vibration, air quality, groundwater, biodiversity and heritage.

3.6.1.3 Inter-generational Equity

Peel Mining recognises that all members of the local and wider community would benefit appropriately from the activity either directly or indirectly. In order to ensure a realistic distribution of benefits, Peel Mining would continue to consult with its workforce, the local community and relevant regulators to maintain a pro-active approach to issues of interest. This dialogue would also include a system to record, manage and respond to any complaints relating to the operation of the exploration programs. In addition, the activity would be crucial to establish the economic feasibility of any future mining operation within the REF Area.

3.6.1.4 Conservation of Biological Diversity and Ecological Integrity

Peel Mining is committed to undertaking all activities in an environmentally responsible manner, and recognises the need to ensure that changes to natural components of the environment do not adversely affect biological diversity or ecological integrity. Peel Mining would retire biodiversity credits required for the Project, thereby offsetting and compensating for any temporary loss of biodiversity values as a result of surface disturbance associated with the Project. This would ensure that that temporary changes in biological diversity or ecological integrity are adequately and appropriately managed in a manner that is consistent with current community expectation and government policy.

3.6.1.5 Improved Valuation and Pricing of Environmental Resources

The principles of this strategy will be applied to all proposed activities including the recycling of materials, segregation of waste materials and disposal at designated waste facilities.

3.6.1.6 Conclusion

The proposed exploration activities are essential to further define the extent of mineralisation within the REF Area, permit testing of drill samples, and to optimise planning for subsequent full scale mining operations. Given that the anticipated residual environmental impacts would low, and able to be sufficiently managed, it is considered that the proposed activities are justified.

3.6.2 Analysis of Feasible Alternatives

Peel Mining considered several alternatives to the proposed exploration program.

1. Deferring or not going ahead with the program. This alternative was rejected for the following reasons.
   - Peel Mining has invested significant time and capital in the preliminary definition of the Mallee Bull resource.
   - Copper within the copper dominated Mallee Bull resource is listed under the NSW Government Critical Minerals.
   - Not going ahead would result in significant financial losses for Peel Mining.
2. Surface Mining. This alternative was rejected for the following reasons.
   - Preliminary analysis showed there were no economic resources within a sufficiently shallow distance from the surface at Mallee Bull to be economically extractable using current mining and processing technologies.
3. The placement of surface infrastructure. The REF Area contains areas of existing disturbance resulting from historic pastoral and mining activities. Surface infrastructure footprints have been sited within existing disturbance areas where practicable to minimise disturbance.

3.6.3 Consequences of Not Carrying Out the Activity

The consequences of not carrying out the activity would include the following.

- The opportunity to develop a better understanding of the distribution of ore in the REF Area would be lost, resulting in a greater risk of sub-optimal or delayed mining operations following granting of the required development consent.
- The opportunity to optimise processing operations for the ore to be removed would be lost, potentially resulting in suboptimal recoveries during the initial stages of full scale mining operations.

4. Impact Assessment

4.1 Assessment of Physical and Pollution Impacts

4.1.1 Air Impacts

Todoroski Air Sciences Pty Ltd (Todoroski) undertook an Air Quality Impact Assessment (AQIA) of the Project to assess the potential impacts on air quality associated with the construction and exploration drive. The resulting report, hereafter referred to as Todoroski (2022), is presented as **Appendix 6**. The following subsections present a summary of the assessment, as outlined by Todoroski (2022).

4.1.1.1 Sensitive Receivers

Figure 1 presents the locations of the closest sensitive receivers to the REF Area. Two of the receivers are Project-related, namely at "Wirchilleba" and "Wilkerboon". The closest non-project related residence "Mount View" is located a minimum of 11km from the REF Area.

4.1.1.2 Assessment Criteria

Table 25 presents the NSW EPA air quality impact assessment criteria adopted for this assessment. It is noted that the criterion for total impact considers background pollutant levels as well as contribution from the Project.

Table 25
Air Quality Impact Assessment Criteria

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90µg/m^3
PM_{10}	Annual	Total	25µg/m^3
	24 hour	Total	50µg/m^3
$PM_{2.5}$	Annual	Total	8µg/m^3
	24 hour	Total	25µg/m^3
Deposited dust	Annual	Incremental	2g/m^2/month
		Total	4g/m^2/month
Note: Total impact air quality goals relate to cumulative total pollutant burden on the surrounding air quality level.			
Source: Todoroski (2022) – after Table 3.1			

Background levels for the REF Area were quantified using data sourced from the nearest and most relevant air quality monitor operated by the DPE at Wagga Wagga North. Annual average and maximum 24-hour average PM_{10} and $PM_{2.5}$ levels are presented in **Table 26**. PM_{10} concentrations were found to exceed the criteria of annual average concentrations in 2018 and 2019, and of maximum 24-hour average concentrations for all reviewed years. $PM_{2.5}$ concentrations were found to exceed the criteria of annual average concentrations from 2017 to

2020, and of maximum 24-hour average concentrations for all reviewed years with the exception of 2015 and 2018. The exceedances of annual average concentrations of PM_{10} are attributed to the bush fires and drought conditions at the time, which are also reflected in $PM_{2.5}$ background levels (Todoroski, 2022).

Table 26
PM_{10} and $PM_{2.5}$ Background Levels from Wagga Wagga North Monitor (µg/m³)

Year	Criterion	Annual Average	Criterion	Maximum 24-hour Average
PM_{10}				
2015	25	19.1	50	145.1
2016		20.6		114.7
2017		20.6		171.6
2018		27.4		127.2
2019		35.3		251.7
2020		23.2		295.3
2021		17.7		69.1
$PM_{2.5}$				
2015	8	7.6	25	24.2
2016		7.4		28.1
2017		8.1		32.5
2018		8.4		21.6
2019		11.3		239.6
2020		10.7		559.5
2021		6.3		25.4
Source: Todoroski (2022) – modified after Tables 4-2 and 4-3				

Based on the background level data as well as meteorological data, the 2020 calendar year was adopted to represent the PM_{10} background annual average and maximum 24-hour average levels for the Project, as well as $PM_{2.5}$ maximum 24-hour average levels. An average of data from the 2015 to 2018 and 2021 periods was used to represent $PM_{2.5}$ annual average levels as the 2019/2020 data was not representative of typical background levels due to the bush fire event. An analysis of long-term data trends in meteorological data is outlined in Appendix A of Todoroski (2022).

Estimates of the average background Total Suspended Particulate matter (TSP) and deposited dust concentrations were determined from a relationship between PM_{10}, TSP and deposited dust, based on NSW EPA air quality impact criteria (Todoroski, 2022). **Table 27** presents the adopted background levels for PM_{10}, $PM_{2.5}$, TSP and deposited dust concentrations.

Table 27
Adopted Background Levels for PM_{10}, $PM_{2.5}$, TSP and Deposited Dust Concentrations

Pollutant	Averaging Period	Adopted Background Level
TSP	Annual	83.6µg/m³
PM_{10}	Annual	21.3µg/m³
	24-hour	48.9 µg/m³
$PM_{2.5}$	Annual	7.5µg/m³
	24-hour	23.2 µg/m³
Deposited dust	Annual	3.7g/m²/month
Source: Todoroski (2022) – after Section 4.3.3.4		

4.1.1.3 Assessment Methodology

Todoroski (2022) used a combination of the CALPUFF Modelling System and The Air Pollution Model (TAPM) to undertake the modelling for this assessment. The CALPUFF Modelling System is an advanced air dispersion model, which was setup in accordance with methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'* (TRC, 2011). TAPM was applied to the available data to generate a three-dimensional upper air data file for use in CALPUFF.

The full methodology and modelling approach used to inform this assessment is described in Section 5 of Todoroski (2022).

4.1.1.4 Assessment Results

Table 28 and **Figures 13** to **18** present the predicted incremental and cumulative particulate dispersion modelling results at each of the assessment locations described in Section 4.1.1.1. The cumulative (total) impact is defined as the modelling impact associated with the operation of the Project combined with the estimated ambient background levels presented in Section 4.1.1.2.

The predicted incremental results show that minimal incremental effects would arise at the assessed sensitive receiver locations as a result of the Project (Todoroski, 2022). The predicted cumulative results indicate that all of the assessed sensitive receivers are predicted to experience levels below the relevant criteria for each of the assessed dust metrics (Todoroski, 2022).

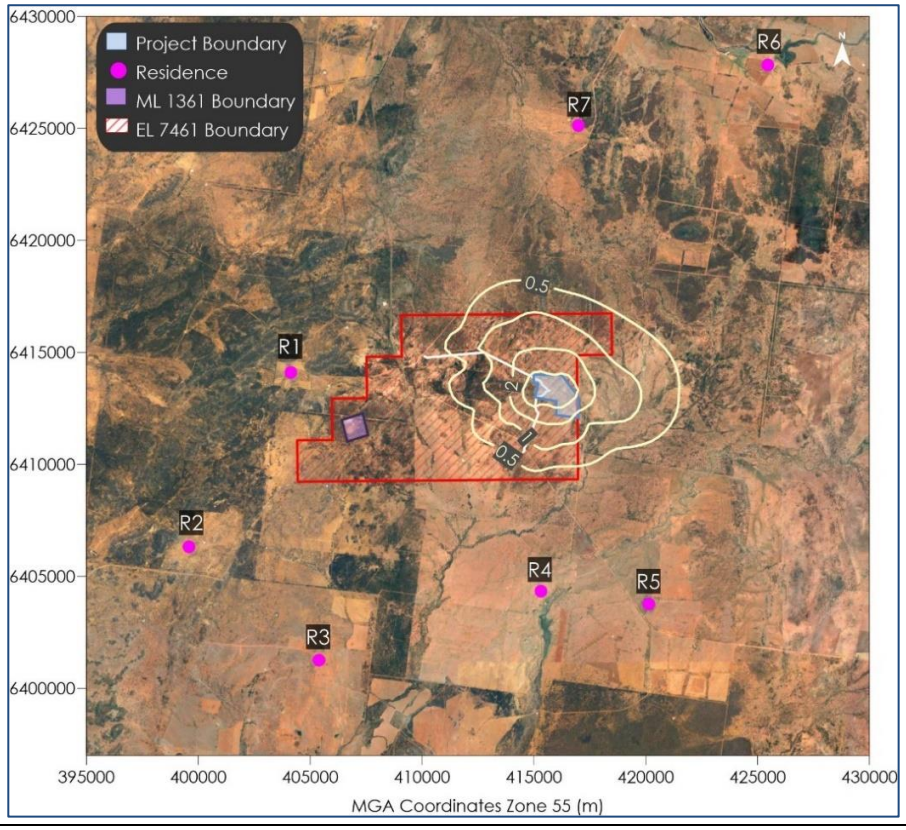

Figure 13
Predicted Incremental Maximum 24-hour Average $PM_{2.5}$ Concentrations (µg/m³)

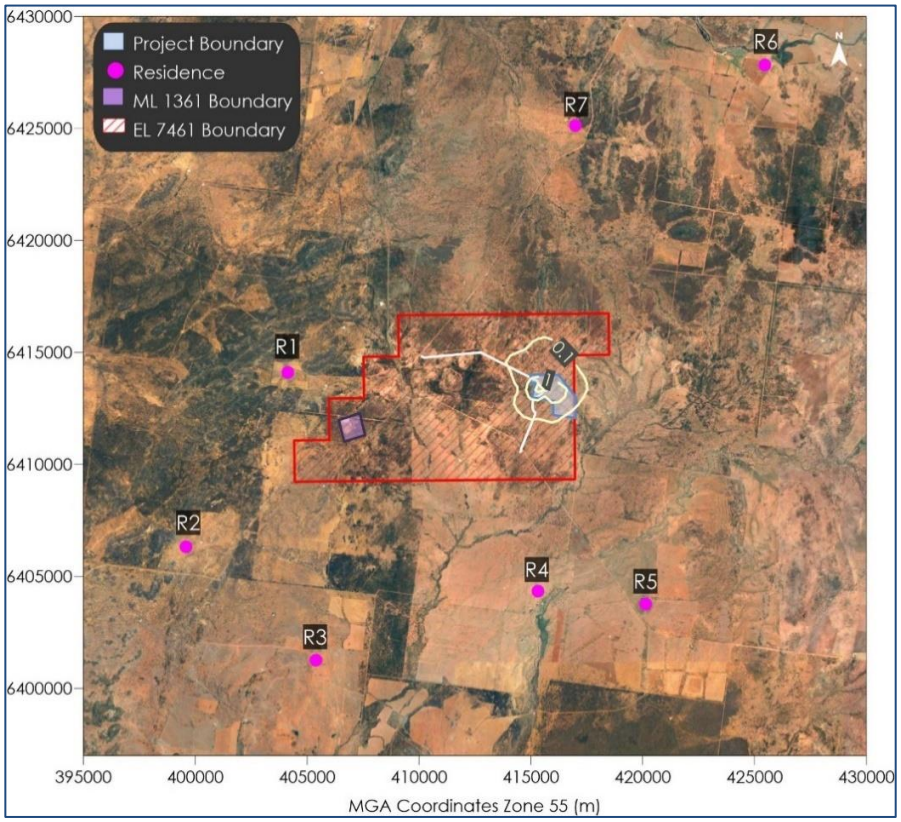

Figure 14
Predicted Incremental Annual Average PM2.5 Concentrations (µg/m3)

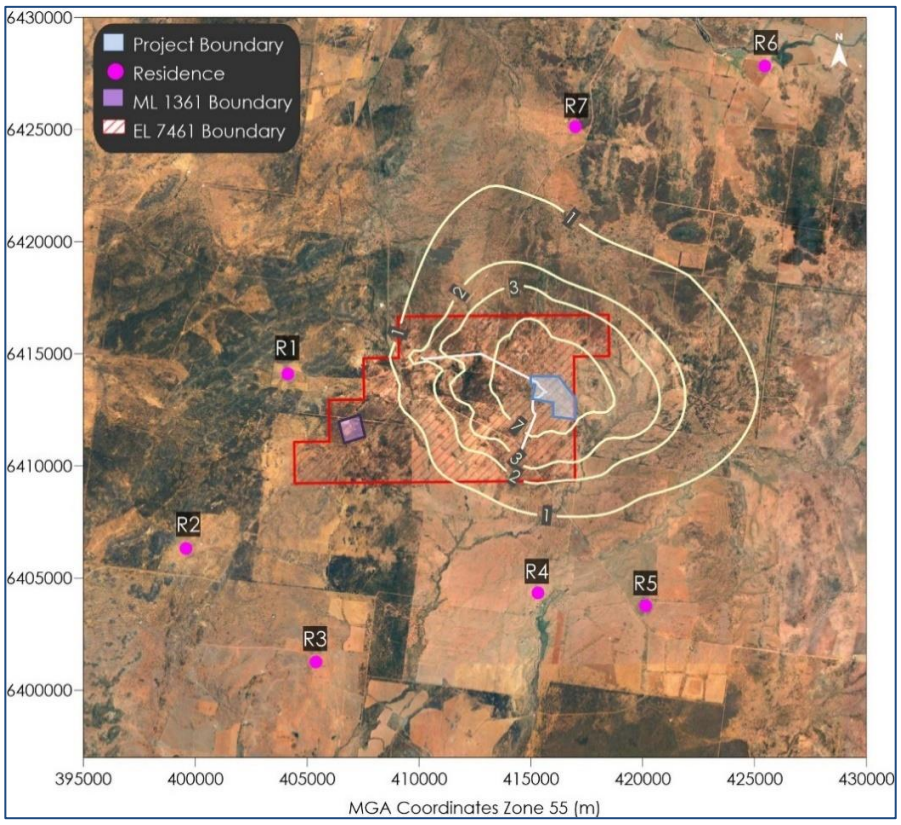

Figure 15
Predicted Incremental Maximum 24-hour Average PM10 Concentrations (µg/m3)

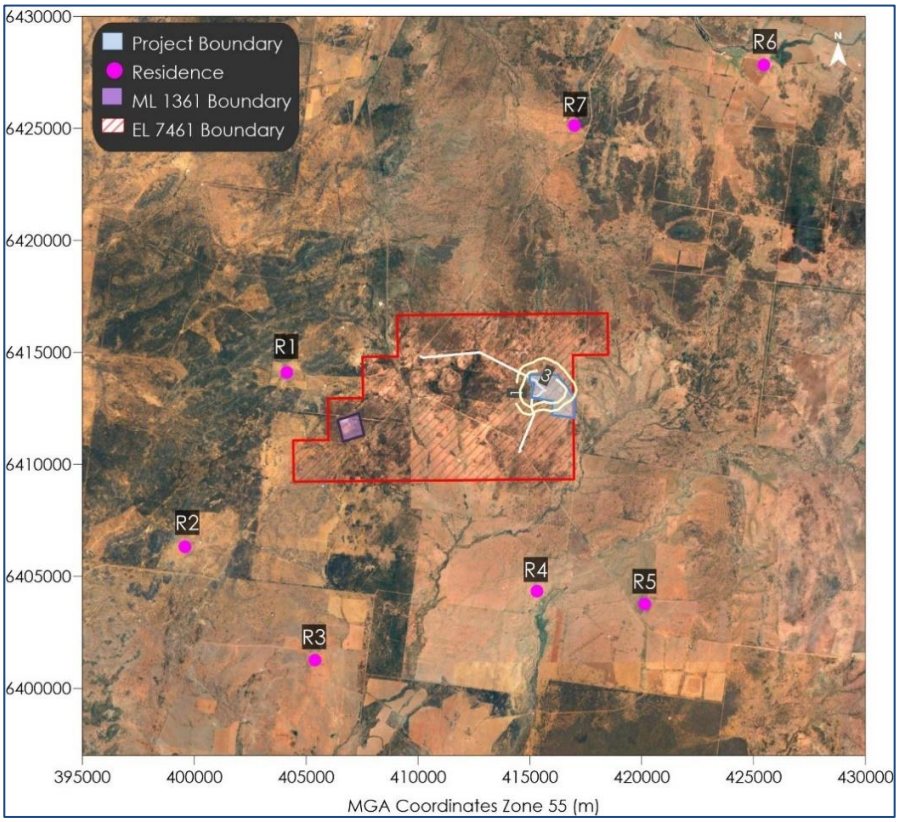

Figure 16
Predicted Incremental Annual Average PM_{10} Concentrations (µg/m^3)

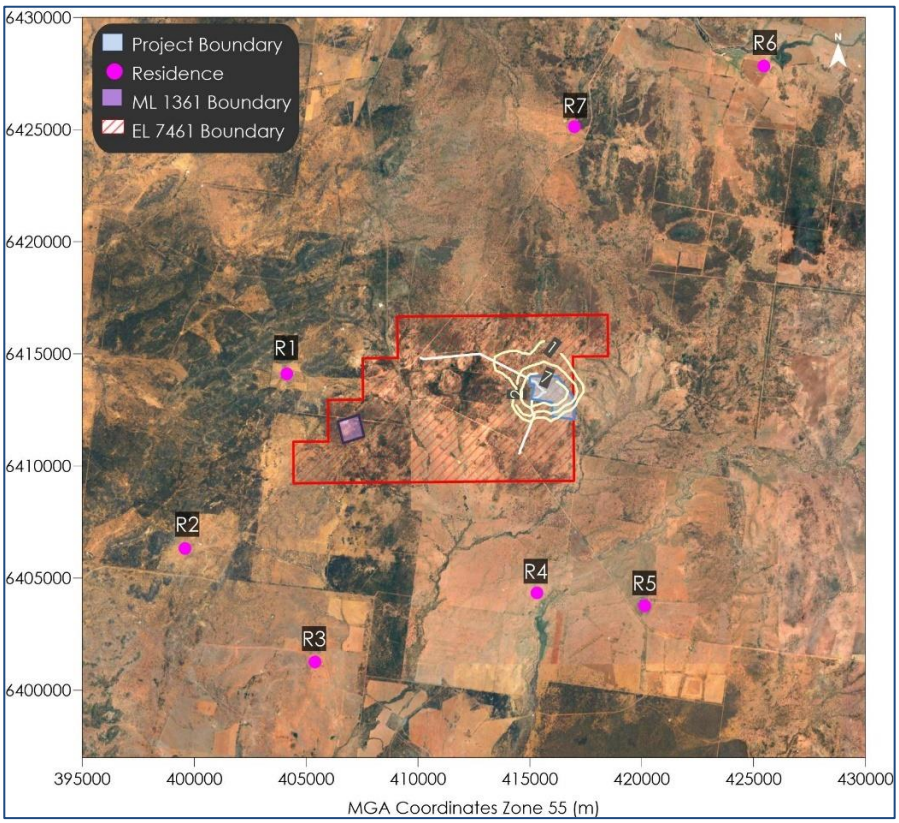

Figure 17
Predicted Incremental Annual Average TSP Concentrations (µg/m3)

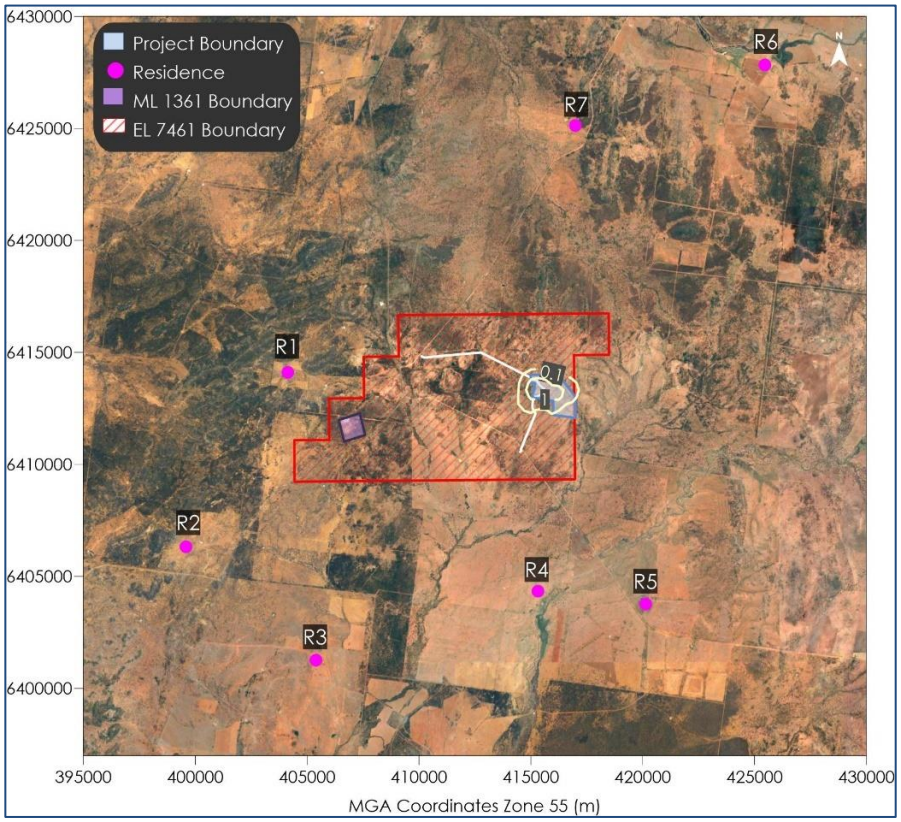

Figure 18
Predicted Incremental Annual Average Dust Deposition Levels (g/m2/month)

4.1.1.5 Assessment of Impacts

Todoroski (2022) predicts that all assessed air pollutants generated by the REF would comply with the applicable assessment criteria at the assessed sensitive receivers, and therefore would not lead to any unacceptable level of environmental harm or impact to the surrounding area.

Nevertheless, Peel Mining would apply the dust management measures described in Section 4.1.1.5 to ensure the potential occurrence of excessive air emissions from the REF Area is minimised.

4.1.2 Water Impacts

4.1.2.1 Surface Water

The surface water assessment was completed by RWC based on information provided by Peel Mining.

Potential surface water-related risks associated with the Project are described below, which also includes an assessment of why the residual impacts are considered to be negligible.

Table 28
Predicted Incremental and Cumulative Particulate Dispersion Modelling Results

Sensitive Receiver[1]	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD* (g/m²/mth)	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD* (g/m²/mth)
	Incremental				Cumulative			
	Criteria							
	-	-	-	-	-	2	25	8	50	25	90	4
	24-hour Average	Annual Average	24-hour Average	Annual Average	Annual Average	Annual Average	24-hour Average	Annual Average	24-hour Average	Annual Average	Annual Average	Annual Average
R1	0.1	<0.1	0.3	<0.1	<0.1	<0.1	23.3	7.50	49.2	23.2	83.6	3.7
R2	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	23.2	7.50	49.0	23.2	83.6	3.7
R3	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	23.2	7.50	49.1	23.2	83.6	3.7
R4	0.1	<0.1	0.5	<0.1	<0.1	<0.1	23.3	7.50	49.4	23.2	83.6	3.7
R5	0.1	<0.1	0.4	<0.1	<0.1	<0.1	23.3	7.50	49.3	23.2	83.6	3.7
R6	0.1	<0.1	0.3	<0.1	<0.1	<0.1	23.3	7.50	49.2	23.2	83.6	3.7
R7	0.1	<0.1	0.4	<0.1	<0.1	<0.1	23.3	7.51	49.3	23.2	83.6	3.7

* DD = deposited dust.

Note 1: See sensitive receiver locations on **Figure 1**.

Source: Todoroski (2022) – modified after Table 6-1.

Release of Contaminated / Salt-laden Water to Downstream Watercourses

The Project would result in PAF waste rock and drill sample material (which may also be classified as PAF) being stored temporarily at surface prior to either being transported back underground to backfill the decline or transported to an off-site processing facility. This material has the potential to form an acidic, low pH leachate while stored on the surface. However, this risk would be managed as follows.

- All PAF waste rock would be stored within the ROM Pad or PAF waste rock storage areas and all surface water in these areas would flow to the adjacent lined water storage facility. The water storage facility would not be permitted to discharge.
- A minimum of 30cm of freeboard would be maintained within the water storage facility and water within the facility would not be permitted to discharge to natural drainage.
- PAF waste rock stored at surface would be stored temporarily and would be relocated back underground to backfill the exploration decline within a relatively short period.

In addition, water would be pumped to the surface from the exploration decline and stored within the lined water storage facility. The risk of potentially salt or chemical-laden water being discharged to natural drainage would be negligible.

Release of Sediment-laden Water to Downstream Watercourses

All disturbed areas within the REF Area, with the exception of those that would drain to the lined water storage facility, would drain to a series of sediment basins. The sediment basins are designed to contain runoff under a 1 in 100-year rainfall event (i.e. 140mm over 72 hours). The capacity of the sediment basins is well in excess of that required by *Managing Urban Stormwater – Volume 2E.* All other dirty and clean water diversions would be designed and constructed in accordance with *Managing Urban Stormwater.* The risk of potentially sediment-laden water being discharged to natural drainage would be negligible.

Removal of Sections of Natural Catchments Through Containment of Water on Site

The REF Area is located within the western harvestable rights area under the Harvestable Rights Policy. As a result, landholders are permitted to retain all runoff on their land. In addition, surface water drainages surrounding the REF Area are typically indeterminate, ephemeral and do not flow to the Darling River. As a result, environmental risks associated with temporarily removing the disturbed area from the catchment of a nearby unnamed watercourse would be negligible.

Flooding and Subsidence

The REF Area is not subject to flooding.

The proposed exploration decline would not result in surface disturbance due to subsidence.

As a result, environmental risks associated with flooding and subsidence would be negligible.

4.1.2.2 Groundwater

GHD Group Pty Ltd (GHD) undertook a Groundwater Impact Assessment of the Project to assess the potential impacts on groundwater resources arising from with the construction and exploration drive. The resulting report, hereafter referred to as GHD (2023), is presented as **Appendix 3**. The following subsections provide a summary of the assessment, as outlined by GHD (2023).

Potential impacts to groundwater include changes to water levels (due to dewatering) potentially resulting in adverse impacts to surrounding groundwater users and/or GDEs. Dewatering occurs when excavation takes place below the groundwater table. This results in lowering of the groundwater level, and therefore pressure, causing a groundwater inflow due to water moving from high pressure to low pressure. A decline in groundwater levels from the dewatering point is then observed, which is referred to as 'drawdown' (GHD, 2023).

Based on the hydraulic properties associated with the fractured rock aquifer underlying the REF Area, GHD (2023) determined that the fractured rock groundwater source falls within the 'Level 1 Minimal Impact Considerations' for 'Less Productive, Porous and Fractured Rock Water Sources' under the *NSW Aquifer Interference Policy* (AIP).

Changes to groundwater levels were assessed as part of the Project (see **Appendix 3**) in terms of the impact to existing groundwater uses, GDEs, groundwater quality, post exploration groundwater inflow, and cumulative impacts.

Existing Groundwater Users

Based on the aquifer parameters considered most likely to occur within the REF Area (see Section 2.5.2.5), GHD (2023) determined the predicted radius of drawdown influence to be approximately 0.9km to 2.9km. The closest registered stock and domestic bore to the REF Area is 4.9km. Therefore, the impact of drawdown would not impact the surround stock and domestic bores. If the drawdown radius is larger than predicted, the impact to users of the stock bores is still considered low due to the intermittent use of the bores. However, a range of mitigation measures are available to ensure continued supply of water to the bores, if impacts to occur. These include:

- lowering of production pump intake (if the bore has capacity);
- installation of a deeper production bore to replace or supplement the bore; and/or
- provision of an alternate water supply (e.g. transport of water to the landholder).

Groundwater Dependent Ecosystems

As discussed in Section 2.5.2.7, no known GDEs were identified within 20km of the REF Area. During the installation of monitoring bores, the groundwater was intercepted at depths greater than 50m, which is beyond the reasonable limit of tree rooting depths (GHD, 2023). Groundwater interceptions at shallower depths recorded at monitoring bores MBGW06 and MBGW07 were attributed to partially confined aquifer conditions (GHD, 2023). Further, exploration drilling and monitoring bore installation has indicated that the shallow strata is dry, making the presence of a perched aquifer unlikely (GHD, 2023).

Groundwater Quality

Groundwater within and around the REF Area can have naturally elevated heavy metal concentrations due to the land being in a mineralised region, commonly in the form of sulfides (GHD, 2023). When the sulfides interact with oxygen, sulphates are produced, resulting in low pH and potentially high heavy metal concentrations of resultant materials. Groundwater seeping through these materials can mobilise pH and heavy metal concentrations into the environment.

Dewatering for a period of approximately 2 years (the REF timeline) could result in the exposure of acid generating geological materials (GHD, 2023). A sink or depression would form in the regional water table due to the decline dewatering, creating a tendency for acid or metalliferous drainage to be collected, or its movement hydraulically controlled.

Once construction and exploration activities are complete, PAF material would be placed back underground or capped with NAF material. If mining does not proceed, the boxcut will be filled and the portal sealed, and the site will continue to be a groundwater sink until the decline fills with water and the groundwater levels reach equilibrium. Capping of the PAF material and inundation with groundwater, together with sealing of the vent rises would prevent further oxidation and greatly minimising the risk of post closure acid mine drainage (GHD, 2023).

Post Exploration Groundwater Inflow

Groundwater inflow, post exploration, is expected to be less than or similar to groundwater inflow during exploration (i.e. between 0.31ML/day and 0.5ML). Following cessation of exploration activities, the rate of groundwater inflow would decline over time as groundwater levels gradually recover.

Cumulative Impacts

As there are no mining operations currently operating within 20km of the REF Area (thus within the predicted radius of influence), no cumulative impacts are expected (GHD, 2023).

Conclusions And Recommendations

As the REF is not predicted to adversely impact landholder bore use, GDEs or groundwater quality, GHD (2023) determined that the impacts of the Project meet the Level 1 Minimal Impact Considerations.

GHD (2023) recommends the following measures be undertaken by Peel Mining to ensure the impacts to groundwater remain low.

- Continued monitoring of groundwater levels and groundwater quality using the existing monitoring bore network.
- Record all water pumped into and out of the exploration decline (including material movements and ventilation rates) to enable a robust assessment of groundwater inflows to the exploration decline.
- Engage with surrounding landholders (including owner of bore GW017889 which is 4.9km southeast of the REF Area) to determine if the bores are operational, and potentially implementing a monitoring program to assist in documenting any changes in groundwater levels and the consequent management and mitigation of groundwater impacts.

- Apply for a works approval for the exploration decline and a Water Access Licence (WAL) for 183 ML/year from the Lachlan Fold Belt MDB groundwater source of the Water Sharing Plan for the NSW Murray Darling Basin Fractured Groundwater Sources.

4.1.2.3 Annual Water Balance

For the purposes of this assessment, water within the dirty water catchment (i.e. potentially sediment-laden water) that will flow to sediment basins and sumps has been excluded from this assessment because it will either be used for dust suppression or allowed to evaporate. As a result, this water balance considers only potentially contaminated water generated through dewatering of the exploration decline and as runoff from the ROM Pad and PAF Stockpiling Area, with the water storage facility representing the key water storage REF Area.

Water Inflows

- Rainfall – rainfall inflow would be limited to incident rainfall within the ROM Pad, PAF Stockpiling Area and water storage facility (total approximate catchment size of 6.9ha). Given the low mean annual rainfall of 389.5mm, annual rainfall would likely be approximately 26.9ML.
- Groundwater inflows and decline dewatering – GHD (2023) anticipate that groundwater inflows would likely be between 0.31ML/day and 0.5ML/day. Conservatively assuming 0.5ML/day inflow, annual inflows to the underground workings would be approximately 182.5ML/year. However, water would be lost through the following.
  - Ventilation system - Assuming that air removed from the decline has a temperature of 28ºC and a relative humidity of 60%, the moisture content of the air would be 0.02L/m^3. Allowing for a ventilation rate of 180m^3/s, annual water losses via ventilation would be approximately 114ML/year.
  - Water removed with waste rock – Assuming 360,000t of waste rock removed over two years and a moisture content of 3%, annual water losses via waste rock transportation (while this is occurring) would be approximately 0.4ML/year. However, as this activity is likely to occur for only 2 years of the proposed 4-year life of the program, it has been ignored for the purposes of this assessment.

  As a result, net annual dewatering from the decline is expected to be 68.5ML. It is anticipated that any water accumulating at the base of the exploration decline would be used for exploration-related purposes.

Water Losses

- Return water – if necessary, water would be pumped from the water storage facility and/or sediment basins to the exploration decline for exploration-related purposes. A proportion of that water would be returned to the pond with decline dewatering. For the purposes of the water balance, water inflows and outflows have been assumed to be equal. As a result, net return water is assumed to be nil.

- Evaporation – based on a water storage facility area of approximately 3.8ha (**Figure 5**), a mean annual evaporation rate of 2,397mm and a pan evaporation to pond evaporation conversion rate of 75%, annual evaporation from the dewatering pond is assumed to be 68.3ML.
- Dust suppression – water from the water storage facility would not be used for dust suppression purposes. As a result, annual usage of water from the water storage facility for dust suppression is assumed to be nil.

Net Water Balance

Table 29 presents the water balance for the Exploration Decline Program. In summary, a net total of approximately 27.1ML of potentially contaminated would be generated by the Exploration Decline Program each year. However, it is noted that these calculations assume a conservative groundwater inflow rate of 0.5ML/day into the decline. **Table 29** also presents water balance calculations based on the lower end of the predicted groundwater inflow range (i.e. 0.31ML/year) which indicate that the net water balance for the Exploration Decline Program would be nil.

Table 29
Water Balance

Water Inputs		Water Losses	
Conservative Water Balance (0.5ML/day Groundwater Inflow Rate)			
Source	**Annual Volume (ML)**	**Source**	**Annual Volume (ML)**
Decline Dewatering	68.5	Return Water	Nil
Rainfall	26.9	Evaporation	68.3
Total	**95.4**	**Total**	**68.3**
Net Water Balance (Inputs minus Losses)			**27.1**
Water Balance (0.31ML/day Groundwater Inflow Rate)			
Decline Dewatering	0.0	Return Water	Nil
Rainfall	26.9	Evaporation	68.3
Total	**26.9**	**Total**	**68.3**
Net Water Balance (Inputs minus Losses)			**0.0[1]**

Note 1: Whilst water losses exceed water inputs, the net water balance would not become negative as evaporation of decline dewatering water from the Water Storage Dam would not occur.

4.1.3 Soil and Stability Impacts

The Project would disturb approximately 26.9ha of soils. One soil landscape system Yackerboon, has been identified within the REF Area, as displayed on **Figure 7**.

As discussed in Section 2.1.3, the land within the REF Area has been classified as Land Capability Class 5 – Moderate–low capability land with high limitations for high-impact land uses. Land Capability Class 5 will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation.

Following completion of exploration activities or subsequent mining operation, decommissioning of site infrastructure and rehabilitation of the REF Area, the surface area would return to its existing capability class and land use.

4.1.4 Noise and Vibration Impacts

4.1.4.1 Introduction

A Noise and Vibration Impact Assessment (NVIA) for the Project was undertaken by Muller Acoustic Consulting Pty Ltd (MAC). The resulting report is presented as **Appendix 7** and is hereafter referred to as MAC (2022). The following subsections provide a summary of the NVIA and describe the operational safeguards and management measures to be implemented.

4.1.4.2 Sensitive Receivers and Assessment Criteria

Figure 2 presents the location of the closest sensitive receivers. The REF Area is located a minimum of 11km from the closest non-project related residence "Mount View".

The Project Noise Trigger Levels (PNTLs) and the Rating Background Level (RBL) were determined for the REF in accordance with the EPA's Noise Policy for Industry (NPI) 2017. PNTLs are the criteria of noise levels, above which noise management measures are required to be considered.

The RBL is a single background level representing each assessment day (day, evening and night) over the monitoring period (MAC, 2022). Project Intrusiveness Noise Level (PINL) is the RBL +5dB and is generally considered the acceptable noise level from an industrial source (MAC, 2022). **Table 30** presents the RBLs and PINLs that have been determined for the Project.

Table 30
Rating Background Levels and Project Intrusive Noise Levels

Receiver Type	Period[1]	Adopted RBL[2] dB LA90	PINL dB $L_{Aeq(15min)}$
Residential	Day	35	40
	Evening	30	35
	Night	30	35
Note 1: Day – period from 7:00am to 6:00pm Monday to Saturday or 8:00am to 6:00pm on Sundays and public holidays; Evening – period from 6:00pm to 10:00pm; Night – the remaining periods.			
Note 2: Minimum RBLs have been adopted for this REF.			
Source: MAC (2022) – after Table 6			

Amenity Noise Levels (ANLs) are noise levels within a receiver area which considers all current and future industrial noise, and Project Amenity Noise Level (PANL) is the level at which the combined ambient noise level in area from all industrial sources would remain below (MAC, 2022). This is calculated as the ANL minus 5dB(A) for new industrial developments. **Table 31** presents the ANLs and PANLs for the REF.

Table 31
Amenity Noise Levels and Project Amenity Noise Levels

Receiver Type	Noise Amenity Area	Period[1]	Recommended ANL dB $L_{Aeq(period)}$[2]	PANL dB $L_{Aeq(15min)}$[3]
Residential	Rural	Day	50	53
		Evening	45	48
		Night	40	43
Note 1: Day – period from 7:00am to 6:00pm Monday to Saturday or 8:00am to 6:00pm on Sundays and public holidays; Evening – period from 6:00pm to 10:00pm; Night – the remaining periods.				
Note 2: Recommended ANLs as per Table 2.2 of the NPI.				
Note 3: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.				
Source: MAC (2022) – after Table 7				

The PNTLs are the lower of either the PINL or the PANL. **Table 32** presents the PNTLs for the REF determined by MAC (2022).

Table 32
Project Noise Trigger Levels

Receiver Type	Period[1]	RBL	PINL dB $L_{Aeq(15min)}$	PANL dB $L_{Aeq(15min)}$	PNTL dB $L_{Aeq(15min)}$
Residential	Day	35	40	53	40
	Evening	30	35	48	35
	Night	30	35	43	35
Note 1: Day – period from 7:00am to 6:00pm Monday to Saturday or 8:00am to 6:00pm on Sundays and public holidays; Evening – period from 6:00pm to 10:00pm; Night – the remaining periods.					
Source: MAC (2022) – after Table 8					

The PNTLs presented in **Table 32** have been adopted as the construction noise criteria for the REF.

Maximum noise trigger levels are applied to transient or short-term noise events that have the potential to cause sleep disturbance. The criteria for maximum noise trigger levels, presented in **Table 33**, are based on night time RBLs and trigger levels in accordance with Section 2.5 of the NPI.

Table 33
Maximum Noise Trigger Levels

Residential Receivers			
$L_{A(15min)}$		L_{Amax}	
Trigger	40dB(A)	Trigger	52dB(A)
RBL 30 + 5dB	35dB(A)	RBL 30 + 15dB(A)	45dB(A)
Highest	**40dB(A)**	**Highest**	**52dB(A)**
Note: Monday to Saturday; Night 10:00pm to 7:00am. On Sundays and Public Holidays; Night 10:00pm to 8:00am.			
Note: As per Section 2.5 of the NPI, the highest of the two criteria are adopted as the trigger level.			
Source: MAC (2022) – modified after Table 9			

Table 34 presents the relevant road traffic noise criteria adopted by MAC (2022) in accordance with the *NSW Road Noise Policy Criteria* (DECCW, 2011).

Table 34
Road Traffic Noise Assessment Criteria

Road Category	Project Type	Assessment Criteria[1]	
		Day (7:00am – 10:00pm)	Night (10:00pm – 7:00am)
Freeways / arterial / sub-arterial	Existing residences affected by additional traffic on existing freeways/sub-arterial roads generated by land use developments.	60dB(A) $L_{Aeq(15hr)}$	55dB(A) $L_{Aeq(9hr)}$
Note 1: For road noise assessments, the day period is from 7:00am to 10:00pm (i.e. there is no evening assessment period as there is with operational noise). Night is from 10:00pm to 7:00am.			
Source: MAC (2022) – after Table 10			

Table 35 presents the relevant increase criteria for receivers experiencing increases in total traffic noise levels due to the addition of Project-related vehicles on Glenwood Road and the Kidman Way.

Table 35
Relevant Road Traffic Increase Criteria for Residential Receivers

Road Category	Project Type	Total Traffic Noise Level Increase, dB(A)	
		Day (7:00am – 10:00pm)	Night (10:00pm – 7:00am)
Freeways / arterial / sub-arterial	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing land.	Existing traffic $L_{Aeq(15hr)}$ + 12dB (external)	Existing traffic $L_{Aeq(9hr)}$ + 12dB (external)
Source: MAC (2022) – after Table 11			

Table 36 presents the ANZEC blasting limit guidelines for air-blast overpressure and ground vibration.

Table 36
ANZEC Blasting Limit Guidelines

Component	Overpressure dB (Linear Peak)	Ground Vibration PPV (mm/s)
Recommended Maximum (95% of all blasts)	115	5
Level Not to be Exceeded	120	10
Long Term Goal for Ground Vibration	N/A	2
Source: MAC (2022) – after Table 12		

4.1.4.3 Assessment Methodology

The following presents a summary of the methodology used by MAC (2022). The full methodology is detailed in Section 5 of MAC (2022).

MAC (2022) developed a computer model, including a three-dimensional digital terrain map, using DGMR (iNoise, Version 2022.1) noise modelling software to quantify noise emissions generated by the REF at sensitive receivers in the vicinity of the REF Area. The model adopted

standard meteorological conditions and noise-enhancing meteorological conditions, as defined in Table D1 of the NPI, a conservative approach that considers source to receiver winds for all receivers, and F class temperature inversions with wind speeds of up to 2m/s at night.

Assumed sound power levels for construction and operational noise sources are listed in Table 15 of MAC (2022). The United States (US) Environmental Protection Agency's road traffic calculation method was used to predict the LA_{eq} noise levels from project-related trucks travelling past receivers adjacent to the haul road.

Air-blast overpressure and ground-bourne vibration levels were calculated using equations from AS2187.2, adopting a Maximum Instantaneous Charge (MIC) of 152kg for a typical 50,000t blast within the box cut, with blasting locations assumed to be at the extremities of the decline to model a worst-case scenario.

4.1.4.4 Noise Scenarios

MAC (2022) considered two scenarios to assess noise impacts, a construction scenario, and an operational scenario, presented in **Figures 19** and **20** respectively. The construction scenario assessed activities undertaken for the establishment of the site and construction of major infrastructure. The operational scenario assessment included decline development works, maintenance operations and on-site light and heavy vehicle movements.

4.1.4.5 Assessment of Impacts

Operational and Construction Noise Assessment

Table 37 presents the noise predictions from all operational sources at surrounding residential receivers (**Figure 1**). MAC (2022) conclude that the results comply with the relevant NPI criteria for all assessment periods at the most affected sensitive receivers.

Table 37
Predicted Operational Noise Levels, dB $L_{Aeq(15min)}$

Receiver	Period[1]	Predicted Noise Level dB $L_{Aeq(15min)}$		PNTL dB $L_{Aeq(15min)}$	Compliant
		Scenario 1 (Operational)	Scenario 2 (Construction)		
R1	Day	<30	<30	40	Yes
	Evening	<30	<30	35	Yes
	Night	<30	<30	35	Yes
R2	Day	<30	<30	40	Yes
	Evening	<30	<30	35	Yes
	Night	<30	<30	35	Yes
R3	Day	<30	<30	40	Yes
	Evening	<30	<30	35	Yes
	Night	<30	<30	35	Yes
R4	Day	<30	<30	40	Yes
	Evening	<30	<30	35	Yes
	Night	<30	<30	35	Yes
R5	Day	<30	<30	40	Yes
	Evening	<30	<30	35	Yes
	Night	<30	<30	35	Yes
R6	Day	<30	<30	40	Yes
	Evening	<30	<30	35	Yes
	Night	<30	<30	35	Yes
R7	Day	<30	<30	40	Yes
	Evening	<30	<30	35	Yes
	Night	<30	<30	35	Yes

Note 1: Day – period from 7:00am to 6:00pm Monday to Saturday or 8:00am to 6:00pm on Sundays and public holidays; Evening – period from 6:00pm to 10:00pm; Night – the remaining periods.

Source: MAC (2022) – after Table 17

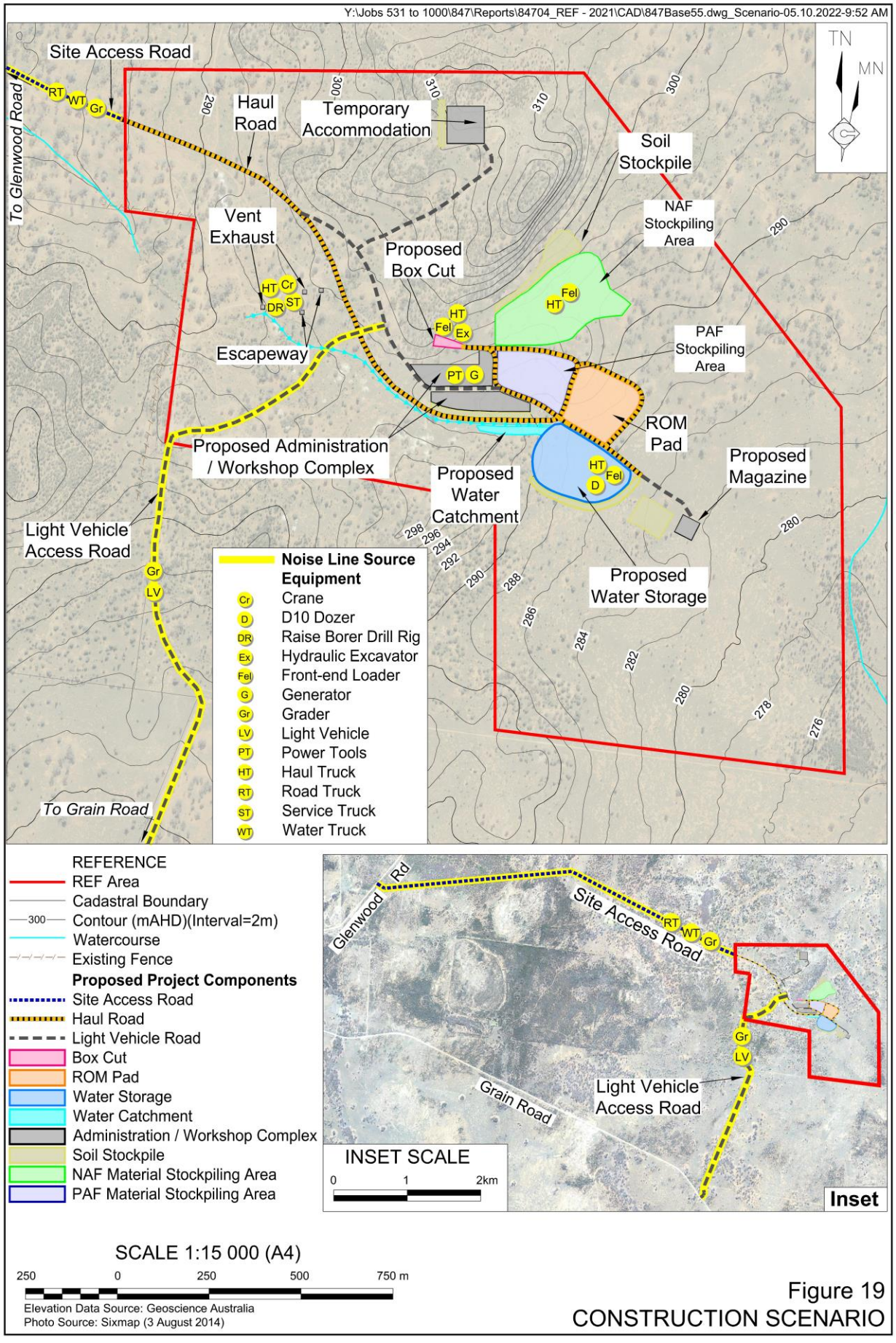

Figure 19
CONSTRUCTION SCENARIO

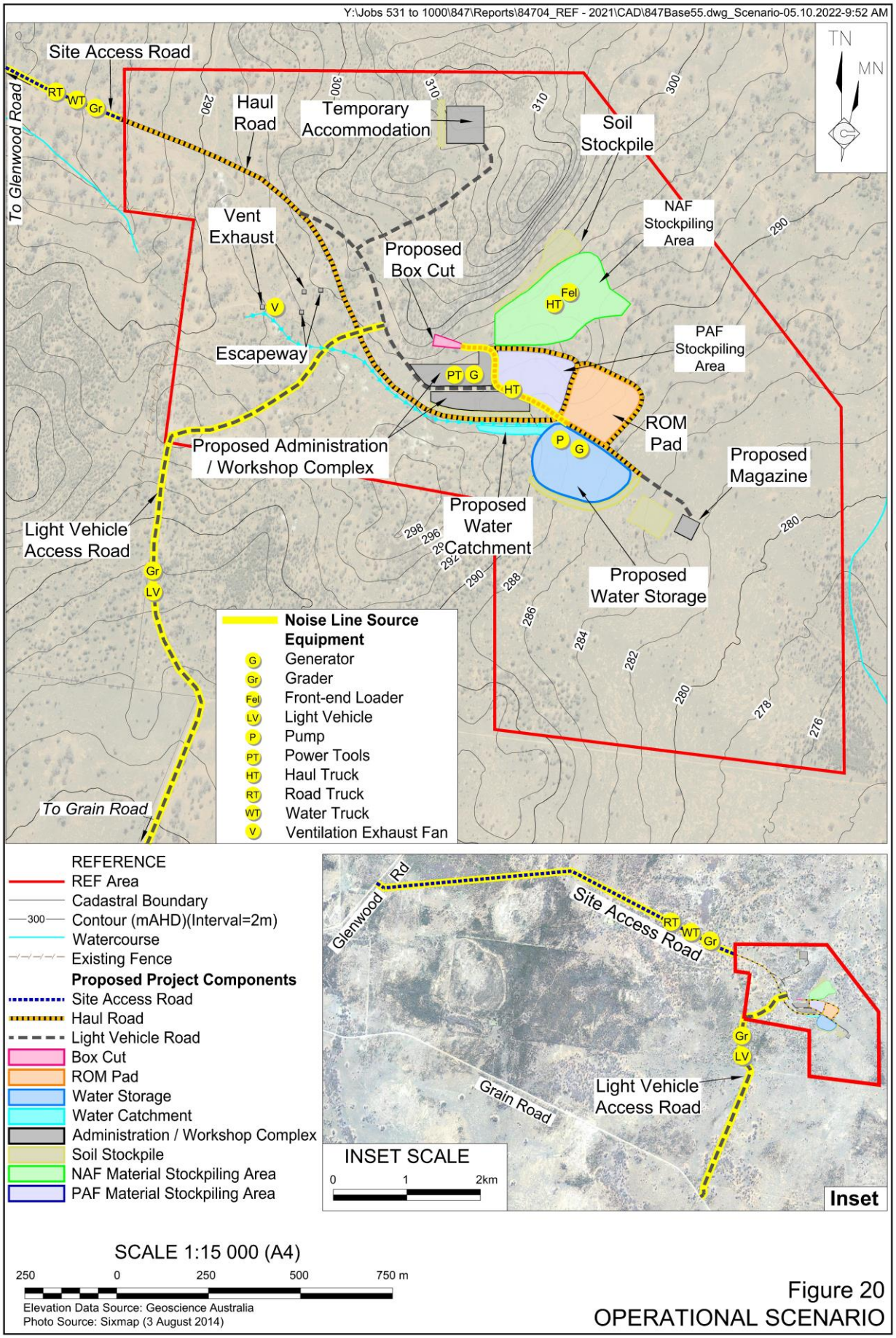

Figure 20
OPERATIONAL SCENARIO

Maximum Noise Level Assessment

Table 38 presents the maximum noise level assessment for assessing sleep disturbance. The results identify that the maximum noise trigger level will be satisfied for all residential receivers, therefore awakening reactions due to maintenance activities are unlikely to occur (MAC, 2022).

Table 38
Maximum Noise Level Assessment (Night)[1]

Receiver	Predicted Noise Level dB LA_{max}	Maximum Trigger Levels dB LA_{max}	Compliant
R1	<30	52	Yes
R2	<30	52	Yes
R3	<30	52	Yes
R4	<30	52	Yes
R5	<30	52	Yes
R6	<30	52	Yes
R7	<30	52	Yes
Note 1: Monday to Saturday; Night 10:00pm to 7:00am. On Sundays and Public Holidays; Night 10:00pm to 8:00am.			
Source: MAC (2022) – after Table 18			

Road Noise Assessment

Table 39 presents the road traffic noise calculations for typical operational traffic for the closest residential receivers to Kidman Way (MAC, 2022). The traffic noise contribution during construction and operations is predicted to remain below the relevant day period assessment criteria for all dwellings along the travel routes and is demonstrated to satisfy the relative increase criteria. MAC (2022) concludes that the road noise criteria will be satisfied at the nearest potentially affected receivers for worst case operational road traffic.

Table 39
Operational Road Traffic Noise Levels – Residential Receivers

Offset Distance (m)	Project Traffic Noise dB $LA_{eq(period)}$	Assessment Criteria[1]	Compliant
Kidman Way – R7			
830	<30 dB $LA_{eq(15hr)}$	60 dB $LA_{eq(15hr)}$	Yes
Note 1: Day – 7:00am to 10:00pm			
Source: MAC (2022) – after Table 19			

Blasting Assessment

Table 40 presents the calculated levels for overpressure and vibration in comparison to the relevant ANZEC criteria. MAC (2022) demonstrates that blasts of MICs up to 152kg would satisfy the relevant ANZEC overpressure and vibration criteria. There are no anticipated impacts to infrastructure as a result of blasting as there is no significant infrastructure located in the REF Area. Further, the closest public road (Wiltshire Road) is approximately 5km west of the REF Area, where ground vibration levels are expected to be 0.3mm/s, below the ANZEC recommended maximum.

Table 40
Blasting Emissions

Receiver	Distance to Charge[1] km	Airblast Overpressure dBZ Peak	Ground Vibration mm/s
ANZEC Criteria (Recommended Maximum)		115	5
R1	11.7	85	0.02
R2	17.7	80	0.01
R3	15.9	81	0.01
R4[2]	8.9	89	0.03
R5[2]	10.4	86	0.02
R6	17.5	80	0.01
R7	11.9	84	0.02
Note 1: Denotes distance from drill rig to receiver location, as per operational scenario. Note 2: Project-related residence.			
Source: MAC (2022) – modified after Table 20			

4.1.5 Other Physical or Pollution Impacts

The other potential physical or pollution impacts considered include the following.

- Coastal Processes and Coastal Hazards

  The REF Area is not located within proximity to the coast and the proposed activities would not affect coastal processes or hazards.

- Hazardous Substances and Waste

  Management measures associated with waste and chemical management has been described in Section 3.5.5. The hazardous substances proposed to be utilised within the REF Area would be stored according to Safety Data Sheets (SDS) and Australian Standards and removed from the REF Area when no longer required.

  All waste would be removed from the REF Area on a regular basis and recycled or disposed of by a licenced contractor at a licenced facility.

4.2 Assessment of Biological Impacts

4.2.1 Introduction

AREA (2022a) prepared a Biodiversity Development Assessment Report (BDAR) for the Project (see **Appendix 4**). Section 2.6 presents an overview of the vegetation communities and threatened species within the REF Area. This subsection presents an overview of the impact assessment prepared in accordance with the *Biodiversity Assessment Methodology 2020.*

4.2.2 Biodiversity-related Impacts

Peel Mining has taken steps to avoid and minimise biodiversity-related impacts by modifying and condensing earlier versions of the impact footprint to:

- avoid rocky habitat;
- avoid impact to habitat connectivity and undisturbed vegetation by placement of mine components in a previously disturbed area; and
- utilise existing site access roads to minimise the need for extra clearing.

Nonetheless, the Project would result in the removal of approximately 37ha of the following native vegetation and habitat (**Figure 10)**.

- PCT 103_Open - Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion 30.0ha
- PCT 104_Disturbed - Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion 4.9ha
- PCT 104_Open - Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion 1.4ha
- PCT 176_Recovering - Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion 0.63ha

Other prescribed impacts identified by AREA (2022a) include the following.

- Karst, caves, crevices, cliffs, rocks or other geological features of significance – AREA (2022a) identified that Curly-bark Wattle, which has habitat constraints of rocky slopes and ridges, was not identified during surveys and is therefore unlikely to be impacted.
- Old mine shafts – AREA (2022a) identified that old mine shafts, potentially used by Little Pied Bat, are not within the development footprint and are unlikely to be impacted.
- Non-native vegetation – AREA (2022a) determined that threatened entities are unlikely to use or be part of non-native HTE Saffron thistle, contained within PCT 103.
- Habitat connectivity – AREA (2022a) identified that there are no specific corridors or other areas of connectivity that link habitat for threatened entities.
- Water bodies, water quality and hydrological processes – AREA (2022a) identified that there are minor waterways that intersect the Site Access Road, however none are within the development footprint.
- Vehicle strike – AREA (2022a) identified that the Project would increase vehicle movements in the area, however no specific threatened fauna or potential locations part of a TEC would be vulnerable to vehicle strike. Common species, such as Kangaroo, would be more likely to be impacted.

Given the management and mitigation measures described in Section 3.5.11, AREA (2022a) assessed that the biodiversity impacts of the Project have been mitigated to the greatest extent practicable. Residual biodiversity impacts would be offset in accordance with the *Biodiversity Assessment Methodology* to achieve a 'no net loss standard'.

4.2.3 Biodiversity Offset

Peel Mining has elected to "opt in" to the *NSW Biodiversity Offset Scheme* for the Project. AREA (2022a) identified that a total of 683 ecosystem credits would be required for the Project (**Table 41**). Peel Mining would retire these credits prior to undertaking vegetation disturbance associated with Project through:

- establishment of a Stewardship Site; or
- purchase of required credits on the open market; or
- payment into the Biodiversity Conservation Trust.

Table 41
Impact Requiring an Offset

Vegetation Zone	PCT	TEC	Area (ha)	Credits
Zone 1 PCT103_Open	PCT 103 – Poplar Box – Gum Coolabah – White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion	No	30.00	544
Zone 2 PCT104_Disturbed	PCT 104 – Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	No	4.9	106
Zone 3 PCT104_Open	PCT 104 – Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	No	1.4	21
Zone 4 PCT176_Recovering	PCT 176 – Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	No	0.6	12
		Total	**36.9**	**683**

Source: AREA (2022a) – modified after Table E2.

4.3 Assessment of Resource Use Impacts

4.3.1 Community Resources

The proposed exploration program would generate approximately 15 full-time equivalent positions during the construction phase (4 months) and approximately 50 full-time equivalent positions during the subsequent exploration phase (remainder of the 4 year anticipated project timeframe). It is anticipated that workers would be employed from local population centres including Cobar, Condobolin and nearby Central West region centres.

Given the above, it is expected that the proposed activity would not degrade or result in a significant increase in demand for services and infrastructure resources available to the local or broader community and would result in increased levels of local employment. As a result, the proposed activity is anticipated to result in a positive community impact.

4.3.2 Natural Resources

The proposed activity would not significantly deplete natural resources, with water and soils being protected and significant vegetation clearing limited to approximately 37ha. The proposed activity would not substantially deplete ore materials, rather it would better define the resource for future beneficial exploitation. Therefore, as the proposed activity would not significantly disrupt, deplete or destroy natural resources, the impact would be negligible.

4.4 Assessment of Community Impacts

4.4.1 Social Impacts

Given that the workforce would be drawn from existing local population centres, potential impacts upon the demographic structure of the community are considered negligible. It is also considered that the environmental impacts would not cause any substantial change or distribution to the community, loss of facilities or loss of community identity.

4.4.2 Economic Impacts

Given the increased levels of employment, particularly locally, it is expected that there would be a positive economic impact from activities including the purchase of consumables, and spending on local goods and services.

4.4.3 Heritage Impacts

4.4.3.1 Aboriginal Heritage

AREA (2022b) prepared an Archaeological Survey for the Project. That report is presented in **Appendix 5**. That survey identified 41 sites of Aboriginal heritage significance within the area surveyed (**Figure 11**). The Project design and Site layout (**Figure 12**) has been assembled with the intent of minimising the potential impacts upon Aboriginal sites. As a consequence, only one identified site would be partially impacted by the Project (AS05). Site AS05 is a large stone artefact scatter comprising hundreds of artefacts in the central portion of the proposed limit of disturbance.

Peel Mining would apply for an Aboriginal Heritage Impact Permit (AHIP) prior to any disturbance within the REF Area. AREA (2022b) also identified 12 sites within 100m of the development footprint. These sites would be avoided by the Project, however management and mitigation measures described in Section 3.5.10 would be implemented to reduce the likelihood of indirect impacts. The remaining 28 sites are more than 100m from the development footprint and would not be impacted by the Project.

Tangible and intangible Aboriginal cultural heritage values are contained in two "Heritage Zones" within the Bimble Box grassy woodland in the eastern section of the development footprint. These two areas would be avoided and fenced off and any other Aboriginal sites identified during the assessment would be avoided. Where this is not possible, a surface collection of Aboriginal objects at risk of direct or indirect harm would be conducted and the artefacts placed within one of the "Heritage Zones" under an approved (AHIP).

In light of the above, impacts upon Aboriginal cultural heritage as a result of the Project would be appropriately managed to ensure there are minimal adverse impacts to the Aboriginal cultural heritage values in the area.

4.4.3.2 Historic Heritage Impacts

There are no sites of historic heritage within the REF Area. As a result, the proposed activities would not adversely impact on historic heritage.

4.4.4 Aesthetic impacts

The REF Area is well vegetated and the proposed disturbance areas are set well back from the only publicly accessible vantage point on Glenwood Road and Grain Road. No proposed activities would be visible from surrounding residences. As a result, the Project would have a negligible aesthetic impact.

4.4.5 Cultural Impacts

One site of Aboriginal cultural heritage would be partially impacted by the Project. Peel Mining would apply for an AHIP prior to any disturbance within the REF Area. Therefore, it is considered that cultural impacts would be appropriately managed.

4.4.6 Land Use Impacts

As the disturbance footprint associated with the proposed activities would be limited to the area of the box cut, exploration decline, ventilation rise, access tracks and surface water, water management components no significant land use impacts would occur and impacts on future agricultural land uses would be negligible. An Agricultural Impact Statement is included as **Appendix 9**.

4.4.7 Transportation Impacts

TTPP (2022) prepared a Traffic Impact Assessment for the Project and is presented as **Appendix 8**. The survey identified that the Project would generate the total vehicle movements for each stage of the Project as described in **Table 42.**

Table 42
Summary of Project Trip Generation

	Light Vehicles Grain Road	Heavy Vehicles Glenwood Road	Oversize Vehicles Glenwood Road	Total Trips per Day	
				Average	Peak
Start of Project Construction Stage					
Equipment Transport	-	-	28 trips over 5 days	5.6	10
Construction Activity					
Deliveries	-	18 trips per month	-	0.6	4
Workforce	30 trips at weekly roster change	-	-	4.3	30
End of Project Construction Stage					
End Construction Equipment Transport	-	-	22 trips over 5 days	4.4	10
Start of Project Operational Stage					
Start Operations Equipment Transport	-	-	24 trips over 5 days	4.8	10
Operational Activity					
Deliveries	-	26 trips per month	-	0.9	6
Workforce	60 trips at weekly roster change	-	-	8.6	60
End of Project Operational Stage					
End Operations Equipment Transport	-	-	30 trips over 5 days	6.0	10
From Table 4.1 TTPP (2022)					

With the exception of the workforce traffic, the Project-generated traffic would use Kidman Way between Gilgunnia and Cobar. Equipment and deliveries that are not sourced from Cobar would use Barrier Highway to the east of Cobar and Mitchell Highway south of Barrier Highway. The distribution of the workforce-generated trips would be dependent on the places of residence of the workers.

The contribution of the Project to traffic on the road network is summarised in **Table 43** on both an average daily and peak daily basis during the construction and operational activity periods. This does not include the short periods of mobilisation and demobilisation at the start and end of the construction and operational stages.

Table 43
Daily Project-Generated Traffic on the Road Network (vehicles per day)

Location	During Construction Activity		During Operational Activity	
	Average	Peak	Average	Peak
Glenwood Road				
West of Site Access Road	0 (0.6)	0 (4)	0 (0.9)	0 (6)
Kidman Way				
north of Glenwood Road	2.9 (0.6)	20 (4)	5.7 (0.9)	40 (6)
Kidman Way				
south of Grain Road	1.4 (0)	10 (0)	2.9 (0)	20 (0)
Site Access Road				
5 light vehicles, (5) heavy vehicles				
From Table 4.2 TTPP (2022)				

Forecasted traffic modelling indicates that on a peak day for traffic generated by the Project, the busiest part of Kidman Way between the Peak and New Cobar Complex accesses would be expected to carry up to 1,070 vehicles per day. In the vicinity of the REF Area, Kidman Way would carry up to 420 vehicles per day.

In rural areas, peak hourly traffic volumes would be expected to be in the order of 8 to 12 percent of the daily volumes. On that basis, and assuming all inbound or outbound vehicle movements by employees on a shift change day may occur in one hour, traffic on Kidman Way during the life of the Project would be expected to be fewer than 60 vehicles per hour south of Priory Tank Road, and fewer than 140 vehicles per hour between Peak and New Cobar Complex accesses.

Comparing the volume ranges for Hourly Traffic Volume Ranges for Class I and Class II Roads (vehicles per hour) with the forecast future peak hourly traffic on Kidman Way of fewer than 140 vehicles per hour on a peak day of activity with the Project, it is evident that the Level of Service (LOS) experienced by drivers on Kidman Way would be A, representing good conditions with drivers experiencing negligible restriction on their desired travel speed (TTPP ,2022).

Comparing the forecast future traffic volumes on Kidman Way of up to 130 vehicles per hour on a peak day of the Project, with the threshold volumes, it is evident that the peak hourly volumes are well below the threshold volumes for analysis, and as such, there is no capacity concerns regarding the operation of the intersections.

For the operating speed of 100km/h on Kidman Way, the Safe Intersection Sight Distance (SISD) required for car drivers is 248m on a level road surface. Observations on site indicate that the available sight distance between a driver stopped on the minor road and approaching vehicles on Kidman Way exceeds 248m at both the Glenwood Road and Grain Road intersections. Observations on site indicate that the available sight distance between a driver stopped on the Site Access Road and approaching vehicles on Glenwood Road exceeds 194m. The available Safe Intersection Sight Distance at the Site Access Road intersection with Glenwood Road is therefore satisfactory. Observations on site indicate that the available sight distance between a driver stopped on the Site Access Road and approaching vehicles on Grain Road exceeds 132m. The available Safe Intersection Sight Distance at the Light Vehicle Access Road intersection with Grain Road is therefore satisfactory.

The Project does not trigger a need for any specific upgrade to the Kidman Way and Grain Road, and Kidman Way and Glenwood Road intersections. The survey recommended that the Site Access Road be widened at its approach to Glenwood Road modified to reflect the right in and left out only movements by heavy vehicles, and the existing dip at the edge of the Glenwood Road carriageway at the Site Access Road be flattened to provide adequate ground clearance for the oversize vehicles expected to use it, and to ensure the angle of articulation of articulated vehicles remains satisfactory.

The layout of the Light Vehicle Access Road intersection is satisfactory for its continued use by light vehicles, which permits two light vehicles to pass in proximity to Grain Road. It is recommended that signage be provided on Glenwood Road and Grain Road to alert drivers to the presence of the Site Access Road and Light Vehicle Access Road respectively.

The Project-generated vehicles are not considered to trigger a need to upgrade the Kidman Way and Glenwood Road intersection. The Project would generate only light vehicle movements at the intersection of Kidman Way with Grain Road, therefore a review of vehicle swept paths at that intersection is not considered to be warranted.

The Site Access Road and the Light Vehicle Access Road would each be constructed as two-way, two-lane unsealed roads, suitable for use by heavy and light vehicles respectively. The Site Access Road would desirably have two 3.5m travel lanes with 1.0m wide shoulders, and the Light Vehicle Access Road would desirably have two 3.0m wide travel lanes with 0.5m wide shoulders.

The proposed movement of oversize vehicles would be negotiated with TfNSW and relevant local councils on a case-by-case basis. All oversize loads would be transported with the relevant permits and load declarations obtained in accordance with relevant guidelines (TTPP, 2022) and any other licences and escorts as required by regulatory authorities.

The transportation, handling and storage of all dangerous goods at the site would be conducted in accordance with the requirements of the relevant Australian Standards, driver and vehicle licencing requirements, and the current version of the Australian Dangerous Goods Code.

The review of the road crash history of the roads expected to be used for haulage associated with the Project (Section 3.4) did not identify any causation factors associated with the existing road network that may be exacerbated by increased traffic demands with the Project.

The existing safety issues with the rest area access at the intersection of Kidman Way with Grain Road may be improved by closing off the non-compliant access at the corner of the intersection, requiring all vehicles to use the signposted entry from Grain Road. This is an existing issue that is not the result of Project-generated traffic.

4.5 Assessment of National Impacts

The proposed activity is not likely to impact on matters of National Environmental Significance under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

4.6 Assessment of Cumulative Impacts

Peel Mining considers that the Project would have a negligible cumulative impact for the following reasons.

- The REF Area exists within marginal agricultural land in a community familiar with the impacts of mining.
- The proposed disturbance of approximately 37ha of native vegetation would be offset under the Biodiversity Offset Scheme and would not result in unacceptable cumulative biodiversity impacts.
- The proposed additional traffic movements would be limited to equipment mobilisation/demobilisation, irregular deliveries, and employee light vehicle movements. As a result, there would be no unacceptable cumulative traffic impacts.

All other environmental impacts would not result in cumulative impacts associated with other mining projects such as the Hera Mine or Federation Project.

5. Summary of Impacts

Table 44 provides a summary of the anticipated environmental impacts associated with the proposed activities and the overall ranking of potential significance.

Table 44
Summary of Potential Impacts

Impacts	Size	Scope	Intensity	Duration	Level of confidence in predicting impacts	Resilience of environment to cope with impacts?	Level of reversibility of impacts?	Ability to manage or mitigate impacts	Ability of the impacts to comply with standards, plans or policies?	Level of public interest	Requirement for further information on the impacts of the activity or mitigation	Ranking of potential significance
Physical or Pollution Impacts												
Air	Small scale	Localised	26.9ha of surface disturbance Up to 360,000t of ore and waste rock transported	Disturbance - 4 years Transportation – 2 years	High	High	Impacts reversible	Effective mitigation measures available (Section 3.5.8)	Compliance almost certain	Low	High level of understanding and information on the impact based on specialist assessment	Negligible
Surface Water	Small scale	Localised	26.9ha removed from catchment	4 years	High	High	Impacts reversible	Effective mitigation measures available (Section 3.5.1)	Compliance almost certain	Low	High level of understanding and information on the impact based on prior experience in the area	Negligible
Groundwater	Small scale	Localised	up to 183MLpa extraction under licence	4 years plus recovery period	High	High	Impacts reversible	Effective mitigation measures available (Section 3.5.2)	Compliance almost certain and mitigation measures in place to mitigate potential impacts	Low	High level of understanding and information on the impact based on specialist assessment	Negligible
Soil and Land Capability	Small scale	Localised	26.9ha of soils disturbed	Short Restricted to the duration of the exploration program	High	High	Impacts reversible	Effective mitigation measures available (Section 4.1.3).	Compliance almost certain	Low	High level of understanding and information on the impact based on specialist assessment	Negligible
Noise and Vibration	Small scale	Localised Nearest residence is approximately 11km from the REF Area	Low	4 Years	High	High	Impacts reversible	Effective mitigation measures available (Section 3.5.4)	Compliance almost certain	Low	High level of understanding and information on the impact based on specialist assessment	Negligible
Coastal Processes and Hazards	Not applicable											
Hazardous Substances and Chemicals	Small scale	Localised	Low Small quantities stored in bunded containers / areas	4 years	High	High	Impacts reversible	Effective mitigation measures available (Section 3.5.5)	Compliance almost certain	Low	High level of understanding and information on the impact based on prior experience in the area	Negligible
Non-production Wastes	Small scale	Localised Waste removed regularly and disposed of at a licenced facility.	Low	4 years	High	High	Impacts reversible	Effective mitigation measures available (Section 3.5.5)	Compliance almost certain	Low	High level of understanding and information on the impact based on prior experience in the area	Negligible
Biological Impacts												
Flora and Fauna	Small scale	Localised Impact limited to approximately 37ha with impacts offset under the *Biodiversity Conservation Act 2016*	Disturbance of 37ha of native vegetation 683 ecosystem credits required.	4 years plus rehabilitation period	High	High	Impacts reversible	Effective mitigation measures available (Section 3.5.11).	Compliance almost certain	Low	High level of understanding and information on the impact based on specialist assessment	Negligible

Table 44 (Cont'd)
Summary of Potential Impacts

Impacts	Size	Scope	Intensity	Duration	Level of confidence in predicting impacts	Resilience of environment to cope with impacts?	Level of reversibility of impacts?	Ability to manage or mitigate impacts	Ability of the impacts to comply with standards, plans or policies?	Level of public interest	Requirement for further information on the impacts of the activity or mitigation	Ranking of potential significance
Resource Use Impacts												
Community Resources	Small scale	Localised resources will predominately be sought from Hera Mine and will not place additional burden on local community (e.g. catering and accommodation)	Low	4 years	High	High	Impacts reversible	Effective mitigation measures available.	No standards, plans or policies apply.	Low	High level of understanding and information on the impact based on prior experience in the area	Negligible
Natural Resources	Small scale	Localised	Low	4 years	High	High	Impacts reversible	Effective mitigation measures available.	No standards, plans or policies apply	Low	High level of understanding and information on the impact based on prior experience in the area	Negligible
Community Impacts												
Social Factors	Small scale	Localised	Low	4 years	High	High	Impacts reversible	Effective mitigation measures available.	No standards, plans or policies apply	Low	High level of understanding and information on the impact based on prior experience in the area	Negligible
Economic Factors	Small scale	Localised	Low	4 years	High	High	Impacts reversible	Effective mitigation measures available.	No standards, plans or policies apply	Low	High level of understanding and information on the impact based on prior experience in the area	Positive
Heritage Impacts	Small scale	Localised	Low	4 years	High	High	Impacts reversible	Effective mitigation measures available (see Section 3.5.10).	No standards, plans or policies apply	Low	High level of understanding and information on the impact based on specialist assessment	Negligible
Aesthetic Impacts	Small scale	Localised	Low	4 years	High	High	Impacts reversible	Effective mitigation measures available.	No standards, plans or policies apply	Low	High level of understanding and information on the impact based on prior experience in the area	Negligible
Cultural Impacts	Small scale	Localised	Low	4 years	High	High	Impacts reversible	Effective mitigation measures available.	No standards, plans or policies apply	Low	High level of understanding and information on the impact based on specialist assessment	Negligible
Land Use	Small scale	Localised	Low	4 years plus rehabilitation period	High	High	Impacts reversible	Effective mitigation measures available.	No standards, plans or policies apply	Low	High level of understanding and information on the impact based on prior experience in the area	Negligible
Transportation	Small scale	Localised	Low	Transportation – 2 years	High	High	Impacts reversible	Effective mitigation measures available.	No standards, plans or policies apply	Low	High level of understanding and information on the impact based on specialist assessment	Negligible
Ranking of Activity as a Whole												
In consideration of the REF Area and proposed disturbance, the activities are anticipated to have a negligible impact individually across all impacts identified. However, taking into account the proposed intensity and duration of the Project, the environmental impacts of the Project are assessed as Negligible.												Negligible

6. Conclusions

Peel Mining considers that the Project would:

- be unlikely to have a significant effect on the environment within and surrounding the REF Area with respect to threatened species, populations, ecological community or habitats and that any residual impacts would be offset by retiring the required 683 ecosystem credits;
- be unlikely to impact on surrounding groundwater users and, in the unlikely event that such impacts occurred, Peel Mining would make good any adverse impacts;
- have a negligible impact on surrounding air quality, noise, vibration, surface water or traffic-related aspects;
- have a partial impact on Aboriginal heritage values, however these would be appropriately managed;
- not result in permanent or substantial adverse changes to the environment; and
- not result in further unacceptable cumulative impacts.

Furthermore, Peel Mining is of the opinion that there is a high level of confidence in relation to the determined impacts and that the proposed activities would not, therefore, result in unacceptable impacts.

7. Statement of Commitments

Table 45 provides a summary of the Statement of Commitments for the proposed exploration activity.

Table 45
Statement of Commitments

<table>
<tr><th>Item</th><th>Commitment</th></tr>
<tr><td>Activity Type and Scope</td><td>• Exploration activity comprising an exploration decline and underground drilling, together with associated surface infrastructure.</td></tr>
<tr><td>Activity Location</td><td>• Within EL7461 approximately 100km south of Cobar, New South Wales.</td></tr>
<tr><td>Activity Scope (including any ancillary activities)</td><td>• Disturbance of approximately 37ha of native vegetation.
• Construction and use of a box cut, decline, two ventilation rises and an escape way.
• Construction and use of surface infrastructure.
• Drilling of underground exploration drill holes.</td></tr>
<tr><td>Hours of Operation</td><td>
<table>
<tr><th>Activity</th><th>Proposed Days of Operation</th><th>Proposed Hours of Operation</th></tr>
<tr><td>Site establishment</td><td rowspan="2">7 days per week</td><td rowspan="2">7:00am – 6:00pm</td></tr>
<tr><td>Box cut excavation</td></tr>
<tr><td>Exploration decline development</td><td rowspan="4">7 days per week</td><td rowspan="4">24 hours</td></tr>
<tr><td>Underground exploration</td></tr>
<tr><td>Rehabilitation</td></tr>
<tr><td>Maintenance Activities</td></tr>
</table>
</td></tr>
<tr><td>Activity Duration</td><td>• Approximately 4 years from commencement of decline development and after site establishment activities.
– Site establishment and construction ..... approximately 2 years
– Box cut development ..... approximately 6 months
– Exploration decline development ..... approximately 2 years
– Underground drilling ..... approximately 2 years</td></tr>
<tr><td>Proposed commencement date</td><td>2023 – 2024 (subject to finance arrangements and ancillary approvals).</td></tr>
<tr><td>Proposed completion date</td><td>2027 – 2028</td></tr>
<tr><td>Maximum area of disturbance</td><td>
<table>
<tr><td>PCT 176 - Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion</td><td>0.63ha</td></tr>
<tr><td>PCT104 - Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion</td><td>6.3ha</td></tr>
<tr><td>PCT – 103 - Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion</td><td>30.0ha</td></tr>
</table>
</td></tr>
</table>

Table 45 (Cont'd)
Statement of Commitments

Item	Commitment
Air quality	• An Air Quality Management Plan would be developed to assist with the management of dust emissions. It would include aspects such as key performance indicators (KPIs), monitoring methods, response mechanisms, compliance reporting and complaints management. • Where reasonable levels of dust cannot be maintained due to adverse weather conditions, operations would be modified or cease until reasonable levels of dust are returned. • The weather forecast would be checked prior to undertaking material handling or processing. • On-site vehicles and plant engines would be switched off when not in use. • Vehicles would be serviced according to manufacturer's specifications and fitted with pollution reduction devices where practicable. • Visual monitoring of activities would be undertaken to identify dust generation. • The extent of exposed surfaces and stockpiles would be kept to a minimum and would be dampened with water as far as is practicable if dust emissions are visible or there is potential for dust generation to occur outside of operating hours. • Drop heights from loading and handling equipment would be reduced where practicable. • Haul roads would be regularly inspected to remove potholes or depressions. Driveways and hardstand areas would be cleaned regularly. • Vehicle traffic would be restricted to designated routes, where speed limits would be enforced. Vehicle loads would be covered when travelling off-site.
Protection of water sources and Erosion and sediment controls	• Prepare and implement an *Erosion and Sediment control Plan* for the REF Area. • Ensure that surface water within the ROM Pad and PAF storage areas are directed to the lined water storage facility. • Maintain a minimum of 30cm freeboard within the water storage facility to prevent discharge. • Ensure that surface water from all other disturbed areas is directed to sediment basins and that all diversions and the sediment basins themselves are constructed in accordance with *Managing Urban Stormwater*. • Ensure that clean water from undisturbed sections of the REF Area is diverted away from disturbed areas. • Preferentially use water from the sediment basins and water catchment area for dust suppression and other exploration operations. • Ensure, where practicable, that water within on-site water storages is tested prior to discharge.
Protection of water sources and Erosion and sediment controls (Cont'd)	• Store all hydrocarbons and other chemicals in a bunded container or on a self-bunded pallet. • Ensure hydrocarbon spill kits are available at each active work site as appropriate. • Ensure that all water removed from the exploration decline is pumped to the lined water storage facility. • Cease to pump water from the exploration decline to the water storage facility in the event that the water level in the pond is less than 30cm from the pond invert. • Ensure that all water pumped into and out of the exploration decline, as well material movements and ventilation rates are recorded to enable a robust assessment of groundwater inflows to the proposed exploration decline. • Continue monitoring groundwater levels and quality within the existing monitoring bores. • Engage with surrounding landholders, including the owner of bore GW017889, to ensure that groundwater impacts are appropriately managed and mitigated. • Apply for a water access licence (WAL) and works approval for the exploration decline.

Table 45 (Cont'd)
Statement of Commitments

Item	Commitment
Noise and vibration	• Maintain vehicles, plant equipment and generators to system requirements and relevant standards to retain appropriate sound power level. • Promptly respond to any complaints relating to noise.
Use of chemicals, fuels and lubricants	• Ensure all equipment is regularly inspected and maintained, including scheduled replacement of hydraulic hoses to minimise the risk of hydrocarbon spills. • Ensure that all personnel are trained and aware of the procedures and requirements of hydrocarbon and chemical materials management prior to the proposed activities commencing. • Ensure that all personnel are trained and aware of waste storage and disposal requirements.
Waste	• All non-production waste materials will be collected and disposed of at a licenced waste facility.
Ecology Fauna and livestock Weeds, pests and diseases	• Induct all personnel in environmental procedures (i.e. vegetation management, sediment and erosion control, protective fencing, ethical procedures for handling fauna, etc). • Clearly mark out and ensure that surface disturbance is limited to the proposed limit of disturbance presented on **Figure 12**. • Undertake pre-clearance surveys prior to any vegetation clearing. • Avoid, where practicable, clearing native vegetation in Spring. • Implement staged habitat removal to allow fauna to vacate if present. Habitat trees would be felled carefully using equipment that allows habitat trees to be lowered to the ground with minimal impact and hollows inspected. • Assign a spotter/catcher during removal of hollow bearing trees. • Salvage and relocate tree hollows from trees cleared and affected as part of the Project. • Use nest-boxes or prune remaining trees to create hollows to compensate for the loss of large hollows as a result of the Project. • Develop and implement a Biodiversity Management Strategy and a Biosecurity Management Strategy prior to construction.
Aboriginal cultural heritage Other heritage	• The Registered Aboriginal Parties (RAPs) identified during the consultation process would be consulted in determining the management of Aboriginal objects. • An Aboriginal Heritage Impact Permit (AHIP) would be applied for prior to any impact to the recorded sites. • Should the AHIP be issued, removal of artefacts would include salvage/surface collection and may include relocation of impacted items to a suitable location in accordance with the *Code of Practice of archaeological Investigation of Aboriginal Objects in NSW.* • Create an exclusion zone around the "Heritage Zones" to avoid indirect or inadvertent impact. • Aboriginal sites outside the "Heritage Zones" would be avoided and fenced off. The sites would be re-identified with the assistance of a qualified archaeologist and the Aboriginal community. • Aboriginal sites within 100 metres of proposed impacts would be fenced off using standard farm fencing with a buffer of ten metres from the trunk of the Culturally Modified Trees and five metres from the boundaries of the Open Stone Artefact Sites. • Induct all personnel on the presence, significance and management of the cultural heritage sites identified by AREA (2022b).

Table 45 (Cont'd)
Statement of Commitments

Item	Commitment
Aboriginal cultural heritage Other heritage (Cont'd)	• Locations of the cultural heritage sites would be provided to the relevant supervisors responsible for the construction and operation of the Project and be indicated on project maps and documents such that it is clear where Aboriginal sites are located, and that they are to remain unharmed by work. • Relevant supervisors would be informed that cultural heritage sites are protected under the *National Parks and Wildlife Act 1974* and no harm is to come to them. • If any objects of suspected Aboriginal heritage origin be encountered during the Project, work in the area of the find would cease and the unexpected finds protocol (Appendix B of **Appendix 5**) would be implemented. • If suspected human remains are located during any stage of the Project, work must stop immediately, and the NSW police must be notified.
Traffic and Transport	• widen the Site Access Road at its approach to Glenwood Road to reflect the swept paths of the heavy vehicles expected to use it; • flatten the existing dip at the edge of Glenwood Road at the Site Access Road to provide adequate ground clearance for vehicles, and to ensure the angle of articulation of articulated vehicles remains satisfactory; • construct the Site Access Road to a desirable standard of two 3.5m travel lanes with 1.0m wide shoulders, and the Light Vehicle Access Road to a desirable standard of two 3.0m wide travel lanes with 0.5m wide shoulders; • provide signage on Glenwood Road and Grain Road to alert drivers to the presence of the Site Access Road and Light Vehicle Access Road; • develop a Traffic Management Plan (TMP) and Driver Code of Conduct for the heavy vehicle transport associated with the Project. The TMP would form part of the employee contract or transport contractual arrangements, and would be prepared in consultation with Cobar Shire Council prior to commencement of construction of the Project, to address such matters as: – compliance with access routes and travel restrictions that may be applicable during or following wet weather; – compliance with road rules, laws and regulations, including those relating to OSOM vehicles and dangerous good transport; – maintaining safe following distances between vehicles, and increasing separation in poor visibility (e.g. dusty conditions on unsealed roads); – reporting of any unsafe driving practices or incidents; and – driver behaviour expectations at any specific locations including in the vicinity of any school bus during bus operating hours.
Rehabilitation commitments and timeframes	• Scrape all sheeting material from road and hardstand areas to be rehabilitated. • Remove infrastructure and transport off site. • Design, manufacture and install appropriate caps for ventilation rises. • Remove infrastructure and transport off site. • Design, manufacture and install appropriate caps for ventilation rises. • Shape final landform to mimic current landform to the extent practicable. • Back fill decline and box cut with stockpiled PAF waste rock and cover with NAF waste rock, and shape the final landform to mimic current landform to the extent practicable. • Place stockpiled soil on the shaped landform. • Spread locally collected seed of species consistent with the required vegetation communities and/or permit natural revegetation of disturbed areas. • Maintain vegetation communities, including management of weed and over abundant fauna species and reseeding as required.

Table 45 (Cont'd)
Statement of Commitments

Item	Commitment
Other regulatory approvals required	• Water Access Licence and works approval from Natural Resources Access Regulator under the *Water Management Act 2000* for the exploration decline. • Aboriginal Heritage Impact Permit for partial disturbance of site AS05.
Community consultation	• Peel Mining maintains open, transparent lines of communication with the local community and this relationship will continue to be fostered.
Complaint management	• Complaints would be handled as per the Peel Mining Complaints Management Procedure. • A Complaints Hotline and email address would be advertised to the local community via signage at the entrance to the REF Area and regular appearances in the local Cobar and Nyngan newspapers.
Incident management	• Peel Mining incident management procedures would be applied to the Project. • Relevant authorities would be notified of all incidents in accordance with relevant legislation, Exploration Lease conditions, Environmental Protection Licence conditions and project approval conditions.
Monitoring	• Monitoring of all exploration activities will be undertaken regularly by senior officers of Peel Mining.
Continuous improvement	• No additional measures identified.
Reporting	• Ensure reporting requirements are in accordance with the Exploration Licence conditions and the conditions of this REF.

8. References

AREA Environmental and Heritage Consultants Pty Ltd (2022a). *Biodiversity Development Assessment Report.* Presented as Appendix 4 of this report.

AREA Environmental and Heritage Consultants Pty Ltd (2022b). *Archaeological Survey.* Presented as Appendix 5 of this report.

GHD Pty Ltd (2021). *Wirlong Production Bore – Pumping Test*. Prepared by GHD Pty Ltd for Peel Mining Limited.

GHD Pty Ltd (2023). *Groundwater Impact Assessment.* Presented as Appendix 3 of this report.

Muller Acoustic Consulting Pty Ltd (2022). *Noise and Vibration Assessment.* Presented as Appendix 7 of this report.

NSW Department of Environment, Climate Change and Water (2010). *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.*

NSW Department of Environment, Climate Change and Water (2011). *NSW Road Noise Policy Criteria*.

NSW Environment Protection Authority (EPA) (2017). *Noise Policy for Industry*.

NSW Department of Planning, Industry and Environment (2022) *Biodiversity Assessment Methodology.*

Todoroski Air Sciences Pty Ltd (2022). *Air Quality Impact Assessment.* Presented as Appendix 6 of this report.

The Transport Planning Partnership (TTPP) (2022). *Traffic Impact Assessment*. Presented as Appendix 8 of this report.

TRC (2011). *Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia*. Prepared for the NSW Office of Environment and Heritage by TRC Environmental Corporation.

Walker, P.J. 1991. *Land Systems of Western New South Wales. Soil Conservation Service Technical Report No. 25.*

Appendices

Appendix 1

ESF4 Form

(Total No. of pages including blank pages = 65)

NSW GOVERNMENT | Regional NSW

NSW Resources Regulator

FORM

ESF4 Application to conduct exploration activities for assessable prospecting operations

May 2020

Mining Act 1992, Petroleum (Onshore) Act 1991 and *Work Health and Safety (Mines and Petroleum Sites) Act 2013.*

When to use this form

This form must be used to:

- seek approval to conduct assessable prospecting operations in NSW (refer to Sections 23A and 44A of the *Mining Act 1992*)
- seek approval to modify an approved assessable prospecting operation.

This form may also be used to:

- notify the NSW Resources Regulator of the appointment of a mine operator of a workplace where exploring for minerals is taking place, prior to commencement (refer to clauses 6 and 7 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014, which requires notification of the appointment of a 'mine operator', being the operator of a workplace where 'mining operations' are being carried out, prior to commencement. Mining operations includes exploring for minerals by mechanical means.
- notify the NSW Resources Regulator of the commencement of exploring for minerals (refer to clause 129 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014, which requires notification prior to the commencement of 'mining operations' - which includes exploring for minerals, however, excludes exploring by non-mechanical means.

You do not need to complete this form if you are conducting prospecting operations identified as exempt development under State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007.

This form has been prepared and approved in accordance with the *Mining Act 1992*, *Mining Regulation 2016, Petroleum (Onshore) Act 1991,* Petroleum (Onshore) Regulation 2016, *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and Work Health and Safety (Mines and Petroleum Sites) Regulation 2014.

The information requested in this form may not be specifically referenced in the *Mining Act 1992,* Mining Regulation 2016, *Petroleum (Onshore) Act 1991*, Petroleum (Onshore) Regulation 2016, *Work Health and Safety (Mines and Petroleum Sites) Act 2013* or Work Health and Safety (Mines and Petroleum Sites) Regulation 2014, however, its inclusion in the approved form validates the authority of the NSW Department of Planning, Industry and Environment, NSW Resources Regulator to request it.

If there is insufficient room in the fields please provide the information as an attachment.

Important notes

Any information or template that is required to accompany this application should be lodged within 10 business days of the lodgement date. Failure to supply the information within this timeframe may be considered as grounds for refusing the application according to Schedule 1B, clause 6(d) of the *Mining Act 1992.*

If this application is lodged by any party other than the authority holder (i.e. an agent), the department may seek confirmation of that authority and any limits of that authority (*Mining Act 1992* Section 163F and Mining Regulation 2016 Clause 97).

The department may make the information in the form and any supporting information available for inspection by members of the public, including by publication on the department's website or by displaying the information at any of its offices. If you consider any part of your application to be confidential, please provide that part in a separate addendum clearly marked 'Confidential'.

Please read the following guides before completing this form:

- ESG5: Assessment requirements for exploration activities
- ESG2: Guideline for preparing a review of environmental factors
- Guideline for agricultural impact statements at the exploration stage

Exploration in exempted areas

Exempted areas are defined in the *Mining Act 1992* and the *Petroleum (Onshore) Act 1991* as lands set aside for public purposes. Exempted areas include travelling stock routes, road reserves, state forests, state conservation areas, public reserves/commons and land held under a lease for water supply.

The Minister's consent is required before the department can approve exploration activities in exempted areas.

This application cannot be processed until Ministerial consent has been obtained.

To apply for approval to prospect in an exempted area, contact the Division of Resources and Geoscience – Resource Operations by phone: (02) 4063 6600 or email: titles.services@planning.nsw.gov.au

Exploration in State Conservation Areas

The Department of Planning, Industry and Environment (National Parks and Wildlife Service) is responsible for management of State Conservation Areas (SCAs) under the *National Parks and Wildlife Act 1974.* This application cannot be processed until approval from the National Parks and Wildlife Service has been obtained. If you are applying to carry out activities in a State Conservation Area, you must first obtain the following before your application can be processed by the department:

- approval from the Minister administering the *National Parks and Wildlife Act 1974* (Section 47J(7))
- a Review of Environmental Factors (REF) approved by the National Parks and Wildlife Service.

Surface Disturbance Notice

The conditions of some older authorities require authority holders to provide a Surface Disturbance Notice before carrying out exploration activities. This application is regarded as a Surface Disturbance Notice (SDN) for the notification of exploration activities.

Modification of approved exploration activities

To modify an already approved exploration activity, the modification must be substantially the same as the existing approval and have environmental impacts consistent with those already assessed and approved. Otherwise, a new application for the entire activity must be made.

A modification could include:

1. A change to the timing/scheduling of the activity (including extending a time-based approval).
2. A change to the location and/or layout of the activity. For example:
   - within the boundary of an area already assessed
   - within an area already disturbed
   - within an area where the impact will be similar to that already assessed.

This could include the relocation of approved drill holes within a reasonable distance of the original location/s that meet the above standards.

3. A reduction in the nature and scale, and related disturbance, of the originally approved activity.

A modification does not include:

- a change to the location of the activity outside of the area previously assessed.
- an increase in the nature and scale, and related disturbance, of the original activity.
- an increase in the quantity/number of activities (e.g. number of drill holes, number of excavations, increased clearing etc.).

How to submit this form

- By email: Send an electronic copy of the form including any attachments to: nswresourcesregulator@service-now.com
- By mail: Mail your form and attachments to: NSW Resources Regulator, Mining Act Inspectorate, PO Box 344, Hunter Region Mail Centre NSW 2310.
- In person: Submit your application in person at Department of Planning, Industry and Environment, NSW Resources Regulator, 516 High Street, Maitland, NSW. Office hours are 9.30am to 4.30pm.

How this application will be processed

Once your application has been registered and checked, it will be assessed by the department. The Minister (or their delegate) will consider the department's recommendation and all relevant information and may propose to grant or refuse the application.

1. Authority details

Exploration licence (EL) or Assessment lease (AL) number	EL 7461
Act	Mining Act 1992
Authority expiry date	4 March 2027

2. Authority holder/s details

Provide the full name of authority holder/s and if applicable, the ACN or ARBN (for foreign companies)

Name	Peel Mining Limited
ACN/ARBN	42 119 343 734
Registered street address	Unit 1, 34 Kings Park Road, WEST PERTH WA 6005
Postal address	☒ Same as above Enter here if different

Name	
ACN/ARBN	
Registered street address	
Postal address	☐ Same as above Enter here if different

Name	
ACN/ARBN	
Registered street address	
Postal address	☐ Same as above Enter here if different

Additional authority holders

Provide the full name, ACN or ARBN (for foreign companies) registered street address and postal address details of additional authority holders

3. Contact for the authority holder

Any correspondence relating to this application will be sent to this person

Contact name	Jane Yelland
Position held	Manager Environment, Social and Sustainability
Company	PEEL Mining Limited
Postal address	Unit 1, 34 Kings Park Rd West Perth Western Australia, 6005
Phone (including area code)	
Mobile	0434 077 267
Email	jane.yelland@peelmining.com.au

Your preferred contact method

☒ Email (For companies – provide a generic company email address that is regularly monitored rather an individual employee's email address.)

☐ Mail

4. Appointment of a 'mine operator'

The *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and associated Regulation requires the authority holder to provide notification of the appointment of a 'mine operator', being the operator

of a workplace where 'mining operations' are being carried out. 'Mining operations' includes exploring for minerals by mechanical means (refer Section 5 for clarification regarding 'mechanical means'). **Appointment of a 'mine operator' and notification to the NSW Resources Regulator is required prior to the commencement of exploring by mechanical means.**

4.1. Do you want to appoint a mine operator and give notice to the Regulator pursuant to clauses 6 and 7 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014?

☐ No. Go to Section 5

☐ Yes. Complete the table below and the declaration in Section 4.2

Name of mine operator	
ACN/ABN/ARBN	
Postal address	
Business address	
Phone (including area code)	
Mobile	
Email	
Date appointment takes effect	
Name of contact person	

4.2. Declaration by mine operator

I am the nominated mine operator listed in **Section 4.1** above and I declare that:

- I agree to be appointed as the mine operator for the mine(s) or petroleum site(s) listed in **Section 11.**
- I am / will be a person conducting a business or undertaking at the mine or petroleum site.
- I have been appointed to carry out mining operations at the mine, or petroleum operations at the petroleum site, on behalf of the mine holder or petroleum site holder

- I have the skills, knowledge, experience and resources to exercise the functions of the mine operator of the mine or petroleum site.
- I have been appointed by the mine or petroleum site holder to have management or control of the mine or petroleum site and to discharge the duties of the mine operator under the work health and safety laws.
- I have been given all the relevant information under the control of the mine or petroleum site holder that is required by the mine operator to discharge the duties imposed on the mine operator under the work health and safety laws.
- I authorise the contact person (identified in **Section 4.1** above) to receive any documents (including notices) on my behalf, for the purposes of the work health and safety laws.
- I consent to NSW Resources Regulator making enquiries and exchanging information with government agencies, in NSW and in other states or territories or the Commonwealth regarding any matter relevant to this form.
- The details of the mine operator specified in **Section 4.1** of this form are correct.

Mine operator's name	
Position/title	
Date	
Signature	

NOTE: Giving false or misleading information is a serious offence under section 268 of the *Work Health and Safety Act 2011* and Part 5A of the *Crimes Act 1900.*

NOTE: Clause 7(2) of the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* requires an authority holder who is also a mine operator to notify the Regulator.

NOTE: A mine or petroleum site 'mine operator' must notify the regulator of any change to the contact person's details provided below. Penalties apply if changes are not notified as soon as practicable (and

no later than 28 days) after any change. Notifications must be made by submitting the Change of contact details of operator form to the Regulator.

5. Notification of commencement of operations

The *Work Health and Safety (Mines and Petroleum Sites) Act 2013* and associated Regulation requires notification prior to the commencement of 'mining operations' - which includes exploring for minerals by mechanical means that disturb the ground (refer to clause 129 of the Work Health and Safety (Mines and Petroleum Sites Regulation 2014)

Mechanical exploration that disturbs the ground must be notified before commencement.

Notification is **not required** for mining or petroleum operations that only involve exploration for minerals or petroleum **by non-mechanical means. Non-mechanical exploration** means exploring for minerals or petroleum (other than by mechanical means that disturb the ground) and includes the following:

- geological mapping
- sampling and coring using hand-held equipment
- geophysical surveying (but not seismic surveying) and borehole logging
- access by vehicle (but not if access requires the construction of an access way such as a track or road)
- shallow reconnaissance drilling involving no more than minimal site preparation (e.g. non-mechanical means such as a hand auger)
- minor excavations (but not costeaning or bulk sampling) (e.g. non-mechanical means such as using hand held equipment)

5.1. Do you want to notify the Regulator of the commencement of operations the subject of this application pursuant to clause 129 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014?

☐ No. Go to **Section 6**

☐ Yes. Complete the table below and declaration in **Section 5.2**

Name of mine operator	
ACN/ABN/ARBN	
Proposed date of commencing operations	(notification must be before commencement)
Date of intended conclusion of operations	
GPS co-ordinates of the **area** covered by the exploration site and in the case of a petroleum site, the coordinates of the location of any proposed wells.	cross reference can be made to the details provided in Section 11

5.2. Declaration of commencement of operations by the mine operator

I declare that:

- In giving this notice as the mine operator, I understand that I have satisfied the requirements under clause 129 of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 to notify the regulator of commencement of mining.

Mine operator's name	
Position/title	
Date	
Signature	

NOTE: Giving false or misleading information is a serious offence under section 268 of the *Work Health and Safety Act 2011* and Part 5A of the *Crimes Act 1900*.

6. Exempted areas

Exempted areas are defined in the *Mining Act 1992* and *Petroleum (Onshore) Act 1991* as lands set aside for public purposes, which includes travelling stock routes, road reserves, state forests, state

conservation areas, public reserves/commons and land held under a lease for water supply. Exempted areas require Ministerial consent – **this application cannot be processed until Ministerial consent has been obtained.**

6.1. Will the activity include prospecting in an exempted area?

☒ No. Go to **Section 7**

☐ Yes. Continue to **Section 6.2**

6.2. Prospecting in exempted areas

6.2.1. Minister's consent

Attach a copy of the Minister's consent to prospecting in exempted areas. To apply for approval to prospect in an exempted area, contact the Division of Resources and Geoscience – Resource Operations Unit by phone (02) 4063 6600 or email titles.services@planning.nsw.gov.au.

☐ I have attached a copy of the Minister's consent to prospect in an exempted area.

6.2.2. Identify exempted areas

Identify the exempted areas where prospecting activities will take place:

Insert a map in the field above or enter your text here

7. State conservation areas

If you are applying to conduct prospecting activities in a State Conservation Area, **you must** obtain the approvals below (**Section 7.2**) before your application can be processed by the department. Requests for approval to prospect in a State Conservation Area are to be submitted to the relevant regional office of the National Parks and Wildlife Service.

7.1. Will the activity include prospecting in a State Conservation Area?

☐ No. Go to **Section 8**

☐ Yes. **Complete Sections 7.2, 8, 10, 18, 19 and 20 only.**

7.2. Prospecting in a State Conservation Area

7.2.1. Minister's consent

If you are applying to carry out activities in a State Conservation Area, you must obtain approval from the Minister administering the *National Parks and Wildlife Act 1974* (Section 47J(7)).

☐ I have attached a copy of the Minister's consent to prospect in a State Conservation Area.

7.2.2. Review of environmental factors

The Department of Planning, Industry and Environment (National Parks and Wildlife Service) manages State Conservation Areas under the *National Parks and Wildlife Act 1974*. If you are applying to conduct prospecting activities in a State Conservation Area, you must provide the department with a Review of Environmental Factors which has been approved by the National Parks and Wildlife Service.

☐ I have attached a copy of the review of environmental factors approved by the National Parks and Wildlife Service.

7.2.3. Identify the State Conservation Area

Identify the State Conservation Area/s where prospecting activities will take place.

Insert a map in the field above or enter your text here

8. New application or modification of approved exploration activities

To modify an already approved exploration activity, the modification must be substantially the same as the existing approval and have environmental impacts consistent with those already assessed and

approved. Otherwise, a new application for the entire activity must be made. Refer to explanatory notes on page 3 of this form for further clarification.

8.1. Is this a new application for approval or an application to modify an existing approved activity?

☐ New application for approval. Complete the details below, then go to **Section 9**

Project name	Mallee Bull Exploration Project
Project location	located at Gilgunnia approximately 100km south of Cobar, New South Wales
Brief description	Construction of a box cut, exploration decline, including associated surface infrastructure. Drilling of the Mallee Bull deposit from underground. Storage of waste rock extracted during decline development. Rehabilitation of the REF Area.

OR

☐ **Modification of an approved application.** Complete the details below, then continue to **Sections 8.2, 11, 18, 19 and 20 only.**

Approved project or activity name	
Department reference and date of previous approval	
Reason for modification	

8.2. Modification of an approved application

Describe the modification to the approved application and the environmental impacts.

9. Application type and assessment requirements

Environmental assessment requirements vary depending on whether a proposed activity is a 'Complying Exploration Activity' or a 'Non-Complying Exploration Activity'. Refer to Section 4 of ESG5 Assessment requirements for exploration activities to determine whether a proposed activity is a Complying Exploration Activity or a Non-Complying Exploration Activity.

An activity can only be assessed under the Complying Exploration Activity pathway if all boxes in **Sections 14** and **15** have been ticked as 'No' and none of the impact thresholds and criteria in **Section 15** have been exceeded.

Petroleum exploration activities are not eligible to be assessed under the Complying Exploration Activity assessment pathway.

Select one application type and assessment pathway only.

☐ **Complying exploration activity (minerals or coal authorities only)**

Complete all sections in this form, apart from **Sections 10, 12 and 17.**

Note: Information provided in this form regarding an activity which meets the Complying Exploration Activity criteria will be taken to be a Review of Environmental Factors for the purposes of any authority conditions which require the submission of a Review of Environmental Factors.

OR

☒ **Non-complying exploration activity (minerals or coal authorities only)**

Select one of the options below

☐ Option 1: Complete all sections in this form to provide a targeted review of environmental factors.

☒ Option 2:

- Complete only **Sections 1-3, 6-11** and **18-20** of this form
- Attach a Guideline Review of Environmental Factors prepared in accordance with ESG2 Guideline for preparing a Review of Environmental Factors

OR

☐ **Petroleum exploration activity (petroleum authorities)**

- Complete only **Sections 1-3, 6-11** and **18-20** of this form
- Attach a Guideline Review of Environmental Factors prepared in accordance with ESG2 Guideline for preparing a Review of Environmental Factors

10. Agricultural impact statement

Under the NSW Strategic Regional Land Use Policy, certain **Non-Complying Exploration Activities** must be accompanied by either a Leve 1 or Level 2 Agricultural Impact Statement. When preparing an Agricultural Impact Statement, you should refer to the Guideline for Agricultural Impact Statements at the Exploration Stage. An Agricultural Impact Statement may be included as part of a Guideline Review of Environmental Factors.

10.1. Project area location

Is any part of the project area located on, or within, 2 km of Strategic Agricultural Land or directly on Land and Soil Capability Classes 1, 2 or 3?

☐ Yes. Attach a Level 2 Agricultural Impact Statement. Go to **Section 11**

☒ No. Continue to **Section 10.2**

10.2. Entire project area

10.2.1. Indicate where the entire project area is located

The entire project area is located (check one or multiple boxes)

☐ A. Within a State Forest, Nature Reserve or State Conservation Area or

☐ B. on existing residential, village, business or industrial zoned land under a Local Environment Plan (LEP), or

☐ C. within an existing mining lease, or

☐ D. on Land and Soil Capability Classes 7 or 8

☐ E. **and** 500 metres or further inside the boundary of the areas listed above.

If you **checked** boxes A or B or C or D (**and** then E above), go to **Section 11**

If **not**, continue to **Section 10.2.2**

10.2.2. Agricultural Impact Statement

If you **did not** check the relevant boxes in **Section 10.2.1**, you will need to attach a Level 1 Agricultural Impact Statement.

☒ I have attached a Level 1 agricultural impact statement. Enter any additional comments below.

11. Site plan and location details

Attach site plans and/or maps at an appropriate scale showing the following (as relevant):

- boundaries of the authority
- lot/DP numbers and boundaries
- topographic contours
- location of the proposed activity (including location of key features of the activity using MGA94 co-ordinates **or** co-ordinates of the **area** specified for proposed activity)
- GPS co-ordinates of the **area** covered by the exploration site and in the case of a petroleum site, the coordinates of the location of any proposed wells (**Note: This is a requirement of Clause 129 of the *Work Health and Safety (Mines and Petroleum Sites) Act 2013* when notification of commencement of operations is provided to the Regulator (see Section 5).**
- layout of the proposed activity (using dimensions and alignments where appropriate)
- major regional features
- existing and proposed access tracks
- existing structures and infrastructure (including dimensions and alignments where relevant)
- nearby sensitive receptors (including residences, educational establishments, hospitals, places of worship, etc)
- location of Aboriginal and European heritage sites (including AHIMS search) (refer to **Section 12.11** and **12.10**, respectively)
- location of identified sensitive land (refer to **Section 14**)

- location of threatened species or ecological communities, or their habitats (refer to **Section 15.4**).

Note: The site plans and/or maps required here can be included in a Guideline review of environmental factors.

Where the exact location of exploration sites are unknown, the plan(s) and/or map(s) should show the area that the proposed exploration activities and associated disturbance will occur. As such, the scope of this application to conduct assessable prospecting operations will be applicable to the areas demarcated on the attached plan(s) and/or map(s). Assessable prospecting operations proposed to be undertaken outside of approved areas would need to be the subject of a new application (or modification of the approved activities as outlined in **Section 8**).

11.1. Identify the area

Identify the map sheet within which the activities are proposed (where relevant include block number/s and unit letter/s for mineral authorities and petroleum titles). These details are referenced on your authority conditions.

Name of map sheet	Block number	Unit letter/s
CANBERRA	314	w, v
CANBERRA	386	a, b

11.2. Site plan/s and map/s

List the site plans and maps you have attached to this application, including relevant plan/map title, dates, reference numbers.

	Reference No.	Name/title	Date
1	847/04	Figure 1 Locality Plan	Sep 2022
2	847/04	Figure 2 Site Plan and Location Details	Dec 2022
3			
4			
5			
6			

	Reference No.	Name/title	Date
7			
8			
9			
10			
Add additional references and notes here			

11.3. Photographs of all sites to be disturbed

Attach photographs of all sites to be disturbed. List all the photographs attached, including relevant photograph titles, site locations and dates. Include a plan illustrating where the photographs were taken from and their aspect.

	Photo number /reference	Photo name/description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Add additional references and notes here		

12. Site description and existing environment

For help answering this section, refer to Sections 1 and 2 of esg2 guideline for preparing a review of environmental factors. Spatial information regarding the site and existing environment can be viewed at the NSW SEED environmental data portal. Importantly, where the exact location of assessable prospecting operations is unknown at the time of the application, a description of the sites and existing

environment needs to address the areas as demarcated on the plan(s) and/or map(s) provided in **Section 11** of the application.

12.1. Existing land uses

Provide details of existing land uses that may be affected by the proposed activity and any proposed changes (temporary or otherwise) to the current land use/s during the activity.

12.2. Sensitive receptor/s

Describe the location, type and distance to the nearest sensitive receptor/s (including residences, educational establishments, hospitals, places of worship).

12.3. Soil types and properties

Describe the soil types and properties (including susceptibility to compaction, erosion and dispersion; presence of acid sulfate soils and potential acid sulfate soils). Refer to Strategic Agricultural Land Maps, Land and Soil Capability Class Maps and Acid Sulfate Soils Maps.

12.4. Surface water sources

Provide details of the existing surface **water** sources in the area that are likely to be affected by the activity. Provide details of the nearest watercourse/s and the distance between the proposed disturbance area/s and the nearest watercourse/s.

12.5. Groundwater sources

Provide details of any existing groundwater sources that occur in the area that are likely to be affected by the activity.

12.6. Vegetation cover

Describe the vegetation cover type, density and condition.

12.7. Critical habitat/area of outstanding biodiversity value

Provide details of any critical habitat/area of outstanding biodiversity value that is likely to be affected by the activity including:

- declared areas of outstanding biodiversity value under the Biodiversity Conservation Act 2016 as listed in the Register maintained by the Department of Planning, Industry and Environment.
- areas declared as critical habitat under the *Fisheries Management Act 1994* as recorded in the Department of Primary Industries register of critical habitat.

12.8. Threatened species record search (wildlife and vegetation)

Attach copies of any relevant threatened species records kept by the Department of Planning, Industry and Environment according to the *Biodiversity Conservation Act 2016*. Refer to mailto:www.bionet.nsw.gov.au for this information. Ensure searches are relevant to the proposed disturbance areas.

☐ A copy of the NSW BioNet search is attached (refer to NSW BioNet).

12.9. Aquatic habitat species record search

Attach copies of any relevant threatened and protected species records for aquatic habitats kept by the Department of Primary Industries according to the *Fisheries Management Act 1994.*

☐ A copy of the threatened and protected species records for aquatic habitats search is attached.

12.10. Historic cultural or natural heritage items

12.10.1. Record searches

Attach copies of record searches for any historic cultural or natural heritage items that may be impacted by the activity. As a minimum, identify if any of the following are impacted. For any of the items below, only attach copies of **relevant** heritage searches.

- ☐ Items listed on the World Heritage List
- ☐ Items listed on the Commonwealth Heritage List
- ☐ Items listed on the National Heritage List
- ☐ State Heritage Register
- ☐ Items listed in the heritage schedule of an environmental planning instrument, such as a local council's Local Environment Plan

12.10.2. Describe any items of historic cultural or natural heritage that may be impacted by the activity

12.11. Aboriginal heritage sites

12.11.1. Describe the nearest Aboriginal sites or any sites that may be affected

Describe the location, type and distance to the nearest Aboriginal heritage sites and any impact the proposed activity will have on Aboriginal heritage sites (Aboriginal objects and places).

12.11.2. AHIMS search

For exploration activities, the *National Parks and Wildlife Act 1974* requires you to exercise due diligence to check if Aboriginal sites will be harmed.

The Department of Premier and Cabinet (Heritage) maintains the Aboriginal Heritage Information Management System (AHIMS) which you can use to undertake due diligence. The AHIMS includes:

- information about Aboriginal objects that have been reported to the Secretary, Department of Premier and Cabinet
- information about Aboriginal Places which have been declared by the Minister for Energy and Environment to have special significance with respect to Aboriginal culture

- archaeological reports.

Attach your AHIMS search to support that you have undertaken due diligence for this application.

☐ I have attached a copy of the AHIMS search.

13. Description of the exploration activity

For guidance answering this section, refer to Section 3 ESG2 Guideline for preparing a Review of Environmental Factors.

13.1. Activity description

Describe all stages of the activity, including before, during and after exploration, including rehabilitation. For drilling activities include drilling type, number of drill holes, drill hole depths and size of drill pads.

13.2. Exploration methods

Describe the exploration methods, including machinery and equipment to be used (including what equipment will be operating at any one time).

13.3. Total surface disturbance

Provide the total surface disturbance (in sqm/ha) for the proposed exploration program.

13.4. Earthworks or vegetation clearing

Detail any earthworks or vegetation clearing, including the re-use and disposal of cleared material (including use of spoil-on-site).

13.5. Timing and phasing of the activity

Describe the timing and any phasing of the activity (including anticipated commencement dates and anticipated completion dates for all activities).

13.6. Proposed sealing/suspension of drill holes/wells

Describe the proposed sealing/suspension of drill holes/wells, including details of any well head suspension, security, maintenance and monitoring programs.

13.7. Venting, flaring or re-use of gases

Describe any proposed venting, flaring or re-use of gases, including details of the system design and venting/flaring/re-use processes.

13.8. Access to exploration activities

Describe the means of access to the various exploration activities. Describe any upgrading of existing access tracks and any construction of new access tracks.

13.9. Ancillary activities

Provide details of any activities which are ancillary to the proposed exploration activities including requirements for water storage, ancillary infrastructure, temporary accommodation.

Note: Certain ancillary works and activities (such as accommodation camps and environmental assessment activities) do not constitute an 'exploration' or 'prospecting' activity under the *Mining Act 1992* or the *Petroleum (Onshore) Act 1991* and therefore cannot be approved by the department. The authority holder should obtain their own advice, and/or make their own enquiries with the relevant local council, Crown Lands controlling authority or the landholder regarding separate consent or approvals required under the *Environmental Planning and Assessment Act 1979* and/or *Local Government Act 1993.*

13.10. Proposed hours of operation

Provide details of the proposed hours of operation.

13.11. On-site employee or contractor numbers

Provide an estimate of on-site employee or contractor numbers.

13.12. Surface water management

Describe how surface water will be managed (including water sources, water usage, water storage and water disposal/reuse).

Note: for guidance answering this section, refer to Section 3.5 of ESG2 Guideline for preparing a Review of Environmental Factors.

13.13. Groundwater management

Describe how groundwater will be managed (including water produced, stored and disposed of/reused during exploration).

Note: for guidance answering this section, refer to Section 3.5 of ESG2 Guideline for preparing a Review of Environmental Factors.

13.14. Waste and excess material management

Describe the type, quantities and management of any waste and excess materials (including drill cuttings, waste water, solid wastes, radioactive material, hazardous wastes, restricted wastes or special wastes).

Note: for guidance refer to Section 3.5 of ESG2 Guideline for preparing a Review of Environmental Factors.

13.15. Chemical management

Detail the handling, use, storage and transportation of any chemicals and hydrocarbons.

Note: for guidance refer to Section 3.5 of ESG2: Guideline for preparing a Review of Environmental Factors.

13.16. Noise management

Describe how noise will be managed to minimise impacts on any nearby sensitive receivers.

Note: for guidance refer to Section 3.5 of ESG2: Guideline for preparing a Review of Environmental Factors.

13.17. Air quality management

Describe how air quality will be managed, including measures to minimise impacts resulting from any dust generation, venting, flaring and fugitive emissions.

Note: for guidance refer to Section 3.5 of ESG2: Guideline for preparing a Review of Environmental Factors.

14. Sensitivity of land to be disturbed

Advise whether the activity will occur on any of the types of land listed below (use the SEED mapping portal to view map layers). All sections must be completed. Explanatory notes are provided in Section 7.1 of ESG5: Assessment Requirements for Exploration Activities to assist authority holders in identifying land to which these location restrictions apply.

An activity can only be assessed under the Complying Exploration Activity assessment pathway if all boxes have been ticked as 'No'. Some of these areas are also 'exempted areas' under the *Mining Act 1992* and *Petroleum (Onshore) Act 1991* (refer to **Section 6**).

If you answer '**yes**' to any of the sections below, provide an assessment of impacts by completing **Section 17.**

14.1. Conservation areas

Land	Yes	No
Land reserved under the *National Parks and Wildlife Act 1974*	☐	☐
Land acquired by the Minister for Energy and Environment under Part 11 of the *National Parks and Wildlife Act 1974*	☐	☐

Land	Yes	No
Land subject to a 'conservation agreement' under the *National Parks and Wildlife Act 1974*	☐	☐
Land declared as an aquatic reserve under the *Marine Estate Management Act 2014*	☐	☐
Land declared as a marine park under the *Marine Estate Management Act 2014*	☐	☐
Land within State Forests set aside under *the Forestry Act 2012* for conservation values, including Flora Reserves or Special Management (and other) Zones	☐	☐
Land reserved or dedicated under the *Crown Lands Act 1989* / *Crown Lands Management Act 2016* (as applicable) for the preservation of flora, fauna, geological formations or other environmental protection purposes	☐	☐
Land identified as wilderness or declared a wilderness area under the *Wilderness Act 1987*	☐	☐
Land subject to a Biodiversity Banking and Offsets Scheme under the *Biodiversity Conservation Act 2016*	☐	☐

14.2. Drinking water catchment protection areas

Land	Yes	No
Land declared to be a 'controlled area' or a 'special area' under the *Water NSW Act 2014*	☐	☐
Land declared to be a 'special area' under the *Water Management Act 2000 or Hunter Water Act 1991*	☐	☐

14.3. Sensitive areas

Note: The upgrade or use of existing access tracks on waterfront land can still be assessed as a Complying Exploration Activity, refer to Sections 7.1 and 7.2 of ESG5 Assessment Requirements for Exploration Activities

Land	Yes	No
Land declared as area of outstanding biodiversity value under the *Biodiversity Conservation Act 2016* or critical habitat under Part 7A of the *Fisheries Management Act 1994*	☐	☐
Wetlands of international significance listed under the Ramsar Wetlands Convention	☐	☐
Land designated as a nationally important wetland in the Directory of Important Wetlands	☐	☐
Coastal wetlands mapped under *State Environmental Planning Policy (Coastal Management) 2018*	☐	☐
Littoral rainforests mapped under *State Environmental Planning Policy (Coastal Management) 2018*	☐	☐
Coastal zone as defined in the *Coastal Management Act 2016*	☐	☐
Land identified in an environmental planning instrument as being of biodiversity significance or zoned for environmental conservation	☐	☐
Waterfront land defined under the *Water Management Act 2000*	☐	☐
Land with a slope greater than 18 degrees measured from the horizontal	☐	☐

14.4. Land with potential for soil and water contamination

Land	Yes	No
Land mapped as Actual Acid Sulfate Soils (AASS) or Potential Acid Sulfate Soils (PASS) on the Acid Sulfate Soils Risk Maps for NSW	☐	☐

14.5. Heritage protection areas (Aboriginal and European)

Land	Yes	No
Land declared as an Aboriginal place under the *National Parks and Wildlife Act 1974*	☐	☐
Land listed on the World Heritage List, National Heritage List or Commonwealth Heritage List	☐	☐
Land, places, buildings or structures listed on the NSW State Heritage Register	☐	☐
Land identified in an environmental planning instrument (such as a State Environmental Planning Policy, Regional Environment Plan or Local Environment Plan) as being of Aboriginal or European heritage significance	☐	☐

14.6. Critical industry clusters

Land	Yes	No
Land identified as Critical Industry Cluster under *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*	☐	☐

14.7. Community land

Land	Yes	No
Public land classified as community land under the *Local Government Act 1993*	☐	☐

14.8. Other areas

Land	Yes	No
Land identified on the authority as environmentally sensitive land	☐	☐

15. Impact thresholds and criteria

Provide details relating to the impact thresholds and criteria outlined below. These include cumulative impact thresholds from existing approved activities that have not yet been undertaken/rehabilitated to the satisfaction of the department. Explanatory notes are provided in Section 7.2 of ESG5 Assessment Requirements for Exploration Activities to assist authority holders in completing these details.

Note: An activity can only be assessed under the Complying Exploration Activity assessment pathway if all boxes have been ticked as 'no' and none of the impact thresholds and criteria have been exceeded. A previously approved/undertaken activity must be counted unless the department has acknowledged in writing that the area has been satisfactorily rehabilitated.

All sections, tick boxes and values must be completed – even if the value is zero

15.1. Vegetation clearing

15.1.1. Will cumulative vegetation clearing and/or removal of tree canopy exceed more than 1,000 square metres in any single hectare?

Note: Use a grid overlay of 1ha cells over the authority area for this calculation

☐ Yes. Provide assessment of impacts by completing Section 17.

☐ No

A = Clearing proposed	*example text* *Drill hole a - 400sqm per ha* *Drill hole b - 400sqm per ha*	m^2

B = Clearing previously approved or undertaken	*Within 1ha around drill hole a - 300sqm* *Within 1ha around drill hole b - 200sqm*	m^2
C = Clearing in B that has now been rehabilitated AND approved in writing by the Department (include Departmental Ref. No.)	*Within 1ha around drill hole a - 100sqm* *Within 1ha around drill hole b - 100sqm*	m^2
Total Clearing = A + B - C	*Within 1ha around drill hole a - 600sqm* *Within 1ha around drill hole b - 500sqm*	m^2

15.1.2. Will cumulative vegetation clearing and/or removal of tree canopy exceed more than 1 hectare in any single unit of the authority (or every 250 hectares in the case of authorities which do not have units or do not align to unit boundaries)?

☐ Yes. Provide assessment of impacts by completing Section 17.

☐ No

A = Clearing proposed	*example text* *0.08 ha*	ha
B = Clearing previously approved or undertaken	*0.05 ha*	ha
C = Clearing in B that has now been rehabilitated AND approved in writing by the department (include department Ref. No.)	*0.02 ha*	ha
Total Clearing = A + B - C	*0.11 ha*	ha

15.1.3. Will cumulative vegetation clearing and/or removal of tree canopy exceed more than 5 hectares in any single authority?

☐ Yes. Provide assessment of impacts by completing Section 17.

☐ No

A = Clearing proposed	*example text* *0.08 ha*	ha

B = Clearing previously approved or undertaken	*0.05 ha*	ha
C = Clearing in B that has now been rehabilitated AND approved in writing by the department (include department Ref. No.)	*0.02 ha*	ha
Total Clearing = A + B - C	*0.11 ha*	ha

15.2. Surface disturbance and excavations

15.2.1. Will cumulative surface disturbances exceed a total of 1 hectare within any single unit of an authority (or every 250 hectares in the case of authorities which do not have units or do not align to unit boundaries)?

☐ Yes. Provide assessment of impacts by completing Section 17.

☐ No

A = Disturbance proposed		ha
B = Disturbance previously approved or undertaken		ha
C = Disturbance in B that has now been rehabilitated AND approved in writing by the department (include department Ref. No.)		ha
Total disturbance = A + B - C		ha

15.2.2. Will cumulative surface disturbance exceed a total of 5 hectares within any single authority?

☐ Yes. Provide assessment of impacts by completing **Section 17.**

☐ No

A = Disturbance proposed		ha

B = Disturbance previously approved or undertaken		ha
C = Disturbance in B that has now been rehabilitated AND approved in writing by the department (include departmentRef. No.)		ha
Total disturbance = A + B - C		ha

15.2.3. Will cumulative excavations exceed 200 cubic metres within any single unit of an authority (or every 250 hectares in the case of authorities which do not have units or do not align to unit boundaries)?

☐ Yes. Provide assessment of impacts by completing **Section 17.**

☐ No

A = Excavations proposed		m^3
B = Excavations previously approved or undertaken		m^3
C = Excavations in B that has now been rehabilitated AND approved in writing by the Department (include Departmental Ref. No.)		ha
Total excavations = A + B - C		m^3

15.2.4. Will cumulative excavations exceed 1,000 cubic metres within any single authority?

☐ Yes. Provide assessment of impacts by completing **Section 17.**

☐ No

A = Excavations proposed		m^3
B = Excavations previously approved or undertaken		m^3

C = Excavations in B that has now been rehabilitated AND approved in writing by the Department (include Departmental Ref. No.)		ha
Total excavations = A = B - C		m^3

15.3. Extraction of groundwater (produced water)

15.3.1. Will cumulative extraction of groundwater from all exploration activities within the authority exceed 3 megalitres (ML) per year?

☐ Yes. Provide assessment of impacts by completing **Section 17.**

☐ No

A = Extraction proposed		ML per year
B = Extraction previously approved or undertaken		ML per year
C = Extraction in B that has now ceased		ML per year
Total extraction = A + B - C		ML per year

15.4. Ecology

15.4.1. Will the activity have a significant effect on threatened species or their habitats?

☐ No. Continue to **Section 15.4.2**

☐ Yes. Provide assessment impacts by completing **Section 17** and any relevant details below (and attach copies as relevant) of any supporting documentation e.g. test of significance undertaken in accordance with the criteria set out in Section 7.3 of the *Biodiversity Conservation Act 2016*.

15.4.2. Will the activity have a significant effect on threatened ecological communities or their habitats?

☐ No. Continue to **Section 15.4.3**

☐ Yes. Provide assessment impacts by completing **Section 17** and any relevant details below (and attach copies as relevant) of any supporting documentation e.g. test of significance undertaken in accordance with the criteria set out in Section 7.3 of the *Biodiversity Conservation Act 2016*.

15.4.3. Will vegetation be removed as part of access track upgrade works in waterfront land?

☐ No. Go to **Section 15.5**

☐ Yes. Provide assessment impacts by completing **Section 17** and relevant details of vegetation removal.

15.5. Aboriginal heritage

15.5.1. Will the activity harm Aboriginal objects?

☐ No. Go to **Section 15.6**

☐ Yes. Provide assessment impacts by completing **Section 17** and any relevant details below (and attach copies as relevant) of any supporting documentation (e.g. any Aboriginal archaeological due diligence assessments undertaken in accordance with the NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects (NSW Minerals Council Ltd, 2010).

15.6. European heritage

15.6.1. Will the activity damage heritage items?

☐ No. Go to **Section 16**

☐ Yes. Provide assessment impacts by completing **Section 17** and any relevant details below (and attach copies as relevant) of any supporting documentation.

16. Compliance with exploration codes of practice

Exploration codes of practice have been prepared by the department. The codes of practice are **only** applied to prospecting authorities granted, renewed or transferred in respect of applications received **after 1 July 2015**. Exploration activities undertaken pursuant to these titles must comply with the relevant exploration codes of practice to be assessed under the complying exploration activity pathway.

The codes of practice provide authority holders with information about the minimum performance requirements to ensure that exploration is undertaken to manage and minimise risks to the environment.

16.1. Does the authority include references to Category 1, Category 2 and Category 3 prospecting operations?

☐ Yes. Do not complete remainder of **Section 16**. (Note: Compliance with the exploration codes of practice is not required as the existing conditions of the authority will apply as the management controls).

☐ No. Complete **Section 16.2**, to confirm that the proposed prospecting operations will comply with the relevant exploration codes of practice.

16.2. Compliance requirements

Check the boxes to indicate that the proposed prospecting operations will comply with the relevant code.

☐	**Environmental management** Yes, the activity will be undertaken in accordance with the Exploration code of practice: Environmental management.
☐	**Rehabilitation** Yes, the activity will be undertaken in accordance with the Exploration code of practice: Rehabilitation.
Produced water management, storage and transfer	
☐	Yes, the activity will be undertaken in accordance with the Exploration code of practice: Produced water management, storage and transfer. [This code is only relevant to prospecting operations where produced water will need to be stored on

	site (excluding the management of incidental groundwater mixed with drilling fluids that can be temporarily contained in drilling sumps or above ground tanks)].
☐	Not applicable.

16.3. Further details

Provide any further details relating to the above management controls and codes of practice as required.

17. Targeted review of environmental factors for non-complying exploration activities

Complete **Section 17** below to provide a Targeted Review of Environmental Factors (REF). This information should focus on the potential environmental impacts associated with the departure(s) from the relevant Complying Exploration Activities location restriction, impact threshold/criteria or management control. This would generally be appropriate for activities that do not significantly depart from the Complying Exploration Activities criteria.

17.1. Physical and pollution impacts

For guidance refer to Section 4.1 of ESG2 Guideline for preparing a review of environmental factors.

17.1.1. Air impacts

Is the activity likely to impact on air quality? Consider air quality impacts:

- such as dust, smoke, odours, fumes, fugitive emissions, toxic or radioactive gaseous emissions with economic, health, ecosystem or amenity considerations
- through generation of greenhouse gas emissions or release of chemicals
- on nearby sensitive receptors

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.1.2. Water impacts

Is the activity likely to impact on water quality and/or water quantity? Consider impacts from:

- the use of surface or groundwater
- the storage of water
- changes to natural waterbodies, wetlands or runoff patterns
- aquifer interference including changes to inter-aquifer connectivity
- changes to flooding or tidal regimes
- changes in surface and groundwater quality and quantity

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.1.3. Soil and stability impacts

Is the activity likely to impact on soil quality or land stability? Consider any:

- degradation of soil quality including contamination, salinisation or acidification
- loss of soil from wind or water erosion
- increased land instability with high risks from landslides or subsidence

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.1.4. Noise and vibration impacts

Is the activity likely to have noise or vibration impacts on nearby sensitive receptors?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.1.5. Coastal processes and hazards

Is the activity likely to affect coastal processes and hazards including those under projected climate change conditions?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.1.6. Hazardous substances and chemicals

Is the activity likely to result in impacts associated with the use, generation, storage or transport of hazardous substances or chemicals? Consider any:

- use, storage or transport of hazardous substances
- use or generation of chemicals which may build up residues in the environment
- chemicals or radioactive material that will be reacted, returned to the surface or left in a drill hole or target formation.

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.1.7. Wastes and emissions

Is the activity likely to result in any impacts to the environment resulting from the generation or disposal of gaseous, liquid or solid wastes or emissions?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2. Biological impacts

For guidance refer to Section 4.2 of ESG2: Guideline for preparing a review of environmental factors.

Fauna and flora (including impact on Threatened Species, or Ecological Communities or their Habitats) – for the purposes of Section 7.3 of the Biodiversity Conservation Act 2016, and in the administration of Sections 5.5 and 5.7 of the Environmental Planning and Assessment Act 1979, the matters below must be taken into account in deciding whether there is likely to be a significant effect on threatened species, or ecological communities or their habitats.

This assessment of significance must be undertaken pursuant to the assessment guidelines issued and in force under the Biodiversity Conservation Act 2016 or the Fisheries Management Act 1994. This assessment of the significance is the first step in considering potential impacts. When a significant effect is likely, a Species Impact Statement (SIS) prepared in accordance with the Biodiversity Conservation Act 2016 or the Fisheries Management Act 1994 may be required.

17.2.1. Vegetation

Is any vegetation to be cleared or modified (including vegetation of conservation significance)?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.2. Threatened species

Is the activity likely to have an adverse effect on the life-cycle of a threatened species such that a viable local population of the species is likely to be placed at risk of extinction?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.3. Area of outstanding biodiversity value (AOBV)/Critical habitat

Is the activity likely to have an adverse effect on AOBV / critical habitat (either directly or indirectly)? (Refer to **Section 12.7**)

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.4. Endangered ecological community or critically endangered ecological community

Select as relevant:

☐ The activity 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.

☐ The activity 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.

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.5. Habitat of a threatened species or ecological community

Select as relevant:

☐ The extent to which the habitat is likely to be removed or modified as a result of the activity will be significant.

☐ The area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the activity.

☐ The habitat to be removed, modified, fragmented or isolated is important to the long-term survival of the species, population or ecological community in the locality.

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.6. Recovery plan or threat abatement plan

Is the activity consistent with the objectives or actions of any relevant plan?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.7. Declared area of outstanding biodiversity value

Is the activity likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.8. Key threatening process

Will the activity constitute or form part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.9. Barriers to movement

Does the activity have the potential to endanger, displace or disturb fauna or create a barrier to their movement?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.2.10. Ecological and biosecurity impacts

Select as relevant:

☐ The activity is likely to cause a threat to the biological diversity or ecological integrity of an ecological community.

☐ The activity is likely to create a biosecurity risk or introduce modified organisms into an area.

☐ The activity is likely to cause a bushfire risk.

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.3. Resource use impacts

For guidance refer to Section 4.3 of ESG2 Guideline for preparing a review of environmental factors.

17.3.1. Community resources

Is the activity likely to degrade or significantly increase the demand for services and infrastructure resources?

Note: Infrastructure includes roads, power, water, drainage, waste management, educational, medical or social services.

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Is the activity likely to require any significant resource recycling or reuse schemes to reduce resource usage?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Is the activity likely to result in any diversion of resources to the detriment of other communities or natural systems?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.3.2. Natural resources

Is the activity likely to disrupt, deplete or destroy natural resources?

Note: Natural resources include land and soil, water, air and minerals.

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Is the activity likely to disrupt existing activities (or reduce options for future activities)?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Is the activity likely to result in the degradation of any area reserved for conservation purposes?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.4. Community impacts

For guidance refer to Section 4.4 of ESG2 Guideline for preparing a review of environmental factors.

17.4.1. Social impacts

Is the activity likely to result in a change to the demographic structure of the community, including changes to workforce or industry structure of the area/region?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Is the activity likely to have an environmental impact that may cause substantial change or disruption to the community, including loss of facilities, reduced links to other communities or loss of community identity?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

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

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Is the activity likely to result in any impacts on the health, safety, privacy or welfare of individuals or communities because of factors such as air pollution, odour, noise, vibration and lighting?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.4.2. Economic impacts

Is the activity likely to have significant economic impacts? Consider any impacts that may:

- affect economic activity (positive or negative), particularly impacts which result in a decrease to net economic welfare
- result in a decrease in the economic stability of the community
- result in a change to the public sector revenue or expenditure base.

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.4.3. Heritage impacts

Is the activity likely to cause impacts on localities, places, landscapes, buildings or archaeological relics of heritage significance?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.4.4. Aesthetic impacts

Is the activity likely to cause impacts on the visual or scenic landscape, including any venting or flaring of gas?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.4.5. Cultural impacts

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

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Will the activity affect known Aboriginal objects or Aboriginal places?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Is the activity located in areas where landscape features indicate the presence of Aboriginal objects?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Can harm to Aboriginal objects or disturbance of landscape features be avoided?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Will the activity affect areas subject to native title claims, indigenous land use agreements or joint management agreement?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.4.6. Land use impacts

Is the activity likely to result in major changes to land use, including any curtailment of other beneficial land uses?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

Is the activity likely to result in any significant property value impacts with land use implications?

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.4.7. Transportation impacts

Is the activity likely to result in any significant impacts on transportation? Consider any:

- substantial impacts on existing transportation systems (such as road, rail, pedestrian) which alter present patterns of circulation or movement
- impacts associated with direct or indirect additional traffic.

Impact level	Detail of impacts	Outline any management controls/mitigation measures
Select level...		

17.4.8. Matters of national environmental significance

For guidance refer to Section 4.5 of ESG2 Guideline for preparing a review of environmental factors.

Is the activity likely to impact on any of the following matters of national environmental significance under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*? Select as relevant:

- ☐ N/A
- ☐ Listed threatened species and communities
- ☐ Listed migratory species
- ☐ Ramsar wetlands of international importance
- ☐ Commonwealth marine environment
- ☐ World heritage properties
- ☐ National heritage places
- ☐ Great Barrier Reef Marine Park
- ☐ Nuclear actions
- ☐ A water resource, in relation to coal seam gas development and large coal mining development

Provide further details relating to any impacts on matters of national environmental significance.

18. Rehabilitation cost estimate

All authority holders are required to lodge a security deposit with the department to cover the government's full costs in undertaking rehabilitation in the event of default by the authority holder. The Rehabilitation cost estimate is used by the department to help determine the amount of the security. Refer to ESG1 Rehabilitation cost estimate guidelines and Rehabilitation cost estimation tool for more information.

The scope of the Rehabilitation cost estimate must include the cost of fulfilling any rehabilitation liabilities or other obligations associated with on-going previously approved exploration activities on the authority, as well as proposed exploration activities subject to this application.

18.1. Is your application for a complying exploration activity?

☐ **Yes.** Go to **Section 18.2**.

☒ **No.** Go to **Section 18.3**.

18.2. Will the cost of fulfilling any rehabilitation liabilities associated with the proposed complying exploration activity, as well as any previously approved exploration activities on the authority, exceed $10,000?

☐ **Yes.** Go to **Section 18.3**.

☐ **No.** Go to **Section 19**. No rehabilitation cost estimate needs to be lodged.

18.3. Have you already lodged an RCE related to this application?

☐ **Yes.** Provide the rehabilitation cost estimate lodgement date and further details in text box below and **go to Section 19**.

☒ **No.** Attach a rehabilitation cost estimate which evidences how the estimate is derived and complete the fields below.

Select one of the options below to confirm the methodology

Department's rehabilitation cost schedule	☒	Other	☐
Current security held by the department			
$49,000			
Total of this rehabilitation cost estimate			
See Appendix 2 of REF			

19. Checklist of items included with this application (as applicable)

Item		Reference
Minister's consent to prospect in exempted areas	☐	Section 6
Minister's consent to prospect in a State Conservation Area	☐	Section 7
A Guideline Review of Environmental Factors	☒	Sections 9 and 17
Agricultural Impact Statement	☐	Section 10
Site plan/maps showing location of activities and proposed site layout	☒	Section 11
Site photographs of the site/s prior to disturbance	☐	Section 11
Copy of the NSW BioNet System search	☐	Section 12.8
Threatened species assessment of significance	☐	Sections 12.8 and 15.4
Copy of threatened and protected species records for aquatic habitats	☐	Section 12.9
Heritage database searches	☐	Sections 11, 12.10, 15.5 and 15.6
AHIMS search	☐	Sections 11 and 12.11

Aboriginal heritage due diligence assessment	☐	Sections 12.11 and 15.5
Rehabilitation Cost Estimate	☒	Section 18
For agents only – evidence of appointment as agent by the authority holder/s	☐	Section 20
Other (list below)	☐	

19.1. Have you lodged all the required information with this form?

☒ Yes

☐ No. I will provide outstanding information within 10 business days of lodging this application. **Note:** failure to supply the required information may result in the refusal of the application.

Describe the additional information to be provided.

20. Declaration by authority holder/s or authorised agent

This form must be signed by the authority holder/s or an agent authorised to act on behalf of the authority holder/s.

I/We certify that the information provided in this application is true and correct. I/We understand that under Part 5A of the *Crimes Act 1900*, that knowingly giving false or misleading information is a serious offence; and under Section 378C of the *Mining Act 1992* or Section 135 of the *Petroleum (Onshore) Act 1991*, any person who provides information that the person knows to be false or misleading is guilty of an offence, for which they may be subject to prosecution.

Declaration

Authority holder name			
Position/title			
Signature		Date	

Authority holder name			
Position/title			
Signature		Date	

Authority holder name			
Position/title			
Signature		Date	

Or

Declaration by agent authorised to act for this authority holder

Provide evidence of appointment by the authority holder.

Authority holder name	Peel Mining Limited		
Position/title	Jane Yelland (Manager - Environment, Social and Sustainability)		
Signature	Jane Yelland	Date	23 December 2022

Office use only

Application received	
Time:	
Date:	

Received under delegation from the Secretary

Name:	
Signature	

Document control

Authorised by Director Compliance DOC19/936714

Amendment schedule

Date	Version #	Amendment
01 March 2016	2.0	New template
06 March 2016	2.1	Hyperlinks updated, minor edits
19 July 2016	2.2	Repeated note from Page 2 "Requests for approval to prospect in a SCA" at Q5
12 September 2016	2.3	Updated links to legislation; updated Q7 & Q8 clarifying that an AIS is not required for CEAs; clarifying Q15 for non-CEAs; amending Q16 so that an RCE is not required for CEAs where rehabilitation liability is less than $10,000.
29 September 2017	2.4	Updated Department name; Updated hyperlinks and reference to new *Biodiversity Conservation Act 2016*; changed "Common Exploration Activity" references to "Complying Exploration Activity"; Q10.8 – referenced new NSW BioNet search; Q11.1 – included explanatory note re. drilling hole details; Q13.1 – added explanatory note and example text to assist with calculations; Q14.2 – added explanatory note to explain when Produced Water Code applies; Q17 – updated checklist to reflect changes to NSW BioNet search; Q18 – "Company Name" added to Agent declaration.
28 May 2018	2.5	Updated hyperlinks to SEED environmental mapping portal; update to legislative changes being: *Environmental Planning and Assessment Act, 1979*; *State Environmental Planning Policy (Coastal Management) 2018, Coastal Management Act 2016* and *Biodiversity Conservation Act 2016*.
4 November 2019	2.6	Amended to include notification of mine operator details and notifiable activities at the mine or petroleum site under the *Work Health and Safety (Mines and Petroleum Sites) Act 2013*. Additional guidance note regarding modifications of approved exploration activities.

		Updated names of departments and Ministers. Updated section numbers.

DOC19/936714

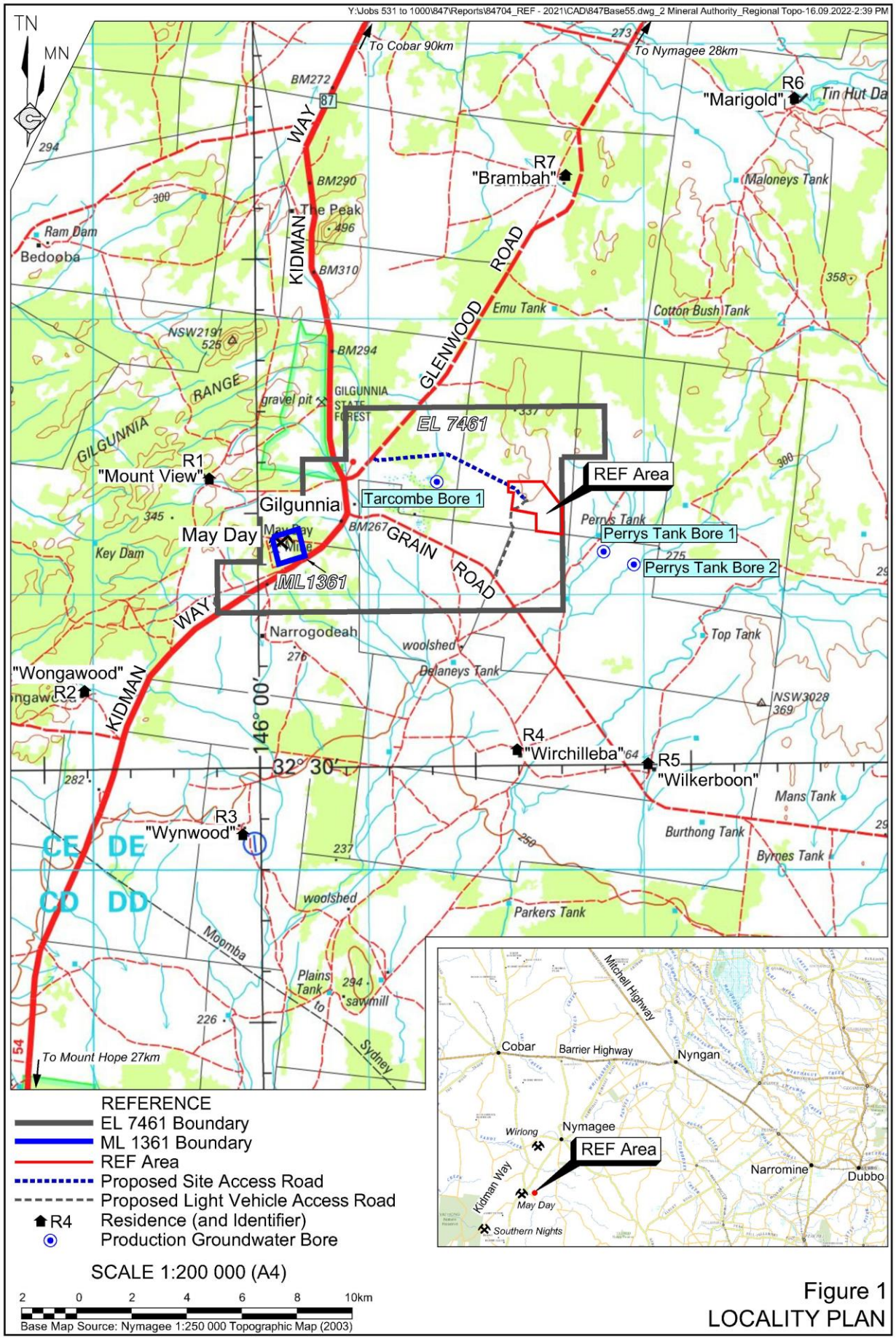

Figure 1
LOCALITY PLAN

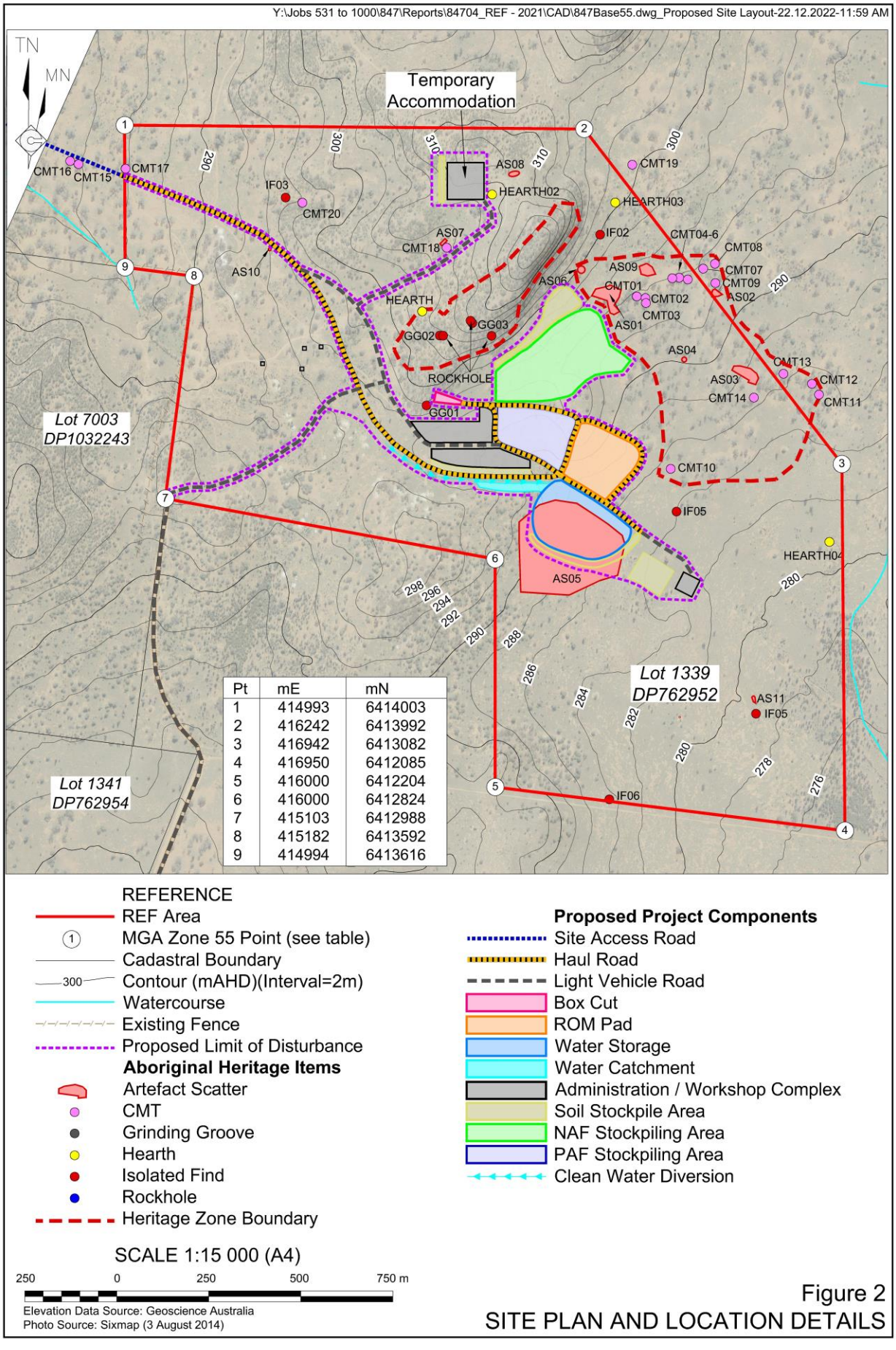

Figure 2
SITE PLAN AND LOCATION DETAILS

Appendix 2

Rehabilitation Cost Estimate

(Total No. of pages including blank pages = 8)

Site Registration

Date December 2022

Complete the following fields prior to calculating the security deposit.

Exploration Authorisation Number	EL 7461
Exploration Authorisation Holder Name	Peel Mining Limited
Expiry of Authorisation	4-3-2027
Current Security	$49,000
Date of last Security Deposit review	01-11-15
RCE Contact	Jane Yelland
Position	Manager Environment, Social and Sustainability
Address	Unit 1, 34 Kings Park Road, WEST PERTH WA 6005
Phone	0434 077 267
Email	jane.yelland@peelmining.com.au

Site Description

The following site specific information is requested to provide background information in the context of calculating the security deposit.

Summary of Exploration Activities

Authorisation area (ha):	Hectares	8 100ha (27 Units)
Exploration Activity (Assessable Prospecting Operations) Approval references for activities which have not been rehabilitated to the satisfaction* of the Department.	1	
	2	
	3	
	4	

**Rehabilitation of prospecting operations is deemed 'satisfactory' when:*

• a Form ESF2 – Rehabilitation Completion and/or Review of Rehabilitation Cost Estimate is submitted to the Department by the authority holder, and
• the Department has formally notified the authority holder that the rehabilitation is satisfactory.

Exploration Summary Rehabilitation Cost Estimation

Note: Sections of this page are automatically filled in from the registration page

Exploration Authorisation Number	EL 7461
Exploration Authorisation Holder Name	Peel Mining Limited
Expiry of Authorisation	04-03-27
Current Security	$49,000
Date of Last Security Deposit Review	01-11-15
RCE Contact	Jane Yelland
Position	Manager Environment, Social and Sustainability
Address	Unit 1, 34 Kings Park Road, WEST PERTH WA 6005
Phone	0434 077 267
Email	jane.yelland@peelmining.com.au

Domain		Security Deposit
Total Cost for all Rehabilitation Activities		$1,087,083
Subtotal (Domains and Sundry Items)		**$1,087,082.80**
Contingency	**10%**	**$108,708.28**
Post Closure Environmental Monitoring	**5%**	**$54,354.14**
Total Security Deposit for the Project (excl. of GST)		**$1,250,145.22**

Note: GST is not included in the above calculation or as part of rehabilitation security deposits required by the Department.

☐ Alterations have been made to unit prices within this spreadsheet. (Attach a separate sheet providing details of changes).

This Registration Form, Summary Report and calculation pages are to be printed and attached as an appendix to the RCE.

This security calculation has been estimated using the best available information at the time.
It is a true and accurate reflection of the total rehabilitation liability held by the authorisation holder/s for the exploration authorisation/s concerned.

Jane Yelland
Authorisation Representative's Name

23 December 2022
Date:

Manager Environment, Social and Sustainability
Authorisation Representative's Role / Responsibility

Jane Yelland
Signature

Exploration

Domain 1a: All Rehabilitation Activities

Total Cost for all Rehabilitation Activities **$1,087,083**

Additional Assumptions: *Record any relevant assumptions to this domain below:*

Costs for 'Additional Items' reflects costs from 'Underground' mining/exploration options in this tool.	**Key Rehabilitation Area Data for Domain**	**Enter data below manually**
Disturbance areas include aproximately 37ha of land covered by native vegetation (see Section 4.2.2 of the REF) and a further approximately 3.04ha	**Total Landform Establishment:**	
of existing unvegetated unsealed road surface. The total disturbance footrpint is equal to approximately 40.04ha.	**Total Growth Media Development:**	
	Total Ecosystem Establishment:	

Management Precinct	Activity / Description	Applicable (Y or N)	Quantity	Unit	Default Unit Rate	Alternative Unit Rate	Total Cost	Basis for Costs Estimation and Additional Relevant Information	Description / Notes:
Termination of Services and Demolition Works	Disconnect and terminate services at remote areas (i.e. pump stations, remote workshops, sewage treatment plant etc.)	**Y**	1	allow	**$5,850**		**$5,850**	**Small mine site reliant on power from generators.**	Used for infrastructure remote from primary connection. Can also be used for small mines / quarries that do not have dedicated supplies from supply authorities such as steel lattice power lines.
	Demolish and remove light industrial buildings and disposal on-site/locally	**Y**	150	m2/floor	**$90.00**		**$13,500**	**Assume demolition and removal of worshop structure (150m2).**	Needs to be calculated per floor/level (Assume 1 floor/level = 3-4 m) - does not include transport to regional disposal facility or equivalent. Assumes asbestos free and mechanically demolished.
	Remove surface pipelines (unsupported) and disposal on-site/locally	**Y**	500	m	**$15.00**		**$7,500**	**Assume removal and disposal of surface water pipelines (500m).**	~300 mm pipes and assumes pipes are used for water transfer between pits (or similar) and remotely located. Does not include transport to regional disposal facility or equivalent.
	Remove concrete pads & footings (>300 mm thickness) and disposal on-site/locally	**Y**	200	m2	**$75.00**		**$15,000**	**Assume removal and on site disposal of concrete pad under workshop (150m2) and footings under demountable structures (assume 50m2 total).**	Breaking up slab and disposal or for conversion to aggregate. Generally haulage rates will be $0.60 - $1.20 / km, depending on truck fleet, loaders etc. For off-site disposal use alternate rate option and add $0.90 / km for transport.
	Waste disposal to Council landfill - fees (general waste)	**Y**	5	tonne	**$193.00**		**$965**	**Assume 5 tonnes of general waste to be disposed of at Council landfill.**	Fee for waste disposal of general waste to local Council landfill; transport rates separate. Please note that this is not applicable to operations with approval for building and demolition waste disposal on site.
Contaminated Materials	Onsite remediation of hydrocarbon contaminated soils (<50 m3) - manual land farming	**Y**	10	m3	**$100.00**		**$1,000**	**< 50m3**	Overall rate for bio-remediation in the order of $75 - $120 /m3 depending on volume, additives
Roads and Tracks	Removal and disposal of plastic liner (i.e. dam, leach pad, sump etc.)	**Y**	37600	m2	**$1**		**$37,600**	**Assume removal of Water Storage Dam liner (3.76ha).**	Provisional sum for cutting using ripping tynes and on-site disposal of the liner.
	Unsealed roads / vehicle park-up areas – Minor earthworks, final trim and deep rip, ameliorate and seed (native tree/shrub/grass)	**Y**	19.2	ha	**$4,485**		**$86,112**	**Assume removal and amelioration of unsealed Site Access Road (9.6ha), Haul Road (4.8ha) and Light Vehicle Road (4.8ha).**	D7 Dozer @ $205 per hour and Grader @ $212 per hour (50% utilisation) - tree/shrub seed.
Earthworks / Structural Works (Landform Establishment)	Minor reshaping and pushing - this may include backfilling costeans; bulk samples, camp areas etc.	**Y**	12.69	ha	**$3,900**		**$49,491**	**Assume minor profiling works across all disturbed site areas (except roads) (total 20.84ha). Assume that this includes respreading of topsoil from adjacent topsoil storage areas.**	D7 Dozer @ $205 per hour and Grader @ $212 per hour (50% utilisation).
	Deep rip hard stand / lay down areas	**Y**	5.04	ha	**$960.00**		**$4,838**	**Deep rip ROM Pad (2.67ha) and PAF Stockpile (2.37ha).**	D7 Rip at ~$205 / hr, 12 hr day, ~2.5 ha / day
	Direct seeding / fertiliser (tree or native grass species)	**Y**	20.84	ha	**$4,135**		**$86,173**	**Direct seeding of all areas (except roads) (20.84ha)**	Includes treating, weighing, mixing with fertiliser + spreading by tractor or helicopter (aerial seeding).
Maintenance of Rehabilitated Areas	Maintenance of areas that have been shaped and seeded and revegetation has been 'successful'	**Y**	40.04	ha	**$925.00**		**$37,037**	**Assume maintanece of all revegtated areas (total 40.04ha).**	Rehabilitation maintenance might include re-seeding, watering, fertilising, minor re-shaping, erosion control, inspections/audits - does not include major repair works.
Maintenance of Other Land	Land management of undisturbed areas (rehabilitation, weeds, ferals, erosion and sediment control works)	**Y**	40.04	ha	**$400.00**		**$16,016**	**Assume management of all revegetated areas (40.04ha).**	Undisturbed areas within the lease boundary that require land management activities.
Additional Items	Other 1 <insert>	**Y**	1		**This is**	$126,000.00	**$126,000**	**Sealing of decline Portal.**	This item includes **<<to be added by the operator>>**
	Other 2 <insert>	**Y**	4		**deliberately**	$150,000.00	**$600,000**	**Sealing of ventilation exhaust (x2) and escapeway (x2).**	This item includes **<<to be added by the operator>>**

Exploration

Domain 1b: All Rehabilitation Activities

Total Cost for all Rehabilitation Activities $0

Additional Assumptions: *Record any relevant assumptions to this domain below:*

	Key Rehabilitation Area Data for Domain	Enter data below manually
	Total Landform Establishment:	
	Total Growth Media Development:	
	Total Ecosystem Establishment:	

Management Precinct	Activity / Description	Applicable (Y or N)	Quantity	Unit	Default Unit Rate	Alternative Unit Rate	Total Cost	Basis for Costs Estimation and Additional Relevant Information	Description / Notes:

Exploration

Domain 1c: All Rehabilitation Activities

Total Cost for all Rehabilitation Activities $0

Additional Assumptions: *Record any relevant assumptions to this domain below:*

	Key Rehabilitation Area Data for Domain	Enter data below manually
	Total Landform Establishment:	
	Total Growth Media Development:	
	Total Ecosystem Establishment:	

Management Precinct	Activity / Description	Applicable (Y or N)	Quantity	Unit	Default Unit Rate	Alternative Unit Rate	Total Cost	Basis for Costs Estimation and Additional Relevant Information	Description / Notes:

Assumptions and rehabilitation requirements

List or record any assumptions made when completing this tool:

Regional NSW

Justification for Change of Rates in the Rehabilitation Cost Estimation Tool

Domain	Activity	DRG unit/rate	Adopted Rates	Justification

In completing the Rehabilitation Cost Estimation, we are seeking an adjustment to the rates currently utilised in the Rehabilitation Cost Estimation Tool. A justification for the rate change by a third party has been included and I confirm that only the rates identified in the above table have been altered in the Rehabilitation Cost Estimation Tool.

Authrorisation Representatives Name ..... **Date** .....

Authorisation Representatives Role / Responsibility ..... **Signature** .....

Appendix 3

Groundwater Impact Assessment

prepared by
GHD Pty Ltd

(Total No. of pages including blank pages = 45)

Mallee Bull Project

Groundwater impact assessment

Peel Mining Limited

31 January 2023

→ **The Power of Commitment**

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Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
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Contents

Table index

Figure index

Abbreviations

Acronym	Definition
AHD	Australian Height Datum
AIP	Aquifer Interference Policy
bgl	Below ground level
BoM	Bureau of Meteorology
btoc	Below top of casing
CRD	Cumulative Rainfall Departure
EC	Electrical conductivity
GDE	Groundwater Dependent Ecosystem
GHD	GHD Pty Ltd
km	Kilometres
L/s	Litre per second
LGA	Local Government Area
m	Metres
m/day	Metre per day
m^2/day	Metres squared per day
m^3/day	Metres cubed per day
MDB	Murray Darling Basin
mg/L	Milligrams per litre
ML	Megalitre
ML/day	Megalitres per day
REF	Review of Environmental Factors
SWL	Standing water level
TDS	Total dissolved solids
TSS	Total suspended solids
WAL	Water Access Licence
WSP	Water Sharing Plans
WM Act	Water Management Act 2000
µS/cm	Microsiemens per centimetre

1. Introduction

Peel Mining Limited (Peel Mining) is undertaking exploration activities at the Mallee Bull exploration project (Mallee Bull). Mallee Bull is located approximately 100 km south of Cobar within EL 7461 and contains one of the highest grade undeveloped copper resources in Australia. Mallee Bull also contains zinc, lead, silver and gold mineralisation. The location of Mallee Bull is shown in Figure 1-1. As part of exploration activities, Peel Mining is proposing to construct an exploration decline and box cut (the Project).

GHD Pty Ltd (GHD) was engaged by Peel Mining to undertake a groundwater assessment to support the Review of Environmental Factors (REF) for the Project.

1.1 Purpose of this report

The purpose of this report is to provide a groundwater assessment to support the REF for the Project.

1.2 Scope

The scope of the groundwater assessment as part of the REF for the Project is as follows:

– Review of available geological maps, exploration data and hydrogeological reports for Mallee Bull and surrounds.
– Undertake searches of the groundwater bore and Groundwater Dependent Ecosystem (GDE) online databases and identify groundwater receptors.
– Provide a description of the existing groundwater environment, including a summary of monitoring data from site bores, production bores and groundwater receptors in the vicinity of Mallee Bull.
– Development of a conceptual groundwater model including sensitive groundwater users.
– Classification of the groundwater source under the NSW Aquifer Interference Policy (AIP).
– Assess the rate of groundwater inflow and radius of drawdown due to the proposed exploration decline using appropriate analytical methods.
– Assess potential impacts on identified groundwater receptors including assessment of impacts against the groundwater level and quality criteria in the AIP.
– Identify groundwater licensing requirements.

1.3 Limitations

This report: has been prepared by GHD for Peel Mining Limited and may only be used and relied on by Peel Mining Limited for the purpose agreed between GHD and Peel Mining Limited as set out in Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Peel Mining Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

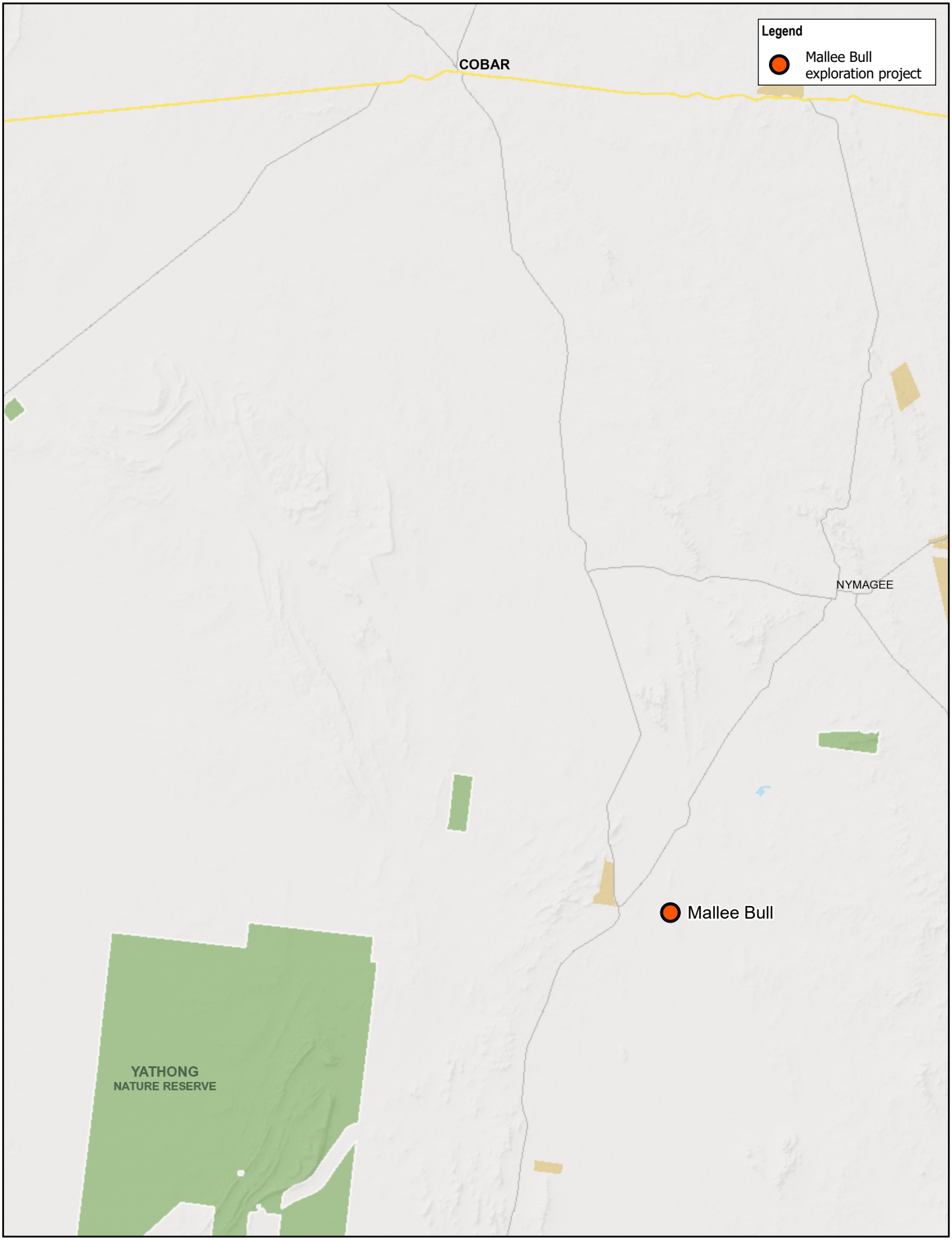
The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

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. GHD disclaims liability arising from any of the assumptions being incorrect.

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

The 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.



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Kilometres

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

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GHD

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Mallee Bull Project - Groundwater Impact Assessment

Project No. **12538802**
Revision No. **A**
Date **18/11/2021**

Locality Plan

FIGURE 1-1

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Data source: Locations (GA, 2020 via MineView) Basemap/OEHBasemapNPWSHillshade: Basemap/OEHBasemapNPWSText: . Created by: dschmidt

2. Regulatory context

2.1 Legislation

2.1.1 Mining Act 1992 and Environmental Planning and Assessment Act 1979

The Project is to be undertaken as an exploration activity within EL7461. The proposed activities are classified as non-complying exploration for which a Guideline Review of Environmental Factors is required. That document is to be prepared under ESG2: Guideline for Preparing a Review of Environmental Factors and is to be assessed by the Resources Regulator under Part 5 of the Environmental Planning and Assessment Act 1979. This report has been prepared to support that application.

2.1.2 Water Management Act 2000

The aim of the *Water Management Act 2000* (WM Act) is to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and in-stream uses as well as to provide for protection of catchment conditions.

Historically, the *Water Act 1912* was the main legislation for managing water resources in NSW, however, this Act has been progressively phased out and replaced by water sharing plans (WSPs) under the WM Act. Once a WSP commenced, existing licences under the *Water Act 1912* were converted to water access licences (WALs), water supply works and use approval (controlled activity approvals) under the WM Act. All new WALs and controlled activity approvals are also issued under the WM Act.

2.1.2.1 Water sharing plans

Fresh water sources throughout NSW are managed via WSPs under the WM Act. Provisions within WSPs provide water to support the ecological processes and environmental needs of GDEs and waterways. WSPs also regulate how the water available for extraction is shared between the environment, basic landholder rights, town water supplies and commercial uses. Key rules within the WSPs specify when licence holders can access water and how water can be traded.

Mallee Bull falls within the porous and fractured groundwater sources of the Lachlan Fold Belt MDB groundwater source, a sub-area of the WSP for the NSW Murray Darling Basin (MDB) Fractured Rock Groundwater Sources. This WSP commenced in July 2011 and was updated in June 2020 and regulates the interception and extraction of groundwater within the defined WSP area. Mallee Bull is located outside the Great Artesian Basin.

Therefore, the interference and extraction of groundwater at Mallee Bull would normally require an access licence under the WM Act.

2.1.2.2 Water Management (General) Regulation 2018

Clause 37 of the Water Management (General) Regulation 2018 exempts certain activities from the requirement of a works approval and a WAL, including the taking of water for prospecting and fossicking activities approved under the *Mining Act 1992*. Under the Water Management (General) Regulation 2018, up to 3 ML of water can be taken per water year as part of prospecting or fossicking activities. Estimates of groundwater inflow into the exploration decline exceed 3 ML/year discussed in Section 6.1.

As more than 3 ML per year of groundwater will be taken during the construction of the exploration decline, the Project will require a WAL as discussed in Section 6.5.

Section 91 of the WM Act details the requirements for controlled activity approval to carry out work on waterfront land, which includes the bed of any river, lake or estuary and any land within 40 m of its high water mark. The exploration decline is located greater than 40 m of any mapped watercourse. Additionally, clause 42 of the Water Management (General) Regulation 2018 exempts activities carried out in accordance with any lease or licence under the *Mining Act 1992*. Thus, controlled activity approvals will not be required for the drilling and construction of the proposed exploration decline. However, it remains an offence to harm waterfront land when carrying out an exempt controlled activity.

2.2 Policies

2.2.1 NSW Aquifer Interference Policy

The NSW Aquifer Interference Policy (AIP) was finalised in September 2012 and clarifies the water licensing and approval requirements for aquifer interference activities in NSW, including the taking of water from an aquifer in the course of carrying out mining.

The Policy outlines the water licensing requirements under the WM Act. A water licence is required whether water is taken for consumptive use or whether it is taken incidentally by the aquifer interference activity (such as groundwater filling a void), even where that water is not being used consumptively as part of the activity's operation. Under the WM Act, a water licence gives its holder a share of the total entitlement available for extraction from the groundwater source. The WAL must hold sufficient share component and water allocation to account for the take of water from the relevant water source at all times.

Sufficient access licences must be held to account for all water taken from a groundwater or surface water source as a result of an aquifer interference activity, both for the life of the activity and after the activity has ceased. Many mining operations continue to take water from groundwater sources after operations have ceased. This take of water continues until an aquifer system reaches equilibrium and must be licensed.

The NSW AIP requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the Policy. If the predicted impacts meet the Level 1 minimal impact considerations, then these impacts will be considered as acceptable. The adopted Level 1 minimal impact considerations for this project are discussed in Section 6.3.

2.2.2 NSW State Groundwater Policy

The objective of the NSW State Groundwater Policy Framework Document is to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. The NSW groundwater policy has three parts:

– NSW Groundwater Quantity Protection Policy
– NSW Groundwater Quality Protection Policy
– NSW Groundwater Dependent Ecosystems Policy

2.2.2.1 NSW Groundwater Quantity Protection Policy

The principles of this policy include:

– Maintain total groundwater use within the sustainable yield of the aquifer from which it is withdrawn.
– Groundwater extraction shall be managed to prevent unacceptable local impacts.
– All groundwater extraction for water supply is to be licensed. Transfers of licensed entitlements may be allowed depending on the physical constraints of the groundwater system.

2.2.2.2 NSW Groundwater Dependent Ecosystems Policy

This policy was designed to protect ecosystems that are dependent on groundwater as a primary water source so that the ecological processes and biodiversity of these ecosystems are maintained or restored for the benefit of present and future generations. It provides guidance on how to protect and manage groundwater dependent ecosystems in a practical sense.

Analysis of the application of the NSW GDEs Policy to this groundwater assessment is outlined in Section 3.6.3.

3. Regional environment

3.1 Topography and land use

Mallee Bull is located approximately 100 km south of Cobar in the Cobar Local Government Area (LGA) of NSW as seen in Figure 1-1. The topography in the vicinity of the proposed exploration decline is generally flat with gentle undulating rises and depressions with elevations from approximately 280 m AHD to 300 m AHD, however, rises to 440 m AHD approximately 13 km to the west of the exploration decline.

Land use within the surrounding area includes:

– The Gilgunnia State Forest, approximately 6 km west of the exploration decline
– Sparsely scattered rural residences
– Agriculture (livestock grazing)

3.2 Climate

A historical record of climate data was obtained in the form of a point data set from the Scientific Information for Land Owners (SILO) database operated by the Queensland Department of Environment and Science (DES). SILO point data is based on spatially interpolating observed historical data from surrounding Bureau of Meteorology (BoM) stations (DSITI, 2021).

Data have been obtained from SILO grid point -32.4 (latitude) and 146.1 (longitude). This point is located approximately 1.5 km north of the exploration decline. The period of rainfall data used for this assessment extended from January 1901 to September 2021.

The historical SILO rainfall data between 1901 and 2021 are shown in Figure 3-1.

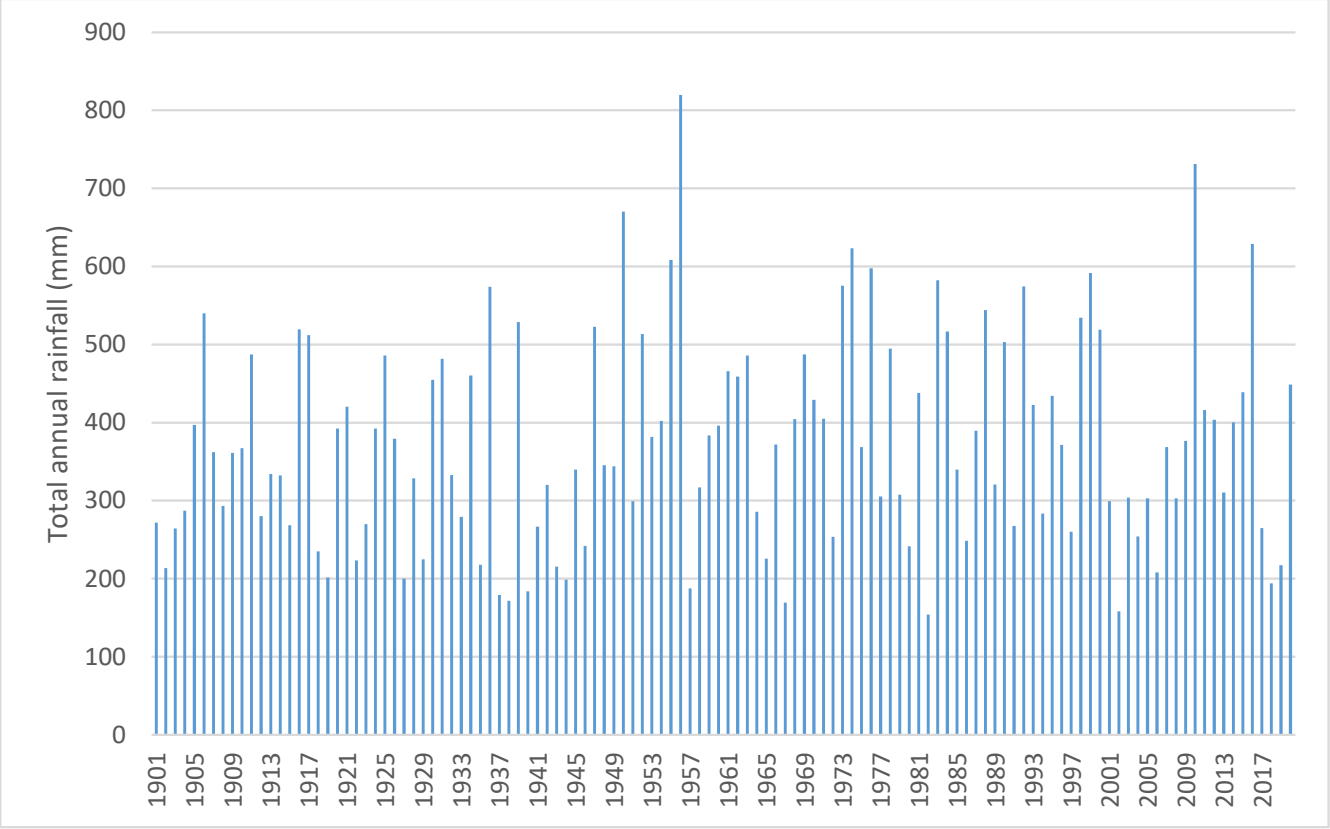


Figure 3-1 Historical rainfall record

The monthly rainfall dataset was used to generate a Cumulative Rainfall Departure (CRD) curve. CRD is the monthly accumulation of the difference between the observed monthly rainfall and the long-term average monthly rainfall. Any increase in the CRD reflects above average rainfall while a decrease in CRD reflects below average rainfall. A constant or steady CRD curve represents average rainfall. The CRD curve only deviates from zero due to atypical (above and below average) rainfall. The CRD over the period 1901 to 2021 is shown in Figure 3-2.

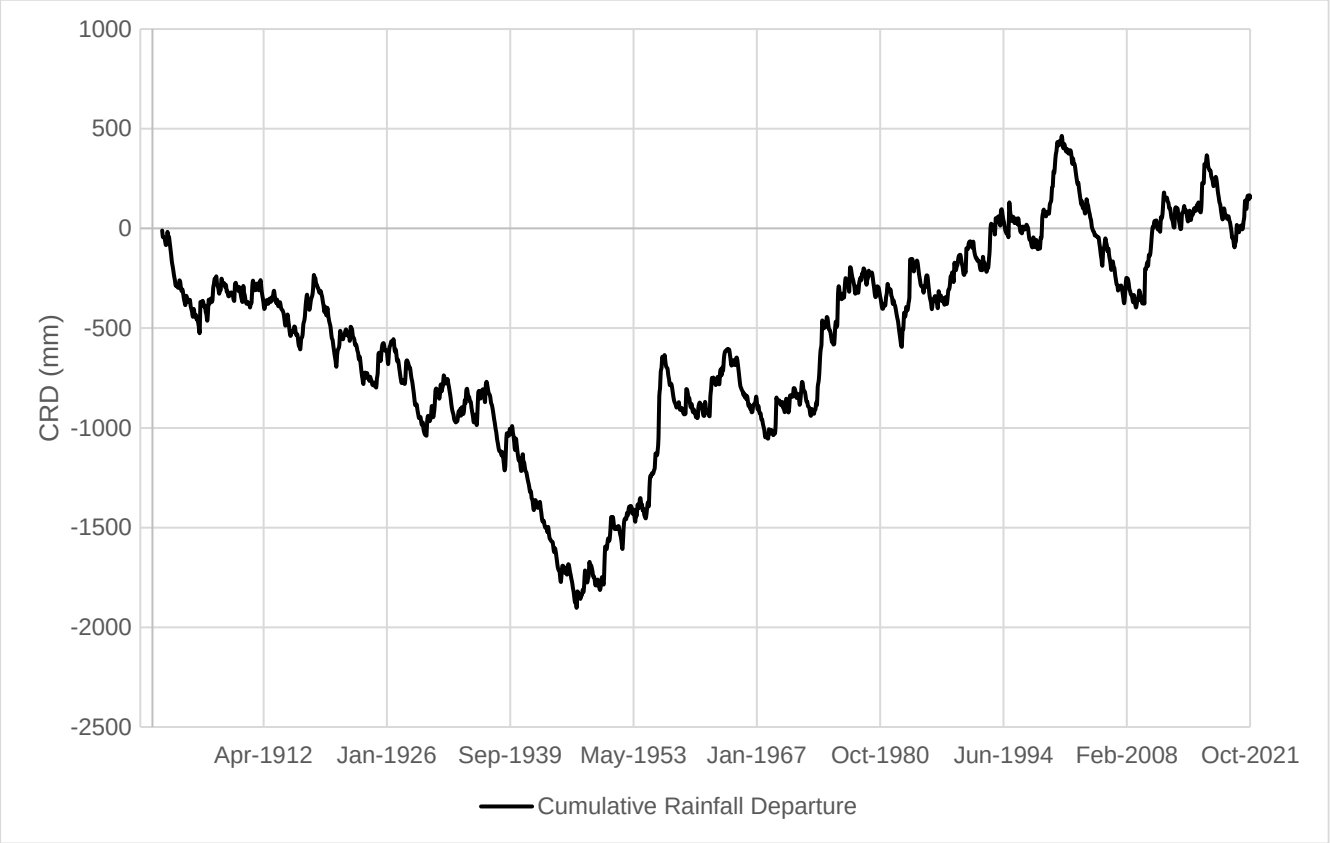


Figure 3-2 Rainfall CRD curve

The CRD curve was generally decreasing between mid-2016 and early 2020 indicating below average rainfall conditions. This reflects the recent drought conditions in western NSW. The CRD has been increasing since early 2020, reflecting a period of above average rainfall.

A plot of average monthly evaporation is compared to average monthly rainfall from the historical record in Figure 3-3.

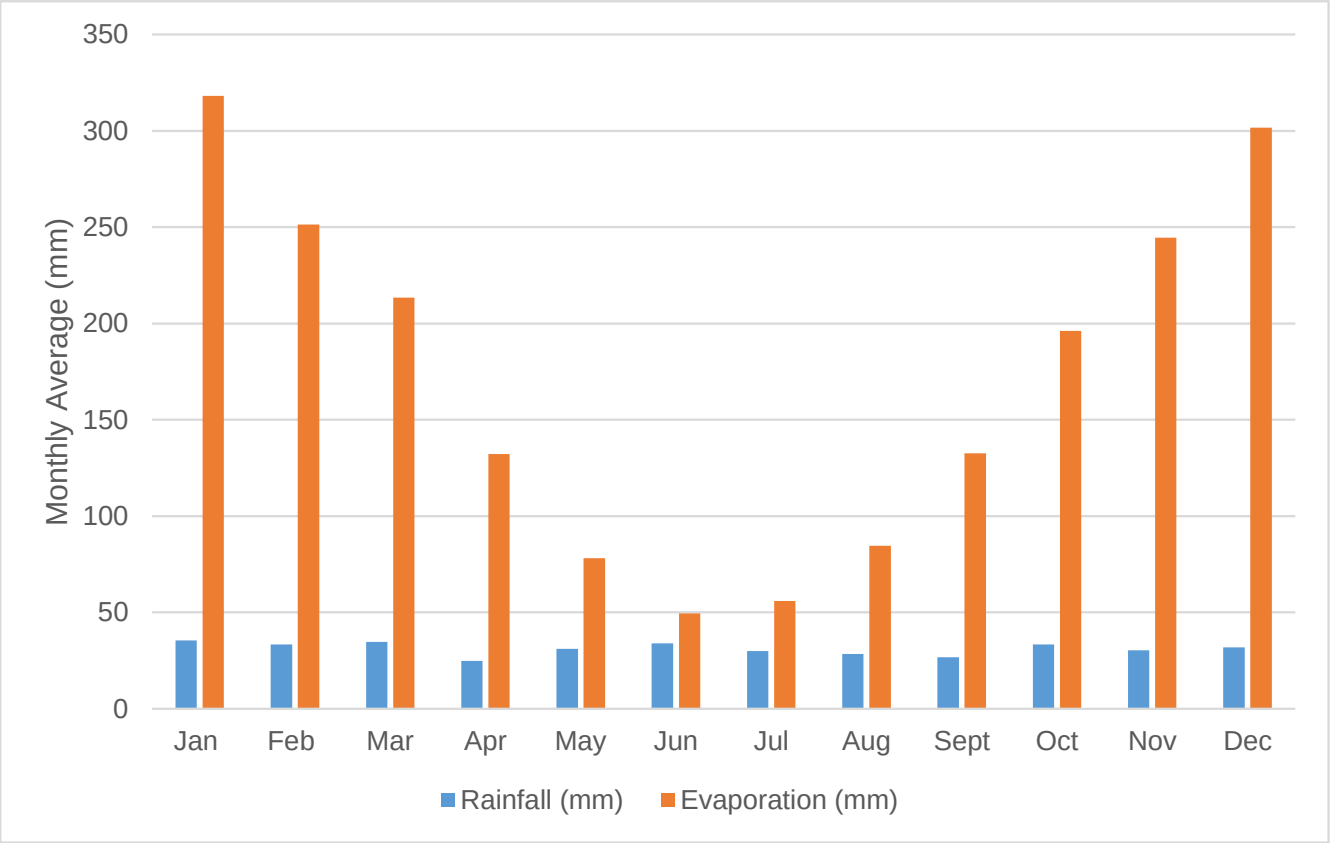


Figure 3-3 Monthly average evaporation and rainfall

As shown in Figure 3-3 evaporation varies seasonally, having higher records in summer compared to winter. The site has an average monthly net rainfall deficit for all parts of the year. There is minimal variation in monthly rainfall throughout the year.

3.3 Geology

Mallee Bull is located in the south-central part of the Cobar Trough. It is underlain by a thin layer of Quaternary sediments, and the Palaeozoic rocks (Devonian age) of the Amphitheatre Group. The host rock is dominated by shale, siltstone and sandstone but coarse volcaniclastic debris flow sediments are also present (APM, 2020). The regional geological surrounding Mallee Bull is shown in Figure 3-4.

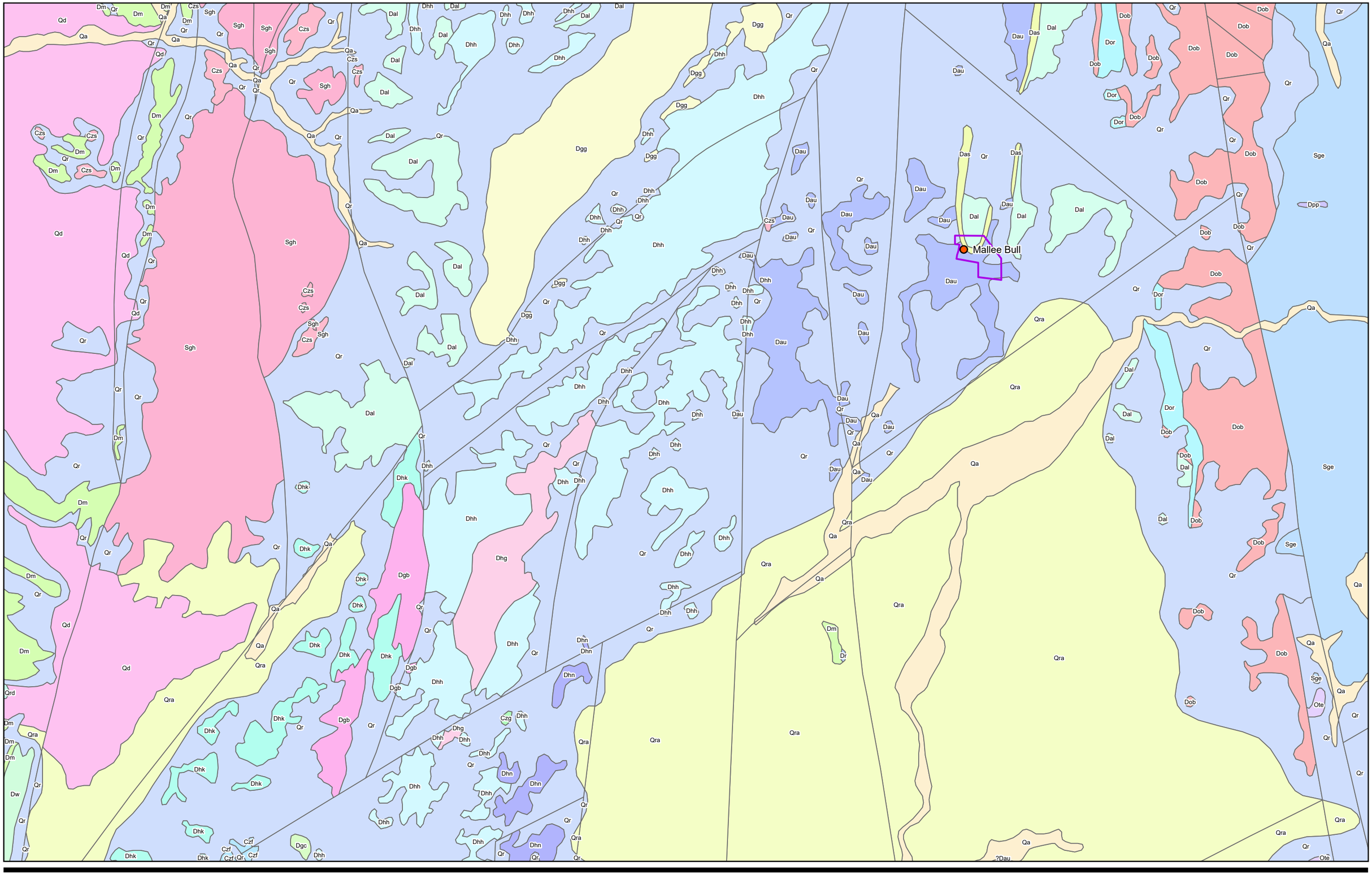
The Amphitheatre Group is divided into Upper Amphitheatre and the Lower Amphitheatre (MacRae 1987). Both the Upper Amphitheatre and Lower Amphitheatre outcrop in the vicinity of the Project Area. The Amphitheatre Group conformably overlies the upper parts of the Mouramba Group. The Mouramba Group is further subdivided into the Roset Sandstone and Burthong Formation. The Burthong Formation consists of fine to very fine sandstone interbedded with siltstone. The Roset Sandstone consists of a sequence of fine to medium-grained sandstone interbedded with fine to very fine sandstone.

A geological cross section has been developed based on the Nymagee 1:100,000 Geological Sheet (MacRae 1987). The geological cross section is shown in Figure 3-5. The geological cross section shows the folded Upper Amphitheatre and Lower Amphitheatre in the vicinity of Mallee Bull.

3.4 Hydrology

There are no identified permanent watercourses or drainage lines running through the extent of Mallee Bull. There are a number of ephemeral tributaries and topographic drainage lines of Burthong Creek, as shown in Figure 3-6. These tributaries and drainage lines generally drain south from Mallee Bull. The Lachlan River is located approximately 70 km south of Mallee Bull.

Due to the depth of groundwater (refer Section 4.2.1), interactions between surface water and groundwater at Mallee Bull are unlikely.



Legend

Mallee Bull exploration project

Study Area

Nymagee 250K Rock Units

?Dau
Czf
Czg
Czs
Dal
Das
Dau
Dgb
Dgc
Dgg
Dhg
Dhh
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Paper Size ISO A3

0 1 2 3 4

Kilometres

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

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Mallee Bull Project - Groundwater Impact Assessment

Geological Map

Project No. **12538802**
Revision No. **A**
Date **20/12/2021**

FIGURE 3-4

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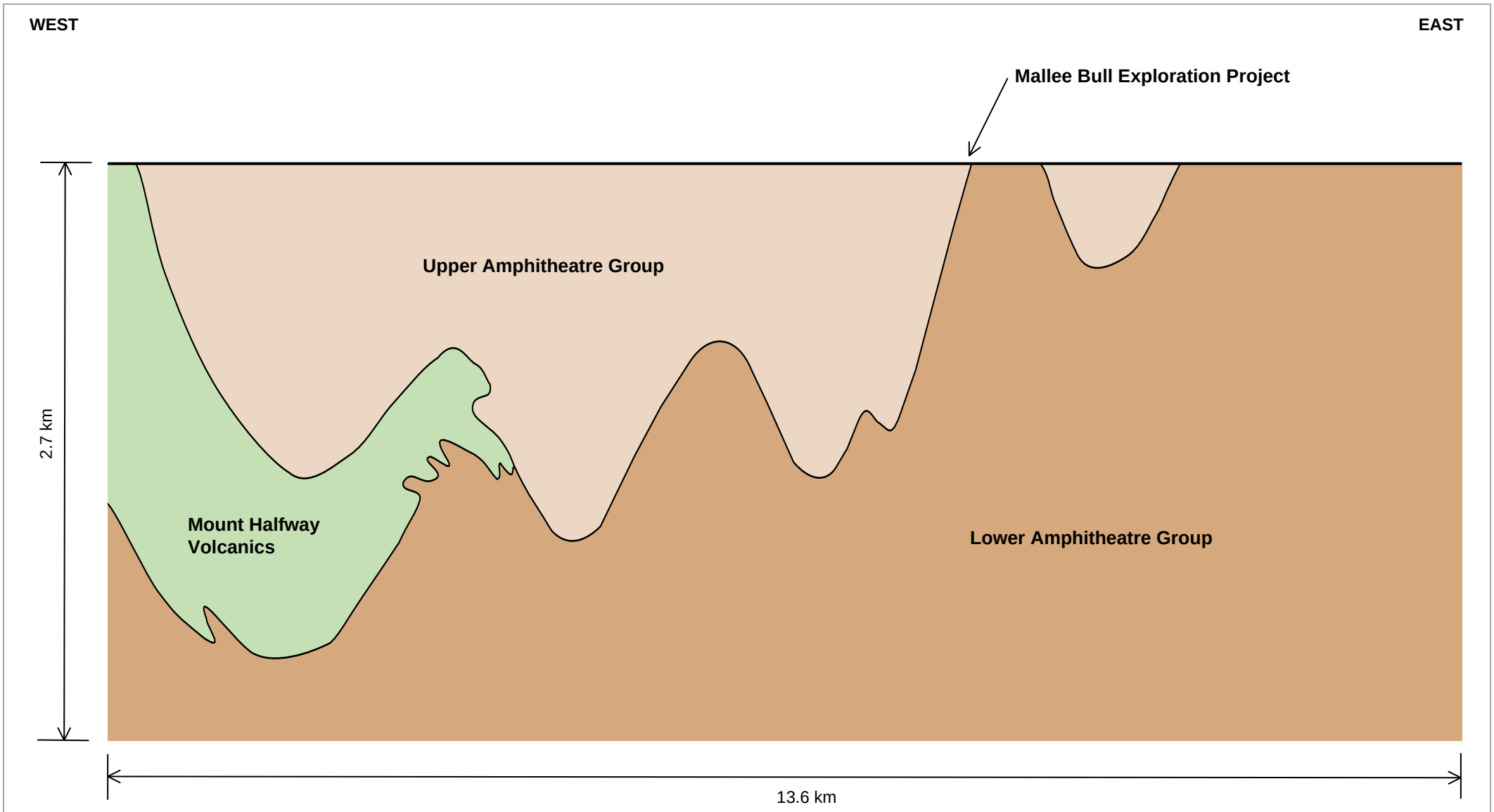

Legend

Peel Mining
Mallee Bull Exploration Decline
Groundwater Impact Assessment

Geological cross section

Project No. **12538802**
Revision No. **0**
Date **19/11/2021**

FIGURE 3-5

Created by: Jean Marie Macatanong

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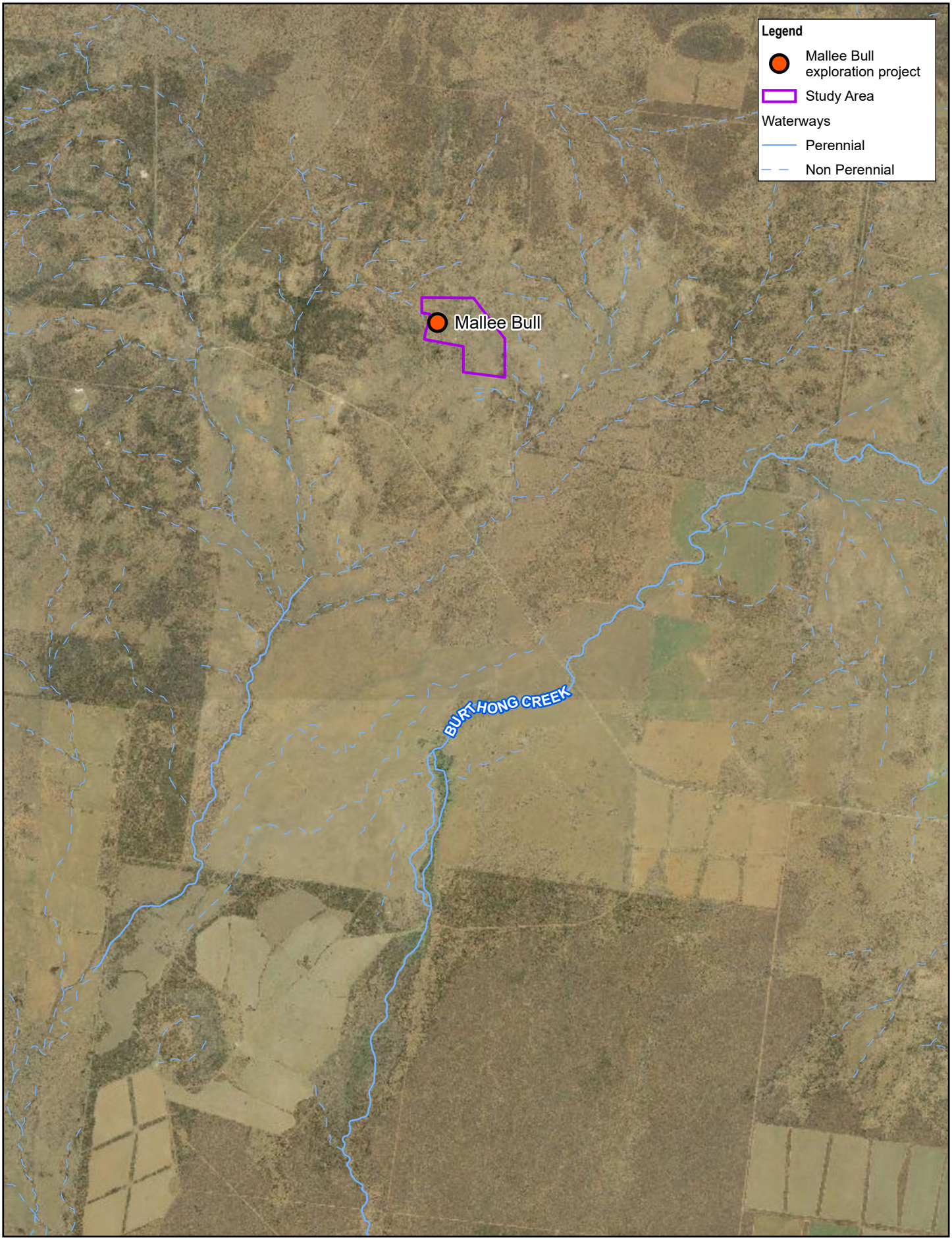

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Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 55

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Peel Mining
Mallee Bull Project - Groundwater Impact Assessment

Project No. **12538802**
Revision No. **A**
Date **20/12/2021**

Hydrology

FIGURE 3-6

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3.5 Hydrogeology

The indurated Palaeozoic sediments constitute a fractured rock aquifer where groundwater is stored and transmitted via fractures, joints and other discontinuities within the rock mass.

Primary porosity flow (that is, movement between grains) is mostly negligible in these materials except where the original matrix has been altered by weathering. On a local scale, the hydraulic character of the aquifers may vary because of:

– Weathering
– Nature of fracturing (size, density, persistence, infilling)
– Nature of their formation, such as dykes, karst, and contact metamorphism
– Tectonic history
– Local variations in lithology

Geological processes including deformation and weathering phases may enhance or reduce the permeability of these aquifers. Highly weathered rocks tend to have fractures with clay coatings or infillings and these tend to impede groundwater movement.

3.5.1 Nature of confinement

Inferences on the nature of confinement of aquifers have been made based on the geological setting.

The fractured rock aquifers are unconfined or water table aquifers where they are mapped in outcrop. Some impediment to the vertical migration of groundwater, i.e. semi confinement, may occur where:

– They are overlain by thick sequences of fine grained, low permeability material (e.g. younger alluvial sediments). The geological setting would suggest that there is a limited likelihood of such occurring.
– Where thick saprolitic or weathered profiles are present within the shallower parts of the rock mass that act to impart confinement on deeper, fresher rock.
– Where locally, deeper fracture sets are developed that are hydraulically disconnected (or have restricted connection) with shallow fracturing.

3.5.2 Aquifer water strikes

3.5.2.1 Groundwater monitoring network

Peel Mining is progressively establishing a groundwater monitoring network at Mallee Bull. Monitoring bore details are provided in Section 4.1.1. During drilling of monitoring bores a number of water strikes were intercepted. A summary of water strikes is provided in Table 3.1.

The majority of water strikes were at greater than 50 m below ground level (bgl), indicating that groundwater at the site is deep. Drillers records indicated that yields at all water strikes were low, less than 1 L/s.

Table 3.1 Monitoring bore installation water strikes

Monitoring bore	Water strike 1		Water strike 2		Water strike 3		Water strike 4	
	Depth (m bgl)	Yield (L/s)	Depth (m bgl)	Yield (L/s)	Depth (m bgl)	Yield (L/s)	Depth (m bgl)	Yield (L/s)
MBGW03	97*	NR	104	NR	108	0.3	162	0.3
MBGW04	87*	NR	96	0.4	N/A	N/A	N/A	N/A
MBGW06	50	NR	110	NR	N/A	N/A	N/A	N/A
MBGW07	60 to 72	0.3	96	0.8	N/A	N/A	N/A	N/A
MBGW08	48	NR	54	NR	78 to 84	N/A	N/A	N/A

Note to table:
* denotes minor seepage only
NR: not recorded
N/A: not intercepted

3.5.2.2 Exploration drilling

During exploration drilling, there were a number of water strikes in the exploration boreholes. Standing water levels were recorded by Peel Mining at these drill holes between May 2019 and February 2020. The location of exploration drill holes is summarised in Table 3.2. Monitoring at these locations ceased over time as the drill holes were uncased and they gradually collapsed. Note that these locations are different to the monitoring bores discussed in Section 3.5.2.1. Whilst the water strikes can be influenced by the drilling method, drilling disturbance and prevailing climate, monitoring of groundwater levels in the exploration drill holes indicated the depth to groundwater was generally between 60 m bgl and 90 m bgl, as shown in Figure 3-7.

Table 3.2 Exploration drill holes

Sample ID	Hole ID	Easting	Northing	Elevation (m AHD)	Dip (Degrees)
MBGW1	MBRCDD060	415,156.82	6,413,735.84	288.88	65.06
MBGW2	MBRC014	416,573.55	6,413,691.85	295.02	69.78
MBGW3	GRC008	415,050.00	6,415,021.00	300.00	60.00
MBGW4	MBRCDD114	415,248.60	6,413,403.58	292.00	64.60
MBGW5	MBRCDD103	415,163.72	6,413,349.94		61.11
MBGW6	MBDD001	415,160.07	6,413,292.25	290.41	60.00
MBGW7	MBRCDD004	415,400.00	6,413,522.06	293.82	66.36

Note to table: these locations are different to monitoring bores discussed in Section 3.5.2.1

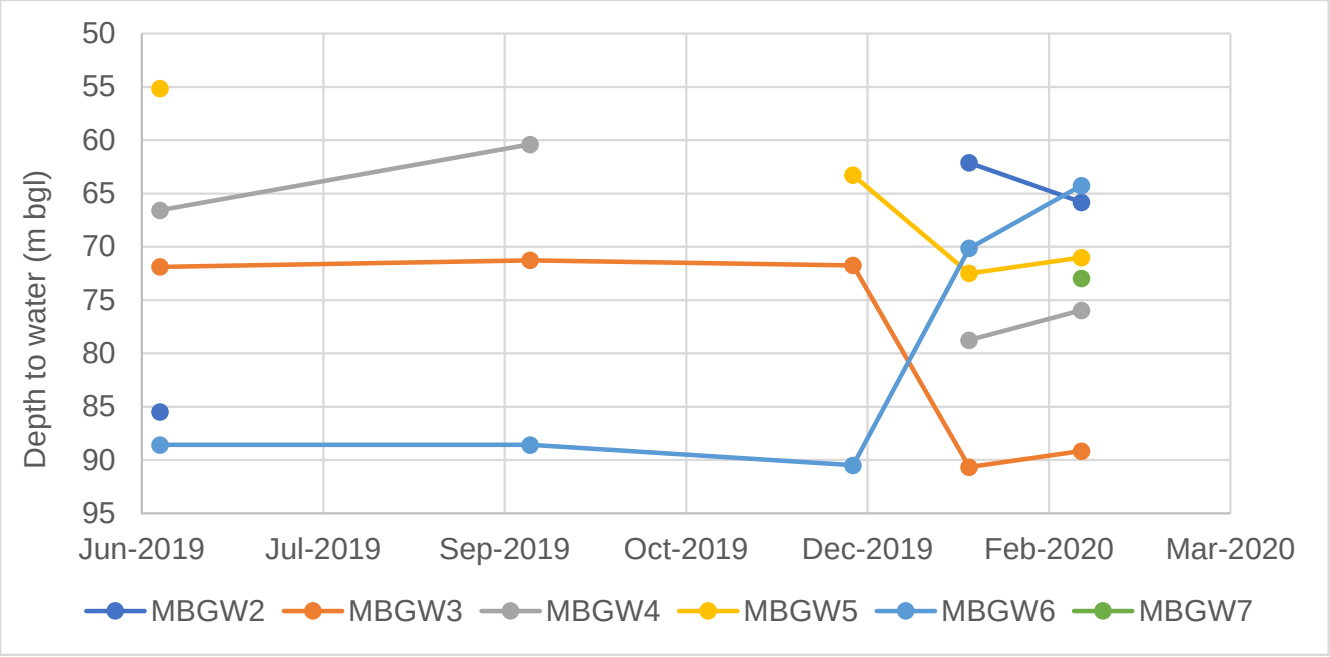


Figure 3-7 Depth to groundwater – exploration drill holes

3.5.3 Groundwater yield

Peel Mining has two production bores at Mallee Bull – Tarcombe Bore and Perry's Bore. Production bore details are shown in Table 3.3.

Reported yields at Tarcombe Bore and Perry's Bore were 0.4 L/s and 1.7 L/s respectively. This indicates that the groundwater aquifer at Mallee Bull is likely low yielding.

Table 3.3 Production bores

Name	Monitoring Hole ID	Easting	Northing	Elevation (m AHD)	Depth (m bgl)
Tarcombe Bore	MBWRC003	412,382.87	6,413,982.00	268.52	119
Perry's Bore	MBWRC002	418,445.68	6,411,445.03	268.51	100

3.5.4 Aquifer hydraulic parameters/ previous studies

No aquifer testing has been undertaken at Mallee Bull. Parameters from groundwater studies at surrounding mining operations have been reviewed to determine the aquifer parameters at Mallee Bull.

3.5.4.1 Wirlong exploration project

The Wirlong exploration project is operated by Peel Mining and is located 34 km north of Mallee Bull. A pumping test was undertaken by AquaWest in 2021 and was observed by Peel Mining personnel. The results of the pumping test were analysed by GHD (2021a). The transmissivity was estimated to be 81 m^2/day. As part of the pumping test, the bore was placed at the top of the uncased section of the bore and therefore this transmissivity likely represents the upper section of the aquifer which is likely to have the highest transmissivity. The transmissivity is expected to decrease with depth as overburden pressure would tend to close and tighten fractures.

3.5.4.2 Avoca Tank

The Avoca Tank Groundwater Assessment (ES, 2014) adopted aquifer parameters from pumping tests at Girilambone Mine. A range of values were reported, which are represented by Value 1 and Value 2 in Table 3.4. Solutions matched to close and distant observation wells respectively (ES, 2014).

Table 3.4 Fractured rock aquifer parameters (ES, 2014)

Parameter	Value 1	Value 2
Hydraulic conductivity (m/day)	0.483	0.781
Specific storage (1/m)	4.563×10^{-6}	1.565×10^{-6}

3.5.4.3 New Cobar Complex

Slug testing was undertaken at monitoring bores at the New Cobar Complex as part of the *New Cobar Complex Project Groundwater Assessment* (EMM, 2020). Based on the results of the slug testing at six monitoring bores the effective hydraulic conductivity was estimated to be between 1.2 and 5.4×10^{-4} m/day. EMM (2020) noted that the monitoring bores are preferentially screened across the highest yielding sections of the intersected lithology.

The modelled aquifer parameters from the calibrated numerical groundwater model for the New Cobar Complex (EMM, 2020) are summarised in Table 3.5.

Table 3.5 New Cobar Complex modelled aquifer properties (EMM, 2020)

Hydrostratigraphic unit	Horizontal hydraulic conductivity (m/day)	Specific storage (1/m)
Weathered fractured rock	0.015	1.3×10^{-5}
Fractured rock	7.39×10^{-4}	1.3×10^{-5}
Fractured rock -500 to -1000 m AHD	1×10^{-5}	1.3×10^{-5}
Fractured rock below -1000 m AHD	1×10^{-6}	1.3×10^{-5}

3.5.4.4 Federation Exploration Decline

The *Federation Exploration Decline Groundwater Assessment* (GHD, 2021b) included a review of groundwater inflows into the existing Hera Mine. The review indicated that average groundwater inflows into the Hera Mine are typically 0.3 ML/day to 0.5 ML/day.

3.6 Groundwater receptors

3.6.1 Landholder bores

A search of the Australian Groundwater Explorer (BoM 2021) and Water NSW Real Time Data (Water NSW 2021) was undertaken to identify registered bores near Mallee Bull. The search identified 24 bores within an approximate 20 km radius of Mallee Bull. Landholder bore details are summarised in Table 3.6 and locations are shown in Figure 3-8.

Of the bores within 20 km of Mallee Bull, the majority of bores (21) were registered as stock or domestic bores, with one bore registered as a test bore. The registered purpose of two bores was unknown.

The results of the search indicate that the aquifer in the vicinity of Mallee Bull is generally low yielding, with reported yields generally less than 1 L/s.

Table 3.6 Registered bores

Bore	Depth	Purpose	SWL (m)	Yield (L/s)	Salinity	Strata	Distance from Mallee Bull (km)
GW013673	50.6	Stock	19.2	1.14	–	Sand, diorite - within layers of conglomerate	15.5
GW013674	24.4	Stock	–	–	–	–	19.9
GW013676	38.1	Stock	–	–	–	Shale	15.7
GW013817	21.9	Stock	–	–	–	Shale	16.2
GW013890	43.3	Stock	–	–	3001-7000 ppm	Shale, sandstone	11.5
GW014111	54.3	Stock	39.6	0.13	Brackish	Limestone, granite	10.3
GW014159	108.8	Stock	39.6	1.26	Good	Slate	9.3
GW014217	55.5	Stock	–	–	Brackish	Slate	11.1
GW015819	25.9	Unknown	–	–	–	Sandstone	17.7
GW015820	50.3	Stock	–	–	–	–	17.7
GW017033	36.6	Stock	18.3	1.26	Salty	Slate	9.0
GW017788	16.8	Stock, domestic	3	0.76	Good	Granite	15.4
GW017789	69.5	Stock	36	0.09	Good stock	Sandstone	19.6
GW017790	56.1	Stock	–	–	Very salty	Granite	15.6

Bore	Depth	Purpose	SWL (m)	Yield (L/s)	Salinity	Strata	Distance from Mallee Bull (km)
GW017889	54.9	Stock	36.6	0.13	Salty	Slate	4.9
GW018098	6.4	General use	2.7	0.08	–	Gravel	15.1
GW018099	15.2	General use	–	–	Salty	Clay	15.1
GW022674	90.8	Stock, domestic	45.7, 39.6	0.63	10001-14000 ppm	Slate	17.6
GW061097	151	Stock, domestic	28	0.15	Brackish	Sandstone, shale	8.9
GW061098	103	Stock, domestic	39	0.4	Brackish	Sandstone	5.8
GW700816	30	Stock	20	1.26	Potable		18.2
GW702178	43	Test bore	–	–	–	Clay, bedrock	19.0
GW704759	96	Stock, domestic	48	0.189	–	Shale	8.1
GW706182	–	Unknown	–	–	–	–	15.0

Note to table:
SWL: standing water level
'–' denotes information not available

3.6.2 Unregistered landholder bores

As part of a site visit undertaken by GHD on 8 December and 9 December 2021, three landholder bores have been identified within 20 km of Mallee Bull that were not identified as part of the bore search outlined in Section 3.6.1. Coordinates of these bores are provided in Table 3.7. Bores visited had headworks installed and were not able to be dipped to gauge the depth to groundwater.

Table 3.7 Identified landholder bores

Bore	Easting	Northing	Distance from Mallee Bull (km)
May Day bore	404958	6411347	10.6
Narro Godeah bore 1	403632	6408830	12.6
Narro Godeah bore 2	403628	6408825	12.6

3.6.3 Groundwater dependent ecosystems

3.6.3.1 Definition

A GDE is an ecosystem which has its species composition and natural ecological processes determined by groundwater. That is, GDEs are natural ecosystems that require access to groundwater to meet all (obligatory), or some (facultative) of their water requirements so as to maintain their communities of plants and animals, ecological processes and ecosystem services. If the availability of groundwater to GDEs is reduced, or if the quality is allowed to deteriorate, these ecosystems will be impacted.

It is widely acknowledged that a poor understanding exists in recognising GDEs, or understanding the hydrogeological processes affecting GDEs, or their environmental water requirements. GDEs can be broadly grouped into three categories:

– Ecosystems that depend on the surface expression of groundwater:
  - Swamps and wetlands can be sites of groundwater discharge and may represent GDEs. The sites may be permanent or ephemeral systems that receive seasonal or continuous groundwater contribution to water ponding or shallow water tables. Tidal flats and inshore waters may also be sites of groundwater discharge. Wetlands can include ecosystems on potential acid sulphate soils and in these cases maintenance of high water levels may be required to prevent waters from becoming acidic.

- Permanent or ephemeral stream systems may receive seasonal or continuous groundwater contribution to flow as baseflow. Interaction would depend upon the nature of stream bed and underlying aquifer material and the relative water level heads in the aquifer and the stream.

– Ecosystems that depend on the subsurface presence of groundwater.
  - Terrestrial vegetation such as trees and woodlands may be supported either seasonally or permanently by groundwater. These may comprise shallow or deep-rooted communities that use groundwater to meet some or all of their water requirements. Animals may depend upon such vegetation and therefore indirectly depend upon groundwater. Groundwater quality generally needs to be high to sustain vegetation growth.
– Ecosystems that reside within a groundwater resource.
  - These are referred to as hypogean ecosystems. Micro-organisms in groundwater systems can exert a direct influence on water quality, for example, stygofauna typically found in karstic, fractured rock or alluvial aquifers.

3.6.3.2 Occurrence within the region

A search of the Groundwater Dependent Ecosystem Atlas (BoM 2021) was undertaken to identify groundwater dependent ecosystems (GDEs) within 20 kilometres of Mallee Bull. There were no known GDEs identified within 20 km of Mallee Bull. The Murray-Darling Basin Fractured Rock Groundwater Sources Water Sharing Plan was also reviewed to identify any high priority GDEs within the Lachlan Fold Belt groundwater source. There were no listed high priority GDEs within or near Mallee Bull.

Potential GDEs are identified based on regional assessments of groundwater levels, remote sensing of vegetation and surface topography. Potential aquatic GDEs within 20 km of Mallee Bull include Burthong Creek, Crowl Creek and Thule Creek.

Moderate potential terrestrial GDEs identified by BoM (2021) within 20 km of Mallee Bull include Poplar Box - Mulga - Ironwood woodland, Belah/Black Oak - Western Rosewood - Leopardwood low open woodland and Black Bluebush low open shrubland. High potential terrestrial GDEs include Chenopod low open shrubland and River Red Gum - Black Box woodland wetland. The closest of these potential terrestrial GDEs is within approximately 4 km of Mallee Bull.

Identified potential terrestrial GDEs are shown in Figure 3-9. It is considered unlikely that these aquatic and vegetative communities are GDEs given the deep water levels identified at Mallee Bull.

SANDY CREEK ROAD
GW015819
GW015820
SANDY CREEK
GW022674
MIDDLE CREEK
BEDOOBA ROAD
GLENWOOD ROAD
KIDMAN WAY
MOOTHUMBOOL CREEK
GW014111
GW014217
Mallee Bull
GW014159
BURTHONG CREEK
BURTHONG ROAD
GW017889
GW061098
GW704759
GW013890
GW061097
GW017033
GW013817
GW013676
MERRI ROAD
GW702178
GW017790
GW013673
GW706182
GW700816
GW018098
GRAIN ROAD
GW017788
GW018099
GW017789
TALLEBUNG ROAD

Legend

- Mallee Bull exploration project
- Study Area
- Groundwater Monitoring Locations
- Road
- Waterway

Paper Size ISO A3

0 1 2 3 4

Kilometres

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

N

GHD

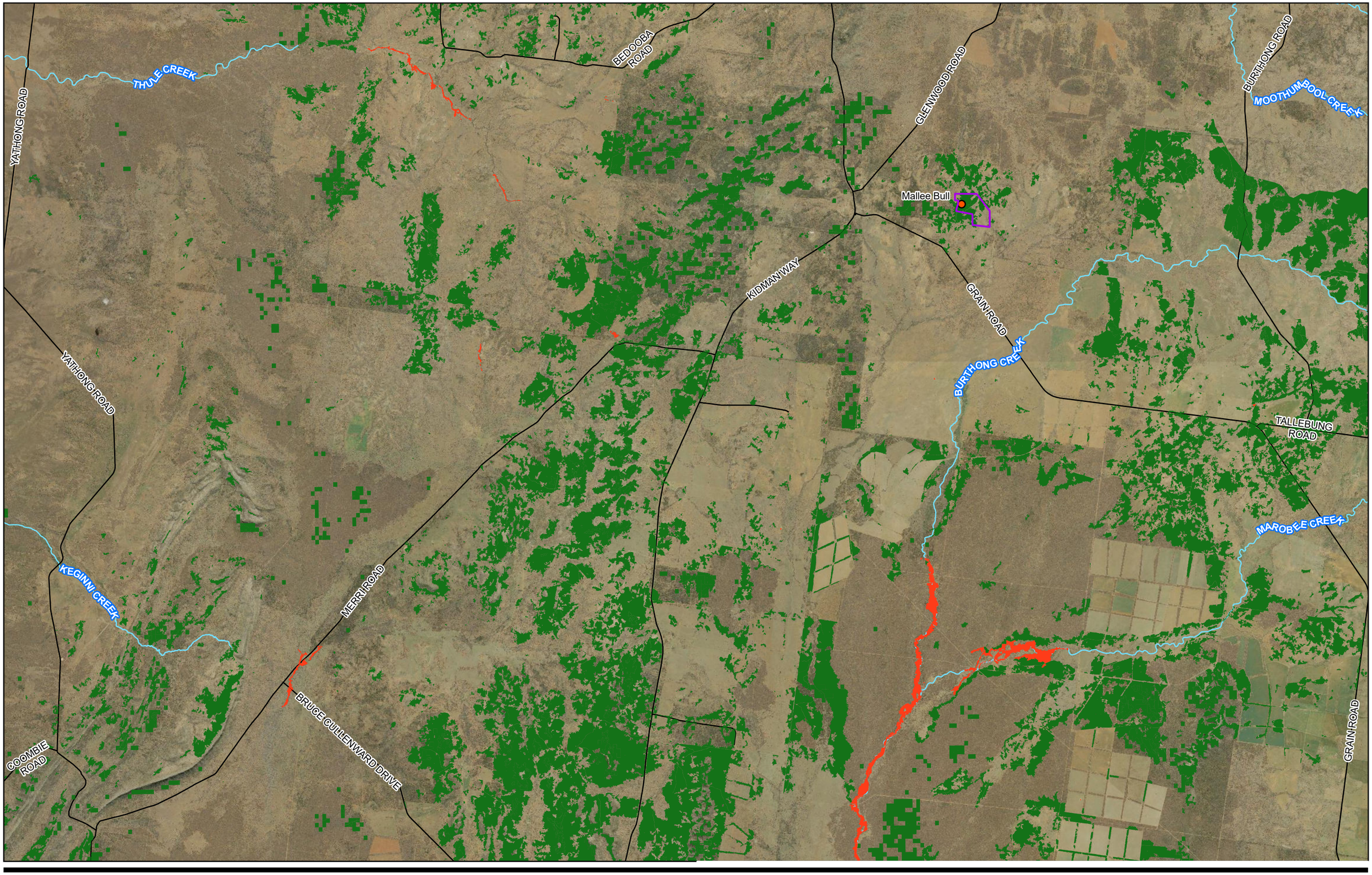
Peel Mining
Mallee Bull Project - Groundwater Impact Assessment

Registered Bores

Project No. **12538802**
Revision No. **A**
Date **20/12/2021**

FIGURE 3-8

N:\AU\Newcastle\Projects\22\12538802\GIS\Maps\Deliverables\12538802_PeelMiningGroundwaterManagementPlan\GroundwaterImpactAssesment_A.aprx\12538802_GIA004_RegisteredBoresA3_A
Print date: 20 Dec 2021 - 09:07



Legend

- Mallee Bull exploration project
- Study Area
- Waterway
- Road

Groundwater Dependent Ecosystems - Aquatic and Terrestrial

- High potential GDE - from regional studies
- Moderate potential GDE - from regional studies
- Low potential GDE - from regional studies

Paper Size ISO A3

0 1.5 3 4.5 6

Kilometres

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

N

GHD

Peel Mining
Mallee Bull Project - Groundwater Impact Assessment

Groundwater Dependent Ecosystems

Project No. **12538802**
Revision No. **A**
Date **20/12/2021**

FIGURE 3-9

N:\AU\Newcastle\Projects\22\12538802\GIS\Maps\Deliverables\12538802_PeelMiningGroundwaterManagementPlan\GroundwaterImpactAssesment_A.aprx\12538802_GIA005_GroundwaterDependentEcosystems_A
Print date: 20 Dec 2021 - 09:08

Data source: GDE (BOM, 2020) public_NSW_Imagery: © Department of Customer Service 2020. Created by: dschmidt

4. Groundwater monitoring and management

4.1 Groundwater monitoring network

4.1.1 Groundwater monitoring bores

Peel Mining is in the process of establishing a groundwater monitoring network at Mallee Bull. The process of establishing a groundwater monitoring network commenced in May 2021. A baseline assessment was undertaken in 2021 to establish a groundwater monitoring plan at Mallee Bull (GHD, 2021c). Details of the established groundwater monitoring bores are provided in Table 4.1. Details of the proposed monitoring bores yet to be installed are provided in Table 4.2. Bore locations are shown in Figure 4-1.

Table 4.1 Monitoring bores

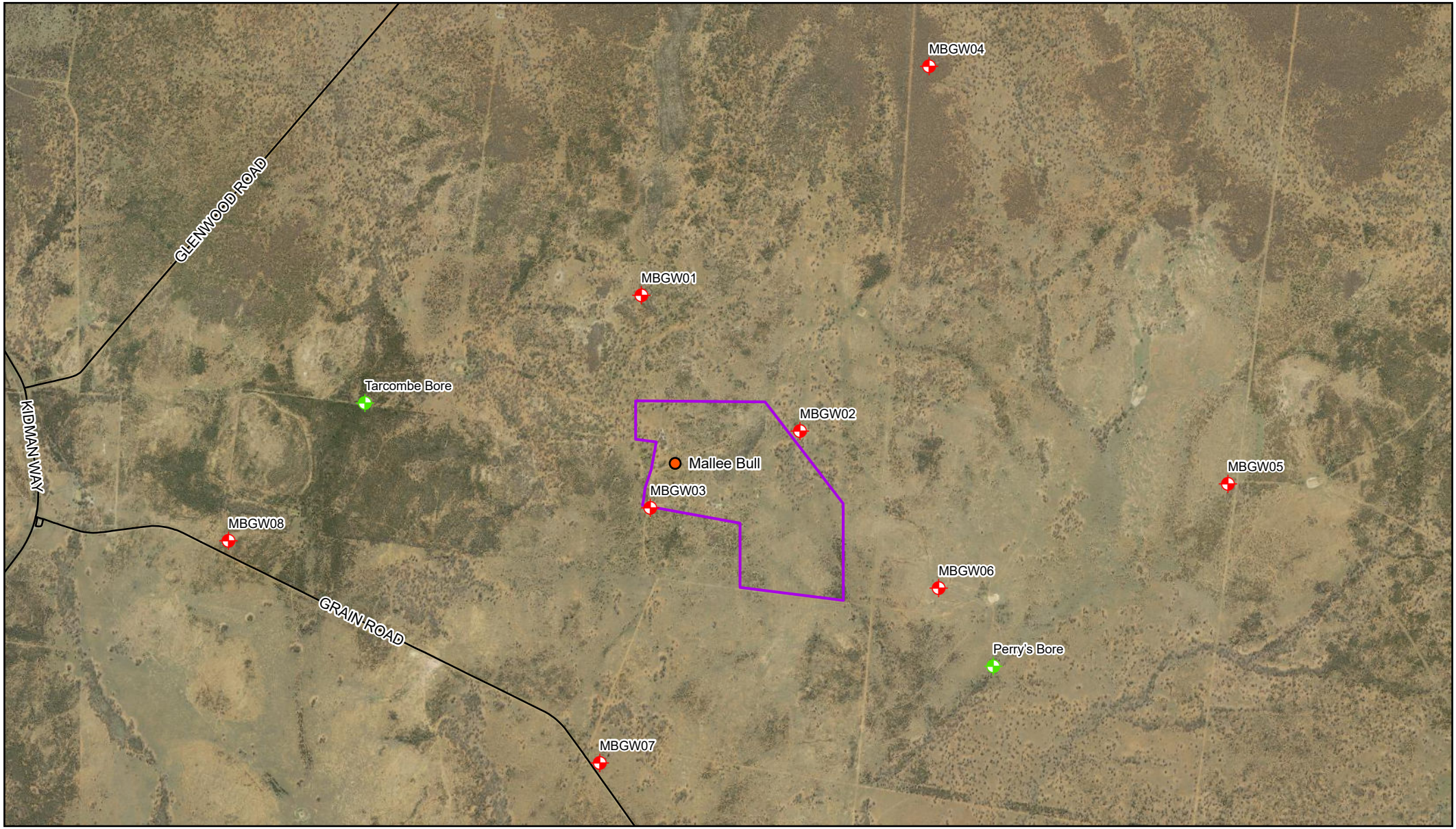
Bore	Easting	Northing	Depth (m bgl)	Screened interval (m bgl)	Gravel pack (m bgl)	Installation completion date
MBGW03	415,114	6,412,812	240	84 – 90, 120 – 126, 172 – 178, 228 – 234	90 – 240	13/06/2021
MBGW04	417,639	6,417,224	240	84 – 90, 120 – 126, 172 – 178, 228 – 234	90 – 240	6/06/2021
MBGW06	418,159	6,412,210	204	78 – 94, 120 – 126, 172 – 178, 192 – 198	75 – 204	17/06/2021
MBGW07	414,695	6,410,747	204	60 – 66, 120 – 126, 172 – 178, 192 – 198	50 – 204	17/06/2021
MBGW08	411,018	6,412,917	180	48 – 54, 78 – 84, 120 – 126, 168 – 174	45 – 180	18/05/2021

Table 4.2 Proposed monitoring bores

Bore	Proposed location	
	Easting	Northing
MBGW01	414,308	6,415,010
MBGW02	416,581	6,413,709
MBGW05	420,485	6,413,245

4.1.2 Production bores

As discussed in Section 3.5.3, Peel Mining has two production bores at Mallee Bull – Tarcombe Bore and Perry's Bore. Production bore details are shown in Table 3.3 and locations are shown in Figure 4-1.



Legend

- Mallee Bull exploration project
- Study Area
- Roads
- Monitoring bores
- Production Bores

Paper Size ISO A4

0 500 1,000

Metres

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

N

Peel Mining
Mallee Bull Project - Groundwater Impact Assessment

Project No. **12538802**
Revision No. **A**
Date **20/12/2021**

Groundwater bores

FIGURE 4-1

N:\AU\Newcastle\Projects\22\12538802\GIS\Maps\Deliverables\12538802_PeelMiningGroundwaterManagementPlan\GroundwaterImpactAssesment_A.aprx\12538802_GIA006_ProposedGroundWaterMonitoringLocations_A
Print date: 20 Dec 2021 - 09:08

Data source: Proposed Water Monitoring Locations (GHD, 2020); Roads, Waterways - LPI, 2017; Production Bores - Peel Mining, 2020; public_NSW_Imagery: © Department of Customer Service 2020. Created by: dschmidt

4.2 Groundwater monitoring results

4.2.1 Groundwater levels

Monitoring of groundwater monitoring bores at Mallee Bull commenced following installation of bores in May 2021. Recorded groundwater levels at monitoring bores are summarised in Table 4.3.

Recorded groundwater levels vary from approximately 24.5 m below top of casing (btoc) to 77 m btoc. Recorded groundwater levels at MBGW06, MBGW07 and MBGW08 indicate potentially confined or partially confined aquifer conditions in the vicinity of Mallee Bull.

Review of groundwater levels indicates that groundwater flow is from south to north. This groundwater flow direction does not correspond with topography. Ground surface levels generally decrease to the south. Continued groundwater monitoring is recommended to confirm the groundwater flow direction at Mallee Bull.

Table 4.3 Groundwater level monitoring

Bore	Depth to groundwater (m btoc)	
	June 2021	November 2021
MBGW03	NM	77.15
MBGW04	NM	77.20
MBGW06	NM	24.61
MBGW07	26.4	24.96
MBGW08	34.7	NM

Note to table:
m btoc: metres below top of casing
NM: not measured

4.2.2 Groundwater quality

4.2.2.1 Monitoring network bores

Monitoring network bores water quality sampling was undertaken in June 2021, with results shown in Table 4.4.

Groundwater at Mallee Bull is slightly basic to basic (7.73 pH units to 8.98 pH units) and saline (8680 µS/cm to 33300 µS/cm). Groundwater alkalinity is primarily in the bicarbonate form.

Dissolved metals concentrations at Mallee Bull are generally low. Dissolved antimony is variable across the monitoring bores, with concentrations ranging between 0.004 mg/L and 0.019 mg/L. Dissolved boron concentrations in excess of 0.7 mg/L and up to 1.6 mg/L have been observed. Concentrations of molybdenum and nickel were recorded above the limit of reporting across the monitoring bores.

At MBGW03, dissolved metals concentrations were above the limit of reporting for arsenic (0.002 mg/L) and chromium (0.048 mg/L). Dissolved zinc is observed to be below the limit of reporting at all monitoring bores except for MBGW07 (0.007 mg/L).

Groundwater quality at the Mallee Bull monitoring bores has been plotted in a piper diagram, shown in Figure 4-2. The piper diagram indicates that groundwater quality is similar at all Mallee Bull monitoring bores. Monitoring bores MBGW03, MBGW04 and MBGW07 are sodium chloride water type while MBGW06 sodium chloride/sulfate water type. The similar water quality indicates that the fractured rock aquifer is connected across the Mallee Bull monitoring bores.

Table 4.4 Monitoring Network Bores water quality results

Analyte	Unit	Limit of reporting (LOR)	MBGW03	MBGW04	MBGW06	MBGW07
Physicochemical						
pH	pH units	0.01	8.98	7.77	7.73	7.74
EC	µS/cm	1	8680	29700	33300	12800
TDS	mg/L	10	6640	25200	34100	10500
Alkalinity (as $CaCO_3$)						
Hydroxide	mg/L	1	<1	<1	<1	<1
Carbonate	mg/L	1	45	<1	<1	<1
Bicarbonate	mg/L	1	36	628	546	387
Total alkalinity	mg/L	1	81	628	546	387
Ions						
Calcium	mg/L	1	198	526	654	512
Magnesium	mg/L	1	265	966	1940	580
Sodium	mg/L	1	1410	6650	7310	1950
Potassium	mg/L	1	43	81	48	43
Chloride	mg/L	1	2490	9120	9260	3870
Sulfate	mg/L	1	1020	4150	10100	1800
Dissolved metals						
Antimony	mg/L	0.001	0.004	<0.010	0.019	<0.001
Arsenic	mg/L	0.001	0.002	<0.01	<0.01	<0.001
Boron	mg/L	0.05	0.71	1.54	1.03	1.02
Cadmium	mg/L	0.0001	<0.0001	<0.001	<0.001	<0.0001
Chromium	mg/L	0.001	0.048	<0.01	<0.01	<0.001
Copper	mg/L	0.001	<0.001	<0.01	<0.01	<0.001
Iron	mg/L	0.05	<0.05	<0.1	<<0.1	<0.05
Lead	mg/L	0.001	<0.001	<0.01	<0.01	<0.001
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	0.002	<0.01	0.02	0.002
Nickel	mg/L	0.001	<0.001	0.012	0.03	0.015
Silver	mg/L	0.001	<0.001	<0.01	<0.01	<0.001
Tin	mg/L	0.001	<0.001	<0.01	<0.01	<0.001
Zinc	mg/L	0.005	<0.005	<0.05	<0.05	0.007

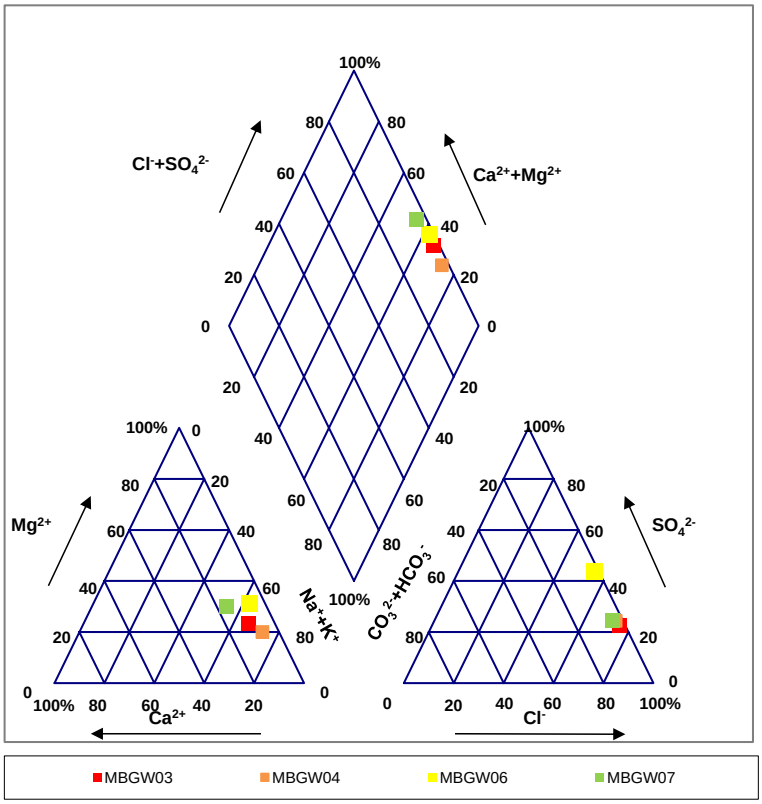


Figure 4-2 Piper plot

4.2.2.2 Production bores

Groundwater samples have been collected from the Tarcombe Bore in May 2018 and March 2020, while Perry's Bore was sampled in March 2020. The results of these sampling events are shown in Table 4.5.

In 2018, the groundwater quality at the Tarcombe Bore was circumneutral with pH of 7.34 pH units, and saline (8,860 µS/cm). Based on the salinity, the beneficial use category for groundwater at the Tarcombe Bore is limited to stock use (ANZG, 2018). In 2018, total metal concentrations at the Tarcombe Bore were generally low or below the limit of reporting with the exception of barium (0.007 mg/L), manganese (0.290 mg/L), zinc (0.042 mg/L), boron (0.82 mg/L) and iron (0.11 mg/L). In 2020 pH and electrical conductivity (EC) were not measured, though water quality parameters alkalinity and major ion results are comparable to 2018 concentrations. Total metals concentrations in 2020 were below the limit of reporting except for arsenic (0.002 mg/L), chromium (0.004 mg/L) and zinc (0.022 mg/L).

A groundwater sample was collected from Perry's Bore in March 2020. Total metal concentrations were low or below the limit of reporting with the exception of zinc (1.04 mg/L). Major ions concentrations are much higher in comparison to the Tarcombe Bore.

Table 4.5 Production bore water quality results

Analyte	Unit	LOR	2018	2020	
			Tarcombe Bore	Tarcombe Bore	Perry's Bore
Physicochemical					
pH	pH units	0.01	7.34	ND	ND
EC	µS/cm	1	8860	ND	ND
TDS	mg/L	10	5760	ND	ND
TSS	mg/L	5	8	ND	ND

Analyte	Unit	LOR	2018	2020	
			Tarcombe Bore	Tarcombe Bore	Perry's Bore
Alkalinity (as $CaCO_3$)					
Hydroxide	mg/L	1	<1	<1	<1
Carbonate	mg/L	1	<1	<1	<1
Bicarbonate	mg/L	1	504	477	522
Total alkalinity	mg/L	1	504	477	522
Ions					
Calcium	mg/L	1	327	292	997
Magnesium	mg/L	1	272	300	1200
Sodium	mg/L	1	1460	1670	3690
Potassium	mg/L	1	30	28	38
Chloride	mg/L	1	1990	3080	8670
Sulfate	mg/L	1	1420	1320	3540
Nutrients					
Nitrate as N	mg/L	0.01	0.26	0.06	0.18
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01
Nitrite plus Nitrate as N (NOx)	mg/L	0.01	0.26	0.06	0.18
Total metals					
Aluminium	mg/L	0.001	0.01	ND	ND
Arsenic	mg/L	0.001	<0.001	0.002	<0.001
Barium	mg/L	0.001	0.007	ND	ND
Boron	mg/L	0.05	0.82	ND	ND
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	<0.001	0.004	<0.001
Copper	mg/L	0.001	0.002	<0.001	<0.001
Fluoride	mg/L	0.1	0.7	ND	ND
Iron	mg/L	0.05	0.11	ND	ND
Lead	mg/L	0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.290	ND	ND
Mercury	mg/L	0.0001	<0.0001	ND	ND
Molybdenum	mg/L	0.001	<0.001	ND	ND
Nickel	mg/L	0.001	0.002	<0.001	0.002
Silver	mg/L	0.001	<0.001	ND	ND
Thallium	mg/L	0.001	<0.001	ND	ND
Vanadium	mg/L	0.01	<0.01	ND	ND
Zinc	mg/L	0.005	0.042	0.022	1.04

Note to table: ND means not sampled

5. Groundwater conceptualisation

The preliminary conceptual site model has been developed and is shown in Figure 5-1. The conceptualisation is a tool that formalises an understanding of the major components of a hydrogeological system, their interaction and how external changes can modify the system. They can often be a highly simplified way of expressing what is known about a system and can assist in defining (and/or testing hypotheses regarding) the critical components that make up the structures, processes and interactions, the relationships of cause and effect, and more generally how a system works.

Geological data have been compiled from regional mapping and the Mallee Bull geological model.

Figure 5-1 shows a block representation of the Mallee Bull decline. The decline itself is understood to have the following characteristics:

– The outer diameter of the spiral is approximately 50 m
– Estimated construction duration of 24 months
– Depth below surface of 400 m
– The decline is fully drained, i.e. not constructed to be a watertight structure

In terms of the geology, a thin layer of Cainozoic sediments has been shown overlying the Palaeozoic bedrock. The later comprises indurated siltstones and sandstones and comprises a fractured rock aquifer. The model indicates that the upper part of the bedrock is weathered. Fracturing is shown indicatively on the diagram only, and it is uncertain in terms of:

– Fracture density variations with depth
– Fracture orientations relative to bedding

Water intercepts during installation of groundwater monitoring bores indicates that the aquifer is deep, with water intercepts greater than 50 m bgl. Groundwater levels are reported at approximately 24 m bgl to 77 m bgl. Recharge to groundwater would occur through infiltrating rainfall, and lateral throughflow from adjoining aquifers. Given the depth to water in the bedrock and annual rainfall volumes, recharge rates are likely to be very low, and potentially have some lag, owing to the long migration pathway through the unsaturated zone.

Review of groundwater levels indicates that groundwater flow direction is from south to north.

Observations from installation of monitoring bores indicates that there is no perched groundwater in the shallow unconsolidated superficial sediments. Therefore, the Cainozoic sediments have been shown to be unsaturated in Figure 5-1.

It is not possible to determine the saturated thickness of the Palaeozoic sediments based on available information, however, permeabilities are expected to decrease with depth as overburden pressure would tend to close and tighten fractures. It is suspected that there will be discrete zones within the Palaeozoic, e.g. shearing, micro-faulting, where fracture densities are locally greater.

Review of registered bores in Section 3.6.1 indicates that there are stock and domestic bores in the region of the decline and confirms that the groundwater quality can support livestock grazing and is an existing beneficial use of groundwater. There are no permanent waterways near the project area and groundwater levels are considered to be too deep to support terrestrial vegetation or interact with waterways.

The box cut and upper parts of the decline structure are located above the water table and therefore tunnelling inflows would be negligible. The decline is likely to be supported with rock bolts, mesh, struts and shotcrete as required, but would be a drained structure. As the decline continues below the regional water table, groundwater intersected by the construction of the decline would be pumped back to the surface. This would result in the slow dewatering around the structure and decline in the regional water table as groundwater migrates towards the ‘sink’. These changes give rise to a number of potential impacts which are assessed in Section 6.

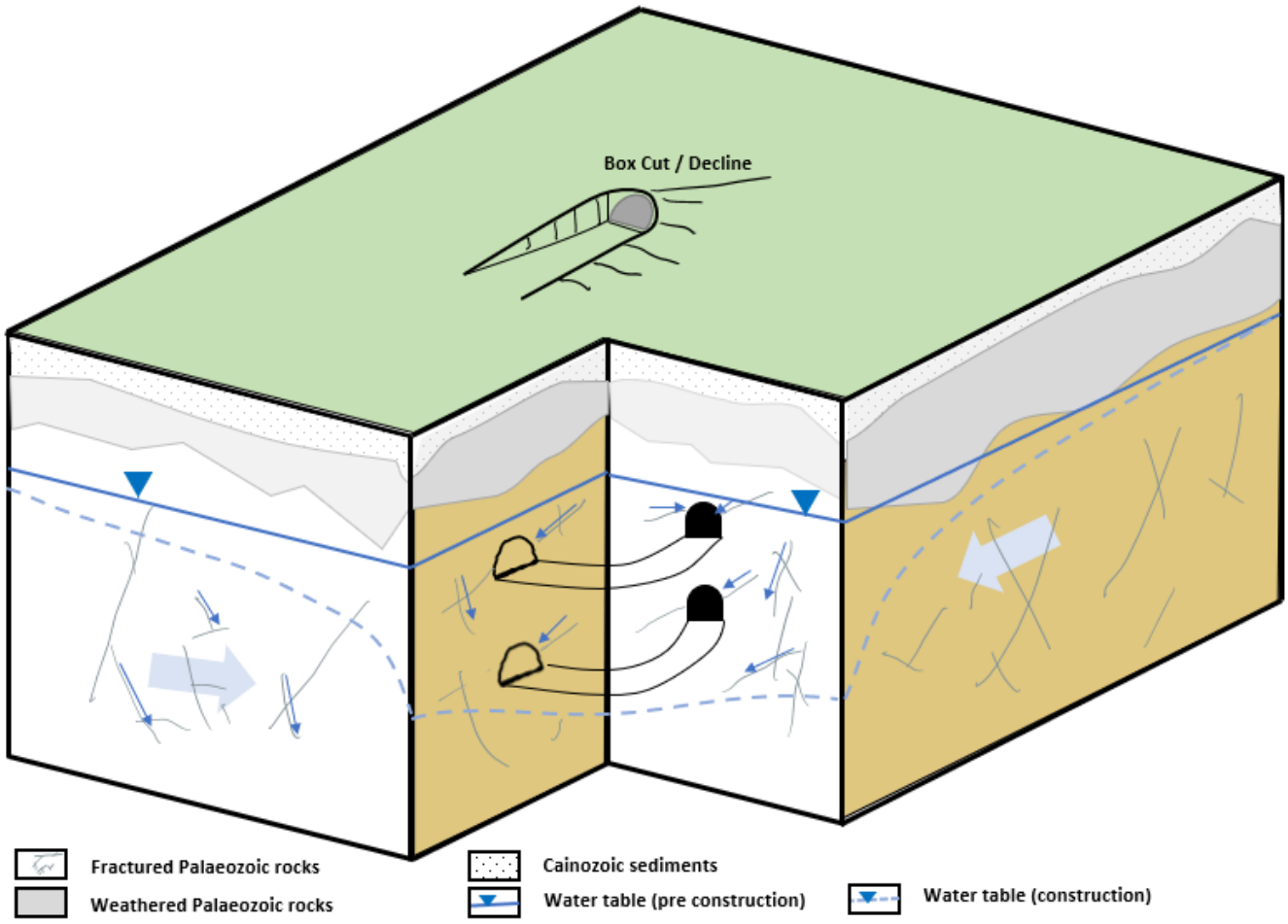


Figure 5-1 Conceptual site model

6. Impact assessment

6.1 Prediction of groundwater inflows

6.1.1 Method

The assessment of inflows into the decline has been undertaken using analytical techniques. Analytical techniques require the simplification of the complex hydrogeology and exploration decline geometry. The approaches rely on treating the development as an equivalent well, and as such the method documented by Singh and Atkins (1983) has been applied. The conceptualisation of the exploration decline and associated underground workings has been shown in Figure 6-1, i.e. the down water spiralling decline would be simplified and approximated as a vertically oriented cylinder. Two analytical approaches have been applied:

a. Treating the decline as a large diameter shaft
   Solution based around the Theis well equation.
b. Dewatering as a large pit
   Solution based around the Jacob-Lohman equation.

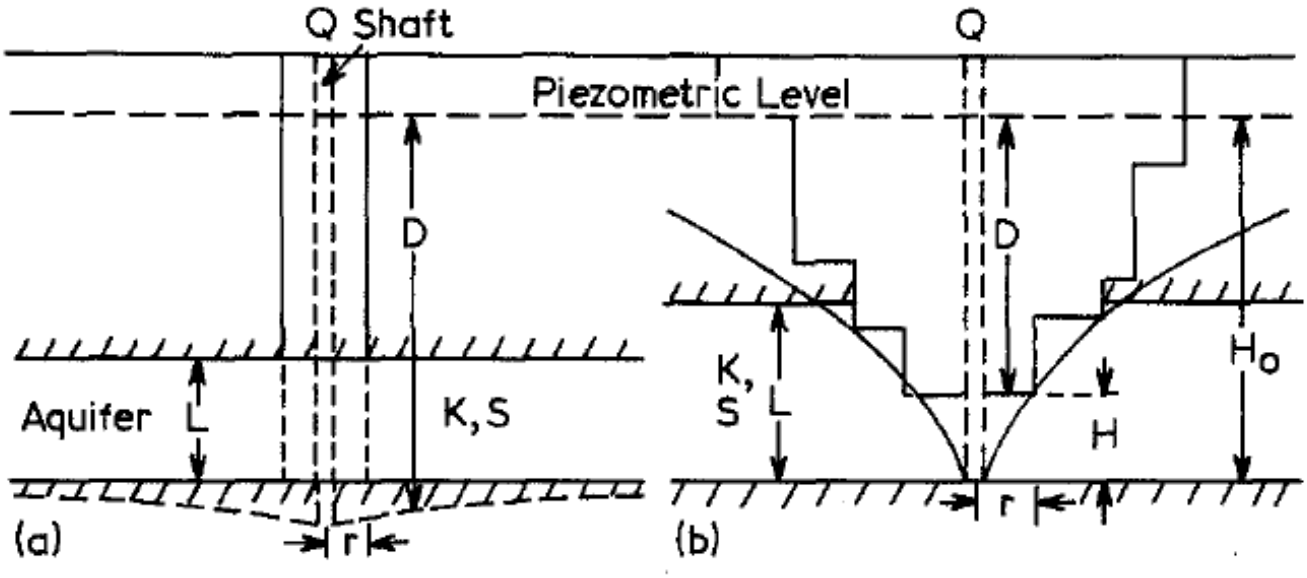


Figure 6-1 Analytical conceptualisation of the decline

The limitations of the equivalent well approach are:

– The aquifer has a seemingly infinite areal extent.
– The aquifer is homogeneous, isotropic and of uniform thickness over the area influenced by the exploration decline.
– Prior to pumping, the piezometric surface and/or phreatic surface are horizontal over the area influenced by exploration.
– The aquifer is pumped at a constant discharge rate.
– The imaginary well fully penetrates the aquifer and water flows to the well from the entire thickness of the aquifer by horizontal flow.
– Water removed from storage is discharged instantaneously with decline of head.

6.1.2 Analytical inputs

A summary of the analytical inputs into the analytical methods has been provided in Table 6.1.

Table 6.1 Summary of analytical inputs

Parameter	Value
Aquifer hydraulic conductivity, k (m/day)	Aquifer hydraulic conductivity will be influenced by the proportion of larger water bearing fractures within the rock mass. There is no aquifer testing at Mallee Bull. Adopted hydraulic conductivity values from groundwater assessments at surrounding mining operations have been considered (Section 3.5.4). To address uncertainties, a range of transmissivities (T) have been applied (where T = k × L)
Aquifer thickness, L (m)	Assuming an average SWL of 50 m bgl based on the water strike and groundwater monitoring data. The effective base of the transmissive portion of the Palaeozoic rocks has been assumed as 700 m. Therefore, an aquifer thickness of 650 m has been adopted.
Drawdown required, H (m)	The maximum depth of the proposed decline is 400 m bgl, and therefore a drawdown of 350 m has been adopted.
Radius at which drawdown is required	The outer diameter of the decline is 50 m. A radius of 100 m has been conservatively assumed.
Elapsed time, t (days)	It is understood that the decline has an estimated construction time of 24 months (730 days).
Storage coefficient, S (m/m)	The aquifer storage is unknown. Fractured rock aquifers tend to have low groundwater storage, and therefore 1 x 10^{-4} has been initially adopted. Adopted aquifer storage values from groundwater assessments at surrounding mining operations have been considered (Section 3.5.4). Based on the specific storage observed at Avoca Tank (1 x 10^{-6} /m) and aquifer thickness of 650 m, the storage coefficient would be 6.5 x 10^{-4}. Based on the calibrated specific storage at Cobar Complex, the storage coefficient would be 6.5 x 10^{-3}. Therefore the best estimate for the storage coefficient would be 1 x 10^{-3} to 1 x 10^{-4}. For additional conservativeness (in terms of radius of drawdown), a storage coefficient of 1 x 10^{-5} has also been adopted.

6.1.3 Results

The inflow analysis based upon the application of the two analytical approaches identified in Section 6.1.1 has been summarised in Table 6.2. The predicted inflows are sensitive to the transmissivity of the aquifer, with a more transmissive aquifer resulting in greater inflows. There is essentially no difference in the volumes estimated by the two methods, which is expected given they have similar theoretical backgrounds.

As discussed in Section 3.5.4.4, observed inflows into the existing Hera Mine workings are typically 0.3 ML/day to 0.5 ML/day. The proposed decline is significantly smaller than the Hera Mine workings that commenced in January 2013, and groundwater levels are also shallower (average 50 m compared with 70 to 90 m below ground level at Hera) and therefore, the rate of inflow into the proposed decline is expected to be similar to or less than that observed at the Hera Mine.

The transmissivity at Wirlong was estimated to be 81 m^2/day, however this is likely representative of the uppermost portion of the aquifer. Transmissivity over the entire depth of the decline is likely to be lower due to a decrease in hydraulic conductivity with depth as overburden pressure would close and tighten fractures. Modelled hydraulic conductivities from the calibrated numerical groundwater model for the New Cobar Complex (EMM, 2020), varied between 1 x 10^{-5} m/day and 7.39 x 10^{-4} m/day (fractured rock above -1000 m AHD, excluding weathered fractured rock). Interpreted, effective hydraulic conductivity from slug testing at the Cobar Complex varied between 5.4 x 10^{-4} m/day and 1.2 m/day (EMM, 2020). These monitoring bores however are preferentially screened across the highest yielding sections of the intersected lithology.

Therefore based on a review of aquifer parameters from other nearby projects and the inflows observed at Hera, the best estimate for groundwater inflow is 0.31 ML/day to 0.50 ML/day. The transmissivity associated with this inflow is 0.5 m^2/day (k = 7.7 x10^{-4} m/day assuming an aquifer thickness of 650 m). This hydraulic conductivity value is just greater than the upper end of the values calibrated for the New Cobar Complex, and at the lower end of the values interpreted from the slug tests. The inflow estimates are similar to observed inflows at Hera, which was expected.

Table 6.2 Estimated inflows

Transmissivity	Storativity	Method a		Method b	
		m^3/day	ML/day	m^3/day	ML/day
0.01	1×10^{-3}	54	0.05	24	0.02
0.1	1×10^{-3}	155	0.16	125	0.13
0.15	1×10^{-3}	205	0.21	171	0.17
0.5	1×10^{-3}	498	0.50	447	0.45
1	1×10^{-3}	862	0.86	791	0.79
0.01	1×10^{-4}	16	0.02	13	0.01
0.1	1×10^{-4}	86	0.09	79	0.08
0.15	1×10^{-4}	120	0.12	111	0.11
0.5	1×10^{-4}	328	0.33	310	0.31
1	1×10^{-4}	594	0.59	565	0.57
0.01	1×10^{-5}	9	0.01	8	0.01
0.1	1×10^{-5}	59	0.06	57	0.06
0.15	1×10^{-5}	85	0.09	81	0.08
0.5	1×10^{-5}	244	0.24	235	0.23
1	1×10^{-5}	453	0.45	437	0.44

Note to table: Shading denotes interpreted best estimate inflow range

It is further noted that inflows may be initially higher than that predicted as the pumping radius of influence expands towards a steady state. Following initial drainage of fractures local to the decline, flow rates would then decline as fracture flow paths to the decline increase in distance, and the system approaches a steady state.

Monitoring of inflows (and nearby drawdowns) within the existing monitoring bore network is recommended during the development of the exploration decline to verify the accuracy of the predictions (see Section 7).

6.2 Prediction of dewatering influence

6.2.1 Method

An approximation of the Theis equation (to the same form of the Dupuit-Forchheimer radial flow equation) to determine the radius of influence (R_o) was applied, as per equation 1.

(1) $$R_0 = \sqrt{\frac{2.25kLt}{S}}$$

Where

kL = Transmissivity (m^2/day)

t = Pumping duration (days)

S = Aquifer storativity (dimensionless)

The analytical inputs are the aquifer transmissivity, storativity, drawdown and pumping duration, which are summarised in Table 6.1. The formula assumes radial groundwater flow into the decline.

6.2.2 Results

The extent of the dewatering based upon the application of the method has been summarised in Table 6.3. Similarly to the assessment of dewatering inflows, there is uncertainty in the predictions of radius of dewatering influence as aquifer hydraulic parameters have been correlated from surrounding groundwater assessments in the region. It is noted that there is no obvious source of recharge (permanent waterway or lake) that could mitigate the expansion of the cone of depression.

Similarly to the inflow analysis, the prediction of the dewatering radius has a broad range of values from 0.1 km to over 12 km. However, based upon the most likely transmissivity and storativity estimates, the likely zone of groundwater drawdown as a result of the exploration decline would be approximately 0.9 km to 2.9 km.

Table 6.3 Estimated extent of dewatering

Storativity	Transmissivity (m^2/day)				
	0.01	0.1	0.15	0.5	1
1×10^{-3}	128 m	405 m	496 m	906 m	1282 m
1×10^{-4}	405 m	1,282 m	1,570 m	2,866 m	4,053 m
1×10^{-5}	1,282 m	4,053 m	4,964 m	9,062 m	12,816 m

Note to table: Shading denotes interpreted best estimate inflow range

6.3 Impact assessment criteria

The potential impacts have been assessed in accordance with the NSW AIP. The AIP requires that potential impacts on groundwater sources, including their users and GDEs, be assessed against minimal impact considerations, outlined in Table 1 of the policy. If the predicted impacts meet the Level 1 minimal impact considerations, then these impacts will be considered as acceptable.

Based on the hydrogeological environment at Mallee Bull discussed in Section 3.5.4.4 and Section 4.2.2, groundwater yield is generally less than 1 L/s and groundwater salinity is over 8000 µS/cm. Therefore, Level 1 minimal impact considerations for Less Productive Fractured Rock Water Sources have been adopted for the groundwater impact assessment and are defined as follows:

– Water table:
  - Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, at a distance of 40 m from any high priority GDE or high priority culturally significant site listed in the schedule of the relevant WSP. A maximum of a 2 m water table decline cumulatively at any water supply work.
  - If more than 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 m from any high priority GDE; or high priority culturally significant site; listed in the schedule of the relevant WSP then appropriate studies (including the hydrogeology, ecological condition and cultural function) will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than 2 m decline cumulatively at any water supply work, then make good provisions should apply.
– Water pressure:
  - A cumulative pressure head decline of not more than a 2 m decline at any water supply work.
  - If the predicted pressure head decline is greater than the requirement above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.
– Water quality:
  - Any change in groundwater quality should not lower the beneficial use category of the groundwater source, beyond 40 m from the activity.

If the above condition is not met then appropriate studies will need to demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply work.

6.4 Discussion of impacts

6.4.1 Impact to existing groundwater users

When an excavation is to occur below the groundwater table, the geologic materials need to be dewatered (become unsaturated). The lowering of the groundwater level (pressure) results in the creation of a hydraulic gradient towards the excavation or tunnel, and groundwater moves from high pressure to low pressure. This results in groundwater inflow, and a decline in groundwater levels remote from the seepage face (or dewatering point). The decline in water level is referred to as the 'drawdown cone' or 'cone of depression' around the pumping bore, or drawdown zone around an excavation.

The extent of drawdown depends primarily on the nature of the aquifer, the pumping rate and pumping duration. If the aquifer system consists of fractured rock, or is of odd shape, the shape and extent of drawdown may vary in certain preferential directions. If the drawdown extends a certain distance from the extraction centre such that it intersects other bores or (in the case of unconfined aquifers) it intersects with environmental features such as creeks, rivers and dependent ecosystems, it is said to have interfered with these features.

It is Important to understand the term drawdown (lowering of the water level in the aquifer due to removal of groundwater) and limitations in predicting drawdown. The extent of influence is time-dependent, and therefore dependent on construction depths and size, and construction progress (or excavation and ground support) rates/time periods considered.

The extent and magnitude of drawdown is not only dependent on the aquifer hydraulic parameters (principally transmissivity, storativity and homogeneity), but also factors such as leakage between adjoining aquifers and aquitards and interactions with hydraulically connected waterways/discharge features. Where hydrogeological systems become more complex, the accuracy of the drawdown predictions may be impacted by the presence of these complex features listed above.

Bores within 10 km of Mallee Bull identified include:

– Bore GW017889 a stock bore located 4.9 km from Mallee Bull
– Bore GW061098 a stock and domestic bore located 5.8 km from Mallee Bull
– Bore GW704759 a stock and domestic bore located 8.1 km from Mallee Bull
– Bore GW061097 a stock and domestic bore located 8.9 km from Mallee Bull
– Bore GW017033 a stock bore located 9.0 km from Mallee Bull
– Bore GW014159 a stock bore located 9.3 km from Mallee Bull

As discussed in Section 6.2, based on aquifer parameters considered most likely to occur at Mallee Bull, the predicted radius of influence is approximately 0.9 km to 2.9 km. Therefore, the radius of drawdown is not predicted to impact on surrounding stock and domestic bores. However, if radius of drawdown is greater than predicted, stock bores are used intermittently and therefore the loss in the available drawdown may not necessarily result in impact to the operation of landholder bores. If impacts to landholder bores do occur, there are a number of mitigations available for consideration by Peel Mining to ensure a continued supply of water to the landholder:

– Lower the production pump intake (provided there is capacity in the bore)
– Installation of a deeper production bore to replace or supplement the bore
– Provision of an alternative water supply, e.g. tankering supply to the landholder

As the radius of influence due to the exploration decline is not predicted to impact on landholder bores, the impacts of the Mallee Bull exploration decline meet the Level 1 minimal impact considerations from the NSW AIP for landholder bores.

6.4.2 Impacts to GDEs

The likelihood of adverse impact to GDEs was assessed as being low. This is based upon the following lines of evidence:

– A review of broad scale mapping did not identify any known GDEs within 20 km of Mallee Bull. There are potential aquatic and terrestrial GDEs in the vicinity of Mallee Bull. Given the deep-water levels it is considered unlikely that these vegetative communities are GDEs. Due to the deep groundwater levels and the ephemeral nature of watercourses in the vicinity of Mallee Bull, it is considered unlikely that there are aquatic GDEs in the vicinity of Mallee Bull.
– The deep depths at which groundwater was intercepted during installation of monitoring bores (greater than 50 m) in the Palaeozoic sediments are beyond the reasonable limit of tree rooting depths.

It is considered unlikely that a perched aquifer is present based on exploration drilling and installation of monitoring bores has consistently indicated that the shallow strata is dry.

As there are no known GDEs within 20 km of Mallee Bull, potential impacts of the Project meet the Level 1 minimal impact considerations for GDEs from the NSW AIP outlined in Section 6.3.

6.4.3 Impacts to groundwater quality

Owing to it being a mineralised province, it is not uncommon for native groundwater to be naturally elevated with heavy metals.

Mineralisation is commonly in the form of metal sulfides, e.g. principally in the form of pyrite. The geological materials are stable when undisturbed or located below the water table. However, when oxygen is introduced, the metal sulfides oxidise to form sulfate, with resultant materials having low pH and potentially high concentrations of the heavy metals. Groundwater leaching through these materials may mobilise pH and heavy metals into the environment.

For the approximately two years of decline construction and exploration activities, the dewatering would result in the potential exposure of acid generating geological materials. The decline dewatering, however, would result in a sink or depression forming in the regional water table, and therefore there is a tendency for acid / metalliferous drainage being collected or its movement hydraulically controlled by the dewatering operations. Following the end of dewatering, the exploration decline will be sealed, and the site will continue to be a groundwater sink until groundwater levels start to recover and reach equilibration. Oxidation will cease once the portal and vent rises are sealed. As a result, acid mine drainage post closure is unlikely to be a significant risk.

As the potential impacts on groundwater quality will be limited to the immediate vicinity of the exploration decline, the Mallee Bull exploration project will not lower the beneficial use category of the groundwater source. Therefore, impacts on groundwater quality are expected to meet the Level 1 minimal impact considerations for groundwater quality from the NSW AIP as outlined in Section 6.3.

6.4.4 Post exploration

Post exploration groundwater inflow is expected to be less than or similar to groundwater inflow during exploration. Therefore, post exploration groundwater inflow is predicted to be 0.31 ML/day or lower. The rate of groundwater inflow would decline over time following the end of exploration as groundwater levels gradually recover.

6.4.5 Cumulative impacts

There are no operating mining operations within 20 km of Mallee Bull. The historical May Day open cut pit is located approximately 9 km west of Mallee Bull. Mining at May Day was undertaken in the mid to late 1990's (Burton, 2012). Due to the distance from Mallee Bull to May Day (i.e. well beyond the predicted radius of influence of the Mallee Bull exploration decline), cumulative impacts are not predicted.

Hera Mine is located approximately 40 km to the northeast of Mallee Bull. Proposed mining at Federation deposit is located approximately 30 km northeast of Mallee Bull. Therefore, due to the distance between Mallee Bull and Hera Mine and the Federation deposit no further cumulative impact assessment has been undertaken.

6.5 Water sharing plan licensing requirements

As discussed in Section 2.1.2.2, under the Water Management (General) Regulation 2018, up to 3 ML of water can be taken per water year as part of prospecting or fossicking activities. Predicted water take at Mallee Bull is approximately 0.31 ML/day to 0.50 ML/day. Therefore, it is recommended that Peel Mining obtain a WAL volume of 183 ML/year from the Lachlan Fold Belt MDB groundwater source of the WSP for the NSW Murray Darling Basin (MDB) Fractured Rock Groundwater Sources. A works approval that covers the exploration decline will also be required.

7. Mitigation measures and recommendations

This report makes the following recommendations:

– Continued monitoring of groundwater levels and groundwater quality at Mallee Bull using the existing monitoring bore network.
– Ensure that all water pumped into and out of the exploration decline, as well as material movements and ventilation rates, are recorded to enable a robust assessment of groundwater inflows to the proposed exploration decline.
– Engage with surrounding landholders, including the owner of bore GW017889, a stock bore located 4.9 km southeast of Mallee Bull. While predicted impacts do not extend to this bore, determining if this bore is operational and potentially monitoring this bore will assist in the management and mitigation of groundwater impacts.
– Apply for a WAL and works approval for the exploration decline.

8. Conclusions

8.1 Hydrogeological setting

Mallee Bull is located within indurated Palaezoic sediments. These sandstones and siltstones form a fractured rock aquifer and extend to depths over 700 m. The groundwater levels are deep at the exploration site, with groundwater generally encountered below 50 m bgl. Bore yields during drilling of monitoring bores were low, less than 1 L/s.

The groundwater salinity ranges between 8,000 µS/cm and 30,000 µS/cm. There is limited use of groundwater in the region, however, stock and domestic bores have been identified on public groundwater databases.

8.2 Impact assessment approach

As part of the impact assessment, analytical modelling was undertaken to quantify groundwater inflows into the decline and the dewatering radius of influence. Owing to the limited site-specific aquifer hydraulic parameters, broad ranges of inflows were estimated. However, based on a review of aquifer parameters adopted by other nearby projects and inflows recorded at other mining operations in the region, the best estimate for groundwater inflow is 0.31 ML/day to 0.50 ML/day and the best estimate for the radius of drawdown is 0.9 km to 2.9 km.

8.3 Summary of impacts

Interference impacts to existing groundwater users were assessed as being low, based on the lack of stock and domestic bores within 2.9 km radius of Mallee Bull.

The likelihood of adverse impact to GDEs was assessed as being low. This was based upon an absence of identified GDEs (based upon regional mapping), and the depth to groundwater.

Peel Mining does not currently hold any WALs. It is recommended that Peel Mining apply for a WAL and works approval for the exploration decline. Based on the rate of inflow into the exploration decline estimated by analytical equations a WAL volume of 183 ML/year is required.

9. References

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Appendix 4

Biodiversity Development Assessment Report

prepared by
AREA Environmental & Heritage Consultants Pty Ltd

(Total No. of pages including blank pages = 170)

Department of Planning and Environment

Biodiversity Development Assessment Report
Peel Mining Limited, Mallee Bull Project
Gilgunnia, NSW Cobar LGA

Prepared by Phil Cameron of AREA Environmental & Heritage Consultants Pty Ltd
BAM accredited assessor (BAAS17082)

Final Report December 2022

Document control

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V3.0	23/09/2022	G. Peel	FINAL submitted to Client
V3.1	13/12/2022	G. Peel	BDAR update as per BCS comments
FINAL	22/12/2022	G. Peel	BAM-C finalised, BDAR certified for submission

Summary

Peel Mining Limited (the proponent) proposes to construct an exploration decline, 'Mallee Bull Project' within Exploration Licence 7461 for definition drilling of the deeper portions of the Mallee Bull Prospect. The Mallee Bull Prospect is located in the vicinity of Gilgunnia, NSW, approximately 110 kilometres south of Cobar. The development footprint is located on Lot 1339 DP 762952 (Figures 1 and 2 Chapter 13).

The project will require approval under the *Mining Act 1992* as a Non-complying Exploration Activity and application will be assessed by the NSW Resources Regulator. The project will impact native vegetation and, as results from exploration may justify the development of the site as a mining operation and potentially become a State Significant Development (SSD), the proponent has chosen to opt into the NSW Biodiversity Offsetting Scheme. Therefore, a full site-based assessment has been undertaken by appropriately experienced and qualified personnel using the Biodiversity Assessment Method 2020 (BAM).

This Biodiversity Development Assessment Report (BDAR) will inform a Review of Environmental Factors (REF) being prepared for the project by RW Corkery (the client) and has been prepared to meet requirements under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). AREA Environmental & Heritage Consultants (AREA EHC) has prepared this BDAR which includes an assessment of landscape values in the study area, the vegetation communities present in the study area and their condition, the known or potential presence of threatened flora or fauna species, populations and communities as well as potential matters of Serious and Irreversible Impact (SAII) listed in NSW under the *Biodiversity Conservation Act 2016* (BC Act) and/or the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed activities of the project include;

- construction of a box cut to a maximum depth of approximately 25 metres below ground level
- construction of an exploration decline to a maximum depth of approximately 700 metres below ground level
- construction of associated surface infrastructure
- drilling of the deposit from underground
- rehabilitation.

This BDAR uses the following terms:

project: Mallee Bull Exploration Project - the activities for which development consent is sought comprising all proposed associated activities.

subject land: The area of land subject to the development (including site access roads)

development footprint: The anticipated outer limit of disturbance from the construction and operation of the project which is the area assessed by this BDAR. This was determined using the site component layouts with a 10-metre construction buffer.

The **Review of Environmental Factors (REF) Area**: A broad boundary around the land subject to the REF being prepared for the project by RW Corkery. With the exception of the site access roads, it is anticipated that surface disturbance associated with the proposed activities would be limited to the REF Area.

study area: The broader area surrounding the subject land assessed through field surveys and desktop analysis, with information from the study area used to assess potential direct and indirect project impacts. The initial study area for this project was notably larger than the final development footprint

site access roads: Two existing site access roads, one to the west and one to the east of the exploration decline will be utilised for the project. As these roads are existing (the west one which is a proposed haul road is already cleared to a width of 20 metres) there will be no impact to native vegetation and these areas are therefore not included in the development footprint which is limited to the REF Area.

This BDAR assesses subject land of approximately 52.53 hectares of which approximately 15.59 hectares is existing cleared site access roads, and 36.94 hectares is native vegetation within the development footprint.

The topography of the development footprint is generally flat ranging from 282m to 296m AHD, apart from a rocky outcrop which rises in the north-east of the REF Area to a height of approximately 316m AHD. No waterways are located in the development footprint. Three minor drainage lines intersect the existing western access road.

The development footprint and REF Area have endured heavy disturbance since the late 1800s from a combination of historic exploration and other mining activities including associated timber cutting as well as heavy grazing from native fauna and exotic species such as goats and sheep. Despite historical disturbance in the study area, vegetation cover is high; sparse but extensive. Breaks in native vegetation are established roads to the north and west and the existing site access roads as well as some small clear breaks between areas of vegetation. Notable landscape features in the study area are a number of old mine shafts in the REF Area from historic mining in the area remaining unaffected by the project, the rocky outcrop to the north-east of the development footprint and extensive high threat exotic (HTEs aka weed) cover in the form of Saffron Thistle *Carthamus lanatus* across most of the REF area.

Vegetation within the development footprint has been assessed as aligning with the BioNet Vegetation Classification Plant Community Types (PCTs) identified in Table E1 below.

Table E1 PCTs identified within the development footprint

PCT ID	PCT name	Development footprint area (ha)
103	Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion	30.00
104	Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	6.31
176	Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	0.63
	Total area	**36.94**

Native vegetation within the development footprint is further delineated in zones which mostly aligned with the ground truthed PCT map. Four vegetation zones were entered into the BAM Credit Calculator (BAM-C). One for PCT103 and 176 but two for PCT104. The difference between the two PCT104 zones were PCT 104 varied between the north and the south on the subject land due to existing disturbance levels which have impacted the condition state of the PCT. ‘PCT 104_Disturbed’ zone showed evidence of clearing and historic ground surface disturbance, whereas ‘PCT 104_Open’ zone also showed evidence of past timber clearing but was not as disturbed.

There are no Threatened Ecological Communities (TECs) associated with the PCTs identified in the development footprint. No TEC’s listed under the BC Act or EPBC Act were found to occur in the study area.

Fourteen BAM (2020) vegetation plots were used to describe the vegetation values present in the development footprint. Data from these plots was entered into the BAM-C which provided a vegetation integrity score for each zone and generated predicted and candidate species lists.

The BAM-C identified 29 predicted species (ecosystem credit species) assumed to occur based on known association with PCTs and sixteen candidate species (species credit species) that cannot be reliably predicted to occur based on the PCTs present.

The proponent accepted the burden of proof and undertook targeted threatened species assessment for species credit species following the threatened species survey guidelines and an EPBC Act Matters of National Environment Significance (MNES) protected matters report generated for the project.

AREA EHC conducted seasonal field survey and threatened species surveys in and around the development footprint in May and October 2021 and additional survey occurred over four days 6 to 9 December 2021 to inform this BDAR. Threatened species survey effort included targeted search transects, bird searches, flora and fauna habitat assessment, diurnal tree hollow observation, call playback, spotlight, bioacoustics recording and ultrasonic bat recording.

The following three threatened fauna species, all of which was listed a Vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act) [not also EPBC listed], were positively identified during fauna surveys:

- Little Eagle *Hieraaetus morphnoides* detected by spotlight foraging / resting in the study area
- Grey-crowned Babbler (eastern subspecies) *Pomatostomus temporalis temporalis* heard calling in the study area
- Little Pied Bat *Chalinolobus picatus* confidently recorded in bat call analysis.

Little Eagle and Grey-crowned Babbler are already accounted for as Ecosystem credit species and Little Pied Bat was added to the calculator as an Ecosystem credit species (it is not a dual credit species). Little Eagle is a dual credit species, but no breeding site was identified in accordance with the BAM 2020, so this species could be excluded as a candidate species credit species.

Overall, a total of 30 predicted species and 16 candidate species were assessed by the BAM-C. Two predicted species were excluded as habitat constraints for them are not present in the development footprint. No survey is required for the remaining 28 and potential impact to these species is calculated in the ecosystem credits generated by the BAM-C.

Candidate species (species credit species) are assumed present unless survey effort undertaken in accordance with relevant guidance material proves otherwise. Five candidate species were excluded from being present and affected by the project based on required habitat or geographic constraints not being present in the development footprint. The remaining eleven candidate species were excluded after targeted survey effort following requisite guidelines. Consequently, there are no species credits generated by the proposal.

The proponent has avoided and minimised direct and indirect impacts by locating the project in an area which has had a history of ongoing disturbance through mining and agricultural practices. Placement of the project in the proposed location avoids impact to ‘pristine’ and undisturbed areas of native vegetation. Opportunities to minimise direct and indirect impacts, especially to native vegetation, has been achieved by:

- service and access roads located on existing access roads avoids vegetation clearance associated with building new roads through remnant native vegetation hereby also avoiding adding new roads which would increase risk of vehicle strike

- consulting with field ecologists to inform the design to avoid impact to denser, less disturbed vegetation, thereby reducing the potential impact to threatened species and their habitat
- utilising previously disturbed areas to minimise additional clearance attributable to the project
- as the project involves underground exploration, impact associated with large open cut mining areas are avoided
- the proponent has condensed the project area into the smallest area possible without compromising the functionality or its purpose
- the original design has been significantly altered to avoid impact to Aboriginal heritage sites which, as a consequence, has resulted in the avoidance of impact to many mature native trees
- avoiding 16.35 hectares of rocky habitat
- avoiding impact to habitat connectivity and undisturbed vegetation by placement in a previously disturbed area
- avoiding impact to waterbodies, water quality and hydrological processes
- avoiding impact to existing mine shafts (potential bat habitat) in the study area.

In total 36.9 ha of native vegetation will be impacted reducing the assessed vegetation integrity score to zero. A small area of rocky habitat (0.63 hectares) will be destroyed. Loose rock within the development footprint would be collected and re-established in adjacent vegetation to minimise the impact to rocky habitat dependent species.

There are no areas within the development footprint that do not trigger an offsetting obligation under the NSW Biodiversity Offsetting Scheme. There are no serious and irreversible impacts associated with the project. There are no impacts on threatened species (species credits) triggering an offsetting obligation.

Details of proposed mitigation and management measures for residual impacts have been included in this report. There are no indirect and prescribed impacts that remain after measures to avoid (first), minimise and mitigate (second) have been applied which need to be offset (as a last consideration). There are no impacts to MNES that require further consideration.

In conclusion, this BDAR determines the total offsetting obligation for the project as shown in Table E2:

Table E2 Impacts that require an offset – ecosystem credits

Vegetation zone	PCT	TEC/EC	Impact area (ha)	Number of ecosystem credits required
Zone 1 PCT103_Open	PCT 103 Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion	N/A	30	544
Zone 2 104_Disturbed	PCT 104 Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	N/A	4.9	106
Zone 3 104_Open	PCT 104 Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	N/A	1.4	21
Zone 4 176_Recovering	PCT 104 Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	N/A	0.63	12
			Total credits	**683**

Contents

List of tables

List of figures

Shortened forms

BAM	Biodiversity Assessment Method
BAM-C	Biodiversity Assessment Method Calculator
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BC Regulation	Biodiversity Conservation Regulation 2017 (NSW)
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOS	Biodiversity Offsets Scheme
CEEC	critically endangered ecological community
DBH	diameter at breast height over bark
EC	ecological community listed under the EPBC Act
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EEC	endangered ecological community
HTW	high threat weed
IBRA	Interim Biogeographic Regionalisation for Australia
LLS Act	*Local Land Services Act 2013* (NSW)
MNES	matters of national environmental significance
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NSW	New South Wales

PCT	plant community type
SAII	serious and irreversible impact
SEARs	Secretary's Environmental Assessment Requirements
TBDC	Threatened Biodiversity Data Collection
TEC	threatened ecological community
VEC	vulnerable ecological community
Vegetation SEPP	*State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017* (NSW)

Declarations

i. Certification under clause 6.15 *Biodiversity Conservation Act 2016*

I certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method and clause 6.15 of the *Biodiversity Conservation Act 2016* (BC Act).

Signature: 

Date: 22.12.2022

BAM Assessor Accreditation no: BSSA17082

This BDAR has been prepared to meet the requirements of BAM 2020. Appendix A provides an assessment of compliance with the minimum information requirements outlined in BAM Appendix K.

ii. Details and experience of author/s and contributors

Authors and contributors

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iii. Conflict of interest

I declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest

This declaration has been made in the interests of full disclosure to the decision-maker. Full disclosure has also been provided to the client.

Signature: 

Date: 22.12.2022

BAM Assessor Accreditation no: BSSA17082

1. Introduction

Stage 1: Biodiversity assessment

1.1 Proposed development

1.1.1 Development overview

Peel Mining Limited propose to construct an exploration decline, 'Mallee Bull Project' within Exploration Licence 7461 for definition drilling of the deeper portions of the Mallee Bull Prospect. The Mallee Bull Prospect is located in the vicinity of Gilgunnia, NSW, approximately 110 kilometres south of Cobar (Figures 1 and 2, Chapter 13).

The project will require approval under the *Mining Act 1992* as a Non-complying Exploration Activity. The application will be assessed by the NSW Resources Regulator.

As results from this exploration may justify the development of the site as a mining operation, Peel Mining Limited has chosen to opt into the NSW Biodiversity Offsetting Scheme. This Biodiversity Development Assessment Report (BDAR) will inform a Review of Environmental Factors (REF) being prepared for the project and has been prepared to meet requirements under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

This BDAR uses the following terms:

project: Mallee Bull Exploration Project - the activities for which development consent is sought comprising all proposed associated activities.

subject land: The area of land subject to the development (including site access roads)

development footprint: The anticipated outer limit of disturbance from the construction and operation of the project which is the area assessed by this BDAR. This was determined using the site component layouts with a 10 metre construction buffer.

The **Review of Environmental Factors (REF) Area**: A broad boundary around the land subject to the REF being prepared for the project by RW Corkery. With the exception of the site access roads, it is anticipated that surface disturbance associated with the proposed activities would be limited to the REF Area.

study area: The broader area surrounding the subject land assessed through field surveys and desktop analysis, with information from the study area used to assess potential direct and indirect project impacts. The initial study area for this project was notably larger than the final development footprint

site access roads: Two existing site access roads, one to the west and one to the east will be utilised for the project. As these roads are existing (the west one which will is a proposed haul road is already cleared to a width of 20 metres) there will be no impact to native vegetation and these areas are therefore not included in the development footprint which is limited to the REF Area, see Section 1.3.

1.1.2 Location

Mallee Bull Project is located in the vicinity of Gilgunnia, NSW, on the Gilgunnia goldfields approximately 110 kilometres south of Cobar within the Cobar Local Government Area on land zoned RU1 – Primary Production. The Mallee Bull Project is situated on a NSW Western Lands Lease held by Peel Mining which is 8,101 hectares in extent and currently subleased to a local grazier. The development footprint is located on Lot 1339 DP 762952.

Refer to Figure 1 for location overview and Figure 2 for cadastre boundaries relevant to the proposal. All Figures are included in Section 13 of this report.

1.1.3 Proposed development and the subject land

Proposed activities include;

1. Construction of a box cut to a depth of approximately 10 metres below ground level
2. Construction of an exploration decline to a maximum depth of approximately 700 metres below ground level
3. Construction of associated surface infrastructure including a:
   a) workshop
   b) administration buildings
   c) core yard and geology block
   d) magazine
   e) potentially acid forming waste rock emplacement
   f) non-acid forming waste rock emplacement
   g) water storage dam
   h) site access road and internal roads
   i) other ancillary infrastructure
4. Drilling of the deposit from underground
5. Rehabilitation of the REF Area (R.W. Corkery & Co. Pty. Limited, 2021).

Refer to Figure 3 Site Component Map and Figure 4 Proposed Site Layout.

This BDAR assesses subject land of approximately 52.53 hectares of which approximately 15.59 hectares is existing cleared site access roads and 36.94 hectares is native vegetation within the development footprint.

The topography of the development footprint is generally flat ranging from 282m to 296m AHD, apart from a rocky outcrop which rises in the north-east of the REF Area to a height of approximately 316m AHD. Refer to Figure 5 for the location of the development footprint, REF Area boundary and contours in the study area.

No waterways are located in the development footprint. Three minor drainage lines intersect the existing western access road. Refer to Figure 6.

The development footprint and REF Area have endured heavy disturbance since the late 1800s from a combination of historic exploration and other mining activities and associated timber cutting as well as heavy grazing from native fauna and exotic species such as goats and sheep.

1.1.4 Other documentation

N/A

1.2 Biodiversity Offsets Scheme entry

The project will impact native vegetation. As results from exploration may justify the development of the site as a mining operation, and therefore potentially become a State Significant Development (SSD), the proponent has chosen to opt into the NSW Biodiversity Offsetting Scheme. This BDAR will inform a Review of Environmental Factors (REF) being

prepared for the project and has been prepared to meet requirements under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Therefore, a full site-based assessment has been undertaken by appropriately experienced and qualified personnel using the Biodiversity Assessment Method (BAM).

1.3 Excluded impacts

The proposed site access roads to the west and south of the exploration infrastructure follow existing roads and therefore these areas are not considered by this BDAR.

The western site access road which is a proposed haul road has an existing width of 20 metres, see Photo 1 and Photo 2 below. It is assumed any native grasses growing along an existing access track will be graded occasionally under standard routine maintenance and this activity is not part of the BDAR.

The southern access road is an existing road which will be used for light vehicles only. See Photo 3. The location of these excluded impacts are shown on Figure 7.

Photo 1: Existing western site access road

Photo 2: Existing western site access road

Photo 3: Existing southern site access road

1.4 Matters of national environmental significance

The proposed development is not a controlled action and does not need referral under the EPBC.

The Commonwealth Protected Matters Search Tool was used to generate a report on Matters of National Environmental Significance predicted to occur within 1500 metre radius around the development footprint. This report is included in Appendix B and is summarised below.

MNES	Result	Is there an implication for this assessment?
World Heritage Properties	None	No
National Heritage Places	None	No
Wetlands of International Importance	3	No – all three are more than 400km away
Great Barrier Marine Park	None	No
Commonwealth Marine Area	None	No
Listed Threatened Ecological Communities	3	No – field assessment confirmed none of these communities occur in the development footprint
Listed Threatened Species	16	No – assessed under NSW legislation or likelihood of presence considered (see Appendix B)
Listed Migratory Species	7	No – the project is unlikely to impact these 7 bird species, see Appendix B
Commonwealth Land	None	No
Commonwealth Heritage Places	None	No
Listed Marine Species	13	No - The project will not impact these species
Whales and other Cetaceans	None	No
Critical Habitats	None	No
Australian Marine Parks	None	No
Commonwealth Reserves Terrestrial	None	No
State and Territory Reserves	None	No
Forest Regional Agreements	None	No
Nationally Important Wetlands	None	No
EPBC Referrals	1	No - Completed and Not Controlled Action
Key Ecological Features (Marine)	None	No
Biologically Important Areas	None	No
Bioregional Assessments	None	No
Geological and Bioregional Assessments	None	No

No Commonwealth listed threatened species have been recorded on BioNet within 1500 metres of the development footprint.

Likelihood of occurrence of 16 EPBC listed threatened species predicted in the Commonwealth Protected Matters report is considered in Appendix B. Appendix B also considers the possible presence of one vulnerable EPBC listed bat species, Large-eared pied bat *Chalinolobus dwyeri* in the study area, as this was *potentially* indicated by bat echolocation call analysis during field survey, bringing the total to 17 species.

In summary, each EPBC Act listed species is either unlikely to be present and impacted or is addressed under NSW legislation. This BDAR, by implementing the burden of proof through BAM (2020), confirms MNES species and ecosystems are unlikely to occur and will not be significantly impacted, therefore a Referral under the EPBC Act is not required.

1.5 Information sources

Information sources used to inform this BDAR have been provided in the following sections.

Spatial data

GIS layer name	Reference
IBRA bioregions and subregion	NSW data portal
NSW landscape regions	Mitchell Landscapes V3
Rivers and streams	Six Viewer / SEED WMS topographic layer
Wetlands	Directory of Important Wetlands
Waterways	Waterway NSW Final
Key Fish Habitat	DPI Key Fish Habitat GIS layer
Connectivity of different areas of habitat	Western State Vegetation Plant Community Type map 4492 and ESRI Satellite
Native vegetation extent	Western State Vegetation Plant Community Type map 4492 and ESRI Satellite

Web sites (and links to documents)

Title	Web address
Legislation	
Commonwealth Environment Protection & Biodiversity Conservation Act 1999	Environment Protection and Biodiversity Conservation Act 1999 (legislation.gov.au)
Environmental Planning and Assessment Act 1979	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-1979-203
Fisheries Management Act 1994	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-1994-038
National Parks and Wildlife Act 1974	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-1974-080
Threatened Species Conservation Act 1995	https://legislation.nsw.gov.au/view/whole/html/inforce/2016-11-25/act-1995-101
Water Management Act 2000	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-2000-092
Biodiversity	
BAM 2020	https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity-offsets-scheme/accredited-assessors/biodiversity-assessment-method-2020
BioNet TBDC	https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet
Threatened Species Survey and Assessment Guidelines: Field Survey Methods for Fauna –Amphibians (DECCW, 2009)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/amphibians-field-survey-methods-090213.pdf
Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC 2004)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/draft-threatened-biodiversity-survey-guide.pdf
Survey requirements (birds, bats, reptiles, frogs, fish and mammals) for species listed under the EPBC Act	https://www.environment.gov.au/system/files/resources/b1c6b237-12d9-4071-a26e-ee816caa2b39/files/survey-guidelines-mammals.pdf

Title	Web address
Guide to Surveying Threatened Plants (DPIE, 2020)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/surveying-threatened-plants-and-habitats-nsw-survey-guide-biodiversity-assessment-method-200146.pdf
DPIE Threatened Species website	https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species
Atlas of NSW Wildlife	http://www.environment.nsw.gov.au/wildlifeatlas/about.htm
PlantNET	http://plantnet.rbgsyd.nsw.gov.au/
Online Zoological Collections of Australian Museums	http://www.ozcam.org.au/
Threatened Species Assessment Guideline - The Assessment of Significance (DPI, 2008)	Threatened Species Assessment Guidelines (nsw.gov.au)
Significant Impact Guidelines 1.1 - Matters of National Environmental Significance	https://www.environment.gov.au/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance
Principles for the use of biodiversity offsets in NSW	https://www.environment.nsw.gov.au/biodivoffsets/oehoffsetprincip.htm
NSW Native Vegetation Regulatory Map	https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap
NSW Biodiversity Values Map	https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap
Groundwater Dependent Ecosystems	http://www.bom.gov.au/water/groundwater/gde/

2. Methods

2.1 Site context methods

2.1.1 Landscape features

Landscape features were initially identified using aerial imagery and GIS files including contours, vegetation maps, hydrology, etc during field planning. Seasonal site visits in May, October and December 2021 were used to confirm the extent and condition of landscape features in and around the development footprint.

2.1.2 Native vegetation cover

Native vegetation cover was initially identified using current and historical aerial imagery and GIS files including land use, land zoning and vegetation maps etc during field planning.

Site visits in May, October and December 2021 were used to confirm the extent and condition of native vegetation cover in and around the development footprint. Despite historical disturbance in the study area, vegetation cover is high at greater than 70%.

2.2 Native vegetation, threatened ecological communities and vegetation integrity methods

2.2.1 Existing information

Prior to field survey, the Central West Lachlan SVM (state vegetation map) v1p4_PCT_E_4468 was reviewed to see what Plant Community Types (PTC's) have previously been mapped in and around the development footprint.

The field assessment to map native vegetation was undertaken to ground truth the SVM and to correct any errors. The development footprint was first assessed to broadly indicate what vegetation formation and classes were present then which Plant Community Types (PCTs) occurred and lastly what vegetation zones were likely present. Once these were preliminarily mapped BAM (2020) plots were allocated to each zone for further assessment. Plots were placed in representative[1] native vegetation zones likely to be impacted.

Flora species, formation, class and type were recorded on each BAM (2020) plot sheet and this data was entered into the BioNet Vegetation Classification Community Identification Tool to provide statistically valid options on what PCT best matched the native vegetation. After consideration of the upper, mid and ground-stratum species recorded in the development footprint and the regional context, PCT's were ground truthed and mapped.

2.2.2 Mapping native vegetation extent

Native vegetation extent was initially identified using current and historical aerial imagery and GIS files including land use, land zoning and vegetation maps etc during field planning.

Seasonal site visits in May, October and December 2021 were used to confirm the extent and condition of native vegetation in and around the development footprint. The entire development footprint was found to contain native vegetation.

[1] Not the best or worst examples – just what most represented the average values of each zone.

Areas that are not native vegetation are the site access roads to the west and the south of the development footprint.

2.2.3 Plot-based vegetation survey

AREA conducted preliminary field survey and seasonal threatened species surveys in and around the development footprint in May and October 2021 and survey for the plot based assessment occurred over four days 6 to 9 December 2021 to inform this BDAR. All surveys followed BAM (2020) guidance materials listed in Section 1.5 of this BDAR.

BAM (2020) is approved by the NSW government as it is scientifically robust and transparent. BAM (2020) ensures all accredited assessors can assess the same location and with the BAM Credit Calculator (BAM-C) get a same or very similar score. The BAM-C generates a number against a benchmark to indicate quality i.e., a Vegetation Integrity Score of 67 equals 67 percent of the benchmark for the described PCT.

The field assessment to map native vegetation was undertaken to ground truth map layer - Central West Lachlan SVM (state vegetation map) v1p4_PCT_E_4468 aerial imagery and to correct any errors. The development footprint was first assessed to broadly indicate what Plant Community Types (PCTs) and zones were likely present and where BAM (2020) plots and further assessment could be located. Plots were placed in representative native vegetation zones likely to be impacted.

Twenty-five 20 by 20 metre in 20 by 50 metre ‘nested’ plots following BAM (2020) were undertaken in and around the development footprint, a proportion of which were used to inform this BDAR. The 20 by 20 metre area measures biodiversity (plant composition or floral biodiversity, hence evidence to identify the PCT and its quality) and the 20 by 50 metre structure plot, including the one-by-one-metre leaf litter plots, measure the function of the same area. Function includes an assessment of size classes of trees and tree hollows, which are both indicative of the age of trees assessed, ground logs and the amount of leaf litter. These attributes indicate the quality of habitat present and influences what species of listed fauna or flora can use the vegetation.

AREA’s team observed and recorded characteristics of each plot including species composition and abundance for each layer (including upper/canopy, mid-storey/shrub stratum, and groundcover/ orbs and grasses). Using this data, PCTs in the development footprint were identified. If the presence of a listed threatened species was detected in a plot, relevant NSW or Commonwealth guidelines were employed to find others in or next to the plot to indicate the extent of the local viable population.

Effort was made to have all vegetation plots used in this assessment located within the development footprint. However, the initial study area for this project was notably larger than the final development footprint and due to change of scope following ecology and heritage field surveys, some BAM plots were outside the final development footprint. BAM plots located outside the development footprint are within vegetation representative of the same vegetation type and condition as the vegetation within the development footprint, however some BAM plots were deemed too far away from the final development footprint to be considered relevant.

Plot data collected per BAM (2020) was entered into the BAM-C. Refer to Appendix C ‘Vegetation survey data’ for survey locations. Figure 8 ‘Field survey locations’ shows where all 25 BAM plots were done within the REF Area. Figure 9 shows the location of the vegetation zones mapped in the REF Area and the BAM plots used in BAM-C calculations. Figure 10 shows tracks from search transects and field survey during all three site visits (see Section 2.6 Limitations for more information).

2.2.4 Vegetation integrity survey

Plots were located within vegetation zones to provide a representative assessment of vegetation integrity of the vegetation zone by locating vegetation plots to ensure they capture representative attributes of that zone.

Standard BAM 2020 plot size and shape were used for all plots.

The initial study area for this project was notably larger than the final development footprint. The original design has been significantly altered to avoid impact to Aboriginal objects which, as a consequence, has resulted in the avoidance of impact to many mature native trees, see Section 7. Therefore, when the Avoid principle was applied to minimise harm to Aboriginal objects, the design was modified and reissued, resulting in many BAM plots being too far outside the reissued (current) development footprint to be included in this assessment were not used in this assessment.

2.3 Threatened flora survey methods

2.3.1 Review of existing information

A default list of threatened flora species with potential to occur in the subject land was firstly identified using the assessment filtering tool in the BAM-C. This list was used to inform the field and threatened species assessments. A background review was also conducted to confirm these, and possible additional, threatened species using the resources shown in the table below.

Wildlife databases used to identify potentially occurring threatened species

Database / resource	Search area	Date accessed
BAM credit calculator (BAM-C)	Cobar Peneplain IBRA > Subregion Nymagee Downs	May 2021
DPE NSW Atlas of Wildlife (BioNet)	Approximately 10 X10 kilometres centred on the study area	May 2021
MNES Protected Matters Search Tool (DEE)	One kilometre radius around the study area	May 2021
DPE Threatened Species Profile Database (TSPD)	IBRA subregion	May 2021

Aerial imagery, contour maps and vegetation maps were also reviewed to identify habitat constraints and microhabitats for threatened species.

2.3.2 Habitat constraints assessment

Aerial imagery, contour maps and vegetation maps were reviewed to identify specific habitat constraints and microhabitats for threatened flora species, such as the presence of rocky habitat, caves or wetland habitat.

Three separate seasonal field surveys, as described in Section 2.2, were also used to assess the subject land to see what habitat constraints were present and determine what species might require these constraints and possibly be present, so subsequent field survey could then be tailored to be species specific.

2.3.3 Field surveys

The targeted seasonal threatened species assessment focused on listed species highlighted by the BAM-C and the EPBC Act Protected Matters Report following all survey requirement

identified on the BAM-C and BioNet data collection. Threatened species searches were undertaken as per the threatened species survey guidelines.

Refer to Section 5.3 for survey methods used and species targeted and see Figure 8, 9 and 10 for illustration of threatened flora survey effort. AREA ecologists conducted vehicular[2], and pedestrian transects across the development footprint to identify the species listed in Section 5.3 or suitable habitat for these species. The transect techniques included parallel transects and random meanders in areas with higher likelihood of occurrence of listed plants, as per the Department of Planning and Environment's *Surveying threatened plants and their habitats - NSW survey guide for the Biodiversity Assessment Method 2020* and *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - Working Draft November 2005.*

No threatened flora species listed under the BC Act or EPBC Act were detected in the development footprint.

2.4 Threatened fauna survey methods

2.4.1 Review of existing information

As per Section 2.3.1, a default list of threatened fauna species with potential to occur in the development footprint was firstly identified using the assessment filtering tool in the BAM-C. This list was used to inform the threatened fauna assessment. A background review was also conducted to confirm these, and possible additional, threatened species using the resources shown in the Section 2.3.1.

Aerial imagery, contour maps and vegetation maps were also reviewed to identify habitat constraints and microhabitats for threatened species.

2.4.2 Habitat constraints assessment

Aerial imagery, contour maps and vegetation maps were reviewed to identify habitat constraints and microhabitats for threatened species.

Three separate seasonal field surveys, as described in Section 2.2, were also used to assess the subject land so see what habitat constraints were present and determine what species might require these constraints and possibly be present, so subsequent field survey could then be tailored to be species specific.

The vegetation in the development footprint can provide habitat for a wide range of terrestrial fauna. Trees were inspected for hollows; fallen logs, rocks, crevices and shrubby habitat were observed, and the area was checked for infrastructure which may provide artificial habitat for microbats and other fauna species. Farm dams exist in the study area, however these lack aquatic vegetation and habitat. Large trees, some with hollows, are present in or adjacent to the development footprint. Old abandoned mine shafts are present in the study area.

2.4.3 Field surveys

AREA conducted preliminary field survey and seasonal threatened species surveys in and around the development footprint in May and October 2021 and additional survey occurred over four days 6 to 9 December 2021 to inform this BDAR. Survey focussed on targeted assessment which could occur at the time, but additional consideration was given to

[2] Only used in monocultures of mature Saffron Thistle (a High Threat Weed)

threatened species which may be present in other more suitable seasons for their detection. All surveys followed BAM (2020) guidance materials listed in Section 1.5 of this BDAR.

The targeted threatened fauna species assessment focused on listed fauna species highlighted by the BAM-C and the EPBC Act Protected Matters Report following all survey requirement identified on the BAM-C and BioNet data collection. Threatened species searches were undertaken as per the threatened species survey guidelines.

The following survey effort was completed to inform this BDAR:

Call Playback and spotlighting

Call playback was conducted on one night in May 2021 which targeted Masked Owl and Barking Owl following the guidelines provided in *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities- Working Draft November 2005.* Spotlighting was conducted in conjunction with the call playback. Call playback and spotlighting were completed at three sites in the development footprint.

Bioacoustic recorders

Two bioacoustics recorders were placed in the development footprint. These were in place from 21 May to 6 August 2021. These recorders were set to collect data for five minutes in every hour which targeted nocturnal species including owls, Koala, Bush Stone-curlew and diurnal species such as Glossy Black-Cockatoo. Data collected was analysed by AREA's Principal Scientist (PhD qualified bat and bird expert).

Bat monitors

Two ultrasonic bat monitors were placed in the development footprint over three nights from 6 to 8 December 2021. Data collected was analysed by AREA's Principal Scientist (PhD bat and bird expert). And results are included in Appendix D.

Refer to Section 5.3 for survey methods used and species targeted and Figure 11 for the location of fauna monitoring points.

2.4.4 Fauna Survey Results

The following threatened fauna species were positively identified during fauna surveys:

- Little Eagle *Hieraaetus morphnoides* detected by spotlight foraging /resting in the study area
- Grey-crowned Babbler (eastern subspecies) *Pomatostomus temporalis temporalis* heard calling in the study area
- Little Pied Bat *Chalinolobus picatus* was confidently recorded in bat call analysis.

Little Eagle and Grey-crowned Babbler are already accounted for as Ecosystem credit species and Little Pied Bat was added to the calculator as an Ecosystem credit species (it is not a dual credit species), see Section 5.1.1.

Little Eagle is a dual credit species, but no breeding site was identified in accordance with the BAM, so this species was excluded as a candidate species credit species.

2.5 Weather conditions

Weather conditions in Table 1 to document conditions at the time of surveys at the nearest weather station at Cobar.

All Candidate species highlighted by the BAM-C requiring specific survey were either birds, plants or one mammal species, whose presence and likelihood of detection are not overly affected by average weather fluctuations.

Table 1 Environmental conditions during threatened species surveys

Survey undertaken (e.g. method / targeted species)	**Date**	**Time**	**Temperature** (min. & max.)	**Wind**	**Rainfall** (mm)	**Other conditions relevant to the species**
Threatened species searches	21-22 May 2021	7am to 10pm	2.8ºC to 22.1 ºC	Light	0	N/A
Threatened species searches	10-11 Oct 2021	7am to 5pm	10.6 ºC to 23.8 ºC	Moderate	7.2mm	N/A
Threatened species searches	6-10 Dec 2021	7am to 7pm	11.3 ºC to 33.1 ºC	Light	3.2mm	N/A

2.6 Limitations

Change of scope post ecological surveys meant that no search transects were completed in an area in the northern extent of the development footprint, see northern yellow square of development footprint in Figure 10. This area is proposed to be an administration area which earlier designs had located east of the current layout; however the design was changed to avoid impact to Aboriginal objects, consequently avoiding impact to an area with mature trees.

Professional judgment, based on a lot of survey effort in the immediate area has been applied to assume that no threatened species are present in this area because:

- The existing disturbance levels in this and the surrounding area are high and the vegetation in this area is commensurate with the vegetation immediately east of it which received adequate survey effort
- There are no habitat features evident in this area which differ to the immediate surroundings
- The vegetation within the current development footprint in this location is within the same surrounding vegetation zone where no threatened species were detected
- No threatened species have previously been recorded in this area.

3. Site context

3.1 Assessment area

The assessment area for this BDAR includes the subject land and the surrounding study area, as defined in Section 1.1. Refer to Figure 2. BAM calculations are limited to the development footprint.

3.2 Landscape features

A discussion of relevant landscape features is provided in the following subsections.

The topography of the development footprint is generally flat ranging from 282m to 296m AHD, apart from a rocky outcrop which rises in the north-east of the REF Area to a height of approximately 316m AHD. Refer to Figure 5 for the location of the development footprint and contours.

Notable landscape features in the study area are a number of historic mine shafts in the REF Area from historic (1800s) mining in the area, the rocky outcrop to the north-east and extensive high threat weed cover in the form of Saffron Thistle *Carthamus lanatus* across most of the REF area. The location of these landscape features is indicated on Figure 12 and their relevance is discussed in the following sections.

3.2.1 IBRA bioregions and IBRA subregions

The development footprint lies within the Cobar Peneplain Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion and the Nymagee IBRA Subregion, see Figure 13.

The Cobar Peneplain Bioregion lies in central NSW and is entirely with NSW. The Bioregion extends from south of Bourke to north of Griffith. The bioregion has a total area of 7,334, 664 hectares and occupies 9.2 per cent of the state.

In the north of the bioregion, Yanda Creek, a major stream, discharges directly into the Darling River which meanders across the bioregional boundary in the northwest. In the east, several small streams flow occasionally into the Bogan River as it criss-crosses the eastern boundary of the bioregion (Morgan and Terrey 1992). The Lachlan River traverses the bioregion in the south with contributions of minor runoff from smaller streams (Morgan and Terrey 1992). The bioregion lies wholly within the Murray-Darling Basin and includes the Barwon, Macquarie, Yanda, Darling, Lachlan and Murrumbidgee catchments.

An overview of the Nymagee subregion is shown below (Source: DPE https://www.environment.nsw.gov.au/bioregions/CobarPeneplain-Subregions.htm):

Geology

Ordovician to Devonian granites, quartzose sandstones, phyllites, slates and acid volcanics. Quaternary aeolian sands and alluvium.

Characteristic landforms

Low hills and ridges with steep slopes. Form controlled by rock type, rounded hills with tors on granite, asymmetric strike ridges in sedimentary rocks. Sandplains from adjacent bioregions lap onto lower slopes.

Typical soils

Gritty red and yellow earthy sands on granite. Stony red earths and texture contrast soils on sedimentary rocks. Calcareous red earths in sandplains, minor earths and grey clays in alluvium.

Vegetation

Dwyer's mallee gum, white cypress pine, kurrajong, golden wattle on granite crests, poplar box and red box on slopes and creeks. White cypress pine, red box, belah with mallee, western wattle grey box and rosewood on crests and slopes of Sedimentary rocks. Mallee communities on sandplains. Dense poplar box and white cypress pine in creek lines.

3.2.2 Rivers, streams, estuaries and wetlands

Waterways in the study area are shown in Figure 6. The project occurs in a semi-arid area with no wetlands of international or national importance located within relevant distance and no major waterways occurring within 1500 metres.

No waterways occur in or around the development footprint, there are however several unnamed ephemeral tributaries and topographic drainage lines which intersect the northern site access road and flow south.

Dams and waterways in the study area lack aquatic habitat which would attract insects and amphibian species. No waterways mapped as Key Fish Habitat exist within ten kilometres of the subject land.

3.2.3 Habitat connectivity

The development footprint is well connected to native vegetation from all directions. There are no corridors which will be impacted and no specific corridors or other areas of connectivity linking habitat for threatened entities present in the study area. Habitat connectivity across the development footprint is shown in Figure 14, cover is sparse but extensive.

3.2.4 Karst, caves, crevices, cliffs, rocks or other geological features of significance

No Karsts, caves, cliffs, crevices or other geographically significant features were identified in the development footprint.

A ridge containing surface rocks is located to the north of the development footprint between the proposed administration/workshop area and the NAF material stockpiling area (refer Figure 12). Majority of this area will not be impacted by the project (see Section 8.3).

3.2.5 Areas of outstanding biodiversity value

No areas of outstanding biodiversity value are within 1500 metres of the development footprint, see Figure 15.

3.2.6 NSW (Mitchell) landscape

The subject land is situated entirely within the Nymagee Downs Mitchell Landscape, see Figure 16.

3.2.7 Additional landscape features identified in SEARs

There are no Secretary’s Environmental Assessment Requirements (SEARs) for the project.

3.2.8 Soil hazard features

No soil hazard features such as dryland salinity, acidification, compaction, structural breakdown, sodicity and contamination are mapped in the subject land on the DPE eSPADE spatial viewer.

No areas of other geological significance or soil hazards are known in the subject land.

3.3 Native vegetation cover

Seasonal site visits in May, October and December 2021 combined with desktop surveys were used to confirm the extent and condition of native vegetation cover in and around the subject land.

Despite historical disturbance in the study area, vegetation cover is high at greater than 70%. Cover is sparse but extensive. Breaks in native vegetation are established roads to the north and west and the existing site access roads as well as some small clear breaks between areas of vegetation.

Table 2 summarises the extent of native vegetation cover within the assessment area. Figure 17 shows native vegetation cover within the assessment area.

Table 2 Native vegetation cover in the assessment area

Assessment area (ha)	3773 ha
Total area of native vegetation cover (ha)	3674 ha
Percentage of native vegetation cover (%)	97%
Class (0-10, >10-30, >30-70 or >70%)	>70%

High threat weed (HTW) weed cover in the form of Saffron Thistle *Carthamus lanatus* is high across the subject land, mostly associated with Plant Community Types (PCTs) 103 and 104 where surface soils are deeper. See Photo 1 below for example of an area with a heavy weed burden on the study area.

Photo 1: Example of Saffron thistle *Carthamus lanatus* in the study area

4. Native vegetation, threatened ecological communities and vegetation integrity

4.1 Native vegetation extent

Native vegetation extent within the subject land is approximately 97%. Cover is sparse but extensive. Refer to Figure 17 and previous section.

4.1.1 Changes to the mapped native vegetation extent

There are no significant differences between the actual native vegetation extent and that shown on the aerial imagery used in the figures. Refer to Figure 17 Native vegetation extent.

4.1.2 Areas that are not native vegetation

Breaks in native vegetation are established roads to the north and west and the existing site access roads as well as some small clear breaks between areas of vegetation. HTW cover in the form of Saffron Thistle *Carthamus lanatus*, interspersed amongst native groundcover species, is high across the subject land, mostly associated with PCTs 103 and 104 where surface soils are deeper.

4.2 Plant community types

4.2.1 Overview

Vegetation within the development footprint has been assessed as aligning with the BioNet Vegetation Classification PCTs identified within Table 3 and their extent is shown in Figure 18 Plant community types. Detailed descriptions of each PCT are provided in the following subsections.

Table 3 PCTs identified within the development footprint

PCT ID	PCT name	Subject land area (ha)
103	Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion	30.00
104	Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	6.31
176	Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	0.63
	Total area	**36.94**

4.2.2 PCT 103 Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion

4.2.2.1 PCT 103 overview

PCT 103 in the development footprint is described below.

Table 4 PCT 103 Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion

PCT ID	103
PCT name	Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
Vegetation formation	Semi-arid Woodlands (Shrubby sub-formation)
Vegetation class	Western Peneplain Woodlands
Per cent cleared value (%)	50
Extent within subject land (ha)	30.00 ha

PCT103 is usually an open woodland to 25 metres high dominated by Poplar Box (*Eucalyptus populnea subsp. bimbil*) often with Gum Coolabah (*Eucalyptus intertexta*) and White Cypress Pine (*Callitris glaucophylla*), with a dense to sparse shrub layer and small shrubs and grasses as groundcover.

Due to past disturbance through historic gold mining, pastoral activities and more recently exploration drilling, vegetation condition has been impacted by thinning out the large trees and disturbing the groundcover vegetation, see Photo 2 for photo of example vegetation.

Photo 2: PCT 103 in the central area of the development footprint

4.2.2.2 Justification of PCT selection

Justification for the decision pathway for allocating PCT 103 is based on assemblage of species, its location, and supplementary descriptors[3] as shown below:

- Assemblage of species for the canopy matched but there is a difference in the canopy composition. *Eucalyptus intertexta* and *Eucalyptus populnea* are sparse; however, the footprint has been historically cleared so some discrepancies are expected. White Cypress Pine *Callitris glaucophylla* is present
- Shrub layer assemblage of species for the mid stratum species is consistent with descriptions (dense to sparse) containing *Geijera parviflora, Eremophila mitchellii, Sclerolaena species* etc
- Ground stratum assemblage of species is consistent with PCT description
- Its location i.e. Bioregion and sub-region are correct
- As per PCT supplementary descriptors, its position in landscape (foot slopes and plains) is consistent
- As per PCT supplementary descriptors, it *grades into Eucalyptus intertexta woodland (ID104) upslope or on rockier ground, or Green Mallee or Eucalyptus dwyeri communities on ridges*
- As per PCT supplementary descriptors, the vegetation description is consistent - Open woodlands to 25 metres high
- The State Vegetation Map also maps PCT103 across most of the areas ground truthed as the same by AREA.

4.2.2.3 Alignment with TECs

There are no TECs associated with this PCT.

4.2.2.4 Alignment with EPBC Act listed ECs

There are no EPBC Act listed ECs associated with this PCT.

[3] As per *Guidelines for interpreting listing criteria for species, populations and ecological communities under the NSW Biodiversity Conservation Act 2016*

4.2.3 PCT 104 Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion

4.2.3.1 PCT 104 overview

PCT 104 in the development footprint is described below.

Table 5 PCT 104 Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion

PCT ID	104
PCT name	Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
Vegetation formation	Semi-arid Woodlands (Shrubby sub-formation)
Vegetation class	Inland Rocky Hill Woodland
Per cent cleared value (%)	25
Extent within subject land (ha)	6.31ha

PCT 104 is usually a mid-high woodland dominated by Gum Coolabah *Eucalyptus intertexta* often with patches of White Cypress Pine *Callitris glaucophylla*. A sparse shrub understorey and sparse ground cover is usually present.

Due to past disturbance through historic gold mining, pastoral activities and more recently exploration drilling, vegetation condition has been impacted by thinning out the large trees and disturbing the groundcover vegetation, see Photo 3 for photo of example vegetation.

Photo 3: PCT 104_Disturbed in the northern section of the development footprint

4.2.3.2 Condition states

PCT 104 was found to vary between the north and the south on the subject land due to existing disturbance levels which have impacted the vegetation. PCT 104_Disturbed showed evidence of clearing and historic ground surface disturbance, whereas PCT 104_Open also

showed evidence of past timber clearing but was not as disturbed, see Photo 4 for photo of example vegetation.

Photo 4: PCT 104_Open in the southern section of the development footprint

4.2.3.3 Justification of PCT selection

Justification for the decision pathway based on assemblage of species, its location and supplementary descriptors for allocating PCT 104 is shown below:

- The assemblage of canopy species is correct but there is a difference in the canopy composition, *Eucalyptus intertexta* are sparse; White Cypress Pine *Callitris glaucophylla* is more dominant, however the footprint has been historically cleared so some discrepancies are expected
- The assemblage of shrub species is consistent with descriptions (sparse) containing *Geijera parviflora*, *Eremophila mitchellii, Dodonaea* species etc.
- The assemblage of ground stratum is consistent with PCT description
- Bioregion and sub-region are correct (its particular area)
- Position in landscape (foot slopes and rises) is consistent with the PCTs supplementary descriptors
- As per PCT supplementary descriptors it grades into and contains many similar understorey species to ID103 - Poplar Box - Gum Coolabah woodland and also grades into stands of Green Mallee *Eucalyptus viridis* (ID176) on stony crests.
- Vegetation supplementary descriptors is consistent – Mid-high woodland
- PCT104 is mapped on PCT State Vegetation Map 4468 as occurring in the area.

4.2.3.4 Alignment with TECs

There are no TECs associated with this PCT.

4.2.3.5 Alignment with EPBC Act listed ECs

There are no EPBC Act listed ECs associated with this PCT.

4.2.4 PCT 176 Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion

4.2.4.1 PCT 176 overview

PCT 176 in the development footprint is described below.

Table 6 PCT 176 Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion

PCT ID	176
PCT name	Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Vegetation formation	Semi-arid Woodlands (Shrubby sub-formation)
Vegetation class	Inland Rocky Hill Woodlands
Per cent cleared value (%)	20
Extent within subject land (ha)	0.63 ha

PCT 176 is generally described as very tall or extremely tall mallee woodland to 10 m high dominated by Green Mallee *Eucalyptus viridis* often with White Cypress Pine *Callitris glaucophylla* with Currawang *Acacia doratoxylon* and occasionally Gum Coolabah *Eucalyptus intertexta*.

There is evidence of past drought affecting many of the Eucalypts in this PCT with many showing signs of stress and epicormic growth, see Photo 5 for photo of example vegetation.

Photo 5: PCT 176 Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion

4.2.4.2 Justification of PCT selection

Justification for the decision pathway for allocating PCT 176 based on assemblage of species, its particular area and supplementary descriptors is shown below:

- Assemblage of species for the upper stratum is correct, dominated by Green Mallee *Eucalyptus viridis*
- Assemblage of species for the shrub layer is consistent with descriptions containing Wilga *Geijera parviflora*, hopbush *Dodonaea sp* and *Sclerolaena spp.*
- Assemblage of species for the ground stratum is consistent with PCT description
- Bioregion and sub-region are correct (its particular area)
- As per PCT supplementary descriptors it is restricted to gravel, upper slopes and rises on rolling downs mainly in the eastern section of the Cobar Peneplain Bioregion
- As per PCT supplementary descriptors its position in landscape (hillslope and hillcrest) is consistent
- As per PCT supplementary descriptors its vegetation description is consistent – Tall mallee woodland to 10m
- PCT176 is mapped on PCT State Vegetation Map 4468 as occurring in the area.

4.2.4.3 Alignment with TECs

There are no TECs associated with this PCT.

4.2.4.4 Alignment with EPBC Act listed ECs

There are no EPBC Act listed ECs associated with this PCT.

4.3 Threatened ecological communities

No TECs are present in the subject land.

4.4 Vegetation zones

Vegetation zones are defined as ‘one or more relatively homogeneous areas of native vegetation within a proposal in the same PCT and broad condition state’, i.e. one PCT can occur as one zone or more if each zones condition are notably different from each other.

Vegetation zones within the subject land were allocated after the PCT was identified. Flora species, formation, class and type were recorded on each BAM (2020) data sheet and this data was entered into the BioNet Vegetation Classification Community Identification Tool to provide statistically valid options on what PCT best matched the native vegetation. After consideration of the upper, mid and ground-stratum species recorded and the regional context, PCT’s were ground truthed and mapped across the whole subject land, see Figure 18.

The broad PCT areas were then assessed to see if they varied enough in composition, structure and state to be further delineated into zones. PCT 104 was found to vary between the north and the south on the subject land due to existing disturbance levels which have impacted the vegetation. PCT 104_Disturbed showed evidence of clearing and historic ground surface disturbance, whereas PCT 104_Open also showed evidence of past timber clearing but was not as disturbed.

A patch is an area of native vegetation that occurs on the subject land and includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤ 30 m for non-woody ecosystems). A patch may extend onto adjoining land. Patch size for all

zones was determined to be ≤100 hectares. The vegetation in and around the subject land has all been historically disturbed and cleared. Rather than broadscale clearing, this disturbance has mainly impacted the vegetation by thinning out the large trees. Vegetation cover is still extensive as connected native woody vegetation extends kilometres in all directions.

Refer to Table 7 Vegetation zones and patch sizes. Refer to Figure 9 for vegetation zones identified. Figure 19 shows the extent of vegetation zones in the development footprint which will be impacted.

Table 7 Vegetation zones and patch sizes

Vegetation zone ID	PCT ID number and name	Condition / other defining feature	Area (ha)	Patch size class (select multiple if areas of native vegetation are discontinuous)	No. vegetation integrity plots required	No. vegetation integrity plots completed	No. vegetation integrity plots used in assessment	Plot IDs of vegetation integrity plots used in assessment
1	PCT 103 *Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion*	Open – PCT has been historically disturbed and shows evidence of past timber clearing	30.00	☐ <5 ha ☐ 5–24 ha ☐ 25–100 ha ☒ >100 ha	4	6	5	Plots 4,5,6,7 and 9
2	PCT 104 *Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion*	Disturbed – PCT shows evidence of clearing and historic ground surface disturbance	4.92	☐ <5 ha ☐ 5–24 ha ☐ 25–100 ha ☒ >100 ha	2	5	4	Plots 10,11,12 and 13
3	PCT 104 *Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion*	Open – PCT shows evidence of past timber clearing but ground surface was not as disturbed.	1.39	☐ <5 ha ☐ 5–24 ha ☐ 25–100 ha ☒ >100 ha	1	3	2	Plots 14 and 15
4	PCT 176 *Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion*	Recovering – PCT shows evidence of drought recovery, many trees with epicormic growth.	0.63	☐ <5 ha ☐ 5–24 ha ☐ 25–100 ha ☒ >100 ha	1	4	3	Plots 1,2 and 3

4.5 Vegetation integrity (vegetation condition)

4.5.1 Vegetation integrity survey plots

The required number of plots were completed for each zone in accordance with BAM (2020) Table 3.

Due to the concept of 'avoid and minimise' the scope of the project has constantly evolved between its inception and finalisation. The project design used to inform the field survey for this BDAR was different to the current layout as avoid has been enacted to minimise harm to Aboriginal objects recorded during the heritage assessment. Therefore, some vegetation plots lie outside the development footprint, however they have been done within vegetation in the same patch which and is representative of the vegetation within the final development footprint. For this reason, additional plots above the minimum requirements have been used to inform this BDAR to ensure the average vegetation attributes have been adequately captured. Plots that were not relevant to this BDAR i.e., either too far away from the final development footprint have not been entered into the BAM-C.

4.5.2 Scores

Vegetation Integrity scores for the vegetation within the development footprint are shown in Table 8.

Table 8 Vegetation integrity scores

Vegetation zone ID	Composition condition score	Structure condition score	Function condition score (where relevant)	Vegetation integrity score	Hollow bearing trees present?
Zone 1 PCT 103_Open	66.2	56.6	19	41.4	No
Zone 2 PCT 104_Disturbed	72	50.1	52.7	57.5	Yes
Zone 3 PCT 104_Open	59.8	47.3	23.6	40.6	No
Zone 4 PCT 176_Recovering	82.6	50.1	34	52	No

4.5.3 Use of benchmark data

Community Condition Benchmarks as per the BAM calculator (in line with the BioNet Vegetation Classification) was used to assess vegetation integrity attributes in each zone.

5. Habitat suitability for threatened species

5.1 Identification of threatened species for assessment

5.1.1 Ecosystem credit species

Table 9 lists ecosystem credit species (and their sensitivity to gain class) likely to occur on or use the subject land as per the BAM-C combined with the results of site survey. Two Ecosystem credit species predicted to occur in the development footprint have been excluded as required habitat constraints are not present.

Table 9 Predicted ecosystem credit species

Common name	Scientific name	Listing status*		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act						
Kultarr	*Antechinomys laniger*	E	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	High
Dusky Woodswallow	*Artamus cyanopterus cyanopterus*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate
Glossy Black-Cockatoo (Foraging)	*Calyptorhynchus lathami*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	No	Habitat constraints *'Presence of Allocasuarina and casuarina species'* not present	-	High

Common name	Scientific name	Listing status*		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act						
Pied Honeyeater	*Certhionyx variegatus*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate
Little Pied Bat	*Chalinolobus picatus*	V	-	No	☐ BAM-C ☐ TBDC ☐ Previous survey ☒ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	High
Speckled Warbler	*Chthonicola sagittata*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	High
Chestnut Quail-thrush	*Cinclosoma castanotum*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open	High
Spotted Harrier	*Circus assimilis*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open	Moderate
Varied Sittella	*Daphoenositta chrysoptera*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate

Common name	Scientific name	Listing status*		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act						
Grey Falcon	*Falco hypoleucos*	E	V	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate
Black Falcon	*Falco subniger*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open	Moderate
Painted Honeyeater	*Grantiella picta*	V	V	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	No	Habitat constraints *'Mistletoes present at a density of greater than five mistletoes per hectare'* not present	-	Moderate
Black-breasted Buzzard (Foraging)	*Hamirostra melanosternon*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open	Moderate
Little Eagle (Foraging)	*Hieraaetus morphnoides*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☒ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate

Common name	Scientific name	Listing status*		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act						
White-throated Needletail	*Hirundapus caudacutus*	-	V	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 4 PCT176_Recovering	High
Shy Heathwren	*Hylacola cautus*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 4 PCT176_Recovering	High
Malleefowl	*Leipoa ocellata*	E	V	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 4 PCT176_Recovering	High
Major Mitchell's Cockatoo (Foraging)	*Lophochroa leadbeateri*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate
Hooded Robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open	Moderate

Common name	Scientific name	Listing status*		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act						
Barking Owl (Foraging)	*Ninox connivens*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open	High
Corben's Long-eared Bat	*Nyctophilus corbeni*	V	V	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	High
Gilbert's Whistler	*Pachycephala inornata*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate
Superb Parrot (Foraging)	*Polytelis swainsonii*	V	V	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 4 PCT176_Recovering	Moderate
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☒ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate
Stripe-faced Dunnart	*Sminthopsis macroura*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 4 PCT176_Recovering	High

Common name	Scientific name	Listing status*		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act						
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	High
Diamond Firetail	*Stagonopleura guttata*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering	Moderate
Masked Owl (Foraging)	*Tyto novaehollandiae*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 2 PCT104_Disturbed Zone 3 PCT104_Open	High
Inland Forest Bat	*Vespadelus baverstocki*	V	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 4 PCT176_Recovering	High

* V = Vulnerable, E = Endangered, CE = Critically Endangered

5.1.2 Species credit species

Table 10 (flora) and Table 11 (fauna) list all species credit species predicted to occur in the development footprint as per the BAM calculator and results or field survey. Five Species credit species predicted to occur in the development footprint have been excluded from further survey as required habitat constraints are not present.

Table 10 Predicted flora species credit species

Common name	Scientific name	Listing status		Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID
		BC Act	EPBC Act				
Curly-bark Wattle	*Acacia curranii*	V	V	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering
A spear-grass	*Austrostipa wakoolica*	E	E	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	No	Excluded based on habitat constraint: Development footprint is not located on an alluvial plain, or plain.	-
Commersonia procumbens	*Commersonia procumbens*	V	V	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	No	Species excluded from further assessment, due to Habitat constraints as no 'Pilliga sandstone' occurs in the development footprint. AREA Principal Consultant is a DPIE nominated expert for this species and participated in the 2021 assessments.	-
Pine Donkey Orchid	*Diuris tricolor*	V	-	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering

Common name	Scientific name	Listing status		Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID
		BC Act	EPBC Act				
Holly-leaf Grevillea	*Grevillea ilicifolia subsp. ilicifolia*	CE	-	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering
Greenhood Orchid	*Pterostylis cobarensis*	V	-	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering

Table 11 Predicted fauna species credit species

Common name	Scientific name	Listing status		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID
		BC Act	EPBC Act					
Bush Stone-curlew	*Burhinus grallarius*	E	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering
Glossy Black-Cockatoo (Breeding)	*Calyptorhynchus lathami*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	No	Species excluded from further assessment, due to Habitat constraints as there are no suitable tree hollows in the development footprint (Living or dead tree with hollows greater than 15cm diameter and	-

Common name	Scientific name	Listing status		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID
		BC Act	EPBC Act					
							greater than 8m above ground).	
Glossy Black-Cockatoo, Riverina population	*Calyptorhynchus lathami - endangered population*	EP	-	No	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 3 PCT104_Open
Black-breasted Buzzard (Breeding)	*Hamirostra melanosternon*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	No	Excluded based on habitat constraints: No suitable waterbodies are present and the development footprint is not within 40 m of riparian woodland on inland watercourses/ waterholes containing dead or dying eucalypts.	-
Little Eagle (Breeding)	*Hieraaetus morphnoides*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☒ Current survey	No	Excluded based on habitat constraints: Due to historical clearing development footprint does not contain large old trees within vegetation. No large stick nests are present. No breeding behaviours observed.	-
Major Mitchell's Cockatoo (Breeding)	*Lophochroa leadbeateri*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering

Common name	Scientific name	Listing status		Dual credit species	Sources	Species retained for further assessment?	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID
		BC Act	EPBC Act					
Barking Owl (Breeding)	*Ninox connivens*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering
Koala (Breeding)	*Phascolarctos cinereus*	E	E	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open Zone 4 PCT176_Recovering
Superb Parrot (Breeding)	*Polytelis swainsonii*	V	V	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open
Masked Owl (Breeding)	*Tyto novaehollandiae*	V	-	Yes	☒ BAM-C ☐ TBDC ☐ Previous survey ☐ Current survey	Yes	-	Zone 1 PCT103_Open Zone 2 PCT104_Disturbed Zone 3 PCT104_Open

5.2 Presence of candidate species credit species

The remaining candidate species credit species requiring further survey are outlined in Table 12 (flora) and Table 13 (fauna). Targeted species surveys (in accordance with BAM 2020 Subsection 5.2.4) over three separate survey periods determined none of these candidate species credit species are present in the development footprint.

Table 12 Determining the presence of candidate flora species credit species on the subject land

Common name	Scientific name	Listing status		Method used to determine presence	Present?	Further assessment required? (BAM Subsections 5.2.5 and 5.2.6)
		BC Act	EPBC Act			
Curly-bark Wattle	*Acacia curranii*	V	V	Targeted threatened species survey	No	No
Pine Donkey Orchid	*Diuris tricolor*	V	-	Targeted threatened species survey	No	No
Holly-leaf Grevillea	*Grevillea ilicifolia subsp. ilicifolia*	CE	-	Targeted threatened species survey	No	No
Greenhood Orchid	*Pterostylis cobarensis*	V	-	Targeted threatened species survey	No	No

Table 13 Determining the presence of candidate fauna species credit species on the subject land

Common name	Scientific name	Listing status		Method used to determine presence	Present?	Further assessment required? (BAM Subsections 5.2.5 and 5.2.6)
		BC Act	EPBC Act			
Bush Stone-curlew	*Burhinus grallarius*	E	-	Targeted threatened species survey	No	No
Glossy Black-Cockatoo, Riverina population	*Calyptorhynchus lathami - endangered population*	EP*	-	Targeted threatened species survey	No	No
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	V	-	Targeted threatened species survey	No	No

Common name	Scientific name	Listing status		Method used to determine presence	Present?	Further assessment required? (BAM Subsections 5.2.5 and 5.2.6)
		BC Act	EPBC Act			
Barking Owl	*Ninox connivens*	V	-	Targeted threatened species survey	No	No
Koala	*Phascolarctos cinereus*	E	E	Targeted threatened species survey	No	No
Superb Parrot	*Polytelis swainsonii*	V	V	Targeted threatened species survey	No	No
Masked Owl	*Tyto novaehollandiae*	V	-	Targeted threatened species survey	No	No

*EP = endangered population

5.3 Threatened species surveys

Targeted threatened species surveys used to determine presence or absence of species are shown the Table 14 (flora) and Table 15 (fauna).

Table 14 Threatened species surveys for candidate flora species credit species on the subject land

Common name	Scientific name	Threatened flora species surveys			Present?	Further assessment required?
		Survey method (transects or grids)	Timing of survey – within recommended period? (BAM-C / TBDC)	Effort (hours & no. people)		
Curly-bark Wattle	*Acacia curranii**	Transects	☒ Yes 21-22 May 2021 10-11 Oct 2021 6-10 Dec 2021	May - 2 people 16 hours each Oct – 2 people 20 hours each Dec – 2 people vegetation plots 40 hours each	No	No
Pine Donkey Orchid	*Diuris tricolor*	Transects	☒ Yes 10-11 Oct 2021	Oct – 2 people 20 hours each	No	No
Holly-leaf Grevillea	*Grevillea ilicifolia subsp. ilicifolia*	Transects	☒ Yes 21-22 May 2021 10-11 Oct 2021 6-10 Dec 2021	May - 2 people 16 hours each Oct – 2 people 20 hours each Dec – 2 people vegetation plots 40 hours each	No	No

Common name	Scientific name	Threatened flora species surveys			Present?	Further assessment required?
		Survey method (transects or grids)	**Timing of survey – within recommended period?** (BAM-C / TBDC)	**Effort** (hours & no. people)		
Greenhood Orchid	*Pterostylis cobarensis*	Transects	☒ Yes 10-11 Oct 2021	Oct – 2 people 20 hours each	No	No

*AREA is extremely familiar with this species. AREA annually undertakes monitoring of *A. curranii* populations around Yathong for NSW NPWS and AREA's Managing Director, Phil Cameron, is considered a DPIE species expert for *Acacia curranii*

Table 15 Threatened species surveys for candidate fauna species credit species on the subject land

Common name	Scientific name	Threatened fauna species surveys			Present	Further assessment required?
		Survey method (e.g. harp trap, Elliott trap, bioacoustics, etc.)	**Timing of survey – within recommended period?** (BAM-C / TBDC)	**Effort** (hours & no. people)		
Bush Stone-curlew	*Burhinus grallarius*	• Search transects, covering areas of fallen timber • Spotlighting • Bioacoustic recording	☒ Yes 21-22 May 2021 10-11 Oct 2021 6-10 Dec 2021	May - 2 people 16 hours each Oct – 2 people 20 hours each Dec – 2 people 40 hours each	No	No
Glossy Black-Cockatoo, Riverina population	*Calyptorhynchus lathami –endangered population*	• Search transects • Diurnal tree hollow observations, no suitable hollows identified, no signs of breeding identified • No *Allocasuarina* and *casuarina* species present	☒ Yes 21-22 May 2021 10-11 Oct 2021 6-10 Dec 2021	May - 2 people 16 hours each Oct – 2 people 20 hours each Dec – 2 people 40 hours each	No	No
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*	• Search transects • Diurnal tree hollow observations, no individuals present, no signs of breeding identified	☒ Yes 10-11 Oct 2021 6-10 Dec 2021	Oct – 2 people 20 hours each Dec – 2 people 40 hours each	No	No

Common name	Scientific name	Threatened fauna species surveys			Present	Further assessment required?
		Survey method (e.g. harp trap, Elliott trap, bioacoustics, etc.)	**Timing of survey – within recommended period?** (BAM-C / TBDC)	**Effort** (hours & no. people)		
Barking Owl	*Ninox connivens*	• Search transects • Spotlighting • Call playback • Bioacoustic recording • Diurnal tree hollow observations, no suitable hollows identified, no signs of breeding identified	☒ Yes 21-22 May 2021 10-11 Oct 2021 6-10 Dec 2021	May - 2 people 16 hours each Oct – 2 people 20 hours each Dec – 2 people 40 hours each	No	No
Koala	*Phascolarctos cinereus*	• Search transects • Spotlighting • Bioacoustics recording • Scat detection and Spot Assessment Technique	☒ Yes 21-22 May 2021 10-11 Oct 2021 6-10 Dec 2021	May - 2 people 16 hours each Oct – 2 people 20 hours each Dec – 2 people 40 hours each	No	No
Superb Parrot	*Polytelis swainsonii*	• Search transects • Diurnal tree hollow observations, no individuals present, no signs of breeding identified	☒ Yes 10-11 Oct 2021	Oct – 2 people 20 hours each	No	No
Masked Owl	*Tyto novaehollandiae*	• Search transects • Spotlighting • Call playback • Bioacoustic recording • Diurnal tree hollow observations, no suitable hollows identified, no signs of breeding identified	☒ Yes 21-22 May 2021	May - 2 people 16 hours each	No	No

5.4 Expert reports

No expert reports were used.

5.5 Species polygons

No species credit species are assumed to be present, or determined to be present, or likely to use suitable habitat on the subject land, therefore no species polygons are required.

6. Identifying prescribed impacts

Table 16 shows consideration of prescribed impacts on the habitat of threatened entities identified in the development footprint.

Table 16 Prescribed impacts on the habitat of threatened entities identified

Feature	Present	Description of feature characteristics and location	Threatened entities that use, are likely to use, or are part of the habitat feature. Where relevant, threatened species or fauna that are part of a TEC or EC, that are at risk of vehicle strike
Karst, caves, crevices, cliffs, rocks or other geological features of significance	☒Yes / ☐No	PCT176 has surface rocks in the development footprint.	*Acacia curranii* Curly-bark Wattle which has the habitat constraints of rocky slopes and ridges as per the BAM-C. This species was not detected during survey and single plants in other communities are unlikely as the species mostly occurs in patches of its own species.
Human-made structures	☐Yes / ☒No	Old mine shafts are present adjacent to the development footprint but are not within the development footprint and will not be impacted by the project.	Little Pied Bat *Chalinolobus picatus* is a cave dwelling species which may use mine shafts. This habitat feature will not be impacted by the project.
Non-native vegetation	☐Yes / ☒No	There are large areas across the development footprint, mainly PCT 103 which contain the HTE Saffron thistle *Carthamus lanatus*	N/A Threatened entities are unlikely to use or be part of this non-native vegetation.
Habitat connectivity	☐Yes / ☒No	The development footprint is well connected to native vegetation from all directions, there are no corridors which will be impacted.	N/A There are no specific corridors or other areas of connectivity that link habitat for threatened entities.
Waterbodies, water quality and hydrological processes	☐Yes / ☒No	Minor waterways/drainage lines intersect the site access road but not the development footprint	N/A
Wind turbine strikes	☐Yes / ☒No	N/A	N/A
Vehicle strikes	☐Yes / ☒No	The development will result in increased vehicle movements in the area and increased potential for vehicle strike to occur on access roads.	N/A There are no specific threatened fauna or animals nor specific potential impact locations that are part of a TEC which will be vulnerable to this prescribed impact. Common species such as kangaroos are more likely to be at risk.

Stage 2: Impact assessment (biodiversity values and prescribed impacts)

7. Avoid and minimise impacts

7.1 Avoid and minimise direct and indirect impacts

7.1.1 Project location

The project is located in an area which has had a history of ongoing disturbance through mining and agricultural practices. Placement of the project in the proposed location avoids impact to 'pristine' and undisturbed areas of native vegetation.

The proponent has aimed to avoid and minimise impact to the environment as far as possible. Opportunities to minimise direct and indirect impacts, especially to native vegetation has been achieved by:

- modifying earlier versions of the project by placing site access roads on existing cleared areas
- consulting with field ecologists to inform the design to avoid impact to denser, less disturbed vegetation, thereby reducing the potential impact to hollow bearing trees and threatened species and their habitat
- utilising previously disturbed areas to minimise additional clearance attributable to the project.

7.1.2 Project design

The project has been designed to avoid and minimise impacts because of the following:

- as the project involves underground exploration, impact associated with large open cut mining areas are avoided.
- the proponent has condensed the project area into the smallest area possible without compromising the functionality or its purpose
- service and access roads located on existing access roads avoids vegetation clearance associated with building new roads through remnant native vegetation
- the original design has been significantly altered to avoid impact to Aboriginal objects which, as a consequence, has resulted in the avoidance of impact to many mature native trees.

7.2 Avoid and minimise prescribed impacts

7.2.1 Project location

The project location has avoided and minimised prescribed impacts by:

- avoiding 16.35 of rocky habitat where PCT 176 occurs adjacent to the northern section of the development footprint (see Figure 12)
- avoiding impact to habitat connectivity and undisturbed vegetation by placement in a previously disturbed area
- avoiding impact to waterbodies, water quality and hydrological processes

- avoiding impact to existing mine shafts in the study area
- locating site access roads on existing roads and tracks to avoid adding new roads which would increase risk of vehicle strike.

7.2.2 Project design

The project design has avoided and minimised prescribed impacts by:

- avoiding 16.35 of rocky habitat where PCT 176 occurs adjacent to the northern section of the development footprint (see Figure 12)
- avoiding impact to existing mine shafts
- avoiding impact to habitat connectivity and undisturbed vegetation by placement in a previously disturbed area
- designing site access roads to follow existing roads and tracks to avoid adding new roads which would increase risk of vehicle strike.

The proponent has condensed the project area into the smallest area possible without compromising the functionality or its purpose, thereby minimising impacts as far as possible.

7.3 Other measures considered

The results of the heritage survey for the project, also undertaken by AREA EHC, has initiated significant demonstration of 'avoidance of impact' through project design change, see the heritage report for details.

7.4 Summary of measures to avoid and minimise impacts

Table 17 documents the measures to avoid and minimise direct, indirect and prescribed impacts.

Table 17 Avoidance and minimisation measures for direct, indirect and prescribed impacts

Action	Outcome (Describe the outcome of implementing the measure, with reference to specific entities identified in Sections 4 and 5)	Timing	Responsibility
Locating the project within a previously disturbed area	Avoids impact to 'pristine' and undisturbed areas of native vegetation	Planning phase	Proponent
Modify project design	Avoid mature trees, avoid rocky habitat, avoid less disturbed vegetation, avoid Aboriginal objects, avoid impact to existing mine shafts.	Planning phase	Proponent
Utilise existing road corridors	Minimise impact to native vegetation.	Planning phase	Proponent
Condensing project area into smallest area	Minimise impact to native vegetation.	Planning phase	Proponent

8. Impact assessment

8.1 Direct impact

8.1.1 Residual direct impacts

Impacts likely to occur on the subject land after steps taken to avoid and minimise impacts are documented in the table below.

Table 18 Summary of residual direct impacts

Direct impact	BC Act status	EPBC Act status	SAII entity	Project phase/timing of impact	Extent (ha, number of individuals)
Vegetation clearance will impact all PCT's in the development footprint. This vegetation could provide suitable habitat for a range of threatened species. Hollow bearing trees are present and will be impacted, as well as some areas of rocky habitat. As such, direct impact to habitat for threatened species could occur during construction. Potential impact to threatened fauna habitat has been minimised by avoidance of impact to native vegetation as far as possible.	Ecosystem credit species as per Section 5.1.1	Ecosystem credit species as per Section 5.1.1	No	Construction and operation	36.94 ha of native vegetation will be impacted and approximately 0.63 hectares of rocky habitat
Displacement of resident fauna, injury to wildlife and vehicle strike is possible during construction and operations of the project due to vegetation removal and increased vehicle movements. Impact will be minimised as far as possible by strict mine site speed limits and compulsory staff inductions.	Ecosystem credit species as per Section 5.1.1	Ecosystem credit species as per Section 5.1.1	No	Construction and operation	Within the development footprint
Contamination, erosion, exposed soil and stockpiles are potential direct impacts. Soils would be disturbed where vegetation removal and construction will occur. Disturbed soils have the potential to negatively impact the environment if not appropriately managed. Regular testing, erosion and sediment control measures will be implemented.	N/A	N/A	No	Construction and operation	Within the development footprint and surrounding study area

Direct impact	BC Act status	EPBC Act status	SAII entity	Project phase/timing of impact	Extent (ha, number of individuals)
Dust emissions will potentially impact air quality which will require mitigation.	N/A	N/A	No	Construction and operation	The development footprint and surrounding study area
Changes to surface water flow and capture, water contamination are potential impacts which will be mitigated in a water management plan.	N/A	N/A	No	Construction and operation	Within the development footprint

8.1.2 Change in vegetation integrity score

The table below documents the change in vegetation integrity for residual direct impacts on native vegetation.

Table 19 Impacts to vegetation integrity

Vegetation zone	PCT ID	Management zone	Area (ha)	Before development				After development				Change
				Composition	Structure	Function	VI score	Composition	Structure	Function	VI score	Change in VI score
1	103_Open	N/A	30	66.2	56.6	19	41.4	0	0	0	0	-41.4
2	104_Disturbed	N/A	4.92	72	50.1	52.7	57.5	0	0	0	0	-57.5
3	104_Open	N/A	1.39	59.8	47.3	23.6	40.6	0	0	0	0	-40.6
4	176_Recovering	N/A	0.63	82.6	50.1	34	52	0	0	0	0	-52

8.2 Indirect impact

Table 20 documents residual indirect impacts which have the possibility to occur on native vegetation, threatened entities and their habitat beyond the development footprint.

Table 20 Summary of residual indirect impacts

Indirect impact (Describe impact, e.g. transport of weeds and pathogens form the site to adjacent vegetation)	**Impacted entities** (PCT/threatened entity and their habitats and where relevant, EPBC Act listing)	**Extent** (ha or zone reference)	**Frequency**	**Duration** (long-term/ short-term/ medium-term)	**Project phase/ timing of impact** (e.g. construction, operation, rehabilitation)	**Likelihood and consequences**
Introduction and spread of disease and pathogens from the site to adjacent vegetation	Native vegetation surrounding the development footprint	Study area	Ongoing	Life of project	During construction and operation	Unlikely if adequately mitigated
Introduction and spread of weeds and pests from the site to adjacent vegetation	Native vegetation surrounding the development footprint	Study area	Ongoing	Life of project	During construction and operation	Unlikely if adequately mitigated
Edge Effects and Fragmentation to adjacent vegetation	Native vegetation surrounding the development footprint	Study area	Ongoing	Life of project	During construction and operation	Unlikely if adequately mitigated
Dust, Noise and Vibration impacts to surrounding vegetation and habitat values	Native vegetation surrounding the development footprint	Study area	Ongoing	Life of project	During construction and operation	Unlikely if adequately mitigated

8.3 Prescribed impacts

Impact assessment for all prescribed impacts identified in Section 6 are shown below.

8.3.1 Karst, caves, crevices, cliffs, rocks or other geological features of significance

8.3.1.1 Nature

Rocky habitat where 0.63 hectares PCT176 occurs in and around the northern section of the development footprint (refer to Photo 5 in Section 4.2.4 and Figure 12 where the development footprint overlaps rocky habitat).

8.3.1.2 Extent

0.63 hectares within the development footprint.

8.3.1.3 Duration

Disturbance within the development footprint will be ongoing for the life of the project.

8.3.1.4 Consequences

A small area of rocky habitat will be destroyed. Loose rock within the development footprint would be collected and re-established in adjacent vegetation to minimise the impact to rocky habitat dependent species. See following section for mitigation measures for residual impacts.

Acacia curranii Curly-bark Wattle, which has the habitat constraints of rocky slopes and ridges as per the BAM-C, was determined not to occur in the development footprint so will not be impacted.

8.4 Mitigating residual impacts – management measures and implementation

Table 21 details proposed mitigation and management measures for residual impacts.

Table 21 Summary of proposed mitigation and management measures for residual impacts (direct, indirect and prescribed)

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	**Likely efficacy** (including risk of failure)	**MNES** (when relevant)
Staff inductions	Ensure all staff working on the project are inducted on site environmental procedures (i.e. vegetation management, sediment and erosion control, protective fencing, weeds, hygiene protocols, ethical procedures for handling fauna displaced on the site, site speed limits, biodiversity considerations etc).	Prior to any employee commencing work	As required	HR officer	Likely	N/A
Physical vegetation clearing boundary at the approved clearing limit is to be identified and effectively communicated to personnel	The delineation of such a boundary may include the use of temporary fencing or parawebbing and marked as 'No-Go Zones'. Regular inspections should be undertaken to ensure all retained vegetation/fauna habitat is clearly marked and that fencing is in place, where appropriate.	Prior to construction	As required	Project manager/ Environment Officer	Likely	N/A
Vegetation clearance occurs as per biodiversity recommendations to minimise impacts	• Preclearing inspection should be undertaken by a qualified ecologist • An ecologist or spotter/catcher should be present for the removal of hollow-bearing trees, logs or stags which could contain native fauna • Avoid clearing in Spring where possible • Implement staged habitat removal • Reuse fallen timber for habitat • Compensate for the loss of large hollows using nest-boxes or creating tree hollows through pruning remaining trees	During and post construction	As required	Project manager/ Environment Officer	Likely	N/A

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	Likely efficacy (including risk of failure)	MNES (when relevant)
Minimise impact to rocky habitat	Rocky habitat will be avoided wherever possible. Loose rock within the development footprint would be collected and re-established in adjacent vegetation, piled similarly to the current arrangement to maintain habitat values between the rocks and to minimise the impact to rocky habitat dependent species. Rock would be moved with suitable machinery so as not to damage the rock or result in excessive disturbance.	During and post construction	As required	Project manager/ Environment Officer	Likely	N/A
Manage dust, stockpiles, waste rock	Devise a soil and waste rock management strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A
Manage water (run off, wastewater etc) onsite	Devise a Water management strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A
Manage waste onsite	Devise a Waste management strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A
Manage dust and air quality onsite	Devise an Air quality management strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A
Manage biodiversity onsite (including management of displaced fauna)	Devise a Biodiversity management strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A
Prevent bushfire	Devise a Bushfire management strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A
Manage noise onsite	Devise a Noise management strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A

Mitigation measure	Method/technique	Timing	Frequency	Responsibility	Likely efficacy (including risk of failure)	MNES (when relevant)
Prevent weed, pest and disease occurrences	Devise a Biosecurity management strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A
Rehabilitate post exploration	Devise a Rehabilitation strategy	Prior to construction	Review as required	Project manager/ Environment Officer	Likely	N/A

Further details on implementation of the mitigation and management measures in Table 21 are recorded in Table 22.

Table 22 Mitigation and management measures implementation

Measure/action	Monitoring and evaluation strategy (Data, frequency, timing and reporting)	Performance criteria (linked to monitoring and evaluation strategy)	Adaptive management threshold (trigger for adaptive management plan/actions)	Adaptive management response (when triggered)
Staff inductions	Annual review of currency and effectiveness	Staff performance	Staff incidences	Review induction material, investigate and action response.
Demark clearing limits	Regular inspections (daily) should be undertaken to ensure all retained vegetation/fauna habitat is clearly marked and that fencing is in place, where appropriate	Clearing undertaken effectively, safely and within approved limits	Vegetation clearing or other impact outside approved limits	Cease work, report, and notify, investigate and action response.
Vegetation clearance occurs as per biodiversity recommendations to minimise impacts	Regular inspections (daily) should be undertaken to ensure vegetation clearance occurs as per recommendations	Clearing undertaken effectively, safely and within approved limits	Vegetation clearing or other impact outside approved limits, injury to wildlife reported	Cease work, report, and notify, investigate, and action response.
Manage dust, stockpiles, waste rock	Regular monitoring and inspections (monthly)	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.

Measure/action	**Monitoring and evaluation strategy** (Data, frequency, timing and reporting)	**Performance criteria** (linked to monitoring and evaluation strategy)	**Adaptive management threshold** (trigger for adaptive management plan/actions)	**Adaptive management response** (when triggered)
Manage water (run off, wastewater etc) onsite	Regular monitoring and inspections (monthly)	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.
Manage waste onsite	Regular monitoring and inspections (monthly)	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.
Manage dust and air quality onsite	Regular monitoring and inspections (monthly)	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.
Manage biodiversity onsite	Regular monitoring and inspections (monthly)	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.
Prevent bushfire	Regular monitoring and inspections (monthly)	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.
Manage noise onsite	Regular monitoring and inspections (monthly)	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.
Prevent weed, pest and disease occurrences	Regular monitoring and inspections (monthly)	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.
Rehabilitate post exploration	TBC, will occur at the end of the life of the project	No incidence recorded or reported	Incident recorded	Report and notify, investigate, and action response.

9. Serious and irreversible impacts

There are no entities at risk of a SAII associated with the project.

10. Impact summary

10.1 Determine an offset requirement for impacts

10.1.1 Impacts on native vegetation and TECs or ECs (ecosystem credits)

The table below identifies impacts that require an offset (as per BAM Subsection 9.2.1(1.)). There are no areas within the development footprint that do not require offset.

Table 23 Impacts that require an offset – ecosystem credits

Vegetation zone	PCT name	TEC	Impact area (ha)	Current VI score	Future VI score	Change in VI score	Biodiversity risk weighting	Number of ecosystem credits required
1	103_Open	N/A	30	41.4	0	-41.4	1.75	544
2	104_Disturbed	N/A	4.9	57.5	0	-57.5	1.5	106
3	104_Open	N/A	1.4	40.6	0	-40.6	1.5	21
4	176_Recovering	N/A	0.63	52	0	-52	1.5	12
							Total credits	683

10.1.2 Impacts on threatened species and their habitat (species credits)

There are no impacts on threatened species (species credits) that require an offset.

10.1.3 Indirect and prescribed impacts

There are no indirect and prescribed impacts that remain after measures to avoid, minimise and mitigate have been applied, which need to be offset.

11. Biodiversity credit report

Ecosystem credit classes and matching credit profiles are presented in Table 39 below. Refer to Appendix E for copies of the credit reports.

11.1 Ecosystem credits

Table 24 Ecosystem credit class and matching credit profile

Ecosystem credits	Attributes shared with matching credits						
	PCT name	**PCT vegetation class**	**PCT vegetation formation**	**Associated TEC or EC**	**Offset trading group** (BAM Section 10.2, Tables 4 & 5)	**Hollow bearing trees present?**	**IBRA subregion** (in which proposal is located)
544	103_Open	Western Peneplain Woodlands	Semi-arid Woodlands (Shrubby sub-formation)	No	Western Peneplain Woodlands >=50% and <70%	No	Nymagee
106	104_Disturbed	Inland Rocky Hill Woodlands	Semi-arid Woodlands (Shrubby sub-formation)	No	Inland Rocky Hill Woodlands <50%	Yes	Nymagee
21	104_Open	Inland Rocky Hill Woodlands	Semi-arid Woodlands (Shrubby sub-formation)	No	Inland Rocky Hill Woodlands <50%	No	Nymagee
12	176_Recovering	Inland Rocky Hill Woodlands	Semi-arid Woodlands (Shrubby sub-formation)	No	Inland Rocky Hill Woodlands <50%	No	Nymagee

11.2 Species credits

There are no species credits requiring offset.

12. References

Animal Plant Mineral Pty Ltd. (2020). *Mallee Bull Exploration Project- Review of Environmental Factors.* Henley Brook : Animal Plant Mineral Pty Ltd.

R.W. Corkery & Co. Pty. Limited. (2021, September). Mallee Bull Project- Brief for A Biodiversity Development Assessment Report for a Review of Environmental Factors. Orange: R.W. Corkery & Co. Pty. Limited.

13. Figures

Figure 1 Location Overview

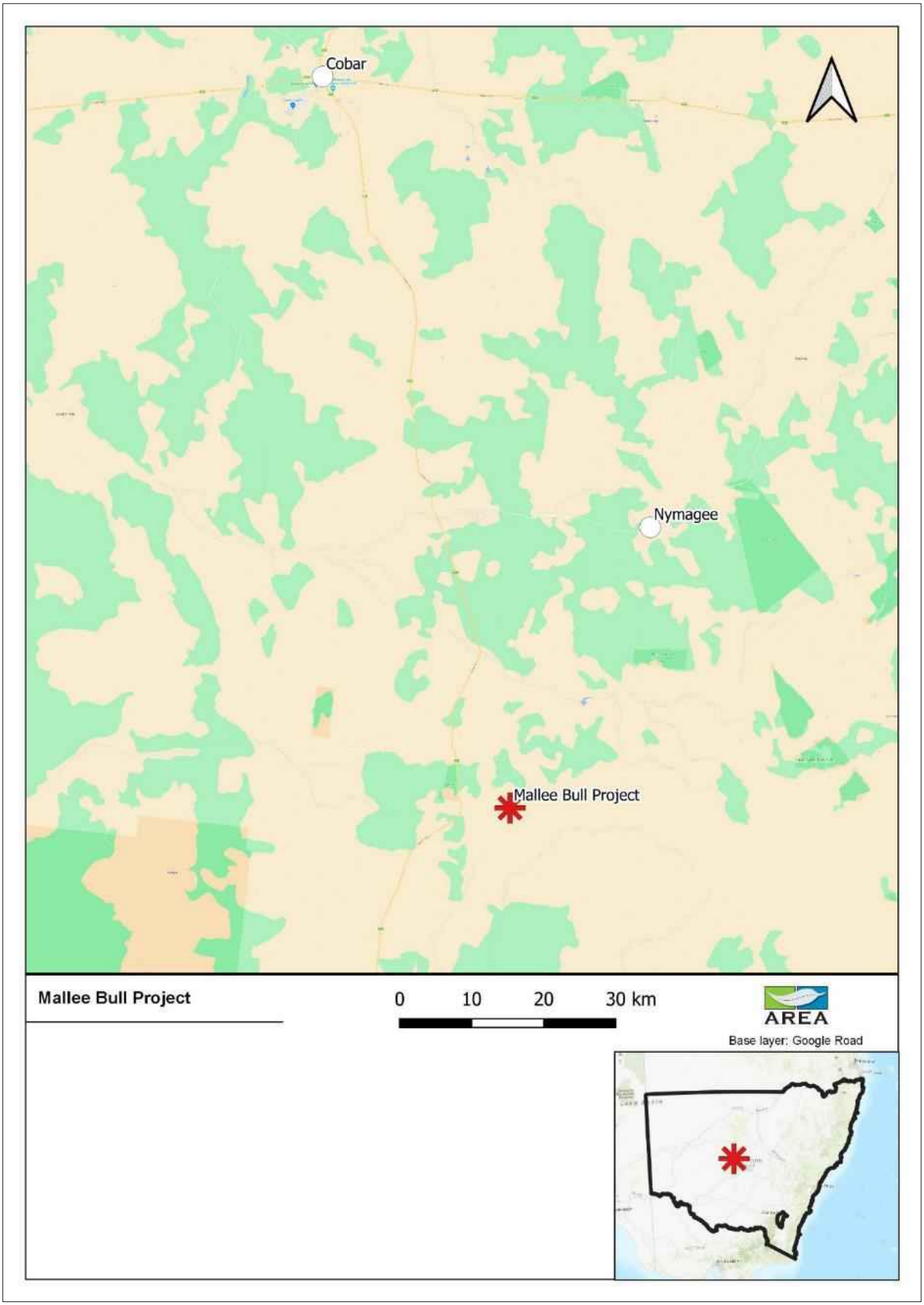


Figure 2 Cadastre Boundaries

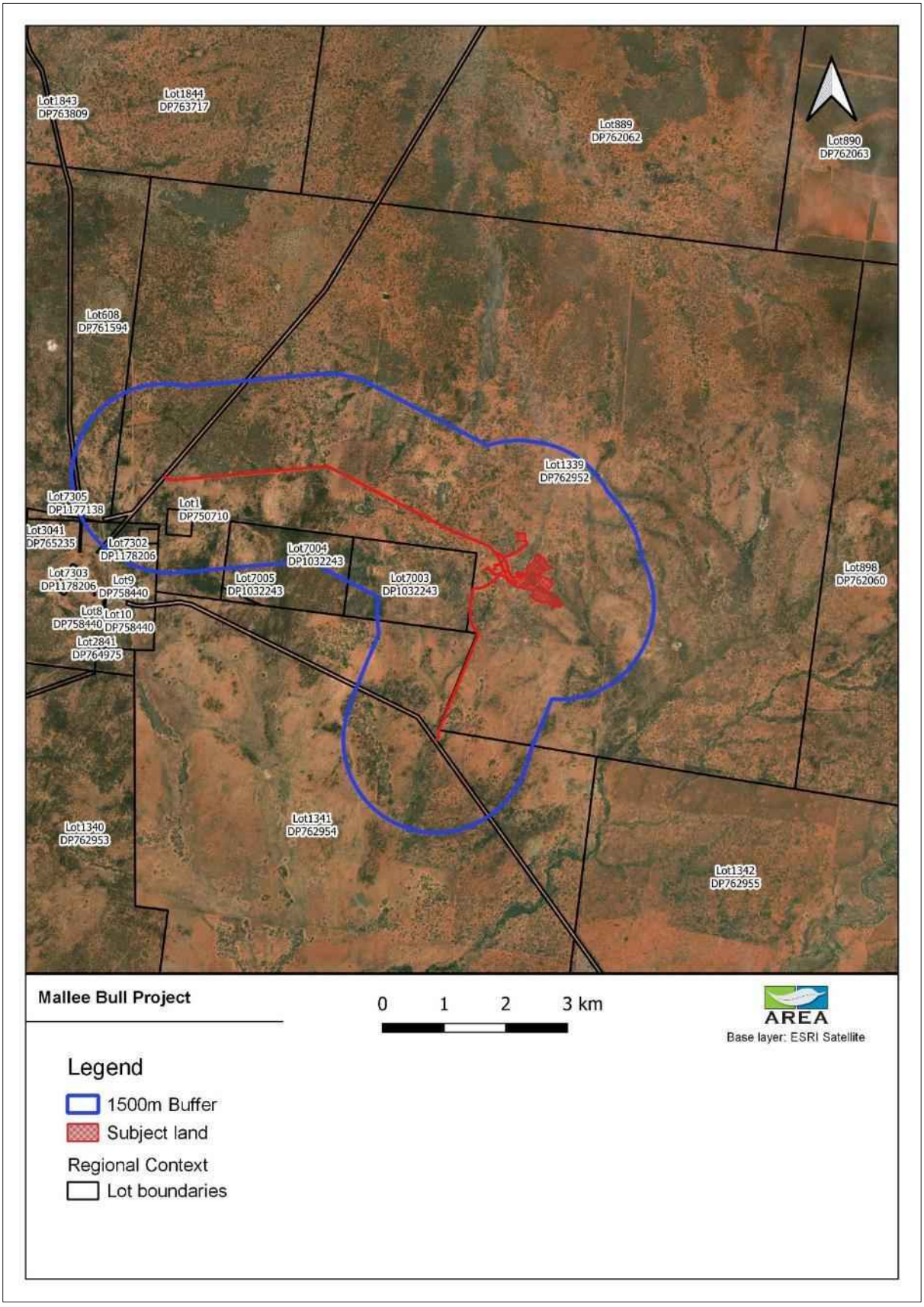


Figure 3 Site Components Map

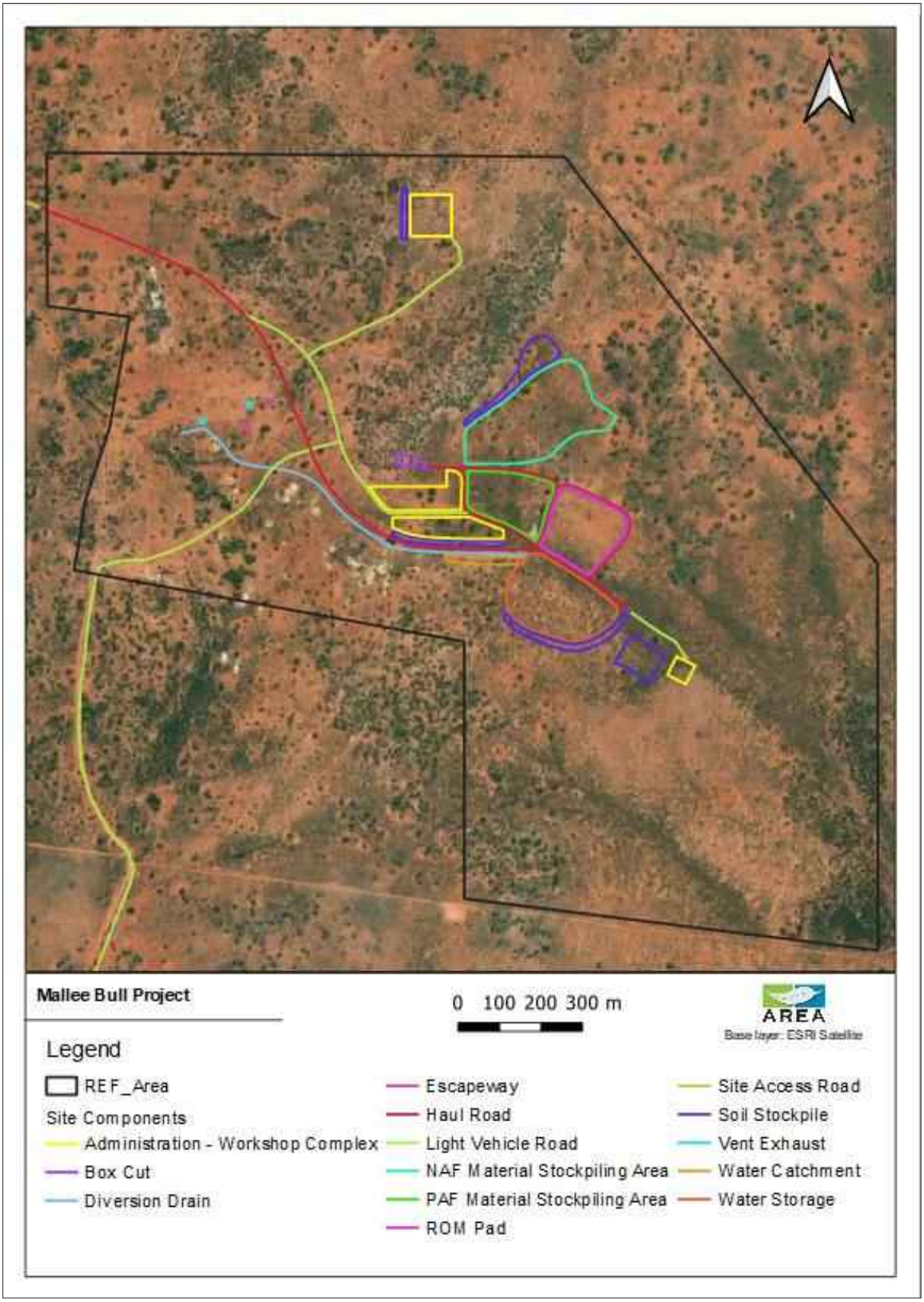


Figure 4 Proposed Site Layout (Source: RW Corkery)

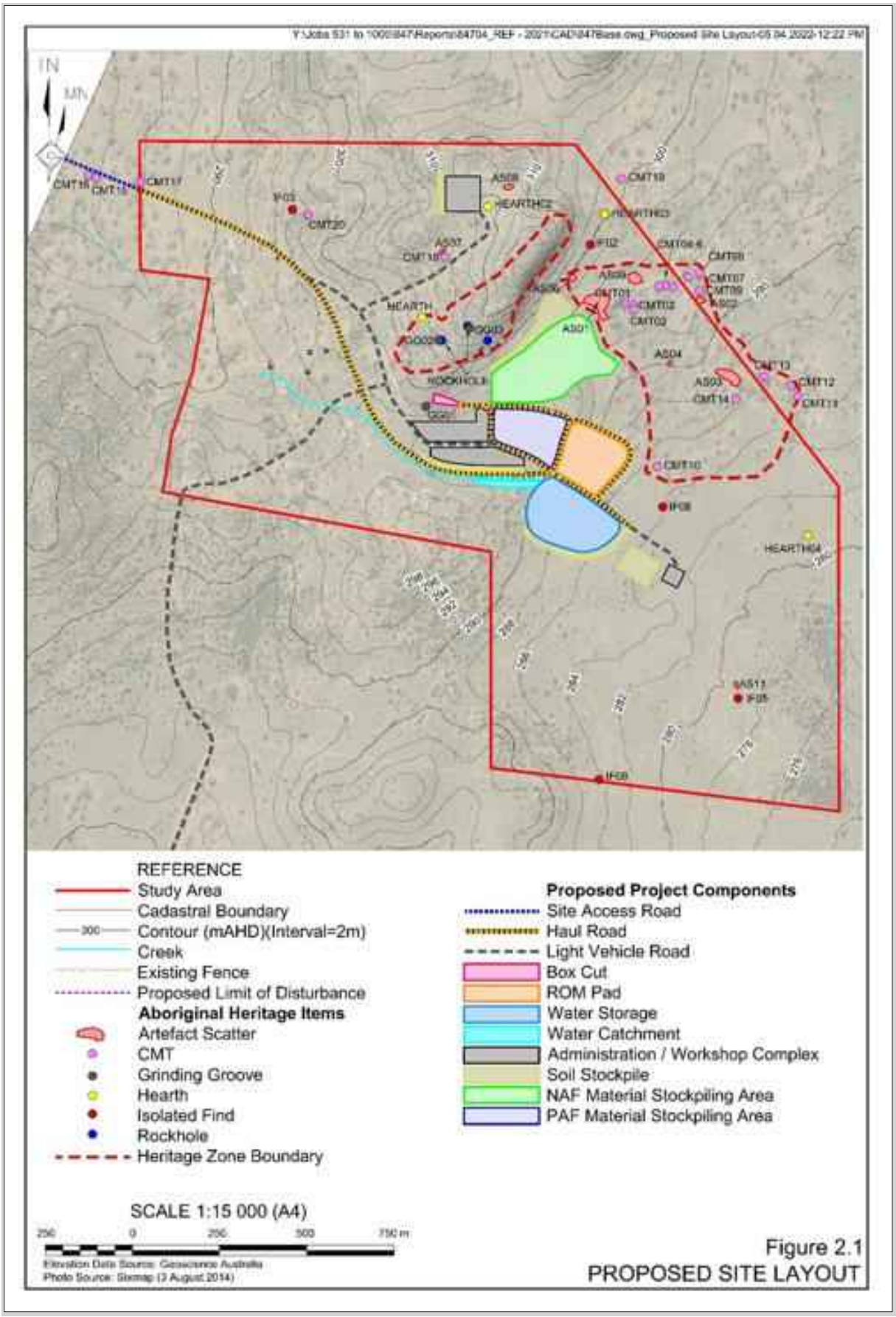


Figure 5 Development footprint and contours

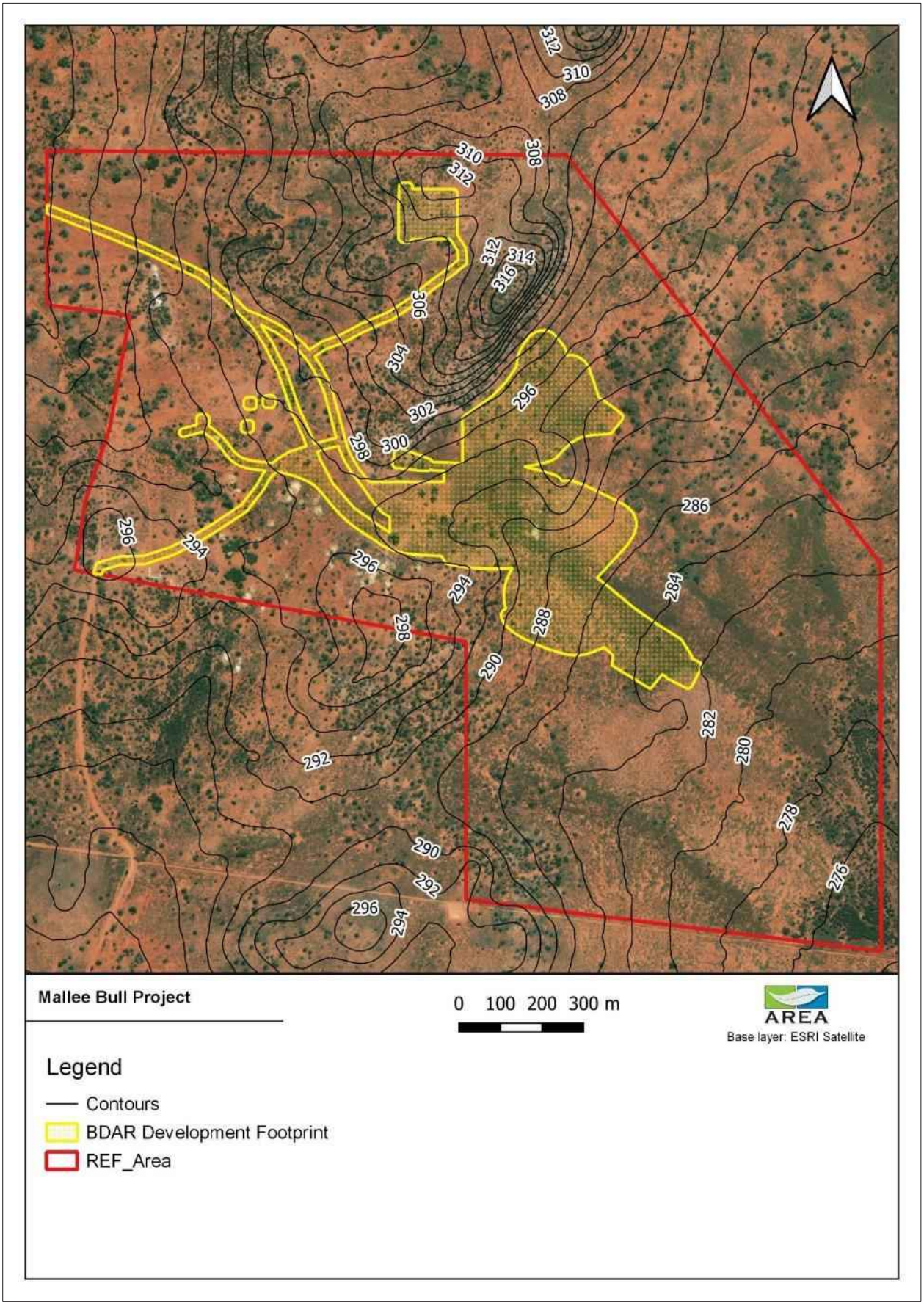


Figure 6 Waterways

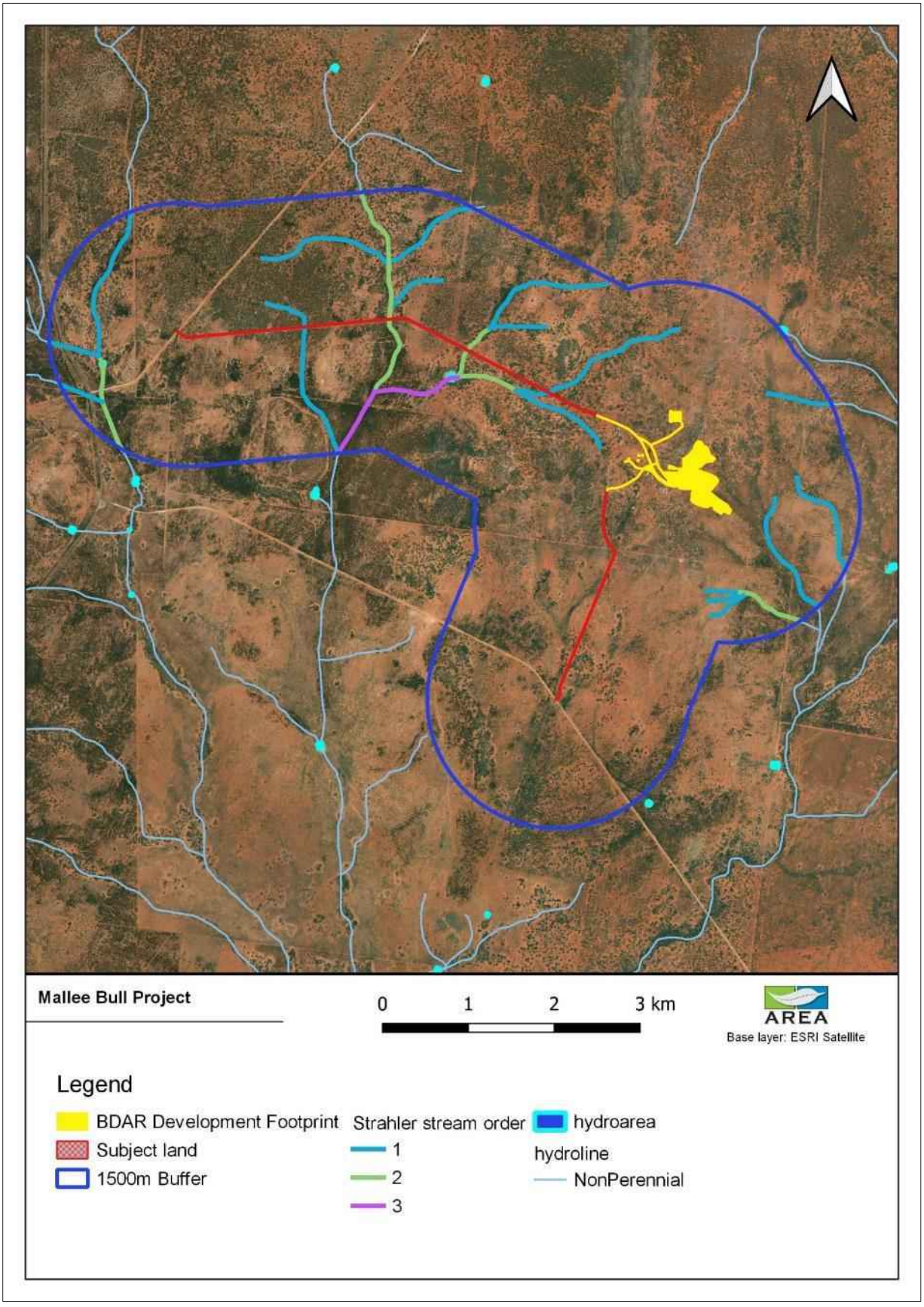


Figure 7 Excluded impacts

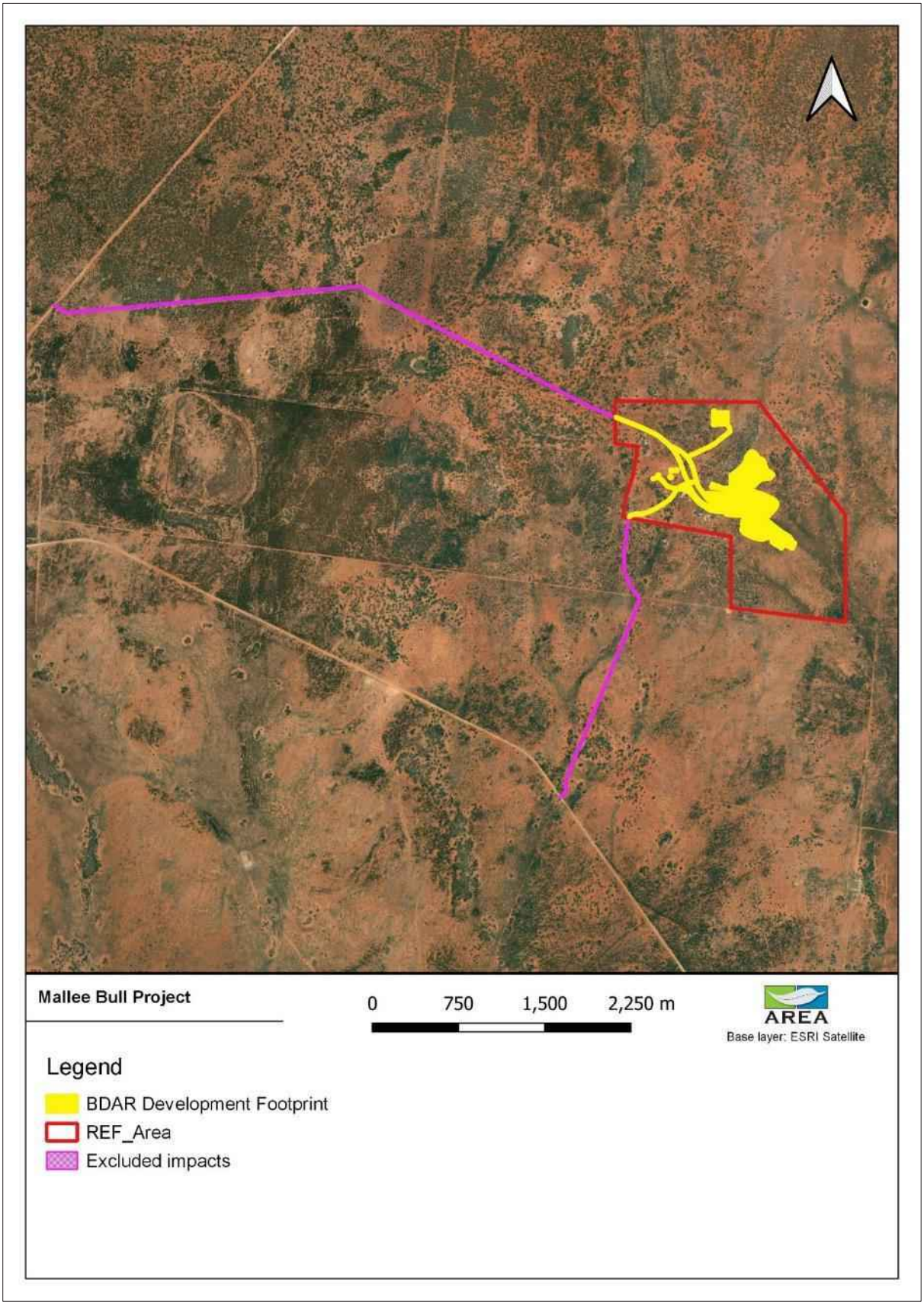


Figure 8 Field survey locations

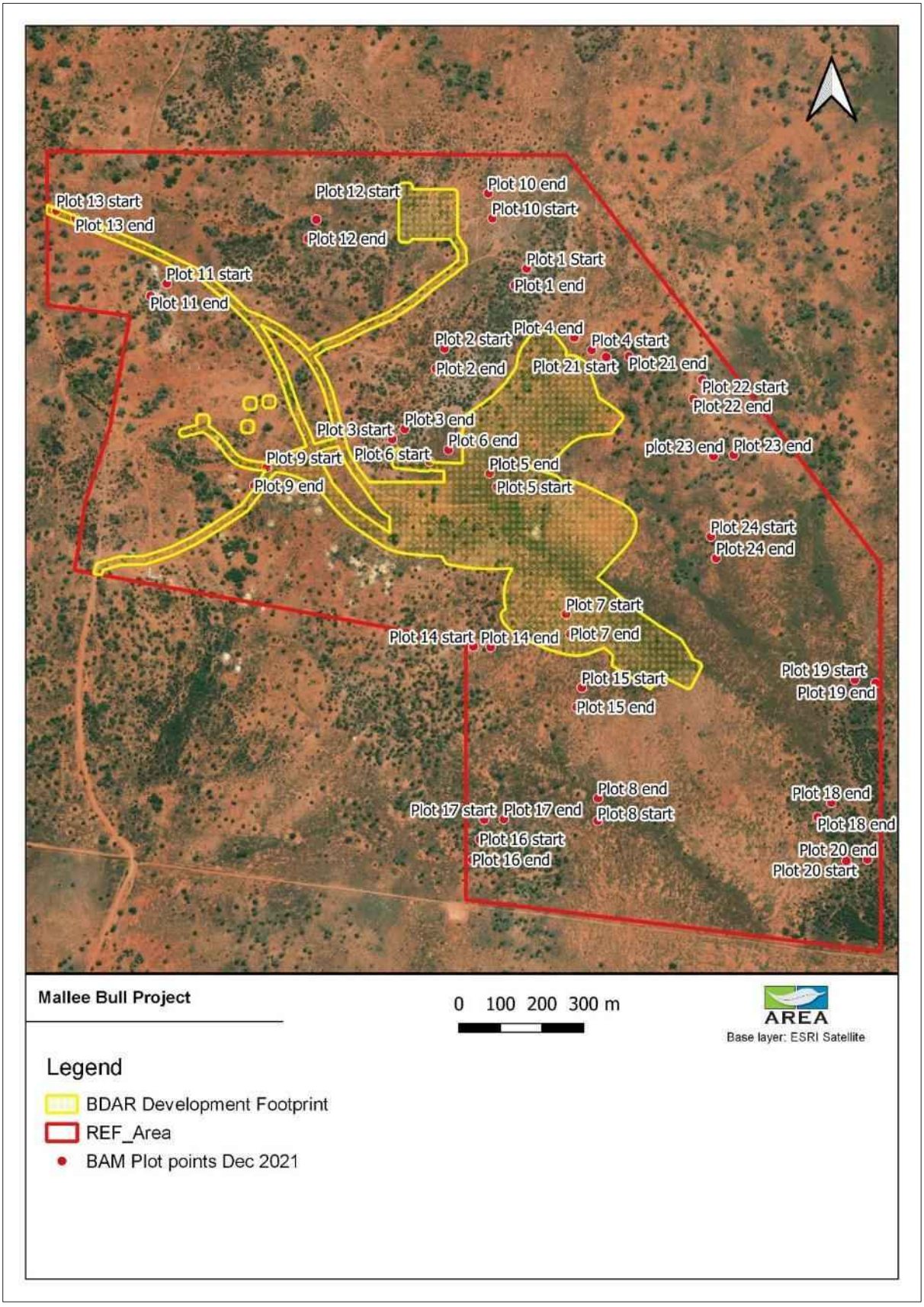


Figure 9 Vegetation Zones and BAM plots entered into the BAM-C

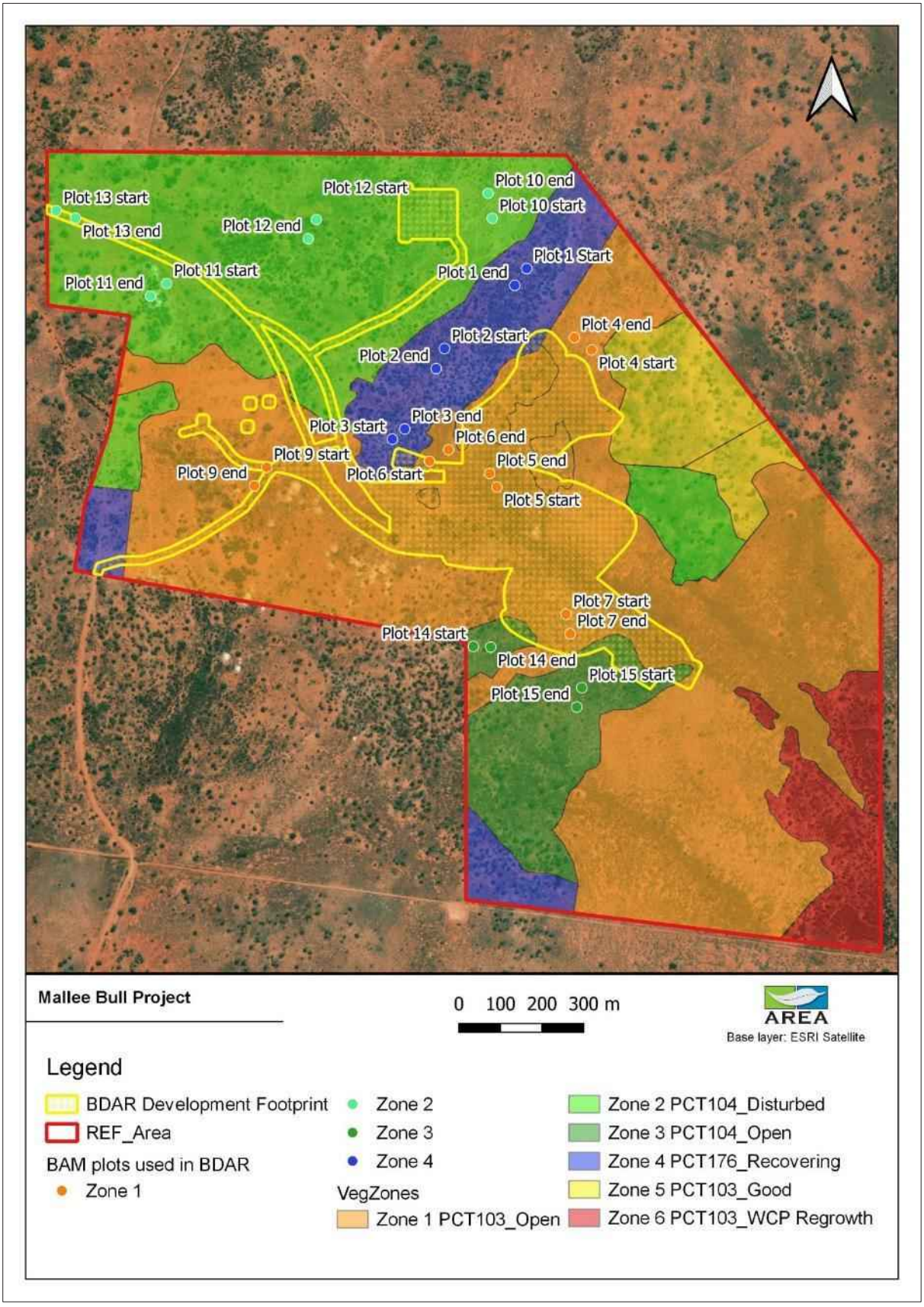


Figure 10 Survey tracks

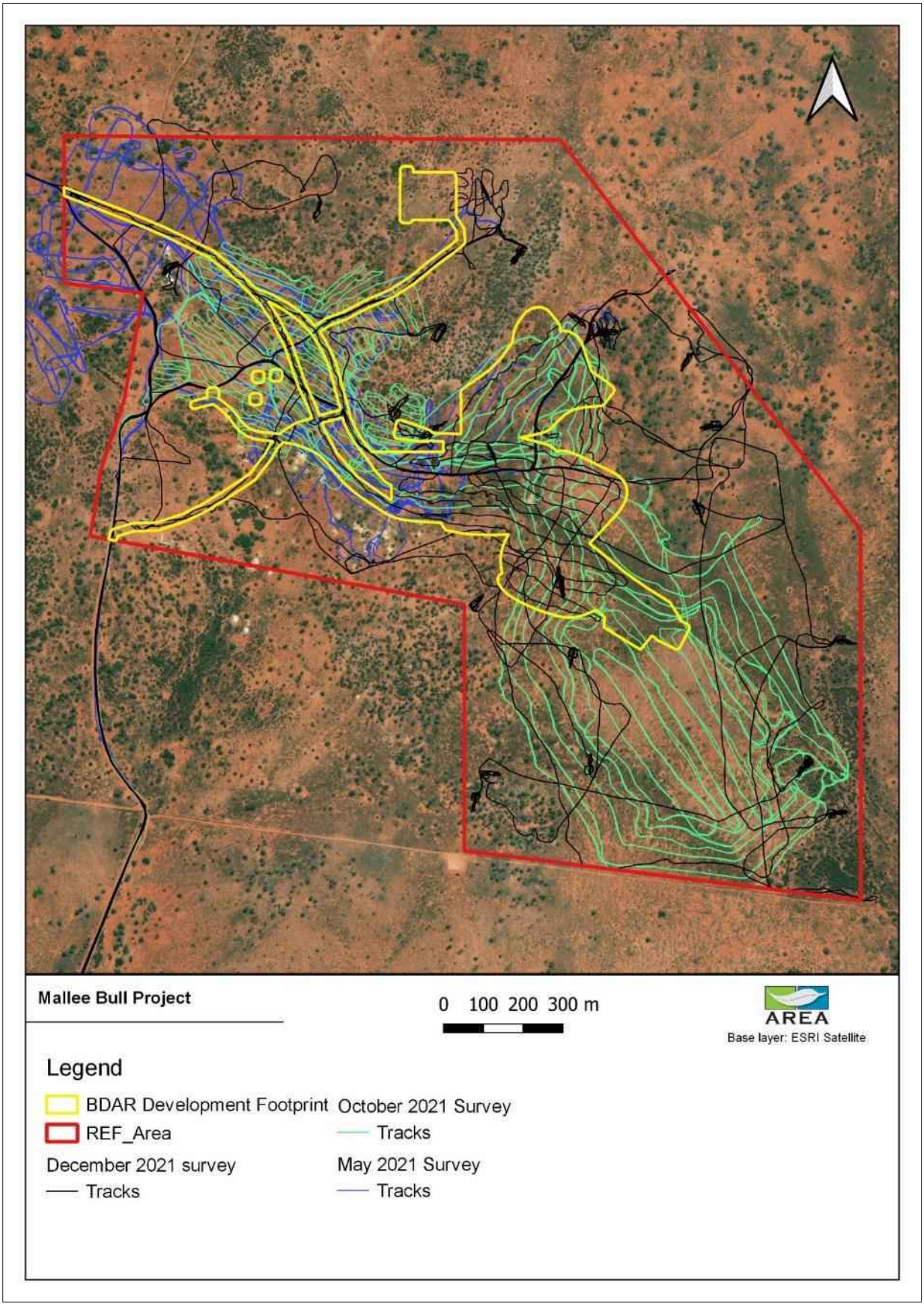


Figure 11 Fauna monitoring points

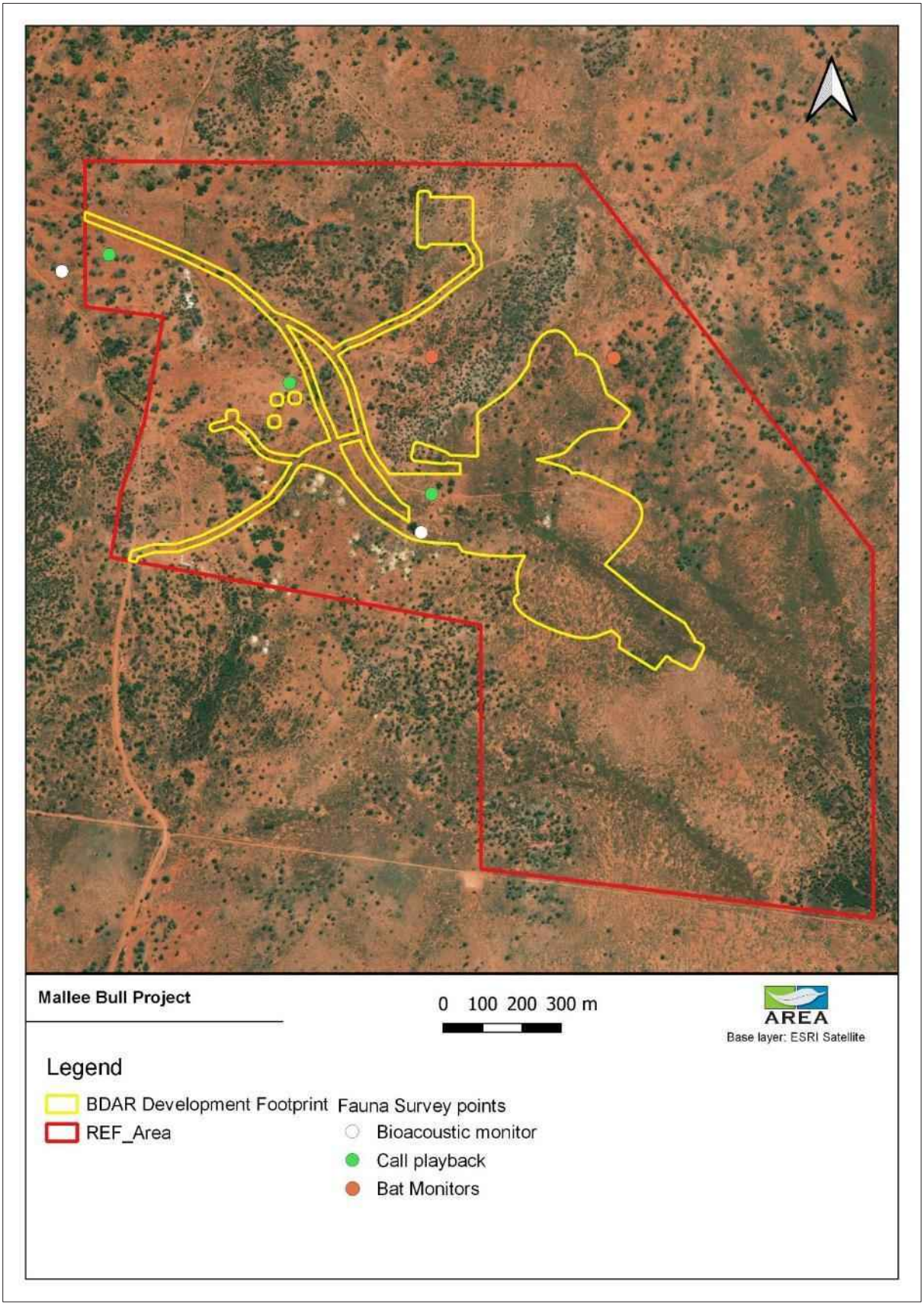


Figure 12 Landscape features

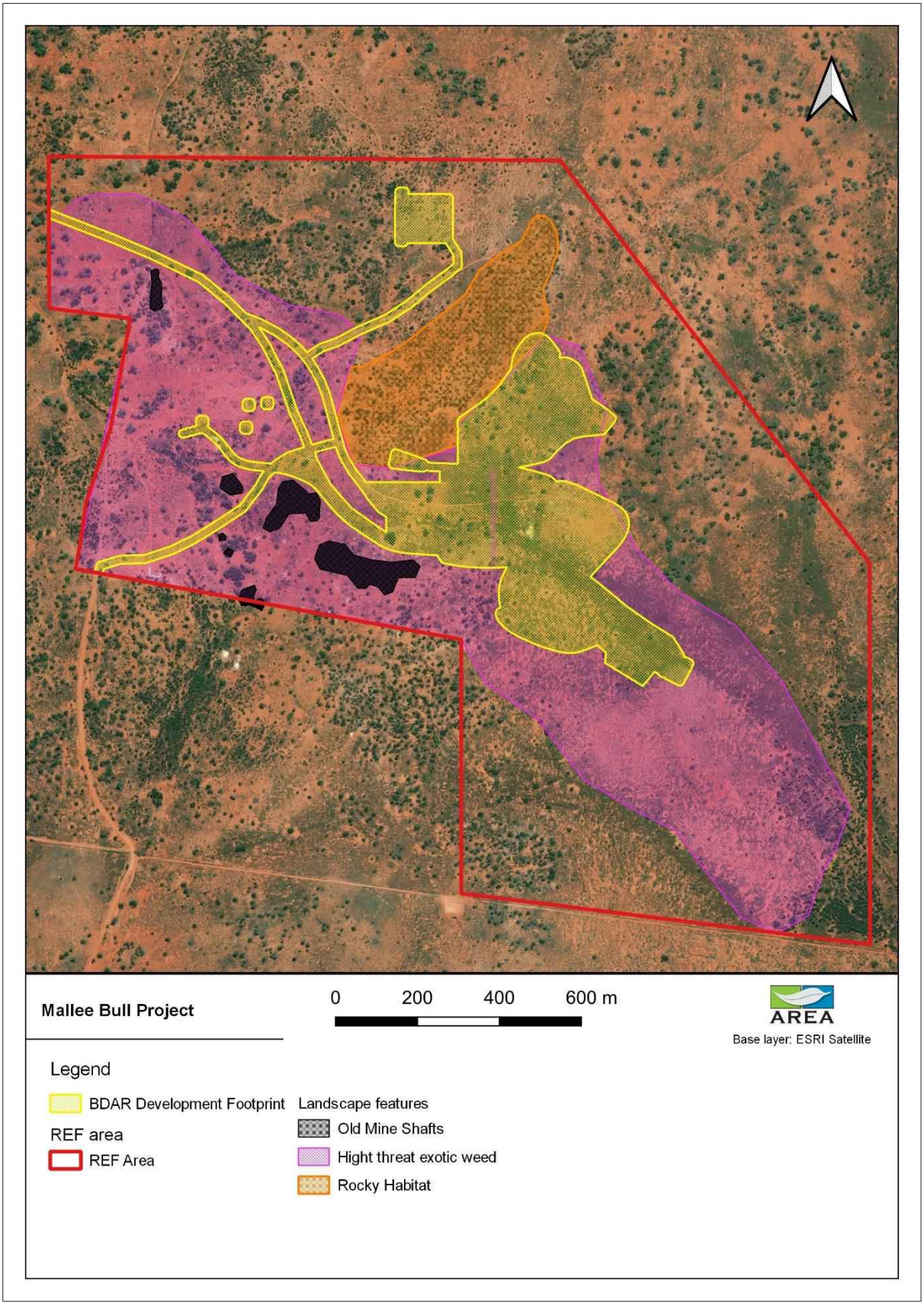


Figure 13 IBRA regions and subregions

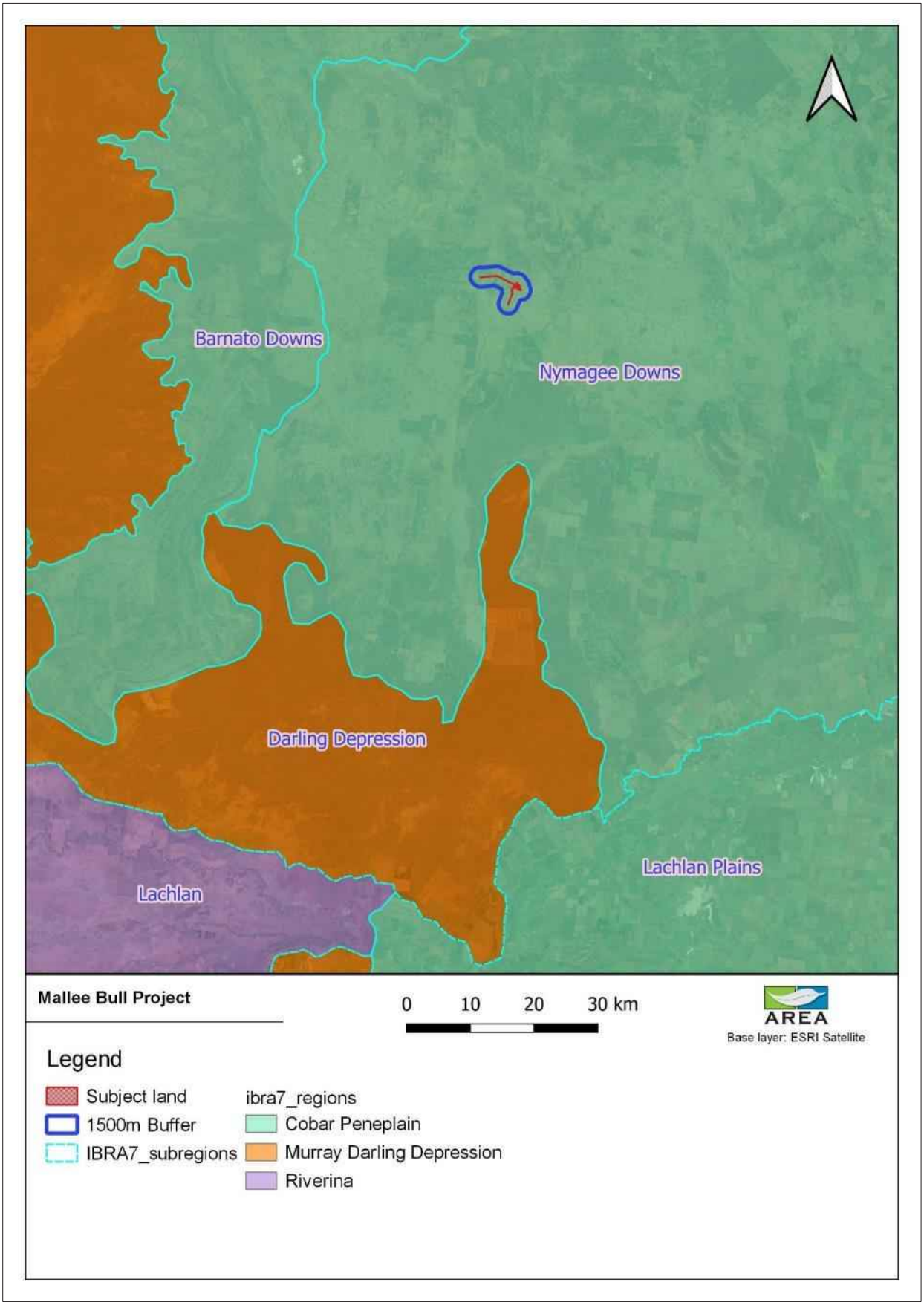


Figure 14 Habitat Connectivity

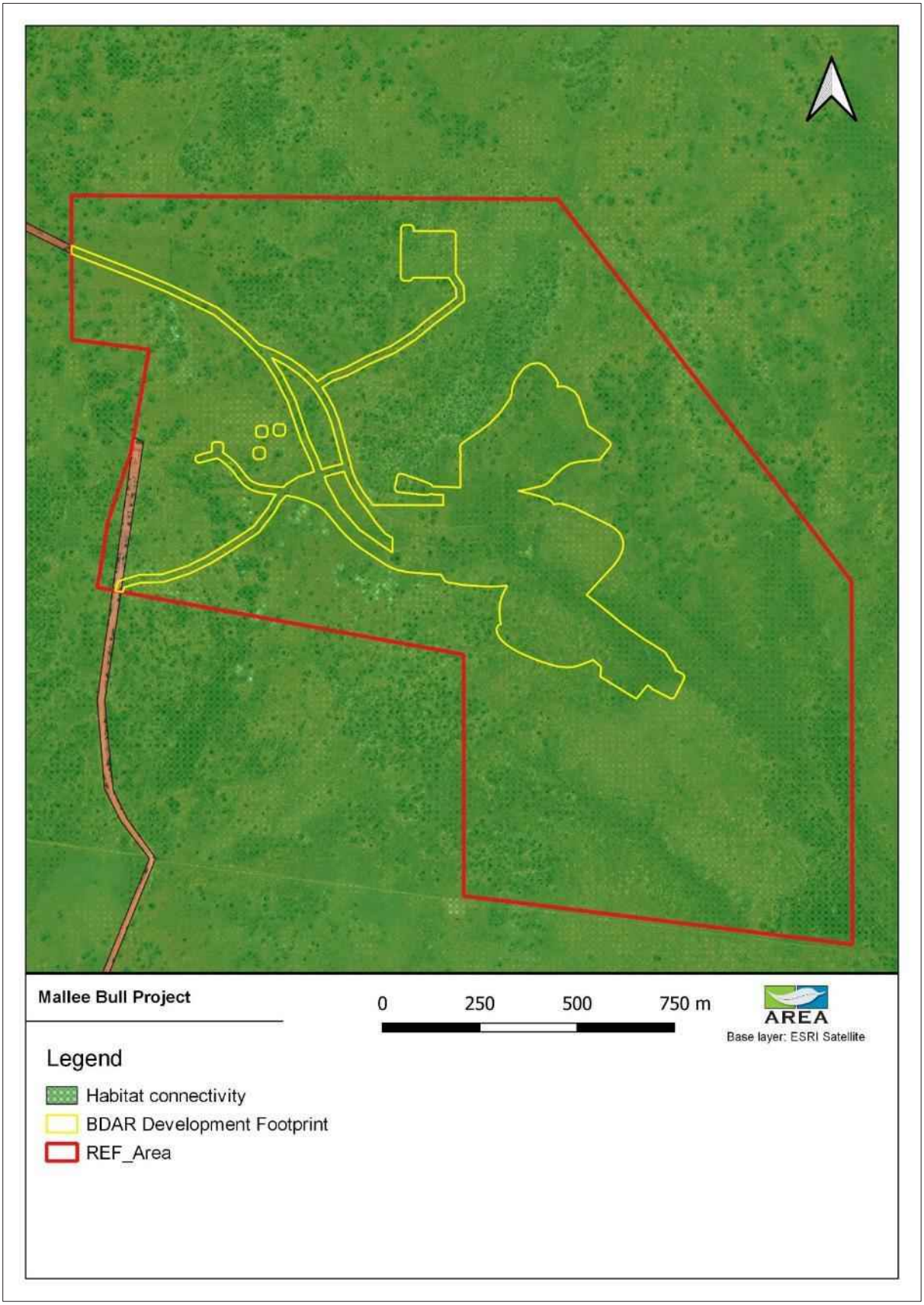


Figure 15 Biodiversity Values

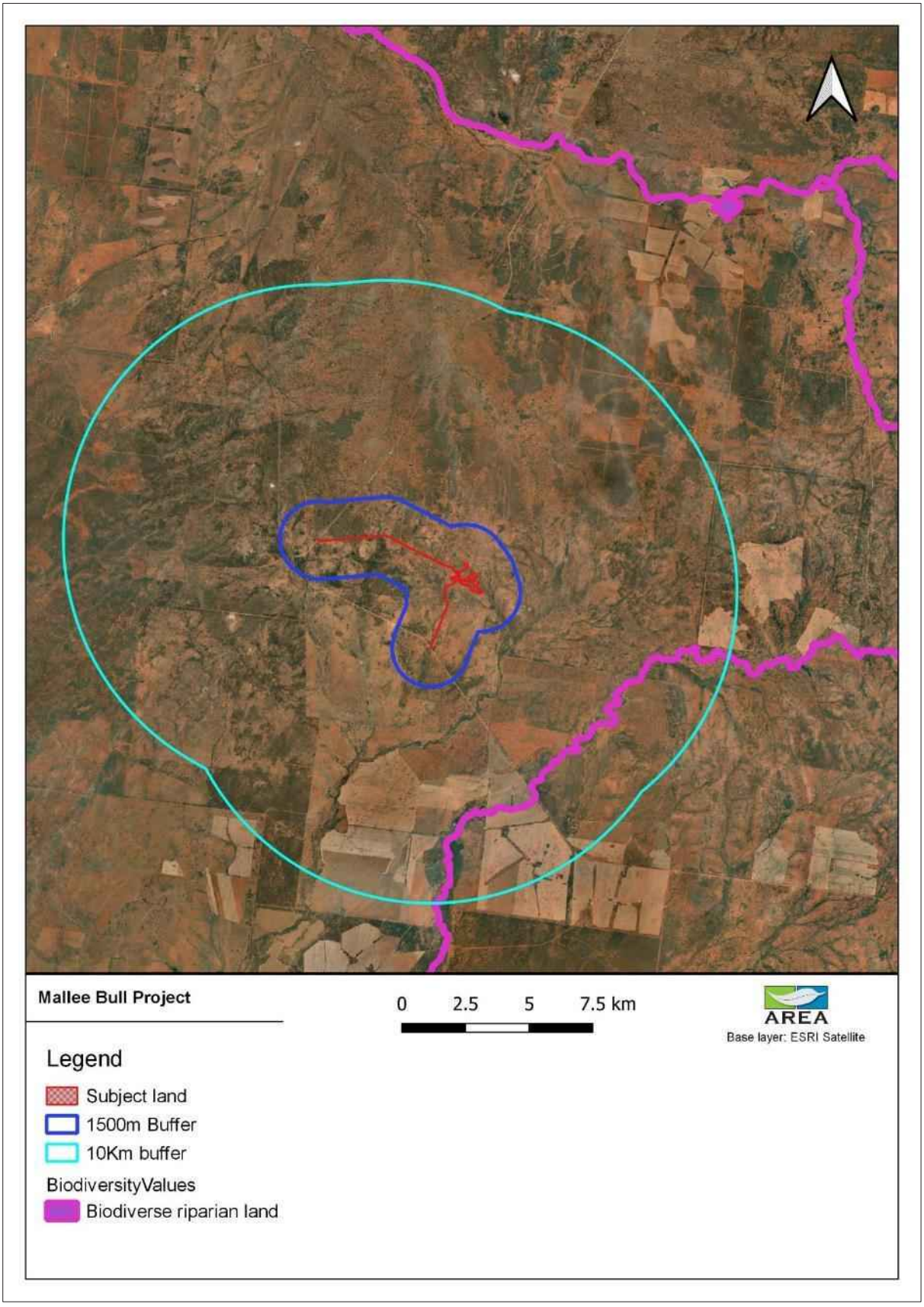


Figure 16 Mitchell landscapes

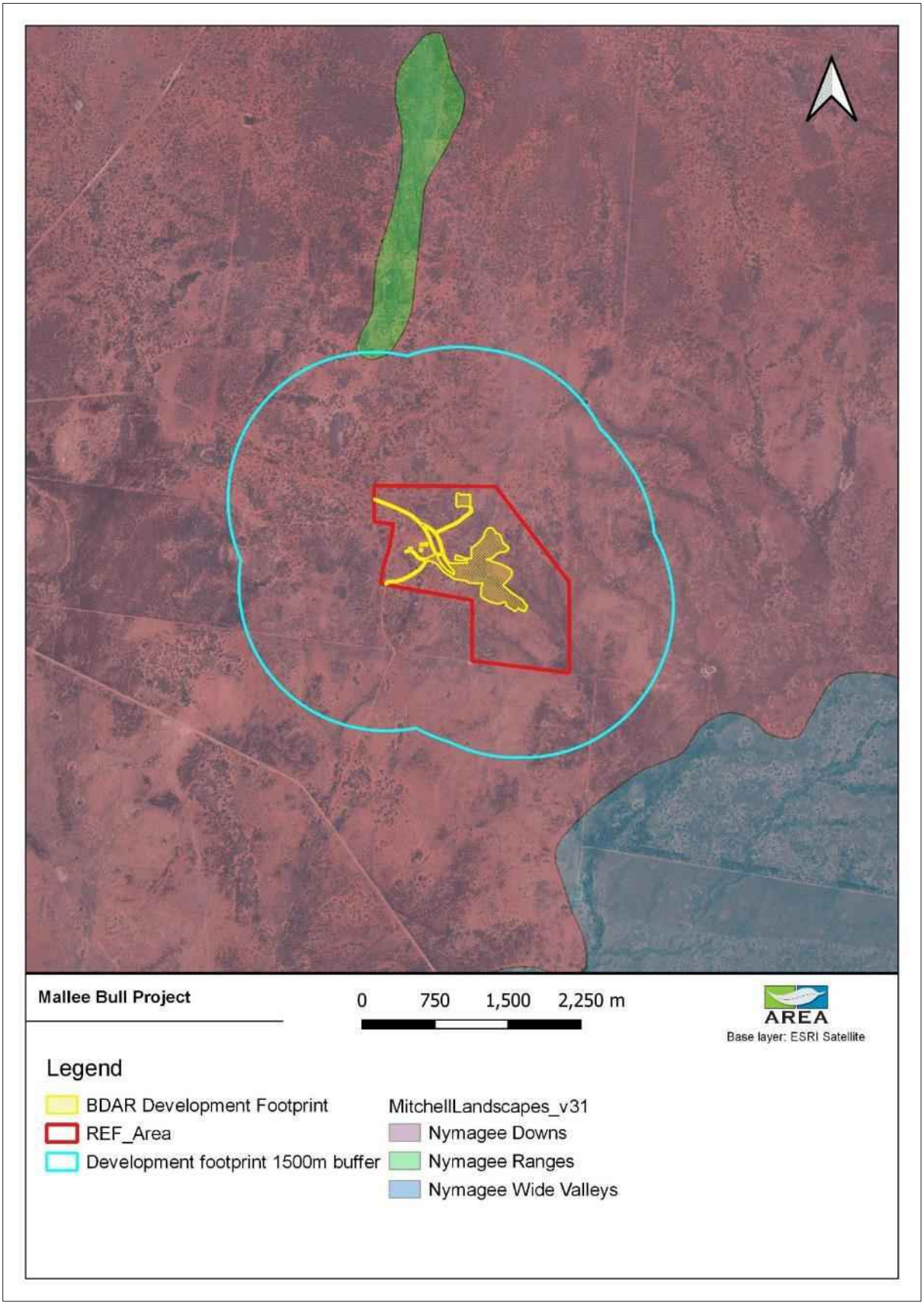


Figure 17 Native vegetation cover

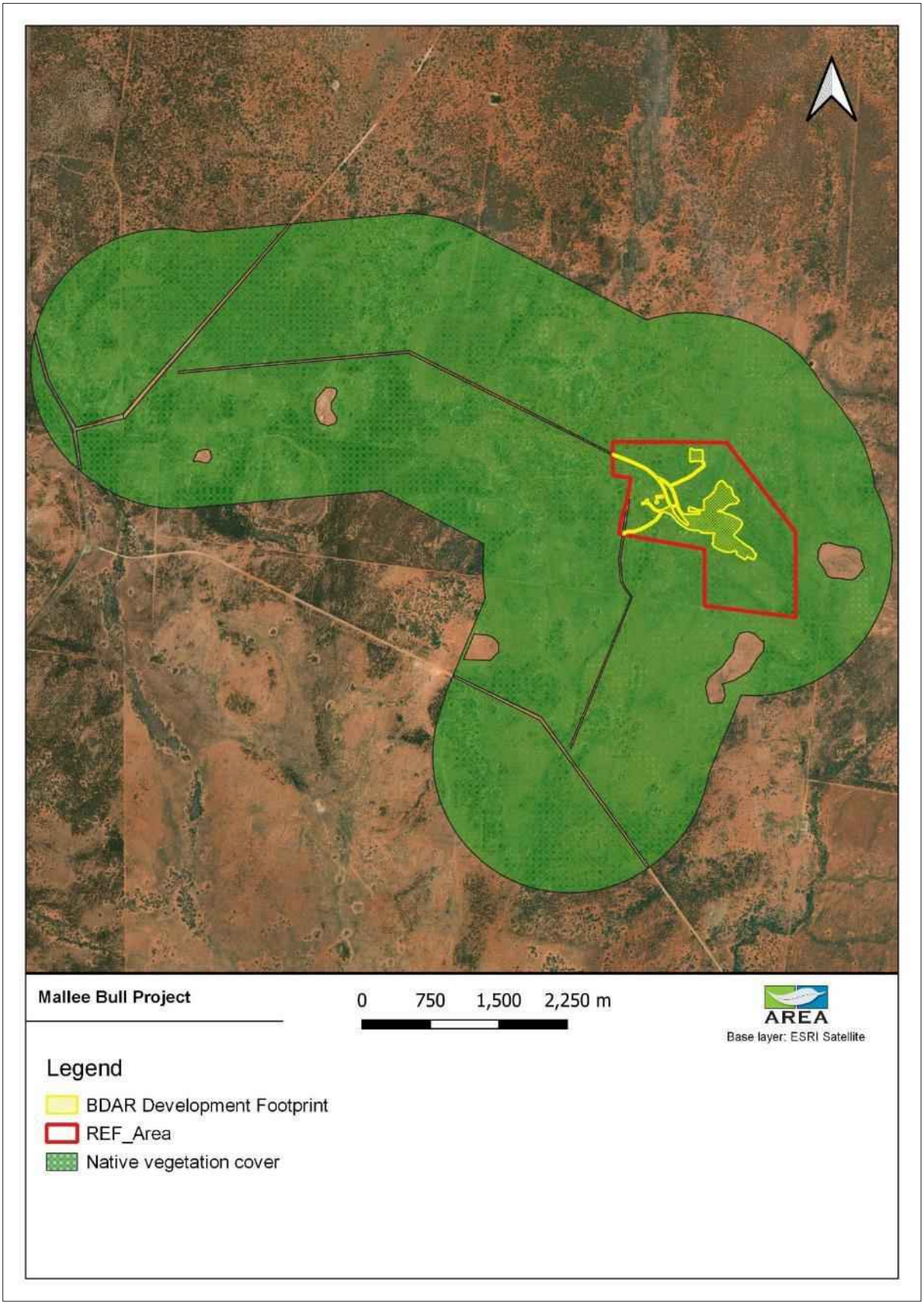


Figure 18 Plant Community Types

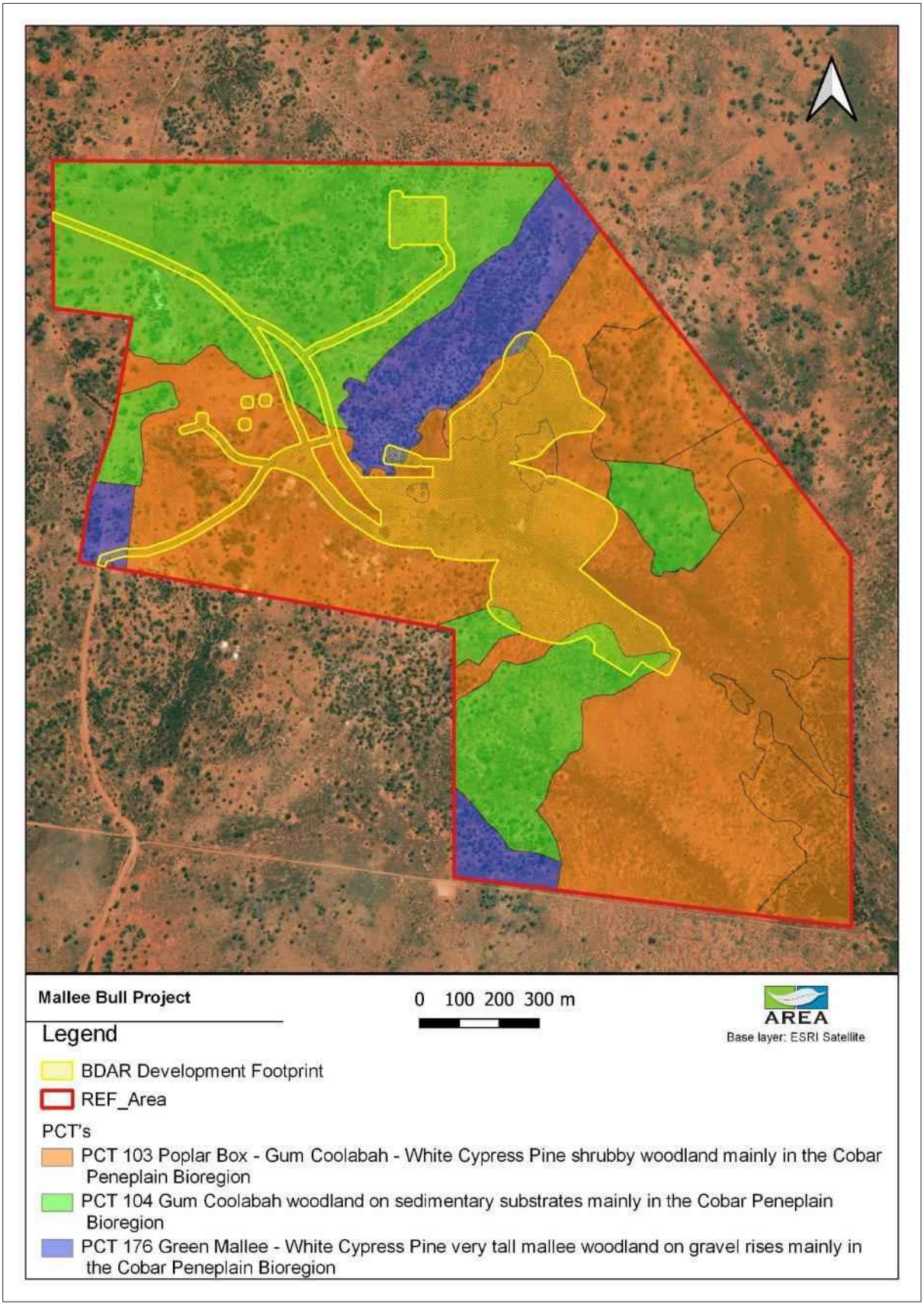
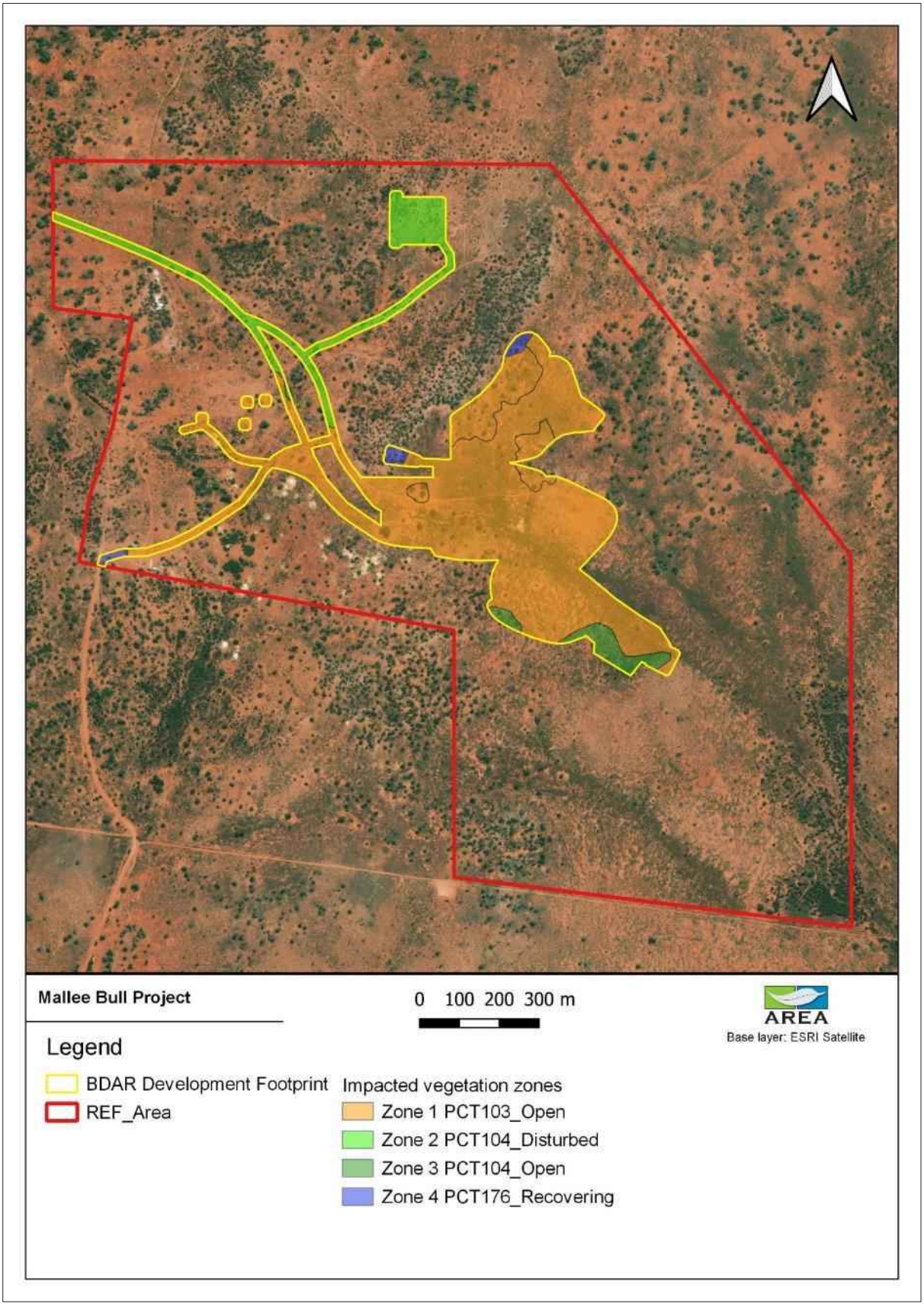


Figure 19 Vegetation Zones



Appendix A: BDAR requirements compliance

Table 25 to specifies where each component of the BDAR minimum information requirements has been addressed in accordance with BAM Appendix K.

Table 25 Assessment of compliance with BDAR minimum information requirements

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
Introduction	Chapters 2 and 3	**Information**	
		Introduction to the biodiversity assessment including:	–
		brief description of the proposal	1.1.1
		identification of subject land boundary, including: operational footprint construction footprint indicating clearing associated with temporary/ancillary construction facilities and infrastructure	1.1.3
		general description of the subject land	1.1.3
		sources of information used in the assessment, including reports and spatial data	1.5
		identification and justification for entering the BOS	1.2
		Maps and tables	
		Map of the subject land boundary showing the final proposal footprint, including the construction footprint for any clearing associated with temporary/ancillary construction facilities and infrastructure	Section 13, Figure 3 and Figure 5

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
Landscape	Sections 3.1 and 3.2, Appendix E	**Information**	
		Identification of site context components and landscape features, including:	–
		general description of subject land topographic and hydrological setting, geology and soils	1.1.3
		per cent native vegetation cover in the assessment area (as described in BAM Section 3.2)	3.3
		IBRA bioregions and subregions (as described in BAM Subsection 3.1.3(2.))	3.2.1
		rivers and streams classified according to stream order (as described in BAM Subsection 3.1.3(3.) and Appendix E)	3.2.2
		wetlands within, adjacent to and downstream of the site (as described in BAM Subsection 3.1.3(3.))	3.2.2
		connectivity of different areas of habitat (as described in BAM Subsection 3.1.3(5–6.))	3.2.3
		karst, caves, crevices, cliffs, rocks and other geological features of significance and for vegetation clearing proposals, soil hazard features (as described in BAM Subsections 3.1.3(7.) and 3.1.3(12.))	3.2.4
		areas of outstanding biodiversity value occurring on the subject land and assessment area (as described in BAM Subsection 3.1.3(8–9.))	3.2.5
		any additional landscape features identified in any SEARs for the proposal	3.2.7
		NSW (Mitchell) landscape on which the subject land occurs	3.2.6
		details of field reconnaissance undertaken to confirm the extent and condition of landscape features and native vegetation cover (as described in Operational Manual Stage 1 Section 2.4)	Section 2
		Maps and tables	
		Site Map Property boundary Boundary of subject land Cadastre of subject land (including labelling of Lot and DP or section plan if relevant) Landscape features identified in BAM Subsection 3.1.3	Section 13, Figure 3, Figure 5 and Figure 12 (Property boundary not available, cadastre boundary adequate)
		Location Map Digital aerial photography at 1:1,000 scale or finer Boundary of subject land	Section 13, Figure 5, Figure 2 and Figure 7 (1:1,000 scale too

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		Assessment area (i.e. the subject land and either 1500 m buffer area or 500 m buffer for linear development) Landscape features identified in BAM Subsection 3.1.3 Additional detail (e.g. local government area boundaries) relevant at this scale	fine to view location)
		Landscape features identified in BAM Subsection 3.1.3 and to be shown on the Site Map and/or Location Map include:	–
		IBRA bioregions and subregions rivers, streams and estuaries wetlands and important wetlands connectivity of different areas of habitat karst, caves, crevices, cliffs, rocks and other geological features of significance and if required, soil hazard features areas of outstanding biodiversity value occurring on the subject land and assessment area any additional landscape features identified in any SEARs for the proposal NSW (Mitchell) landscape on which the subject land occurs	Section 13: Figure 6, Figure 12, Figure 13, Figure 14, Figure 15 and Figure 16
		Data	
		All report maps as separate jpeg files	–
		Individual digital shape files of:	–
		subject land boundary	–
		assessment area (i.e. subject land and 1500 m buffer area) boundary	–
		cadastral boundary of subject land	–
		areas of native vegetation cover	–
		landscape features	–

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
Native vegetation	Chapter 4, Appendix A and Appendix H	**Information**	
		Identify native vegetation extent within the subject land, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery (as described in BAM Section 4.1(1–3.) and Subsection 4.1.1)	4.1 & Figure 17
		Provide justification for all parts of the subject land that do not contain native vegetation (as described in BAM Subsection 4.1.2)	4.1.2
		Review of existing information on native vegetation including references to previous vegetation maps of the subject land and assessment area (described in BAM Section 4.1(3.) and Subsection 4.1.1)	2.2.2
		Describe the systematic field-based floristic vegetation survey undertaken in accordance with BAM Section 4.2	2.2.3
		Where relevant, describe the use of more appropriate local data, provide reasons that support the use of more appropriate local data and include the written confirmation from the decision-maker that they support the use of more appropriate local data (as described in BAM Subsection 1.4.2 and Appendix A)	N/A
		For each PCT within the subject land, describe:	–
		PCT name and ID	4.2.1 & Figure 18
		vegetation class	4.2.2, 4.2.3, 4.2.4
		extent (ha) within subject land	4.2.2, 4.2.3, 4.2.4
		evidence used to identify a PCT including any analyses undertaken, references/sources, existing vegetation maps (BAM Section 4.2(1–3.))	4.2.2, 4.2.3, 4.2.4
		plant species relied upon for identification of the PCT and relative abundance of each species	4.2.2, 4.2.3, 4.2.4 and Appendix F
		if relevant, TEC status including evidence used to determine vegetation is the TEC (BAM Subsection 4.2.2(1–2.))	N/A
		estimate of per cent cleared value of PCT (BAM Subsection 4.2.1(5.))	4.2.2, 4.2.3, 4.2.4
		Describe the vegetation integrity assessment of the subject land, including:	–
		identification and mapping of vegetation zones (as described in BAM Subsection 4.3.1)	4.4 & Figure 9
		description of vegetation zones within the subject land (as described in Operational Manual Stage 1 Table 2 and Subsection 3.3.2)	4.4 & Figure 10
		area (ha) of each vegetation zone	4.4
		assessment of patch size (as described in BAM Subsection 4.3.2)	4.4

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		survey effort (i.e. number of vegetation integrity survey plots) as described in BAM Subsection 4.3.4(1–2.)	4.4
		use of relevant benchmark data from BioNet Vegetation Classification (as described in BAM Subsection 4.3.3(5.))	4.5.3
		Where use of more appropriate local benchmark data is proposed (as described in BAM Subsection 1.4.2, BAM Subsection 4.3.3(5.) and BAM Appendix A):	–
		identify the PCT or vegetation class for which local benchmark data will be applied identify published sources of local benchmark data (if benchmarks obtained from published sources) describe methods of local benchmark data collection (if reference plots used to determine local benchmark data)	N/A
		provide justification for use of local data rather than BioNet Vegetation Classification benchmark values	N/A
		provide written confirmation from the decision-maker that they support the use of local benchmark data	N/A
		Maps and tables	
		Map of native vegetation extent within the subject land at scale not greater than 1:10,000 including identification of cleared areas (as described in BAM Section 4.1(1–3.)) and all parts of the subject land that do not contain native vegetation (BAM Subsection 4.1.2)	Figure 17
		Map of PCTs within the subject land (as described in BAM Section 4.2(1.))	Figure 18
		Map of vegetation zones within the subject land (as described in BAM Subsection 4.3.1)	Figure 9
		Map the location of floristic vegetation survey plots and vegetation integrity survey plots relative to PCT boundaries	Figure 8 and Figure 9
		Map of TEC distribution on the subject land and table of TEC listing, status and area (ha)	N/A
		Map of patch size locations for each native vegetation zone and table of patch size areas (as described in BAM Subsection 4.3.2)	Figure 9 and Table 7
		Table of current vegetation integrity scores for each vegetation zone within the site and including:	–
		composition condition score structure condition score function condition score presence of hollow bearing trees	Table 8
		Data	
		All report maps as separate jpeg files	–

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		Plot field data (MS Excel format)	
		Plot field datasheets	Appendix F
		Digital shape files of:	–
		PCT boundaries within subject land	–
		TEC boundaries within subject land	–
		vegetation zone boundaries within subject land	–
		floristic vegetation survey and vegetation integrity plot locations	–
Threatened species	Chapter 5	**Information**	
		Identify ecosystem credit species likely to occur on the subject land, including:	–
		list of ecosystem credit species derived from the BAM-C (as described in BAM Subsection 5.1.1 and Section 5.2(1.))	5.1.1
		justification and supporting evidence for exclusion of any ecosystem credit species based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	5.1.1
		justification for addition of any ecosystem credit species to the list	2.4.4 and 5.1.1
		Identify species credit species likely to occur on the subject land, including:	–
		list of species credit species derived from the BAM-C (as described in BAM Subsection 5.1.1)	Table 10 & Table 11
		justification and supporting evidence for exclusions based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	5.1.2
		justification and supporting evidence for exclusions based on degraded habitat constraints and/or microhabitats on which the species depends (as described in BAM Subsection 5.2.2)	5.1.2
		justification for addition of any species credit species to the list	5.1.2
		From the list of candidate species credit species, identify:	–
		species assumed present within the subject land (if relevant) (as described in BAM Subsection 5.2.4(2.a.)) species present within the subject land on the basis of being identified on an important habitat map for a species (as described in BAM Subsection 5.2.4(2.d.)) species for which targeted surveys are to be completed to determine species presence (BAM Subsection 5.2.4(2.b.)) species for which an expert report is to be used to determine species presence (BAM Subsection 5.2.4(2.c.))	Table 12 & Table 13

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		Present the outcomes of species credit species assessments from:	–
		threatened species survey (as described in BAM Section 5.2.4)	Table 14 & Table 15
		expert reports (if relevant) including justification for presence of the species and information used to make this determination (as described in BAM Subsection 5.2.4, Section 5.3, Box 3)	N/A
		Where survey has been undertaken include detailed information on:	–
		survey method and effort (as described in BAM Section 5.3)	Table 14 & Table 15
		justification of survey method and effort (e.g. citation of peer-reviewed literature) if approach differs from the department's taxa-specific survey guides or where no relevant guideline has been published	N/A
		timing of survey in relation to requirements in the TBDC or the department's taxa-specific survey guides. Where survey was undertaken outside these guides include justification for the timing of surveys	Table 14 & Table 15 & 5.3
		survey personnel and relevant experience	Declarations ii
		describe any limitations to surveys and how these were addressed/overcome	2.6
		Where an expert report has been used in place of survey (as described in BAM Section 5.3, Box 3), include:	–
		justification of the use of an expert report identify the expert, provide evidence of their expert credentials and departmental approval of expert status all requirements of Box 3 have been addressed in the expert report	N/A
		Where use of local data is proposed (BAM Subsection 1.4.2):	–
		identify relevant species identify data to be amended identify source of information for local data, e.g. published literature, additional survey data, etc. justify use of local data in preference to VIS Classification or TBDC data	N/A
		provide written confirmation from the decision-maker that they support the use of local data	N/A
		Species polygon completed for species credit species present within the subject land (assumed present or determined on the basis of survey, expert report or important habitat map) ensuring that:	–
		the unit of measure for each species is documented	N/A
		for species assessed by area:	–

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		the polygon includes the extent of suitable habitat for the target species within the subject land (as described in BAM Subsection 5.2.5)	N/A
		a description of, and evidence-based justification for, the habitat constraints, features or microhabitats used to map the species polygon including reference to information in the TBDC for that species and any buffers applied	N/A
		for species assessed by counts of individuals:	–
		the number of individual plants present on the subject land (as described in BAM Subsection 5.2.5(3.))	N/A
		the method used to derive this number (i.e. threatened species survey or expert report) and evidence-based justification for the approach taken	N/A
		the polygon includes all individuals located on the subject land with a buffer of 30 m around the individuals or groups of individuals on the subject land	N/A
		Identify the biodiversity risk weighting for each species credit species identified as present within the subject land (as described in BAM Section 5.4)	N/A
		Maps and tables	
		Table showing ecosystem credit species in accordance with BAM Subsection 5.1.1, and identifying:	
		the ecosystem credit species removed from the list	Table 9
		the sensitivity to gain class of each species	Table 9
		Table detailing species credit species in accordance with BAM Section 5.2 and identifying:	Table 10 & Table 11
		the species credit species removed from the list of species because the species is considered vagrant, out of geographic range or the habitat or microhabitat features are not present	Table 10 & Table 11
		the candidate species credit species not recorded on the subject land as determined by targeted survey, expert report or important habitat map	Table 12 & Table 13
		Table detailing species credit species recorded or assumed as present within the subject land, habitat constraints or microhabitats associated with the species, counts of individuals (flora)/extent of suitable habitat (flora and fauna) (as described in BAM Subsection 5.2.6) and biodiversity risk weighting (BAM Section 5.4)	N/A
		Map indicating the GPS coordinates of all individuals of each species recorded within the subject land and the species polygon for each species (as described in BAM Subsection 5.2.5)	N/A
		Data	
		Digital shape files of suitable habitat identified for survey for each candidate species credit species	N/A
		Survey locations including GPS coordinates of any plots, transects, grids	N/A

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		Digital shape files of each species polygon including GPS coordinates of located individuals	N/A
		Species polygon map in jpeg format	N/A
		Expert reports and any supporting data used to support conclusions of the expert report	N/A
		Field datasheets detailing survey information including prevailing conditions, date, time, equipment used, etc.	N/A

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
Prescribed impacts	Chapter 6	**Information**	
		Identify potential prescribed biodiversity impacts on threatened entities, including:	–
		karst, caves, crevices, cliffs, rocks and other geological features of significance (as described in BAM Subsection 6.1.1) occurrences of human-made structures and non-native vegetation (as described in BAM Subsection 6.1.2) corridors or other areas of connectivity linking habitat for threatened entities (as described in BAM Subsection 6.1.3) waterbodies or any hydrological processes that sustain threatened entities (as described in BAM Subsection 6.1.4)	Table 16
		protected animals that may use the proposed wind farm development site as a flyway or migration route (as described in BAM Subsection 6.1.5)	N/A
		where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community (as described in BAM Subsection 6.1.6)	Table 16
		Identify a list of threatened entities that may be dependent upon or may use habitat features associated with any of the prescribed impacts	Table 16
		Describe the importance of habitat features to the species including, where relevant, impacts on life cycle or movement patterns (e.g. Subsection 6.1.3)	Table 16
		Where the proposed development is for a wind farm:	–
		identify a candidate list of protected animals that may use the development site as a flyway or migration route, including: resident threatened aerial species, resident raptor species and nomadic and migratory species that are likely to fly over the proposal area (as described in BAM Subsection 6.1.5)	N/A
		provide details of targeted survey for candidate species of wind farm developments undertaken in accordance with BAM Subsection 6.1.5(2–3.)	N/A
		predict the habitual flight paths for nomadic and migratory species likely to fly over the subject land and map the likely habitat for resident threatened aerial and raptor species (BAM Subsection 6.1.5(4.))	N/A

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		Where the proposal may result in vehicle strike:	–
		identify a list of threatened fauna or protected fauna species that are part of a TEC and at risk of vehicle strike due to the proposal	Table 16
		Maps and tables	
		Map showing location of any prescribed impact features (i.e. karst, caves, crevices, cliffs, rocks, human-made structures, etc.)	Figure 12
		Map showing location of potential vehicle strike locations	N/A
		Maps of habitual flight paths for nomadic and migratory species likely to fly over the site and maps of likely habitat for threatened aerial species resident on the site (for wind farm developments only)	N/A
		Data	
		Digital shape files of prescribed impact feature locations	–
		Prescribed impact features map in jpeg format	–
Avoid and minimise impacts	Chapter 7	**Information**	
		Demonstration of efforts to avoid and minimise impacts on biodiversity values (including prescribed impacts) associated with the proposal location in accordance with Chapter 7, including an analysis of alternative:	–
		modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology	7.1.2 & 7.2.2
		routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route	7.1.1 & 7.2.1
		alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location	7.1.1 & 7.2.1
		alternative sites within a property on which the proposal is located that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site	N/A
		Describe efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through proposal design (as described in BAM Sections 7.1 and 7.2)	7.1.2 & 7.2.2
		Identification of any other site constraints that the proponent has considered in determining the location and design of the proposal (as described in BAM Subsection 7.2.1(3.))	7
		Detail measures or options considered but not implemented because they are not feasible and/or practical (e.g. due to site constraints)	N/A
		Maps and tables	

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		Table of measures to be implemented to avoid and minimise the impacts of the proposal, including action, outcome, timing and responsibility	Table 17
		Map of alternative footprints considered to avoid or minimise impacts on biodiversity values; and of the final proposal footprint, including construction and operation	N/A
		Maps demonstrating indirect impact zones where applicable	N/A
		Data	
		Digital shape files of:	–
		alternative and final proposal footprint	N/A
		direct and indirect impact zones	N/A
		Maps in jpeg format	–
Assessment of impacts	Chapter 8, Sections 8.1 and 8.2	**Information**	
		Determine the impacts on native vegetation and threatened species habitat, including a description of direct impacts of clearing of native vegetation, threatened ecological communities and threatened species habitat (as described in BAM Section 8.1)	Table 18
		Assessment of indirect impacts on vegetation and threatened species and their habitat including (as described in BAM Section 8.2):	–
		description of the nature, extent, frequency, duration and timing of indirect impacts of the proposal	Table 20
		documenting the consequences to vegetation and threatened species and their habitat including evidence-based justifications	8.2
		reporting any limitations or assumptions, etc. made during the assessment	N/A
		identification of the threatened entities and their habitat likely to be affected	Table 20
		Assessment of prescribed biodiversity impacts (as described in BAM Section 8.3) including:	–
		assessment of the nature, extent frequency, duration and timing of impacts on the habitat of threatened species or ecological communities associated with:	–
		karst, caves, crevices, cliffs, rocks and other features of geological significance	8.3.1
		human-made structures	N/A
		non-native vegetation	N/A
		connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	N/A
		movement of threatened species that maintains their life cycle	N/A

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities	N/A
		assessment of the impacts of wind turbine strikes on protected animals	N/A
		assessment of the impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	N/A
		evaluate the consequences of prescribed impacts	6
		describe impacts that are uncertain	N/A
		document limitations to data, assumptions and predictions	N/A
		Maps and tables	
		Table showing change in vegetation integrity score for each vegetation zone as a result of identified impacts	Table 19
		Data	
		N/A	–
Mitigation and management of impacts	Chapter 8, Sections 8.4 and 8.5	**Information**	
		Identification of measures to mitigate or manage impacts in accordance with the recommendations in BAM Sections 8.4 and 8.5 including:	–
		techniques, timing, frequency and responsibility identify measures for which there is risk of failure evaluate the risk and consequence of any residual impacts	Table 21
		document any adaptive management strategy proposed	Table 21
		Identification of measures for mitigating impacts related to:	–
		displacement of resident fauna (as described in BAM Subsection 8.4.1(2.)) indirect impacts on native vegetation and habitat (as described in BAM Subsection 8.4.1(3.)) mitigating prescribed biodiversity impacts (as described in BAM Subsection 8.4.2)	Table 21
		Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain (BAM Section 8.5)	N/A
		Maps and tables	
		Table of measures to be implemented before, during and after construction to mitigate and manage impacts of the proposal, including action, outcome, timing and responsibility	Table 21
		Data	

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		N/A	–
Impact summary	Chapter 9	**Information**	
		Identification and assessment of impacts on TECs and threatened species that are at risk of a serious and irreversible impacts (SAII, in accordance with BAM Section 9.1) including:	–
		addressing all criteria in Subsection 9.1.1 for each TEC listed as at risk of an SAII present on the subject land	N/A
		for each TEC, report the extent of the TEC in NSW	N/A
		addressing all criteria in Subsection 9.1.2 for each threatened species at risk of an SAII present on the subject land	N/A
		for each threatened species, report the population size in NSW	N/A
		documenting assumptions made and/or limitations to information documenting all sources of data, information, references used or consulted clearly justifying why any criteria could not be addressed	N/A
		Identification of impacts requiring offset in accordance with BAM Section 9.2	N/A
		Identification of impacts not requiring offset in accordance with BAM Subsection 9.2.1(3.)	N/A
		Identification of areas not requiring assessment in accordance with BAM Section 9.3	N/A
		Maps and tables	
		Map showing the extent of TECs at risk of an SAII within the subject land	N/A
		Map showing location of threatened species at risk of an SAII within the subject land	N/A
		Map showing location of:	–
		impacts requiring offset	Figure 19
		impacts not requiring offset	N/A
		areas not requiring assessment	N/A
		Data	
		Digital shape files of:	–
		extent of TECs at risk of an SAII within the subject land	N/A
		location of threatened species at risk of an SAII within the subject land	N/A
		boundary of impacts requiring offset	–
		boundary of impacts not requiring offset	–
		boundary of areas not requiring assessment	N/A

BDAR section	BAM ref.	BAM requirement	Section reference in the BDAR
		Maps in jpeg format	–
Impact summary	Chapter 10	**Information**	
		Ecosystem credits and species credits that measure the impact of the development on biodiversity values, including:	–
		future vegetation integrity score for each vegetation zone within the subject land (Equation 25 and Equation 26 in BAM Appendix H) change in vegetation integrity score (BAM Subsection 8.1.1) number of required ecosystem credits for the direct impacts of the proposal on each vegetation zone within the subject land (BAM Subsection 10.1.2)	Table 23
		biodiversity risk weighting for each	Table 23
		number of required species credits for each candidate threatened species that is directly impacted on by the proposal (BAM Subsection 10.1.3)	N/A
		Maps and tables	
		Table of PCTs requiring offset and the number of ecosystem credits required	Table 23
		Table of threatened species requiring offset and the number of species credits required	N/A
		Data	
		Submitted proposal in the BAM Calculator	–
Biodiversity credit report	Chapter 10	**Information**	
		Description of credit classes for ecosystem credits and species credits at the development or clearing site or land to be biodiversity certified (BAM Section 10.2)	Table 24
		BAM credit report in pdf format	Appendix E
		Maps and tables	
		Table of credit class and matching credit profile	N/A
		Data	
		BAM credit report in pdf format	Appendix E

Appendix B: Matters of national environmental significance

The Commonwealth Protected Matters Search Tool was used to generate a report on Matters of National Environmental Significance predicted to occur within 1500m radius around the development footprint. This report is summarised in Section 1.4 of this report and included in this Appendix.

Likelihood of occurrence of 16 EPBC listed threatened species predicted in the Commonwealth Protected Matters report is considered in the table on he following page, as well as the presence of one vulnerable EPBC listed bat species, Large-eared pied bat *Chalinolobus dwyeri* in the study area, as this was potentially indicated by bat echolocation call analysis during field survey (17 species in total).

In summary, each EPBC Act listed species is either unlikely to be present and impacted or is addressed under NSW legislation. This BDAR, by implementing the burden of proof through BAM (2020), confirms MNES species and ecosystems are unlikely to occur and will not be significantly impacted, therefore a Referral under the EPBC Act is not required.

Commonwealth Protected Matters report – predicted threatened species

Common name	Scientific name	Comm. status	Potential to occur in the study area and/or be impacted by the proposal?	Assessment of significance required?	Significant impact?	NSW status	Included in BAMC
Birds							
Australasian Bittern	*Botaurus poiciloptilus*	E	**Unlikely** The Australasian Bittern's preferred habitat is comprised of wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over a muddy or peaty substrate. There is no suitable wetland habitat in or around the study area which is relatively arid and only contains a few ephemeral drainage lines and farm dams with no aquatic habitat. This species has not been recorded in the study area and is unlikely to occur and unlikely to be impacted.	No	No	E	No
Curlew Sandpiper	*Calidris ferruginea*	CE	**Unlikely** Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters. Curlew Sandpipers forage on mudflats and nearby shallow water. This species is gregarious, often occurring in large flocks. There is no suitable wetland habitat in or around the study area which is relatively arid and only contains a few ephemeral drainage lines and farm dams with no aquatic habitat. This species has not been recorded in the study area and is unlikely to occur and unlikely to be impacted.	No	No	E	No
Grey Falcon	*Falco hypoleucos*	V	**Unlikely** The Grey Falcon is an elusive species endemic to mainland Australia and occurs at low densities across inland Australia. The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in	No	No	E	Yes

Common name	Scientific name	Comm. status	Potential to occur in the study area and/or be impacted by the proposal?	Assessment of significance required?	Significant impact?	NSW status	Included in BAMC
			winter. The nests chosen are usually in the tallest trees along watercourses, particularly River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. coolabah*), but falcons also nest in telecommunication towers. This species has not been recorded in or around the study area, no suitable tree-lined watercourses are present in the study area and no suitable nests were detected in the study area. This species in unlikely to occur in the study area and is unlikely to be impacted by the project.				
Painted Honeyeater	*Grantiella picta*	V	**Unlikely** 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. Inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus *Amyema.* This species has not been recorded in or around the study area. No suitable habitat exists in the study area which are semi-arid woodlands with a shrubby formation and no suitable vegetation and mistletoe density. This species is unlikely to occur in the study area and is unlikely to be impacted by the project.	No	No	V	Yes
Malleefowl	*Leipoa ocellata*	V	**Unlikely** There are no records of this species in or around the study area and no mounds were detected during site survey. Active nests are a key indicator of presence. No population was detected in the study area. Due to historic and current disturbances, this species in unlikely to occur in the study area and is unlikely to be impacted by the project.	No	No	E	Yes
Plains-wanderer	*Pedionomus torquatus*	CE	**Unlikely** Plains-wanderers inhabit sparse grasslands with c.50% bare ground, with most vegetation less than 5 cm in height and some widely spaced plants up to 30 cm high. Overgrazing causes the species to leave an area when grassland is reduced to a remnant less than 2–3 cm high with 60% or more bare ground. Habitat structure appears to play a more important role than plant species composition. Preferred habitat of the Plains-wanderer typically comprises 50% bare ground, 10% fallen litter, and 40% herbs, forbs and grasses. The vast majority (>99%) of records of Plains-wanderers in NSW	No	No	E	No

Common name	Scientific name	Comm. status	Potential to occur in the study area and/or be impacted by the proposal?	Assessment of significance required?	Significant impact?	NSW status	Included in BAMC
			over the past 30 years come from an area of the western Riverina bounded by Hay and Narrandera on the Murrumbidgee River in the north, the Cobb Highway in the west, the Billabong Creek in the south, and Urana in the east. This species has not been recorded in or around the study area. There is no suitable grassy habitat structure and leaf litter in the study area which has been historically cleared and grazed. This species is unlikely to occur in the study area and is unlikely to be impacted by the project.				
Superb Parrot	*Polytelis swainsonii*	V	**Potential** The Superb Parrot mainly inhabits forests and woodlands dominated by eucalypts, especially River Red Gums (Eucalyptus camaldulensis) and box eucalypts such as Yellow Box (*Eucalyptus melliodora*) or Grey Box (*E. microcarpa*). The species also seasonally occurs in box-pine (*Callitris*) and Boree (*Acacia pendula*) woodlands. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Has not been recorded within 1500 metres of the study area. Suitable foraging habitat may occur in the development footprint; however preferred tree species are not present in the development footprint and no population was detected in the study area during field surveys. Hollows in and around the development footprint were observed and no Superb Parrots were recorded. No evidence of nesting Superb Parrots was recorded. This species is unlikely to occur in the study area and is unlikely to be impacted by project.	No	No	V	Yes
Australian Painted Snipe	*Rostratula australis*	E	**Unlikely** The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of *lignum Muehlenbeckia* or canegrass or sometimes tea-tree (Melaleuca). Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Nest records are all, or nearly all, from or near small islands in freshwater wetlands (D. Rogers 2002, pers. comm.), provided that these islands are a	No	No	E	No

Common name	Scientific name	Comm. status	Potential to occur in the study area and/or be impacted by the proposal?	Assessment of significance required?	Significant impact?	NSW status	Included in BAMC
			combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover There is no suitable wetland habitat in or around the study area which is relatively arid and only contains a few ephemeral drainage lines and farm dams with no aquatic habitat. This species has not been recorded in the study area and is unlikely to occur and unlikely to be impacted.				
Fish							
Murray Cod	*Maccullochella peelii*	V	**Unlikely** No waterways in the development footprint therefore this aquatic species is unlikely to occur and be impacted.	No	No	-	No
Macquarie Perch	*Macquaria australasica*	E	**Unlikely** No waterways in the development footprint therefore this aquatic species is unlikely to occur and be impacted.	No	No	-	No
Mammals							
Corben's Long-eared Bat, South-eastern Long-eared Bat	*Nyctophilus corbeni*	V	**Unlikely** This microbat species has a scattered distribution mostly within the Murray-Darling Basin, but with some records outside of this area. It is more common in box, ironbark and cypress pine woodland on the western slopes and plains. Its stronghold seems to be the Pilliga Scrub. It roosts in tree hollows, crevices and under loose bark. It is a slow flying agile bat that hunts for non-flying prey, especially caterpillars and beetles. This species has not been recorded in the study area and is therefore unlikely to be present and unlikely to be impacted by the project.	No	No	V	Yes
Large-eared pied bat	Large-eared pied bat *Chalinolobus dwyeri*	V	**Unlikely** Sandstone cliffs and fertile woodland valley habitat within close proximity of each other is habitat of importance to the Large-eared Pied Bat. Records from south-east Queensland suggest that rainforest and moist eucalypt forest habitats on other geological substrates (rhyolite, trachyte and basalt) at high elevation are of similar importance to the species The species requires a combination of sandstone cliff/escarpment to provide roosting habitat that is adjacent to higher fertility sites, particularly box gum woodlands or river/rainforest corridors which are used for foraging. Roosting has also been observed in disused mine shafts, caves, overhangs and disused Fairy Martin	No	No	V	No

Common name	Scientific name	Comm. status	Potential to occur in the study area and/or be impacted by the proposal?	Assessment of significance required?	Significant impact?	NSW status	Included in BAMC
			(*Hirundo ariel*) nests. It also possibly roosts in the hollows of trees The structure of primary nursery roosts appears to be very specific, i.e. arch caves with dome roofs (that need to be deep enough to allow juvenile bats to learn to fly safely inside) and with indentations in the roof (presumably to allow the capture of heat). These physical characteristics are not very common in the landscape and therefore a limiting factor. This species is threatened by disturbance to roosting areas by goats and clearing and isolation of forest and woodland habitats for agriculture or development. Only a few possible passes from this species were recorded in the study area in December 2021, however no definitive calls have been recorded so this cannot be considered a record of presence. The specifically required structure of primary nursery roosts is not present in the development footprint which has been thoroughly surveyed. The study area has been historically disturbed by clearing and grazing and is unlikely to contain suitable habitat for this species. This species is unlikely to occur and is unlikely to be impacted by the development footprint.				
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory	*Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)*	V	**Unlikely** Koalas naturally inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by *Eucalyptus* species. Koala habitat can be broadly defined as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees. The distribution of this habitat is largely influenced by land elevation, annual temperature and rainfall patterns, soil types and the resultant soil moisture availability and fertility. Preferred food and shelter trees are naturally abundant on fertile clay soils. No Koala records exist on BioNet within 10km of the study area – the closest over 70 kilometres south. There is not a resident local population of koala present, this species has not been recorded in the study area. This species is unlikely to occur in the study area and is unlikely to be impacted by the project.	No	No	V	Yes
Plants							
Curly-bark Wattle	*Acacia curranii*	V	**Unlikely** Has not been recorded in the study area but is known to occur at Yathong and Nombinnie Natures Reserves which lie approximately 50km south of the development footprint.	No	No	V	Yes

Common name	Scientific name	Comm. status	Potential to occur in the study area and/or be impacted by the proposal?	Assessment of significance required?	Significant impact?	NSW status	Included in BAMC
			AREA is extremely familiar with this species. AREA annually undertakes monitoring of *A. curranii* populations around Yathong for NSW NPWS and AREA's Managing Director, Phil Cameron, is considered a DPIE species expert for *Acacia curranii* AREA conducted surveys (including search transects and numerous BAM plots) in and around the development footprint in May, October and December 2021. No Curly-bark Wattle was recorded during these surveys. This species is unlikely to occur in the study area and is unlikely to be impacted by the project.				
A spear-grass	*Austrostipa metatoris*	V	**Unlikely** *Austrostipa metatoris* grows in sandy mallee areas of the Murray Valley. Habitat includes sandhills, sand ridges, undulating plains and flat open mallee country, with red to red-brown clay-loam to sandy-loam soils (DECC NSW, 2005a). Associated species include the trees and shrubs Bimble Box (*Eucalyptus populnea*), Gum Coolibah (*E. intertexta*), White Cypress Pine (*Callitris glaucophylla*), Belah (*Casuarina cristata*), Sweet Quandong (*Santalum acuminatum*), Sticky Hopbush (*Dodonaea viscosa*), *Hakea ivoryi*, and the grasses *Austrostipa drummondii* and *A. eremophila.* The main identified threats to A. metatoris are clearing of habitat grazing pressure by rabbits (Oryctolagus cuniculus), domestic stock and kangaroos; habitat degradation by rabbits and stock. This species has not been recorded within 50km of the study area. The development footprint has a history of historic clearing and grazing. Survey effort meeting requirement of NSW and Commonwealth guidelines were followed to determine this species is not present in the development footprint. This species is unlikely to occur in the study area and is unlikely to be impacted by the project.	No	No	V	No
Winged Peppercress	*Lepidium monoplocoides*	E	**Unlikely** Winged Peppercress occurs predominantly in mallee scrub in semi-arid areas (Leigh et al. 1984). Sites are seasonally moist to water-logged with heavy, fertile soils and a mean annual rainfall of around 300 to 500 mm. The predominant vegetation is usually an open-woodland dominated by *Allocasuarina leuhmannii* and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *Eucalyptus populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses (notably *Danthonia* spp. and *Stipa* spp.), but the seasonally waterlogged sites preferred by Winged Pepper-cress also support a number of moisture	No	No	E	No

Common name	Scientific name	Comm. status	Potential to occur in the study area and/or be impacted by the proposal?	Assessment of significance required?	Significant impact?	NSW status	Included in BAMC
			dependent herbs, such as *Marsilea* spp. (Nardoo) (Leigh & Briggs 1992). Also known from riparian woodland. This species was not recorded during field surveys and has not been recorded within 50 km of the study area. No suitable moist or water-logged habitat present in the study area. This species is unlikely to occur in the study area and is unlikely to be impacted by the project.				
Slender Darling Pea	*Swainsona murrayana*	V	**Unlikely** The Slender Darling-pea often grows in heavy soils, especially depressions, and is also found on grey and red to brown clay and clay-loam soils in *Atriplex vesicaria* (Bladder Saltbush) herbland, *Eucalyptus largiflorens* (Black Box) woodland and grassland communities and is frequently associated with *Maireana* species. Was not recorded during field surveys and has not been recorded within 50km of the study area. No suitable habitat is present. This species is unlikely to occur in the study area and is unlikely to be impacted by the project.	No	No	V	No

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 02-Jun-2022

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	16
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	1
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Banrock station wetland complex	500 - 600km upstream from Ramsar site
Riverland	400 - 500km upstream from Ramsar site
The coorong, and lakes alexandrina and albert wetland	600 - 700km upstream from Ramsar site

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Falco hypoleucos		
Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta		
Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Pedionomus torquatus		
Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Polytelis swainsonii		
Superb Parrot [738]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
FISH		
Maccullochella peelii		
Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Macquaria australasica		
Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
MAMMAL		
Nyctophilus corbeni		
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
PLANT		
Acacia curranii Curly-bark Wattle [3908]	Vulnerable	Species or species habitat likely to occur within area
Austrostipa metatoris [66704]	Vulnerable	Species or species habitat may occur within area
Lepidium monoplocoides Winged Pepper-cress [9190]	Endangered	Species or species habitat may occur within area
Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray Swainson-pea [6765]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Chalcites osculans as Chrysococcyx osculans		
Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area overfly marine area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Neophema chrysostoma		
Blue-winged Parrot [726]		Species or species habitat known to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed

Appendix C: Vegetation survey data

The vegetation survey data is shown in Table 27 below. Copies of the field data sheets are included in Appendix F. Data will also be submitted in electronic format (MS Excel) to the decision-maker.

Table 26 Vegetation survey data and locations

plot	pct	area	patchsize	condition class	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic	Plot-based vegetation survey?	Vegetation integrity survey?
4	103	30	101	Open	1	416302	6413525	305	1	7	5	10	0	0	5	10.7	15	11.6	0	0	1	0	9	4	-	-	Y	N/A	N/A	-	20	☒Yes ☐ No	☒Yes ☐ No
5	103	30	101	Open	1	416074	6413196	250	1	3	3	8	0	0	3	66	2.2	4.1	0	0	1	0	38	26	-	-	-	N/A	N/A	-	20	☒ Yes ☐ No	☒Yes ☐ No
6	103	30	101	Open	1	415913	6413259	30	0	3	5	8	0	0	0	45.5	6.4	8.9	0	0	0	0	20.2	0	-	-	-	N/A	N/A	-	40	☒ Yes ☐ No	☒Yes ☐ No
7	103	30	101	Open	1	416241	6412891	170	0	2	3	7	0	0	0	13	20.1	8.4	0	0	0	0	11.2	0	-	-	-	N/A	N/A	-	50	☒ Yes ☐ No	☒Yes ☐ No
9	103	30	101	Open	1	415521	6413244	180	1	4	5	10	0	0	3	14.2	7.4	24.1	0	0	0	0	24	6	-	Y	Y	N/A	N/A	-	10-	☒ Yes ☐ No	☒Yes ☐ No
10	104	4.92	101	Disturbed	2	416064	6413842	310	0	3	4	9	0	0	0	4.1	48.1	3.6	0	0	0	0	4.9	0	-	-	-	N/A	N/A	-	5	☒ Yes ☐ No	☒Yes ☐ No
11	104	4.92	101	Disturbed	2	415281	6413686	240	1	8	2	9	0	0	10	12.7	3.3	6.5	0	0	3	1	49	42	-	Y	Y	N/A	N/A	-	2	☒ Yes ☐ No	☒Yes ☐ No
12	104	4.92	101	Disturbed	2	415640	6413839	180	1	5	4	10	0	0	15	66.1	7.1	1.3	0	0	3	1	25	62	-	-	-	N/A	N/A	-	0	☒ Yes ☐ No	☒Yes ☐ No
13	104	4.92	101	Disturbed	2	415016	6413861	110	0	4	2	9	0	0	0	10.3	25.3	15.4	0	0	0	0	5.4	0	Y	-	-	N/A	N/A	-	2	☒ Yes ☐ No	☒Yes ☐ No

plot	pct	area	patchsize	condition class	zone	easting	northing	bearing	compTree	compShrub	compGrass	compForbs	compFerns	compOther	strucTree	strucShrub	strucGrass	strucForbs	strucFerns	strucOther	funLargeTrees	funHollowtrees	funLitterCover	funLenFallenLogs	funTreeStem5to9	funTreeStem10to19	funTreeStem20to29	funTreeStem30to49	funTreeStem50to79	funTreeRegen	funHighThreatExotic	Plot-based vegetation survey?	Vegetation integrity survey?
14	104	1.39	101	Open	3	416018	6412814	30	0	5	6	8	0	0	0	40.2	11.3	2.7	0	0	0	0	49	30	-	-	-	N/A	N/A	-	15	☒ Yes ☐ No	☒Yes ☐ No
15	104	1.39	101	Open	3	416279	6412714	180	0	4	2	4	0	0	0	11.1	25	7.1	0	0	1	0	10	0	-	-	-	N/A	N/A	-	25	☒ Yes ☐ No	☒Yes ☐ No
1	176	0.63	101	Recovering	4	416146	6413721	190	1	4	3	8	0	1	10	7.6	10.3	10	0	0.1	1	0	4.6	25	Y	Y	Y	N/A	N/A	Y	0	☒ Yes ☐ No	☒Yes ☐ No
2	176	0.63	101	Recovering	4	415949	6413528	210	1	7	6	10	0	0	5	37.2	60.4	26.5	0	0	0	0	9	20	-	Y	Y	N/A	N/A	-	0.1	☒ Yes ☐ No	☒Yes ☐ No
3	176	0.63	101	Recovering	4	415823	6413312	30	1	8	5	12	0	1	10	6.4	12.3	23.6	0	0.1	1	0	10	9	-	Y	Y	N/A	N/A	-	0	☒ Yes ☐ No	☒Yes ☐ No

Appendix D: Bat Call Analysis

Impact Ecology

ABN: 92895504799

BAT CALL ANALYSIS **8 February 2022**

Client: Phil Cameron AREA

Location: Mallee Bull, south of Cobar NSW

Vegetation type:

- SM#5 - PCT176 (Green Mallee)
- SM#6 - ecotone of PCT103 and PCT 104 (Bimble Box / Bimble Box Gum Barked Coolibah).

Reporting standard

This report follows the nationally accepted standards for the interpretation and reporting of bat echolocation data (Reardon 2003). More recent versions these reporting standards are available from the Australasian Bat Society on-line at http://www.ausbats.org.au/. Calls were analysed by Heidi Kolkert using Analook V4.2 bat call analysis software.

Methods for species identification

Bats produce a wide range of different shaped pulses which can all be broken down into standard components for comparison (Pennay *et al.* 2004). In relation to the analysis of those microchiropteran (microbat) calls obtained, it is noted that some insectivorous bat species have distinctive echolocation calls that are unlikely to be confused with those of other species. Other bat species overlap in both call frequency and structure making identification difficult. Poor quality calls confound the issues of identifying species with similar call frequencies.

Species nomenclature

Species names used in this summary follow Churchill (2008), except for Mormopterus (Ozimops) species, which follow Reardon *et al.* (2014).

Call identification

Call identification was based on existing call descriptions and keys presented in Pennay *et al.* (2004) as well as reference calls collected in New South Wales. Species' identification was further refined by considering probability of occurrence based on distributional information presented in Churchill (2008) and Van Dyck & Strahan (2008) and spatial data stored on the NSW Bionet and Atlas of Living Australia (ALA 2022) and BatMap (Australasian Bat Society 2022).

Results

At least eleven species of insectivorous bat were positively identified during the sampling period (Table 1). The Little Pied Bat listed under the *Biodiversity Conservation Act 2016* (BC Act) was

confidently recorded each night and each location. One pass from *Chalinolobus dwyeri* listed under the *Environmental Protection and Biodiversity Act 1999* (EPBC Act) was possibly recorded in the study area. Some pulses had the correct shape and showed alternation ~ 22kHz, however with only one pass, the presence of this species could not be confirmed. Both habitat types had a similar number of passes and bat assemblage.

Notes on species identification

Chalinolobus morio calls were differentiated from *Vespadelus sp.* by the presence of a down-sweeping tail and pulse alternation on the majority of pulses.

Calls from *Ozimops sp.* were differentiated by the presence of mainly flat pulses.

Chalinolobus gouldii was differentiated from other species by the presence of curved, alternating call pulses.

Three Nyctophilus species (*Nyctophilus gouldi* and *N. geoffroyi, N. corbeni*) have the potential to occur in the study area and overlap almost entirely in most frequency characteristics. All have steep near vertical call shapes. Calls belonging to the genus *Nyctophilus* could not be identified to genus level.

Table 1: Insectivorous bat calls recorded during the survey.

	Recording machine	SM4 #5			SM4 #6		
Scientific name	Common name	6/12/2021	7/12/2021	8/12/2021	6/12/2021	7/12/2021	8/12/2021
Bat calls positively identified							
Austronomus australis	White-Striped Freetail Bat	x	x	x	x		x
Chalinolobus gouldii	Gould's Wattled Bat	x	x	x	x	x	x
*Chalinolobus dwyeri #**	Large-Eared Pied Bat	P					
Chalinolobus morio	Chocolate Wattled Bat	x	x	x	x	x	P
Chalinolobus picatus #	Little Pied Bat	x	x	x	x	x	x
Nyctophilus sp. (geoffroyi / gouldii / corbeni)	Long-Eared Bat Complex	x	x	x	x	x	
Ozimops planiceps	South-Eastern Free-tailed Bat	x	x	x		x	x
Ozimops petersi	Inland Free-tailed Bat	x			x	x	
Scotorepens balstoni	Inland Broad-nosed Bat	x	x				
Scotorepens greyii	Little Broad-nosed Bat	x	x	x		x	x
Vespadelus vulturnus	Little Forest Bat	x	x	x	x		x
Bat calls not positively identified							
O. petersi or O. planiceps				x	x		
S. balstoni or S. greyii				x			
	Bat calls	**50**	**98**	**55**	**86**	**28**	**44**
	Noise files	**360**	**594**	**90**	**45**	**385**	**165**
	Total files	**410**	**692**	**145**	**131**	**413**	**209**

\# Species listed under the *Biodiversity Conservation Act 2016*

* Species listed under the *Environmental Protection and Biodiversity Act 1999*

P Possible record

x Positive record

References

Atlas of Living Australia (2022). https://biocache.ala.org.au/explore/your-area#-32.4773|145.9534|11|ALL_SPECIES

Australasian Bat Society - BatMap. http://ausbats.org.au/batmap. Accessed 7/02/2022.

Churchill, S. (2008). Australian Bats . Jacana Books, Allen & Unwin; Sydney.

Pennay, M., Law, B. and Reinhold, L. (2004). *Bat Calls of New South Wales*. Department of Environment and Conservation, Hurstville.

Reardon, T. (2003). Standards in bat detector based surveys. Australasian Bat Society Newsletter 20, 41-43.

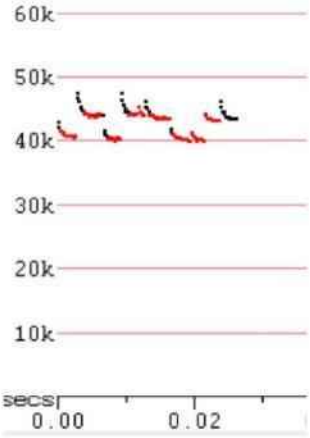
Reardon T. B., McKenzie N. L., Cooper S. J. B., Appleton B., Carthew S. & Adams M. (2014) *A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats Mormopterus (Chiroptera : Molossidae)*. Australian Journal of Zoology 62, 109-36.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales. Department of Natural Resources and Mines, Brisbane.*

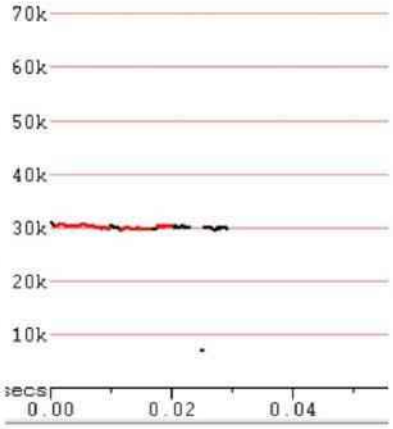
Van Dyck, S. and Strahan, R. (ed.) (2008). *The Mammals of Australia* (Third Edition); New Holland; Sydney.

Impact Ecology

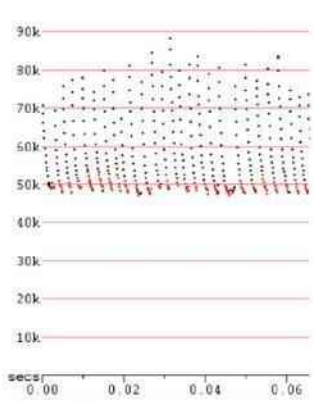
Example Calls



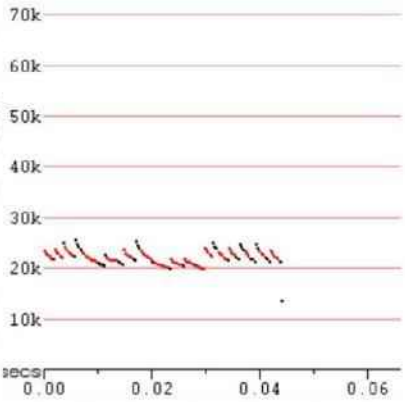
Chalinolobus picatus



O. petersi or O. planiceps

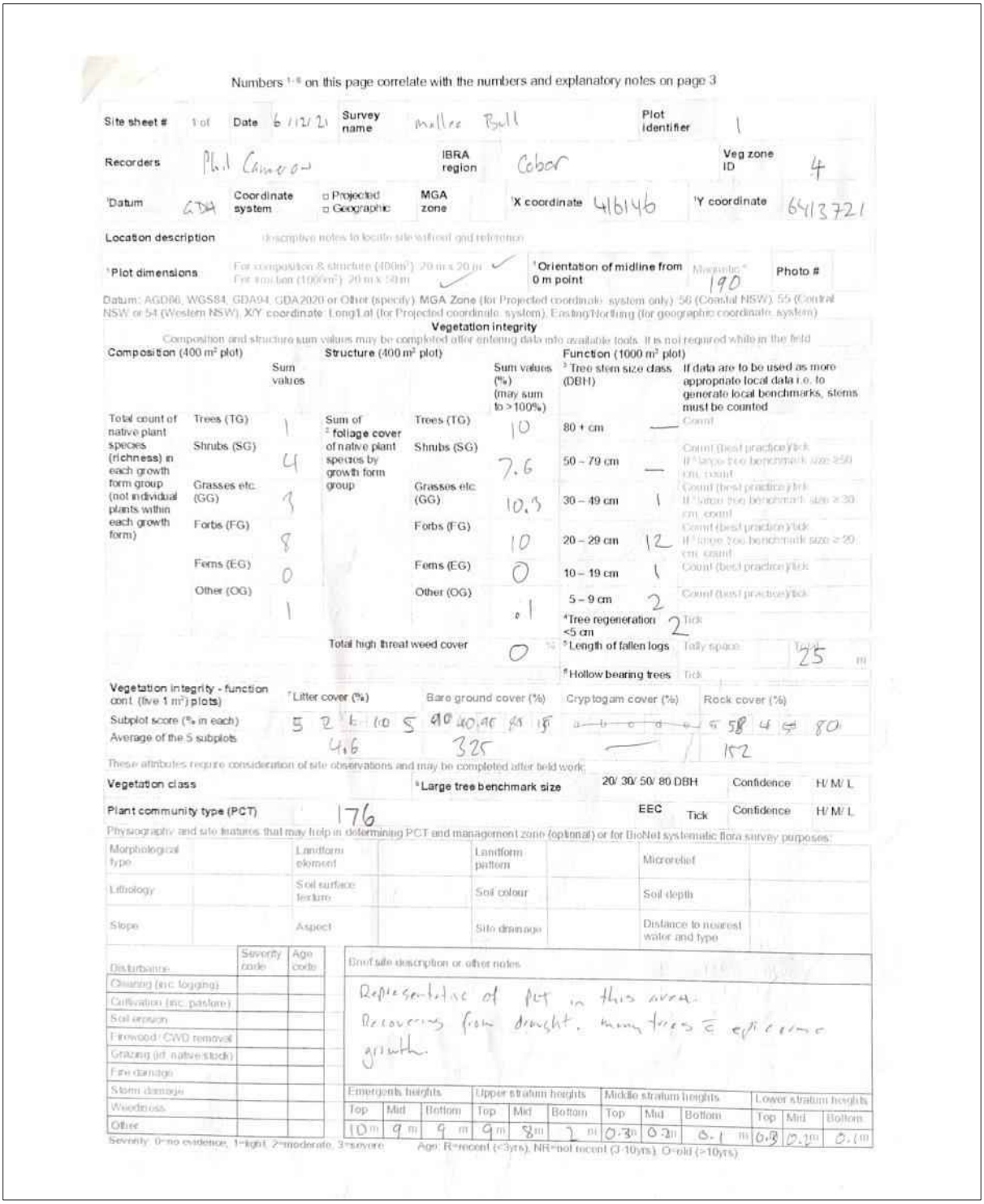


Chalinolobus morio



Chalinolobus dwyeri (possible ~22kHz, showing some alternation)

Appendix F: BAM Plot field data sheets



Numbers [1-6] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	6/12/21	Survey name	Mallee Bull	Plot identifier	1
Recorders	Phil Cameron			IBRA region	Cobar	Veg zone ID	4
[1]Datum	GDA	Coordinate system	☐ Projected ☐ Geographic	MGA zone		[1]X coordinate	416146
[1]Y coordinate	6413721						
Location description	(descriptive notes to locate site without grid reference)						
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m ✓ For function (1000m²): 20 m x 50 m ✓			[1]Orientation of midline from 0 m point	Magnetic ° 190	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW) or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3] Tree stem size class (DBH)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	10	80 + cm	—	Count
	Shrubs (SG)	4		Shrubs (SG)	7.6	50 – 79 cm	—	Count (best practice) tick. If [5]large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)	3		Grasses etc. (GG)	10.3	30 – 49 cm	1	Count (best practice) tick. If [5]other tree benchmark size ≥ 30 cm, count
	Forbs (FG)	8		Forbs (FG)	10	20 – 29 cm	12	Count (best practice) tick. If [5]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)	0		Ferns (EG)	0	10 – 19 cm	1	Count (best practice) tick
	Other (OG)	1		Other (OG)	0.1	5 – 9 cm	2	Count (best practice) tick
						[4]Tree regeneration <5 cm	2	Tick
			Total high threat weed cover		0 %	[5]Length of fallen logs	Tally space	Total 25 m
						[6]Hollow bearing trees	Tick	

Vegetation integrity - function cont. (five 1 m² plots)	[1]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	5 2 6 10 5	90 40 45 85 15	a b c d e	5 58 4 5 80
Average of the 5 subplots	4.6	325	—	152

These attributes require consideration of site observations and may be completed after field work

Vegetation class		[5]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	176		EEC Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)		
Cultivation (inc. pasture)		
Soil erosion		
Firewood / CWD removal		
Grazing (cf. native stock)		
Fire damage		
Storm damage		
Weediness		
Other		

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Brief site description or other notes

Representative of plot in this area. Recovering from drought. many trees & epicormic growth.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
10 m	9 m	9 m	9 m	8 m	7 m	0.3 m	0.2 m	0.1 m	0.3 m	0.2 m	0.1 m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 6 12 21	Mallee Bull	1	P Cameron

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abundance	Voucher
TA	Eucalyptus viridis Green mallee	N	10	5	—
SA	Grevillea parviflora Wilga	N	5	2	
SA	Dodonaea attenuata Needle-leaf Hopbush	N	0.1	15	
GA	Austrostipa nodosa	N	10	800s	
FA	Ptilotus obovatus Silver tails	N	0.5	400	
SA	Sclerolaena birchii	N	0.5	400	
FA	Calotis cuneifolia Purple burr daisy	N	5	1000s	
SA	Sclerolaena intricata Tangled Poverty Bush	N	2	400	
FA	Chenopodium melanocarpum Black crumbweed	N	2	400	
GA	Thyridolepis mitchelliana Mulga Grass	N	0.1	100	
GA	Paspalidium constrictum Bor Grass	N	0.2	400	
FA	Sida cunninghamiana	N	0.2	200	
vine	Parsonsia eucalyptophylla Gargaloo	N	0.1	20	
FA	Nicotiana glauca Tobacco Bush	N	0.1	30	
FA	Ptilotus atriplicifolius Crimson Foxtail	N	2	50	
FA	Atriplex nullen mealy saltbush	N	0.1	20	
FA	Emex australis spiny	N	0.1	20	—

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N**: native, **HTW**: high threat weed.

[2] **Foliage cover**: 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	6/12/21	Survey name	Mallee Bull	Plot identifier	2
Recorders	Phil Cameron			IBRA region	Cobar	Veg zone ID	4
[1]Datum	GDA	Coordinate system	□ Projected □ Geographic	MGA zone	[1]X coordinate	415949	[1]Y coordinate 6413528
Location description	descriptive notes to locate site without grid reference			Sparline			
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			[1]Orientation of midline from 0 m point	-23°	Magnetic?	210° Photo #

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3] Tree stem size class (DBH)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	5	80 + cm	—	Count
	Shrubs (SG)	7		Shrubs (SG)	37.2	50 – 79 cm	—	Count (best practice) tick: If [3]large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)	6		Grasses etc. (GG)	60.4	30 – 49 cm	—	Count (best practice) tick: If [3]large tree benchmark size ≥ 30 cm, count
	Forbs (FG)	10		Forbs (FG)	26.45	20 – 29 cm	1	Count (best practice) tick: If [3]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)	0		Ferns (EG)	0	10 – 19 cm	5	Count (best practice) tick
	Other (OG)	0		Other (OG)	0	5 – 9 cm	—	Count (best practice) tick
						[4]Tree regeneration <5 cm	≤ Tick Ø	
			Total high threat weed cover		0.1	[5]Length of fallen logs	Tally space	Total 20 m
		5148				[6]Hollow bearing trees	Tick —	

Vegetation integrity - function cont. (five 1 m²) plots)	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	3 2 3 5	35 70 30 50 45	0 0 0 0 0	0 20 5 20 0
Average of the 5 subplots	9.0	54	0	57

These attributes require consideration of site observations and may be completed after field work

Vegetation class		[8]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	176		EEC Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	—	
Cultivation (inc. pasture)	—	
Soil erosion	2	O
Firewood / CWD removal	—	
Grazing (d. native/stock)	2	O
Fire damage	—	
Storm damage	—	
Weediness	—	
Other	—	

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Brief site description or other notes:

Randomly selected. Representative of less rocky + more grassy area of PCT. Drought affected. Many eucalyptus & epicormic regrowth

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
— m	— m	— m	7 m	5 m	4 m	5 m	4 m	0.2 m	0.3	0.15	0.1 m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot	Survey name	Plot identifier	Recorders
Date 6 12 21	Mallee Bull	2	Phil Cameron

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	² Foliage cover	Abundance	Voucher
TG	Eucalyptus viridus	Green Mallee	N	5	4	
SG	Eremophila mitchellii	Budda		10	14	
SG	Geijera parvifolia	Wilga		2	2	
GG	Austrostipa nodosa			30	2K	
GG	Austrostipa scabra	Rough speargrass		30	2K	
FG	Nicotiana glauca	Tobacco Bush		0.1	25	
FG	Calotis lappulacea	Yellow burr-daisy		2	400	
FG	Calotis cuneifolia	Purple burr-daisy		2	400	
SG	Kalsoa salsa	Buckbush		5	200	
FG	Ptilotus atriplicifolius	Crimson foxtail		10	400	
FG	Hibiscus sturtii	Hill hibiscus		1.0	400	
SG	Sclerolaena eriacantha	Silky copperburr		10	250	
SG	Sclerolaena diacantha	Grey copperburr		10	250	
FG	Euphorbia drummondii	Caustic weed		0.1	25	
FG	Vittadinia cuneata	Fuzzweed		0.1	10	
SG	Sclerolaena birchii	Galvanised burr		0.1	10	
GG	Thyridolepis mitchelliana	Mulga Grass		0.1	10	
GG	Panicum effusum	Hairy Panic		0.1	10	
FG	Sida cunninghamiana	Ridge Sida		0.1	10	
FG	Waitzia citrina	Pale everlasting		2	350	
GG	Eragrostis lacunaria	Purple lovegrass		0.1	10	
GG	Paspalidium constrictum	Box Grass	N	0.1	10	
—	Carthamus lanatus	Saffron Thistle	HTW	0.1	5	
SG	Dodonaea lobulata	Lobed-leaf hopbush	N	0.1	1	
FG	Boerhavia dominii	Tar Bush	N	0.1	1	

	n		
TG	1		
SG	7		
GG	6		
FG	10		
EG			
OTH			

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

² **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*. Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of | Date 6/12/21 | Survey name Mallee Bull | Plot identifier 3

Recorders Phil Cameron | IBRA region Cobar | Veg zone ID 3 4

[1]Datum GDA | Coordinate system ☐ Projected ☐ Geographic | MGA zone | [1]X coordinate 415823 | [1]Y coordinate 6413312

Location description Spur line

[1]Plot dimensions | [1]Orientation of midline from 0 m point 30° | Photo #

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3]Tree stem size class (DBH)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	10	80 + cm	—	Count
	Shrubs (SG)	8		Shrubs (SG)	6.4	50 – 79 cm	—	Count (best practice) tick ☐ If 'large tree benchmark size ≥50 cm' count
	Grasses etc. (GG)	5		Grasses etc. (GG)	12.3	30 – 49 cm	1	Count (best practice) tick ☐ If 'large tree benchmark size ≥30 cm' count
	Forbs (FG)	12		Forbs (FG)	23.6	20 – 29 cm	7	Count (best practice) tick ☐ If 'large tree benchmark size ≥20 cm' count
	Ferns (EG)	—		Ferns (EG)	0	10 – 19 cm	5	Count (best practice) tick ☐
	Other (OG)	1		Other (OG)	0.1	5 – 9 cm	Ø	Count (best practice) tick ☐
						[4]Tree regeneration <5 cm	Ø	Tick ☐
			Total high threat weed cover		0	[5]Length of fallen logs		Tally space Total 9 m
						[6]Hollow bearing trees	1	Tick ☐

Vegetation integrity - function cont. (five 1 m² plots)	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	5 5 10 10 20 65 45 75 40 45		2 50 15 50 35	
Average of the 5 subplots	101			

These attributes require consideration of site observations and may be completed after field work

Vegetation class | [8]Large tree benchmark size 20/ 30/ 50/ 80 DBH | Confidence H/ M/ L

Plant community type (PCT) 176 | EEC Tick | Confidence H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	—	
Cultivation (inc. pasture)	—	
Soil erosion	2	0
Firewood (CWD) removal	—	
Grazing (d. native/stock)	2	0
Fire damage	—	
Storm damage	—	
Weediness	—	
Other	—	

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe. Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Brief site description or other notes

In the impact footprint. Representative of PCT more broadly. Drought affected canopy, epicormic growth.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
—	—	m	m	m	m	m	m	m	m	m	m

400 m² floristics plot: | **Survey name:** Mallee Bull | **Plot identifier:** 3 | **Recorders:** Phil Cameron

Date 6 12 21

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	Foliage cover	Abundance	Voucher
TG	Eucalyptus viridis Green Mallee	N	10	4	—
SG	Geijera parviflora Wilga		2	4	
FG	Calotis cuneifolia Purple burr daisy		15	350	
FG	Goodenia hederacea		0.2	25	
OG	Parsonsia eucalyptophylla Gargaloo		0.1	40	
GG	Thyridolepis mitchelliana Mulga Grass		2	300	
SG	Solanum ferocissimum Spiny potato bush		0.1	2	
GG	Austrostipa nodosa		10	400	
GG	Eragrostis lacunaria Purple lovegrass		0.1	25	
FG	Pomax umbellatum Pomax		1	100	
SG	Dodonaea attenuata Narrow-leaf hopbush		0.1	1	
FG	Nicotiana glauca Tobacco Bush		0.1	1	
FG	Sida cunninghamiana Ridge Sida		0.1	35	
FG	Hibiscus sturtii ~~Sturt~~ Hill Hibiscus		2	35	
FG	Goodenia pinnatifida		0.1	20	
FG	Oxalis chnoodes		0.1	60	
EG	Ptilotus atriplicifolius Crimson Foxtail		2	180	
SG	Eremophila mitchellii Budda		1	3	
SG	Salsola kali Buckbush		0.1	75	
SG	Sclerolaena birchii Gal. burr		1	20	
GG	Enneapogon avenaceus Curly Windmill		0.1	35	
GG	Aristida ramosa 3-awn Grass		0.1	15	
FG	Calotis lappulacea Yellow burr daisy		1	20	
FG	Chenopodium melanocarpum Black-crumbweed		1	30	
SG	Atriplex ~~stp~~ stipitata Bitter Saltbush		0.1	1	
SG	Sclerolaena dichantha Grey Copperburr		2	15	
FG	Euphorbia drummondii Caustic weed	N	1	20	

	n	%
TG	1	10
SG	8	[illegible]
GG	5	[illegible]
FG	12	[illegible]
EG		
OTH		

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers 1–8 on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	6/12/21	Survey name	Mallee Bull	Plot identifier	4
Recorders	Phil Cameron			IBRA region	Cobar	Veg zone ID	1
Datum	GDA	Coordinate system	Projected / Geographic	MGA zone		X coordinate 416302	Y coordinate 6413525
Location description							
Plot dimensions	For composition & structure (400m²) 20 m x 20 m ✓ For function (1000m²) 20 m x 50 m			Orientation of midline from 0 m point	305	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW) or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field.

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) Tree stem size class (DBH)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of foliage cover of native plant species by growth form group	Trees (TG)	5	80 + cm	—	Count
	Shrubs (SG)	7		Shrubs (SG)	10.7	50 – 79 cm	—	Count (tick)
	Grasses etc. (GG)	5		Grasses etc. (GG)	15	30 – 49 cm	1	Count (tick)
	Forbs (FG)	10		Forbs (FG)	11.6	20 – 29 cm	2	Count (tick)
	Ferns (EG)	—		Ferns (EG)	—	10 – 19 cm	—	Count (tick)
	Other (OG)	—		Other (OG)	—	5 – 9 cm	—	Count (tick)
						Tree regeneration <5 cm	—	Tick
			Total high threat weed cover		20	Length of fallen logs		Tally space / Total 4 m
						Hollow bearing trees	—	Tick

Vegetation integrity - function cont. (five 1 m²) plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	10 30 50 0 0	50 30 94 100 100	—	0 0 1 0 0
Average of the 5 subplots	9	74.8		0.2

These attributes require consideration of site observations and may be completed after field work.

Vegetation class		Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	103	EEC	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

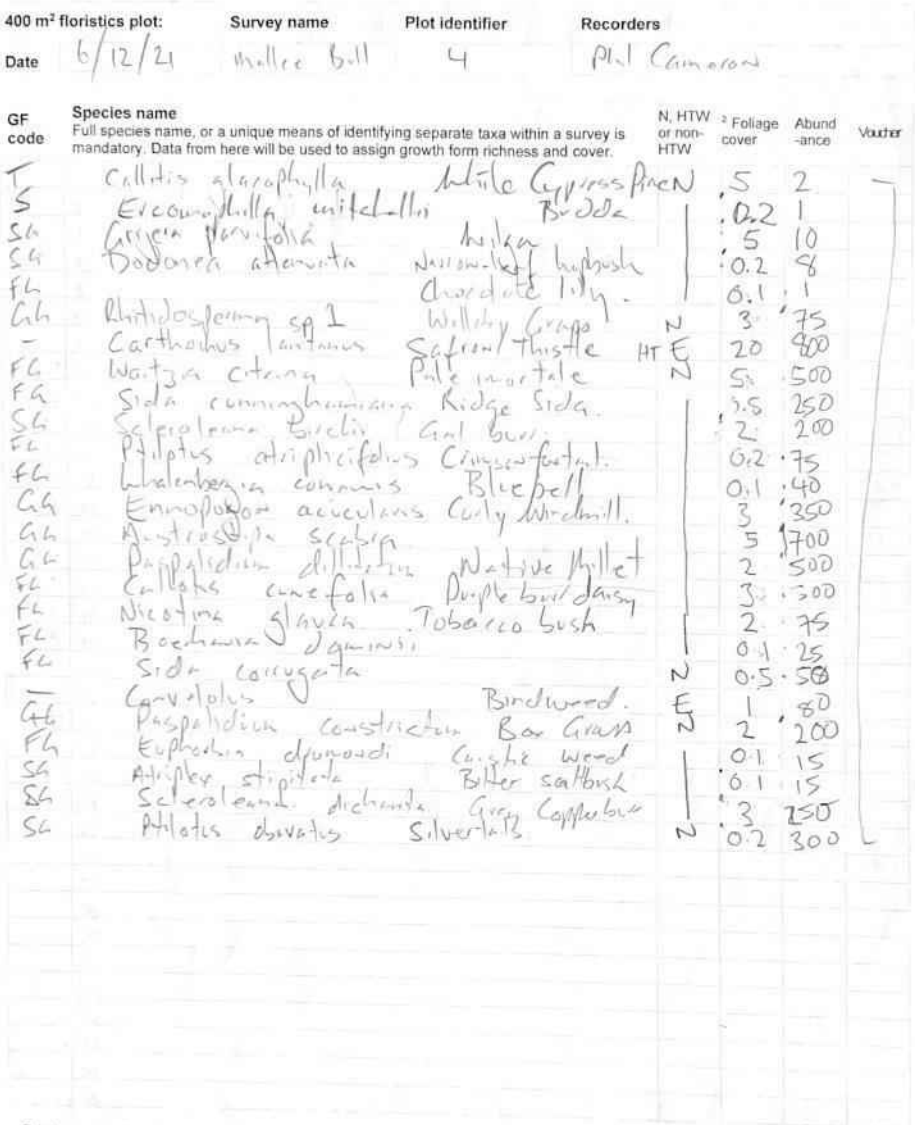
Disturbance	Severity code	Age code
Clearing (inc. logging)	3	O
Cultivation (inc. pasture)	2	O
Soil erosion	2	O
Firewood / CWD removal	2	O
Grazing (id. native/stock)	3	O
Fire damage	—	
Storm damage	—	
Weediness	2	
Other	—	

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe. Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Brief site description or other notes

Within impact footprint. Representative of area to be affected by proposal.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
—	—	—	25 m	—	—	—	4 m	—	0.3	0.2	0.1 m



400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 6/12/21	Mallee Bull	4	Phil Cameron

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	² Foliage cover	Abundance	Voucher
T	Callitris glaucophylla	Mallee Cypress Pine	N	5	2	
S	Eremophila willdenowii	Budda		0.2	1	
Sh	Senna artemisioides	Desert Cassia		5	10	
Sh	Dodonaea attenuata	Narrow-leaf hopbush		0.2	8	
FL		Chocolate Lily		0.1	1	
Gh	Rhytidosporum sp 1	Woolly Grapp	N	3	75	
–	Carthamus lanatus	Saffron Thistle	HT E	20	800	
FG	Wahlenbergia citrina	Pale Bluebell	N	5	500	
FG	Sida cunninghamiana	Ridge Sida		3.5	250	
Sh	Sclerolaena birchii	Galvanised Burr		2	200	
FL	Ptilotus atriplicifolius	Crimson-tails		0.2	75	
FL	Wahlenbergia communis	Bluebell		0.1	40	
GG	Enneapogon avenaceus	Curly Windmill		3	350	
Gh	Austrostipa scabra			5	1700	
GG	Paspalidium distans	Native Millet		2	500	
FL	Calotis cuneifolia	Purple burr daisy		3	300	
FL	Nicotiana glauca	Tobacco bush		2	75	
FL	Boerhavia dominii			0.1	25	
FL	Sida corrugata		N	0.5	50	
–	Convolvulus	Bindweed	E	1	80	
GL	Paspalidium constrictum	Bar Grass	N	2	200	
FL	Euphorbia dyrnowdi	Caustic weed		0.1	15	
Sh	Atriplex stipitata	Bitter saltbush		0.1	15	
Sh	Sclerolaena dichondrifolia	Grey Copperburr		3	250	
Sh	Ptilotus obovatus	Silvertails	N	0.2	300	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

² **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of	Date 6/12/21	Survey name Mallee Bull		Plot identifier 5	
Recorders Phil Cowum		IBRA region Cobar		Veg zone ID 1	
[1]Datum	Coordinate system ☐ Projected ☐ Geographic	MGA zone	[1]X coordinate 416074	[1]Y coordinate 6413196	
Location description 103 (descriptive notes to locate site without grid reference)					
[1] Plot dimensions (For composition & structure (400m²): 20 m x 20 m; For function (1000m²): 20 m x 50 m) ✓ ✓			[1] Orientation of midline from 0 m point 250° Magnetic °		Photo #

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	3
	Shrubs (SG)	3		Shrubs (SG)	66
	Grasses etc. (GG)	3		Grasses etc. (GG)	2.2
	Forbs (FG)	5		Forbs (FG)	4.1
	Ferns (EG)	/		Ferns (EG)	/
	Other (OG)	/		Other (OG)	/
			Total high threat weed cover		20 %

Function (1000 m² plot) [3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
80 + cm —	Count
50 – 79 cm 1	Count (best practice/tick if large tree benchmark size ≥50 cm: count)
30 – 49 cm —	Count (best practice/tick if large tree benchmark size ≥ 30 cm: count)
20 – 29 cm —	Count (best practice/tick if large tree benchmark size ≥ 30 cm: count)
10 – 19 cm —	Count (best practice/tick)
5 – 9 cm —	Count (best practice/tick)
[4]Tree regeneration <5 cm	Tick
[5]Length of fallen logs 26	Tick (best practice) Total m
[6]Hollow bearing trees —	Tick

Vegetation integrity - function cont. (five 1 m²) plots)	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	75 50 15 10 40 5	30 10 80 10	—	10 —
Average of the 5 subplots	38	27	—	2

These attributes require consideration of site observations and may be completed after field work

Vegetation class	[8]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT) 103		EEC Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	3	0
Cultivation (inc. pasture)	2	0
Soil erosion	2	0
Firewood / CWD removal	3	0
Grazing (eg. native/stock)	2	0
Fire damage	—	
Storm damage	—	
Weediness	2	0
Other	—	

Severity: 0=no evidence, 1=slight, 2=moderate, 3=severe

Brief site description or other notes

Representative of area in impact footprint

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
—	—	— m	21	12m	— m	—	4m	— m	0.2	0.2	0.1 m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 6/12/21	Mallee Bull	S	Phil Cameron

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
T	Casuarina Pauper	N	3	1	—
S	Acacia Pendula Wilga		3	4	
S	Sclerolaena birchii		60	600	
G	Austrostipa scabra		0.1	100	
F	Calotis cuneifolia		0.3	100	
F	Sida cunninghamiana		0.3	100	
G	Paspalidium constrictum		0.1	75	
F	Ptilotus obovatus		0.1	50	
F	Alternanthera nodosa		0.1	2	
F	Sida cunninghamiana		0.1	75	
F	Wahlenbergia communis		0.1	50	
G	Enneapogon avenaceus		2	100	
F	Chenopodium desmanchei Blackcrumbweed		3	80	
Sh	Scleroleana diacantha Grey Copperburr		3	250	
—	Carthamus lanatus	HTE	20	800	
F	Boerhavia dominii	N	0.1	20	—

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*. Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	7/12/21	Survey name	Mallee Bull	Plot identifier	6
Recorders	Phil Cameron			IBRA region	Cobar	Veg zone ID	1. (163)
[1]Datum		Coordinate system	□ Projected □ Geographic	MGA zone	[1]X coordinate 415913	[1]Y coordinate	6413259
Location description	descriptive notes to locate site without grid reference						
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m ✓ For function (1000m²): 20 m x 50 m ✓			[1]Orientation of midline from 0 m point	Magnetic ° 30 °	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate, Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	—	[2] foliage cover of native plant species by growth form group	Trees (TG)	—	[3] Tree stem size class (DBH)		
	Shrubs (SG)	7		Shrubs (SG)	45	80 + cm	—	Count
	Grasses etc. (GG)	5		Grasses etc. (GG)	6.4	50 – 79 cm	—	Count (best practice) tick. If large tree benchmark size ≥50 cm, count
	Forbs (FG)	8		Forbs (FG)	8.9	30 – 49 cm	—	Count (best practice) tick. If large tree benchmark size ≥ 30 cm, count
	Ferns (EG)			Ferns (EG)		20 – 29 cm	—	Count (best practice) tick. If large tree benchmark size ≥ 20 cm, count
	Other (OG)			Other (OG)		10 – 19 cm	—	Count (best practice) tick
						5 – 9 cm	—	Count (best practice) tick
						[4]Tree regeneration <5 cm	—	Tick
			Total high threat weed cover		40 %	[5]Length of fallen logs	Tally space	Total 0 m
						[6]Hollow bearing trees	Tick —	

Vegetation integrity - function cont. (five 1 m² plots)	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	15 5 10 6 5	80 0 0 5 10	a b c d e	a b c d e
Average of the 5 subplots	20.2			

These attributes require consideration of site observations and may be completed after field work:

Vegetation class	[8]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	103.	EEC Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	3	0
Cultivation (inc. pasture)	2	0
Soil erosion	2	0
Firewood / CWD removal	3	0
Grazing (cf. native/stock)	2	0
Fire damage	—	
Storm damage	—	
Weediness	2	0
Other	—	

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Brief site description or other notes

In impact footprint. Near Box (c.f. Representative of open (not treed) area affected by proposal.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
— m		— m	m	m	— m	2.5m	2 m	0.3 m	0.3m	0.2m	0.1 m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 7/12/21	Mallee Bull	6	Phil Cameron

GF code		Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	¹ Foliage cover	Abund -ance	Voucher
SG	1	Apophyllum anomalum Warrior Bush	N	0.5	2	–
SG	2	Sclerolaena birchii Gal burr	N	40	>2K	
–	3	Carthamus lanatus Saffron Thistle	HTE	40	>2K	
G	4	Austrostipa scabra	N	5	1K	
G	5	Thyridolepsis mitchelliana Mulga Grass	↓	0.1	200	
G	6	Eragrostis lacunaria Paddock Love Grass	↓	0.1	200	
F	7	Chenopodium desertorum Crumbweed.	↓	0.1	200	
F	8	Erodium Storksbill	↓	0.1	50	
F S	9	Sclerolaena dicantha Grey Copper Burr	↓	5	250	
F	10	Calotis cuneifolia Purple Burr Daisy	↓	5	350	
G	11	Enneapogon acicularis	↓	0.1	50	
F	12	Sida corrugata	↓	0.2	75	
F	13	Sida cunninghamiana	↓	0.2	75	
G	14	Paspalidium constrictum	↓	1	20	
F	15	Ptilotus atriplicifolius Crimson Foxtail	↓	3	50	
F	16	Calotis lappulacea Yellow burr Daisy	↓	3	150	
F	17	Hibiscus sturtii Hill Hibiscus	N	0.2	50	
–	18	Convolvulus Bindweed	E	0.1	50	
G	19	Paspalidium decompositum Hairy Panic	N	0.1	25	
–	20	Caltrop Cathead.	E	0.1	25	
F	21	Boerhavia dominii Tar vine.	N	0.1	2	–

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

¹ **Foliage cover**: 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of	Date 7/12/21	Survey name Mallee Bull		Plot identifier 7	
Recorders Phil Cameron		IBRA region Cobar		Veg zone ID 4	
[1]Datum	Coordinate system ☐ Projected ☐ Geographic	MGA zone	[1]X coordinate 416241	[1]Y coordinate 6412891	
Location description	descriptive notes to locate site without grid reference				
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m ✓ For function (1000m²): 20 m x 50 m ✓		[1]Orientation of midline from 0 m point 170°		Photo #

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW) or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)		Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)		80 + cm —	Count
	Shrubs (SG)	2		Shrubs (SG)	13	50 – 79 cm —	Count (best practice) tick
	Grasses etc. (GG)	3		Grasses etc. (GG)	20.1	30 – 49 cm —	Count (best practice) tick
	Forbs (FG)	7		Forbs (FG)	8.4	20 – 29 cm —	Count (best practice) tick
	Ferns (EG)			Ferns (EG)		10 – 19 cm —	Count (best practice) tick
	Other (OG)			Other (OG)		5 – 9 cm	Count (best practice) tick
						[4]Tree regeneration <5 cm —	Tick
			Total high threat weed cover		50 %	[5]Length of fallen logs —	Tally space / Total m
						[6]Hollow bearing trees —	

Vegetation integrity - function cont. (five 1 m² plots)	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	20 10 10 15 1	3 25 5 80 95		
Average of the 5 subplots	11.2	41.8		

These attributes require consideration of site observations and may be completed after field work

Vegetation class	[8]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT) 103		EEC Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	3	0
Cultivation (inc. pasture)	1	0
Soil erosion	2	0
Firewood / CWD removal	2	0
Grazing (at native stock)	3	NK
Fire damage	—	—
Storm damage	—	—
Weediness	3	R
Other	—	—

Severity: 0=no evidence, 1=slight, 2=moderate, 3=severe

Brief site description or other notes

Within impact footprint. Represents an open area without trees + tall shrubs affected by proposal. Very, very favourable season for assessment. Not best or worst area.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
— m	— m	— m	— m	— m	— m	0.2 m	0.2 m	0.1 m	0.4 m	0.3 m	0.1 m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 7/12/21	MalleeBull	7	Phil Cameron

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
-	Carthamus lanatus	Saffron thistle	HTE	50	→3k	
G	Austrostipa scabra	Rough Spear Grass	N	10	1k	
G	Panicum decompositum	Native Panic	N	10	800	
F	Sida corrugata		N	2	400	
F	Calotis lappulacea	Yellow Burr Daisy	N	2	400	
F	Sida cunninghamiana	Ridge Sida	N	0.1	75	
Sc	Sclerolaena dichantha	Grey Copper Burr	N	3	350	
S	Sclerolaena birchii	Galvanised Burr	N	10	400	
F	Ptilotus citriplicifolius	Crimson Foxtail	N	2	300	
F	Waitzia citriana	Pale immortelle	N	2	300	
F	Wahlenbergia communis	Blue Bell	N	0.1	10	
—	Convolvulus	Bind weed	—	0.1	150	
F	Helichrysum bracteatum	Golden Everlasting	N	0.1	1	
G	Aristida behriana	Bush Wire Grass	N	0.1	1	
F	Euphorbia drummondii	Caustic Weed	N	0.1	1	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet # 1 of	Date 7/12/21	Survey name Mallee Bull		Plot identifier 9	
Recorders Phil Cameron		IBRA region Cobar		Veg zone ID 1	
[1]Datum	Coordinate system ☐ Projected ☐ Geographic	MGA zone	[1]X coordinate 415521	[1]Y coordinate 6413244	
Location description (descriptive notes to locate site without grid reference)					
[1]Plot dimensions For composition & structure (400m²): 20 m x 20 m. For function (1000m²): 20 m x 50 m			[1]Orientation of midline from 0 m point Magnetic 180°		Photo #

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	3	80 + cm —	Count
	Shrubs (SG)	4		Shrubs (SG)	14.2	50 – 79 cm —	Count (best practice) tick. If [4]large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)	5		Grasses etc. (GG)	7.4	30 – 49 cm —	Count (best practice) tick. If [4]large tree benchmark size ≥30 cm, count
	Forbs (FG)	10		Forbs (FG)	24.1	20 – 29 cm 7	Count (best practice) tick. If [4]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm 2	Count (best practice) tick
	Other (OG)			Other (OG)		5 – 9 cm —	Count (best practice) tick
						[5]Tree regeneration <5 cm —	Tick
			Total high threat weed cover		10 %	[6]Length of fallen logs	Tally space Total 6 m
						[7]Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m² plots)	[1]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	5 5 35 25 50 10 85 5 10 35		1 1 1 1 1	
Average of the 5 subplots	24	29	0.2	0.2

These attributes require consideration of site observations and may be completed after field work

Vegetation class	[4]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT) ie. 103		EEC Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type		Landform element		Landform pattern	Microrelief
Lithology		Soil surface texture		Soil colour	Soil depth
Slope		Aspect		Site drainage	Distance to nearest water and type

Disturbance	Severity code	Age code
Clearing (inc. logging)	2	0
Cultivation (inc. pasture)	2	0
Soil erosion	2	0
Firewood / CWD removal	3	0
Grazing (pt. native/stock)	3	NR
Fire damage	—	—
Storm damage	—	—
Weediness	2	R
Other	—	—

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe. Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

Brief site description or other notes

In proposed access track alignment. Historically cleared for mining. Representative of impact area. Some cypress pine regrowth.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
— m		— m	3.5 m	3 m	1.5 m	— m	0.3 m	0.1 m	0.8 m	0.2 m	0.1 m

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 7 12 21	Mallee Bull	9	Phil Cameron

GF code		**Species name** Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.	N, HTW or non-HTW	² Foliage cover	Abund -ance	Voucher
T	1	Callitris glaucophylla White Cypress	N	3	7	
S	2	Eremophila mitchelii Budda		0.2	1	
F	3	Waitzia citriana Pale imortale		15	>2000	
F	4	Calotis lappulacea Yellow Burr Daisy		5	800	
F	5	Whalenbergia communis Blue Bell		0.2	200	
F	6	Sida corrugata Corrugated sida		2	250	
S	7	Scleroleana dichantha Grey Copper Burr	N	10	800	
—	8	Carthamus lantanus Safron thistle HTE	E	10	>1500	
G	9	Pannicum decompositum Hairy Panic	N	2	400	
G	10	Austrostipa scabra Rough Spear Grass		5	1000	
S	11	Atriplex stipitata Bitter saltbush		2	300	
S	12	Scleolenna brachii Gal burr		2	150	
G	13	Aristida behriana Brushwire Grass		0.1	50	
G	14	Aristida ramosa 3-awn grass		0.1	50	
—	15	Salvia verbenaca Wild Sage	E	0.1	50	
F	16	Erodium crinitum Storksbill	N	0.1	20	
F	17	Euphorbia drummondii Caustic Weed	N	0.1	5	
—	18	Convolvulus arvensis Bindweed	E	3	400	
G	19	Enneapogon aviculans Curly Windmill	N	0.2	150	
F	20	Ptilotus atriplicifolius Crimson foxtail	N	0.5	150	
F	21	Abutilon leucopetalum Lantern Bush	N	0.1	20	
F	22	Calotis cuneifolia Purple burr daisy	N	1	150	
F	23	Chrysocephalum bracteatum Golden Everlasting	N	0.1	15	
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

²**Foliage cover**: 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*. Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-6] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	7/12/21	Survey name	Mallee Bull		Plot identifier	10	
Recorders	Phil Cameron			IBRA region	Cobar		Veg zone ID	2	
[1]Datum	GDA	Coordinate system	☐ Projected ☐ Geographic	MGA zone	55	[1]X coordinate	416064	[1]Y coordinate	6413842
Location description	descriptive notes to locate site without grid reference								
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m					[1]Orientation of midline from 0 m point	Magnetic ° 310	Photo #	

Datum: AGD66, WGS84, GDA84, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW); 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3] Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	/	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	/	80 + cm —	Count
	Shrubs (SG)	3		Shrubs (SG)	4.1	50 – 79 cm —	Count (best practice) tick. If large tree benchmark size ≥50 cm, count
	Grasses etc (GG)	4		Grasses etc (GG)	48.1	30 – 49 cm —	Count (best practice) tick. If large tree benchmark size ≥ 30 cm, count
	Forbs (FG)	9		Forbs (FG)	3.6	20 – 29 cm —	Count (best practice) tick. If large tree benchmark size ≥ 20 cm, count
	Ferns (EG)	/		Ferns (EG)	/	10 – 19 cm —	Count (best practice) tick
	Other (OG)	/		Other (OG)	/	5 – 9 cm —	Count (best practice) tick
						[4]Tree regeneration <5 cm —	Tick
			Total high threat weed cover		5 %	[5]Length of fallen logs —	Tally span / Total m
						[6]Hollow bearing trees	Tick 0

Vegetation integrity - function cont. (five 1 m² plots)	[1]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	1 0 1 10 10 25 10 80 20 15 0 0 1 0 0 30 90 0 25 1			
Average of the 5 subplots	4.4	30	0.2	29.2

These attributes require consideration of site observations and may be completed after field work

Vegetation class	[1]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT) 104	EEC	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope °		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	3	O
Cultivation (inc. pasture)	—	—
Soil erosion	3	O
Firewood / CWD removal	3	O
Grazing (d. native/stock)	3	NR
Fire damage	—	
Storm damage	—	
Weediness	2	NR
Other	—	

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Brief site description or other notes

In impact foot print. Plot representative of broader area. Substantive timber cleared due to mining. No trees in 20x20m (randomly selected where arrived) but in 20x50 (White Cypress)

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
— m	— m	— m	— m	— m	— m	— m	0.3 m	0.1 m	0.5 m	0.2 m	0.1 m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 7/12/21	Mallee Bull	10	Phil Cameron

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[2] Foliage cover	Abundance	Voucher
S	Eremophila mitchellii	Budda	N	0.1	6	
G	Austrodanthonia setacea	Rough-spike Grass		35	2K	
S	Sclerolaena birchii	Galvanised Burr		10	500	
G	Enteropogon acicularis	Curly Windmill		3	500	
S	Sclerolaena diacantha	Grey Copperburr		3	500	
F	Wahlenbergia communis	Tufted Bluebell		0.1	150	
F	Sida cunninghamiana	Ridged Sida		0.1	100	
F	Sida corrugata	Corrugated Sida		0.1	100	
F	Vittadinia cuneata	Fuzzy Weed		0.1	100	
F	Calotis cuneata	Purple burr daisy		1	400	
F	Ptilotus atriplicifolius	Crimson tails		1	350	
F	Calotis lappulacea	Yellow burr daisy		1	350	
S	Atriplex stipitata	Bitter saltbush		1	200	
F	Boerhavia dominii	Tar Bush	N	0.1	25	
~	Convolvulus arvensis		E	2	250	
G	Austrodanthonia	Hill Wallaby Grass	N	0.1	90	
F	Oxalis chnoodes	Sorrel.	N	0.1	15	
~	Carthamus lanatus	Saffron thistle	HE	5	1000	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-5] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	7/12/21	Survey name	Mallee Bull	Plot identifier	11
Recorders				IBRA region		Veg zone ID	2
[1]Datum	GDA	Coordinate system	☐ Projected ☐ Geographic	MGA zone	55	[1]X coordinate	415281
[1]Y coordinate	6413686						
Location description	descriptive notes to locate site without grid reference						
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m ✓ For function (1000m²): 20 m x 50 m ✓			[1]Orientation of midline from 0 m point	Magnetic ° 240°	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3] Tree stem size class (DBH)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	10	80 + cm	—	Count
	Shrubs (SG)	6		Shrubs (SG)	12.7	50 – 79 cm	1	Count (best practice) tick. If large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)	2		Grasses etc. (GG)	3.3	30 – 49 cm	2	Count (best practice) tick. If large tree benchmark size ≥ 30 cm, count
	Forbs (FG)	9		Forbs (FG)	6.5	20 – 29 cm	1	Count (best practice) tick. If large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	1	Count (best practice) tick
	Other (OG)			Other (OG)		5 – 9 cm	0	Count (best practice) tick
						[4]Tree regeneration <5 cm	0	Tick
			Total high threat weed cover		2 %	[5]Length of fallen logs	Tally space	Total 42 m
						[5]Hollow bearing trees	Tick 1	

Vegetation integrity - function cont. (five 1 m²) plots)	[1]Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	60	80	5	50	50	30	10	70	20	25	10	+	20	5	0	0	15	0	0	1
Average of the 5 subplots	49					31					7					3.2				

These attributes require consideration of site observations and may be completed after field work

Vegetation class		[6]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	104	EEC	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	2	0
Cultivation (inc. pasture)	—	—
Soil erosion	3	0
Firewood / CWD removal	3	0
Grazing (cf. native/stock)	3	0
Fire damage	—	—
Storm damage	—	—
Weediness	1	R
Other	—	

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Brief site description or other notes

Represents an area of some mallee in PCT. Not a pure mallee PCT initself (due to size) just a bit of variation in broader area. Historic disturbance includes tree + substantive veg removal due to mining.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	10 m	8 m	4 m	m	m	m	m	m	m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

* E in bark in 20 x 50m plot.

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 7/12/21	Mallee Bull	11	Phil Cameron

GF code		Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[2] Foliage cover	Abund-ance	Voucher
T	1	E socialis	Pointed Mallee.	N	10	1	
S	2	Eremophila mitchellii	Budda	N	1	13	
S	3	Geijera parvifolia	Wilga	N.	1	4	
S	4	Sclerolaena birchii	Galvanised burr	N	5	400	
S	5	Dodonaea attenuata	Narrow-leaf hopbush	N	0.1	1	
S	6	Atriplex stipitata	Bitter saltbush	N	0.2	150	
F	7	Nicotina spp.	Tobacco Bush	N	0.1	5	
G	8	Paspalidium constrictum	Box Grass.	N	3	400	
S	9	Sclerolaena diacantha	Grey Copper burr	N	5	800	
F	10	Sida corrugata	Corrugated sida	N	0.1	350	
F	11	Sida cunninghamiana	Ridged Sida	N	1	350	
F	12	Oxalis chnoodes	Sour Sob	N	0.1	5	
S	13	Salsola kali	Buckbush	N	0.1	1	
F	14	Vittadinia cuneata	Fuzz weed.	N.	0.1	10	
F	15	Calotis cuneata	Purple burr daisy	N	3	400	
T	16	Carthamus lanatus.	Saffron thistle	HTE	2	400	
G	17	Enneapogon avenaceus	Curly Windmill.	N	0.3	400	
S	18	Ptilotus atriplicifolius	Crimson foxtail	N	0.3	400	
F	19	Solanum esuriale	Quena	N	0.1	10	
F	20	Wahlenbergia communis	Pale immortelle	N	1	250	
F	21	Einadia nutans nutans	Creeping Saltbush	N.	0.1	1	
	22						
	23						
	24						
	25						
	26						
	27						
	28						
	29						
	30						
	31						
	32						
	33						
	34						
	35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover**: 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m*. Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	7/12/21	Survey name	Mallee Bull		Plot identifier	12	
Recorders	Phil Cameron			IBRA region	Cobar		Veg zone ID	2	
[1]Datum	GDA	Coordinate system	☐ Projected ☐ Geographic	MGA zone	55	[1]X coordinate	415640	[1]Y coordinate	6413839
Location description	descriptive notes to locate site without grid reference								
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m ✓					[1]Orientation of midline from 0 m point	140°	Magnetic°	Photo #

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field.

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [2] Tree stem size class (DBH)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	1	Sum of [2] foliage cover of native plant species by growth form group	Trees (TG)	15	80 + cm	1	Count
	Shrubs (SG)	5		Shrubs (SG)	66.1	50 – 79 cm	2	Count (best practice) tick. If [3]large tree benchmark size ≥50 cm, count
	Grasses etc (GG)	4		Grasses etc (GG)	7.1	30 – 49 cm	—	Count (best practice) tick. If [3]large tree benchmark size ≥ 30 cm, count
	Forbs (FG)	10		Forbs (FG)	1.3	20 – 29 cm	—	Count (best practice) tick. If [3]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)			Ferns (EG)		10 – 19 cm	—	Count (best practice) tick
	Other (OG)			Other (OG)		5 – 9 cm	—	Count (best practice) tick
						[4]Tree regeneration <5 cm	—	Tick
			Total high threat weed cover			[5]Length of fallen logs	—	Tally space / Total 62 m
						[6]Hollow bearing trees	Tick 1	

Vegetation integrity - function cont. (five 1 m²) plots)	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	10 80 40 20 45	5 5 50 15 15	✓ ✓ ✓ ✓ ✓	✓ ✓ ✓ ✓ ✓
Average of the 5 subplots	25	14	—	—

These attributes require consideration of site observations and may be completed after field work.

Vegetation class		[8]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	104		EEC Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	1	O
Cultivation (inc. pasture)	—	—
Soil erosion	2	NR
Firewood / CWD removal	3	O
Grazing (pt. native/stock)	3	NR
Fire damage	—	
Storm damage	—	
Weediness	—	
Other	—	

Brief site description or other notes

CIN area of disturbance. Represents an area of large E. Intertexta.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe. Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 7 12 21	Mallee Bull	12	Phil Cameron

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[1] Foliage cover	Abundance	Voucher
TG	Eucalyptus intertexta	Gum-barked Coolibah	N	15	2	—
SG	Eremophila mitchellii	Budda	N	0.5	9	
SG	Cassia phyllodinea	Wilga	N	0.5	7	
FG	Nitraria sp.	Tobacco Bush	N	0.1	250	
SG	Sclerolaena birchii	Galvanised Burr	N	60	>3K	
—	Marrubium vulgare	White Horehound	E	5	300	
FG	Enchylaena tomentosa	Ruby Saltbush	N	0.1	25	
C	Paspalidium constrictum	Bon Grass	N	3	250	
G	Austrostipa scabra	Rough spear Grass	N	3	400	
FG	Calotis lappulacea	Yellow burr daisy	N	0.2	150	
FG	Calotis cuneata	Blue burr daisy	N	0.2	150	
G	Rhytidosporum sp1		N	0.1	3	
FG	Chenopodium desertorum	Black Crumbweed	N	0.2	150	
FG	Sida corrugata	Corrugated sida	N	0.1	50	
FG	Boerhavia dominii	Tar Vine	N	0.1	5	
FG	Erodium cirratum	Storksbill	N	0.1	3	
~~G~~	~~Austrostipa scabra~~	— Repeat	~~N~~			
G	Enteropogon acicularis	Curly Windmill	N	1	150	
F	Solanum ferocissimum	Spiny Potatobush	N	0.1	1	
F	Euphorbia drummondii	Caustic Weed	N	0.1	5	
SG	Atriplex semibaccata	Creeping Saltbush	N	0.1	15	
SG	Sclerolaena diacantha	Grey Copperburr	N	5	400	
—	Sisymbrium officinale	Hedge Mustard	E	0.1	10	
—	Astrebla michellii	Mitga Grass	N	0.1	15	
	Abutilon leucopetalum	Desert Lantern	N	0.1	15	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[1] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	7/12/21	Survey name	Mallee Bull	Plot identifier	13
Recorders	Phil Cameron	IBRA region	Cobar			Veg zone ID	2
[1]Datum	GDA	Coordinate system	□ Projected □ Geographic	MGA zone	[1]X coordinate 415016	[1]Y coordinate	6413861
Location description	descriptive notes to locate site without grid reference						
[2]Plot dimensions	For composition & structure (400m²) 20 m x 20 m ✓ For function (1000m²) 20 m x 50 m ✓		[2]Orientation of midline from 0 m point	Magnetic° 110°	Photo #		

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW) or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3]Tree stem size class (DBH)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	—	Sum of [2]foliage cover of native plant species by growth form group	Trees (TG)	/	80 + cm	—	Count
	Shrubs (SG)	4		Shrubs (SG)	10.3	50 – 79 cm	—	Count (best practice)/tick. If [4]large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)	2		Grasses etc. (GG)	25.5	30 – 49 cm	—	Count (best practice)/tick. If [4]large tree benchmark size ≥ 30 cm, count
	Forbs (FG)	9		Forbs (FG)	15.4	20 – 29 cm	—	Count (best practice)/tick. If [4]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)	/		Ferns (EG)	/	10 – 19 cm	—	Count (best practice)/tick
	Other (OG)	/		Other (OG)	/	5 – 9 cm	2	Count (best practice)/tick
						[4]Tree regeneration <5 cm	—	Tick —
			Total high threat weed cover		2 %	[5]Length of fallen logs		Tally space / Total 4 m
						[6]Hollow bearing trees		Tick 0

Vegetation integrity - function cont. (five 1 m²) plots)	[7]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	5 5 0 2 15	40 45 30 35 50	0 0 1 0 0	15 40 40 25 0
Average of the 5 subplots	5.4	48	0.2	24

These attributes require consideration of site observations and may be completed after field work

Vegetation class		[8]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	104	EEC	Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	3	O
Cultivation (inc. pasture)	—	—
Soil erosion	3	O
Firewood / CWD removal	3	O
Grazing (id. native/stock)	3	O
Fire damage	—	—
Storm damage	—	—
Weediness	1	R
Other	—	—

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Brief site description or other notes: In impact footprint. Representative of area affected by road upgrade. E. intertexta + Callitris glaucophylla not in plot but in 100m. WCV in 20x50m plot

Emergents heights Top	Mid	Bottom	Upper stratum heights Top	Mid	Bottom	Middle stratum heights Top	Mid	Bottom	Lower stratum heights Top	Mid	Bottom
— m	— m	— m	— m	— m	— m	0.2 m	0.1 m	0.1 m	0.4 m	0.3 m	0.1 m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 7/12/21	Mallee Bull	13	Ail Cameron

GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[1] Foliage cover	Abundance	Voucher
GG	Austrostipa scabra	Rough spear-Grass.	N	25	>24	
F	Ptilotus atriplicifolius.	Crimson fortail	N	10	500	
S	Sclerolaena dichanthia	Grey Copper Burr	N	10	2k.	
F	Sida corrugata	Corrugated sida	N	1	510	
F	Sida cunninghamii	Ridge Sida	N	1	560	
F	Waltzia citriana	Pale immortale	N	1	400	
F	Atriplex stipitata	Bitter saltbush	N	6.2	75	
F	Calotis lappulacea	Yellow burr daisy	N	1	300	
G	Thyridolepis mitchelli.	Mulga Grass	N	0.3	200	
F	Euphorbia drummondii.	caustic weed	N	0.1	50	
S	Cleiger parvifolia	Wilga	N	0.1	1	
S	Atriplex leptocarpa	Slender-fruit Saltbush	N	0.1	25	
S	Sclsola kali	Buckbush	N	0.1	1	
F	Calotis cuneifolia	Purple Burr daisy	N	1	300	
F	Boerhavia dominii	Tar Vine	N	0.1	50	
—	Carthamus lanatus	Saffron Thistle	HTE	2	400	

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[1] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date	8/12/21	Survey name	Mallee Bull	Plot identifier	14
Recorders	Phil Cameron			IBRA region	Cobar	Veg zone ID	3
[1]Datum	GDA94	Coordinate system	□ Projected □ Geographic	MGA zone	[2]X coordinate 416018	[2]Y coordinate	6412814
Location description	descriptive notes to locate site without grid reference						
[3]Plot dimensions	For composition & structure (400m²): 20 m x 20 m For function (1000m²): 20 m x 50 m			[4]Orientation of midline from 0 m point	Magnetic° 30°	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	[5]Tree stem size class (DBH)	If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	—	[6]Sum of foliage cover of native plant species by growth form group	Trees (TG)	—	80 + cm —	Count
	Shrubs (SG)	5		Shrubs (SG)	40.2	50 – 79 cm —	Count (best practice) tick. If [7]large tree benchmark size ≥50 cm, count
	Grasses etc (GG)	6		Grasses etc (GG)	11.3	30 – 49 cm —	Count (best practice) tick. If [7]large tree benchmark size ≥ 30 cm, count
	Forbs (FG)	8		Forbs (FG)	2.7	20 – 29 cm —	Count (best practice) tick. If [7]large tree benchmark size ≥ 20 cm, count
	Ferns (EG)	—		Ferns (EG)	—	10 – 19 cm —	Count (best practice) tick
	Other (OG)	—		Other (OG)	—	5 – 9 cm —	Count (best practice) tick
						[8]Tree regeneration <5 cm	Tick
			Total high threat weed cover		15 %	[9]Length of fallen logs	Tally space — Total 30 m
						[10]Hollow bearing trees	Tick 1

Vegetation integrity - function cont. (five 1 m² plots)	[11]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	60 20 60 50 55	5 25 0 10 —	— — 3 — —	— — 15 5 —
Average of the 5 subplots	49	8	.6	4.6

These attributes require consideration of site observations and may be completed after field work:

Vegetation class	[12]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT) 104		EEC Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	2	0
Cultivation (inc. pasture)	—	—
Soil erosion	2	0
Firewood / CWD removal	3	0
Grazing (pf. native/stock)	2	R
Fire damage	—	—
Storm damage	—	—
Weediness	2	R
Other	—	—

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Brief site description or other notes:

Selected to be most representative of zone and closest to impact footprint. Impact footprint was too "erosion-rich" to be representative.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
m	m	m	m	m	m	m	m	m	m	m	m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

C. gracilis + E. populnea 2 in 100m but not in plot (not representative of broader area)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 8/12/21	Mallee Bull	14	Phil Cameron

GF code		Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	² Foliage cover	Abund-ance	Voucher
SG	1	Geijera parviflora	Wilga	N	10	1	–
SG	2	Eremophila mitchelii	Budda	N	10	8	
–	3	Carthamus lanatus	Saffron thistle	HTE	15	1000+	
SG	4	Sclerolaena birchii	Gal burr	N	15	400	
SG	5	Sclerolaena diacantha	Grey Copper Burr	N	15	500	
–	6	Sisymbrium officinale	Hedge Mustard	E	15	2000+	
G	7	Austrostipa scabra		N	5	1500	
G	8	Enneapogon avenaceus	Curly Windmill	N	2	400	
SG	9	Salsola kali	Black bush.	N	0.2	50	
FG	10	Boerhavia dominii	Tar Vine	N	0.1	50	
FG	11	Euphorbia drummondii	Caustic weed	N	0.1	10	
FG	12	Chenopodium desertorum	Black crumbweed	N	0.1	10	
FG	13	Sida corrugata	Corrugated sida	N	0.1	50	
FG	14	Waitzia citrina	Pale immortale	N	2	250	
G	15	Paspalidium constrictum	Box Grass	N	2	300	
G	16	Paspalidium decompositum	Hairy Panic	N	2	300	
S	17	Atriplex semibaccata	Slender-fruited Saltbush	N	0.2	50	
G	18	Rytidosperma bellum	Hill Wallaby Grass	N	0.1	50	
FG	19	Ptilotus atriplicifolius	Crimson foxtail	N	0.1	25	
FG	20	Calotis lappulacea	Yellow burr daisy	N	0.1	15	
FG	21	Nicotiana spp.	Tobacco bush	N	0.1	1	
	22						
	23						
	24						
	25						
	26						
	27						
	28						
	29						
	30						
	31						
	32						
	33						
	34						
	35						

Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

² **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Numbers [1-8] on this page correlate with the numbers and explanatory notes on page 3

Site sheet #	1 of	Date [1]	8/12/21	Survey name	Mallee Bull	Plot identifier	15
Recorders	Phil Cameron			IBRA region	Cobar	Veg zone ID	3
[1]Datum	GDA	Coordinate system	☐ Projected ☐ Geographic	MGA zone	55	[1]X coordinate	416279
[1]Y coordinate	6412714						
Location description	descriptive notes to locate site without grid reference						
[1]Plot dimensions	For composition & structure (400m²): 20 m x 20 m ✓ For function (1000m²): 20 m x 50 m ✓			[1]Orientation of midline from 0 m point	Magnetic ° 140°	Photo #	

Datum: AGD66, WGS84, GDA94, GDA2020 or Other (specify). MGA Zone (for Projected coordinate system only): 56 (Coastal NSW), 55 (Central NSW or 54 (Western NSW). X/Y coordinate: Long/Lat (for Projected coordinate system), Easting/Northing (for geographic coordinate system)

Vegetation integrity

Composition and structure sum values may be completed after entering data into available tools. It is not required while in the field.

Composition (400 m² plot)		Sum values	Structure (400 m² plot)		Sum values (%) (may sum to >100%)	Function (1000 m² plot) [3] Tree stem size class (DBH)		If data are to be used as more appropriate local data i.e. to generate local benchmarks, stems must be counted
Total count of native plant species (richness) in each growth form group (not individual plants within each growth form)	Trees (TG)	—	[2] Sum of foliage cover of native plant species by growth form group	Trees (TG)	—	80 + cm	—	Count
	Shrubs (SG)	4		Shrubs (SG)	11.1	50 – 79 cm	1	Count (best practice) tick. If large tree benchmark size ≥50 cm, count
	Grasses etc. (GG)	2		Grasses etc. (GG)	25	30 – 49 cm	—	Count (best practice) tick. If large tree benchmark size ≥ 30 cm, count
	Forbs (FG)	4		Forbs (FG)	7.1	20 – 29 cm	✓	Count (best practice) tick. If large tree benchmark size ≥ 20 cm, count
	Ferns (EG)	✓		Ferns (EG)	✓	10 – 19 cm	—	Count (best practice) tick
	Other (OG)	✓		Other (OG)	✓	5 – 9 cm	—	Count (best practice) tick
						[4]Tree regeneration <5 cm		Tick
			Total high threat weed cover		25 %	[5]Length of fallen logs		Tally space / Total m
						[6]Hollow bearing trees		Tick

Vegetation integrity - function cont. (five 1 m²) plots)	[1]Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	35 15 — — — 15 10 4 95			3
Average of the 5 subplots	10	24	—	0.6

These attributes require consideration of site observations and may be completed after field work.

Vegetation class		[8]Large tree benchmark size	20/ 30/ 50/ 80 DBH	Confidence	H/ M/ L
Plant community type (PCT)	104		EEC / Tick	Confidence	H/ M/ L

Physiography and site features that may help in determining PCT and management zone (optional) or for BioNet systematic flora survey purposes:

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Disturbance	Severity code	Age code
Clearing (inc. logging)	3	0
Cultivation (inc. pasture)	2	0
Soil erosion	2	0
Firewood / CWD removal	3	0
Grazing (id. native/stock)	3	0
Fire damage	—	—
Storm damage	—	—
Weediness	3	R
Other	—	—

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Brief site description or other notes:

Representative of more open area of zone 2 more White Cypress Pine. This plot included an old growth WCP. Weedy.

Emergents heights			Upper stratum heights			Middle stratum heights			Lower stratum heights		
Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom	Top	Mid	Bottom
— m	— 3.0 m		— 30 m		— m	— m		— m	0.4 m	0.2 m	0.1 m

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m² floristics plot:	Survey name	Plot identifier	Recorders
Date 8/12/21	Phil Cameron	15	Phil Cameron

	GF code	Species name Full species name, or a unique means of identifying separate taxa within a survey is mandatory. Data from here will be used to assign growth form richness and cover.		N, HTW or non-HTW	[2] Foliage cover	Abundance	Voucher
1	T	Cupressus glauophylla	White Cypress	N	5	1	—
2	—	Carthamus lanatus	Saffron Thistle	HTW	25	>3k	—
3	G	Austrostipa scabra	Rough spear grass	N	20	>3k	—
4	S	Sclerolaena birchii	Galvar	N	5	400	—
5	S	Geijera parviflora	Wilga	N	1	2	—
6	S	Sansevia khali	Buckbush	N	01	50	—
7	—	Convolvulus arvensis	Bindweed	N	1	400	—
8	G	Paspalidium constrictum	Box Grass	N	1	400	—
9	FG	Waitzia citrina	Pale everlasting	N	5	1000	—
10	S	Sclerolaena dichoantha	Grey Copper bur	N	5	1000	—
11	G	Enneapogon aristatus	Curly top windmill	N	5	1000	—
12	F	Ptilotus atriplicifolius	Crimson tartail	N	1	400	—
13	F	Euphorbia drummondii	Caustic weed	N	1	400	—
14	F	Atriplex stipitata	Bluebush	N	0.1	200	—
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Print more copies of this page to allow for higher species counts at a plot. All vascular plant species in a plot need to be recorded.

GF Code: see growth form definitions in BAM 2020 Appendix F. **N:** native, **HTW:** high threat weed.

[2] **Foliage cover:** 0.1, 0.2, 0.3, ..., 1, 2, 3, 4, 5, 10, 15, 20, 25, ...100%; Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately *1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m.* Note the top 3 dominant native species within each GF group.

Abundance: Count 1, 2, 3 ..., when ≤10, estimate when >10, 20, 30 ... 100, 200, 300 ..., 1000, 2000, 3000 ... (as integer values).

Appendix E: Credit reports

BAM-C credit reports included on the following pages:

- Credits summary report
- Biodiversity credit report (Like-for-like)
- Candidate threatened species report
- Predicted species report.

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033354/BAAS17082/22/00033355	Mallee Bull Project	19/12/2022
Assessor Name	Report Created	BAM Data version *
Phillip Cameron	22/12/2022	56
Assessor Number	BAM Case Status	Date Finalised
BAAS17082	Finalised	22/12/2022
Assessment Revision	Assessment Type	
0	Part 5 Activities	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits
Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion												
4	176_Recovering	Not a TEC	52	52.0	0.63	PCT Cleared - 20%	High Sensitivity to Gain			1.50		12
											Subtotal	**12**

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BAM Credit Summary Report

Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion											
2	104_Disturbed	Not a TEC	57.5	57.5	4.9	PCT Cleared - 25%	High Sensitivity to Gain			1.50	106
3	104_Open	Not a TEC	40.6	40.6	1.4	PCT Cleared - 25%	High Sensitivity to Gain			1.50	21
										Subtotal	**127**
Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion											
1	103_Open	Not a TEC	41.4	41.4	30	PCT Cleared - 50%	High Sensitivity to Gain			1.75	544
										Subtotal	**544**
										Total	**683**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00033354/BAAS17082/22/00033355	Proposal Name Mallee Bull Project	BAM data last updated * 19/12/2022
Assessor Name Phillip Cameron	Assessor Number BAAS17082	BAM Data version * 56
Proponent Names	Report Created 22/12/2022	BAM Case Status Finalised
Assessment Revision 0	Assessment Type Part 5 Activities	Date Finalised 22/12/2022

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Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		
Species		
Nil		

Additional Information for Approval

PCT Outside Ibra Added

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BAM Biodiversity Credit Report (Like for like)

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Calyptorhynchus lathami / Glossy Black-Cockatoo
Grantiella picta / Painted Honeyeater

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion	Not a TEC	30.0	0	544	544
104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	Not a TEC	6.3	106	21	127
176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	Not a TEC	0.6	0	12	12

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BAM Biodiversity Credit Report (Like for like)

103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Western Peneplain Woodlands This includes PCT's: 103, 135, 145	Western Peneplain Woodlands >=50% and <70%	103_Open	No	544	Nymagee, Barnato Downs, Bogan-Macquarie, Canbelego Downs, Darling Depression, Lachlan Plains and Lower Slopes. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Inland Rocky Hill Woodlands This includes PCT's: 104, 106, 122, 175, 176, 177, 178, 180, 184, 185, 186, 188, 218, 239, 256, 257, 258, 292, 317, 318, 319, 328, 329, 332, 334, 357, 424, 427, 439	Inland Rocky Hill Woodlands <50%	104_Disturbed	Yes	106	Nymagee, Barnato Downs, Bogan-Macquarie, Canbelego Downs, Darling Depression, Lachlan Plains and Lower Slopes. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

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BAM Biodiversity Credit Report (Like for like)

	Inland Rocky Hill Woodlands This includes PCT's: 104, 106, 122, 175, 176, 177, 178, 180, 184, 185, 186, 188, 218, 239, 256, 257, 258, 292, 317, 318, 319, 328, 329, 332, 334, 357, 424, 427, 439	Inland Rocky Hill Woodlands <50%	104_Open	No	21	Nymagee, Barnato Downs, Bogan-Macquarie, Canbelego Downs, Darling Depression, Lachlan Plains and Lower Slopes. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Inland Rocky Hill Woodlands This includes PCT's: 104, 106, 122, 175, 176, 177, 178, 180, 184, 185, 186, 188, 218, 239, 256, 257, 258, 292, 317, 318, 319, 328, 329, 332, 334, 357, 424, 427, 439	Inland Rocky Hill Woodlands <50%	176_Recovering	No	12	Nymagee, Barnato Downs, Bogan-Macquarie, Canbelego Downs, Darling Depression, Lachlan Plains and Lower Slopes. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

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BAM Biodiversity Credit Report (Like for like)

176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion

Species Credit Summary

No Species Credit Data

Credit Retirement Options

Like-for-like credit retirement options

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BAM Candidate Species Report

Proposal Details

Assessment Id 00033354/BAAS17082/22/00033355	Proposal Name Mallee Bull Project	BAM data last updated * 19/12/2022
Assessor Name Phillip Cameron	Report Created 22/12/2022	BAM Data version * 56
Assessor Number BAAS17082	Assessment Type Part 5 Activities	BAM Case Status Finalised
Assessment Revision 0	Date Finalised 22/12/2022	

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List of Species Requiring Survey

Name	Presence	Survey Months
Acacia curranii Curly-bark Wattle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☑ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Burhinus grallarius Bush Stone-curlew	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☑ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Calyptorhynchus lathami* - *endangered population Glossy Black-Cockatoo, Riverina population	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☑ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?

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BAM Candidate Species Report

Diuris tricolor Pine Donkey Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Grevillea ilicifolia subsp. ilicifolia Holly-leaf Grevillea	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☑ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Lophochroa leadbeateri Major Mitchell's Cockatoo	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Ninox connivens Barking Owl	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☑ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Phascolarctos cinereus Koala	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☑ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Polytelis swainsonii Superb Parrot	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

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BAM Candidate Species Report

Pterostylis cobarensis Greenhood Orchid	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Tyto novaehollandiae Masked Owl	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☑ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Threatened species Manually Added

None added

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
A spear-grass	Austrostipa wakoolica	Habitat constraints
Black-breasted Buzzard	Hamirostra melanosternon	Habitat constraints
Commersonia procumbens	Commersonia procumbens	Habitat constraints
Glossy Black-Cockatoo	Calyptorhynchus lathami	Habitat constraints
Little Eagle	Hieraaetus morphnoides	Habitat constraints

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00033354/BAAS17082/22/00033355	Mallee Bull Project	19/12/2022
Assessor Name	Report Created	BAM Data version *
Phillip Cameron	22/12/2022	56
Assessor Number	Assessment Type	BAM Case Status
BAAS17082	Part 5 Activities	Finalised
Assessment Revision		Date Finalised
0		22/12/2022

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Barking Owl	Ninox connivens	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
Black Falcon	Falco subniger	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
Black-breasted Buzzard	Hamirostra melanosternon	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
Chestnut Quail-thrush	Cinclosoma castanotum	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Corben's Long-eared Bat	Nyctophilus corbeni	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion

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BAM Predicted Species Report

Corben's Long-eared Bat	Nyctophilus corbeni	176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Diamond Firetail	Stagonopleura guttata	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Dusky Woodswallow	Artamus cyanopterus cyanopterus	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Gilbert's Whistler	Pachycephala inornata	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Grey Falcon	Falco hypoleucos	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion

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BAM Predicted Species Report

Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Inland Forest Bat	Vespadelus baverstocki	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Kultarr	Antechinomys laniger	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Little Eagle	Hieraaetus morphnoides	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Little Pied Bat	Chalinolobus picatus	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Major Mitchell's Cockatoo	Lophochroa leadbeateri	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion

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BAM Predicted Species Report

Malleefowl	Leipoa ocellata	176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Masked Owl	Tyto novaehollandiae	104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
Pied Honeyeater	Certhionyx variegatus	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Shy Heathwren	Hylacola cautus	176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Speckled Warbler	Chthonicola sagittata	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Spotted Harrier	Circus assimilis	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
Stripe-faced Dunnart	Sminthopsis macroura	176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Superb Parrot	Polytelis swainsonii	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
Varied Sittella	Daphoenositta chrysoptera	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion

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White-throated Needletail	Hirundapus caudacutus	176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion
		176-Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion

Threatened species Manually Added

None added

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Common Name	Scientific Name	Plant Community Type(s)
Glossy Black-Cockatoo	Calyptorhynchus lathami	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
Painted Honeyeater	Grantiella picta	103-Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion
		104-Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C
Glossy Black-Cockatoo	Calyptorhynchus lathami	Habitat constraints
Painted Honeyeater	Grantiella picta	Habitat constraints

Appendix 5

Archaeological Survey

(awaiting final RAP consultation feedback)

prepared by
AREA Environmental & Heritage Consultants Pty Ltd

(Total No. of pages including blank pages = 115)

Peel Mining Limited, Mallee Bull Project

Archaeological Survey Report

Gilgunnia, NSW Cobar LGA

September 2022

AREA
ENVIRONMENTAL & HERITAGE CONSULTANTS

AREA Environmental & Heritage Consultants
"The Old Macquarie Brewery" c1876, 72 Brisbane Street Dubbo NSW 2830

AREA Environmental & Heritage Consultants ABN:29 616 529 867

- ✓ Environmental impact assessment, auditing, and approvals
- ✓ High level preliminary environmental assessment (PEA)
- ✓ Review of environmental factors (REF)
- ✓ Peer review
- ✓ Community engagement
- ✓ Biobanking and biodiversity offsetting assessments
- ✓ Aboriginal heritage assessments and community walkovers
- ✓ Landscape design

AREA Environmental & Heritage Consultants acknowledges Traditional Owners of the country on which we work

Document Controls

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AREA Person(s) Managing this Document	Anna Darby Archaeologist		
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Prepared For	Jack Flanagan - Senior Environmental Consultant **R.W. Corkery & Co.** M: 0402 060 522 E: jack@rwcorkery.com		
Prepared By	Anna Darby - Environmental Consultant **AREA Environmental Consultants & Communication Pty Ltd** 6 Belmore Street Dubbo NSW 2830 E anna@areaenv.com.au ABN:29 616 529 867		

Executive Summary

Background

Peel Mining Limited (PML; the proponent) propose to establish an exploration decline within Exploration Licence 7461 for definition drilling of the deeper portions of the Mallee Bull deposit (the proposal), located approximately 110 km south of Cobar, near Gilgunnia in central New South Wales (NSW).

AREA Environmental & Heritage Consultants (AREA) has been engaged by R.W. Corkery & Co Pty Ltd (the client) on behalf of the proponent to complete an archaeological survey report for the proposal. The aim of this report is to confirm the extent of Aboriginal objects or areas of archaeological potential that would be impacted by the proposal and whether an Aboriginal Heritage Impact Permit (AHIP) would be required from Heritage NSW, as well as to recommend the extent of any further assessment and/or management or mitigation measures that may be required. This archaeological survey report will form part of the Review of Environmental Factors (REF) being prepared in accordance with the requirements of Section 5 of the EP&A Act.

Previous assessments

PML engaged OzArk Environmental & Heritage Management (OzArk) in 2018 to conduct both desktop and visual field surveys of 20 ha of the Mallee Bull exploration area. OzArk concluded that there are no identified Aboriginal heritage sites in the proposed exploration area, however this does not exempt the possibility that there may have been prior to the historical disturbances of the area.

In 2021, PML engaged Everick Heritage Pty Ltd (Everick Heritage) to conduct an archaeological survey of the proposed mining lease areas with the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants, adjacent to the current proposal. The survey team recorded four new Aboriginal sites, three culturally modified scar trees and one hearth complex.

Fieldwork

The fieldwork component of this assessment was undertaken over two weekends on 4 to 6 February 2022 and 12 to 13 February 2022 by Anna Darby and Mel Hancock of AREA. Peter Harris, Janine Ohlsen, Krista Masaarna, and Jarhen Kennedy who represented the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants were in attendance to provide cultural knowledge. The purpose of the field assessment was to support the desktop research and to identify Aboriginal objects, non-physical Aboriginal site types and / or Aboriginal places.

A total of 41 Aboriginal sites have been recorded within the study area and access road. One Aboriginal site (Mallee Bull AS05) will be partially impacted by the proposal, 12 sites within 100m of the impact footprint were avoided but require mitigation actions to reduce the likelihood of indirect impact. The remaining 28 Aboriginal sites are more than 100m away from the impact footprint and will be avoided by the proposal.

Recommendations

Based on the assessment the following recommendations are based on the consideration of:

- The requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010).

- The results of the background research and fieldwork.
- The likely impacts of the proposed development.

Based on the assessment, the following recommendations are made:

- The 'Heritage Zones' should be fenced off with standard farm fencing as shown in Figure 6-163 and Figure 6-164.
- The locations of the Aboriginal cultural heritage sites should be provided to the relevant supervisors responsible for the construction and operation of the proposal. They should be informed that cultural heritage sites are protected under the NPW Act and no harm is to come to them. The presence of the cultural heritage sites should be made clear to the workforce as part of an induction and on project specific maps.
- Aboriginal sites outside the 'Heritage Zones' should be avoided and fenced off. The sites should be re-identified with the assistance of a qualified archaeologist and the Aboriginal community. Any Aboriginal sites within 100 metres of proposed impacts should have standard farm fencing around each with a buffer of ten metres from the trunk of the culturally modified trees and five metres from the boundaries of the open sites.
- Mallee Bull AS05 will be partially impacted by the proposal and an Aboriginal Heritage Impact Permit (AHIP) would be required before any impact to the recorded site.
- Should an AHIP be issued, salvage activities including surface collection within the impact footprint should be undertaken in accordance with OEH's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (2011a).*
- If changes are made to the proposed works which could impact locations outside of the proposed study area, further archaeological investigation may be required.
- If any objects of suspected Aboriginal heritage origin are encountered during the proposed works, work in the area of the find should cease and the unexpected finds protocols (Appendix B) should be implemented.
- If suspected human remains are located during any stage of the proposed works, work must stop immediately, and the NSW police must be notified.

Table of Contents

Figures

Tables

1 Introduction

1.1 Background

Peel Mining Limited (PML; the proponent) propose to establish an exploration decline within Exploration Licence 7461 for definition drilling of the deeper portions of the Mallee Bull deposit (the proposal), located approximately 110 km south of Cobar, near Gilgunnia in central New South Wales (NSW), Figure 1-1.

PML engaged OzArk Environmental & Heritage Management (OzArk) in 2018 to conduct both desktop and visual field surveys of 20 ha of the Mallee Bull exploration area. OzArk concluded that there are no identified Aboriginal heritage sites in the proposed exploration area, however this does not exempt the possibility that there may have been prior to the historical disturbances of the area.

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AREA Environmental & Heritage Consultants (AREA) has been engaged by R.W. Corkery & Co Pty Ltd (the client) on behalf of the proponent to complete an archaeological survey report for the proposal. The aim of this report is to confirm the extent of Aboriginal objects or areas of archaeological or cultural potential that would be impacted by the proposal and whether an Aboriginal Heritage Impact Permit (AHIP) would be required from Heritage NSW, as well as to recommend the extent of any further assessment and/or management or mitigation measures that may be required. This archaeological survey report will form part of the Review of Environmental Factors (REF) being prepared in accordance with the requirements of Section 5 of the EP&A Act.

1.2 Locality

The study area is within the Nymagee subregion of the Cobar Peneplain bioregion which includes low hills and ridges with steep slopes. Sandplains from adjacent bioregions lap onto lower slopes (OEH 2013).

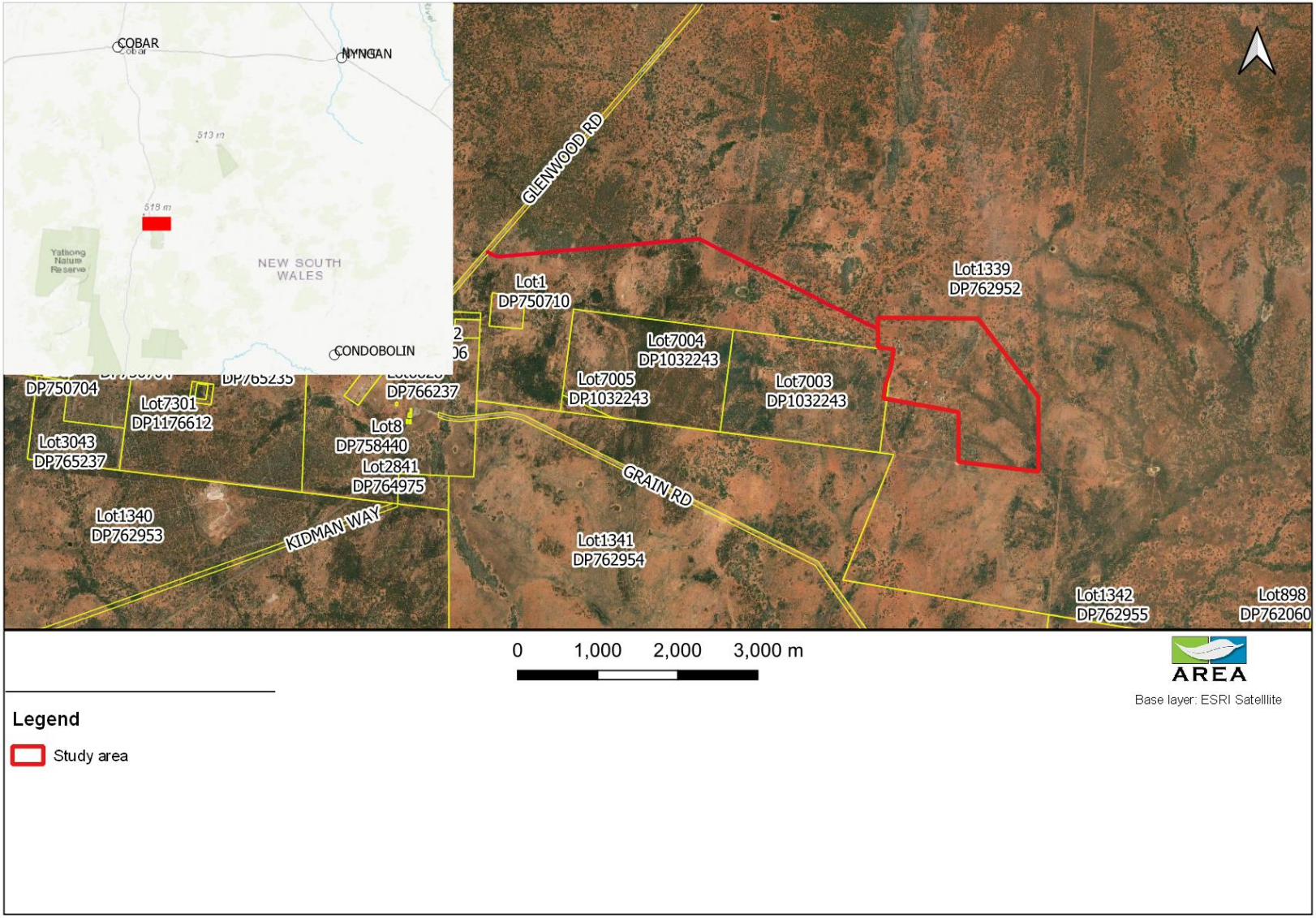
The study area is also within the Murray-Darling Basin. Yanda Creek, a major stream that discharges directly into the Darling River, is approximately 40 kilometres to the north of Hera Mine.

The regional geographical context of the development footprint is provided in Table 1-1.

Table 1-1: Regional geographical context of the study area

Criteria	study area
Central coordinates (GDA94 z55)	E 436566, N 6445779
Interim Biogeographic Regionalisation for Australia (IBRA Region)	Cobar Peneplain Bioregion - Nymagee subregion
State	New South Wales
Topographical map sheet	Nymagee 8133
Local Government Area	Cobar LGA
Local Aboriginal Land Council area (LALC)	Unincorporated
Parish	Tarcombe
County	Blaxland
Schedule of Native Title Determination Applications (Claims, ILUA Future Acts etc.)	Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan native title determination application
Nearest town / locality	Nymagee NSW
Accessed from nearest town by	Grain Road
Land use / disturbance	Mining, farming, Travelling stock route
Nearest waterway (Name, Strahler Order)	Burthong Creek (4th Order Strahler) is located 6.4 km southwest of the study area
Spot point Australian Height Datum (AHD)	Approximately 300m AHD

Figure 1-1: Location of the study area



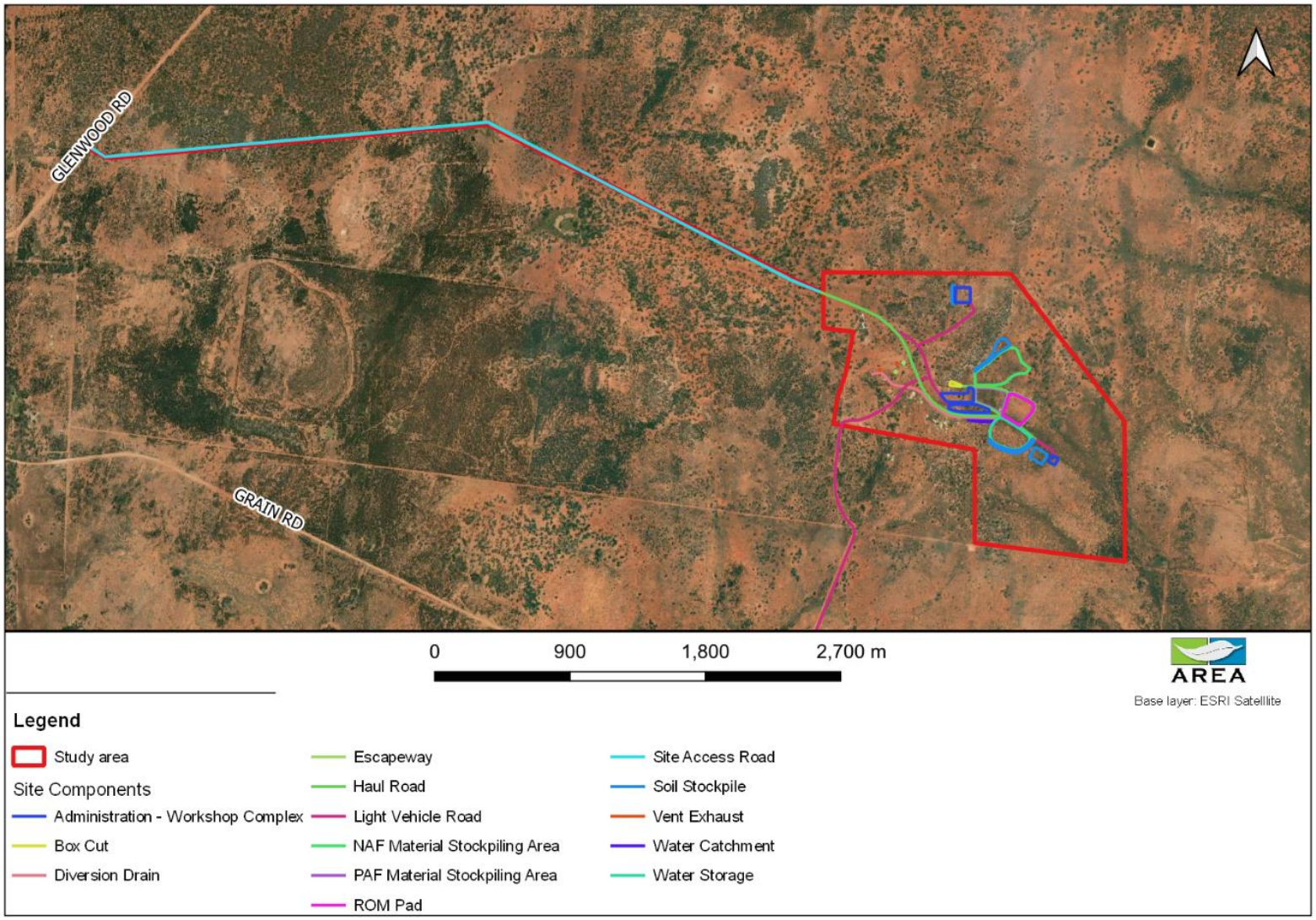
1.3 Proposal description

Peel Mining Limited (PML) propose to establish an exploration decline within Exploration Licence 7461 for definition drilling of the deeper portions of the Mallee Bull deposit. The Mallee Bull deposit features typical Cobar-style attributes of short strike lengths, relatively narrow widths and good vertical continuity. As the lodes at depth are relatively narrow, it is not possible to define a reserve without definition drilling at closer spacing than what is economically possible with surface-only drill programs. Hence, further underground drilling is required for definition of the deeper portions of ore bodies.

The proposal includes an existing light vehicle road from Grain Road into the study area. This road was not assessed as it is an already well form road (unsealed) with an existing 20m clearance zone.

For the purpose of this report the area effected by the proposal will be preferred to as the 'study area'. Proposed impacts and design detail will be referred to as 'site components'.

Figure 1-2: Site components for the proposal



1.4 Aboriginal community involvement

AREA undertook consultation in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (*DECCW 2010).

Peter Harris, Janine Ohlsen, Krista Masaarna, and Jarhen Kennedy represented the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants during the fieldwork.

1.5 Project personnel

This assessment was carried out by appropriately experienced and qualified staff (Table 1-2). Anna Darby conducted the field survey and prepared this report. Phil Cameron provided project management and reviewed this report.

Table 1-2: Summary the project team's qualifications

Name	Position	CV Details	Suitability for the task
Phillip Cameron	Director. Edited report	• BSc. Macquarie University • Ass Dip App Sci. University of Queensland • Certified Environmental Practitioner (EIANZ) • Practicing member of the Environment Institute of Australia and New Zealand (EIANZ).	Phillip Cameron is an appropriately skilled and experienced person (degree or relevant experience) in the field of Aboriginal cultural heritage management, the equivalent of two years full-time experience in Aboriginal archaeological investigation, including involvement in a project of similar scope, a demonstrated ability to conduct a project of the scope required through inclusion as an attributed author on a report of similar scope) under the NSW OEH Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW. Phillip has been undertaking heritage assessments as an environmental consultant since 2004.
Anna Darby	Archaeologist. Authored the report. Undertook site recording and the survey.	• Bachelor of Arts and Bachelor of Science (Archaeology, Paleoanthropology and Forensic Science). University of New England • Bachelor of Science (Honours). University of New England	Anna has worked in Australian archaeology since 2015. She has been involved in all levels of assessment in Aboriginal archaeology, including survey and excavation. She has also worked to varying degrees in historical archaeology.

2 Legislative context

2.1 National Parks and Wildlife Act 1974

Under the *National Parks and Wildlife Act 1974* (NPW Act), the Director-General of the National Parks and wildlife Service (NPWS) is responsible for the care and protection of Aboriginal objects and places in NSW. An *Aboriginal object* means any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains. An *Aboriginal place* is defined as any place of special significance with respect to Aboriginal culture as declared by the Minister.

Under Section 86 of the Act, a person must not harm an Aboriginal object or place. Penalties are in place for anyone who breaches these conditions or knowingly defaces or destroys an Aboriginal object or place without a permit.

In order to undertake a proposed activity which is likely to involve harm to an Aboriginal place or object, it is necessary to apply to Heritage NSW for an Aboriginal heritage impact permit (AHIP). AHIPs are issued by NSW Heritage under Section 90 of the Act, and permit harm to certain Aboriginal objects or Aboriginal places.

2.2 Native Title Act 1994

The *Native Title (New south Wales) Act 1994* was introduced to work in conjunction with the *Native Title Act 1993* (Cth). Native title claims, registers and Indigenous land use agreements are administered under the NSW Act.

The investigation area is within the NC2012/001 - Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan registered native title application.

2.3 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act consists of three main parts of direct relevance to Aboriginal cultural heritage:

- Part 3 which governs the preparation of planning instruments
- Part 4 which relates to development assessment processes for local government (consent) authorities
- Part 5 which relates to activity approvals by governing (determining) authorities.

This archaeological survey report will form part of the Review of Environmental Factors (REF) being prepared by R.W. Corkery for the proposal in accordance with the requirements of Section 5 of the EP&A Act.

3 Landscape features

3.1 Overview

A review of the landscape of the investigation area and surrounds allows for comparison with other archaeologically investigated areas. It also assists in assessing existing and previous disturbances which may have affected the integrity of archaeological remains. Environmental features such as landforms, topography, water sources, geology, soils, and vegetation are also relevant for an archaeological assessment.

The proposal is in the western portion of the Cobar Peneplain Bioregion - Nymagee Downs subregion. The bioregion is in central NSW west of the Great Dividing Range.

3.2 Landforms and topography

The Nymagee subregion is a prominent topographical landscape of rolling downs and flat plains punctuated by stony ridges and ranges and is formed on the north westerly extension of the Lachlan Fold Belt (OEH 2013). The landscape within the study area is generally flat with one elevation (ridgeline).

3.3 Waterways

The bioregion lies wholly within the Murray-Darling Basin (OEH 2013). There are no major water ways present within the study area. However, there are several minor drainage lines within the study area that are ephemeral and are dependent on local rainfall. Burthong Creek is located 8.5 km southeast of the study area (Figure 3-1).

3.4 Geology and soils

The geology of the Nymagee Downs subregion includes granites, quartzose sandstones, phyllites, slates and acid volcanics (OEH 2013). Soils include gritty red and yellow earthy sands on granite, stony red earths and texture contrast soils on sedimentary rocks, calcareous red earths in sandplains, and minor earths and grey clays in alluvium. The study area appears to be comprised of a deflated A-horizon leaving basal deposits and exposed stone materials (OzArk 2013). Due to the deflated topsoils any cultural material (if present) will likely be confined to the surface and/or upper sections of the soil profile.

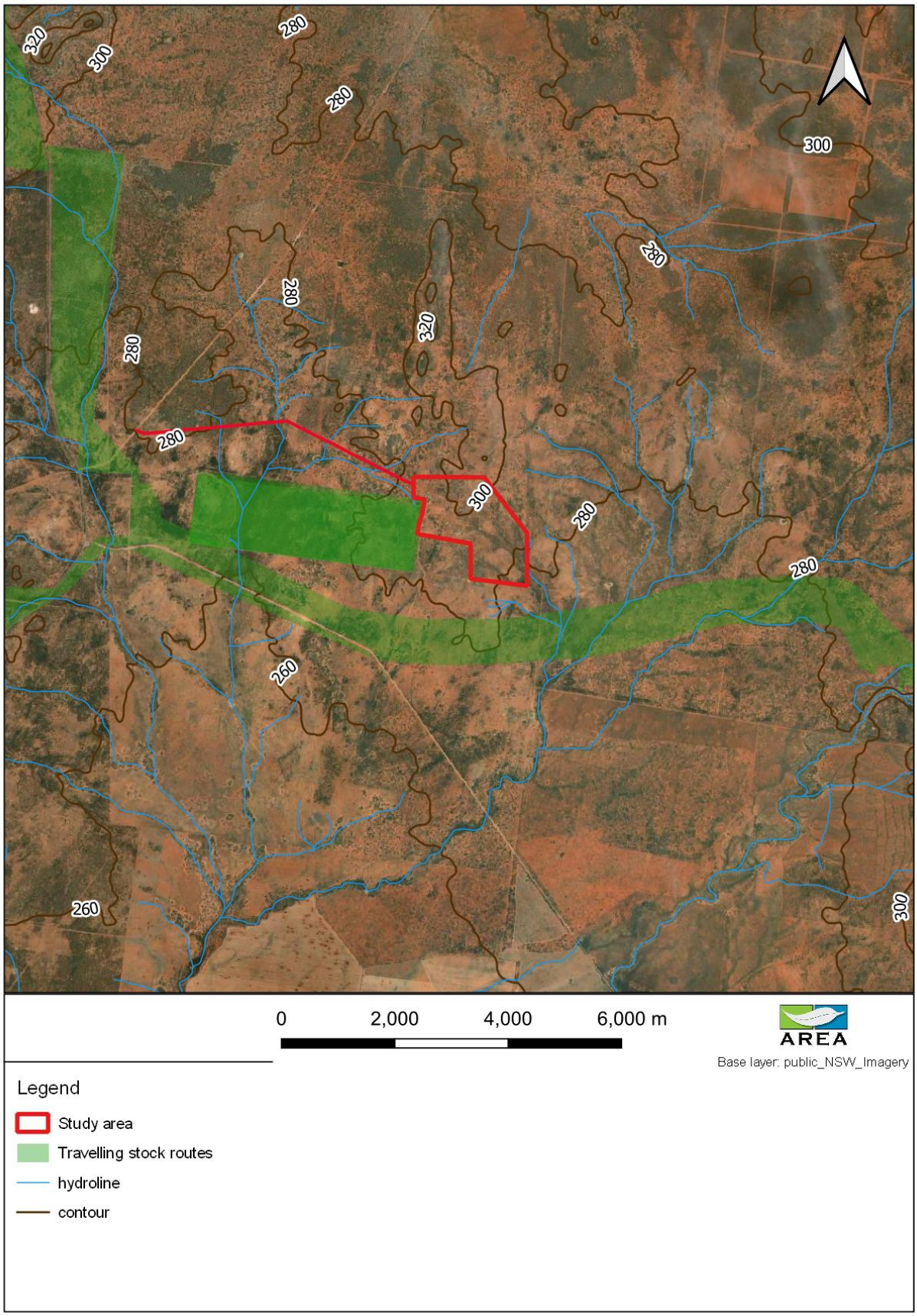
3.5 Vegetation

Vegetation within the Nymagee subregion is characterised by Dwyer's mallee gum, white cypress pine, kurrajong, golden wattle on granite crests, Bimble box and red box on slopes and creeks. White cypress pine, red box, belah with mallee, western wattle grey box and rosewood on crests and slopes of Sedimentary rocks. Mallee communities on sandplains. Dense poplar box and white cypress pine in creek lines (OEH 2013). The vegetation within the study area has been assessed as aligning with the BioNet Vegetation Classification for PCT103 *Poplar Box - Gum Coolabah - White Cypress Pine shrubby woodland mainly in the Cobar Peneplain Bioregion*, PCT 104 *Gum Coolabah woodland on sedimentary substrates mainly in the Cobar Peneplain Bioregion* and PCT176 *Green Mallee - White Cypress Pine very tall mallee woodland on gravel rises mainly in the Cobar Peneplain Bioregion*s.

Aboriginal people used what they could from the vegetation for resource gathering and making shelters. Young White White Cypress Pine saplings were used by the Ngiyampaa people to

make spears as they were long and straight. The sap was also used as an antiseptic for cuts and burns (LLSWR 2016).

Figure 3-1: Overview of the landscape context of the study area



3.6 Climate

The Cobar Peneplain is within Australia's hot, persistently dry semi-arid climatic zone (OEH 2013). Climate data from the Cobar MO weather station shows the development footprint experiences hot summers and mild winters (Table 3-1). Mean rainfall is quite low. Highest rainfall is in summer, although this is distorted by heavier, infrequent rainfall events as indicated by the relatively even spread of median rainfall values throughout the year.

Table 3-1: Summary climate data (red maximum, blue minimum values)

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
	Temperature														
Mean maximum temperature (°C)	34.5	33.4	30.2	25.4	20.1	16.5	16.0	18.1	22.1	26.3	29.7	32.8	25.4	58	1962 2020
Mean minimum temperature (°C)	20.8	20.2	17.2	13.0	9.0	6.2	5.1	6.2	9.1	12.8	16.0	18.9	12.9	58	1962 2020
	Rainfall														
Mean rainfall (mm)	43.6	41.8	35.0	27.4	32.3	28.9	27.5	25.8	24.6	33.7	35.6	34.9	388.8	57	1962 2020
Decile 5 (median) rainfall (mm)	19.1	23.7	28.2	13.6	23.8	24.6	20.7	17.6	17.4	27.4	22.8	19.5	375.6	58	1962 2020
Mean number of days of rain ≥ 1 mm	4.1	3.3	3.6	2.8	3.6	4.4	3.9	3.7	3.6	4.1	4.2	3.6	44.9	58	1962 2020

4 Archaeological context

4.1 Aboriginal cultural heritage

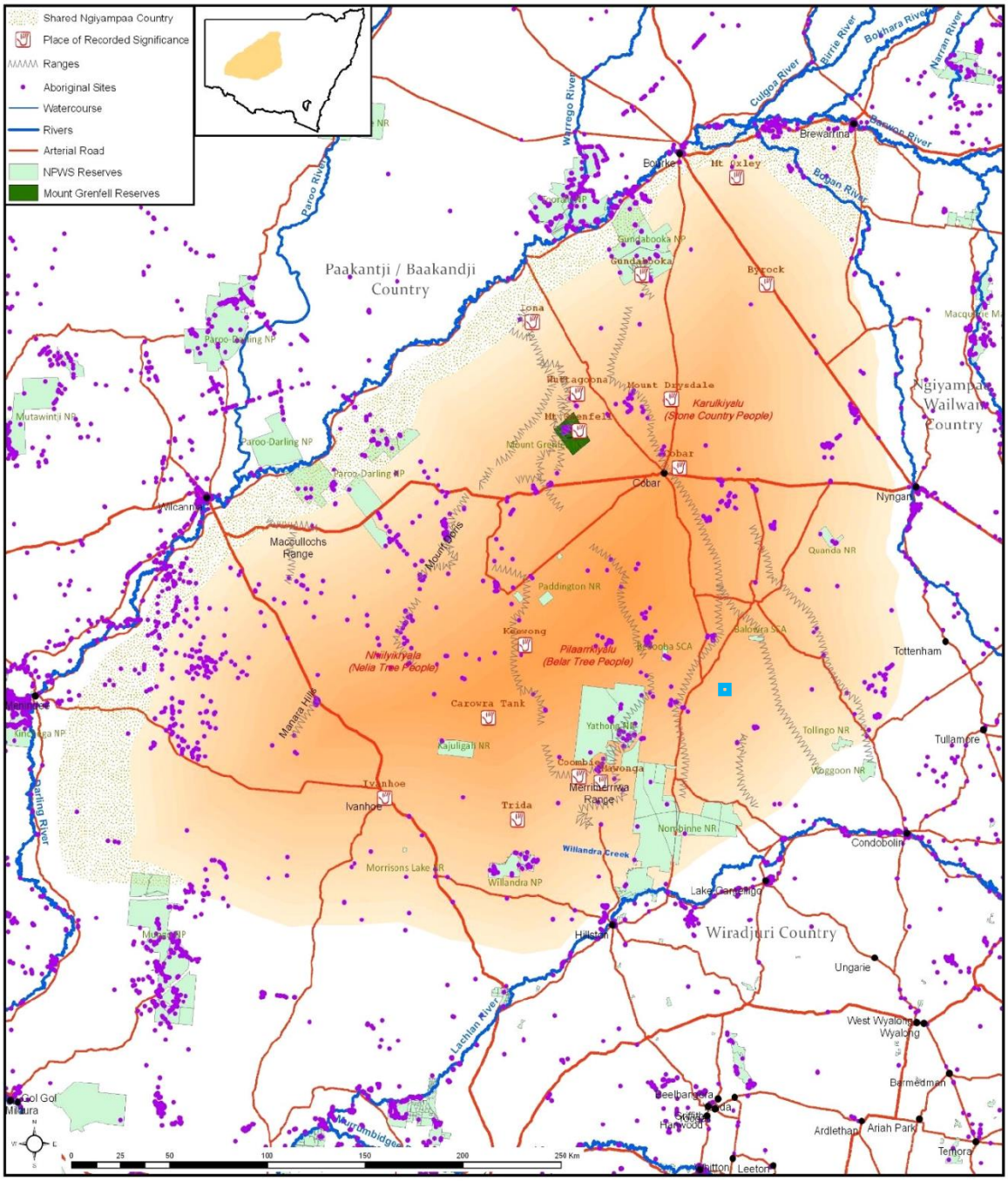
The archaeological record can provide evidence Aboriginal people have been present in Australia for approximately 60,000 years and provides evidence of a dynamic culture coupled with a long occupation of the land. The proposal is within the traditional lands of the Ngiyampaa Wangaaypuwan people who lived in the dry region between the three rivers: the Darling-Barwon to the north, the Bogan River to the east, and the Lachlan River to the south (Beckett 1959; Beckett et al. 2003). They are often associated with the dry backcountry and only visited the Darling-Barwon and Bogan rivers in times of extreme drought (Beckett et al. 2003).

The Ngiyampaa Wangaaypuwan are the people who speak the Ngiyampaa language the Wangaaypuwan way. According to Smart et al (2000) they are the people who use the word *wangaay* for 'no' and *puwan* means 'having' or 'with'. This language can be more fully referred to as Ngiyampaa–Ngemba Wangaaypuwan which reflects the 'heavy tongue' spoken in the north and 'light tongue' spoken in the south. The Wailwan people to the east also use Ngiyampaa as the name of their language (NPWS. 2015). Within the Ngiyampaa Wangaaypuwan people there were local groupings recognised and named geographically according to the type of Country they occupied. The people who camped in the north around Mount Grenfell are *Karulkiyalu* or 'Stone Country' People. Other language groups are the *Pilaarrkiyalu* or 'Belah Tree' People in the south and the *Nhiilyikiyalu* or 'Nelia Tree' People to the west.

The Ngiyampaa Wangaaypuwan had cultural ties with their neighbours, along the boundaries, there is shared Country. The shared country used by other Aboriginal people in times of drought, for ceremony, for marriage or for trade. To the east is Wailwan Country, to the south Wiradjuri Country and to the north and west, Paakantji/Baakantji Country (Figure 4-1; NPWS 2015). The proposal is located along the eastern edge of the of Ngiyampaa Wangaaypuwan country and neighbours the adjoining Wiradjuri country.

The Ngiyampaa people followed a matrilocal residence form of social organisation in which the men tended to live with their wives' people with groupings corresponding to matrilineal totemic clans (Beckett et al. 2003). These clans were grouped into two matri-moieties (called Nilpungerra or Kilpungerra and Makungarra) and into further divided into four sections creating a two generational principle. For marriage the pairings were dependent on the *thingkaa* or 'meat' of the two matriclans marrying, the law in Ngiyampaa Wangaaypuwan being that you never married your own 'meat' (Beckett et al. 2003).

Figure 4-1: Map of Ngiyampaa Wangaaypuwan country, blue box indicates the approximate location of the investigation area (Source: NPWS 2015).



4.2 Local archaeological context

Databases were searched to locate previous archaeological studies and Aboriginal sites within 10km of the study area. The results of these searches are summarised in Figure 4-1. An extensive search of the Aboriginal Heritage Information Management System (AHIMS) was conducted on 2 December 2021 (Client ID: 644078). The AHIMS search provides archaeological context for the area and identifies whether any previously recorded Aboriginal sites are located within or near the investigation area.

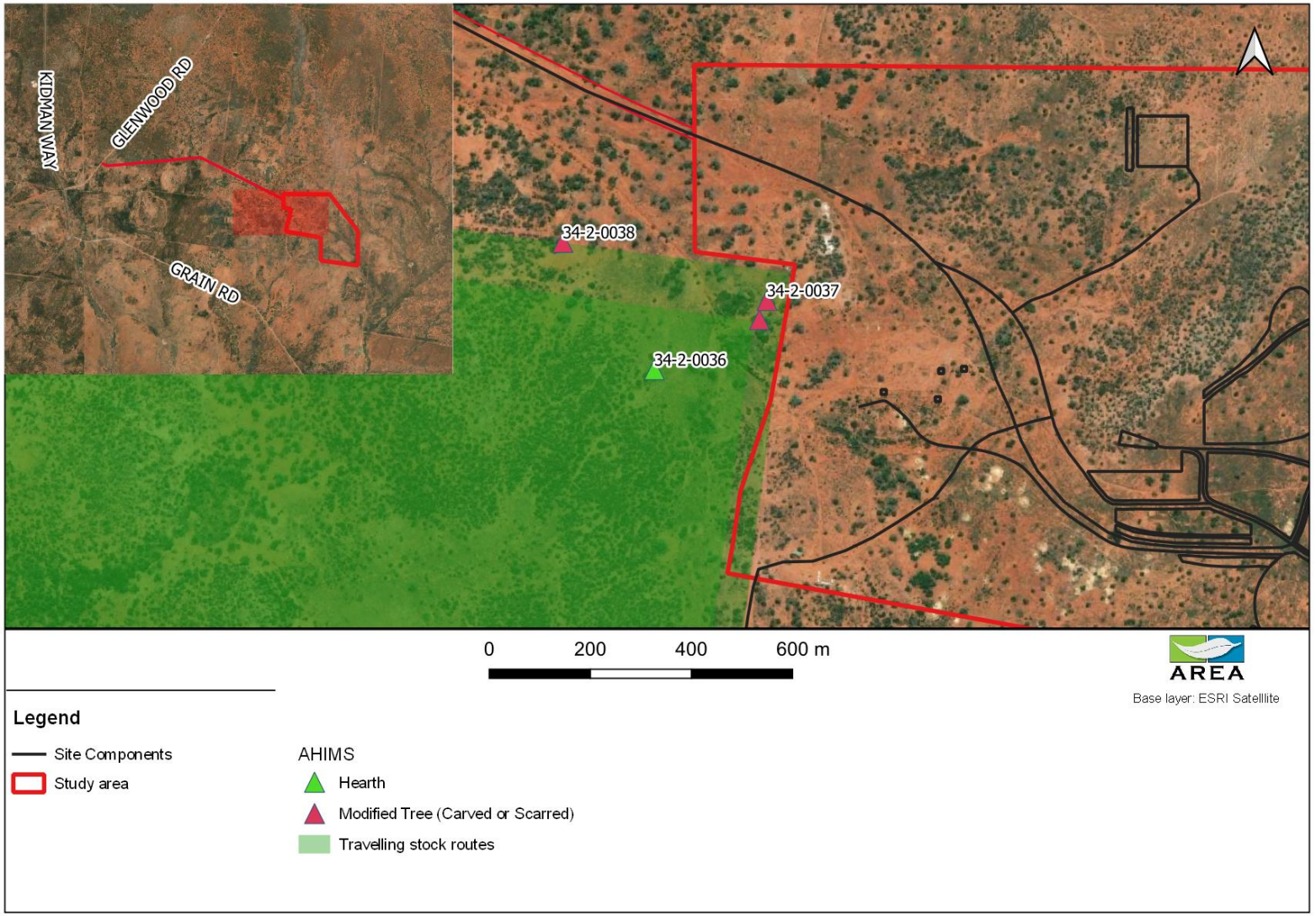
A total of four Aboriginal sites were recorded on the AHIMS database within the search area all recorded by Everick Heritage (2020).

The distribution of the AHIMS sites and previously-recorded Aboriginal sites is shown in Figure 4-2. The full list of results is provided in Appendix A.

Table 4-1: Summary of database searches for Aboriginal heritage

Database	Date of Search	Parameters	Results
Aboriginal Heritage Information Management System (AHIMS) Client ID: 644078	2/12/2021	GDA Zone 55 406087 – 426087 mE 6403198 – 6423198 mN	4 Aboriginal sites (3 culturally modified, and 1 hearth complex) were recorded with the search area and are adjacent to the study area.
Cobar LEP 2012	13/12/2021	Schedule 5: Environmental Heritage	No Sites of Aboriginal Heritage Are on The Database Nearby to the study area.
Native Title Vision https://nntt.maps.arcgis.com/	30/09/20	NSW	The following application covering the investigation area have been accepted for registration: Name: **Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan** Tribunal No: NC2011/006 Fed Court No: NSD38/2019 Type Claimant Status: Active
State Heritage Register http://www.environment.nsw.gov.au/heritageapp/heritagesearch.aspx	30/09/20	Cobar LGA	Mt Drysdale, approximately 140 km north of the Investigation area is recorded in this register.

Figure 4-2: Result of the extensive AHIMS search within 20 km of the investigation area



4.3 Previous archaeological studies

There is a growing body of archaeological investigations in the Cobar and Gilgunnia area. There have been some compliance-based heritage assessments adding to the archaeological record. Below is a summary of several archaeological reports conducted within the study area and surrounding area.

Wagga Tank and Mallee Bull Tank Archaeological Survey report (Everick Heritage 2020)

In 2021, PML engaged Everick Heritage Pty Ltd (Everick Heritage) to conduct an archaeological survey of the proposed mining lease areas at Mallee Bull and Wagga Tank with the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants. The Mallee Bull survey area is adjacent to the western boundary of the current study area, within a TSR.

The survey team recorded four new Aboriginal sites, three culturally modified scar trees and one hearth complex (Table 4-2). Everick assessed the four sites as having an overall high scientific significance.

Table 4-2: Summary of Aboriginal sites located within the Mallee Bull Tank survey (Everick Heritage 2020)

Site ID	Name	Site type
AHIMS ID 34-2-0038	Mallee Bull Tank ST1	Modified Tree (Carved or Scarred)
AHIMS ID 34-2-0037	Mallee Bull Tank ST2	Modified Tree (Carved or Scarred)
AHIMS ID 34-2-0035	Mallee Bull Tank ST3	Modified Tree (Carved or Scarred)
AHIMS ID 34-2-0036	Mallee Bull HC1	Hearth complex

The Mallee Bull Project Mining Lease Area & Proposed Accommodation Camp Aboriginal and Historic Due Diligence Archaeological Assessment (OzArk EHM 2018)

OzArk Environmental & Heritage Management (OzArk) was engaged by PML to complete an Aboriginal and historic heritage Due Diligence assessment within the Mallee Bull Mining Lease Area (MLA) located within the current study area. The survey team identified no items of Aboriginal cultural heritage or landforms of archaeological significance within the study area.

Various Aboriginal cultural heritage assessments at Federation and Hera Mine (AREA 2018, 2020a, 2020b, 2021a, 2021b)

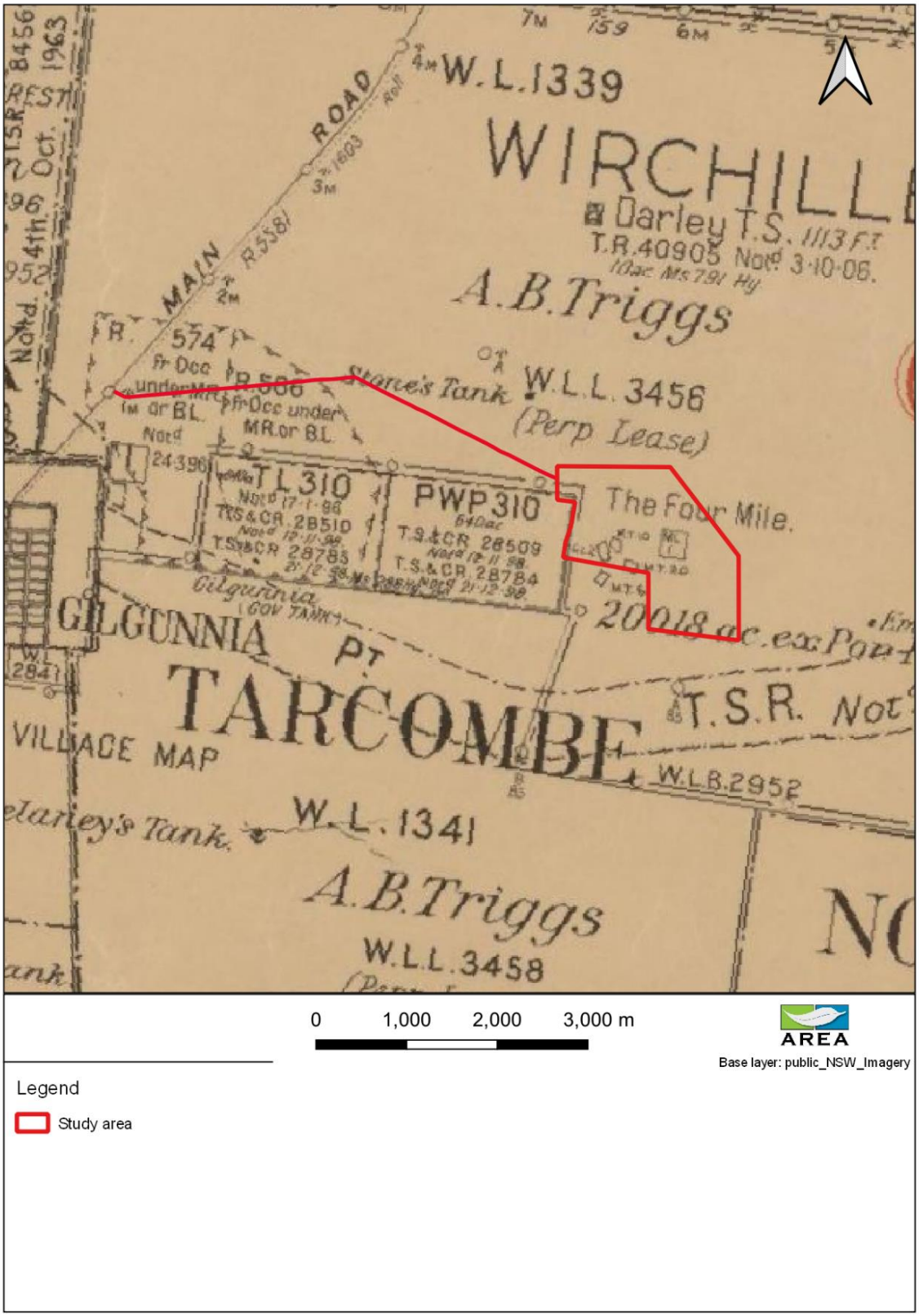
Since 2011 AREA and the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants and Condobolin Aboriginal Land Council have been engaged by Hera Resources to conduct various Aboriginal and archaeological surveys undertaken across the Federation Site, Hera Mine and the Services Corridor connecting the two, located approximately 38 km northeast of the current study area. The landform of the assessed areas included plains with either Bimble Box grassy woodlands or Mallee and Gum Coolabah woodland with spinifex ground cover. Several rocky crests were assessed, while no archaeological material was observed the peaks provided good observation points and would have been utilised by Aboriginal people.

To date 28 Aboriginal sites have been recorded to date including six hearths, 11 culturally modified trees (scarred), and two open sites containing stone artefacts and knappable quartz outcrops (quarries).

4.4 Land use

The land surrounding Gilgunnia has been mined since 1887 when a small amount of alluvial gold was found in the area (Campbell). The first payable reef gold was discovered in 1895 by John “Jackey” Owen by June of that year there were about 450 men on the field with 17 claims on payable gold. The study area is located within the Four Mile deposit which saw a brief but very frenetic burst of exploration activity from 1895–1897 when shafts were sunk exploring the numerous quartz veins which contained some gold values. As no economic gold mineralisation was encountered in the underground prospecting, the goldfield was not further prospected until the Union Corporation began exploring the district in the 1970s (OzArk EHM 2018).

Figure 4-3: 1880 Parish Map, study area outlined in red (source: NSW Department of Lands)



4.5 Predictive model

A predictive model combines the archaeological context for the study area with landscape information to propose likely site types, distributions, and intactness within the area.

Areas of archaeological potential are regarded as any sensitive landform with a reasonable level of intactness (i.e. little to no disturbance or minor ground surface disturbance only and in areas not on self-mulching soils). The definition of disturbance used here follows that of the *National Parks and Wildlife Regulation 2009* (Clause 80B, Subclause 4). Sensitive landforms follow the definitions supplied in the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010):

- within 200m of waters
- located within a sand dune system
- located on a ridge top, ridge line or headland
- located within 200m below or above a cliff face
- within 20m of or in a cave, rock shelter, or a cave mouth.

Aboriginal settlement patterns in areas of low water security likely fluctuated or were cyclical, and marginal areas such as that of the study area would have been exploited for resources during periods of more secure precipitation (Smith 2013: 12). Therefore, the archaeological record of areas within the region that are removed from reliable water should reflect less intense, temporary (but repeated) occupation and resource gathering.

Four sites of Aboriginal heritage have been recorded within five kilometres of the study area on the AHIMS database. The broader archaeological context indicates that sites are very unlikely to occur unless there are landscape features that are at least able to hold water for short periods of time following heavy inundation.

If present, site types are most likely to be stone artefact sites based on the regional archaeological context. The geology of the study area indicates that stone for artefacts would need to be brought into the area rather than locally manufactured. However, many tools and other objects were made from wood, bone and shell which do not survive into the archaeological record as well as stone (Clarke, 2007, p.111).

Culturally modified trees can occur anywhere on old growth trees to produce suitable bark to create carrying dishes (commonly known as *coolamons*), canoes and other items. Trees may also be modified as markers or other types of communication.

Other site types may occur but within the landscape context of the study area they are not likely to exist. Hearths are reasonably common but tend to deteriorate and be destroyed more easily. Quarries are possible where raw material is available. Ochre quarries and stone arrangements are unlikely to occur.

5 Fieldwork

5.1 Background to fieldwork

The fieldwork component of this assessment was undertaken over two weekends on 4 to 6 February 2022 and 12 to 13 February 2022 by Anna Darby and Mel Hancock of AREA. Peter Harris, Janine Ohlsen, Krista Masaarna, and Jarhen Kennedy represented the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants were in attendance. The purpose of the field assessment was to support the desktop research and to identify Aboriginal objects, places and items with cultural heritage values.

5.2 Methods

The field methods used to assess the study area follow those described in the OEH's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (OEH 2011a).

The purpose of the field survey was to identify any previously-undetected Aboriginal sites, places areas with cultural heritage values and evaluate the possible need for further investigation (i.e. test-excavation). A GPS was used to ensure the survey covered the proposal area. It is important to note the tracks for the survey represent only two people from the survey team (AREA staff). With the exception of the last day (where five people did the assessment) the survey team comprised of six people. As a result, survey transects were up to 60m wide. The positions of the tracks and location of sites were recorded (Figure 5-26). Photographic and written records were made of the landscape features relevant to archaeological potential. These features include disturbance levels, Ground Surface Visibility (GSV) and landforms of higher archaeological potential (see Section 4).

All ground exposures were examined for Aboriginal objects (stone artefacts, imported shell, or other traces of Aboriginal occupation). Old growth trees were examined for signs of cultural scarring and marking. Aboriginal sites were recorded using AREA's criteria conforming with *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (OEH 2011a).

5.3 Constraints

The northeast section of the study area contains a dense cluster of Bimble Box tress with many of the trees were culturally modified (scarred). Due to time constraints the decision was made by the survey team to walk the perimeter of the cluster of trees and employ a single transect down the middle to gauge the density of Aboriginal sites within this section. Fifteen Culturally Modified Trees (scarred) and five stone artefact scatters were recorded and discussions with the RAPs determined the area contains a high potential for unrecorded Aboriginal sites and the whole area should be protected as the density of the Aboriginal sites indicate a long and consistent level of Aboriginal occupation of the region. Additional survey effort in this area is likely to reveal additional Aboriginal objects.

On the second last day of the survey the survey team were informed of the death of one of the RAP's family members. The RAP did not participate in the last day of the survey and the remaining RAPs were given the option to return home but opted to stay for the last day. Morale was low on the last day.

Potential sub-surface archaeological sites cannot be directly observed and the detectability of Aboriginal sites with surface remains is contingent on GSV. GSV varied across the investigation area with low to moderate GSV (20-40%) across most of the area with some exposures present (Figure 5-1 and Figure 5-2). GSV was high (90%) along the access tracks, previously cleared areas and within natural scalds.

5.4 Survey units

Due to its large size, the study area was divided into five survey units (SU) based on landform features as well as arbitrary boundaries (Figure 5-25).

5.4.1 Survey Unit 1

Survey unit 1 (SU1) is comprised of the site access road. This survey unit extends 20km from Glenwood Road east and is 20m wide, and 11.6 hectares. The access route has been previously cleared and contains a single carriageway unsealed formed track in the east and peters out further west, on a generally flat landscape (Figure 5-1 and Figure 5-2). The vegetation on either side of the unsealed track is Bimble Box grassy woodland with an increase of Mallee communities towards the western end of the survey unit (Figure 5-3 and Figure 5-4).

Two Culturally Modified Trees (Mallee Bull CMT 15 and Mallee Bull CMT 16), both scarred and one isolated stone artefact (Mallee Bull IF01) were recorded during the survey and are described in Section 6.

Figure 5-1: View west showing unsealed track

Figure 5-2: View west along the western end of the SU1 showing track

Figure 5-3: Example of Bimble box vegetation at the eastern end of SU1

Figure 5-4: Example of vegetation at the western end of SU1

5.4.2 Survey Unit 2

Survey unit 2 (SU2) is comprised of the western section of the study area and measures 75.9 ha in area. SU2 is highly disturbed as evidenced by mine shafts from the 1800s Historic Four Mile Mine, historical clearing, modern exploration drilling and unsealed tracks (Figure 5-5 to Figure 5-8). SU2 is within a flat landform context and in comprised of Bimble Box grassy woodland, White Cypress Pine, Gum-barked Coolabah trees and native grasses (Figure 5-9). GSV within the survey unit is low (20%) due to the dense grass, however large exposures were observed within the survey unit (Figure 5-6).

Two Culturally Modified Trees (Mallee Bull CMT 17 and Mallee Bull CMT 20), both scarred and one isolated stone artefact (Mallee Bull IF02) were recorded in SU2 and are described in Section 6.

Figure 5-5: Mine shaft from historic Four Mile Mine

Figure 5-6: View south across the southern section of SU2 showing topsoil stockpiles from historic Four Mile Mine shaft

Figure 5-7: Example of disturbance from exploration drilling

Figure 5-8: Evidence of exploration drilling collars

Figure 5-9: View west across SU2 showing dense grass and exposures

Figure 5-10: Example of vegetation

5.4.3 Survey Unit 3

Survey unit 3 (SU3) is comprised of the elevated ground in the north of the study area and is comprised of a ridgeline to the east, slopes and an unnamed 1st Order drainage line down the middle. The ridgeline contains rocky outcrops and Mallee woodland (Figure 5-11). A large number of rock holes were observed along the eastern side of the rocky ridge. Vegetation on the slopes is comprised of Cypress Pine, the occasional Gum-barked Coolabah, warrior bush, saltbush, and native grasses. Several mature Bimble Box are located along the drainage line (Figure 5-12). GSV was moderate (50%) throughout the survey unit and evidence of disturbance included unsealed tracks, historical clearing and grazing (Figure 5-14).

One Culturally Modified Tree (Mallee Bull CMT 18), scarred, Two hearths hearth (Mallee Bull Hearth 01 and 02), Two Grinding Grooves (Mallee Bull GG01 and Mallee Bull GG02), and two stone artefact scatters (Mallee Bull AS07 and Mallee Bull AS08) were recorded during the survey and are described in Section 6.

Figure 5-11: View east from the ridgeline

Figure 5-12: Example of vegetation and GSV along the slopes

Figure 5-13: Example of vegetation within SU3

Figure 5-14: Example of GSV

5.4.4 Survey Unit 4

Survey unit 4 (SU4) is the eastern section of the study area and measures 36.5 ha. The survey unit is within a gently undulating landform context that slopes gently downwards towards the southeast, with vegetation comprising of a Bimble Box grassy woodland (Figure 5-15) to the east surrounding several drainage lines, areas of dense native grass and sporadic White Cypress Pine (Figure 5-16). The southwest section of SU4 is heavily disturbed as evidenced by mining activities, clearing, and construction of unsealed tracks (Figure 5-17). GSV across SU4 was low (30%) with some exposures with high (90%) GSV.

Fifteen Culturally Modified Trees (scarred), five stone artefact scatters and one isolated stone artefact were recorded and are described in Section 6.

Figure 5-15: View east towards the eastern boundary of SU4

Figure 5-16: View south across SU4 showing vegetation and grasslands

Figure 5-17: Evidence of mining and exploration drilling activities

Figure 5-18: View northwest across SU4 towards the ridgeline of SU3 showing exposures and unsealed tracks

5.4.5 Survey Unit 5

Survey unit 5 (SU5) is the southeast portion of the study area and is comprised of an undulating plain (Figure 5-19) across the majority of the survey unit with a small crest located in the southwest corner. Vegetation along the plain is comprised of Rosewood, Yarran, White Cyprus Pine and ground cover consisting of dense patches of native grasses and Saffron Thistles a high threat exotic. Vegetation on the crest is comprised of Belah trees, Warrior Bush, White Cypress Pine and native grass (Figure 5-20). GSV varied across SU5 with the majority of the survey unit containing dense long native grass and Saffron Thistles with low (10%) GSV (Figure 5-22), some large exposures with high (95%) GSV were observed throughout the survey unit (Figure 5-23).

Three isolated stone artefacts (Mallee Bull IF03, Mallee Bull IF04, and Mallee Bull IF05) and two stone artefact scatters (Mallee Bull AS05 and Mallee Bull AS11) were recorded during the survey and are described in Section 6.

Figure 5-19: View southeast across SU5 showing vegetation on the plain

Figure 5-20: View west across the southern section of SU5 showing vegetation

Figure 5-21: View northwest showing vegetation on the crest

Figure 5-22: Example of low GSV within SU5

Figure 5-23: Example of high GSV within SU5

Figure 5-24: Example of moderate GSV within SU5

5.5 Coverage

A summary of survey coverage is provided in Table 5-1 and Table 5-2. Effective survey coverage was moderate.

Table 5-1: Survey coverage summary – survey units

Survey unit	Landform	Survey unit area (m^2)	Visibility %	Exposure %	Effective survey coverage (m^2)	Effective Survey Coverage (%)
1	Flat	116,805	10	40	4672.2	4.00
2	Flat	759,272	20	20	30,370.88	4.00
3	Crest, slope	365,880	10	30	10976.4	3.00
4	Flat	445,686	30	10	13,370.58	3.00
5	Flat	911,960	50	20	91196.00	10.00

Table 5-2: Survey coverage summary – landforms

Landform	Landform area (m^2)	Area effectively surveyed (m^2)	% of landform surveyed	Number of Aboriginal sites	Number of Aboriginal objects or or features
Crest	75,165.85	2,254.97	2.99	2	2
Slope	146,983.84	4,409.51	3.00	3	11
Flat	2,377,453.31	237,745.33	9.9	34	200

Figure 5-25: Survey units

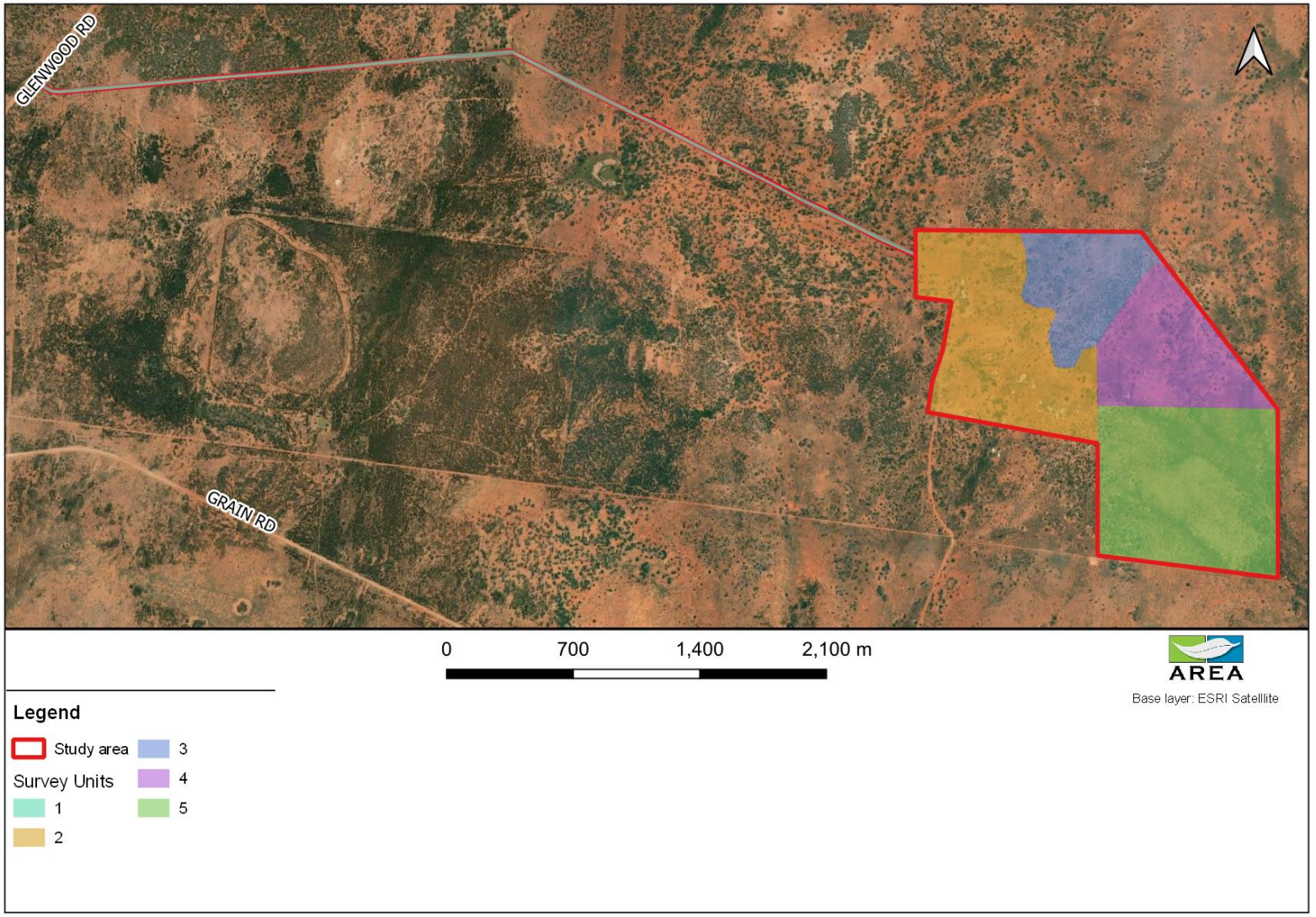
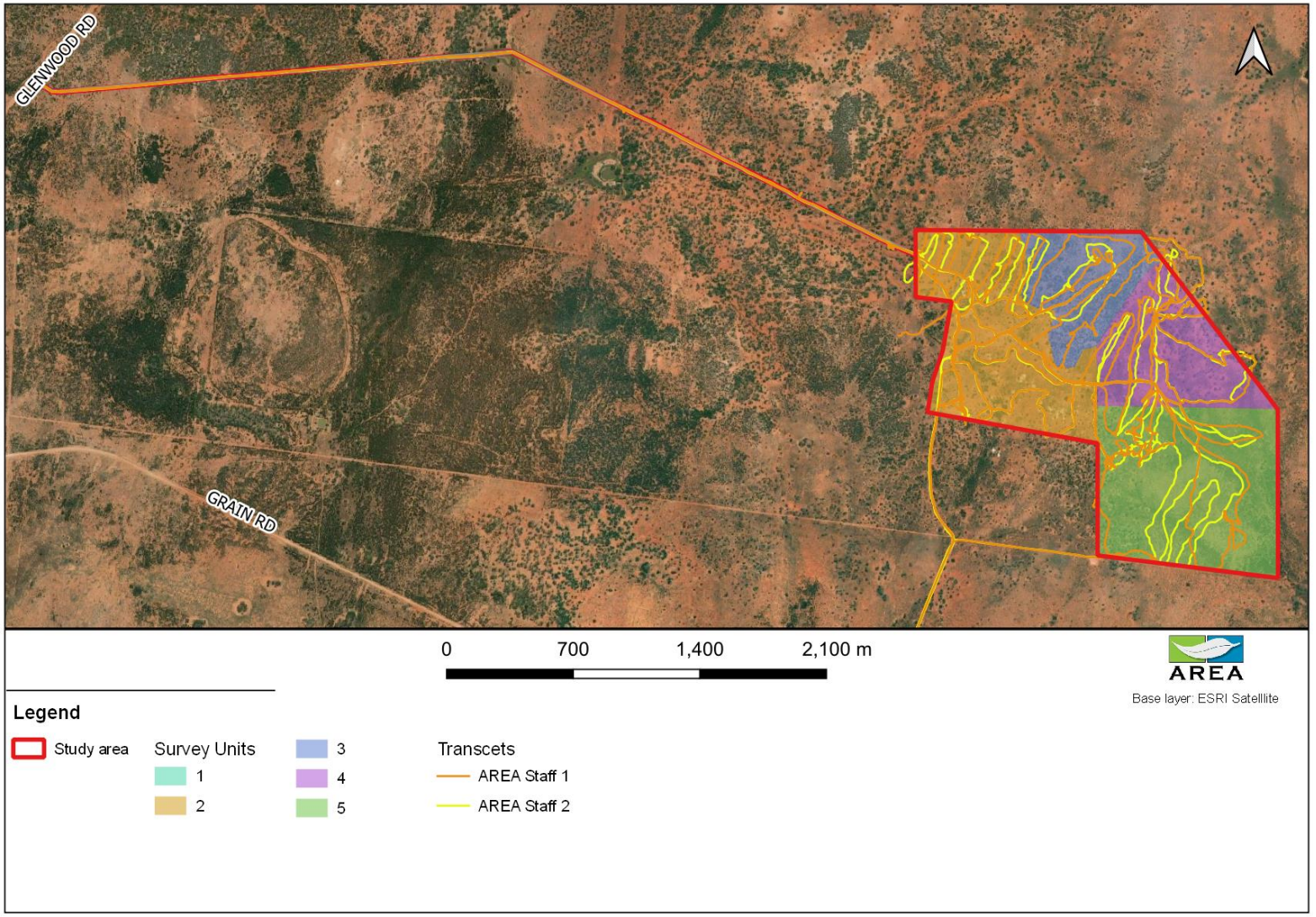


Figure 5-26: Survey units and survey transects



6 Aboriginal sites recorded

Forty-one Aboriginal sites were recorded within the study area, comprising of:

- 12 stone artefacts scatters
- five isolated stone artefacts
- 20 Culturally Modified Trees (scarred)
- two grinding grooves sites
- two hearths.

Several of these Aboriginal sites were associated with natural resource and gathering areas.

6.1 Artefact scatters

6.1.1 Mallee Bull AS01 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416393E 6413237N
Site length: 80m
Site width: 80m

Mallee Bull AS01 is a stone artefact scatter located on mid-slope within a large ground surface exposure either side of an unsealed track (Figure 6-163, Figure 6-1 and Figure 6-2). Vegetation within Mallee Bull AS01 is comprised of Bimble Box grassy woodland, White Cypress Pine and native grasses (Figure 6-3). GSV was moderate (50%) across the site with the areas either side of the track having high GSV (90%). Twenty stone artefacts were observed which included complete flakes, flake fragments, and cores. Approximately 10% of the artefacts possessed cortex, ranging from 5% to 10% of its surface area (Figure 6-4 to Figure 6-6).

Figure 6-1: View north across Mallee Bull AS01

Figure 6-2: View south across Mallee Bull AS01

Figure 6-3: view southeast across Mallee Bull AS01 form north of the unsealed track

Figure 6-4: Example of artefacts from Mallee Bull AS01

Figure 6-5: example of core from Mallee Bull AS01

Figure 6-6: Example of artefacts from Mallee Bull AS01

6.1.2 Mallee Bull AS02 (AHIMS ID Pending)

Site type: Stone Artefact Scatter and hearth
Site centroid: GDA Zone 55 416596E 6413552N
Site length: 20m
Site width: 28m

Mallee Bull AS02 is located on the north eastern boundary of the study area, 13 stone artefacts were observed within the scatter, and include flakes, cores, and a retouched scrapper (Figure 6-163, Figure 6-7 and Figure 6-8). Raw materials include basalt, chert, and silcrete. A hearth was observed within the Aboriginal site, containing hard clumps of baked clay (Figure 6-9). The surrounding vegetation is comprised of Bimble Box grassy woodland, the occasional shrub, and native and non-native grasses. GSV varied from high (90%) to moderate (45%) across the site, GSV was high outside Mallee Bull AS02 indicating the potential for more artefacts to be found outside the site that were not observed during the survey due to the high grass (Figure 6-10).

Figure 6-7: Example of artefacts within Mallee Bull AS02

Figure 6-8: Example of artefacts, including a retouched blade, within Mallee Bull AS02

Figure 6-9: Hearth observed within the AS02

Figure 6-10: View northeast across Mallee Bull AS02 showing low to high GSV

6.1.3 Mallee Bull AS03 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416696E 6413319N
Site length: 20m
Site width: 28m

Mallee Bull AS03 is located in the northeast section of the study area within a large exposure (Figure 6-163) and is comprised of five artefacts, including flakes and a core, made of silcrete and chert (Figure 6-11). All artefacts have been retouched with one dark grey chert flake retouched into a scrapper along the distal edge (Figure 6-12). Mallee Bull AS03 is within a drainage line running in a northwest to southeast direction (Figure 6-13). GSV within the artefact scatter was high (90%) due to the exposure, outside the site GSV was moderate (60%) due to grasses and small shrubs (Figure 6-14).

Figure 6-11: Example of artefacts within Mallee Bull AS03

Figure 6-12: Example of retouched artefact within Mallee Bull AS03

Figure 6-13: View north across AS03

Figure 6-14: View northeast across Mallee Bull AS03

6.1.4 Mallee Bull AS04 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416514E 6413367N
Site length: 5m
Site width: 5m

Mallee Bull AS04 is located 120m west of Mallee Bull AS03 and is located within a small exposure with high GSV (90%) on a flat landform (Figure 6-163, Figure 6-15 and Figure 6-16). The surrounding landscape is flat, and vegetation is comprised of Bimble Box grassy woodland and salt bush (Figure 6-17). Three small stone artefacts are recorded within the site, due to low GSV outside the exposure there is a potential for further artefacts to be recorded. The artefacts are simple flakes of pale brown silcrete (Figure 6-18).

Figure 6-15: View northwest across Mallee Bull AS04

Figure 6-16: View southeast across Mallee Bull AS04

Figure 6-17: Example of landscape and vegetation surrounding Mallee Bull AS04

Figure 6-18: three artefacts associated with Mallee Bull AS04

6.1.5 Mallee Bull AS05 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416280E 641290N
Site length: 300 m
Site width: 400 m

Mallee Bull AS05 is a large stone artefact scatter comprising of hundreds of artefacts located south of an unsealed track, in the central portion of the study area (Figure 6-164). The Aboriginal site measures 300m north-south and 400m east-west. Many of the artefacts are flakes and cores with a number of stone tools including a hammer stone, a ground edges stone axe, and possible stone chisels (Figure 6-19 to Figure 6-25). A variety of the raw materials were observed including quartz, quartzite, silcrete, mudstone, and sandstone (Figure 6-27).

Mallee Bull AS05 is located within a series of exposures of various sizes, on a flat plain (Figure 6-29). Vegetation within the artefact scatter and surrounds is comprised of dense tall grass and saffron thistles, Rosewood trees, White Cypress Pine, Warrior Bush and the sporadic Belah tree (Figure 6-32). GSV within the exposure where the artefacts were observed was high (95%) with GSV outside the exposures very low, approximately 5% (Figure 6-33). Due to the low GSV outside the exposures there is a potential for more artefacts to be within the grass (Figure 6-34).

Figure 6-19: Example of flakes observed within the centre of Mallee Bull AS05

Figure 6-20: Example of flakes observed within the northern section of Mallee Bull AS05

Figure 6-21: Example of artefacts observed within the centre of Mallee Bull AS05

Figure 6-22: Large core recorded within Mallee Bull AS05

Figure 6-23: Quartz flakes observed within the northwest section of Mallee Bull AS05

Figure 6-24: Example of artefacts observed within the southern section of Mallee Bull AS05

Figure 6-25: Example of flakes observed within Mallee Bull AS05

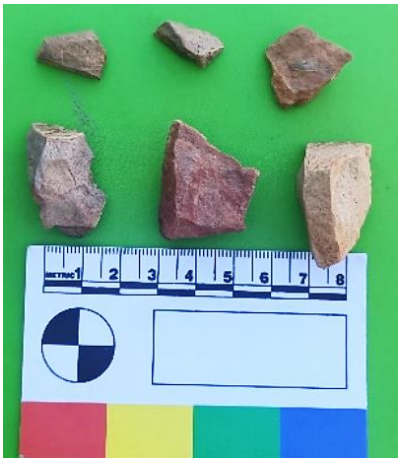


Figure 6-26: Hammer stone recorded

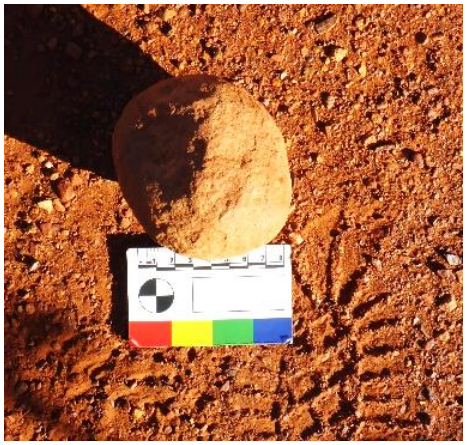


Figure 6-27: Axe head recorded within the western section of Example of artefacts observed within the centre of Mallee Bull AS05

Figure 6-28: Possible chisels or scrapper located in the northern section of Example of artefacts observed within the centre of Mallee Bull AS05

Figure 6-29: View south across Mallee Bull AS05

Figure 6-30: View north across Mallee Bull AS05

Figure 6-31: View southwest across Mallee Bull AS05 showing vegetation

Figure 6-32: View northeast across Mallee Bull AS05 showing vegetation

Figure 6-33: Example of GSV within the exposures

Figure 6-34: Example of GSV outside the exposures

6.1.6 Mallee Bull AS06 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416235E 6413611N
Site length: 15m
Site width: 15m

Mallee Bull AS06 is a small artefact scatter located within a small drainage line sloping gently towards the east (Figure 6-163, Figure 6-35). Vegetation within the artefact scatter is sparse with small tuffs of native grass, a small shrub and a single young Dwyer's Red Gum (Figure 6-36). GSV was high (90%) across the site and decreases outside the exposure due to long grass. The recorded site extent is the exposure were GSV is high, but it is likely that the site extends to the east where artefacts could have washed downhill (Figure 6-37).

Three stone artefacts were recorded at the site (Figure 6-38). Artefacts are made from pale red silcrete, no usewear or retouch was noted on the flakes. Soils are deflated across the site.

Figure 6-35: View east across Mallee Bull AS06

Figure 6-36: View north across Mallee Bull AS06

Figure 6-37: View southeast across Mallee Bull AS06

Figure 6-38: three artefacts associated with Mallee Bull AS06

6.1.7 Mallee Bull AS07 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 415861E 6413685N
Site length: 20m
Site width: 10m

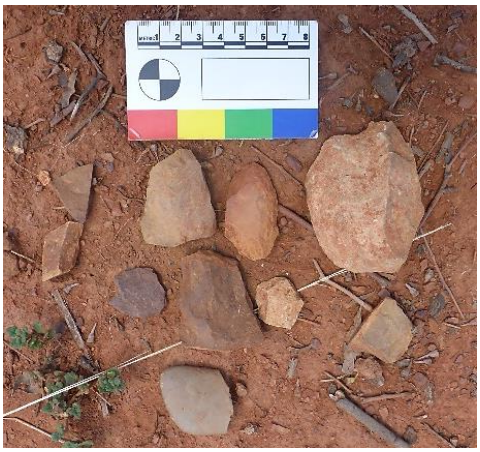
Mallee Bull AS07 is located 12m northwest of Mallee Bull CMT 18 within a section of a dried creek bed (Figure 6-162, Figure 6-39 and Figure 6-40). The artefact scatter is comprised of nine flakes made of either silcrete or mudstone (Figure 6-42). No artefacts were observed along the banks of the 1st Order drainage line suggesting that the artefacts have washed into the waterway or were exposed by erosion. GSV was high (95%) within the drainage line and along the banks due no vegetation occurring. Vegetation outside the artefact scatter is comprised of a Bimble Box grassy woodland with White Cypress Pine, Gum-barked Coolabah and Mallee trees.

Figure 6-39: View south across Mallee Bull AS07

Figure 6-40: view north across Mallee Bull AS07

Figure 6-41: View south across Mallee Bull AS07 showing GSV and vegetation

Figure 6-42: Artefacts within Mallee Bull AS07



6.1.8 Mallee Bull AS08 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416052E 6413871N
Site length: 30m
Site width: 10m

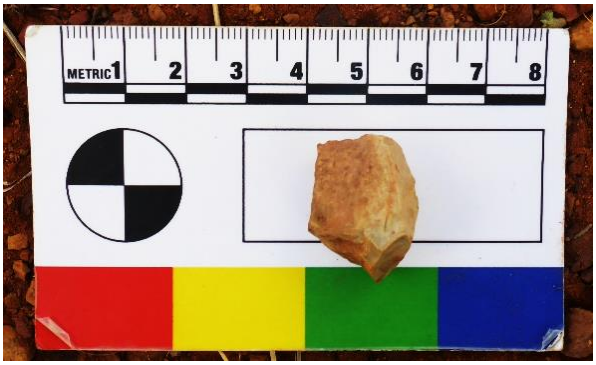
Mallee Bull AS08 is located within an exposure on a small crest in the northern section of the study area (Figure 6-43). Vegetation within the exposure was sparse with minimal ground cover in the form of grass (Figure 6-162, Figure 6-44). Outside the exposure the vegetation comprised of native long grass, Warrior Bush and White Cypress Pine. The artefact scatter is comprised of two artefacts, a large basalt flake with retouch along two of the three edges and a small chert core (Figure 6-45 and Figure 6-46).

Figure 6-43: View northeast across Mallee Bull AS08

Figure 6-44: View east across Mallee Bull AS08

Figure 6-45: Basalt flake with retouch

Figure 6-46: Chert core



6.1.9 Mallee Bull AS09 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416412E 6413621N
Site length: 50m
Site width: 35m

Mallee Bull AS09 is located on a flat landform within a large exposure measuring 50m north to south and 35m east to west (Figure 6-163). The artefacts within the scatter are comprised of 12 chert flakes and cores some with retouch (Figure 6-47). A sandstone hammerstone or possible axe head was also observed within the scatter (Figure 6-48). The exposure extends across an unsealed access track. Vegetation within the exposure is sparse and included small tuffs of native and introduced species of grass (Figure 6-50). Outside the exposure the vegetation is comprised of White Cypress Pine and grasses (Figure 6-51).

The artefact scatter is located within transitional vegetation of a Bimble Box grassy woodland. While GSV within Mallee Bull AS09 was high (90%) due to the low ground cover, outside the Aboriginal site GSV was moderate to low (40-50%).

Figure 6-47: Flake observed within Mallee Bull AS09

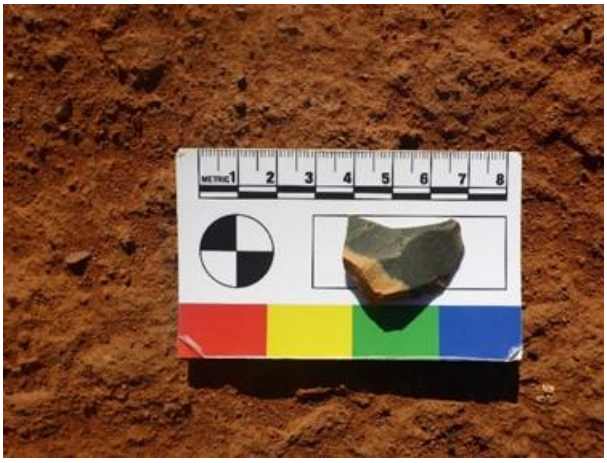


Figure 6-48: Possible grinding stone or axe head and flakes observed within Mallee Bull AS09

Figure 6-49: Artefacts observed within Mallee Bull AS09

Figure 6-50: View south across Mallee Bull AS09

Figure 6-51: View north across Mallee Bull AS09

Figure 6-52: View south west across Mallee Bull AS09

6.1.10 Mallee Bull AS10 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 415389E 6413666N
Site length: 2m
Site width: 2m

Mallee BullAS10 is located on the south western side of an exposure 60m north of an unsealed access track in the central portion of the study area (Figure 6-162, Figure 6-53 to Figure 6-55). Three possible artefacts were observed in an area of high GSV (90%) and comprised of basalt (Figure 6-56).

The archaeologist determined these fragments are not Aboriginal objects but are crushed basalt/blue metal left behind by exploration drilling practices as definitive lithic attributes were not present. The stone pieces observed were recorded as an Aboriginal site by requested of the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants.

Figure 6-53: View west across Mallee Bull AS10

Figure 6-54: Location of artefacts within Mallee Bull AS10

Figure 6-55: View east Mallee Bull AS10

Figure 6-56: Close up of basalt fragments

6.1.11 Mallee Bull AS11 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416702E 6412449
Site length: 10m
Site width: 15m

Mallee Bull AS11 is located on a series of soil surface exposures on an undulating plain in the southeast portion of the study area (Figure 6-165). GSV is high (90%) within the exposures but decreases to less approximately 20% due to the long and dense grass (Figure 6-57). Vegetation is comprised of the scattered White Cypress Pine and native and introduced grasses (Figure 6-58).

The Aboriginal site is comprised of a least eight stone artefacts of the same brown material, possibly indurated mudstone (Figure 6-59). Cortex was observed on the flakes, no backing or retouch was noted (Figure 6-60). Due to the dense grass outside the exposures, there is a potential for more artefacts. The likelihood of intact subsurface artefacts is low based on the landform and shallow thin deflated soils.

Figure 6-57: View west across Mallee Bull AS11

Figure 6-58: View south across Mallee Bull AS11

Figure 6-59: Example of artefacts recorded within Mallee Bull AS11

Figure 6-60: Example of artefacts recorded within Mallee Bull AS11

6.1.12 Mallee Bull AS12 (AHIMS ID Pending)

Site type: Stone Artefact Scatter
Site centroid: GDA Zone 55 416502E 6412395N
Site length: 5m
Site width: 5m

Mallee Bull AS12 is located within an exposure on flat landform context (Figure 6-165). The northern side of the exposure contains a Budda Bush (Figure 6-61 to Figure 6-63). This bush is used for men's business and smoking ceremonies (pers. Coms Peter Harris). The Aboriginal site contains two pale pink basalt artefacts, a flake and possible core (Figure 6-64).

Figure 6-61: View east across Mallee Bull AS12

Figure 6-62: Budda Bush within Mallee Bull AS12

Figure 6-63: View west across Mallee Bull AS12

Figure 6-64: Artefacts recorded within Mallee Bull AS12

6.2 Isolated artefacts

6.2.1 Mallee Bull IF01 (AHIMS ID Pending)

Site type: Isolated stone artefact
Site centroid: GDA Zone 55 410168E 6414812N
Site length: 1m
Site width: 1m

Mallee Bull IF01 is an isolated stone artefact located on an exposure on the northern verge of an unsealed vehicle track, approximately 50m east of Glenwood Road (Figure 6-161). The track extents from Glenwood Road eastward towards the study area, the track will be upgraded for the proposed haul road. GSV within the exposure is high with shallow and stony soils with outcroppings of yellow sandstone (Figure 6-65). Vegetation outside the exposure is comprised of young White Cypress Pine, Mallee trees, and native grasses (Figure 6-66).

The artefact is likely an *arapia* (woodworking tool) made of white sandstone, it measures 11.5cm long, 7.5cm wide and 3cm thick (Figure 6-67 and Figure 6-68).

Figure 6-65: View north towards Mallee Bull IF01

Figure 6-66: View northeast towards Mallee Bull IF01

Figure 6-67: Dorsal side of Mallee Bull IF01

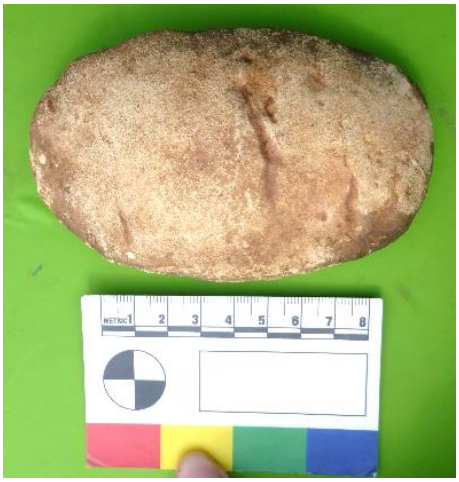


Figure 6-68: Ventral side of Mallee Bull IF01

6.2.2 Mallee Bull IF02 (AHIMS ID Pending)

Site type: Isolated stone artefact
Site centroid: GDA Zone 55 415431E 6413807N
Site length: 1m
Site width: 1m

Mallee Bull IF02 is an isolated stone artefact located on the southern bank of a drainage line in the north eastern portion of the study area (Figure 6-162, Figure 6-85). The landform slopes slightly downwards to the west. GSV within the site was 95% at the time of the survey and decreases towards the south and west as the ground cover increases (Figure 6-71). Vegetation outside Mallee Bull IF02 is comprised of White Cypress Pine, Grey Box and Mallee (Figure 6-70).

The artefact is a stone flake comprised of possibly basalt or chert (Figure 6-71).

Figure 6-69: View north across Mallee Bull IF02

Figure 6-70: View west across Mallee Bull IF02

Figure 6-71: GSV within Mallee Bull IF02

Figure 6-72: Mallee Bull IF01

6.2.3 Mallee Bull IF03 (AHIMS ID Pending)

Site type: Isolated stone artefact
Site centroid: GDA Zone 55 416493E 6412954N
Site length: 1m
Site width: 1m

Mallee Bull IF03 is located in the eastern portion of the study area and approximately 500m northeast of Mallee Bull AS05 (Figure 6-165). The site is located within a small exposure surrounded by dense native grass. Vegetation outside the exposure is comprised of young White Cypress Pine, Mallee trees, and grasses (Figure 6-73 and Figure 6-74). A flake was observed within the site (Figure 6-75). A rectangular block of white basalt was also observed approximately one metre south of the flake (Figure 6-76).

The archaeologist onsite believed the sandstone block was not Aboriginal in origin (i.e. a grinding dish or the like) due to the square shape the block and tools used to cut it and therefore, should not be recorded as part of the Aboriginal site. The Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants believed that the block was used for cultural purposes and should be recorded. Archaeologically the flake has been recorded as an isolated find with the white basalt block noted as part of its listing.

Figure 6-73: View southwest across Mallee Bull IF03

Figure 6-74: View north towards Mallee Bull IF03

Figure 6-75: Flake observed within Mallee Bull IF03

Figure 6-76: White basalt block observed within Mallee Bull IF03

6.2.4 Mallee Bull IF04 (AHIMS ID Pending)

Site type: Isolated stone artefact

Site centroid: GDA Zone 55 416702E 6412449N
Site length: 1m
Site width: 1m

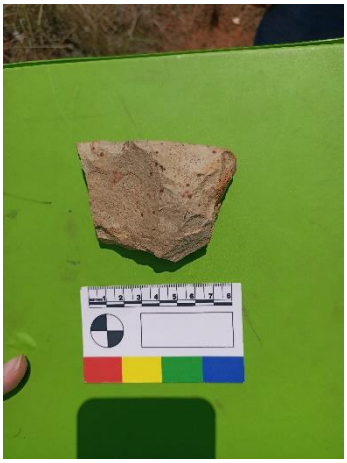
Mallee Bull IF04 is located on a small top slope in the southeast portion of the study area (Figure 6-165). This Aboriginal site is located within an exposure with high GSV (90%) and several Warrior Bushes were surrounding the site (Figure 6-77 and Figure 6-78). Soils were stone and shallow with fragments of sandstone protruding from the soil. The artefact is a large flake or possible core made of pale brown basalt (Figure 6-79 and Figure 6-80).

Figure 6-77: View east across Mallee Bull IF04

Figure 6-78: View northeast towards Mallee Bull IF04

Figure 6-79: Flake or possible core within Mallee Bull IF04

Figure 6-80: Flake or possible core within Mallee Bull IF04



6.2.5 Mallee Bull IF05 (AHIMS ID Pending)

Site type: Isolated stone artefact
Site centroid: GDA Zone 55 416310E 6412172N
Site length: 1m
Site width: 1m

Mallee Bull IF05 is an isolated stone artefact located on a slight mid slope at the southern end of the study area (Figure 6-165). The site is within an exposure with high GSV (90%) surrounded by dense native grass and Saffron Thistles, GSV decreases outside Mallee Bull IF05 to less than 5%. The artefact is a degraded sandstone tool, possibly an *arapia,* a woodworking tool.

Figure 6-81: View north across Mallee Bull IF05

Figure 6-82: View northeast across Mallee Bull IF05

Figure 6-83: Dorsal side of Mallee Bull IF05

Figure 6-84: Ventral side of Mallee Bull IF05

6.3 Culturally modified trees

6.3.1 Mallee Bull CMT 01 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416384mE 6413537mN

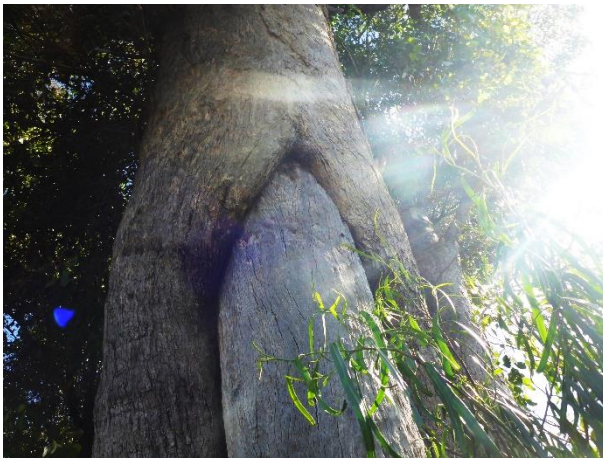
Mallee Bull CMT01 is located within a grove of Bimble Box trees in the northeast section of the study area (Figures 6-163, Figure 6-85). It is within immediate proximity to Culturally Modified Trees 2,3,4,5 and 6. The scar is located on the southern face of a large Bimble Box tree and measures 2.5 m long by 0.7 m wide and with 0.55 m of regrowth (Figure 6-86). The scar 55 cm above the ground level and contains axe marks, possibly stone, in a horizontal linear dash pattern not unlike ring barking across the top and bottom of the scar face (Figure 6-87 and Figure 6-88).

Figure 6-85: View north towards Mallee Bull CMT01

Figure 6-86: Close up of scar on Mallee Bull CMT01

Figure 6-87: Axe marks on the bottom face of the scar

Figure 6-88: Axe markings at the top of the scar



6.3.2 Mallee Bull CMT 02 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416408E 6413533N

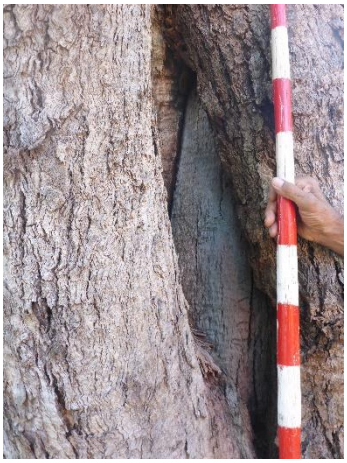
Mallee Bull CMT02 is located within a grove of Bimble Box trees in the northeast section of the study area (Figures 6-163, Figure 6-89). The tree is a large Bimble Box with multiple trunks, with at least one epicormic trunck resulting from the scar itself. The scar is located on the main trunk and on the western side of the tree (Figure 6-90). The scar measures 1.5 m long and 0.4 m at the widest point. The majority of the bottom of the scar has been covered over by the epicormic growth (Figure 6-91 and Figure 6-92). It is within immediate proximity to Culturally Modified Trees 1,3,4, 5 and 6.

Figure 6-89: View east towards Mallee Bull CMT02

Figure 6-90: View north towards Mallee Bull CMT02

Figure 6-91: Close up of the visible scar

Figure 6-92: Close up of the visible scar



6.3.3 Mallee Bull CMT 03 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416409E 6413519N

Mallee Bull CMT 03 is located approximately 15m south of Mallee Bull CMT 02 and is a Bimble Box tree (Figure 6-163,Figure 6-93). The scar is located on the eastern side of the tree and has been mostly grown over by epicormic growth (Figure 6-94). The visible scar measures 0.2 m wide, 0.87 m long and with 0.15 m of regrowth. Discussions with Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants site officers thought the bark from this scar could have been used for a coolamon. The vegetation surrounding the Aboriginal site is within a grove of Bimble Box trees, shrubs and moderate to dense ground cover on the form of tall native grasses and deep leaf litter (Figure 6-95). It is within immediate proximity to Culturally Modified Trees 1,2,4,5 and 6.

Figure 6-93: locations of Mallee Bull CMT 01, Mallee Bull CMT 02, and Mallee Bull CMT 03 relative to each other, view east

Figure 6-94: Close up of the scar on Mallee Bull CMT 03

Figure 6-95: View east towards Mallee Bull CMT 03

6.3.4 Mallee Bull CMT 04 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416481E 6413587N

Mallee Bull CMT04 is located within the same grove of vegetation as Culturally Modified Trees (scarred) 1 to 3 and 5 and 6 (Figure 6-163). The tree is a mature Bimble Box and contains two cultural scars on the northern and western sides on the main trunk. The scar on the northern side extends into the ground and is mostly covered by epicormic growth (Figure 6-96). The scar measures 0.55 m long, 0.2 m wide and with a depth of 0.2 m (Figure 6-97). The scar on the western side of the tree measures 1.3 m long and 0.35 m wide, with a large epicormic growth at the base of the scar (Figure 6-98). The bark from the scar on the western side was probably used for shelters (Figure 6-99).

Figure 6-96: northern scar on Mallee Bull CMT 04

Figure 6-97: View north towards Mallee Bull CMT 04 showing the scar on the western side

Figure 6-98: Close up of the scar on the western side of the tree

Figure 6-99: View north towards Mallee Bull CMT 04

6.3.5 Mallee Bull CMT 05 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416500E 6413588N

Mallee Bull CMT05 is located within the same grove as Culturally Modified Trees 1 to 4 and 6 (Figure 6-163). The tree is a large Bimble Box with two trunks (Figure 6-100). The largest truck on the south side contains two scars (scar 1 and scar 2) and the second possibly older trunk contains a third scar. Scar 1 on the southern side of the trunk is 0.2 m above the ground and measures 1.56 m long, 0.45 m wide, with irregular regrowth around the edges (Figure 6-101). The face of scar 1 is very weathered and damaged. Scar 2 is located on the same truck as the scar 1, on the western side (Figure 6-102). This scar is 10 cm above ground, 47 cm long, 16 cm wide and containing 15 cm of regrowth. The possibly older trunk has been broken off just above the third scar and is very weathered and damaged. The third scar measures 2.6 m in length and 0.45 m wide with 0.1 m of regrowth. The scar face is extremely weathered and mostly gone (Figure 6-103).

Figure 6-100: View east showing the two trunks of Mallee Bull CMT 05, scar 3 on the left and scar 2 on the right

Figure 6-101: View north showing scar 1

Figure 6-102: Close up of scar 2

Figure 6-103: View east showing scar 3

6.3.6 Mallee Bull CMT 06 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416532E 6413583N

Mallee Bull CMT 06 is located on a flat landform context within the grove of Bimble Boxes and bushes (Figure 6-163). It is within immediate proximity to Culturally Modified Trees 1,2,3,4 and 5.

GSV surrounding the site is low due to the dense native grass (Figure 6-104). The scar on the eastern side of the tree has mostly closed over with 15 cm of regrowth and the face of the scar measures 104 cm long and 23 cm wide (Figure 6-105).

Figure 6-104: west showing Mallee Bull CMT 06 and low GSV

Figure 6-105: Close up of the scar on Mallee Bull CMT 06

6.3.7 Mallee Bull CMT 07 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416565E 6413614N

Mallee Bull CMT 07 is located on a flat landform context within Bimble Box grassy woodland (Figure 6-163, Figure 6-106). The tree is a Bimble Box with a small, mostly grown over cultural scar on the eastern side of the trunk. The scar is 0.5m above the ground, 0.55m long, 0.14m wide and with 0.2m of regrowth (Figure 6-107).

Figure 6-106: west showing Mallee Bull CMT 06 and low GSV

Figure 6-107: Close up of the scar on Mallee Bull CMT 06

6.3.8 Mallee Bull CMT 08 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416597E 6413626N

Mallee Bull CMT 08 is located within a patch of Bimble Box trees and Wilga shrubs with moderate to low GSV due to the leaf litter and native grasses (Figure 6-163, Figure 6-108). A 1st Order drainage line lies five metres southwest of Mallee Bull CMT 08. The scar is located on the southwest side of Bimble Box possessing epicormic trunks (Figure 6-109). The scar measures 1.93 m long, 0.40 m wide and with 0.20 m of regrowth (Figure 6-110 and Figure 6-111). The face of the scar is weathered and broken.

Figure 6-108: View north showing vegetation and GSV surrounding Mallee Bull CMT 08

Figure 6-109: Close up of the scar on Mallee Bull CMT 08

Figure 6-110: Close up of the scar on Mallee Bull CMT 08

Figure 6-111: View east showing Mallee Bull CMT 08 and the survey attendants undertaking recording

6.3.9 Mallee Bull CMT 09 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416598E 6413574N

Mallee Bull CMT 09 is a large Bimble Box containing two scars on the southwest and northeast sides of the tree. The southwest facing scar is the largest and measures 2.0 m long, by 0.28 m wide and with 0.2 m of irregular regrowth which bows in the middle (Figure 6-112). The smaller scar on the northeast side of the tree measures 1.46 m long, 0.29 m wide and with 0.24 m of regrowth (Figure 6-113). This Aboriginal site is located within Bimble Box grassy woodland with several Wilga shrubs surrounding the tree (Figure 6-163, Figure 6-114). GSV was moderate due to the native grass and ground cover (Figure 6-115).

Figure 6-112: view northeast showing the largest scar on Mallee Bull CMT09

Figure 6-113: View southwest showing smaller scar on Mallee Bull CMT 09

Figure 6-114: View west with Mallee Bull CMT09 in the foreground,

Figure 6-115: View east with Mallee Bull CMT09 on the left hand side

6.3.10 Mallee Bull CMT 10 (AHIMS ID Pending)

Site type: Culturally modified scar tree
Site centroid: GDA Zone 55 416479E 643069N

Mallee Bull CMT 10 is located within a clump of Bimble box trees and Wilga shrubs with moderate to low GSV due to the leaf litter and grasses (Figure 6-162, Figure 6-116). The scar is located on the eastern side of a Bimble Box tree and measures 70cm long, 23cm wide and with 7cm of regrowth (Figure 6-117 to Figure 6-119). The tree also contains two scars that are not of cultural origin, these a potentially Branch tears or other natural phenomena.

Figure 6-116: View north showing vegetation and GSV surrounding Mallee Bull CMT 08

Figure 6-117: Close up of the scar on Mallee Bull CMT 08

Figure 6-118: Close up of the scar on Mallee Bull CMT 08

Figure 6-119: View east showing Mallee Bull CMT 08 and the survey attendants undertaking recording

6.3.11 Mallee Bull CMT 11 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416880E 6413270N

Mallee Bull CMT 11 is located within a clump of Bimble box trees and Wilga shrubs with moderate to low GSV due to the leaf litter and grasses (Figure 6-163, Figure 6-116). The scar is located on the main trunk of a Bimble Box tree with two epicormic growths caused by the scaring are located at the base of the scar (Figure 6-120). The visible section of the scar measures 150cm long, 30cm wide and with 10cm of regrowth. Steel axe marks were observed along the top of the scar face (Figure 6-121).

Figure 6-120: View north showing Mallee Bull CMT 12

Figure 6-121: Close up of the steel axe marks on the scar

6.3.12 Mallee Bull CMT 12 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416860E 6413300N

Mallee Bull CMT 12 is located outside the northeast boundary of the study area, 34m northwest of Mallee Bull CMT11 and 83m southeast of Mallee Bull CMT13 (Figure 6-163). The site is comprised of a large scar on a Bimble Box (Figure 6-122). The scar is located on the main trunk of the tree measures 2.1 m long, 0.8 m wide and with 0.2 m of regrowth (Figure 6-123). The other trunk is epicormic growth caused by scarring of the tree.

Mallee Bull CMT 12 is outside the study area and will not impacted by the proposal.

Figure 6-122: Large scar on Mallee Bull CMT 12

Figure 6-123: Close up of scar

6.3.13 Mallee Bull CMT 13 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416783E 6413327N

Mallee Bull CMT 13 is located outside the northeast boundary of the study area, on a flat plain within Bimble Box grassy woodland (Figure 6-163). The tree is a mature Bimble Box with three trunks (main trunk, the scarred one and two epicormic trunks likely caused by scarring) within a small cluster of other box trees and Wilga shrubs (Figure 6-124). The scar is on the western trunk, is weathered and degraded and measures 0.7m long and 0.15m wide (Figure 6-125).

Figure 6-124: View north showing Mallee Bull CMT13 and its multiple trunks

Figure 6-125: close up of the scar on Mallee Bull CMT 13

6.3.14 Mallee Bull CMT 14 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416703E 6413262N

Mallee Bull CMT 14 is located within the north eastern portion of the study area and 40m south of Mallee Bull AS03 (Figure 6-163). The mature Bimble Box tree has with multiple epicormic trunks caused by initial scarring on the main trunk. The scar measures 1.2m long, 0.60m wide and with 0.3m of regrowth (Figure 6-126). The scar is slightly damaged by natural weathering at the base (Figure 6-127). GSV surrounding the site was 40% at the time of the survey, increasing to 70% within areas of low ground cover (Figure 6-128 and Figure 6-129).

Figure 6-126: View southwest showing the scar on Mallee Bull CMT 14

Figure 6-127: View northeast showing the scar on Mallee Bull CMT 14

Figure 6-128: View southwest showing Mallee Bull CMT 14 and low GSV

Figure 6-129: View west showing Mallee Bull CMT 14 and higher GSV

6.3.15 Mallee Bull CMT 15 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 414868E 6413897N

Mallee Bull CMT 15 is located 15m south of the eastern end of the proposed haul road, a second unsealed track is located approximately 10m south of this site (Figure 6-162, Figure 6-130). The scar is located on the western side of the mature Bimble box with multiple trunks. The scar measures 1.75 m long, 0.8 m wide and with 0.9 cm of regrowth. Vegetation surrounding the site includes Ironbark, Bimble Box, White Cypress Pine, and small shrubs and grasses (Figure 6-131).

Figure 6-130: Scar located of the central trunk of the tree

Figure 6-131: View north showing proposed haul road track and Mallee Bull CMT 15

6.3.16 Mallee Bull CMT 16 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scared)
Site centroid: GDA Zone 55 414845E 6413905N

Mallee Bull CMT 16 is located 20m south of the eastern end of the proposed haul road, a second unsealed track is located approximately 10m south of the site (Figure 6-161). The site is located approximately 30 m west of Mallee Bull CMT 15 (Figure 6-132). Mallee Bull CMT 16 contains a single large scar on the main trunk of a mature living Bimble Box, the other trunks are epicormic growth from the scar. The scar is on the northeast side of the tree, is rectangular in shape and measures 2.0m long, 0.67m wide, and with 0.15m of regrowth (Figure 6-133). The size of the scar suggests that the bark would have been used as a shelter. Given the location of the tree near historic mining activity in the 1800s, it cannot be determined if the scaring was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin. Vegetation surrounding the site includes Ironbark, Bimble Box, White Cypress Pine, and small shrubs and grasses (Figure 6-134).

Figure 6-132: View southeast showing Mallee Bull CMT 15 and Mallee Bull CMT 15

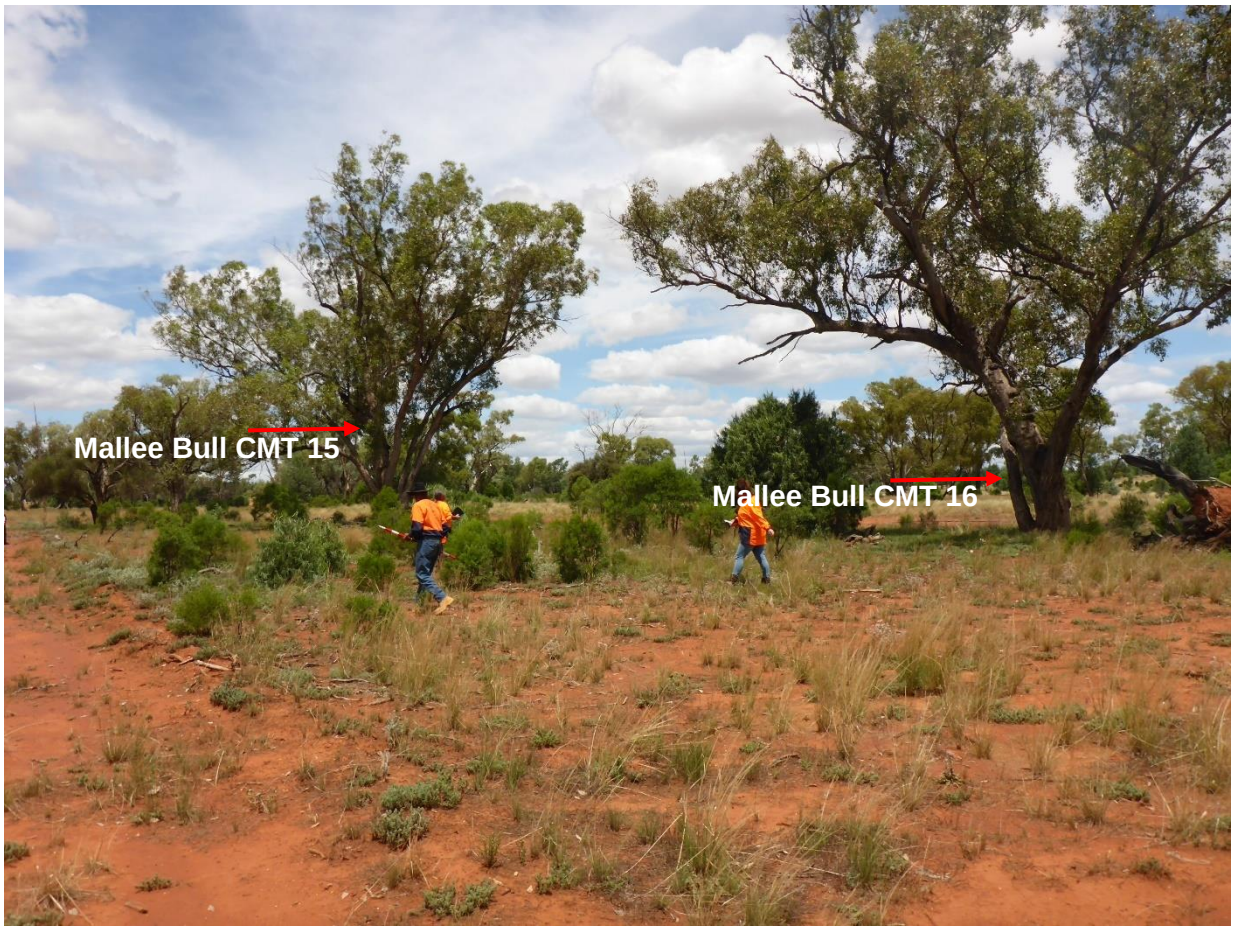


Figure 6-133: View south towards Mallee Bull CMT 16

Figure 6-134: Close up of the scar on Mallee Bull CMT 16

6.3.17 Mallee Bull CMT 17 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 414995E 6413884N

Mallee Bull CMT 17 is located 13 m north of proposed haul road and unsealed track at the western edge of the study area (Figure 6-162, Figure 6-135). The area surrounding the site is flat with vegetation comprising of Gum-barked Coolabah, Ironbark, Wilga and other shrubs (Figure 6-136). The tree is large living Gum-barked Coolabah with the scar located on the main trunk. The other trunks are epicormic growth as a result of the scar. The scar is located on the south side of the tree and measures 3.1m long, 0.65m wide and with 0.25m of regrowth (Figure 6-137 and Figure 6-138). Due to the large size of the scar the bark was potentially used to construct a shelter. Given the location of the tree near historic mining activity in the 1800s, it cannot be determined if the scaring was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin. GSV within the site is low due to the leaf litter but increasing to the south and east where large exposures and unsealed tracks are present.

Figure 6-135: View southwest towards Mallee Bull CMT 17 (red arrow)

Figure 6-136: View north towards Mallee Bull CMT 17

Figure 6-137: Close up of the Mallee Bull CMT 17

Figure 6-138: eastern side of Mallee Bull CMT 17

6.3.18 Mallee Bull CMT 18 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 415868E 6413670N

Mallee Bull CMT 18 is located within a valley 10m east of a 1st Order drainage line and 30m west of an unsealed track that accesses the weather station for Mallee Bull (Figure 6-162, Figure 6-139). Within the drainage line is Mallee Bull AS 07 (Section 0). The tree is a tall Gum-barked Coolabah with the scar located on the eastern side (Figure 6-140). The scar measures 2.1m long, 0.5m wide and with 0.15m of regrowth (Figure 6-140 and Figure 6-141). The large size of the scar suggests that the bark would have been used for a shelter. Given the location of the tree near historic mining activity in the 1800s, it cannot be determined if the scaring was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin. Vegetation within the area is comprised of coolabah, wilga, and White Cypress Pine with an understory of small shrubs and grasses.

Figure 6-139: View northwest showing Mallee Bull CMT 18 and Mallee Bull AS 07 in drainage line in the background

Figure 6-140: Top of the scar

Figure 6-141: Bottom of the scar

6.3.19 Mallee Bull CMT 19 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 416372E 6413895N

Mallee Bull CMT 19 is located on a flat landform context within close proximity of a 1st Order drainage line (Figure 6-163). The scar is located on the southern side of an old growth living Bimble Box tree. The scar measures 1.2m long, 0.40m at its widest point and with 0.3m of regrowth. Vegetation surrounding the tree includes Warrior Bush, Mallee , Bimble Box with ground cover comprising of small native shrubs and grasses.

Figure 6-142: Mallee Bull CMT 19

Figure 6-143: Close up of the scar on Mallee Bull CMT 19

Figure 6-144: View northwest towards Mallee Bull CMT 19

Figure 6-145: View southeast away from Mallee Bull CMT 19 showing vegetation in the surrounding area

6.3.20 Mallee Bull CMT 20 (AHIMS ID Pending)

Site type: Culturally Modified Tree (scarred)
Site centroid: GDA Zone 55 415475E 6413792N

Mallee Bull CMT 20 is located 10m south of a 1st Order drainage line within the northern section of the study area (Figure 6-162, Figure 6-146). The site is located on a flat landform within a grove of Bimble Box grassy woodland with Mallee and White Cypress Pine (Figure 6-147). The scar is located on the south eastern side of the living Bimble box tree and measures 1.6m long by 0.28m wide and with 0.9m of regrowth (Figure 6-148). An epicormic growth is growing at the base of the scar and the top of the scar contains a hatching pattern made by a steel axe (Figure 6-149).

Figure 6-146: View north showing Mallee Bull CMT 20 and the drainage line in the background

Figure 6-147: View northwest towards Mallee Bull CMT 20

Figure 6-148: Close up of the Mallee Bull CMT 20

Figure 6-149: Close up of the steel axe hatchings at the top of the scar

6.4 Grinding grooves

6.4.1 Mallee Bull GG01 (AHIMS ID Pending)

Site type: Grinding Groove / Whetstone
Site centroid: GDA Zone 55 415814E 6413243N
Site length: 5m
Site width: 5m

Mallee Bull GG01 is located on a toe slope on the southern side of a hill dominated by Green Mallee in the central section of the study area (Figure 6-166). The slope contains an outcropping of sandstone rocks and fragments, two of the sandstone fragments contain several grinding grooves (Figure 6-150 and Figure 6-151). The term 'Grinding Groove' has been used as it reflects discussions with the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants during the fieldwork. This artefact could also be called a 'Whetstone' where some have a grinding grove on both sides while others just on one surface. The principle use for Whetstones was for grinding and resharpening the blades of axes, chisels and knives. The grooves measure on average 15cm long, 5cm wide and 3cm deep, and have a U-shaped bottom. GSV within the site is moderate (60%) with vegetation comprising of grass, small shrubs, and grey box (Figure 6-152 and Figure 6-153).

Figure 6-150: Two grinding grooves on a sandstone fragment

Scale inetrval = 10cm

Figure 6-151: One grinding groove on a fragment of sandstone

Figure 6-152: View north and uphill across Mallee Bull GG01

Figure 6-153: View south and downhill across Mallee Bull GG01

6.4.2 Mallee Bull GG02 (AHIMS ID Pending)

Site type: Grinding Groove / Whetstone
Site centroid: GDA Zone 55 415850E 6413433N
Site length: 1m
Site width: 1m

Mallee Bull GG02 is located on a mid slope on the southern side of a hill dominated by Green Mallee in the central section of the study area (Figure 6-166). The crest and mid slope contain an outcropping of sandstone rocks. Approximately five metres downhill from the outcropping a sandstone fragment with a partial grinding groove was observed (Figure 6-154). The term 'Grinding Groove' has been used as it reflects discussions with the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants during the fieldwork. This artefact could also be called a 'Whetstone' where some have a grinding grove on both sides while others just on one surface. The principle use for Whetstones was for grinding and resharpening the blades of axes, chisels and knives. The groove covers the top of the fragment and measures 20 cm long by 20 cm wide (Figure 6-155). GSV within the site was 90% but decreased further uphill and downhill. Vegetation is comprised of native grasses, small shrubs, Wilga and Grey Box.

Figure 6-154: view uphill (north) with Mallee Bull GG02 in the foreground and the sandstone outcrop in the background

Figure 6-155: Grinding groove fragment

Scale inetrval = 10cm

6.5 Hearths / fireplaces

6.5.1 Mallee Bull Hearth 01

Mallee Bull Hearth 01 is located on the mid-slope on the western side of the ridgeline and contains a hearth of burnt clay and charcoal (Figure 6-166, Figure 6-157). The hearth is eroding out of the surface soil and is surrounded by quartz fragments of possible cultural origin (Figure 6-158). Given the location of the hearth near historic mining activity in the 1800s, it cannot be determined if the fireplace was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin. The hearth covers approximately one metre square. GSV within the site was high (80%) but decreased immediately outside the site due to the dense grass.

Figure 6-156: View north across the hearth

Scale inetrval = 10cm

Figure 6-157: Close up of the hearth

6.5.2 Mallee Bull Hearth 02

Mallee Bull Hearth 02 is a circular grouping of stones within a large exposure at the head of a drainage line in the northern section of the study area (Figure 6-166, Figure 6-158). The stones would have been used in place of clay balls when cooking food in a hearth (pers. Comms Peter Harris). The rocks are rectangular in shape and range in size from five centimetres to approximately 15cm (Figure 6-159). The site is 190m northeast of Mallee Bull CMT18 and 70m southwest of Mallee Bull AS08. GSV within the site and around the drainage line was high (95%). Given the location of the hearth near historic mining activity in the 1800s, it cannot be determined if the fireplace was historic or prehistoric. In this instance the precautionary principle has been applied where it is assumed as Aboriginal in origin.

Figure 6-158: View north across the hearth

Scale inetrval = 10cm

Figure 6-159: View southwest across the hearth

6.6 Water resources

The ridgeline in the central portion of the study area is not only the highest landform in the area but also contains several outcroppings of sandstone rocks and boulders. These outcroppings of sandstone were used by the Ngiyampaa people to store water. After times of rainfall the water would pool at the base of the rocks and not evaporate due to the underlying sandstone. The Ngiyampaa people would scoop out the sand and debris to make the holes bigger and sometimes cover the top with bark to stop evaporation.

Figure 6-160: Example of rock formations utilised to water storage

Scale inetrval = 10cm

6.7 Cultural resources

The presence of cultural resources within the Study area was observed during the fieldwork. This included Rosewood, Buddha bush and Belah trees. Buddha bush and was often used by the Ngiyampaa people for bush medicine due to its antibacterial properties. Rosewood was used, and still used today, in smoking ceremonies.

6.8 Discussion

The results of the fieldwork were consistent with the predictive model outlined in Section 4.5. While the climate and lack of permanent water sources is not favourable for consistent, intense settlement of Aboriginal occupation throughout the broader region, there is significant evidence of Aboriginal occupation at Mallee Bull. Forty-one Aboriginal sites were recorded during the survey:

- 20 Culturally Modified Trees (scarred)
- 12 stone artefacts scatters
- five isolated stone artefacts
- two grinding grooves / Whetstone sites
- two hearths.

The archaeological evidence observed at Mallee Bull indicates repeated use of the area over time. Other historic 1800s gold mines assessed in arid or desert / environmentally hostile areas such as Good Friday Mine near Tibooburra, on 'Puramoota' and 'Eurowrie' on the Barrier Ranges near Broken Hill have shown a similar pattern of high numbers of Aboriginal objects in association with an old mining area (P Cameron Pers Com). When mining arrived wells and government tanks were dug creating sources of permeant water in an arid zone as well as opportunities for trade and labour which Aboriginal people are likely to have used and or exploited.

While there is no way to determine if Aboriginal use of the Mallee Bull occurred more frequently by more people before mining arrived or as a result of mining actives, the evidence observed suggests old growth culturally modified trees were scarred predating the mid-1800s. In absence of other evidence such as carbon dating etc there is no way to determine the dates of more frequent use or presence of higher populations of Aboriginal people on the property. What can be confidently stated is Aboriginal people were exploiting resources at Mallee Bull Bull before Europeans were.

Nineteen of the Aboriginal sites were recorded within approximately 23 ha of Bimble Box grassy woodland in the eastern section of the study area. Due to time constraints the area was sample surveyed using a transect around the perimeter and one transect through the middle. There is a likelihood of more Aboriginal sites are likely to be recorded in this area. The artefact scatters contained raw material from a variety of sources including silcrete, chert, and mudstone. The scatters also contained different types of stone tools such as flakes, cores, chisels and hammerstones. Many of the flakes contained retouch.

The ridgeline in the central portion of the study area dominated by Green Malee is not only the highest landform in the area but also contains several outcroppings of sandstone rocks and boulders. This area contains two grinding groove / Whetstone Aboriginal sites and various rock holes with potential to have been utilised by Aboriginal people for water resources. The ridgeline also contains intangible heritage values. As a high point the ridgeline is likely to have been used as a lookout to keep an eye out for approaching tribes, the location of natural resources such as mobs of kangaroo and Emu, and to observe weather patterns.

The Bimble Box grassy woodland in the eastern section of the study area and the ridgeline contain both tangible and intangible Aboriginal cultural heritage values. In consultation with the Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title claimants the two areas, referred to as, 'Heritage zones' should be avoided and fenced off. The Registered Native Title claimants would also like other Aboriginal sites identified during this assessment avoided. If this is not possible a surface collection of Aboriginal objects at risk of direct or indirect harm should be conducted and the artefacts placed within one of the 'Heritage Zones' under an approved Aboriginal Heritage Impact Permit (AHIP).

The area within the central eastern section of the study area contained high levels of disturbance in the form of clearing surrounding the historical mines and the exploration drilling areas. The areas to the east, north and south were relatively undisturbed. While large exposures were present across the study area the majority of the study area contained high and dense native grass, limiting the GSV. There is an ever-present possibility of stone artefacts remaining undetected where GSV is not total.

Figure 6-161: Aboriginal Sites recorded during the survey along the access road

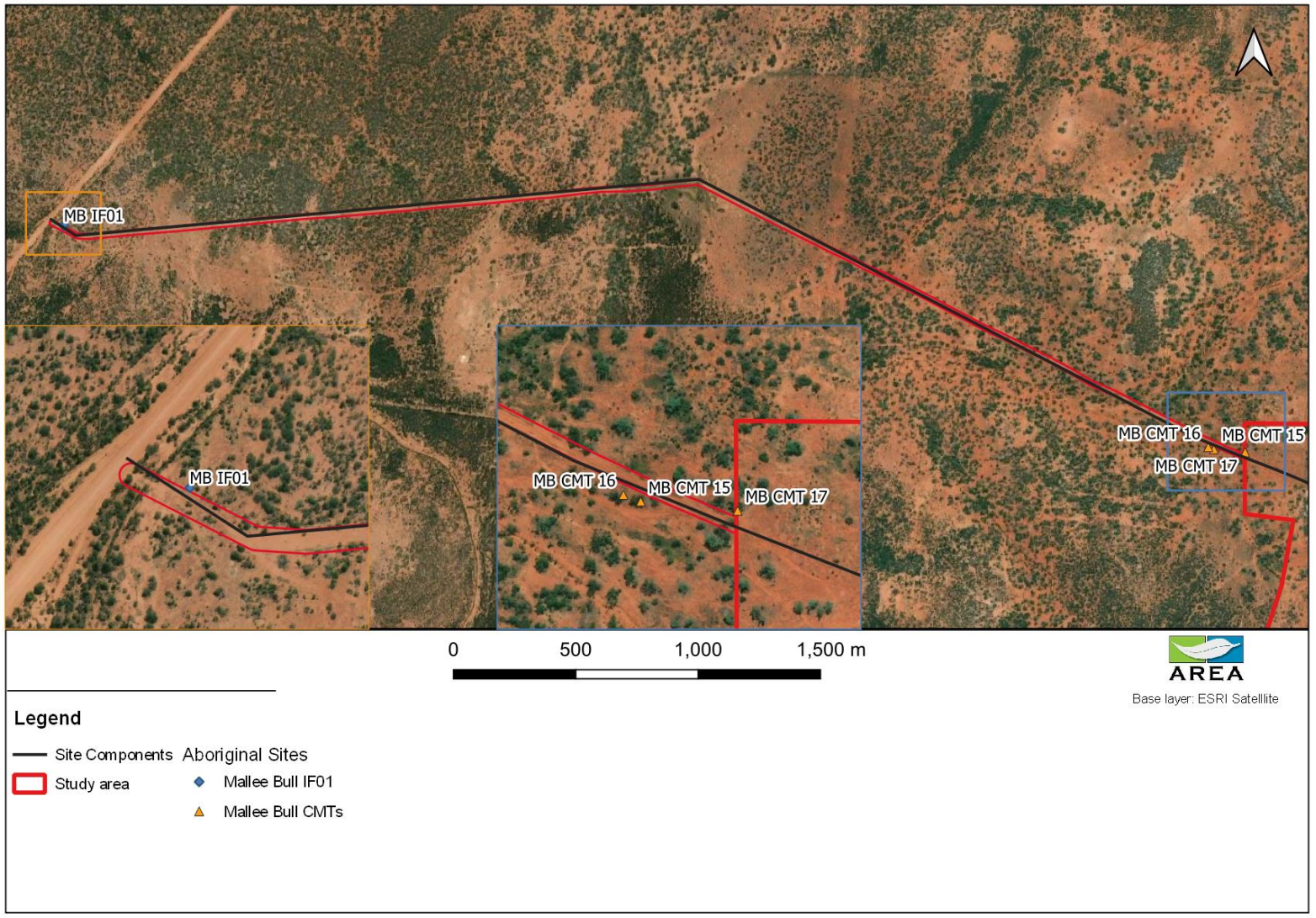


Figure 6-162: Aboriginal sites recorded within the northern section of the study area

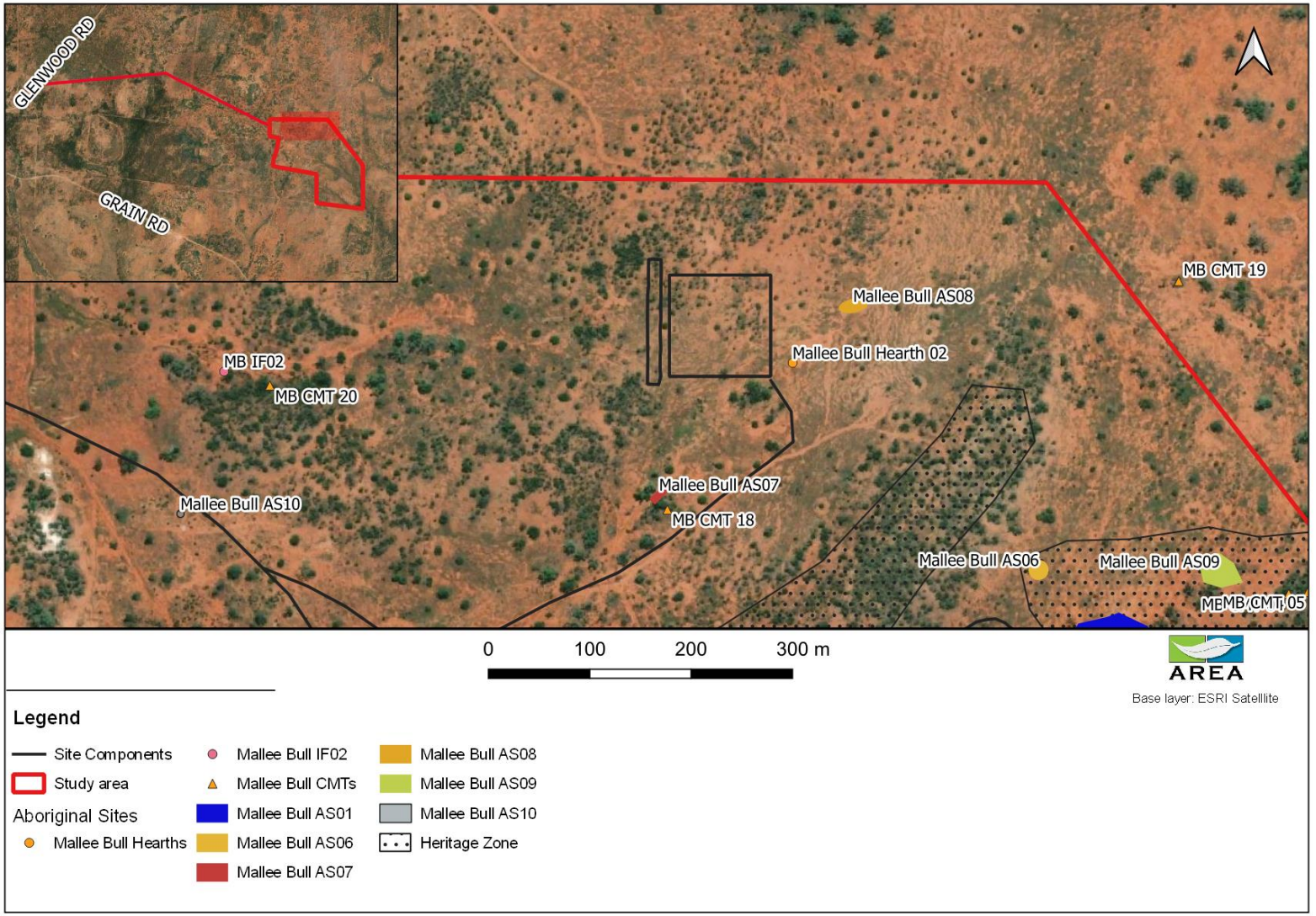


Figure 6-163: Aboriginal sites recorded within the Bimble Box grassy woodland area

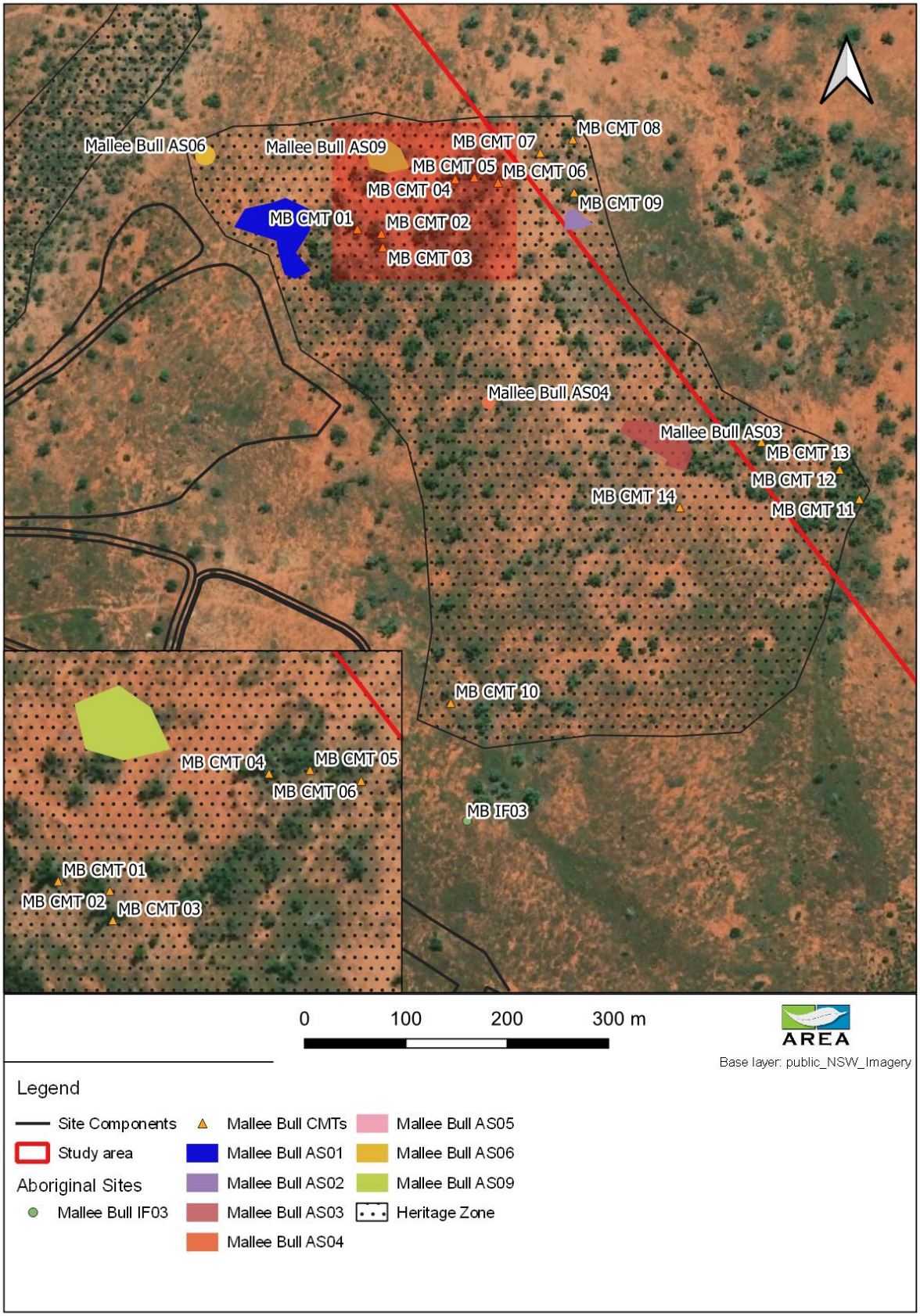


Figure 6-164: recorded location of Mallee Bull AS05

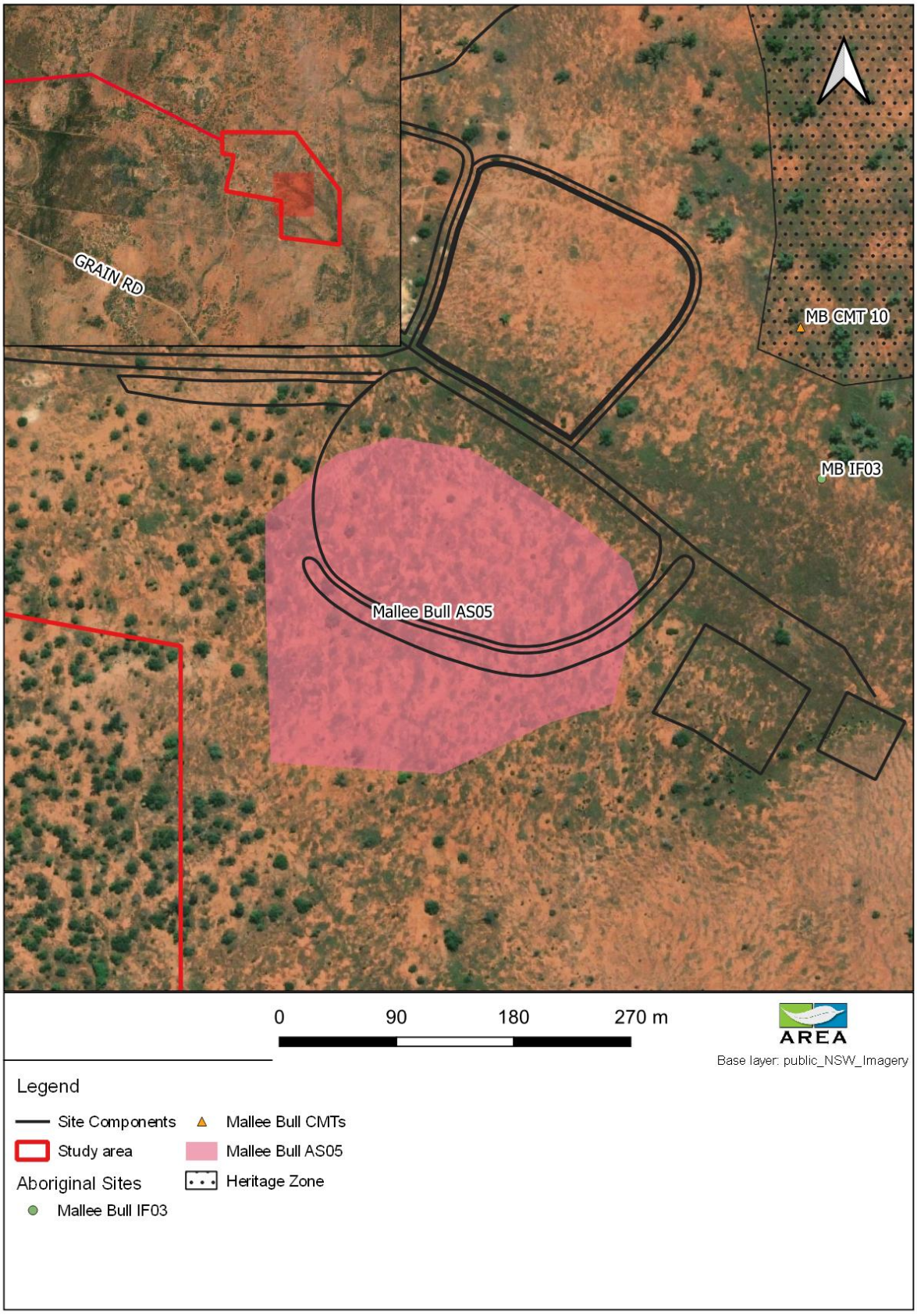


Figure 6-165: Aboriginal sites recorded in the southern section of the study area

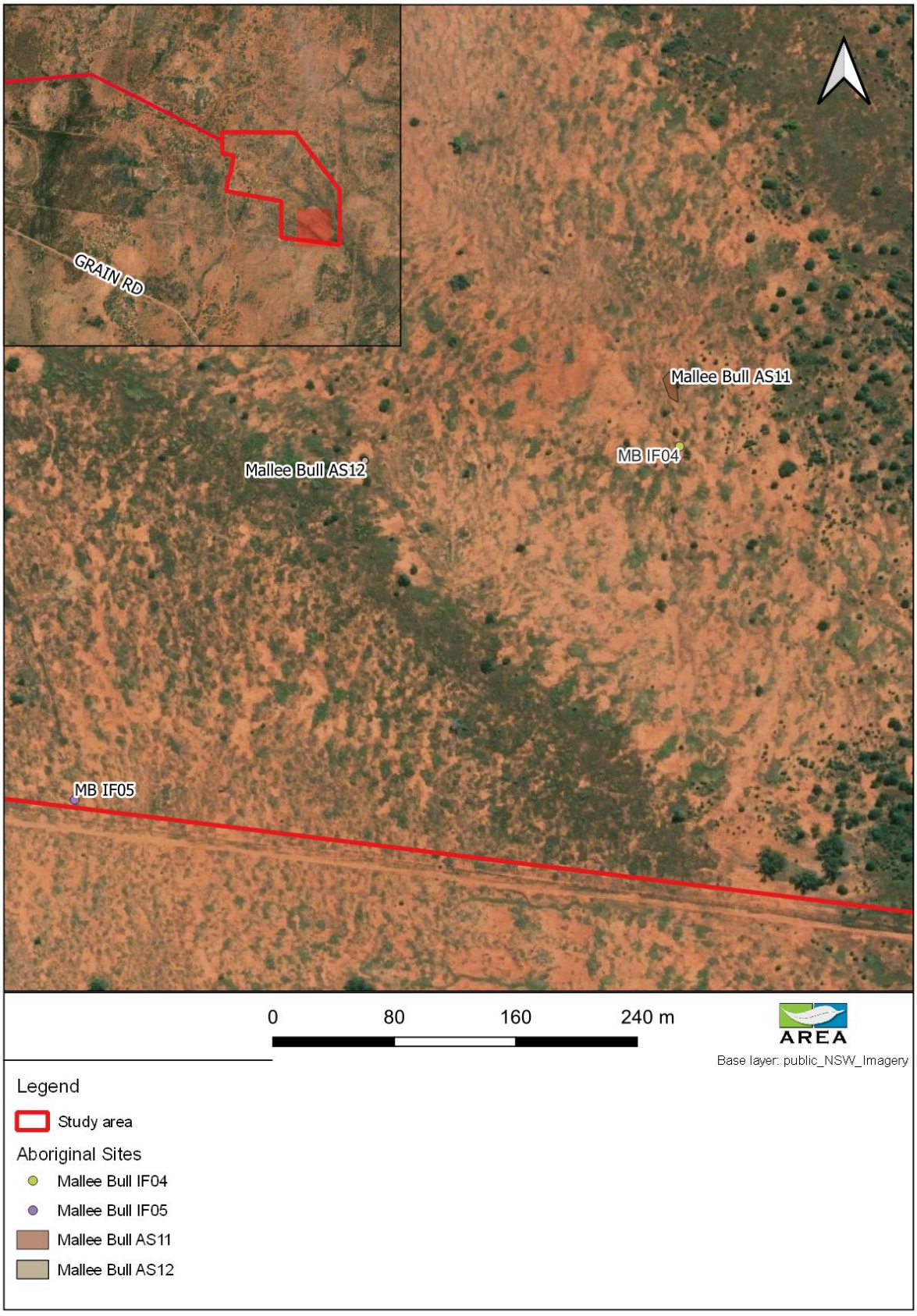
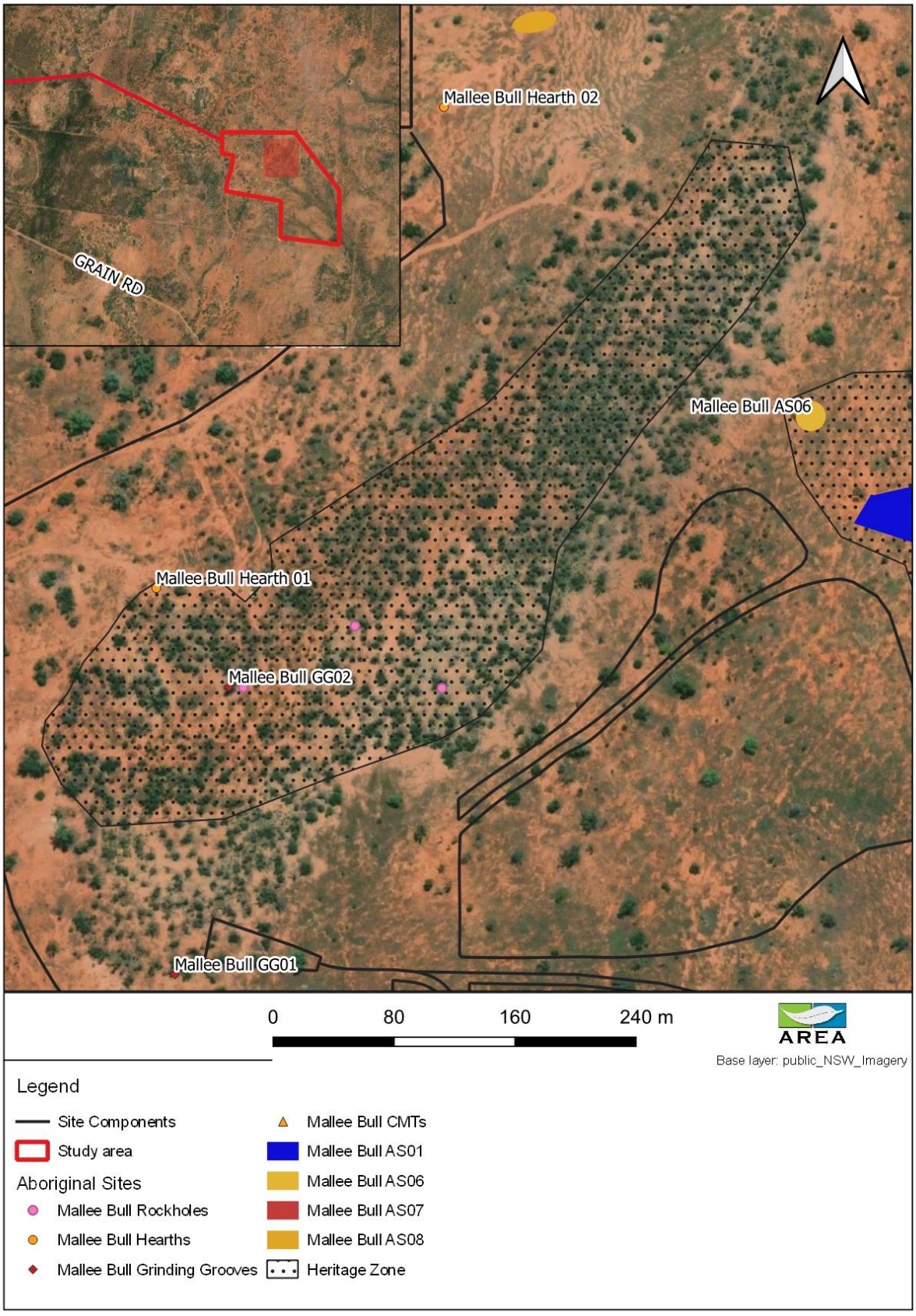


Figure 6-166: Aboriginal sites recorded along the ridgeline



7 Significance

Significance forms the basis for the management of Aboriginal cultural heritage. There are four main criteria for assessing the significance of Aboriginal cultural heritage sites listed in the OEH document *Guide to investigating, assessing, and reporting on Aboriginal cultural heritage in NSW* (OEH 2011b). These are Social or Cultural significance, Aesthetic significance, Historic significance, and Scientific significance.

Each criteria of significance are rated low, moderate, or high. The following questions can be asked to help guide this rating (OEH 2011b; 10):

- **Research potential:** does the evidence suggest any potential to contribute to an understanding of the area and/or region and/or state's natural and cultural history?
- **Representativeness:** how much variability (outside and/or inside the subject area) exists, what is already conserved, how much connectivity is there?
- **Rarity:** is the subject area important in demonstrating a distinctive way of life, custom, process, land-use, function or design no longer practised? Is it in danger of being lost or of exceptional interest?
- **Education potential:** does the subject area contain teaching sites or sites that might have teaching potential?

The level of significance of each site is summarised in Table 7-1.

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Table 7-1: Summary of significance for Aboriginal sites recorded

Site ID	Social Significance	Aesthetic Significance	Historic Significance	Scientific Significance
Mallee Bull **AS01** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS02** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS03** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS04** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS05** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS06** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS07** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS08** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS09** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS10 (AHIM**S ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS11** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **AS12** (AHIMS ID Pending)	Moderate	Moderate	Low	Moderate
Mallee Bull **IF01** (AHIMS ID Pending)	Moderate	Low	Low	Low
Mallee Bull **IF02** (AHIMS ID Pending)	Moderate	Low	Low	Low
Mallee Bull **IF03** (AHIMS ID Pending)	Moderate	Low	Low	Low
Mallee Bull **IF04** (AHIMS ID Pending)	Moderate	Low	Low	Low
Mallee Bull **IF05** (AHIMS ID Pending)	Moderate	Low	Low	Low
Mallee Bull **CMT01** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT02** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT03** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT04** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT05** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT06** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT07** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT08** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT09** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT10** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT11** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT12** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT13** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT14** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT15** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT16** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT17** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT18** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT19** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **CMT20** (AHIMS ID Pending)	Moderate	Moderate	Low	Low
Mallee Bull **GG01** (AHIMS ID Pending)	Moderate	Low	Low	Low
Mallee Bull **GG02** (AHIMS ID Pending)	Moderate	Low	Low	Low
Mallee Bull **Hearth 01** (AHIMS ID Pending)	Moderate	Low	Low	Low
Mallee Bull **Hearth 02** (AHIMS ID Pending)	Moderate	Low	Low	Low

7.1 Social or cultural significance

Social or cultural value refers to the spiritual, traditional, historical, or contemporary associations and attachments the place or area has for Aboriginal people (OEH 2011b; 8). It relates to a contemporary connection that Aboriginal people have with events that have taken place in that location or general area. In general, presence of Aboriginal sites provides evidence of connection to country and therefore is likely to be considered as important and significant regardless of its condition or representativeness.

In consultation with Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants all Aboriginal sites within the study area have **moderate** social significance.

The social significance level of sites within the study area will be reviewed and updated as part of ongoing Aboriginal community consultation for the proposal.

7.2 Aesthetic significance

This refers to the sensory, scenic, architectural, and creative aspects of the place. It is often closely linked with the social values. It may consider form, scale, colour, texture and material of the fabric or landscape, and the smell and sounds associated with the place and its use (Australian ICOMOS1988, as cited in OEH 2011b; 9).

The stone artefact scatters contain a variety of artefact types including flakes and cores, with the raw materials including chert, silcrete and mudstone. These sites have **moderate** aesthetic significance.

Culturally modified trees inherently have some aesthetic value. Mature trees have some level of aesthetic appeal and the cultural scars provide a clear link to the Aboriginal use of the area. The culturally modified trees vary in size and shape which may indicate different functions. These sites have **moderate** aesthetic significance.

The aesthetic significance level of sites within the study area will be reviewed and updated as part of ongoing Aboriginal community consultation for the proposal

7.3 Historic significance

Historic value refers to the associations of a place with a historically important person, event, phase, or activity in an Aboriginal community. Historic places do not always have physical evidence of their historical importance (OEH 2011b; 9).

The Ngemba, Ngiyampaa, Wangaaypuwan and Wayilwan Registered Native Title Claimants have a have a legally recognised connection to the area and in doing so have done so and still camp within the region.

The interaction of prehistory, contact and post contact use of the area has **low** historic significance.

The historic significance level of sites within the study area will be reviewed and updated as part of ongoing Aboriginal community consultation for the proposal

7.4 Scientific significance

This refers to the importance of a landscape, area, place or object because of its rarity, representativeness, and the extent to which it may contribute to further understanding and information (Australian ICOMOS 1988, as cited in OEH 2011b; 9).

The distribution of the Aboriginal sites conformed to the predictive model set out in Section 0. However, the density of the recorded Aboriginal sites was high, particularly in the Bimble Box woodland in the eastern section the study area. On this level, the recorded sites are considered to be representative of these site types but are not rare. The artefact scatters contained a variety of stone tool types and raw materials. The culturally modified trees (scarred) while high in number do not contain features that will contribute to further research. The artefacts scatters have **moderate** scientific significance, while the remaining Aboriginal sites have **low** scientific significance.

8 Impact and management

8.1 Impacts to Aboriginal cultural heritage

Cultural heritage values identified for the proposal require management. Whether an impact is direct, indirect, or possible, Aboriginal sites will require some level of intervention to avoid harm in the first instance and where harm cannot be avoided the residual impact will be mitigated.

Forty-one newly recorded Aboriginal sites are within the study area. The Proponent undertook a significant redesign to avoid impact to these Aboriginal sites. Further management is required to minimise the impact to the recorded sites, and the potential for impact to any unrecorded sites. The impacts to Aboriginal cultural heritage are summarised in Table 8-1.

Mallee Bull AS05 is the only Aboriginal site which cannot be totally avoided (it is partially impacted). The following sites are within 100m of the proposed impacts and at risk of indirect impact:

- Mallee Bull IF01
- Mallee Bull IF03
- Mallee Bull AS01
- Mallee Bull AS06
- Mallee Bull AS07
- Mallee Bull AS08
- Mallee Bull GG01
- Mallee Bull CMT10
- Mallee Bull CMT15
- Mallee Bull CMT16
- Mallee Bull CMT17
- Mallee Bull CMT18

Table 8-1: Summary of impact to Aboriginal heritage by the proposal

Site ID	Impact Unless managed	Effect of proposal on Significance	Actual impact with implementation of the mitigation measures
Mallee Bull AS01 (AHIMS ID Pending)	Indirect	Partial	Partial loss of value
Mallee Bull AS02 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull AS03 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull AS04 (AHIMS ID Pending)	Direct	Total	Total loss of value
Mallee Bull AS05 (AHIMS ID Pending)	Direct	Partial	Partial loss of value
Mallee Bull AS06 (AHIMS ID Pending)	Indirect	Partial	Partial loss of value
Mallee Bull AS07 (AHIMS ID Pending)	Indirect	Partial	Partial loss of value
Mallee Bull AS08 (AHIMS ID Pending)	Indirect	Partial	Partial loss of value
Mallee Bull AS09 (AHIMS ID Pending)	Direct	Partial	Partial loss of value
Mallee Bull AS10 (AHIMS ID Pending)	Direct	Partial	Total loss of value
Mallee Bull AS11 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull AS12 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull IF01 (AHIMS ID Pending)	Indirect	Partial	Partial loss of value
Mallee Bull IF02 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull IF03 (AHIMS ID Pending)	Indirect	Partial	Partial loss of value
Mallee Bull IF04 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull IF05 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT01 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT02 (AHIMS ID Pending)	None	None	No loss of value

Site ID	Impact Unless managed	Effect of proposal on Significance	Actual impact with implementation of the mitigation measures
Mallee Bull CMT03 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT04 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT05 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT06 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT07 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT08 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT09 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT10 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT11 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT12 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT13 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT14 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT15 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT16 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT17 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT18 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT19 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull CMT20 (AHIMS ID Pending)	None	None	No loss of value
Mallee Bull GG01 (AHIMS ID Pending)	Indirect	Partial	Partial loss of value
Mallee Bull GG02	None	None	No loss of value

Site ID	Impact Unless managed	Effect of proposal on Significance	Actual impact with implementation of the mitigation measures
(AHIMS ID Pending)			
Hearth 1	None	None	No loss of value
Hearth 2	Indirect	Partial	Partial loss of value

8.2 Management and mitigation options

Avoidance of impact to sites to Aboriginal cultural heritage is the first method of management. This is advocated in the Burra Charter as well as various other guidelines and codes of practice (Section 2.2). Total avoidance of all sites of heritage value is not always feasible. In the case avoidance presents a proponent with considerable difficulties, they may apply to damage or destroy a site.

Should the impact of any Aboriginal sites or objects be required as part of the proposal, the following mitigation measures are recommended (pending approval):

- The Registered Aboriginal Parties identified during the consultation process be consulted in determining the management of Aboriginal objects.
- An Aboriginal Heritage Impact Permit (AHIP) would be required prior to any impact to the recorded sites.
- Removal would include salvage/surface collection and may include relocation of impacted items to a suitable location in accordance with the *Code of Practice of archaeological Investigation of Aboriginal Objects in NSW.*
- Creating an exclusion zone around the 'Heritage Zones' to avoid indirect or inadvertent impact.
- The locations of the cultural heritage sites be provided to the relevant supervisors responsible for the construction and operation of the proposal and be indicated on project maps and documents such that it is clear where Aboriginal sites are located and they are to remain unharmed by work . They should be informed that cultural heritage sites are protected under the NPW Act and no harm is to come to them. The presence of the cultural heritage sites should be made clear to the workforce as part of an induction.

9 Recommendations

A total of 41 Aboriginal sites have been recorded within the study area and access road. One Aboriginal site Mallee Bull AS05 cannot be avoided and will be partially impacted by the proposal and 12 sites are within 100m of the impact footprint and are at risk form indirect or inadvertent impact. The remaining 28 Aboriginal sites are more than 100m from development areas and will not be impacted by the proposal.

Based on the assessment the following recommendations are based on the consideration of:

- The requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010)
- The results of the background research and fieldwork
- The likely impacts of the proposed development.

Based on the assessment, the following recommendations are made:

- The 'Heritage Zones' should be fenced off with standard farm fencing as shown in Figure 6-163 and Figure 6-164.
- The locations of the Aboriginal cultural heritage sites should be provided to the relevant supervisors responsible for the construction and operation of the proposal. They should be informed that cultural heritage sites are protected under the NPW Act and no harm is to come to them. The presence of the cultural heritage sites should be made clear to the workforce as part of an induction including on maps.
- Aboriginal sites outside the 'Heritage Zones' should be avoided and fenced off. The sites should be re-identified with the assistance of a qualified archaeologist and the Aboriginal community.
- Aboriginal sites within 100 metres of proposed impacts should be fenced off using standard farm fencing using a buffer of ten metres from the trunk of the Culturally Modified Trees and five metres from the boundaries of the Open Stone Artefact Sites.
- Mallee Bull AS05 will be partially impacted by the proposal and an Aboriginal Heritage Impact Permit (AHIP) would be required prior to any impact to the recorded sites.
- Should an AHIP be issued, salvage activities including surface collection within the impact footprint should be undertaken in accordance with OEH's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (2011a)*
- If changes are made to the proposed works which could impact locations outside of the proposed study area, further archaeological investigation may be required
- If any objects of suspected Aboriginal heritage origin be encountered during the proposed works, work in the area of the find should cease and the unexpected finds protocols (Appendix B) should be implemented
- If suspected human remains are located during any stage of the proposed works, work must stop immediately, and the NSW police must be notified.

10 References

AREA (2018). *Aurelia Metals Ltd Exploration on the Dominion Prospect.* Report to Hera Resources Pty Ltd

AREA. (2020a). *Aurelia Metals Federation Surface Exploration Aboriginal Due Diligence Assessment*. Report to R.W. Corkery & Co. Pty Limited.

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Appendix A: Database search results

AHIMS 20 Kilometre Buffer Search Result

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Mallee bull 10km

Client Service ID : 644078

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
34-2-0038	Mallee Bull ST1	GDA	55	414733	6413651	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Everick Heritage Pty Ltd,Mr.Jason Giang					Permits		
34-2-0035	Mallee Bull ST3	GDA	55	415122	6413498	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Everick Heritage Pty Ltd,Mr.Jason Giang					Permits		
34-2-0036	Malle Bull HC1	GDA	55	414914	6413399	Open site	Valid	Hearth : -		
	Contact	Recorders	Everick Heritage Pty Ltd,Mr.Jason Giang					Permits		
34-2-0037	Mallee Bull ST2	GDA	55	415137	6413536	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Everick Heritage Pty Ltd,Mr.Jason Giang					Permits		

**** Site Status**

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 02/12/2021 for Anna Darby for the following area at Datum :GDA, Zone : 55, Eastings : 406087.0 - 426087.0, Northings : 6403198.0 - 6423198.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 4

This information is not guaranteed to be free from error omission. Heritage NSW and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

Page 1 of 1

Appendix B: Unanticipated Finds Protocol

Unanticipated Finds Protocol

The protocol to be followed in the event previously unrecorded or unanticipated Aboriginal object(s) are encountered during the proposed works is as follows:

- All ground surface disturbance in the area of the finds should cease immediately the finds are uncovered.
- If the finds are of human remains, contact the police.
- Seek verification of the finds from a suitably qualified person, such as a heritage consultant.
- If the finds are verified or very likely to be Aboriginal in origin notify the NSW Heritage and the relevant local Aboriginal community representatives.
- All finds should be professionally recorded and registered on appropriate databases.
- A management strategy will be required according to best practice and consultation with the local Aboriginal community. All management will require approval from the relevant determining authority.

Appendix 6

Air Quality Impact Assessment

prepared by
Todoroski Air Sciences Pty Ltd

(Total No. of pages including blank pages = 37)

AIR QUALITY IMPACT ASSESSMENT
MALLEE BULL PROJECT

RW Corkery & Co Pty Ltd

21 September 2022

Job Number 21091332

Prepared by
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Email: info@airsciences.com.au

Air Quality Impact Assessment
Mallee Bull Project

DOCUMENT CONTROL

Report Version	Date	Prepared by	Reviewed by
DRAFT - 001	05/05/2022	R Georgiou & P Henschke	
FINAL - 001	21/09/2022	R Georgiou & P Henschke	

This report has been prepared in accordance with the scope of works between Todoroski Air Sciences Pty Ltd (TAS) and the client. TAS relies on and presumes accurate the information (or lack thereof) made available to it to conduct the work. If this is not the case, the findings of the report may change. TAS has applied the usual care and diligence of the profession prevailing at the time of preparing this report and commensurate with the information available. No other warranty or guarantee is implied in regard to the content and findings of the report. The report has been prepared exclusively for the use of the client, for the stated purpose and must be read in full. No responsibility is accepted for the use of the report or part thereof in any other context or by any third party.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Todoroski Air Sciences has prepared this report for RW Corkery & Co Pty Ltd on behalf of Peel Mining Limited. The report presents an assessment of potential air quality impacts associated with the proposed development of an exploration decline for the Mallee Bull Prospect located at Gilgunnia, New South Wales (NSW) (hereafter referred to as the Project).

This air quality impact assessment has been prepared in general accordance with the New South Wales (NSW) Environment Protection Authority (EPA) document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**).

To assess the potential air quality impacts associated with the Project, this report comprises:

- A background to the Project and description of the proposed site and operations;
- A review of the existing meteorological and air quality environment surrounding the site;
- A description of the dispersion modelling approach and emission estimation used to assess potential air quality impacts; and,
- Presentation of the predicted results and discussion of the potential air quality impacts and associated mitigation and management measures.

2 PROJECT BACKGROUND

2.1 Project setting

The Project site is located approximately 40 kilometres (km) north-east of Mount Hope on the Gilgunnia goldfields within the vicinity of Gilgunnia, NSW. Access to the site is via Kidman Way and Glenwood Road.

The area surrounding the Project site is predominately comprised of rural agricultural land with scattered isolated dwellings identified in the surrounding area, with the closest dwelling located approximately 10km to the south. The nearest residential dwellings are identified in **Table 2-1** and have been assessed as discrete assessment locations in this assessment.

Table 2-1: Assessment locations for the Project

Assessment location ID	Type	X-coordinates (m)	Y-coordinates (m)	Description
R1	Residential	404142	6414099	Mount View
R2	Residential	399569	6406329	Wongawood
R3	Residential	405384	6401253	Wynwood
R4	Residential	415325	6404347	Wirchilleba
R5	Residential	420125	6403763	Wilkerboon
R6	Residential	425453	6427842	Marigold
R7	Residential	416996	6425129	Brambah

Figure 2-1 presents the location of the Project with reference to the assessment locations.

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography in the general vicinity of the Project. The Project site can be characterised as relatively flat with undulating hills to the east and elevated peaks to the northwest of the Project site.

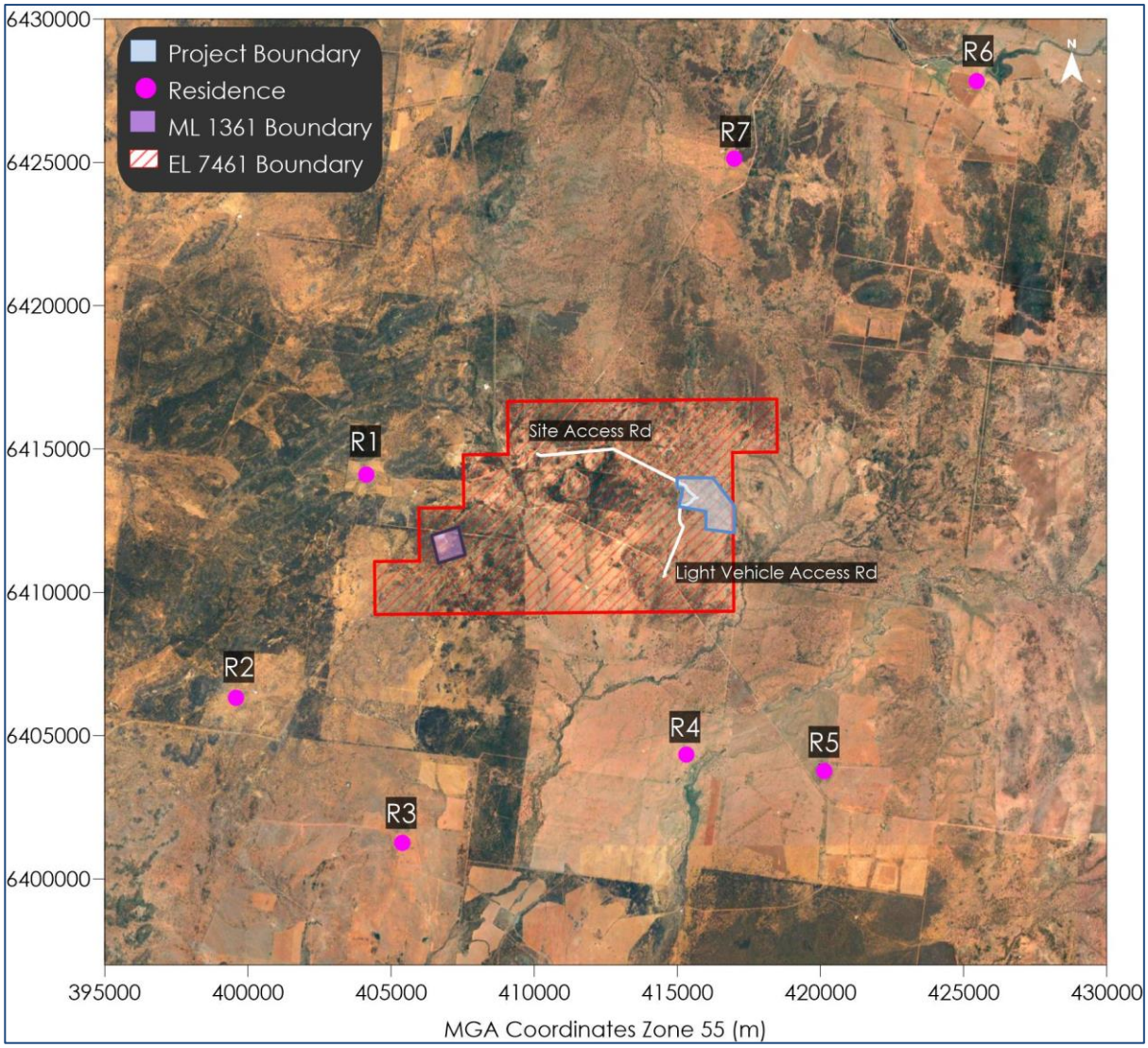

Figure 2-1: Project setting

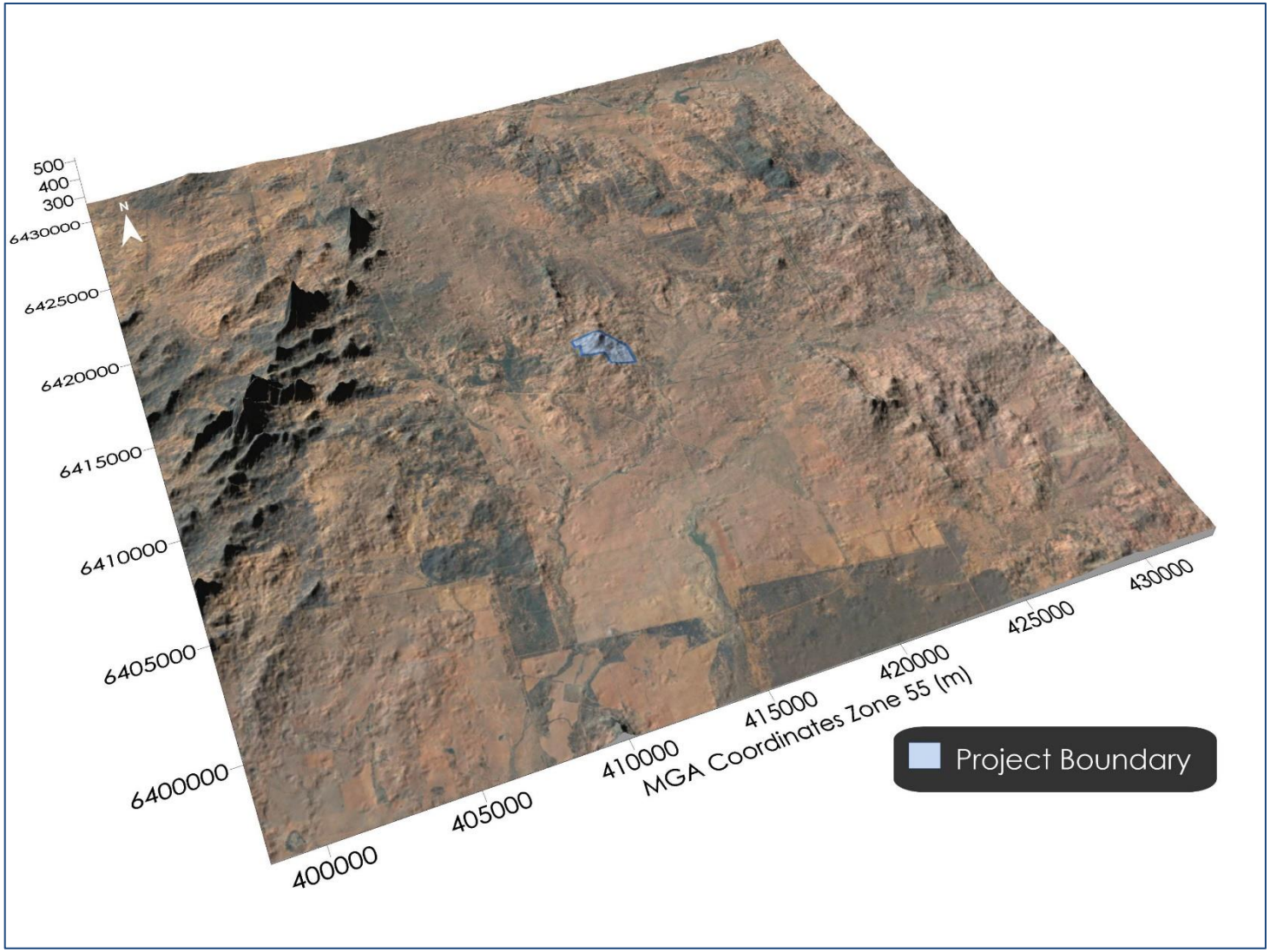

Figure 2-2: Representative visualisation of topography in the area surrounding the Project

2.2 Project description

The Project is seeking to construct an exploration decline for definition drilling of the deeper portions of the Mallee Bull Prospect.

Activities associated with the Project will include construction of a box cut to a maximum depth of 25 metres (m) below ground level, and drilling of deposit underground to a maximum depth of 700m below ground level.

The Project would also involve the construction of key surface infrastructure including a workshop, administration building, accommodation, a non-acid forming (NAF) waste rock emplacement area, a potential acid forming (PAF) waste rock emplacement area, a run of mine (ROM) stockpile pad, water storage dam and other associated infrastructure.

The proposed operating hours for the Project are 7:00am to 6:00pm, 7 days per week.

Figure 2-3 provides an indicative site layout of the Project.

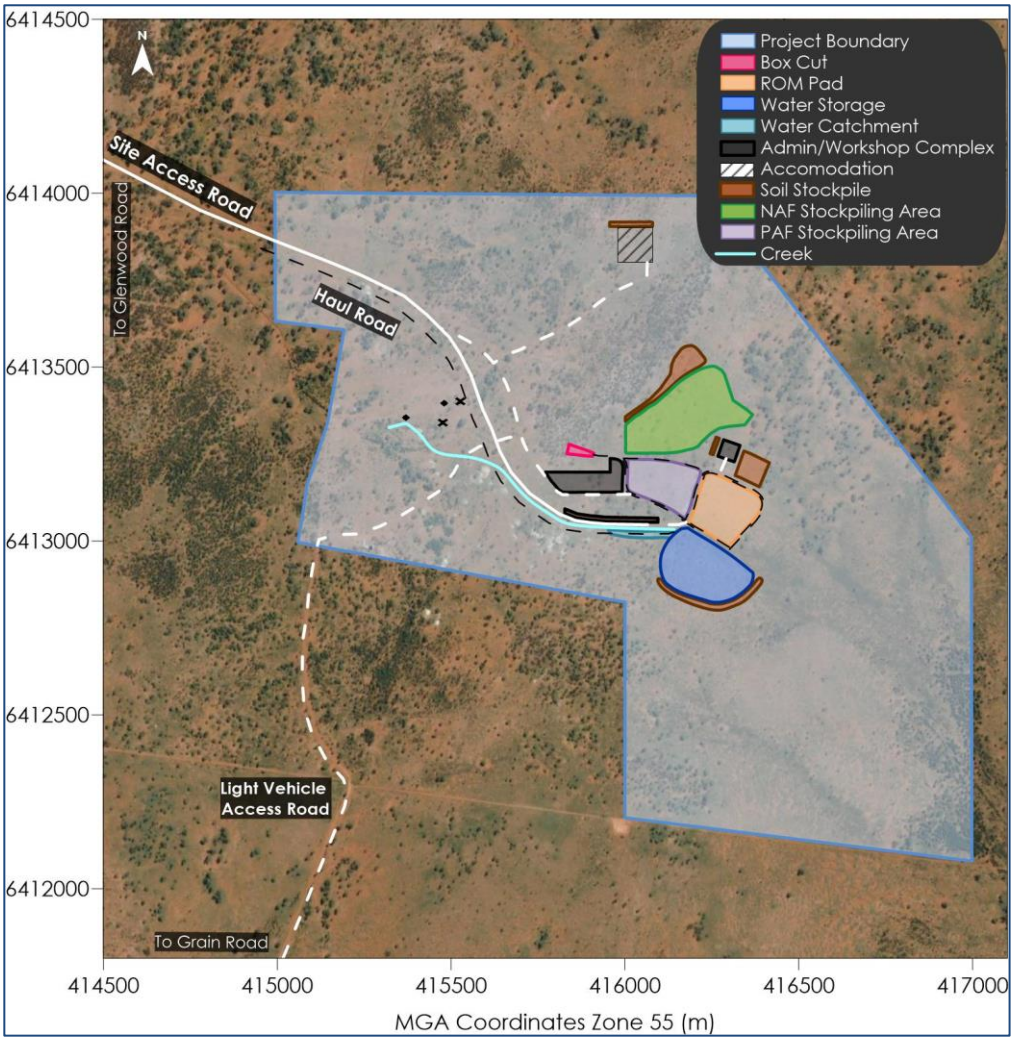

Figure 2-3: Indicative site layout for the Project

3 AIR QUALITY CRITERIA

3.1 Particulate matter

Particulate matter consists of dust particles of varying size and composition. Air quality goals refer to measures of the total mass of all particles suspended in air defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30 micrometres (µm) as in practice particles larger than 30 to 50µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

Two sub-classes of TSP are also included in the air quality goals, namely PM_{10}, particulate matter with equivalent aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with equivalent aerodynamic diameters of 2.5µm or less.

Particulate matter, typically in the upper size range, that settles from the atmosphere and deposits on surfaces is characterised as deposited dust. The deposition of dust on surfaces may be considered a nuisance and can adversely affect the amenity of an area by soiling property in the vicinity.

3.2 NSW EPA impact assessment criteria

Table 3-1 summarises the air quality goals that are relevant to this assessment as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**).

The air quality goals for total impact relate to the total pollutant burden in the air and not just the contribution from the Project. Consideration of background pollutant levels needs to be made when using these goals to assess potential impacts.

Table 3-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging Period	Impact	Criterion
TSP	Annual	Total	90 µg/m^3
PM_{10}	Annual	Total	25 µg/m^3
	24 hour	Total	50 µg/m^3
$PM_{2.5}$	Annual	Total	8µg/m^3
	24 hour	Total	25 µg/m^3
Deposited dust	Annual	Incremental	2 g/m^2/month
		Total	4 g/m^2/month

Source: **NSW EPA, 2017**

µg/m^3 = micrograms per cubic metre

g/m^2/month = grams per square metre per month

4 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the Project.

4.1 Local climatic conditions

Long-term climatic data from the closest Bureau of Meteorology (BoM) weather station at Cobar Airport Automatic Weather Station (AWS) (Site No. 048237) were analysed to characterise the local climate in the proximity of the Project. Cobar Airport AWS is located approximately 110 km north-northeast of the Project.

Table 4-1 and **Figure 4-1** present a summary of data from the Cobar Airport AWS collected over a 17 to 27 year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 35.7 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 3.2°C.

Rainfall decreases during the cooler months, with an annual average rainfall of 341.9 millimetres (mm) over 39.7 days. The data indicate that February is the wettest month with an average rainfall of 36.7mm over 3.4 days and August is the driest month with an average rainfall of 18.3mm over 2.7 days.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity ranges from 40.0% in December to 80.0% in June. Mean 3pm relative humidity levels range from 23.0% in December to 51% in June.

Wind speeds during the cooler months have a greater spread between the 9am and 3pm conditions compared to the warmer months. Mean 9am wind speeds range from 9.8 kilometres per hour (km/h) in July to 18.2km/h in January. Mean 3pm wind speeds range from 14.8km/h in May to 18.3km/h in October.

Table 4-1: Monthly climate statistics summary – Cobar Airport AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	35.7	33.8	30.6	25.9	20.5	16.9	16.4	18.8	23.1	27.0	30.4	33.5	26.0
Mean min. temp. (°C)	21.0	19.9	16.4	11.4	6.8	4.7	3.2	4.2	7.8	11.7	15.7	18.2	11.8
Rainfall													
Rainfall (mm)	35.0	36.7	30.8	20.3	26.3	33.9	21.5	18.3	29.4	28.1	35.8	25.7	341.9
No. of rain days (≥1mm)	3.5	3.4	3.2	2.1	3.1	4.3	3.2	2.7	3.4	3.6	4.0	3.2	39.7
9am conditions													
Mean temp. (°C)	25.9	24.3	21.1	18.4	13.4	9.8	8.6	11.5	16.0	19.6	22.2	24.6	18.0
Mean R.H. (%)	43.0	51.0	54.0	55.0	68.0	80.0	79.0	64.0	55.0	44.0	46.0	40.0	57.0
Mean W.S. (km/h)	18.2	16.5	14.9	14.4	10.7	10.3	9.8	12.5	15.8	17.0	17.2	17.7	14.6
3pm conditions													
Mean temp. (°C)	33.3	31.8	29.3	24.8	19.8	16.4	15.5	18.0	22.0	25.1	28.6	31.6	24.7
Mean R.H. (%)	24.0	31.0	30.0	33.0	43.0	51.0	50.0	38.0	34.0	29.0	28.0	23.0	34.0
Mean W.S. (km/h)	17.0	16.6	15.8	15.1	14.8	15.2	15.6	17.1	17.9	18.3	18.0	18.0	16.6

Source: **Bureau of Meteorology, 2022**

R.H. – Relative Humidity, W.S. – wind speed

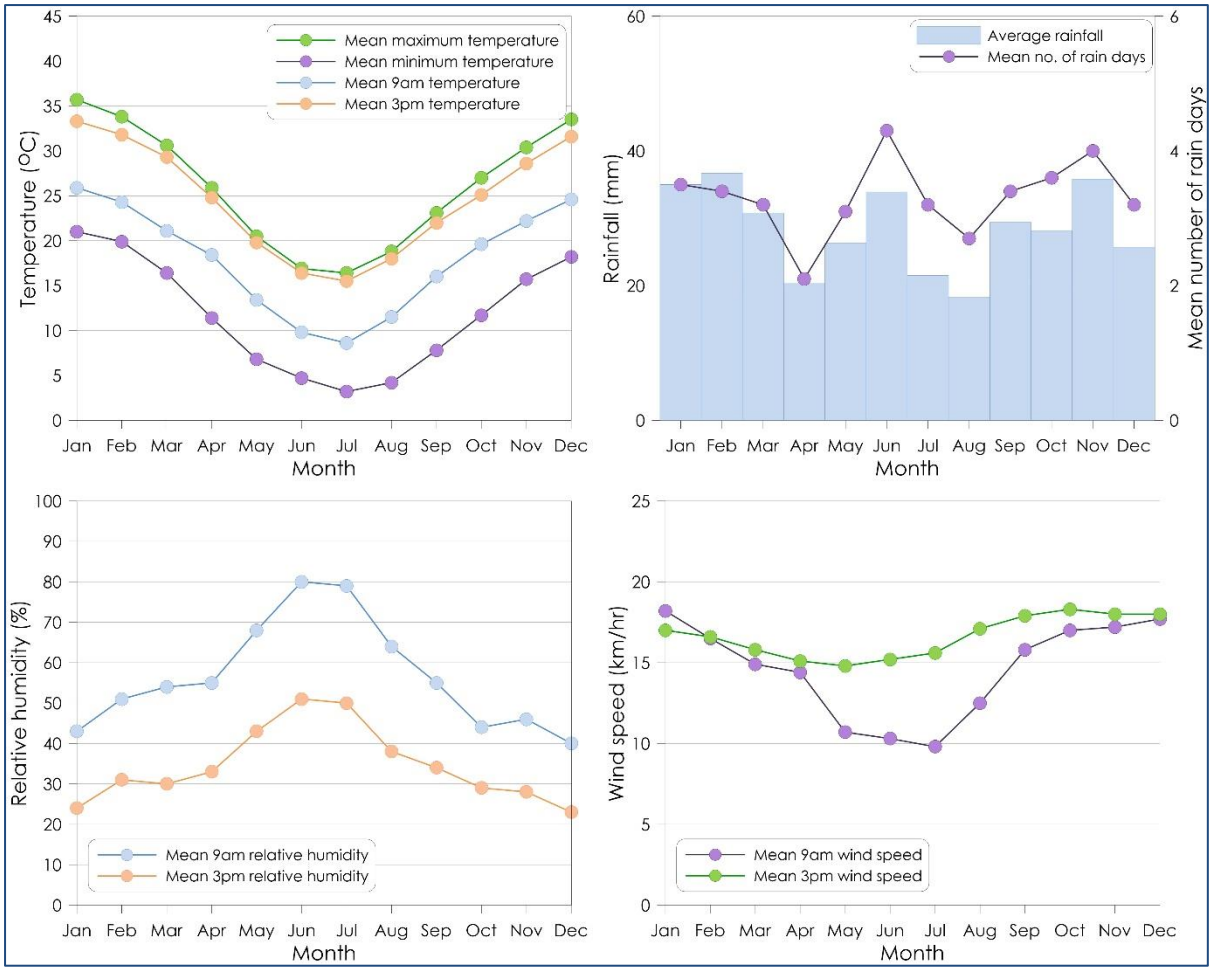

Figure 4-1: Monthly climate statistics summary – Cobar Airport AWS

4.2 Local meteorological conditions

Annual and seasonal windroses for the Cobar Airport AWS during the 2020 calendar period are presented in **Figure 4-2**.

The 2020 calendar year was selected as the meteorological year for the dispersion modelling based on an analysis of long-term data trends in meteorological data recorded and appropriate monitoring data for the area as outlined in **Appendix A**.

On an annual basis, winds predominately follow a northeast to southwest axis with varied winds from other directions. In summer, winds occur predominantly from the south and south-southwest. During winter, winds primarily occur from the northeast and southwest quadrants. The autumn and spring windroses have a similar distribution to the annual distribution with winds flowing on a northeast to southwest axis with varied winds from other directions.

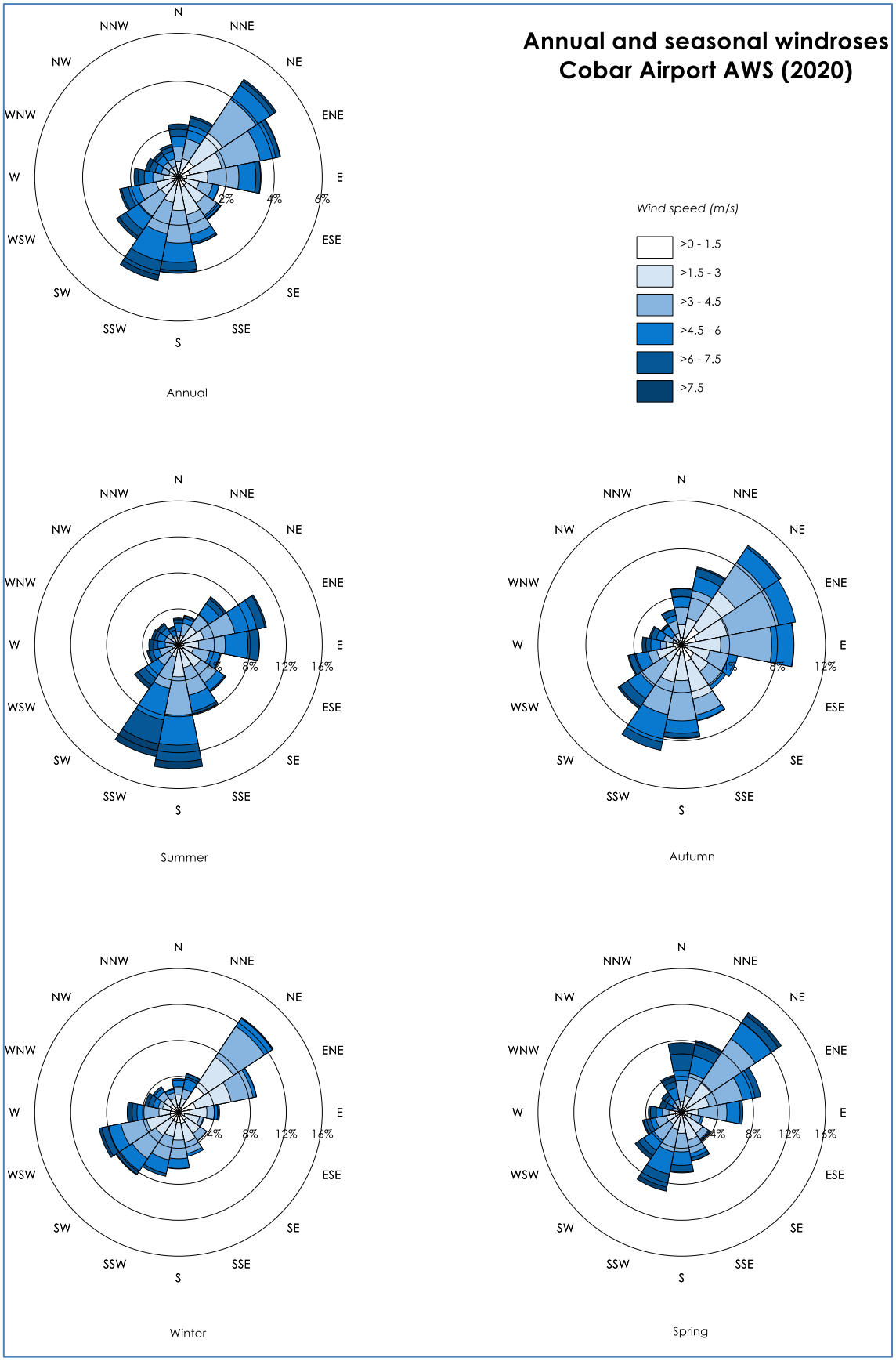

Figure 4-2 : Annual and seasonal windroses – Cobar Airport AWS (2020)

4.3 Local air quality monitoring

The main sources of air pollutants in the area surrounding the Project would include emissions from active extraction operations, agricultural activities, and anthropogenic activities such as various commercial activities and motor vehicle exhaust.

Ambient air quality monitoring data from the Project site are not available. Therefore, the available data from the nearest air quality monitor operated by the New South Wales (NSW) Department of Planning and Environment (DPE) at Wagga Wagga North was used to quantify the background levels for the Project site.

4.3.1 PM_{10} monitoring

A summary of the available PM_{10} monitoring data from 2015 to 2021 for the Wagga Wagga North monitoring station is presented in **Table 4-2**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 4-3.**

A review of **Table 4-2** indicates that the annual average PM_{10} concentrations for the Wagga Wagga North monitoring station were below the relevant criterion of 25µg/m^3 for all years with the exception of 2018 and 2019. The maximum 24-hour average PM_{10} concentrations were found to exceed the relevant criterion of 50µg/m^3 during all years of the review period.

It can be seen from **Figure 4-3** that PM_{10} concentrations fluctuate seasonally, with concentrations increasing during spring and summer with the warmer weather raising the potential for drier ground, elevating the occurrence of windblown dust, bushfires, and increased pollen levels. Anomalously high PM_{10} concentrations recorded in December 2019 and January 2020 are attributed to wildfires and the drought period (**NSW DPIE 2019**).

Table 4-2: Summary of PM_{10} levels from Wagga Wagga North monitoring (µg/m^3)

Year	Annual average	Criterion
2015	19.1	**25**
2016	20.6	**25**
2017	20.6	**25**
2018	**27.4**	**25**
2019	**35.3**	**25**
2020	23.2	**25**
2021	17.7	**25**
Year	**Maximum 24-hour average**	**Criterion**
2015	**145.1**	**50**
2016	**114.7**	**50**
2017	**171.6**	**50**
2018	**127.2**	**50**
2019	**251.7**	**50**
2020	**295.3**	**50**
2021	**69.1**	**50**

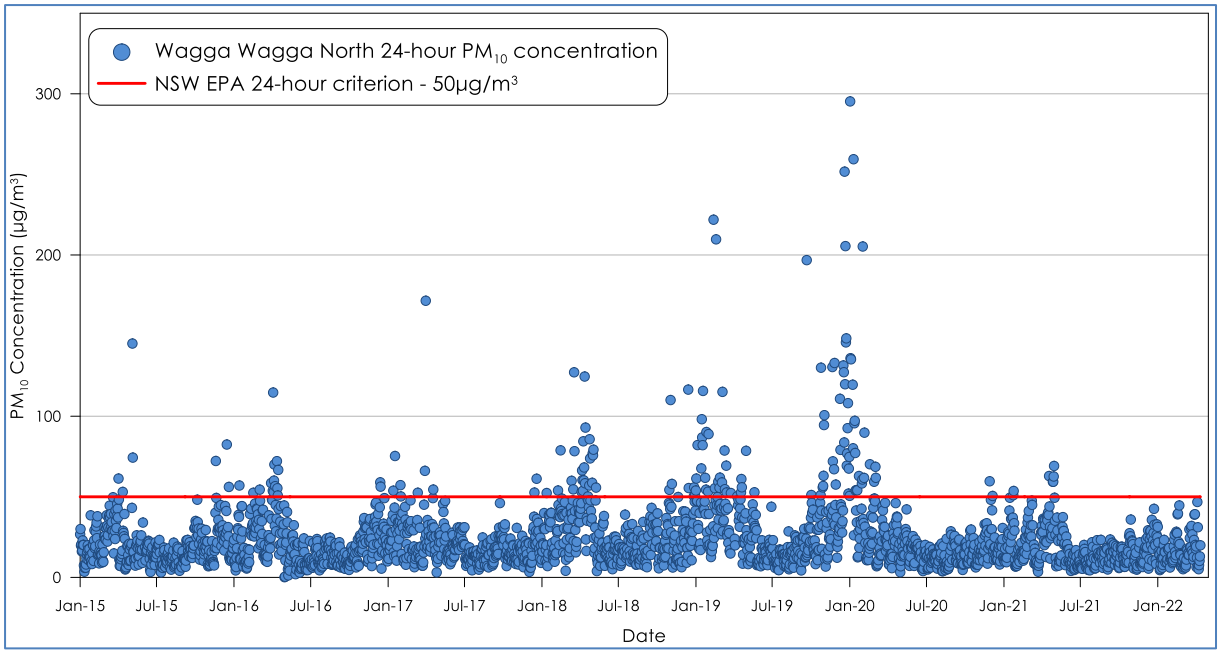

Figure 4-3: 24-hour average PM_{10} concentrations

4.3.2 $PM_{2.5}$ monitoring

A summary of the available data from 2015 to 2021 for the Wagga Wagga North monitoring station is presented in **Table 4-3**. Recorded 24-hour average $PM_{2.5}$ concentrations are presented in **Figure 4-4**.

Table 4-3 indicates that the annual average $PM_{2.5}$ concentrations for the monitoring station were below the annual average criterion of 8µg/m³ for all years except for 2017 to 2020.

The maximum 24-hour average $PM_{2.5}$ concentrations at the Wagga Wagga North monitoring station were found to exceed the relevant criterion of 25µg/m³ on occasion during the review period except for 2015 and 2018. Similar to the PM_{10} monitoring data, the mass bushfires affecting NSW in 2019/2020 are seen in the $PM_{2.5}$ monitoring data. It can be seen from **Figure 4-3** that $PM_{2.5}$ concentrations fluctuate seasonally, peaking during winter which are likely attributed to wood heater combustion.

Table 4-3: Summary of $PM_{2.5}$ levels from Wagga Wagga North monitoring (µg/m³)

Year	Annual average	Criterion
2015	7.6	**8**
2016	7.4	**8**
2017	**8.1**	**8**
2018	**8.4**	**8**
2019	**11.3**	**8**
2020	**10.7**	**8**
2021	6.3	**8**
Year	**Maximum 24-hour average**	**Criterion**
2015	24.2	**25**
2016	**28.1**	**25**
2017	**32.5**	**25**
2018	21.6	**25**
2019	**239.6**	**25**
2020	**559.5**	**25**
2021	**25.4**	**25**

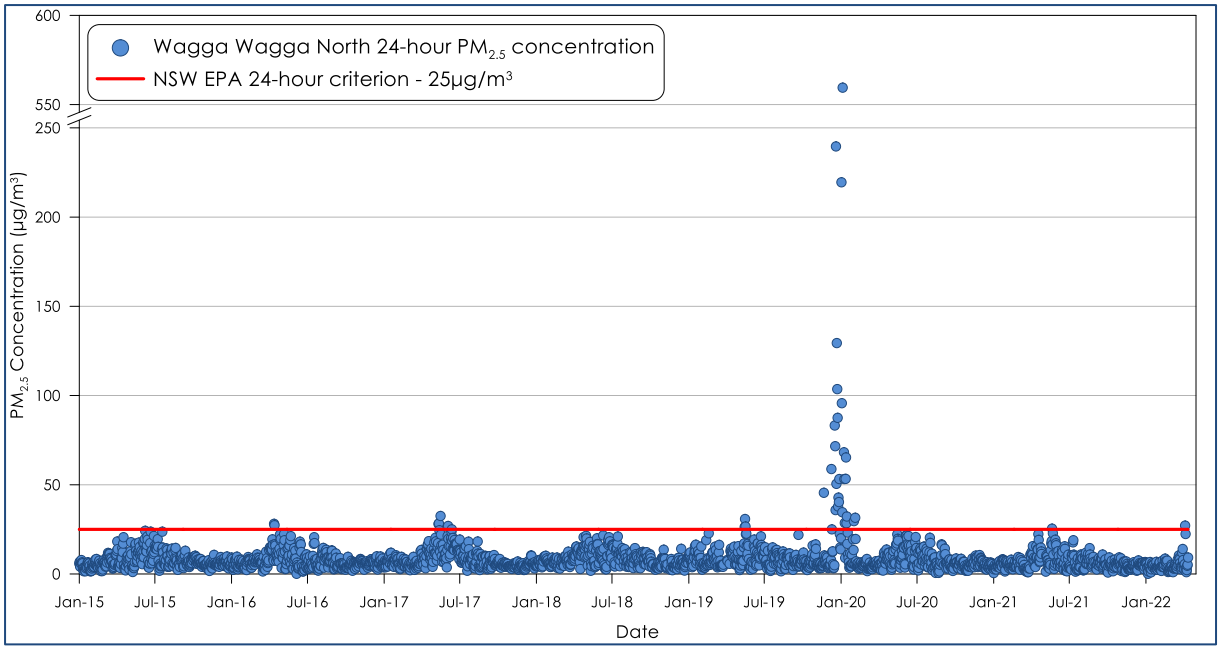

Figure 4-4: 24-hour average $PM_{2.5}$ concentrations

4.3.3 Estimated background levels

As outlined above, there are no readily available site-specific monitoring data, and therefore the background air quality levels from the Wagga Wagga North monitor for the 2020 calendar year were used to represent the background levels for the Project. The 2020 calendar period corresponds to the period of meteorological modelling based on an analysis of long-term data trends in meteorological data and appropriate monitoring data recorded for the area as outlined in **Appendix A**.

We note the Wagga Wagga North monitor is the closest publicly accessible monitor to the Project site and provides a sufficient dataset for 2020. It is noted that the Wagga Wagga North monitor is located in a more urban setting compared to the Project site and would generally experience higher particulate levels due to anthropogenic sources. This would present a conservative estimate of background levels for the Project site used to assess the cumulative impacts.

4.3.3.1 PM_{10}

The 2020 calendar period annual average PM_{10} level from Wagga Wagga North monitoring station was used to represent the background PM_{10} annual average for the Project, with the maximum measured 24-hour average level below the criterion (50µg/m^3) in 2020 was used to represent the 24-hour average background levels for the Project.

4.3.3.2 $PM_{2.5}$

The 2019/2020 bushfire event provided anomalously high $PM_{2.5}$ levels for 2019 and 2020 at the Wagga Wagga North monitoring station which are not representative of typical background levels. Thus, the annual levels from the 2015-2018 and 2021 periods were averaged to represent the background levels for the Project. The 24-hour average level used to represent the daily background levels of the Project is taken to be the maximum measured level below the criterion (25µg/m^3) in 2020 and would exclude periods significantly affected by the bushfire event.

4.3.3.3 TSP and Deposited dust

In the absence of available data, estimates of the annual average background TSP and deposited dust concentrations can be determined from a relationship between PM_{10}, TSP and deposited dust concentrations and the measured PM_{10} levels.

This relationship assumes that an annual average PM_{10} concentration of 25µg/m^3 corresponds to a TSP concentration of 90µg/m^3 and a dust deposition value of 4g/m^2/month. This assumption is based on the NSW EPA air quality impact criteria.

Applying this relationship with the measured annual average PM_{10} concentration of 23.2µg/m^3 indicates an approximate annual average TSP concentration and deposition value of 83.6µg/m^3 and 3.7g/m^2/month, respectively.

4.3.3.4 Summary of background levels

The background air quality levels applied in this assessment are as follows:

- 24-hour average $PM_{2.5}$ concentrations – 23.2 µg/m^3;
- Annual average $PM_{2.5}$ concentrations – 7.5µg/m^3;
- 24-hour average PM_{10} concentrations – 48.9 µg/m^3;
- Annual average PM_{10} concentrations – 21.3µg/m^3;
- Annual average TSP concentrations – 83.6µg/m^3; and,
- Annual average deposited dust levels – 3.7g/m^2/month

5 DISPERSION MODELLING APPROACH

5.1 Introduction

The following sections are included to provide the reader with an understanding of the model and modelling approach applied for the assessment. The CALPUFF is an advanced air dispersion model which can deal with the effects of complex local terrain on the dispersion meteorology over the modelling domain in a three-dimensional, hourly varying time step.

The model was setup in general accord with the methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'* (**TRC**, **2011**).

5.2 Modelling methodology

Modelling was undertaken using a combination of the CALPUFF Modelling System and The Air Pollution Model (TAPM). The CALPUFF Modelling System includes three main components: CALMET, CALPUFF and CALPOST and a large set of pre-processing programs designed to interface the model to standard, routinely available meteorological and geophysical datasets.

5.2.1 Meteorological modelling

The TAPM model was applied to the available data to generate a three dimensional upper air data file for use in CALMET. The centre of analysis for the TAPM modelling used is 32deg 24.5min south and 146deg 6min east. The simulation involved an outer grid of 30km, with three nested grids of 10km, 3km and 1km with 25 vertical grid levels.

CALMET modelling used a nested approach where the three dimensional wind field from a coarser grid outer domain is used as the initial guess (or starting) field for the finer grid inner domain. The CALMET initial domain was run on a 100 x 100km area with a 2km grid resolution and refined for a final domain of 35 x 35km with a 0.35km grid resolution. The available meteorological data for January 2020 to December 2020 from the Cobar Airport AWS and Condobolin Airport AWS BoM meteorological monitoring sites were included in the simulation.

Local land use and detailed topographical information was included to produce realistic fine scale flow fields (such as terrain forced flows) in surrounding areas, as shown in **Figure 5-1**.

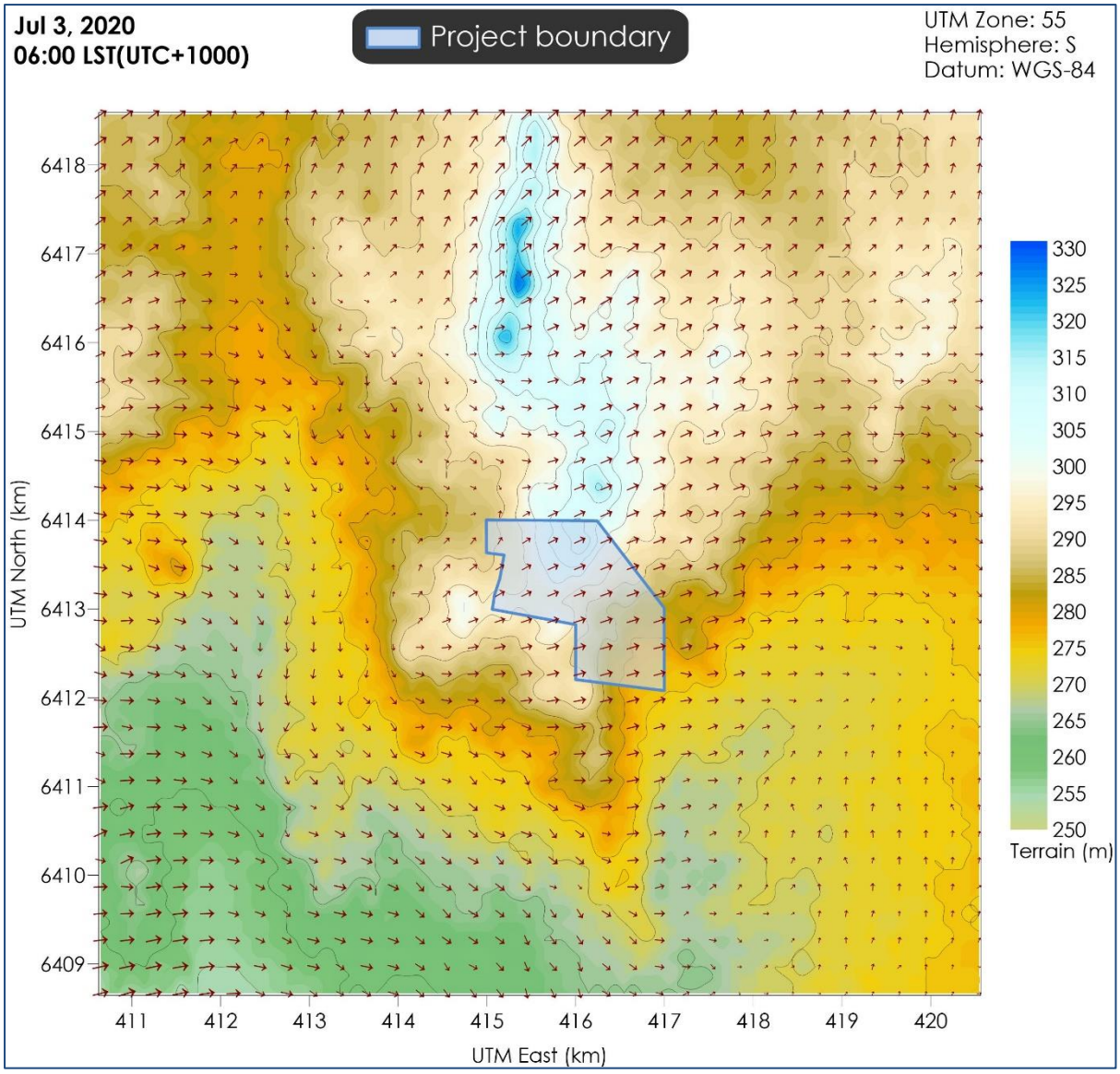

Figure 5-1: Representative 1-hour average snapshot of wind field for the Project

CALMET generated meteorological data were extracted from a point within the CALMET domain and are graphically represented in **Figure 5-2** and **Figure 5-3**.

Figure 5-2 presents the annual and seasonal windroses from the CALMET data. Overall, the windroses generated in the CALMET modelling reflect the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds. **Figure 5-3** includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and shows sensible trends considered to be representative of the area.

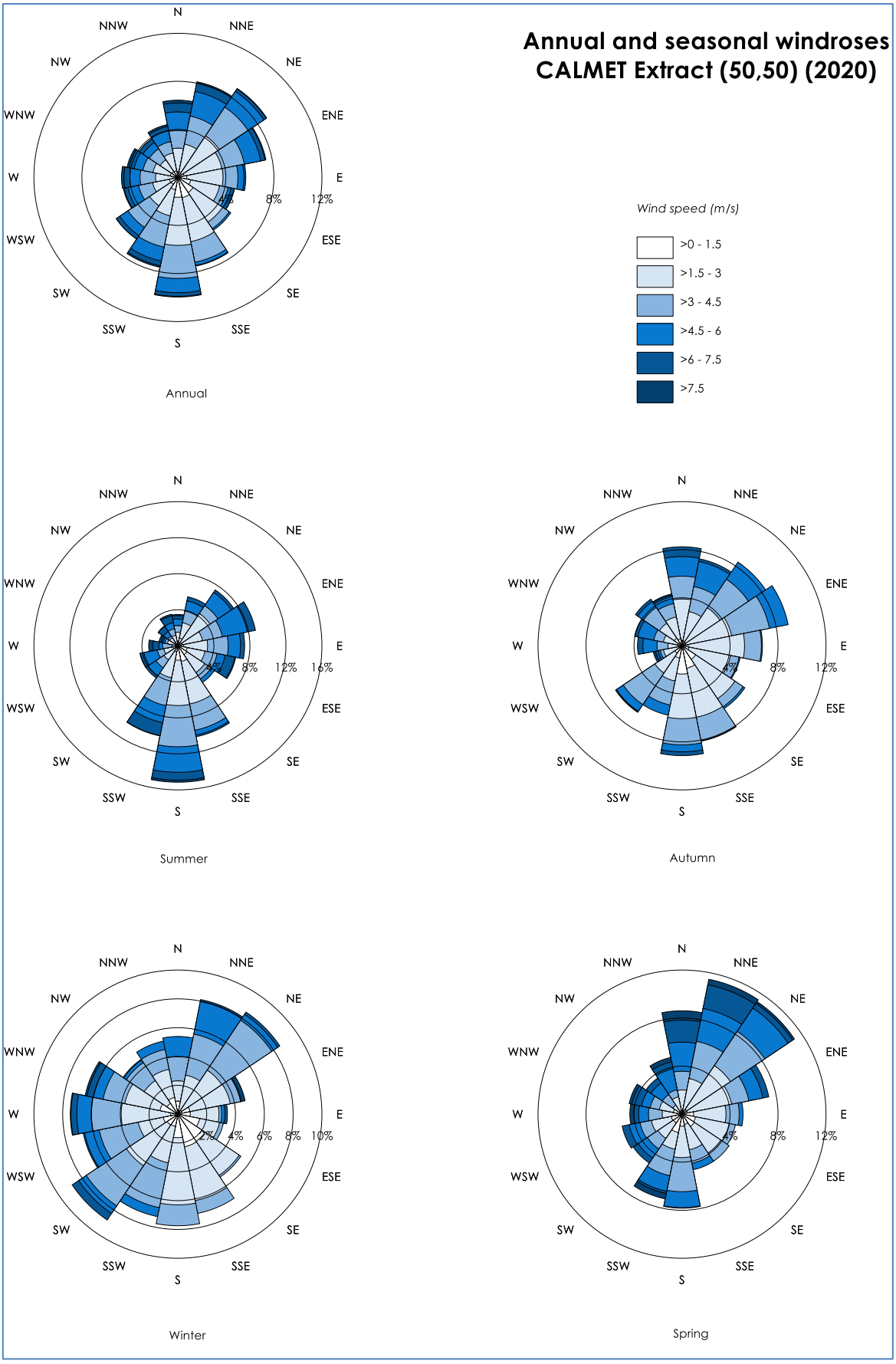

Figure 5-2: Annual and seasonal windroses from CALMET

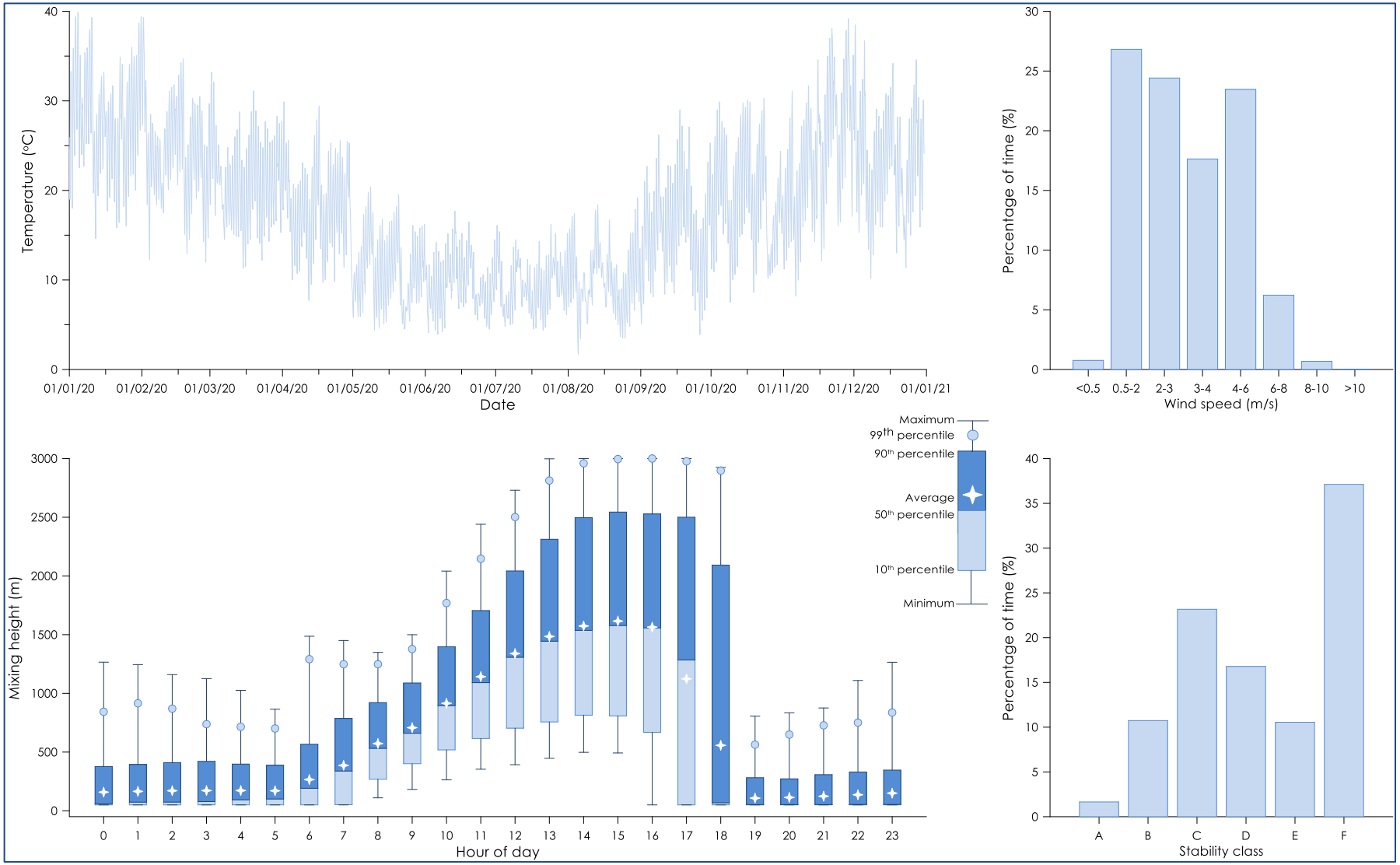

Figure 5-3: Meteorological analysis of CALMET

5.3 Dispersion modelling

Dust emissions from each operational activity of the Project were represented by a series of volume sources and were included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source.

It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment.

5.4 Emission estimation

The significant dust generating activities associated with construction and operation of the Project are identified as the loading/unloading of material, vehicles travelling on-site and off-site, and windblown dust from exposed areas and stockpiles. The on-site and off-site vehicle and plant equipment also have the potential to generate particulate emissions from the diesel exhaust.

The construction of the Project will involve a box cut, exploration decline and associated surface infrastructure. The maximum amount of material handled during construction phase is estimated to be 255,600t of material. It should be noted that the initial proposal for the Project included the off-site dispatch of 20,000t of bulk sample material and was included in the dust emission estimation and modelling assessment, however this is no longer being pursued. Therefore, as the dust emission estimations and modelling assessment include the dispatch of the bulk sample material, the predicted results can be considered to represent a conservative/ worst-case scenario for the Project.

Dust emission estimates have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emissions sourced from both locally developed and United States Environmental Protection Agency (US EPA) developed documentation. The estimated dust emissions for activities associated with the construction and operation of the Project is presented in **Table 5-1**. Detailed calculations of the dust emission estimates are provided in **Appendix B**.

Table 5-1: Summary of estimated dust emissions rate for the Project (kg/year)

Activity	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)	$PM_{2.5}$ Emissions (kg/year)
Dozer working on material	48,323	11,678	5,074
Loading NAF extracted material to haul truck	522	247	37
Hauling extracted material to NAF area (unpaved)	5,082	1,445	145
Unloading NAF extracted material at stockpile area	522	247	37
Loading PAF extracted material to haul truck	522	247	37
Hauling extracted material to PAF area (unpaved)	3,812	1,084	108
Unloading PAF extracted material at stockpile area	522	247	37
Loading ROM extracted material to haul truck	522	247	37
Hauling extracted material to ROM area (unpaved)	497	141	14
Unloading ROM material at stockpile area	41	19	3
Rehandle ROM material to stockpile area	108	51	8
Loading ROM material to Road Truck	41	19	3
Hauling ROM material offsite (unpaved)	9,167	2,607	261
Grader smoothing/flattening surface	28,435	9,935	881
Wind Erosion - infrastructure + stockpiles	6,507	3,254	488
Exhaust emissions	1,209	1209	1,173
Vent Shaft emissions	118,954	46,487	5,567
Total emissions	**224,786**	**79,164**	**13,911**

6 DISPERSION MODELLING RESULTS

This section presents the predicted air quality levels which may arise from air emissions generated by the Project.

6.1 Dust concentrations

The dispersion model predictions presented in this section include those for the operation of the Project in isolation (incremental impact) and the operation of the Project with consideration of other sources (total cumulative impact). The results show the predicted:

- Maximum 24-hour average $PM_{2.5}$ and PM_{10} concentrations;
- Annual average $PM_{2.5}$, PM_{10} and TSP concentrations; and,
- Annual average dust (insoluble solids) deposition rates.

It is important to note that when assessing impacts per the maximum 24-hour average levels, these predictions are based on the highest predicted 24-hour average concentrations which were modelled at each point within the modelling domain for the worst day (i.e. a 24-hour period) during the one year long modelling period.

Associated isopleth diagrams of the dispersion modelling results are presented in **Appendix C**.

Table 6-1 presents the predicted incremental and cumulative particulate dispersion modelling results at each of the assessment locations. The cumulative (total) impact is defined as the modelling impact associated with the operation of the Project combined with the estimated ambient background levels in **Section 4.3.3**.

The predicted incremental results show that minimal incremental effects would arise at the assessment locations due to the Project. The predicted cumulative results indicate that all of the assessed receptors are predicted to experience levels below the relevant criteria for each of the assessed dust metrics.

Table 6-1: Dust dispersion modelling results for residential receptors

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD* (g/m²/mth)	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD* (g/m²/mth)
	Incremental						Cumulative					
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	Ann. ave.	Ann. ave.
	Air quality impact criteria											
	-	-	-	-	-	2	25	8	50	25	90	4
R1	0.1	<0.1	0.3	<0.1	<0.1	<0.1	23.3	7.50	49.2	23.2	83.6	3.7
R2	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	23.2	7.50	49.0	23.2	83.6	3.7
R3	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	23.2	7.50	49.1	23.2	83.6	3.7
R4	0.1	<0.1	0.5	<0.1	<0.1	<0.1	23.3	7.50	49.4	23.2	83.6	3.7
R5	0.1	<0.1	0.4	<0.1	<0.1	<0.1	23.3	7.50	49.3	23.2	83.6	3.7
R6	0.1	<0.1	0.3	<0.1	<0.1	<0.1	23.3	7.50	49.2	23.2	83.6	3.7
R7	0.1	<0.1	0.4	<0.1	<0.1	<0.1	23.3	7.51	49.3	23.2	83.6	3.7

*Deposited dust

7 DUST MITIGATION AND MANAGEMENT

The proposed operations at the Project have the potential to generate dust emissions. To ensure that activities associated with the Project have a minimal effect on the surrounding environment and at residential receptor locations, it is recommended that all reasonable and practicable dust mitigation measures be utilised.

Suggested reasonable and practicable dust mitigation measures for the Project are listed in **Table 7-1**.

Table 7-1: Potential dust mitigation measures

Source	Mitigation Measure
General	Activities to be assessed during adverse weather conditions and modified as required (e.g. cease activity where reasonable levels of dust cannot be maintained using the available means).
	Weather forecast to be checked prior to undertaking material handling or processing.
	Engines of on-site vehicles and plant to be switched off when not in use.
	Vehicles and plant are to be fitted with pollution reduction devices where practicable.
	Vehicles are to be maintained and serviced according to manufacturer's specifications.
	Visual monitoring of activities is to be undertaken to identify dust generation.
Exposed areas/stockpiles	The extent of exposed surfaces and stockpiles is to be kept to a minimum.
	Exposed areas and stockpiles are either to be dampened with water as far as is practicable if dust emissions are visible, or there is potential for dust emissions outside operating hours.
Material handling	Reduce drop heights from loading and handling equipment where practical.
	Dampen material when excessively dusty during handling.
Hauling activities	Haul roads should be watered using water carts such that the road surface has sufficient moisture to minimise on-road dust generation but not so much as to cause mud/dirt track out to occur.
	Regularly inspect haul roads and maintain surfaces to remove potholes or depressions
	Driveways and hardstand areas to be swept/cleaned regularly as required etc.
	Vehicle traffic is to be restricted to designated routes.
	Speed limits are to be enforced.
	Vehicle loads are to be covered when travelling off-site.

It is anticipated that the Project would develop a suitable Air Quality Management Plan (AQMP) (or similar plan) for the site to assist with the management of air emissions. The AQMP would outline the measures to manage dust emissions at the site and include aspects such as key performance indicators, monitoring methods, response mechanisms, compliance reporting and complaints management.

The air emission controls applied at the site would be regularly assessed to ensure they are working effectively and required modification or adjustments to the air emission control measures would be revised on a regular basis and documented in the AQMP.

8 SUMMARY AND CONCLUSIONS

This report has assessed the potential air quality impacts associated with the proposed development of an exploration decline for the Mallee Bull Prospect.

Air dispersion modelling was used to predict the potential for off-site dust impacts in the surrounding area due to the operation of the Project. The estimated emissions of dust applied in the modelling are likely to be conservative and would overestimate the actual impacts.

It is predicted that all the assessed air pollutants generated by the operation of the Project would comply with the applicable assessment criteria at the assessed receptors and therefore would not lead to any unacceptable level of environmental harm or impact in the surrounding area.

Nevertheless, the site would apply appropriate dust management measures to ensure it minimises the potential occurrence of excessive air emissions from the site.

Overall, the assessment demonstrates that even using conservative assumptions, the Project can operate without causing any significant air quality impact at residential receptors in the surrounding environment.

9 REFERENCES

Bureau of Meteorology (2022)

Climate statistics for Australian locations, Bureau of Meteorology website, accessed April 2022. http://www.bom.gov.au/climate/averages

NSW EPA (2015)

"NSW Coal Mining Benchmarking Study Best-practice measures for reducing non-road diesel exhaust emissions", August 2015.

NSW EPA (2017)

"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales", NSW Environment Protection Authority, January 2017.

NSW DPIE (2019)

"Dustwatch Report December 2019", prepared by NSW Department of Planning, Industry and Environment, December 2019.

TRC (2011)

"Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia", Prepared for the NSW Office of Environment and Heritage by TRC Environmental Corporation.

US EPA (1985 and update)

"Compilation of Air Pollutant Emission Factors", AP-42, Fourth Edition United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711.

Appendix A

Selection of Meteorological Year

Selection of meteorological year

A statistical analysis of the latest five contiguous years of meteorological data from the nearest BoM weather station with suitable available data, Cobar Airport weather station, is presented in **Table A-1**.

The standard deviation of the latest five years of meteorological data spanning 2017 to 2021 was analysed against the available measured wind speed, temperature and relative humidity. The analysis indicates that 2020 dataset is closest to the mean for wind speed and relative humidity, and 2021 is closest for temperature. On the basis of a score weighting analysis, 2020 was found to be most representative.

Table A-1: Statistical analysis results for Cobar Airport AWS

Year	Wind speed	Temperature	Relative humidity	Score
2017	0.3	1.1	4.8	6.6
2018	0.3	1.2	7.4	9.1
2019	0.3	1.3	6.4	8.2
2020	0.2	1.2	3.8	5.4
2021	0.2	0.8	4.2	5.5

Figure A-1 shows the frequency distributions for wind speed, temperature and relative humidity for the 2020 year compared with the mean of the 2017 to 2021 data set. The 2020-year data appear to be well aligned with the mean data.

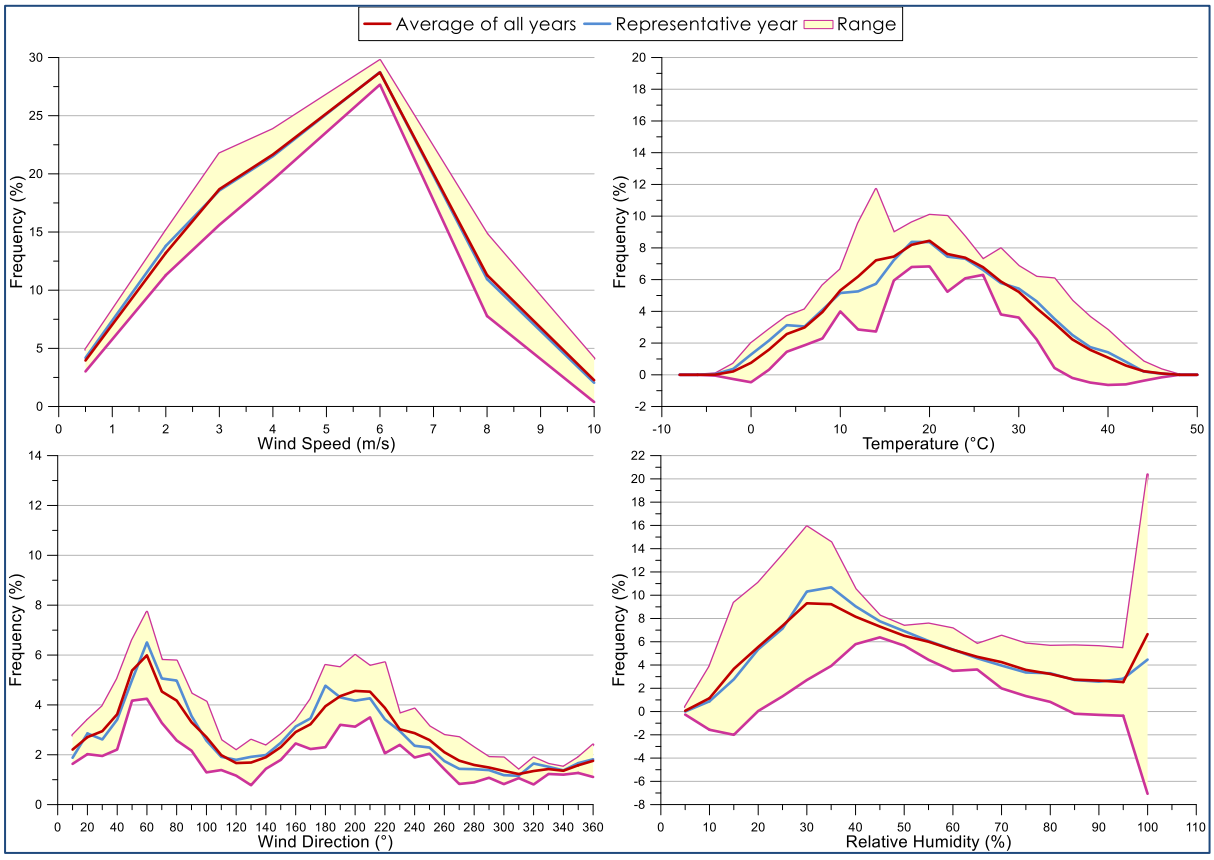

Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix B

Emission Calculations

Emission Calculation

The dust emissions from the Project have been estimated from the operational description of the proposed activities provided by the Proponent and have been combined with emissions factor equations and utilising suitable emission and load factors that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled.

Emission factors and associated controls have been sourced from:

- United States (US) EPA AP42 Emission Factors (**US EPA, 1985 and Updates**);
- Office of Environment and Heritage document, "NSW Coal Mining Benchmarking Study: Best Practise Measures for Reducing Non-Road Diesel Exhaust Emissions, Final Report" (**NSW EPA, 2015**).

The emission factor equations used for each dust generating activity are outlined in **Table B-1** below. A detailed dust emission inventory for the construction and operation scenarios is presented in **Table B-2.**

Control factors include the following:

- Hauling on unpaved surfaces – 75% control for watering of trafficked areas;
- Wind erosion from exposed areas – 50% control for watering of exposed areas.

Table B-1: Emission factor equations

Activity	Emission factor equation		
	TSP	PM_{10}	$PM_{2.5}$
Loading / emplacing material	$EF = 0.74 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.35 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$	$EF = 0.053 \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} / \frac{M}{2}^{1.4}\right) kg/tonne$
Hauling on unsealed surfaces	$EF = \left(\frac{0.4536}{1.6093}\right) \times 4.9 \times (s/12)^{0.7} \times (1.1023 \times M/3)^{0.45} kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 1.5 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45} kg/VKT$	$EF = \left(\frac{0.4536}{1.6093}\right) \times 0.15 \times (s/12)^{0.9} \times (1.1023 \times M/3)^{0.45} kg/VKT$
Hauling on sealed surfaces	$EF = 3.23 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$	$EF = 0.62 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$	$EF = 0.15 \times s.L.^{0.91} \times (1.1023 \times W)^{1.02} kg/VKT$
Wind erosion on exposed areas, stockpiles	$EF = 850\, kg/ha/year$	$0.5 \times TSP$	$0.075 \times TSP$

A = horizontal area (m^2) with blasting depth ≤ 21m, EF = emission factor, U = wind speed (m/s), M = moisture content (%), s = silt content (%), s.L. = silt loading (g/m^2), W = average weight of vehicle (tonne), VKT = vehicle kilometres travelled (km).

Table B-2: Dust Emissions Inventory

Activity	TSP emission	PM10 emission	PM25 emission	Intensity	Units	EF - TSP	EF - PM10	EF - PM25	Units	Var 1	Units	Var 2	Units	Var 3 - TSP/PM10/ PM25	Units	Var 4	Units	Var 5	Units	Var 6	Units
Construction/operation																					
Dozer working on material	48,323	11,678	5,074	2,888	hr/yr	16.7353	4.0442	1.7572	kg/h	10	S.C. %	2	M.C. %								
FEL loading NAF extracted material to haul truck	522	247	37	255,600	t/yr	0.00204	0.00097	0.00015	kg/t	1.73	ave ws (m/s)	2	M.C %								
Hauling extracted material to NAF area (unpaved)	5,082	1,445	145	255,600	t/yr	0.080	0.023	0.002	kg/t	41	t/load	0.8	km/return	4.1/1.2/0.12	kg/VKT	8.3	S.C %	54	weight (t)	75	C %
Unloading NAF extracted material at stockpile area	522	247	37	255,600	t/yr	0.00204	0.00097	0.00015	kg/t	1.73	ave ws (m/s)	2	M.C %								
FEL loading PAF extracted material to haul truck	522	247	37	255,600	t/yr	0.00204	0.00097	0.00015	kg/t	1.73	ave ws (m/s)	2	M.C %								
Hauling extracted material to PAF area (unpaved)	3,812	1,084	108	255,600	t/yr	0.060	0.017	0.002	kg/t	41	t/load	0.6	km/return	4.1/1.2/0.12	kg/VKT	8.3	S.C %	54	weight (t)	75	C %
Unloading PAF extracted material at stockpile area	522	247	37	255,600	t/yr	0.00204	0.00097	0.00015	kg/t	1.73	ave ws (m/s)	2	M.C %								
FEL loading ROM extracted material to haul truck	522	247	37	255,600	t/yr	0.00204	0.00097	0.00015	kg/t	1.73	ave ws (m/s)	2	M.C %								
Hauling extracted material to ROM area (unpaved)	497	141	14	20,000	t/yr	0.099	0.028	0.003	kg/t	41	t/load	1.0	km/return	4.1/1.2/0.12	kg/VKT	8.3	S.C %	54	weight (t)	75	C %
Unloading ROM material at stockpile area	41	19	3	20,000	t/yr	0.00204	0.00097	0.00015	kg/t	1.73	ave ws (m/s)	2	M.C %								
Rehandle ROM material to stockpile area	108	51	8	20,000	t/yr	0.00539	0.00255	0.00039	kg/t	1.73	ave ws (m/s)	1	M.C %								
FEL loading ROM material to Road Truck	41	19	3	20,000	t/yr	0.00204	0.00097	0.00015	kg/t	1.73	ave ws (m/s)	2	M.C %								
Hauling ROM material offsite (unpaved)	9,167	2,607	261	20,000	t/yr	1.833	0.521	0.052	kg/t	24	t/load	13.8	km/return	3.2/0.9/0.09	kg/VKT	8.3	S.C %	31	weight (t)	75	C %
Grader smoothing/flattening surface	28,435	9,935	881	46,200	km	0.6155	0.2150	0.0191	kg/VKT	8	speed (km/hr)										
WE - infrastructure + stockpiles	6,507	3,254	488	15.3	ha	850	425	64	kg/ha/yr											50	C %
Exhaust emissions	1,209	1209	1,173																		
Vent Shaft emissions	118,954	46,487	5,567	63072000	sec/ye	0.0019	0.0007	0.0001	kg/sec	4.72	mg/Nm3	400	m3/s								
Total emissions (kg/yr)	**224,786**	**79,164**	**13,911**																		

Appendix C

Isopleth Diagrams

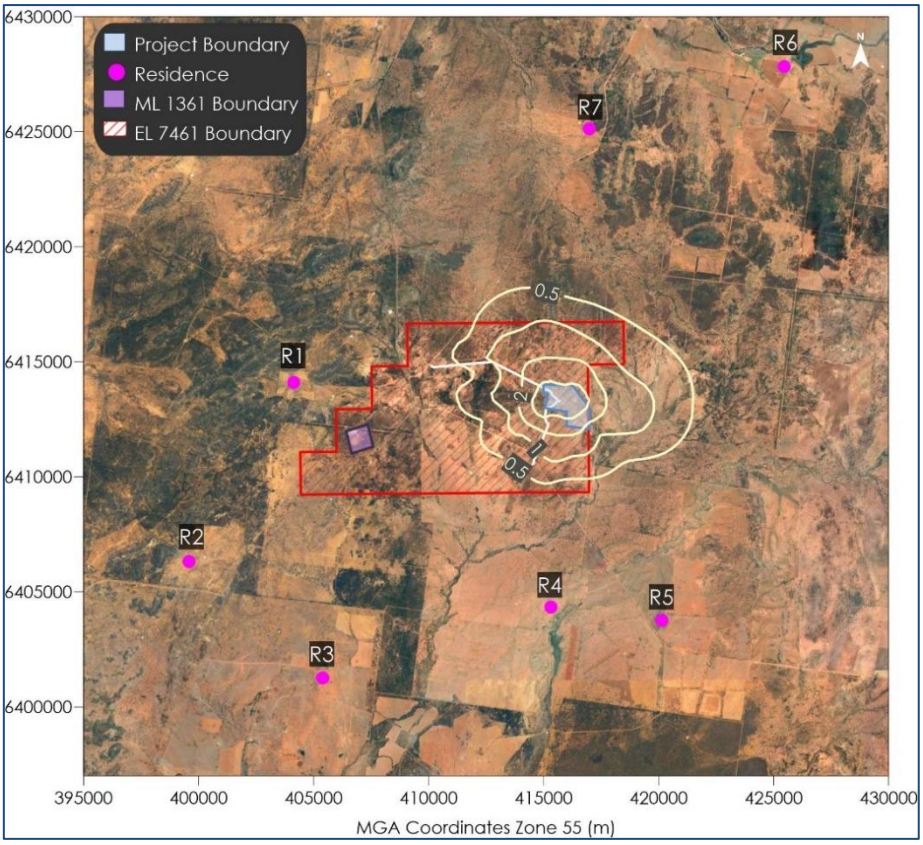

Figure C-1: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³)

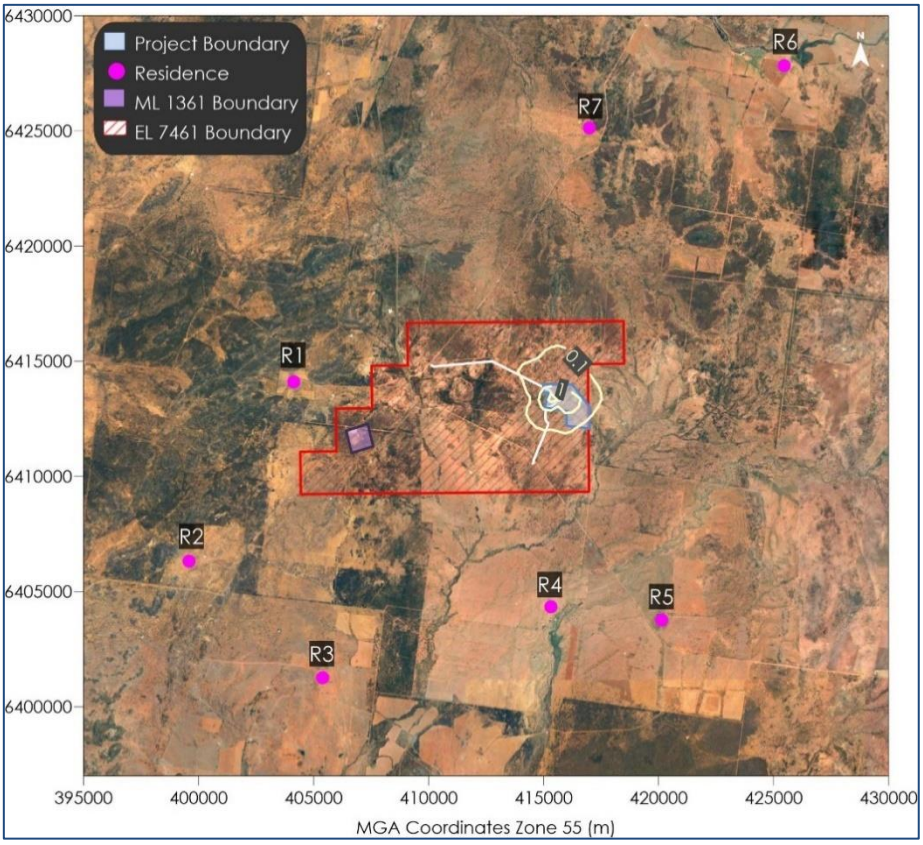

Figure C-2: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³)

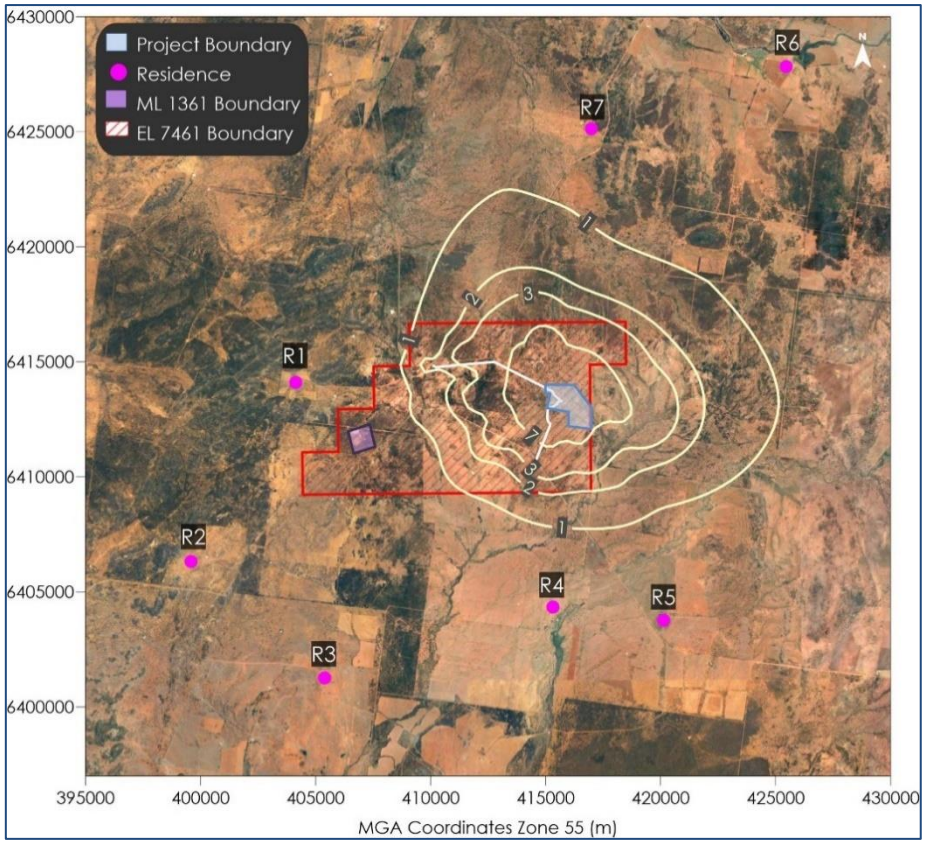

Figure C-3: Predicted incremental maximum 24-hour average PM_{10} concentrations (µg/m³)

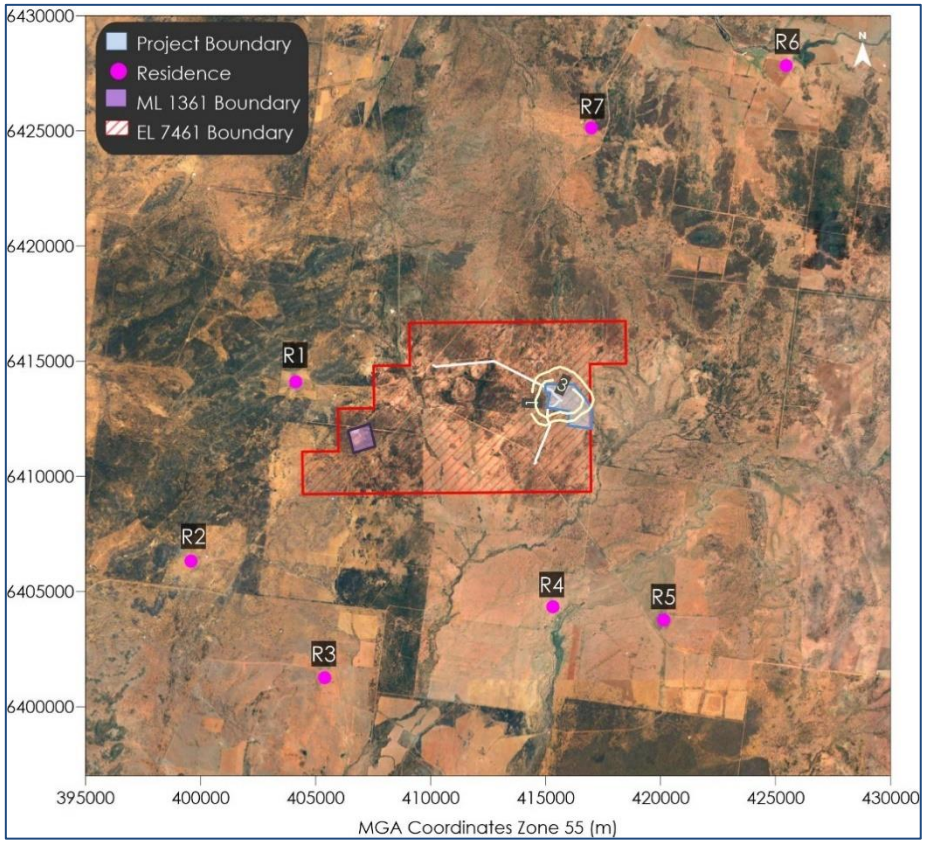

Figure C-4: Predicted incremental annual average PM_{10} concentrations (µg/m³)

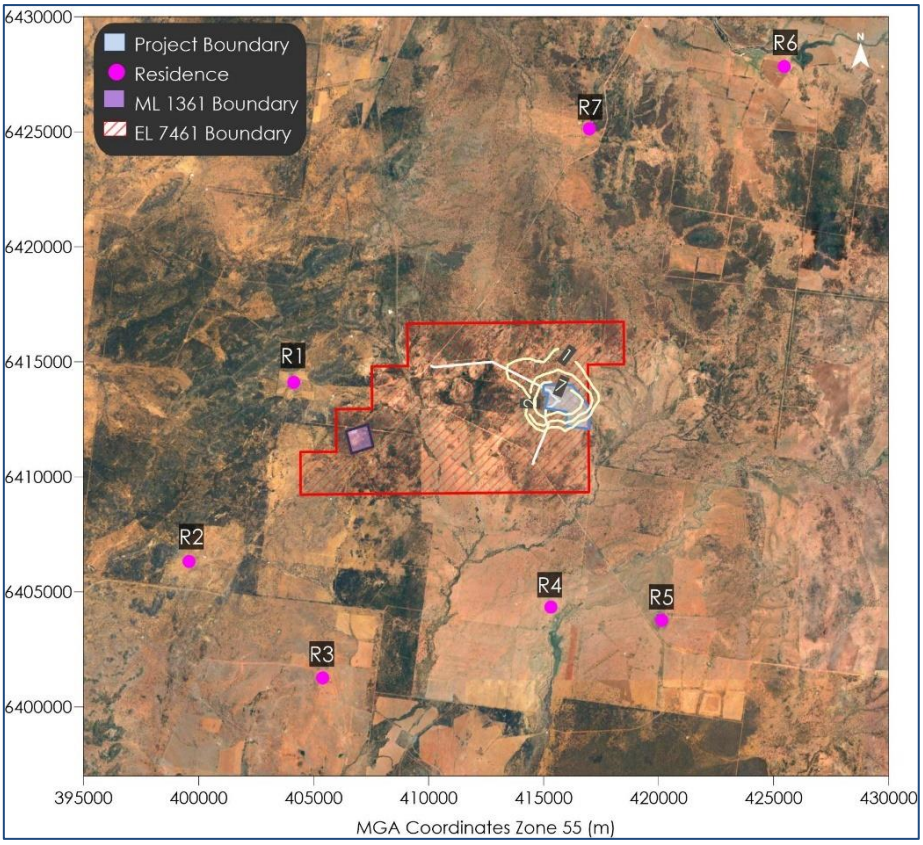

Figure C-5: Predicted incremental annual average TSP concentrations (µg/m³)

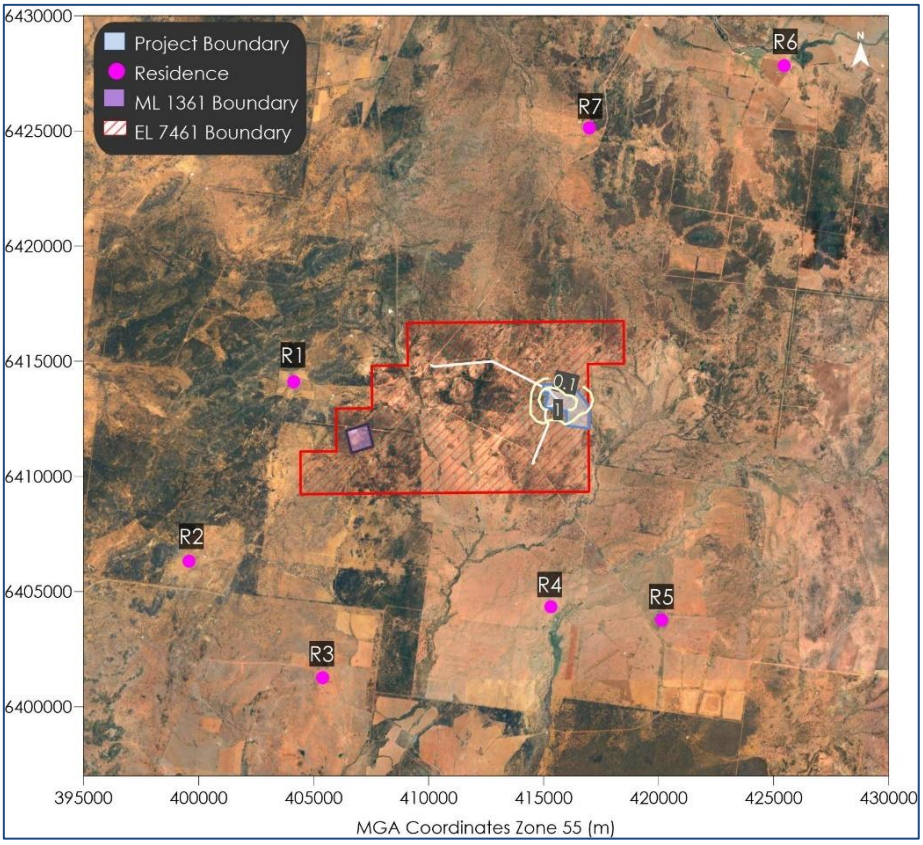

Figure C-6: Predicted incremental annual average dust deposition levels (g/m²/month)

Appendix 7

Noise Impact Assessment

prepared by
Muller Acoustic Consulting Pty Ltd

(Total No. of pages including blank pages = 47)

Noise and Vibration Impact Assessment

Mallee Bull Exploration Decline
Gilgunnia, NSW

Prepared for: RW Corkery & Co Pty Ltd
on behalf of Peeling Mining Ltd
September 2022
MAC211450-01RP1V2

Muller Acoustic Consulting

Document Information

Noise and Vibration Impact Assessment

Mallee Bull Exploration Decline

Gilgunnia, NSW

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MAC211450-01RP1V2	26 September 2022	Robin Heaton	Robin Heaton	Oliver Muller	

CONTENTS

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by RW Corkery & Co Pty Ltd on behalf of Peeling Mining Ltd to prepare a Noise and Vibration Impact Assessment (NVIA) to quantify emissions from the proposed Mallee Bull Exploration Decline (the 'project') in Gilgunnia, NSW.

The NVIA has quantified potential operational and sleep disturbance noise emissions from the project and recommends reasonable and feasible noise controls where required. The NVIA has been prepared to accompany the Review of Environmental Factors (REF) which is being prepared for submission.

This assessment has been undertaken in accordance with the following documents:

- NSW Department of Environment and Climate Change (DECCW), NSW Interim Construction Noise Guideline (ICNG), July 2009;
- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), March 2011;
- NSW Department of Environment and Conservation (DEC) – NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline (the NSW vibration guideline), February 2006;
- Australian Standard AS2187.2-2006 (AS2187.2) – Explosives-Storage and Use Part 2: Use of Explosives; and
- Australian and New Zealand Environment Council (ANZEC), 1990, Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Project Description

2.1 Background

The project site is located at Gilgunnia, NSW approximately 110km south of Cobar. The project proposes to construct an exploration decline in order to undertake core sampling. Samples are investigated for the presence of metalliferous ore for extraction. Exploration works are undertaken under exploration license # 7461. The project proposes the construction of a 25 metre boxcut to accommodate the decline access. The proposed decline will extend to a minimum depth of 300 metres below ground level (mbgl) and a maximum depth of approximately 700mbgl. The project will also comprise the following elements:

- workshop;
- admin building;
- core yard;
- geology yard;
- magazine;
- PAF and NAF emplacements;
- water Storage dams;
- fuel storage and waste management centre; and
- site access and internal roadways

Water from the decline will be stored onsite in the water dam and will be utilised for onsite activities.

2.2 Hours of Operation

Table 1 presents the proposed operating hours for the project. The proposed hours and combination of activities for the project have formed the basis of the noise modelling scenarios for this assessment.

Table 1 Proposed Hours for Project Operation

Activity	Monday to Sunday
Site Establishment and Construction	7am – 6pm
Box Cut Excavation	
Campaign Ore Transport	
Exploration Decline	24 hours/day
Underground Exploration and Core Sampling	
Maintenance and Workshop Operations	
Rehabilitation	7am – 6pm

2.2.1 Receiver Review

From review of aerial imagery and associated project information, the following receivers have been identified. Receivers in the locality are primarily rural / residential. **Table 2** presents a summary of receiver identification, address and MGA(55) coordinates. The location of the receivers are presented visually in **Figure 1** (RWC, Figure 1, 2021).

Table 2 Receiver Locations

Receiver	Address	Coordinates (MGA55)	
		Easting	Northing
R1	25679 Kidman Way, Gilgunnia, NSW	404142	6414099
R2	24497 Kidman Way, Gilgunnia, NSW	399569	6406330
R3	24096 Kidman Way, Gilgunnia, NSW	405385	6401253
R4	1436 Grain Road, Gilgunnia, NSW	425454	6427843
R5	1529 Grain Road, Gilgunnia, NSW	416997	6425129
R6	2671 Glenwood Road, Nymagee, NSW	415326	6404347
R7	3260 Glenwood Road, Nymagee, NSW	420126	6403764

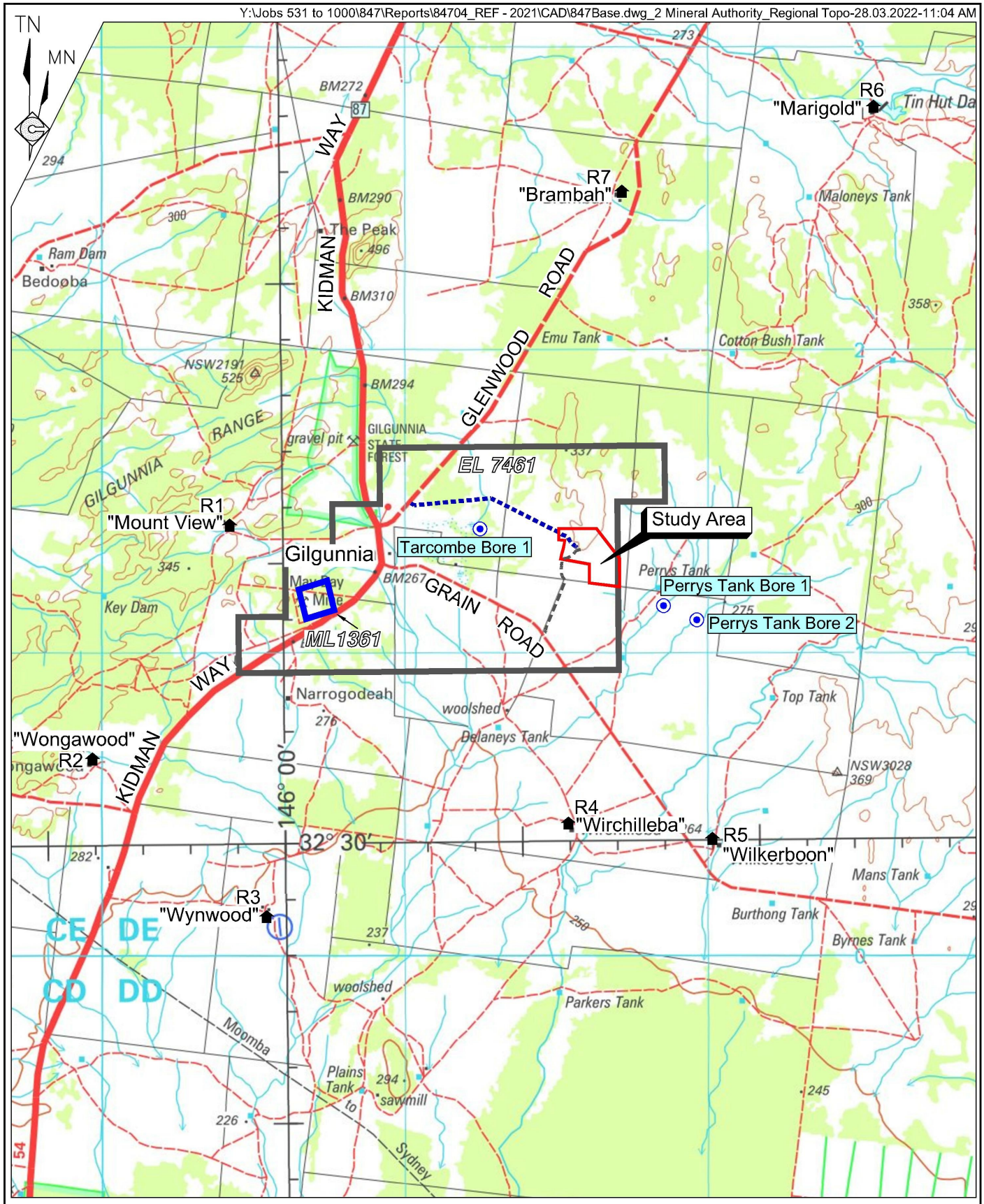

Figure 1
LOCALITY PLAN

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3 Noise Policy and Guidelines

3.1 Noise Policy for Industry

The EPA released the Noise Policy for Industry (NPI) in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The objectives of the NPI are to:

- provide noise criteria that is used to assess the change in both short term and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, considering the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the Project Noise Trigger Levels (PNTLs) (ie criteria) for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.

2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.

3. Compare the predicted or measured noise level with the PNTL, assessing impacts and the need for noise mitigation and management measures.

4. Consider residual noise impacts - that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.

5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.

6. Monitor and report environmental noise levels from the development.

3.1.1 Project Noise Trigger Levels (PNTL)

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) of the **Project Intrusiveness Noise Level** (PINL) and **Project Amenity Noise Level** (PANL) determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.1.2 Rating Background Level (RBL)

The Rating Background Level (RBL) is a determined parameter from noise monitoring and is used for assessment purposes. As per the NPI, the RBL is an overall single figure background level representing each assessment period (day, evening and night) over the noise monitoring period. The RBLs relevant to the project are contained in **Section 4**.

Alternatively, an assessment can adopt the minimum assumed Rating Background Noise Levels (RBLs) outlined in Section 2.3 of the Noise Policy for Industry (NPI, 2017) in lieu of undertaking a background noise survey. These minimum RBLs are considered by EPA to be the most conservative background noise levels for the day, evening and night periods.

3.1.3 Project Intrusiveness Noise Level (PINL)

The PINL ($LA_{eq(15min)}$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. It is generally considered that the intrusiveness of an industrial sources is acceptable if the level of noise from the source, represented by the $LA_{eq(15min)}$ descriptor, does not exceed the RBL by more than 5dB, when beyond a minimum threshold. For low noise environments, such as rural environments, the following minimum assumed RBLs apply within the NPI.

- Minimum Day RBL = 35dBA;
- Minimum Evening RBL = 30dBA; and
- Minimum Night RBL = 30dBA.

3.1.4 Project Amenity Noise Level (PANL)

The PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI). The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area; and
- **Project Amenity Noise Level (PANL)** – is the recommended level for a receiver area, specifically focusing the project being assessed.

Additionally, Section 2.4 of the NPI states: "to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows":

PANL for new industrial developments = recommended **ANL** minus 5dBA.

The following exceptions apply when deriving the PANL:

- areas with high traffic noise levels;
- proposed developments in major industrial clusters;
- existing industrial noise and cumulative industrial noise effects; and
- greenfield sites.

The NPI states with respect to high traffic noise areas:

The level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the LAeq noise level from that industrial noise source may exceed the project amenity noise level. In such cases the project amenity noise level may be derived from the LAeq, period(traffic) minus 15 dB(A).

Where relevant this assessment has considered influences of traffic with respect to amenity noise levels (ie areas where existing traffic noise levels are 10dB greater than the recommended amenity noise level).

The recommended amenity noise levels as per Table 2.2 of the NPI are reproduced in **Table 3**.

Table 3 Amenity Noise Levels			
Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB LAeq(period)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks.	See column 4	See column 4	5dB above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School Classroom	All	Noisiest 1-hour period when in use	35 (internal) 45 (external)
Hospital ward			
- internal	All	Noisiest 1-hour	35
- external	All	Noisiest 1-hour	50
Place of worship - internal	All	When in use	40
Passive Recreation	All	When in use	50
Active Recreation	All	When in use	55
Commercial premises	All	When in use	65
Industrial	All	When in use	70

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7 of the NPI.

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

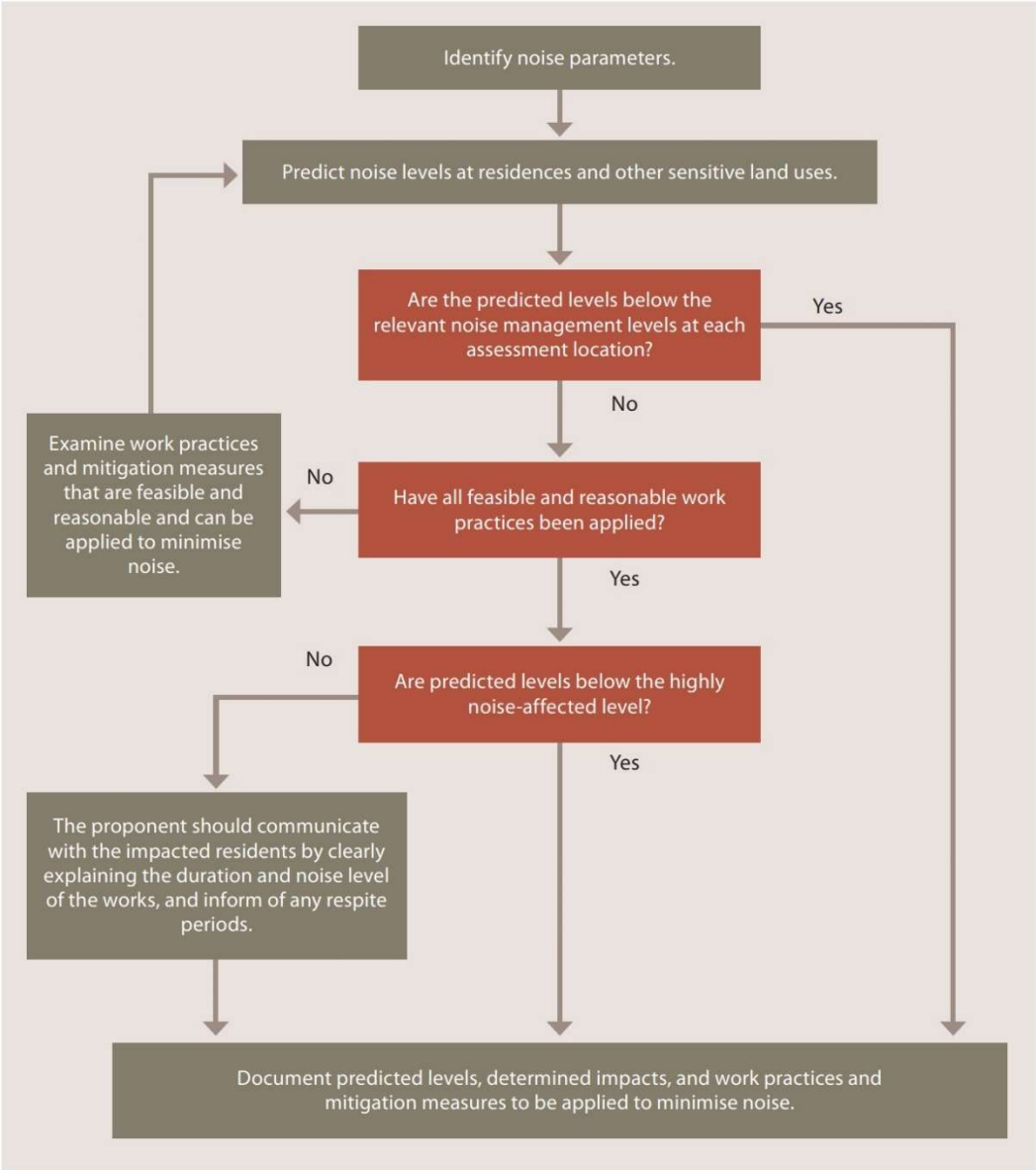
3.2 Interim Construction Noise Guideline

The ICNG sets out procedures to identify and address the impacts of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment. The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; and
- Qualitative, which is suited to short term infrastructure maintenance (< three weeks).

The qualitative assessment methodology is a more simplified approach that relies on noise management strategies. This NA has adopted a quantitative assessment approach which is summarised in **Figure 2**. The quantitative approach includes identification of potentially affected receivers, derivation of the construction noise management levels, quantification of potential noise impact at receivers via predictive modelling and, provides management and mitigation recommendations.

Figure 2 Quantitative Assessment Processes for Assessing and Managing Construction Noise



Source: Department of Environment and Climate Change, 2009.

3.2.1 Standard Hours for Construction

Table 4 presents the ICNG recommended standard hours for construction works.

Table 4 Recommended Standard Hours for Construction

Daytime	Construction Hours
Monday to Friday	7am to 6pm
Saturdays	8am to 1pm
Sundays or Public Holidays	No construction

These recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. Construction activities are anticipated to be undertaken during standard construction hours.

3.2.2 Construction Noise Management Levels

Section 4 of the ICNG details the quantitative assessment method involving predicting noise levels and comparing them with the Noise Management Level (NML) and are important indicators of the potential level of construction noise impact. **Table 5** reproduces the ICNG Noise Management Level (NML) for residential receivers. The NML is determined by adding 10dB (standard hours) or 5dB for Out of Hours (OOH) to the Rating Background Level (RBL) for each specific assessment period.

Table 5 Noise Management Levels		
Time of Day	Management Level LAeq(15min)[1]	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) 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 work to be carried out, the expected noise levels and duration, as well as contact details.
	Highly Noise Affected 75dBA (HNA)	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 for work near schools, or mid-morning or mid-afternoon for work near residences; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5dB	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see Section 7.2.2 of the ICNG.

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction noise management levels for noise assessment purposes and is the median of the ABL's.

3.2.3 Construction Sleep Disturbance

Section 4.3 of the ICNG (DECC, 2009) states that a sleep disturbance assessment is required where construction activities are planned to occur for more than two consecutive nights. Given that construction activities are anticipated to occur during standard construction hours, construction sleep disturbance has not been considered in this assessment.

3.2.4 Maximum Noise Assessment Trigger Levels

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq(15min)}$ 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- L_{Amax} 52dB or the prevailing RBL plus 15dBA, whichever is the greater.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period. Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.3 Road Noise Policy

The road traffic noise criteria are provided in the Department of Environment, Climate Change and Water NSW (DECCW), Road Noise Policy (RNP), 2011. The policy sets out noise criteria that provide for a degree of amenity appropriate for the land use and road category.

For some industries such as mines and extractive industries, that are not served by arterial roads, a principal haulage route may be identified. The RNP indicates that where local authorities identify a 'principal haulage route', the noise criteria for the route should match those for arterial/sub-arterial roads, recognising that they carry a different level and mix of traffic to local roads.

3.4 ANZEC Blasting Guidelines

Noise and vibration levels from blasting are assessable against criteria established in the Australian and New Zealand Environment Council (ANZEC) – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration. The blasting limits are generally consistent with the guideline levels contained within AS2187:2006 Part 2 – Explosives - Storage and Usage – Part 2. Where compliance is achieved, the risk of human annoyance is minimised.

The guidelines recommend that blasting should generally be permitted during the hours of 9am to 5pm Monday to Saturday only. Blasting should not occur on Sundays or Public Holidays. Furthermore, blasting should generally take place no more than once per day. Blasting and vibration induced damage criteria relevant to this assessment are presented in detail in **Section 4.5**

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4 Assessment Criteria

4.1 Operational Project Noise Trigger Levels

4.1.1 Project Intrusiveness Noise Levels

The PINLs for the project are presented in **Table 6** and have been determined based on the RBL +5dBA.

Table 6 Intrusiveness Noise Levels

Receiver Type	Period[1]	Adopted RBL[2] dB LA_{90}	PINL dB $LA_{eq(15min)}$
Residential	Day	35	40
	Evening	30	35
	Night	30	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Minimum RBLs have been adopted for this project.

4.1.2 Project Amenity Noise Levels

The PANLs for residential receivers potentially affected by the project are presented in **Table 7**.

Table 7 Project Amenity Noise Levels

Receiver Type	Noise Amenity Area	Assessment Period[1]	Recommended ANL dB $LA_{eq(period)}$[2]	PANL dB $LA_{eq(15min)}$[3]
Residential	Rural	Day	50	53
		Evening	45	48
		Night	40	43

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Recommended amenity noise levels as per Table 2.2 of the NPI.

Note 3: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.

4.1.3 Project Noise Trigger Levels

The PNTLs are the lower of either the PINL or the PANL. **Table 8** presents the derivation of the PNTL in accordance with the methodologies outlined in the NPI.

Table 8 Project Noise Trigger Levels

Receiver Type	Period[1]	RBL	PINL dB $LA_{eq(15min)}$	PANL dB $LA_{eq(15min)}$	PNTL dB $LA_{eq(15min)}$
Residential	Day	35	40	53	40
	Evening	30	35	48	35
	Night	30	35	43	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2 Construction Noise Management Levels

Activities associated with the construction of the vent shafts for the project include the boring of the shaft holes and installation of the ventilation fans. Noise associated with construction activities for extractive industries are often assessed as operational noise, as the emissions from plant and associated construction equipment are similar. Therefore, the derived operational noise criteria presented in **Table 8** have been adopted as the construction noise criteria for the project.

4.3 Maximum Noise Assessment Trigger Levels

The maximum noise trigger levels shown in **Table 9** are based on night time RBLs and trigger levels as per Section 2.5 of the NPI. The trigger levels will be applied to transient noise events that have the potential to cause sleep disturbance.

Table 9 Maximum Noise Assessment Trigger Levels

Residential Receivers			
$L_{Aeq(15min)}$		L_{Amax}	
40dB $L_{Aeq(15min)}$ or RBL + 5dB		52dB L_{Amax} or RBL + 15dB	
Trigger	40	Trigger	52
RBL 30+5dB	35	RBL 30+15dB	45
Highest	**40**	**Highest**	**52**

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays; Night 10pm to 8am.

Note: As per Section 2.5 of the NPI, the highest of the two criteria are adopted as the trigger level.

4.4 Road Traffic Noise Criteria

In accordance with the RNP, this assessment has adopted the 'Freeway/arterial/sub-arterial road' category for the designated inbound and outbound transport routes, consistent with the classification of the haulage route as a 'principal haulage route'. **Table 10** reproduces the road traffic noise assessment criteria relevant for this road type.

Table 10 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road category	Type of Project/Development	Assessment Criteria - dB(A)	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial road	Existing residences affected by additional traffic on existing freeways/sub-arterial/roads generated by land use developments	60dB(A) $L_{Aeq(15hr)}$	55dB(A) $L_{Aeq(9hr)}$

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

4.4.1 Relative Increase Criteria

In addition to meeting the assessment criteria, any significant increase in total traffic noise at receivers must be considered. Receivers experiencing increases in total traffic noise levels above those presented in **Table 11** due to the addition of project vehicles on Glenwood Road and the Kidman Way should be considered for mitigation.

Table 11 Increase Criteria for Residential Land Uses

Road Category	Type of Project/Development	Total Traffic Noise Level Increase, dB(A)	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial roads and transitways	New road corridor/redevelopment of existing road/land use development with the potential to generate additional traffic on existing road.	Existing traffic $L_{Aeq(15hr)}$ +12dB (external)	Existing traffic $L_{Aeq(9hr)}$ +12dB (external)

4.5 ANZEC Guideline Blasting Limits

The ANZEC blasting limits for air-blast overpressure and ground vibration are presented in **Table 12**.

Table 12 ANZEC Guideline Blasting Limits

	Overpressure dB (Linear Peak)	Ground Vibration PPV (mm/s)
Recommended Maximum (95% of all blasts)	115	5
Level not to be exceeded	120	10
Long term goal for ground vibration	N/A	2

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5 Modelling Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers using DGMR (iNoise, Version 2022.1) noise modelling software. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613:1 and ISO 9613:2 including corrections for meteorological conditions using CONCAWE[1]. The ISO 9613 standards are the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

[1] Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

5.1 Noise Modelling Parameters

The model incorporated three-dimensional digitised ground contours for the fixed plant and surrounding area, as derived from proposed project plans superimposed onto the surrounding land base topography. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

5.1.1 Meteorological Analysis

Noise emissions can be influenced by prevailing weather conditions. Light stable winds (<3m/s) and temperature inversions have the potential to increase noise at a receiver.

Fact Sheet D of the NPI provides two options when considering meteorological effects:

- adopt the noise enhancing conditions for all assessment periods without an assessment of how often the conditions occur – a conservative approach that considers a source to receiver winds for all receivers and F class temperature inversions with wind speeds up to 2m/s at night; or
- determine the significance of noise enhancing conditions. This requires assessing the significance of temperature inversions (F and G Class stability categories) for the night time period and the significance of light winds up to 3m/s for all assessment periods during stability categories other than E, F or G.

Standard meteorological conditions and noise-enhancing meteorological conditions as defined in Table D1of the NPI are reproduced in **Table 13**.

Table 13 Standard and Noise-Enhancing Meteorological Conditions

Meteorological Conditions	Meteorological Parameters
Standard Meteorological Conditions	Day/evening/night: stability categories A–D with wind speed up to 0.5m/s at 10m AGL.
Noise Enhancing Meteorological Conditions	Daytime/evening: stability categories A–D with light winds (up to 3 m/s at 10m AGL). Night-time: stability categories A–D with light winds (up to 3m/s at 10m AGL) and/or stability category F with winds up to 2m/s at 10 m AGL.

A detailed analysis of the significance of noise enhancing conditions has not been undertaken and hence, the NPI noise enhancing meteorological conditions have been applied to the noise modelling assessment are presented in **Table 14**.

Table 14 Modelled Meteorological Parameters

Assessment Condition[1]	Temperature	Wind Speed[2]/ Direction	Relative Humidity	Stability Class[2]
Day	20°C	3m/s all directions	50%	D
Evening	10°C	3m/s all directions	50%	D
Night	10°C	2m/s all directions	50%	F

Note 1: Day 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening 6pm to 10pm; Night - the remaining periods.

Note 2: Implemented using CONCAWE meteorological corrections.

5.2 Assessed Scenarios

Two modelling scenarios have been assessed as part of the project.

The first scenario assessed included the operational phase of the project and included decline development works, maintenance operations and onsite light and heavy vehicle movements. The second scenario assessed activities undertaken for the establishment of the site and construction of major project infrastructure. The two assessed scenarios are presented in **Figure 3** and **Figure 4** respectively (RWC Figure 10 and Figure 9, 2021).

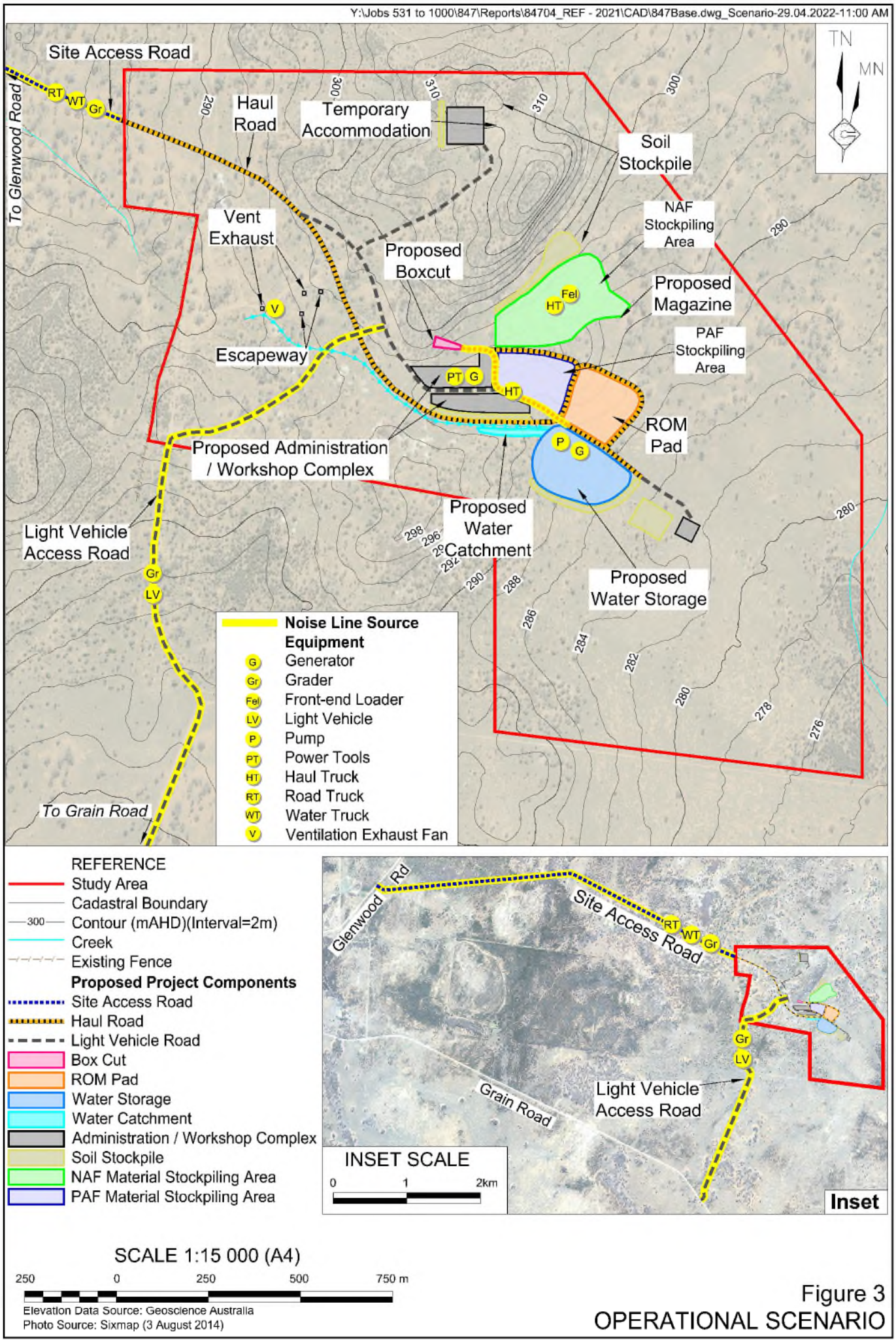


Figure 3
OPERATIONAL SCENARIO

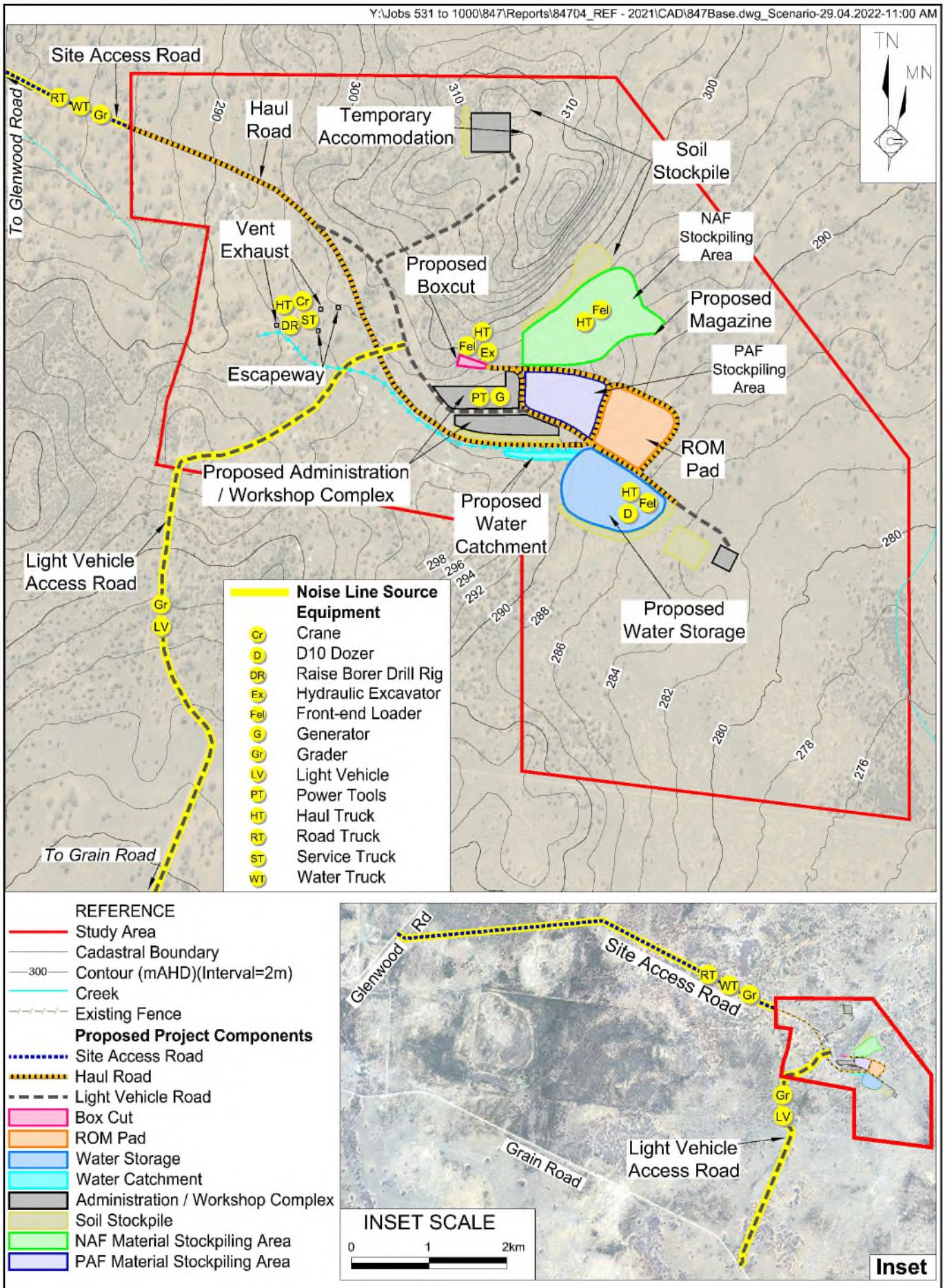


Figure 4
CONSTRUCTION SCENARIO

5.3 Sound Power Levels

Table 15 presents the sound power level for each noise source modelled in each assessed scenario. It is noted that sound power levels were sourced from manufacturer's specifications or from in-field measurements at similar project sites.

Table 15 Single Octave Equipment Sound Power Levels, dB $LA_{eq(15min)}$ ($re10^{-12}W$)

Noise Source/Item	Octave Band Centre Frequency, Hz								Total, dBA
	63	125	250	500	1000	2000	4000	8000	
Construction Equipment									
Light Vehicle	52	62	59	67	66	68	61	54	73
Hand tools	57	57	61	71	83	84	88	96	97
Generator	64	85	95	97	96	93	87	76	102
Crane	79	92	98	107	108	105	100	96	112
Grader	86	95	99	100	109	104	100	88	111
D10 Dozer	86	103	102	105	108	107	101	94	113
Raised Boring Machine	81	103	104	106	109	108	100	92	114
Dump Trucks (35T)	82	98	96	99	103	101	97	88	108
Loader	79	94	93	98	101	100	98	85	106
Water Truck (15,000L)	77	82	89	91	95	97	89	81	101
Road Trucks	70	85	93	98	98	98	93	88	104
Service Truck	70	85	93	98	98	98	93	88	104
Excavator (35t)	77	93	95	101	99	94	81	70	105
Operational Equipment									
Light Vehicle	52	62	59	67	66	68	61	54	73
Hand Tools	57	57	61	71	83	84	88	96	97
Generator	64	85	95	97	96	93	87	76	102
Pump	64	85	95	97	96	93	87	76	102
Grader	86	95	99	100	109	104	100	88	111
Vent Fan	85	93	103	106	100	98	91	75	109
Dump Trucks (35T)	82	98	96	99	103	101	97	88	108
Loader	79	94	93	98	101	100	98	85	106
Water Truck (15,000L)	77	82	89	91	95	97	89	81	101
Road Trucks	70	85	93	98	98	98	93	88	104
Sleep Disturbance Assessment (LA_{max})									
Tail Gate Slam	120								

5.4 Road Noise Assessment Methodology

The United States (US) Environment Protection Agency's road traffic calculation method was is used to predict the LA_{eq} noise levels from project related trucks travelling past receivers adjacent to the haul routes. This method is an internationally accepted theoretical noise prediction model and is ideal for calculating road traffic noise where small traffic flows are encountered.

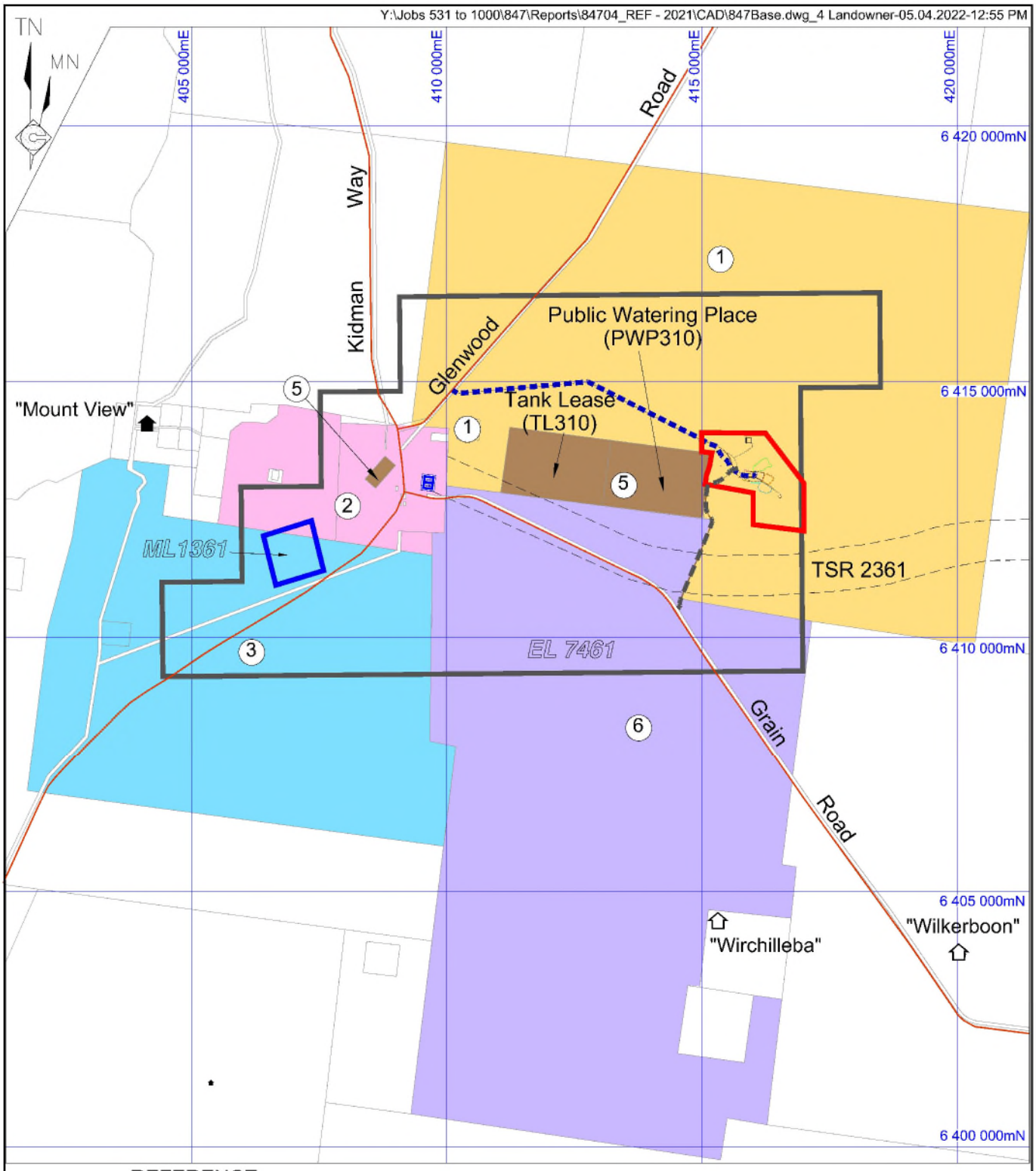
MAC understands that during operation of the project the worst case number of truck movements would be two trips per hour resulting in up to 30 trips during the daytime period.

All trucks accessing and leaving the project site would utilise the site access road and travel along Glenwood Road and the Kidman Way towards Cobar, NSW (see **Figure 5**, RWC Figure 2 2022). This assessment has therefore considered a daily rate of 100% of traffic travelling South on Glenwood Road and north on the Kidman Way.

The closest offset distances to receivers along the haulage route are provided in **Table 16**.

Table 16 Closest Offset Distances – Road Traffic Assessment

Travel Route	Address	Offset Distance (m)
Site Access Road/Glenwood Road/ Kidman Way	3260 Glenwood Road, Nymagee, NSW	685



REFERENCE

- EL 7461 Boundary
- ML 1361 Boundary
- Study Area
- Proposed Site Access Road
- Proposed Light Vehicle Access Road
- Cadastral Boundary
- Travelling Stock Route (TSR)
- (1) Landowner Reference
- Residence (Project related)
- Residence (Non Project related)
- Sealed Road

Ref	Landowner / Lessee
1	Peel Mining Ltd
2	G. Stewart, M. Stewart, J. Stewart
3	P Mcintosh, C. Mcintosh
5	NSW State Government
6	PDG Bell & VJ Bell

SCALE 1:125 000 (A4)

2 0 2 4 6km

Land Owner Source: GlobalX Terrain - Title Search - April 2022

Figure 5
STUDY AREA

5.5 Blasting and Vibration Assessment Methodology

An estimation of air-blast overpressure and ground-borne vibration levels has been conducted in accordance with methods in AS2187.2. The estimation adopted a Maximum Instantaneous Charge (MIC) of 152kg with blasting locations assumed to be at the extremities of the decline, which is a worst case scenario.

5.5.1 Air-Blast Overpressure

Calculation of overpressure has been completed using the following AS2187.2 equation:

$$\mathrm{P} = K_a \left(\frac{R}{(Q^{1/3})} \right)^a$$

Where:

P = Pressure, in kilopascals;

Q = Effective explosives charge mass, in kilograms (MIC);

R = Distance from charge, in metres;

K_a = Site constant, a conservative value of 25 was adopted; and

a = Site exponent, a value of -1.45 was adopted.

The conversion of 'P' to unweighted decibels (dBZ) is completed using the following formula:

$$\mathrm{SPL} = 10\ x \log \left(\frac{P}{P_0} \right)^2$$

5.5.2 Ground-Borne Vibration

Preliminary estimations for vibration have been completed using the following AS2187.2 equation:

$$\mathrm{V} = K_g \left(\frac{R}{(Q^{1/2})} \right)^{-B}$$

Where:

V = ground vibration as vector peak particle velocity, in mm/s;

R = distance between charge and point of measurement, in m;

Q = maximum instantaneous charge (effective charge mass per delay), in kg;

K_g = a constant related to site and rock properties for estimation purposes, a value of 1140 was adopted as per AS2187.2 to predict the 50% chance of exceedance in "average conditions"; and

B = a constant related to site and rock properties for estimation purposes, a value of 1.6 was adopted.

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6 Noise Assessment Results

This assessment has quantified operational noise levels at the nearest receivers.

6.1 Operational and Construction Noise Assessment

Noise predictions from all operational sources have been quantified at surrounding residential receivers to the project site and are presented in **Table 17**.

Table 17 Predicted Operational Noise Levels, dB LAeq(15min)

Receiver	Period[1]	Predicted Noise Level dB LAeq(15min)		PNTL dB LAeq(15min)	Compliant
		Scenario 1 Operation	Scenario 2 Construction		
R1	Day	<30	<30	40	✓
	Evening	<30	<30	35	✓
	Night	<30	<30	35	✓
R2	Day	<30	<30	40	✓
	Evening	<30	<30	35	✓
	Night	<30	<30	35	✓
R3	Day	<30	<30	40	✓
	Evening	<30	<30	35	✓
	Night	<30	<30	35	✓
R4	Day	<30	<30	40	✓
	Evening	<30	<30	35	✓
	Night	<30	<30	35	✓
R5	Day	<30	<30	40	✓
	Evening	<30	<30	35	✓
	Night	<30	<30	35	✓
R6	Day	<30	<30	40	✓
	Evening	<30	<30	35	✓
	Night	<30	<30	35	✓
R7	Day	<30	<30	40	✓
	Evening	<30	<30	35	✓
	Night	<30	<30	35	✓

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

6.1.1 Maximum Noise Level Assessment

In assessing sleep disturbance, a typical LAmax noise source of 120dB representative of transient events such as impact noise from tailgate impact has been quantified to the nearest residential receivers, under F Class stability conditions (ie worst case). The results presented in **Table 18** identify that maximum noise trigger level will be satisfied for all residential receivers assessed.

Table 18 Maximum Noise Level Assessment (Night)[1]

Receiver	Predicted Noise Level dB LAmax	Maximum Trigger Levels dB LAmax	Compliant
R1	<30	52	✓
R2	<30	52	✓
R3	<30	52	✓
R4	<30	52	✓
R5	<30	52	✓
R6	<30	52	✓
R7	<30	52	✓

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays Night 10pm to 8am.

6.2 Road Noise Assessment Results

The results of the road traffic noise calculations for typical operational traffic are presented in **Table 19** for the closest residential receivers to Kidman Way. The traffic noise contribution from the project is predicted to remain below the relevant day period assessment criteria for all dwellings along the travel routes and is demonstrated to satisfy the RNPs relative increase criteria.

Table 19 Operational Road Traffic Noise Levels – Residential Receivers

Offset Distance (m)	Project Traffic Noise dB $LA_{eq(period)}$	Assessment Criteria[1]	Compliant
Kidman Way – R7			
830	<30 dB $LA_{eq(15hr)}$	60 dB $LA_{eq(15hr)}$	✓

Note 1: Day 7am to 10pm

6.3 Blasting Results

Blast overpressure and vibration have been calculated to each assessed receiver for the project site adopting an MIC of up to 152kg for a typical 50,000t blast. Calculated levels for overpressure and vibration have been compared to the relevant ANZEC criteria and are presented in **Table 20**.

Results identify blasts of MICs up to 152kgs would satisfy relevant ANZEC overpressure and vibration criteria. Notwithstanding, the proposed MIC blast patterns should be designed specifically to meet the relevant ANZEC guidelines at receivers and be completed in conjunction with an appropriate blast monitoring program.

Table 20 Blasting Emissions

Receiver ID	Distance to Charge[1] km	Airblast Overpressure dBZ Peak	Ground Vibration mm/s
R1	11.7	85	0.02
R2	17.7	80	0.01
R3	15.9	81	0.01
R4	8.9	89	0.03
R5	10.4	86	0.02
R6	17.5	80	0.01
R7	11.9	84	0.02

Note 1: Denotes distance from drill rig to receiver location, as per operational scenario.

6.3.1 Effects of Vibration on Infrastructure from Blasting

There is no significant infrastructure in the locality of the project site. The nearest public road is Wiltshire Road approximately 5km to the west of the project site, where ground vibration levels of up to 0.03mm/s are predicted to be experienced.

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7 Discussion and Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a NVIA to quantify potential impacts associated with the proposed Mallee Bull Exploration decline project located in Gilgunnia, NSW. The assessment has quantified potential operational noise emissions as well as blasting noise and vibration emissions.

The results of the NVIA demonstrate that operational noise levels (including construction activities) comply with the relevant NPI criteria for all assessment periods at the most affected sensitive receiver locations.

Results of the maximum noise level assessment are identified to remain below the sleep disturbance trigger level at all residential receivers. Therefore, sleep disturbance due to maintenance activities within the project are unlikely to cause awakening reactions to adjacent receivers.

Additionally, the NVIA demonstrates that the road noise criteria as specified in the RNP will be satisfied at the nearest potentially affected receivers for worst case operational road traffic.

Airblast overpressure and vibration levels are also predicted to meet the criteria at all assessed receivers for blasts up to 152kg MIC.

The results of the assessment show compliance with the relevant operational and road noise criteria. Additionally, the results of the assessment demonstrate compliance with the relevant EPA and DECCW policies, without additional ameliorative measures being required.

The noise assessment demonstrates that the proposal complies with relevant criteria without any ameliorate measures being adopted.

Accordingly, the Noise and Vibration Impact Assessment supports the REF for the project.

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Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Acoustical Terms

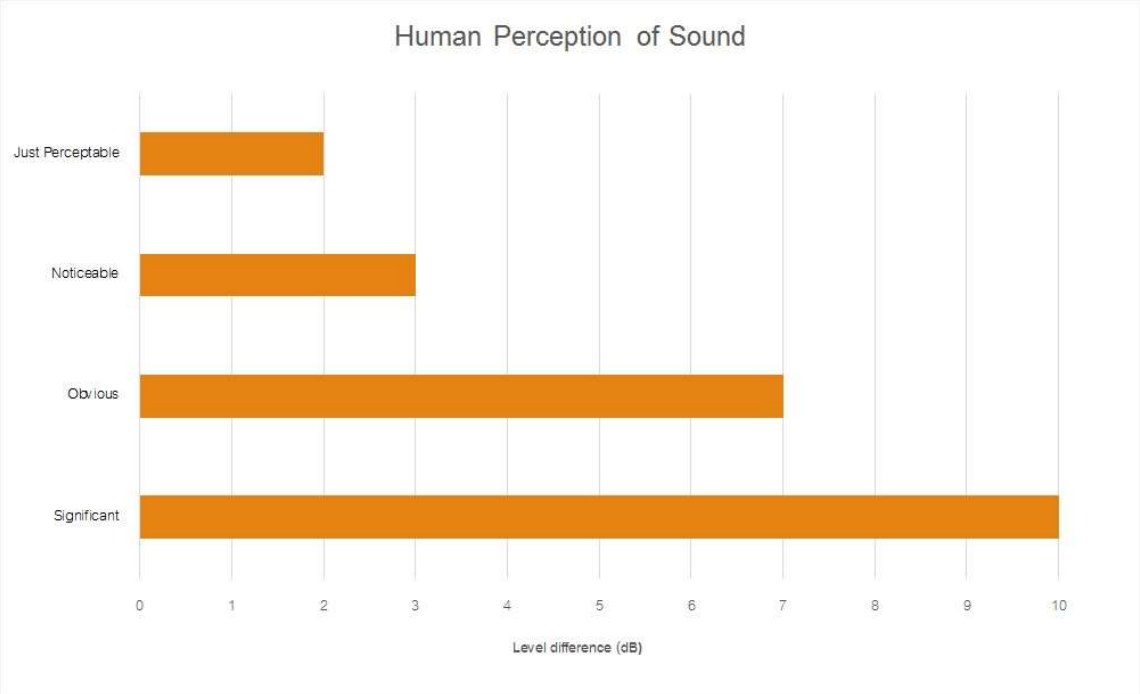
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The total noise associated with a given environment. Typically, a composite of sounds from all sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to sound.
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 usually represented by the LA90 descriptor
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Z-weighted or decibels Linear (unweighted).
Extraneous Noise	Sound resulting from activities that are not typical of the area.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A sound level which is exceeded 10% of the time.
LA90	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
LAeq	Represents the average noise energy or equivalent sound pressure level over a given period.
LAmax	The maximum sound pressure level received at the microphone during a measuring interval.
Masking	The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.
Maximum Instantaneous Charge	The total charge mass of explosives firing at one instant during a blast, a key measure in managing blasting vibration
RBL	The Rating Background Level (RBL) as defined in the NPI, is an overall single figure representing the background level for each assessment period over the whole monitoring period. The RBL, as defined is the median of ABL values over the whole monitoring period.
Sound power level (Lw or SWL)	This is a measure of the total power radiated by a source in the form of sound and is given by 10.log10 (W/Wo). Where W is the sound power in watts to the reference level of 10^{-12} watts.
Sound pressure level (Lp or SPL)	the level of sound pressure; as measured at a distance by a standard sound level meter. This differs from Lw in that it is the sound level at a receiver position as opposed to the sound 'intensity' of the source.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Pressure Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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MAC
Muller Acoustic Consulting

Appendix 8

Traffic Impact Assessment

prepared by
The Transport Planning Partnership Pty Ltd

(Total No. of pages including blank pages = 64)

Mallee Bull Exploration Project
Traffic Impact Assessment

Prepared for:

Peel Mining Limited

21 December 2022

The Transport Planning Partnership

Mallee Bull Exploration Project
Traffic Impact Assessment

Client: Peel Mining Limited

Version: Final

Date: 21 December 2022

TTPP Reference: 22510

Quality Record

Version	Date	Prepared by	Approved by	Signature
Final	21/12/22	PJD	PJD	

Table of Contents

Tables

Figures

Appendices

References

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1 Introduction

This report has been prepared on behalf of Peel Mining Limited (Peel Mining) to present the findings of an assessment of the road transport implications of the Mallee Bull Exploration Project (the Project), being a proposal to construct an exploration decline within Exploration Licence (EL) 7461 at Gilgunnia, located approximately 100 kilometres (km) south of Cobar in New South Wales (NSW).

Following submission of the Review of Environmental Factors (REF) prepared for the Project (R.W. Corkery & Co, 2022), Transport for New South Wales (TfNSW) requested additional information, as follows:

1. *Traffic Impact Assessment (TIA) is to be prepared in accordance with* Austroads Guide Traffic Management Part 12: Integrated transport assessments for developments *discussing the traffic associated with the general exploration activities (i.e. the traffic listed in 3.2.10 - 3.2.15 of the REF document) and supporting ancillary uses including the proposed on-site accommodation. Clarification should be provided explaining where the traffic generated by the proposal will be arriving from / departing to (i.e. addressing traffic distribution).*
2. *A strategic design to scale illustrating the affected intersections and necessary infrastructure / utility upgrades noting the following:*
   a. A swept path analysis on scaled plans is required to be submitted. The plans must be designed in accordance with Austroads turning templates demonstrating that the largest vehicle likely to utilise the Kidman Way/Glenwood Road and Kidman Way/ Grain Road intersections can perform all movements correctly and concurrently, with opposing vehicles have 0.5 m clearance per vehicle lane i.e. 1 m clearance between vehicles.
   b. The above swept path analysis should be accompanied by an assessment of the relevant intersections including identifying the need for any improvements to facilitate the proposed movements.

This report has been prepared to address the above matters requested by TfNSW. Consistent with the REF, this document refers to the Mallee Bull "REF Area", which includes all areas of potential disturbance associated with the proposed Exploration Decline Program.

The remainder of this report is set out as follows:

- Section 2 describes the Project.
- Section 3 discusses the existing road transport environment, including heavy vehicle routes, traffic volumes, road safety history, and potential changes to traffic conditions that may occur regardless of the Project.
- Section 4 assess the impacts of the Project on the road network, including its traffic generating characteristics, the distribution of traffic generated by the Project, future traffic volumes, and impacts on the operation of the roads and intersections. Vehicle

swept paths and intersection treatment requirements are also assessed, and the need for and nature of mitigation measures to address impacts of the Project are discussed.

- Section 5 presents the conclusions of the study.

2 The Project

2.1 Project Description

Peel Mining is proposing to construct an exploration decline and associated surface infrastructure within EL7461. The Project would include the following:

- construction of a box cut, exploration decline, including associated surface infrastructure;
- drilling of the Mallee Bull deposit from underground;
- storage of waste rock extracted during decline development. Non acid-forming (NAF) waste rock would be stored within the NAF Stockpiling Area and potentially acid-forming (PAF) waste rock would be stored within the PAF Stockpiling Area. All PAF waste rock would be transported underground or placed within the Box Cut and capped with NAF;
- rehabilitation of the REF Area.

Vehicular access is proposed to be via:

- the Site Access Road (Heavy Vehicle), to be constructed from Glenwood Road approximately 1.3 km from Kidman Way; and
- the Light Vehicle Access Road, to be constructed from Grain Road approximately 6 km from Kidman Way.

The Project activities, excluding rehabilitation, are expected to occur over a period of approximately four years. Construction activity is anticipated to occur over approximately four months, and operational activity would occur over approximately three years and eight months.

2.2 Project Activities

Site establishment activities would include:

- establishment of the Site Access Road (Heavy Vehicle), which would be an unsealed, two-lane, two-way access suitable for use by heavy vehicles;
- establishment of the Light Vehicle Access Road, which would be an unsealed, two-lane, two-way access suitable for use by **light vehicles only**;
- establishment of all required surface water infrastructure prior to the commencement of land preparation activities, which would include:
  - sediment basins to collect sediment laden water;
  - a lined water storage facility to collect water pumped from the decline and potentially low pH water from the PAF Stockpile Area and ROM Pad;

  - a water catchment area to collect clean water runoff from within the REF Area; and
  - clean and dirty water diversions to ensure that clean water does not flow into disturbed areas and that dirty or sediment-laden water is retained within the surface water management system.
- fencing of sections of the REF Area, including the Site Access Road and proposed disturbance area; and
- progressive establishment of all required surface infrastructure, which would include:
  - an administration / workshop complex;
  - a temporary accommodation building for employees to reside while working in the REF Area;
  - a haul road, box cut, portal and decline;
  - material storage areas, including for NAF material, PAF material and the ROM Pad;
  - ancillary infrastructure areas, including an explosive storage magazine; ventilation rises and surface fans; an escapeway; and soil stockpiles.

Site establishment and excavation of the box cut would occur seven days per week between 7:00 am and 6:00 pm. Site construction activities are anticipated to employ 15 people.

Exploration decline development, underground exploration and drilling, and maintenance activities would occur 24 hours per day, seven days per week. The exploration decline activity is anticipated to employ up to 50 people during exploration campaigns. It is expected that there would be a maximum of 30 personnel on site at any one time.

Underground drilling operations are currently planned to continue for a period of approximately 24 months following completion of decline development operations.

Should a subsequent mining operation not be developed as an outcome of the proposed exploration activities, all waste rock within the PAF Stockpiling Area would be removed and transported back underground for final storage within the exploration decline and the box cut within approximately 12 months following the cessation of drilling. An alternative timeline for rehabilitation activities would be proposed in the event that Peel Mining proceeds with an application to undertake mining operations within the REF Area.

Rehabilitation activities would occur 24 hours per day, seven days per week. Details of the day-to-day rehabilitation activities are not yet known, however are anticipated to be less intense than the initial construction stage activity and the operational activity. Vehicles used during rehabilitation activity would be consistent with those used during the construction and operational stages. This assessment therefore does not consider the potential impacts of the rehabilitation activity on the road network.

2.3 Project Timing

For the purpose of this assessment, it has been assumed that construction activity for the Project would commence during the second half of 2023, and operational activity would commence in early 2024. The Project activity (excluding rehabilitation) would therefore occur until mid-2027.

3 Existing Road Transport Environment

3.1 Road Network

The road network serving the site is presented in Figure 3.1 and briefly described below.

Figure 3.1: Road Network

Kidman Way (MR410) is a State road which forms part of a regional link through western NSW between Mitchell Highway at Bourke and Newell Highway near Jerilderie, via Cobar, Hillston, and Griffith. Between Cobar and Hillston, Kidman Way typically has a single travel lane in each direction, with either solid double centrelines or a single broken centreline, with sealed shoulders. Kidman Way has a posted speed limit of 100 km/h that reduces to 90 km/h over approximately 3 km near Cobar, commencing 300 m south of the intersection with Barrier Highway. There are several school bus stops along Kidman Way. Figure 3.2 indicates the typical conditions along Kidman Way.

Figure 3.2: Typical Section of Kidman Way

Looking south approximately 9km from Barrier Highway.

In the vicinity of its intersection with Glenwood Road, Kidman Way has single dashed dividing line through the intersection, with a double one-way barrier line that prevents northbound passing movements from a point approximately 50 m south of the intersection over a distance of approximately to the 75 m south. North of its intersection with Grain Road, Kidman Way has single dashed dividing line, and to south of the intersection, Kidman Way is marked with a double one-way barrier line that prevents northbound passing movements over approximately 110 m approaching the intersection.

Glenwood Road (MR419) is a regional road that provides a link between Kidman Way at Gilgunnia and Priory Tank Road near Nymagee. It is unsealed along its entire length, and is signposted near Kidman Way as "UNSEALED ROAD DRIVE TO CONDITIONS CLOSED WHEN WET". It is signposted on Kidman Way northbound as a "DRY WEATHER ROAD ONLY" route to Nymagee, with the alternative sealed road route being a longer route via Kidman Way and Priory Tank Road.

Glenwood Road intersects with Kidman Way at a basic rural T-intersection, with no auxiliary turn lanes. Glenwood Road has a sealed surface for approximately 20 m from Kidman Way, and the seal is flared at the intersection. It is signposted with a GIVE WAY sign, and there is GIVE WAY linemarking on the sealed pavement set back approximately 10 m from the edge of Kidman Way. There are widened gravel shoulders on the eastern side of Kidman Way to both the north and south of Glenwood Road, however these are overgrown with vegetation close to the intersection and do not appear likely to be used as trafficable shoulders. There is a property access on the western side of Kidman Way approximately 30 m south of Glenwood Road.

The carriageway of Glenwood Road typically approximately 9 to 11 m wide, and it follows a level alignment with large radius curves. There is a single lane stock grid across Glenwood Road approximately 550 m east of Kidman Way.

Figure 3.3: Typical Section of Glenwood Road

Grain Road (SR20) is a local road that provides a link between Kidman Way at Gilgunnia and Kiacatoo Road at Euabalong. It is an unsealed road for most of its 90 km length, with a sealed surface for approximately 20 km near Euabalong. Grain Road has a sealed surface over approximately 180 m near Kidman Way. It is signposted near Kidman Way as "UNSEALED ROAD DRIVE TO CONDITIONS CLOSED WHEN WET".

Figure 3.4: Typical Section of Grain Road

On the south-eastern corner of the intersection of Grain Road with Kidman Way, there is a rest area, which has direct vehicular access to/from the south-eastern corner of the intersection itself. There is a separate signposted entry/exit on Grain Road approximately 70 m from Kidman Way. There is a separate access on Kidman Way southbound approximately 150 m south of the intersection which appears to be for exit movements to Kidman Way southbound, however there is no signage to confirm this, nor to prevent drivers from turning right in to that access from Kidman Way. Southbound vehicles on Kidman Way need to cross the end of Grain Road to enter the rest area, and northbound vehicles on Kidman Way are able to enter the rest area via an acute angle right turn across the end of Grain Road. It appears that drivers in the rest area may also exit to the north via the intersection access.

The atypical access to the rest area directly from Kidman Way at its intersection with Grain Road is inconsistent with current road design guidelines, as there is lack of clarity regarding priority between opposing movements. This particularly relates to priority between westbound vehicles on Grain Road and vehicles turning into the rest area directly from Kidman Way. It is noted that the GIVE WAY sign for westbound traffic on Grain Road is located east of the rest area entry, which suggests that a driver on Grain Road would be expected to give way to a vehicle entering the rest area from Kidman Way. This atypical expectation is not reinforced through additional signage or provision of a GIVE WAY line. While the westbound driver would be required to give way to a vehicle turning left from Kidman Way into the rest area, they would not be required to give way to a vehicle turning left from Kidman Way to Grain Road. Similarly, while a westbound driver turning left to Kidman Way would be required to give way to a driver turning right in to the rest area, they would not be required to give way to a

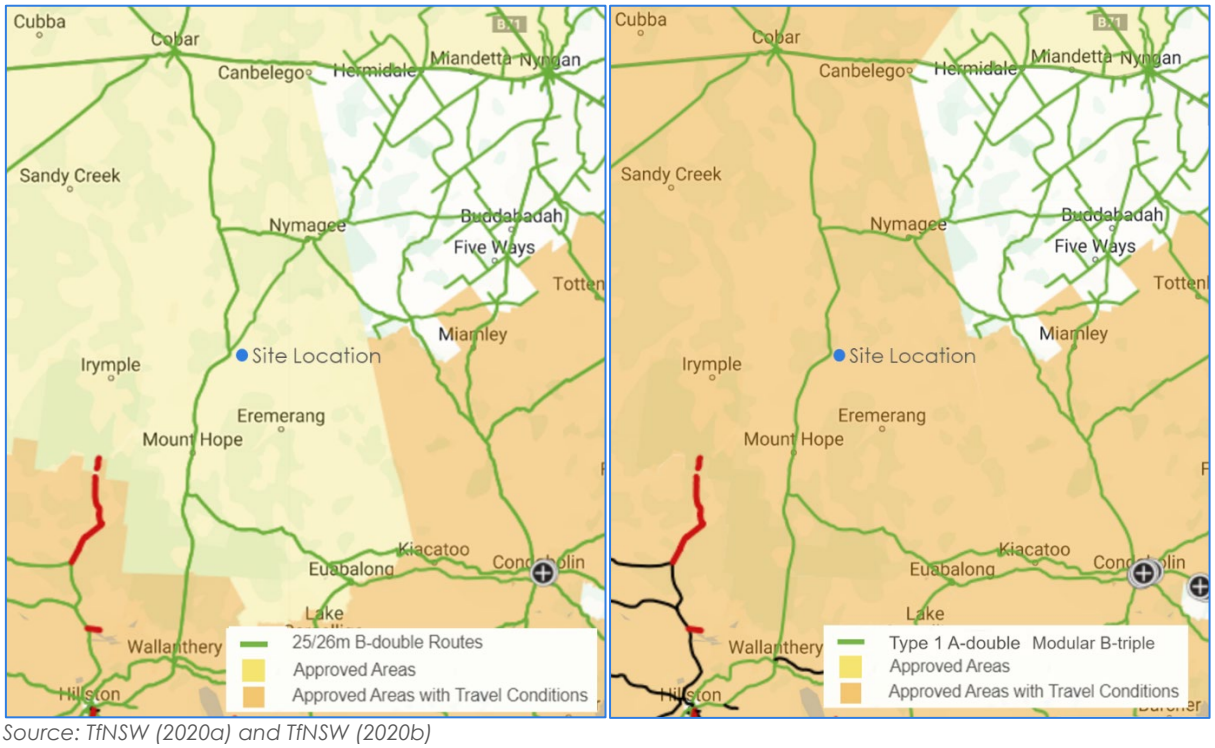
vehicle turning right in to Grain Road. Westbound drivers on Grain Road would not necessarily understand the turning intention of approaching vehicles, which may lead to conflicts between opposing movements.

3.2 Approved Heavy Vehicle Routes

As presented in Figure 3.5, a number of the roads in the region of the Project are approved for use by 25 m GML B-doubles, including Kidman Way and Glenwood Road. The Cobar Shire LGA is an approved area for B-double access. To the south and east, the Carrathool Shire and Lachlan Shire LGAs are approved areas for B-double access, subject to specific conditions. To the east, Bogan Shire LGA is not an approved area, however has numerous approved routes, including Hermidale-Nymagee Road, Peisley Road and The Bogan Way.

Access for General Mass Limit (GML) Type 1 A-double road trains, modular B-triple road trains and Type 1 rigid truck and 2 dog trailer combinations is permitted on all Regional and Local roads throughout the Cobar Shire Council area (with the exception of those located within Cobar town, Euabalong West town, and Euabalong town). A-double road train access is also permitted throughout the Carrathool Shire and Lachlan Shire subject to conditions, and on specified routes within the Bogan Shire LGA. Kidman Way is also an approved route for B-triple and AB-triple road trains.

Figure 3.5: Heavy Vehicle Access Routes



Source: TfNSW (2020a) and TfNSW (2020b)

3.3 Traffic Volumes

TfNSW collects and publishes traffic volume data online from selected locations on its roads (TfNSW, 2020c). Available data on roads in the vicinity of the Project were reviewed and collated, noting that only limited data is available in this region, summarised below:

- Hermidale Nymagee Road 1.8 km south of Currans Road (station 96552). The most recent data is from 2008, which shows that at that time, it carried an average of 1,025 vehicles per day, of which 20.6 percent were heavy vehicles.
- Kidman Way 3.95 km south of East Parade, Cobar (station 96089). The most recent data is from 2008, which shows that at that time, it carried an average of 201 vehicles per day, of which 30.4 percent were heavy vehicles.
- Kidman Way 170 m south of Nyngan Road (Barrier Highway) (station 96088). The most recent data is from 2008, which shows that at that time, it carried an average of 832 vehicles per day, of which 13.9 percent were heavy vehicles.
- Nyngan Road (Barrier Highway) 50 m west of Hartman Street (station 96001). The most recent data is from 2009, which shows that at that time, it carried an average of 546 vehicles per day, of which 22.3 percent were heavy vehicles. Data from 2008 shows that at that time, it carried an average of 604 vehicles per day, of which 20.7 percent were heavy vehicles.

Cobar Shire Council's Roads Development Manager, Engineering Services provided TTPP with traffic volume and classification data on a number of the roads in the region that are relevant to the Project, which is presented in Table 3.1.

Table 3.1: Average Daily Traffic Volume and Classifications

Road	Location	Year	Vehicles per Day	Percent Heavy Vehicles
Barrier Highway	10 km west of Cobar	2013	441	53
Barrier Highway	3 km east of Cobar	2013	710	30
Kidman Way	10 km south of Cobar	2013	851	28.2
Kidman Way	30 km south of Cobar	2013	248	47.9

Source: Cobar Shire Council by email 27 October 2020 and 15 June 2021.

EMM (2020) presents additional daily traffic volume data collected during April 2020 on Kidman Way and the Peak and New Cobar Complex access roads. Based on the data presented, the total daily traffic at the time of the surveys has been estimated and is summarised in Table 3.2.

Table 3.2: Daily Traffic Volume and Classifications 2020 (vehicles per day)

Road	Location	Light Vehicles	Heavy Vehicles	Total Vehicles
Kidman Way	South of Barrier Highway	660	133	793
Kidman Way	North of Peak Complex access	712	127	839
Kidman Way	South of Peak Complex access	173	49	222
New Cobar Complex Heavy Vehicle Access	East of Kidman Way	0	17	17
Peak Complex Access Road	West of Kidman Way	610	71	681

Source: EMM, 2020

TTPP (2022) presents estimated daily traffic on routes of relevance to the Project. These estimates are based on the results of 14-hour intersection turning movement surveys conducted during May 2022, adjusted to 24-hours based on available AADT Station data in the region. The resulting 24-hour volumes are summarised in Table 3.3.

Table 3.3: Estimated Total Daily Traffic Volumes 2022 (vehicles per day)

Road	Location	Light Vehicles	Heavy Vehicles	Total Vehicles
Barrier Highway	West of Youngee Street, Hermidale	581	123	704
Barrier Highway	East of Hermidale rail siding	821	172	993
Kidman Way	North of Priory Tank Road	327	59	386
Kidman Way	South of Priory Tank Road	293	62	355

Source: TTPP (2022)

This traffic volume data suggests that Kidman Way carries in the order of 350 to 400 vehicles per day south and north of Priory Tank Road respectively. Heavy vehicles, including road trains make up approximately 15 to 20 percent of the traffic. In rural areas, the peak hour traffic volumes are typically in the range of 8 to 12 percent of the daily total.

3.4 Road Safety History

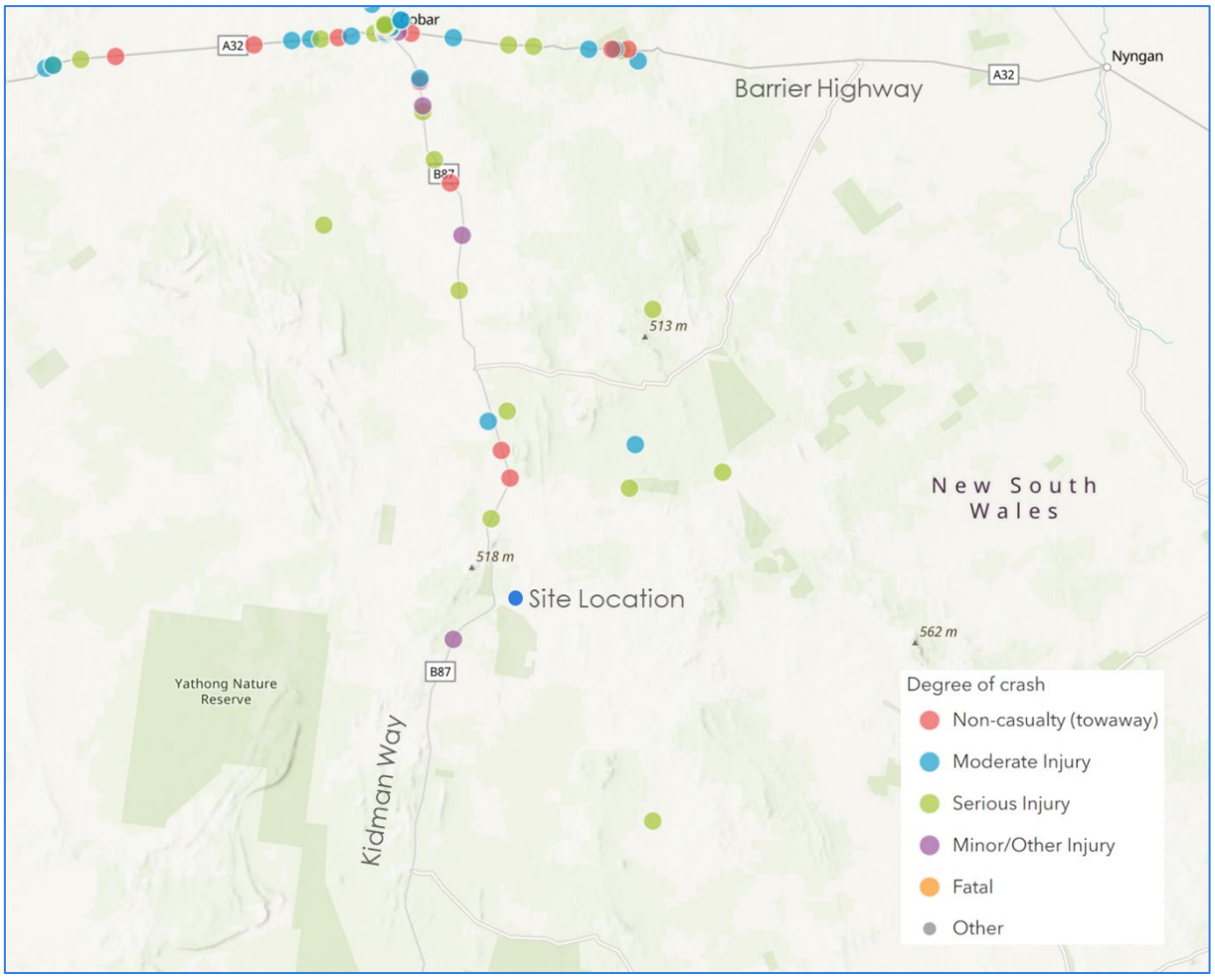
Road crash information was obtained from the Centre for Road Safety over the five-year period between 1 January 2017 and 31 December 2021 for those roads relevant to the Project. The data include crashes which conform to the national guidelines for reporting and classifying road vehicle crashes based on the following criteria:

- The crash was reported to the police.
- The crash occurred on a road open to the public.
- The crash involved at least one moving vehicle.

- The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

Figure 3.6 presents the locations of road crashes in the region.

Figure 3.6: Road Crash Locations 2017-2021



Crash data were reviewed for the principal routes anticipated to be used by Project-related vehicles:

- Kidman Way within Cobar LGA;
- Glenwood Road between Kidman Way and west of the Site Access Road; and
- Grain Road between Kidman Way and west of the Project Light Vehicle Access Road.

Table 3.4 summarises the types of crashes that occurred on the above routes over the investigation period. This indicates that a total of 13 crashes occurred, all of which occurred on Kidman Way. These crashes resulted in six people being seriously injured, three people being moderately injured, and five people having minor injuries.

Table 3.4: Crash Types on Project Access Routes (1 January 2017 to 31 December 2021)

Route	Route Length (km)	Pedestrian	Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On-Path	Off-Path on Straight	Off-Path on Curve	Total
Kidman Way	188	-	-	-	-	-	-	3	10	-	13
Glenwood Road	2	-	-	-	-	-	-	-	-	-	-
Grain Road	6	-	-	-	-	-	-	-	-	-	-
Total Crashes by Type		**-**	**-**	**-**	**-**	**-**	**-**	**3**	**10**	**-**	**13**

Table 3.4 demonstrates that over all the roads investigated, all reported crashes involved a single vehicle, the majority of which left the carriageway on a straight section of road. Known causes of run-off-road crashes include:

- driver behaviours such as speed, inattention, avoidance manoeuvres, errant vehicles;
- driver impairment including fatigue, alcohol, drugs, mood state;
- road conditions such as horizontal alignment, shoulder deficiencies, slippery surface, poor delineation, damaged surfaces;
- vehicle failure; and
- environmental conditions such as rain, fog, snow, livestock or native fauna.

Table 3.5 summarises key characteristics of the crashes reported on Kidman Way over the five year period.

Table 3.5: Crash Characteristics on Kidman Way (2017 to 2021)

	Pedestrian	Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On Path	Off Path on Straight	Off Path on Curve	Miscellaneous	Total
Total Crashes	-	-	-	-	-	-	3	10	-	-	**13**
Road Surface Condition											
Dry	-	-	-	-	-	-	2	10	-	-	**12**
Wet	-	-	-	-	-	-	1	-	-	-	**1**
Natural Lighting											
Dawn	-	-	-	-	-	-	1	-	-	-	**1**
Daylight	-	-	-	-	-	-	1	6	-	-	**7**
Darkness	-	-	-	-	-	-	1	4	-	-	**5**
Weather Conditions											
Fine	-	-	-	-	-	-	2	9	-	-	**11**
Overcast	-	-	-	-	-	-	-	1	-	-	**1**
Raining	-	-	-	-	-	-	1	-	-	-	**1**
Severity of Crash											
Serious Injury	-	-	-	-	-	-	2	3	-	-	**5**
Moderate Injury	-	-	-	-	-	-	-	1	-	-	**1**
Minor/Other Injury	-	-	-	-	-	-	-	3	-	-	**3**
Non-casualty (towaway)	-	-	-	-	-	-	1	3	-	-	**4**
Types of Traffic Units Involved											
Motorcycle	-	-	-	-	-	-	1	-	-	-	**1**
Car, 4WD, utility	-	-	-	-	-	-	-	3	-	-	**3**
Light Truck	-	-	-	-	-	-	1	3	-	-	**4**
Articulated Truck	-	-	-	-	-	-	1	4	-	-	**5**
Contributing Factor											
Fatigue	-	-	-	-	-	-	-	1	-	-	**1**
Speeding	-	-	-	-	-	-	1	-	-	-	**1**
First Impact Type											
Vehicle – Animal	-	-	-	-	-	-	3	-	-	-	**3**
Vehicle – Object	-	-	-	-	-	-	-	2	-	-	**2**
Rollover	-	-	-	-	-	-	-	8	-	-	**8**

Crashes on Kidman Way between Barrier Highway and the Cobar LGA boundary.

The data do not highlight any specific location with a notably poor crash history that may suggest an inherent concern with the road layout at that location.

3.5 Changes to the Road Transport Environment

Changes to the road transport environment can be expected to occur which are unrelated to the Project. These include changes resulting from other approved or proposed developments in the region and non-specific growth in traffic. These potential changes that may impact the routes expected to be used by Project traffic are described below.

3.5.1 Hera Mine, Federation Exploration Decline and Federation Project

Aurelia Metals Limited (Aurelia) operates Hera Mine and the Federation Exploration Decline Program, both located off Burthong Road approximately 43 km northeast of the REF Area. An application for the Federation Project, also located off Burthong Road, is currently under assessment. Aurelia's approved and potential activities on Burthong Road generate light and heavy vehicles trips on Kidman Way north of Priory Tank Road.

TTPP has previously assessed the traffic generation of Aurelia's activities off Burthong Road, which is expected to vary over the proposed Project construction and operating phases. Project Approval (PA10_0191) permits Hera Mine to operate until 31 December 2025, the Federation Exploration Decline Program is anticipated to continue until mid-2023, and if approved, the Federation Project construction activity is expected to commence in early 2023, and continue until mid-2025, with production commencing in mid-2023.

Considering the indicative timing of the Project, Aurelia's activities are estimated to generate the following average daily trips on Kidman Way north of Priory Tank Road.

Table 3.6: Average Daily Hera and Federation Activity Traffic Generation (vehicles per day)

	Light Vehicles	Heavy Vehicles	Haulage Vehicles	Total Vehicles
Existing 2022	42	13	11	66
Project Construction 2nd Half of 2023	60	23	23	106
Project Operation Peak 2nd Half of 2024	66	28	27	121
Life of Project Average mid-2023 to mid-2027	53	20	19	92

Over the life of the Project, the Hera and Federation activities are therefore expected to increase the average daily traffic on Kidman Way by approximately 26 vehicles per day north of Priory Tank Road. The haulage vehicles in Table 3.6 would be travelling to Peak Mine, and so would travel only on that part of Kidman Way between Priory Tank Road and Peak Mine.

3.5.2 Peak Gold Mines and New Cobar Complex Project

Peak Gold Mines Pty Ltd (PGM), a wholly owned subsidiary of Aurelia, owns and operates the Peak Gold Mine off Kidman Way south of Cobar. The operation comprises the New Cobar Complex located 3 km to the south-east of Cobar town centre and the Peak Complex located 10 km south-east of the town centre.

The New Cobar Complex Project (SSD 10419) was approved in April 2022, and permits mining activity to 31 December 2035, with a maximum production of 800,000 tonnes of ore per financial year. A maximum of 100 truck movements per day averaged over a financial year is permitted to transport ore and waste rock between New Cobar Complex and Peak Complex via Kidman Way. This is an increase from 50 truck movements permitted under prior approvals. EMM (2020) anticipates that the New Cobar Complex Project SSD would result in a maximum three additional truck trips per hour on Kidman way between the New Cobar Complex and Peak Complex during the peak hours on a typical weekday. These additional trips would occur when the New Cobar Complex operates at peak production in 2026-27. Ten additional light vehicle trips would be generated at the same time, which EMM (2020) estimates would all occur on Kidman Way to and from the north of the New Cobar Complex access road, i.e., to and from Cobar.

3.5.3 Cobar BioHub

A regional biomass processing facility for vegetation is proposed to be constructed east of Cobar and north of Barrier Highway. The facility would receive vegetation harvested from surrounding agricultural land and process this into goods for sale or export. An Environmental Scoping Report (ESR) (AECOM, 2018) has been submitted to NSW Department of Planning and Environment. That report indicates that approval will be sought for construction and operation of the facility, excluding the harvesting and transport of biomass to the site, the transport of finished products to end markets/customers.

The traffic and transport impacts associated with vehicles entering and exiting the BioHub site via Barrier Highway during construction and operational activities are broadly addressed in the ESR. This indicates that construction would occur over approximately six months (excluding transmission line construction), with construction materials and workforce being transported to the site via Barrier Highway, Kidman Way, Louth Road/Mulya Road and Lerida Road. The ESP does not provide information regarding the likely distribution of the trips on the road network.

Once operational, the BioHub is expected to require up to 30 FTE jobs on a shift basis. It is estimated that each day, 10 light vehicles and one or two maintenance vehicles would access the facility, 20 heavy vehicles would enter the facility with harvested material, and two heavy vehicles would leave the facility daily carrying finished products. The daily traffic generation once operational is therefore in the order of 68 vehicle trips per day. The ESP does not provide information regarding the likely distribution of the trips on the road network.

Should the BioHub proceed, there is the potential for some of its construction or operational traffic to be present on any part of the road network expected to be used by Project traffic. From the information presented in the ESR, it is considered that the number of vehicles generated by the BioHub on roads of relevance to the Project would be very low. In the absence of detailed forecasts relating to the BioHub's potential impacts on the road network, the potential cumulative impacts of the proposed BioHub with the Project have not been considered further in this assessment.

3.5.4 Wirlong Project

Peel Mining owns the Wirlong Prospect located approximately 16 km west of Nymagee. It proposes to construct an exploration decline and associated surface infrastructure, and extract bulk samples to be transported off site for processing. Access to the Wirlong Prospect would be via Shuttleton Road and Kidman Way.

Future activity at the Wirlong Prospect has not yet been defined and will be subject to a Review of Environmental Factors. While there is potential for Wirlong Project activity to occur at the same time as the Project, there is insufficient detail available to allow TTPP to forecast the number and timing of trips that may be generated. The potential implications of the Wirlong Project during the life of the Project have therefore not been considered further in this assessment.

3.5.5 Background Traffic Growth

Regardless of the status of specific developments, other changes in traffic may be expected as a result of general growth or changes in population or travel behaviour. To take account of traffic growth over time that is unrelated to changes in the approved or possible developments in the region, future traffic volumes on the key routes are estimated to grow by 1.0 percent per annum.

3.5.6 Cumulative Changes to Traffic Demands

Table 3.7 summarises indicative forecasts of future traffic with the cumulative impacts of the approved and proposed developments in the region and background growth along Kidman Way.

Table 3.7: Indicative Cumulative Average Daily Traffic (vehicles per day)

	Existing 2022	Hera and Federation	New Cobar Complex	Background Growth	Total
Project Construction Stage					
Kidman Way south of Cobar	673 (136)[A]	18 (10)	-	7 (2)	698 (148)
Kidman Way Peak Mine to New Cobar Complex	726 (130)[A]	18 (10)	(83)[B]	8 (2)	752 (225)
Kidman Way Priory Tank Road to Peak Mine	327 (59)	18 (22)	-	4 (1)	349 (82)
Kidman Way south of Priory Tank Road	293 (62)	-	-	3 (1)	296 (63)
Project Operational Stage[C]					
Kidman Way south of Cobar	673 (136)[A]	24 (15)	-	35 (7)	732 (158)
Kidman Way Peak Mine to New Cobar Complex	726 (130)[A]	24 (15)	(83)[B]	38 (7)	788 (235)
Kidman Way Priory Tank Road to Peak Mine	327 (59)	24 (31)	-	17 (4)	368 (94)
Kidman Way south of Priory Tank Road	293 (62)	-	-	15 (4)	308 (66)

5 light vehicles, (5) heavy vehicles
[A] *Surveyed 2020 with growth over two years.*
[B] *Maximum haulage permitted, increase above 2020 heavy vehicle trips on New Cobar Complex access.*
[C] *Peak 2024 traffic for Hera and Federation, and background growth in 2027.*

These indicative forecasts indicate that traffic volumes on Kidman Way past Glenwood Road and Grain Road are expected to increase above 2022 levels by approximately four vehicles per day during the Project construction stage and by approximately 19 vehicles per day by the end of the life of the Project.

In rural areas, peak hourly traffic volumes would be expected to be in the order of 8 to 12 percent of the daily volumes. On that basis, future traffic volumes on Kidman Way during the life of the Project would be expected to be in the range of 30 to 45 vehicles per hour south of Priory Tank Road, and 80 to 125 vehicles per hour between Peak and New Cobar Complex accesses.

4 Impacts of the Project

4.1 Project Traffic Generation

The Project would generate vehicle trips on the public road network as a result of:

- the mobilisation and demobilisation of equipment at the beginning and end of construction activities;
- infrequent deliveries of equipment and supplies to the REF Area during construction and exploration activities; and
- regular light vehicle movements associated with employee arrivals and departures.

Each of these are discussed below.

4.1.1 Transport of Equipment

Equipment to be transported to the REF Area for Project construction and operational activities would be moved via oversize low loaders, and is expected to be sourced from Orange and Dubbo. All heavy vehicles would use the following route to transport equipment to and from the REF Area:

- Mitchell Highway;
- Barrier Highway;
- Kidman Way;
- Glenwood Road; and
- Site Access (Heavy Vehicle) Road.

The equipment to be transported to the REF Area at the start of the construction stage of the Project is presented in Table 15 of the REF (R.W. Corkery & Co. 2022), and also presented in Appendix A for ease of reference. In addition, a fuel storage unit and explosive containers would be transported to the REF Area at the start of the construction stage.

The transport of equipment to the REF Area at the start of construction would require 14 low loaders over a period of approximately five days. Transport would be managed such that there would be no more than five deliveries on any one day. At the end of the construction activity, with the exception of the fuel storage unit and explosive containers, the equipment would be removed from the REF Area. This would require 11 low loaders and would occur over a period of five days. Transport would be managed such that there would be no more than five vehicles on any one day.

The equipment to be transported to the REF Area at the start of the operational stage of the Project is presented in Table 16 of the REF (R.W. Corkery & Co. 2022), and also presented in Appendix A for ease of reference.

The transport of equipment to the REF Area at the start of operations would require 12 low loaders over a period of approximately five days, and is unlikely to occur at the same time as the removal of construction equipment. Transport would be managed such that there would be no more than five deliveries on any one day. At the end of the operational activity, should a subsequent mining operation not be developed as an outcome of the exploration activities, the equipment including the fuel storage unit and explosive containers, would be removed from the REF Area. This would require 15 low loaders and would occur over a period of five days. Transport would be managed such that there would be no more than five vehicles on any one day.

With the arrival and departure of laden and unladen low loaders, the number of trips generated by the transport of equipment to and from the REF Area would therefore be:

- 28 trips over five days at the start of construction activity;
- 22 trips over five days at the end of construction activity;
- 24 trips over five days at the start of operational activity; and
- 30 trips over five days at the end of operational activity.

With no more than five deliveries on any one day, there would be no more than 10 heavy vehicle trips generated on any one day for the transport of equipment. It is expected that equipment transport would primarily occur during daylight hours.

Oversize vehicles would be accompanied by pilot and/or escort vehicles as required by TfNSW (2020) to provide other road users with an advance warning at adequate sight distances to react and respond in a safe manner to the impact of encountering an oversize vehicle and/or combination.

As all equipment transport vehicles would travel via Cobar, these vehicles would turn left only in to Glenwood Road from Kidman Way, and turn right only from Glenwood Road to Kidman Way.

4.1.2 Miscellaneous Deliveries

Deliveries to the REF Area such as consumables and servicing activities such as waste removal may generate occasional additional heavy vehicles. Peel Mining has estimated that the Project would require:

- 2 semitrailers per month for ground support equipment;
- 2 semitrailers per month for explosives;
- 1 semitrailer per month of mining consumables;

- 1 rigid truck per week for general consumables including for the accommodation camp, increasing to 2 rigid trucks per week during operations.

On this basis, approximately 9 to 13 deliveries are expected per month, or approximately 3 to 4 deliveries per week, generating 6 to 8 heavy vehicle trips on the road network per week. Deliveries are expected to be sourced from Cobar, and would tend to occur during daylight hours only. Delivery vehicles would use the following route to transport equipment to and from the REF Area from Cobar:

- Kidman Way;
- Glenwood Road; and
- Site Access Road.

4.1.3 Construction Workforce

The site establishment activity would require a workforce of 15 people on-site, working from 7:00 am to 6:00 pm. While working, the workers would reside on-site at the temporary accommodation camp. They would therefore remain on-site and would not generate any vehicle trips on a day-to-day basis for travel to and from work.

At the start and end of their rosters, construction workers would typically travel to and from the REF Area accommodation camp to access their usual place of residence. Approximately half of the workforce is anticipated to be drawn from the local area or region (e.g. Dubbo and Orange) and would drive to and from their place of residence. The remaining half of the workforce would reside outside of the region, and would fly in and out of Dubbo or Orange and drive to and from the REF Area from those centres. Workers would typically arrive and depart the site in light passenger vehicles and 4WDs.

With the roster likely to be seven days on / seven days off, the major movement of the construction workforce between the accommodation camp and their places of residence would occur once every seven days. On those days, up to 15 people would arrive at the REF Area for the start of their roster, and up to 15 people would depart the REF Area at the end of their roster. If all workers travel independently, this would generate up to:

- 15 outbound vehicle trips after the end of shift or the following morning; and
- 15 inbound vehicle trips prior to the start of shift or during the previous afternoon/evening.

Car-pooling by workers travelling to and from similar locations would reduce the number of vehicle trips generated. For the remaining days when there is no roster changeover, the construction workforce would generate negligible trips on the public road network.

To access the REF Area, the workforce would travel via Kidman Way and Grain Road to the Light Vehicle Access Road. Those travelling from Cobar or Dubbo would use Kidman Way north of Grain Road. Those travelling from Orange may travel via Parkes and Condobolin, using Henry Parkes Way, Lachlan Valley Way and Tipping Way to Kidman Way south of Grain

Road. Light vehicles generated by the construction workforce may therefore turn left or right in to Grain Road from Kidman Way, and turn left or right out of Grain Road to Kidman Way.

4.1.4 Operational Workforce

The operational activity would require a workforce of 50 people (with 30 personnel on site at any one time) on-site, working 24 hours with two 12-hour shifts per day. While working, the workers would reside on-site at the temporary accommodation camp. They would therefore remain on-site and would not generate any vehicle trips on a day-to-day basis for travel to and from work.

At the start and end of their rosters, operational workers would typically travel to and from the REF Area accommodation camp by private vehicle to access their usual place of residence. With the majority of operational workers likely to work a roster of seven days on / seven days off or 14 days on / seven days off, the movement of the operational workforce between the accommodation camp and their places of residence would occur once every seven days. The number of people arriving and departing for the start or end of their rostered period on any one day would be dependent on the detailed roster arrangements and number of workers per shift. It is estimated that between one-third and half of the total workforce may arrive at the REF Area for the start of their roster, and a similar proportion would depart the REF Area at the end of their roster. As a worst case, it has been assumed that all operational workers would work seven days on / seven days off, such that every seven days, 30 people would arrive at the REF Area for the start of their roster, and 30 people would depart the REF Area at the end of their roster.

Assuming an even split between the number of workers on day shift and on night shift, and if all workers travel independently, this would generate up to:

- 15 outbound vehicle trips after the end of night shift (or later during the day);
- 15 outbound vehicle trips after the end of day shift (or the following morning);
- 15 inbound vehicle trips prior to the start of day shift (or the previous afternoon/evening); and
- 15 inbound vehicles trips prior to the start of night shift (or earlier throughout the day).

Car-pooling by workers travelling to and from similar locations would reduce the number of vehicle trips generated. For the remaining six days per week, when there is no roster changeover, the operational workforce would generate negligible trips on the public road network.

To access the REF Area, the workforce would travel via Kidman Way and Grain Road to the Light Vehicle Access Road. Those travelling from Cobar or Dubbo would use Kidman Way north of Grain Road. Those travelling from Orange may travel via Parkes and Condobolin, using Henry Parkes Way, Lachlan Valley Way and Tipping Way to Kidman Way south of Grain

Road. Light vehicles generated by the operational workforce may therefore turn left or right in to Grain Road from Kidman Way, and turn left or right out of Grain Road to Kidman Way.

4.1.5 Total Project Traffic Generation

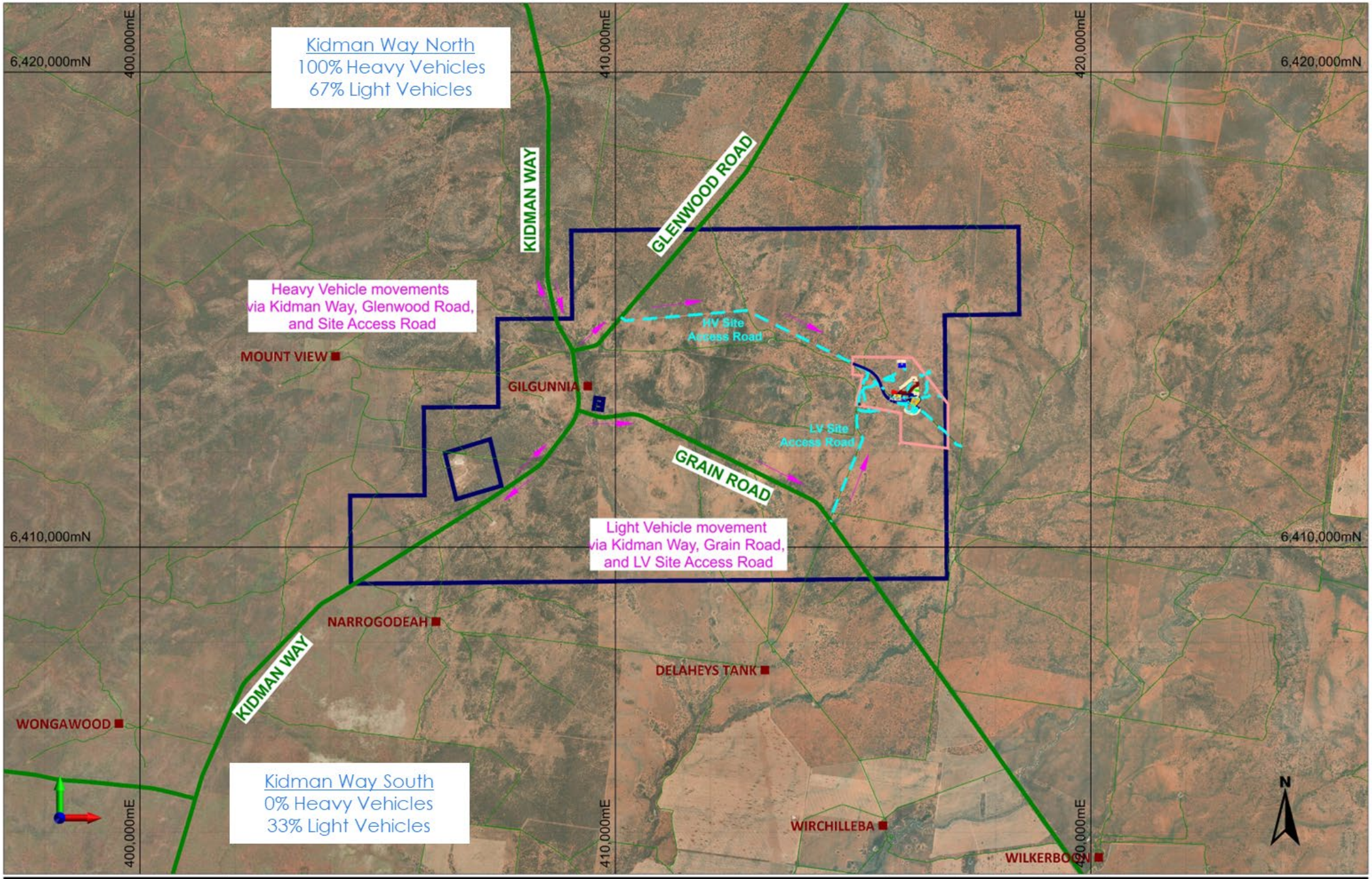
Table 3.1 summarises the total vehicle trip generation of the Project.

Table 4.1: Summary of Project Trip Generation

	Light Vehicles Grain Road	Heavy Vehicles Glenwood Road	Oversize Vehicles Glenwood Road	Total Trips per Day	
				Average	Peak
Start of Project Construction Stage					
Equipment Transport	-	-	28 trips over 5 days	5.6	10
Construction Activity					
Deliveries	-	18 trips per month	-	0.6	4
Workforce	30 trips at weekly roster change	-	-	4.3	30
End of Project Construction Stage					
End Construction Equipment Transport	-	-	22 trips over 5 days	4.4	10
Start of Project Operational Stage					
Start Operations Equipment Transport	-	-	24 trips over 5 days	4.8	10
Operational Activity					
Deliveries	-	26 trips per month	-	0.9	6
Workforce	60 trips at weekly roster change	-	-	8.6	60
End of Project Operational Stage					
End Operations Equipment Transport	-	-	30 trips over 5 days	6.0	10

4.2 Project Traffic Distribution

As described in Section 4.1, with the exception of the workforce traffic, the Project-generated traffic would use Kidman Way between Gilgunnia and Cobar. Equipment and deliveries that are not sourced from Cobar would use Barrier Highway to the east of Cobar and Mitchell Highway south of Barrier Highway. The distribution of Project-generated traffic is illustrated on Figure 4.1.



peel mining LIMITED

Traffic Impact Assessment Map
Project Location and Access
Background: ESRI World Imagery

Scale	Plot Date	Sheet
1 : 100000	07-Dec-2022	1 of 1
	Plot File: Vizex	

1000 0 1000m

Figure 4.1
Project Traffic Distribution

The distribution of the workforce-generated trips would be dependent on the places of residence of the workers. For the purpose of this assessment, it is assumed that of the half of the workforce that reside in the local region, two-thirds would reside to the north of the REF Area and one-third would reside to the south of the REF Area. It is assumed that of the half of the workforce that do not reside locally, two-thirds would travel to/from Dubbo via Kidman Way north, and one-third would travel to/from Orange via Kidman Way south.

The resulting contribution of the Project to traffic on the road network is summarised in Table 4.2 on both an average daily and peak daily basis during the construction and operational activity periods. This does not include the short periods of mobilisation and demobilisation at the start and end of the construction and operational stages.

Table 4.2: Daily Project-Generated Traffic on the Road Network (vehicles per day)

	During Construction Activity		During Operational Activity	
	Average	Peak	Average	Peak
Glenwood Road West of Site Access Road	0 (0.6)	0 (4)	0 (0.9)	0 (6)
Grain Road West of Light Vehicle Access Road	2.9 (0)	30 (0)	5.7 (0)	60 (0)
Kidman Way north of Glenwood Road	2.9 (0.6)	20 (4)	5.7 (0.9)	40 (6)
Kidman Way north of Grain Road	2.9 (0)	20 (0)	5.7 (0.9)	40 (6)
Kidman Way south of Grain Road	1.4 (0)	10 (0)	2.9 (0)	20 (0)
Light Vehicle Access Road North of Grain Road	4.3 (0)	30 (0)	8.6 (0)	60 (0)
Site Access Road East of Glenwood Road	0 (0.6)	0 (4)	0 (0.9)	0 (6)

5 light vehicles, (5) heavy vehicles

4.3 Future Traffic Volumes

Table 4.3 presents indicative forecasts of future daily traffic volumes on Kidman Way with the additional traffic expected to be generated by the Project. These forecasts robustly assume that background traffic on Kidman Way in the vicinity of the REF Area would be similar to those south of Priory Tank Road, which is likely to overestimate the actual daily traffic.

Table 4.3: Future Daily Traffic on Peak Project Day (vehicles per day)

	Background Traffic[A]	Peak Day Project Traffic	Total
During Project Construction Stage			
Kidman Way south of Cobar	698 (148)	20 (4)	718 (152)
Kidman Way Peak Mine to New Cobar Complex	752 (225)	20 (4)	772 (229)
Kidman Way Priory Tank Road to Peak Mine	349 (82)	20 (4)	369 (86)
Kidman Way south of Priory Tank Road	296 (63)	20 (4)	316 (67)
Kidman Way north of Glenwood Road	296 (63)	20 (4)	316 (67)
Kidman Way north of Grain Road	296 (63)	20 (0)	316 (63)
Kidman Way south of Grain Road	296 (63)	10 (0)	306 (63)
During Project Operational Stage			
Kidman Way south of Cobar	732 (158)	40 (6)	772 (164)
Kidman Way Peak Mine to New Cobar Complex	788 (235)	40 (6)	828 (241)
Kidman Way Priory Tank Road to Peak Mine	368 (94)	40 (6)	408 (100)
Kidman Way south of Priory Tank Road	308 (66)	40 (6)	348 (72)
Kidman Way north of Glenwood Road	308 (66)	40 (6)	348 (72)
Kidman Way north of Grain Road	308 (66)	40 (0)	348 (66)
Kidman Way south of Grain Road	308 (66)	20 (0)	348 (66)

5 light vehicles, (5) heavy vehicles
[A] *Refer to Table 3.7.*

These forecasts indicate that on a peak day for traffic generated by the Project, the busiest part of Kidman Way between the Peak and New Cobar Complex accesses would be expected to carry up to 1,070 vehicles per day. In the vicinity of the REF Area, Kidman Way would carry up to 420 vehicles per day.

In rural areas, peak hourly traffic volumes would be expected to be in the order of 8 to 12 percent of the daily volumes. On that basis, and assuming all inbound or outbound vehicle movements by employees on a shift change day may occur in one hour, traffic on Kidman Way during the life of the Project would be expected to be fewer than 60 vehicles per hour south of Priory Tank Road, and fewer than 140 vehicles per hour between Peak and New Cobar Complex accesses.

4.4 Road Network Efficiency

Austroads (2020a) provides guidelines for the capacity and performance of two lane, two-way rural roads, which in turn, refers to the *Highway Capacity Manual* (HCM) (Transportation Research Board, 2016). The capacity of a road is defined as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under the prevailing roadway, traffic and control conditions. The capacity of a single traffic lane will be affected by factors such as the pavement width and restricted lateral clearances, the presence of heavy vehicles and grades. Level of Service (LOS) is defined as a qualitative measure describing the operational conditions within a traffic stream as perceived by drivers and/or passengers.

LOS A provides the best traffic conditions, with no restriction on desired travel speed or overtaking. LOS B to D describes progressively worse traffic conditions. LOS E occurs when traffic conditions are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre in the traffic stream. The service flow rate for LOS E is taken as the capacity of a lane or roadway. In rural situations, LOS C is generally considered to be acceptable. At LOS C, most vehicles are travelling in platoons, and travel speeds are curtailed. At LOS D, platooning increases significantly, and the demand for passing is high, but the capacity to do so is low.

The LOS experienced by drivers on two-way rural roads is dependent on the drivers' expectations regarding the road, and three classes of road are defined in the HCM. Class I roads are those on which motorists expect to travel at relatively high speeds. They most often serve long-distance trips or provide connecting links between facilities that serve long-distance trips. Class II roads are those on which motorists do not necessarily expect to travel at high speeds, and may function as access routes to Class I facilities, serve as scenic or recreational routes, or pass through rugged terrain. Class III roads serve moderately developed areas, and may be portions of a Class I or Class II highway that pass through small towns or developed recreational areas, where local traffic mixes with through traffic, and the density of unsignalised roadside access points increases.

On Class I roads, LOS is defined in terms of either Percent-Time-Spent-Following (PTSF) or Average Travel Speed (ATS). On Class II roads, LOS is defined in terms of PTSF only. The PTSF is a measure of the level of opportunities to overtake, and is estimated from the demand traffic volumes, the directional distribution of that traffic, and the percentage of no-passing zones. On Class III roads, LOS is defined in terms of Percent-Free-Flow-Speed (PFFS). The LOS criteria for the three classes of road are presented in Table 4.4.

Table 4.4: LOS Criteria for Two Lane Two Way Roads

Level of Service	Class I		Class II	Class III
	ATS (km/h)	PTSF (percent)	PTSF (percent)	PFFS (percent)
A	> 90	≤ 35	≤ 40	> 91.7
B	> 80 – 90	> 40 – 50	> 40 – 55	> 83.3 – 91.7
C	> 70 – 80	> 50 – 65	> 55 – 70	> 75.0 – 83.3
D	> 60 – 70	> 65 – 80	> 70 – 85	> 66.7 – 75.0
E	≤ 60	> 80	> 85	≤ 66.7

Source: Austroads (2020a)

As a guide to the hourly traffic volumes that may be carried for each of the LOS ranges, Table 4.5 summarises the indicative volume ranges for each LOS for Class I and Class II roads under the theoretical conditions indicated below the table, using the HCM method.

Table 4.5: Hourly Traffic Volume Ranges for Class I and Class II Roads (vehicles per hour)

Level of Service	Class I Roads	Class II Roads
A	0 to 260	0 to 320
B	260 to 470	320 to 570
C	470 to 830	570 to 1,050
D	830 to 1,490	1,050 to 1,780
E	> 1,490	> 1,780

For travel lanes 3.0m wide, shoulders 0.5m wide, speed limit 100km/h, 20% no-passing, 20% heavy vehicles, 50/50 directional traffic split, peak hour factor 0.88, level topography.

Comparing the volume ranges presented in Table 4.5 with the forecast future peak hourly traffic on Kidman Way of fewer than 140 vehicles per hour on a peak day of activity with the Project (Section 4.3), it is evident that the LOS experienced by drivers on Kidman Way would be A, representing good conditions with drivers experiencing negligible restriction on their desired travel speed.

4.5 Operation of Intersections

At unsignalised intersections with minor roads, where there are relatively low volumes of through and turning vehicles, capacity considerations are usually not significant, and detailed analysis of capacity is not warranted. As a guide, at volumes below the following combinations of maximum hourly volumes at a cross intersection with a two lane two-way road, capacity analysis is not warranted:

- major road 400 vehicles per hour, minor road 250 vehicles per hour;
- major road 500 vehicles per hour, minor road 200 vehicles per hour; and
- major road 650 vehicles per hour, minor road 100 vehicles per hour.

Comparing the forecast future traffic volumes on Kidman Way of up to 130 vehicles per hour on a peak day of the Project, with the threshold volumes above, it is evident that the peak

hourly volumes are well below the threshold volumes for analysis, and as such, there is no capacity concerns regarding the operation of the intersections.

4.6 Intersection Sight Distances

Safe Intersection Sight Distance (SISD) is the minimum sight distance which should be provided on the major road at any intersection, allowing for approaching drivers to see an articulated vehicle which has properly commenced a manoeuvre from a leg without priority, but its length creates an obstruction. SISD allows for an observation time for a driver on the priority legs of the intersection to observe a problem ahead plus the Stopping Sight Distance (SSD). SSD is the distance required to enable a normally alert driver, travelling at the design speed on wet pavement, to perceive, react and brake to a stop before reaching a hazard on the road ahead (Austroads, 2021c). SISD is measured from a driver's eye height of (car 1.1 m, truck 2.4 m) to an object height of 1.25 m (0.2 m less than the 15th percentile height of passenger cars) and assumes the driver on a minor road is situated 7.0 m (minimum 5.0 m) from the potential conflict point on the major road.

4.6.1 Kidman Way Intersections

For the operating speed of 100 km/h on Kidman Way, the SISD required for car drivers is 248 m on a level road surface. Observations on site indicate that the available sight distance between a driver stopped on the minor road and approaching vehicles on Kidman Way exceeds 248 m at both the Glenwood Road and Grain Road intersections.

It is noted that on Grain Road, the GIVE WAY sign for westbound vehicles on Grain Road is located to the east of the access from Kidman Way for the rest area on the south-eastern corner of the intersection. The available sightlines have been checked for a driver at the GIVE Way line, as well as at the edge of Kidman Way.

4.6.2 Unsealed Road Intersections

In the case of unsealed roads, ARRB (2020) provides SSD data for various speeds and reaction times for passenger cars and suggests an arbitrary increase in the SSD of 25% to take into account the many variables peculiar to unsealed roads. As unsealed roads do not have a signposted speed limit, the operating speed on those roads has been estimated as the comfortable car (4WD) travel speeds experienced during fine and dry conditions.

The comfortable travel speed on Glenwood Road approaching the Site Access Road intersection in fine and dry conditions is approximately 60 km/h. Based on ARRB (2020), the SSD for these conditions is 90 m, and 113 m with the application of the arbitrary factor. To reflect the braking characteristics of heavy vehicles, ARRB (2020) also suggests that for an operating speed of 60 km/h, SSD for B-doubles on a level grade is 110 m, increasing to 144 m in wet conditions. With the additional observation time, the SISD required at the intersection

of Glenwood Road with the Site Access Road is 163 m for cars, and 194 m for heavy vehicles in wet conditions.

Observations on site indicate that the available sight distance between a driver stopped on the Site Access Road and approaching vehicles on Glenwood Road exceeds 194 m. The available Safe Intersection Sight Distance at the Site Access Road intersection with Glenwood Road is therefore satisfactory.

The comfortable travel speed on Grain Road in fine and dry conditions is approximately 50 km/h. The single lane stock grid located immediately to the west of the Light Vehicle Access Road reduces the approach speed of vehicles in both directions on Grain Road, however the higher speed has been adopted for the purpose of this review. Based on ARRB (2020), the SSD for an operating speed of 50 km/h is 65 m, and 81 m with the application of the arbitrary factor. To reflect the braking characteristics of heavy vehicles, ARRB (2020) also suggests that for an operating speed of 50 km/h, SSD for B-doubles on a level grade is 80 m, increasing to 90 m in wet conditions. With the additional observation time, the SISD required at the intersection of Grain Road with the Light Vehicle Access Road is 123 m for cars, and 132 m for heavy vehicles in wet conditions.

Observations on site indicate that the available sight distance between a driver stopped on the Site Access Road and approaching vehicles on Grain Road exceeds 132 m. The available Safe Intersection Sight Distance at the Light Vehicle Access Road intersection with Grain Road is therefore satisfactory.

4.7 Intersection Treatments

The intersection of Kidman Way with Glenwood Road and Grain Road have been assessed with regard to the Austroads warrants for major road treatments at rural road intersections to identify whether the additional traffic demands generated by the Project would trigger a need to upgrade the major road treatment at those intersections. The current Austroads (2021b) rural intersection design treatments are briefly described below.

The general minimum preferred treatments at rural road intersections are BAL and BAR treatments. The rural BAL treatment on the major road has a widened shoulder, which assists turning vehicles to move further off the through carriageway, making it easier for through vehicles to pass. The rural BAR treatment features a widened shoulder on the major road that allows through vehicles, having slowed, to pass to the left of turning vehicles.

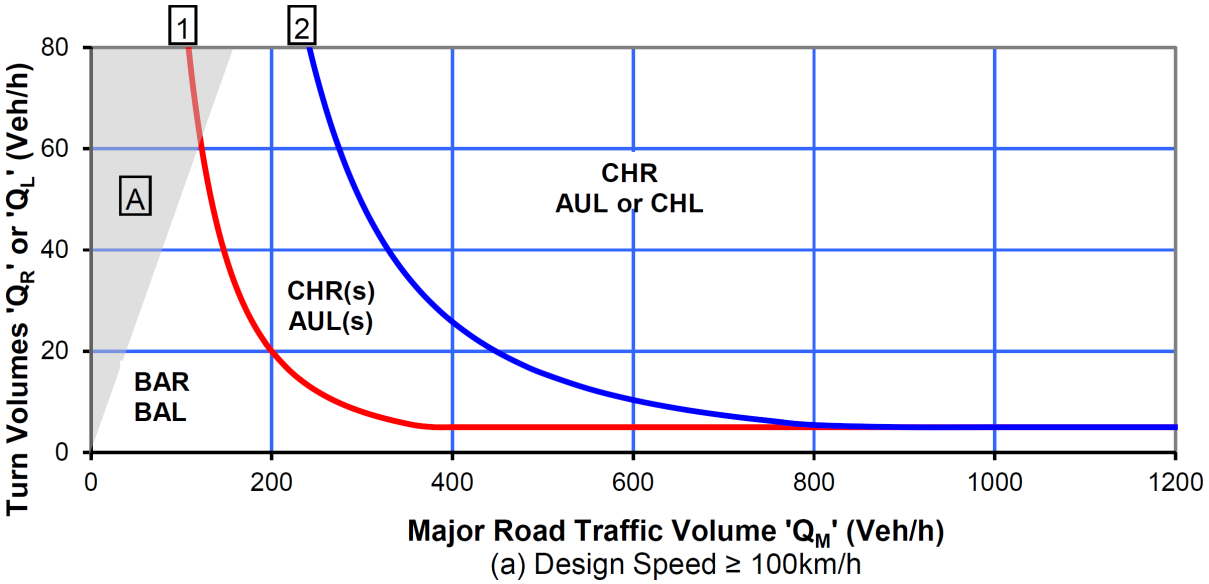
Auxiliary lane turn treatments have short lengths of auxiliary lane provided to improve safety, especially on high speed roads. The Auxiliary Right-turn treatment (AUR) on the major road is not used in NSW, rather a channelised right-turn (CHR) treatment with a short turn bay known as a CHR(S) treatment is used. This is a modification of the channelised treatment described below. Auxiliary Left-turn (AUL) treatments on the major road are normal indented turn lanes, used only by vehicles turning left.

Channelised "CH" treatments separate conflicting vehicle paths by raised or painted medians and/or islands, and often use auxiliary lanes in conjunction with channelisation. The CHR treatment on the major road provides a continuous lane for through vehicles only, and an auxiliary turn lane for right-turning vehicles only. Channelised left-turn (CHL) treatments on the major road provide a separate left-turn "slip" lane, separated from the adjacent lane by a painted or raised island. Channelised treatments are preferred over auxiliary lane treatments where practicable, as the risk of collisions is lower.

The guidelines for the level of treatment in the major road at an intersection are given in Austroads (2020b), which contains details of the warrants for rural road turn treatments for high-speed rural roads that would apply to the intersection of Kidman way with Glenwood Road and with Grain Road. The warranted treatment is based on an assessment of the combination of through and turning movements at the intersection, with higher turning volumes generally requiring higher levels of treatment above the minimum. The warrants are applicable to greenfields intersections, however may also be appropriate to consider when determining upgrade requirements for existing intersections.

The graph relevant to the 100 km/h speeds on Kidman Way is presented in Figure 5.1. In that graph, Q_L and Q_R are the number of vehicles turning left and right respectively from the major road, and Q_M is the major road flow, which calculated depending on whether the left or right-turn treatment is being considered.

Figure 4.2: Warrants for Turn Treatments on Major Roads at Unsignalised Intersections



BAL = Basic Left-turn; BAR = Basic Right-turn, AUL = Auxiliary Left-turn, CHL = Channelised Left-turn, CHR = Channelised Right-turn, (s) = short
Curve 1 is the boundary between a BAR and CHR(S) treatment and between a BAL and an AUL(S) treatment.
Curve 2 is the boundary between a CHR(S) and a CHR treatment and between an AUL(S) and AUL or CHL treatment.
In Area A, more than 50% of approaching traffic turns left or right, and realignment may be considered to suit the major movement.
Source: Austroads (2020b)

4.7.1 Kidman Way and Grain Road

Considering the Project's traffic generation described in Section 4.1, the peak traffic turning from Kidman Way to Grain Road would be up to 15 light vehicles inbound to the REF Area prior to the start of a shift at the beginning of a roster period. Those trips are likely to be spread over several hours, with some vehicles turning right in to Grain Road and some turning left in to Grain Road.

At the end of the life of the Project, peak hourly traffic on Kidman Way not associated with Project in the vicinity of Grain Road is estimated to be fewer than 45 vehicles per hour. As a worst case, should the peak Project vehicles all arrive from one direction only within one hour that also coincides with the peak hour for traffic on Kidman Way, the warrant indicates that the minimum treatments would be appropriate. The existing demands without the Project would also warrant the minimum treatments, so the Project does not trigger a need for any specific upgrade to the intersection.

4.7.2 Kidman Way and Glenwood Road

Considering the Project's traffic generation described in Section 4.1, the peak traffic turning left from Kidman Way to Glenwood Road would be a maximum of 10 oversize vehicles inbound to the REF Area on any one day during mobilisation/demobilisation periods, and up to three delivery vehicles turning left from Kidman Way to Glenwood Road during the operational stage of the Project. The number of vehicles turning left in to Glenwood Road during any one hour is therefore expected to be very low, and in combination with the background non-Project traffic on Kidman Way of fewer than 45 vehicles per hour, the warrant indicates that the minimum treatments would be appropriate. The existing demands without the Project would also warrant the minimum treatments, so the Project does not trigger a need for any specific upgrade to the intersection.

4.7.3 Site Access Intersections

The minimum layout for a rural road property access should be designed for the largest vehicles likely to use the access. Austroads (2021b) presents rural access layouts suitable for use by single unit vehicles, and for use by articulated vehicles. It is recommended that the Site Access Road be widened at its approach to Glenwood Road, generally consistent with Austroads (2021b) for articulated vehicles, modified to reflect the right in and left out only movements by heavy vehicles.

It is further recommended that the existing dip at the edge of the Glenwood Road carriageway at the Site Access Road be flattened to provide adequate ground clearance for the oversize vehicles expected to use it, and to ensure the angle of articulation of articulated vehicles remains satisfactory. The swept paths of semitrailers turning into and out of the Site Access Road are presented in Appendix C (Figure C8), showing the wheel paths of

those vehicles where flattening of the dip would be needed, and the indicative width requirements of the Site Access Road at its intersection with Glenwood Road.

The layout of the Light Vehicle Access Road intersection is satisfactory for its continued use by light vehicles, which permits two light vehicles to pass in proximity to Grain Road.

It is recommended that signage be provided on Glenwood Road and Grain Road to alert drivers to the presence of the Site Access Road and Light Vehicle Access Road respectively, both as an advisory to through drivers, and to aid drivers travelling to the REF Area who may be unfamiliar with the location.

4.8 Vehicle Swept Paths

As requested by TfNSW, the intersections of Kidman Way with Glenwood Road and Grain Road have been reviewed with regard to the swept paths of the largest vehicle likely to use each intersection. The TfNSW request indicates that the swept path assessment demonstrate that the largest vehicle be able to perform all movements correctly and concurrently, with opposing vehicles having 0.5 m clearance per vehicle lane, i.e. 1.0 m clearance between vehicles. In the case of the Project-generated vehicles at the intersection of Kidman Way with Glenwood Road, the largest vehicle would be an oversize low loader, which would be subject to permit and escort requirements. Considering the limited number of such oversize movements, the ability for Peel Mining to appropriately manage the timing of such trips, and the escort requirements to provide adequate warning for other road users to respond in a safe manner, it is highly improbable that two oversize vehicles would use the intersection simultaneously, this the assessment has been undertaken to review the ability for an oversize vehicle to turn in or out of the intersection.

The dimensions of oversize vehicles would vary from load to load, and for the purpose of this review, TTPP has conducted swept path assessments of an indicative large low loader using Austroads' prime mover and long semitrailer with a total length of 25 m. The swept paths of this indicative large low loader vehicle turning left from Kidman Way to Glenwood Road and turning right from Glenwood Road to Kidman Way are presented in Appendix C, noting that oversize vehicles would all travel via Cobar, and so would not turn to or from Kidman Way south of Glenwood Road. These swept paths demonstrates that there is adequate space in the intersection to permit the movement of this vehicle without impacting any roadside infrastructure (Figures C1 and C2). Oversize vehicles would be transported in accordance with all licences and escorts as required by regulatory authorities, with management of potential conflicts with other road users at the intersection as appropriate for the specific vehicle in use.

Aside from the oversize vehicles, the Project would generate trips by semitrailers. TTPP has therefore conducted the assessment on the basis of two semitrailers turning concurrently at the intersection of Kidman Way and Glenwood Road. Project-generated heavy vehicles would all travel via Cobar, and so would not turn to/from Kidman Way south of Glenwood

Road. The resulting swept paths are presented in Appendix C, which demonstrates that the existing intersection does not allow for semitrailers to turn left in and right out concurrently (Figure C3). It does however allow a semitrailer to turn left into Glenwood Road (priority movement) while another large vehicle is stopped at the GIVE WAY line to exit Glenwood Road (non-priority movement). Similarly, a semitrailer would be able to turn right into Glenwood Road (priority movement, not Project-generated traffic) while another large vehicle is stopped at the GIVE WAY line to exit Glenwood Road (non-priority movement) (Figure C4). As westbound drivers in Glenwood Road are likely to remain at the GIVE WAY line rather than enter the intersection while it is occupied by another semitrailer, the existing layout of the intersection is considered to be functional for its use by the largest vehicles anticipated to be generated by the Project.

In this regard, TTPP notes that while both Kidman Way and Glenwood Road are approved routes for access by B-doubles (refer to Section 3.2), a check of the swept paths of B-doubles turning at the intersection of Kidman Way and Glenwood Road indicates that the intersection layout does not support concurrent movements of B-doubles turning left in and right out of Kidman Way (Figure C5). Nor does it support a B-double turning right into Glenwood Road while another vehicle is stopped at the GIVE WAY line on Glenwood Road (Figure C6). The suggested requirement for concurrent movements is not met by the existing large vehicles using the intersection, and the day-to-day Project-generated traffic would not exacerbate this, being smaller vehicles than those currently approved to use the intersection, and generating a maximum of two or three deliveries on any one day during the construction and operational activity stages of the Project.

The Project-generated semitrailers would therefore not raise any fresh concerns regarding their use of the intersection of Kidman Way and Glenwood Road, as there is adequate space for the Project-generated semitrailers to enter Glenwood Road clear of any vehicle waiting to exit Glenwood Road. The Project-generated vehicles are not considered to trigger a need to upgrade the intersection.

The Project would generate only light vehicle movements at the intersection of Kidman Way with Grain Road, therefore a review of vehicle swept paths at that intersection is not considered to be warranted.

4.9 Unsealed Roads

The geometry of Glenwood Road is typical of a Class 4A unsealed road as suggested under the ARRB (2020) functional classification system for unsealed roads. Class 4A roads are used for major movements between population centres and connection to adjacent areas. They can carry heavy vehicles, and typically carry in excess of 150 vehicles per day (Average Daily Traffic [ADT]) with an all-weather surface that supports operating speeds of up to 80 km/h. In flat terrain, Class 4A roads desirably have a minimum carriageway width, including shoulders, of 9 m, with two 3.5 m wide travel lanes which is sufficient to allow two heavy vehicles to pass.

The geometry of Grain Road in the vicinity of the Kidman Way and the Light Vehicle Access Road is consistent with that of a Class 4B unsealed road. Class 4B roads are used for connection between local centres of population and links to the primary road network. They typically carry ADT of between 50 and 150 vehicles per day, with an all-weather surface that supports operating speeds of up to 70 km/h. In flat terrain, Class 4B roads desirably have a minimum carriageway width, including shoulders, of 7 m, with two 3.0 m wide travel lanes which is sufficient to allow two heavy vehicles to pass by moving towards the shoulders.

The proposed use of Glenwood Road between Kidman Way and the Site Access Road by heavy vehicles, and the proposed use of Grain Road to access the Light Vehicle Access Road by light vehicles only is therefore consistent with the existing use and geometry of the unsealed roads. The existing roads are dry weather roads only, and in poor weather conditions, Cobar Shire Council may close the roads to all traffic, or restrict their use to 4WDs and heavy vehicles only. In the event that Grain Road is restricted to 4WD and heavy vehicle traffic only, light passenger cars that may be used by some of the workforce would not be permitted to access the Light Vehicle Access Road. Under those conditions, Peel Mining would facilitate car pooling as required to move workers to and from the REF Area using permitted vehicles, noting that this would only be required for the movement of workers at the beginning or end of each roster due to the establishment of the on-site accommodation facilities.

The Site Access Road and the Light Vehicle Access Road would each be constructed as two-way, two-lane unsealed roads, suitable for use by heavy and light vehicles respectively. The Site Access Road would desirably have two 3.5m travel lanes with 1.0 m wide shoulders, and the Light Vehicle Access Road would desirably have two 3.0 m wide travel lanes with 0.5 m wide shoulders.

4.10 Oversize Vehicles

The proposed movement of oversize vehicles would be negotiated with TfNSW and relevant local councils on a case-by-case basis. All oversize loads would be transported with the relevant permits and load declarations obtained in accordance with *Additional Access Conditions Oversize and overmass heavy vehicles and loads* (TfNSW, 2020) and any other licences and escorts as required by regulatory authorities.

To the extent possible, the movement of OSOM vehicles would be avoided during school bus operating hours on Kidman Way.

4.11 Dangerous Goods Transport

Dangerous goods required for the Project would be transported in accordance with the relevant legislation, including *Dangerous Goods (Road and Rail Transport) Act 2008*, *Dangerous Goods (Road and Rail Transport) Regulation 2014* and *Dangerous Goods (Road*

and Rail Transport) Amendment (Model Law) Regulation 2020, reflecting the new edition of the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (National Transport Commission, 2020) for implementation in New South Wales.

The transportation, handling and storage of all dangerous goods at the site would be conducted in accordance with the requirements of the relevant Australian Standards, driver and vehicle licencing requirements, and the current version of the Australian Dangerous Goods Code.

4.12 Impacts on Road Safety

The review of the road crash history of the roads expected to be used for haulage associated with the Project (Section 3.4) did not identify any causation factors associated with the existing road network that may be exacerbated by increased traffic demands with the Project.

The existing safety issues with the rest area access at the intersection of Kidman Way with Grain Road (Section 3.1) may be improved by closing off the non-compliant access at the corner of the intersection, requiring all vehicles to use the signposted entry from Grain Road. This is an existing issue that is not the result of Project-generated traffic.

4.13 Mitigation Measures

In consideration of the findings of this assessment, the following measures are recommended to minimise and manage the impacts of the proposed Project traffic:

- widen the Site Access Road at its approach to Glenwood Road to reflect the swept paths of the heavy vehicles expected to use it;
- flatten the existing dip at the edge of Glenwood Road at the Site Access Road to provide adequate ground clearance for vehicles, and to ensure the angle of articulation of articulated vehicles remains satisfactory;
- construct the Site Access Road to a desirable standard of two 3.5m travel lanes with 1.0 m wide shoulders, and the Light Vehicle Access Road to a desirable standard of two 3.0 m wide travel lanes with 0.5 m wide shoulders;
- provide signage on Glenwood Road and Grain Road to alert drivers to the presence of the Site Access Road and Light Vehicle Access Road;
- develop a Traffic Management Plan (TMP) and Driver Code of Conduct for the heavy vehicle transport associated with the Project. The TMP would form part of the employee contract or transport contractual arrangements, and would be prepared in consultation with Cobar Shire Council prior to commencement of construction of the Project, to address such matters as:

- compliance with access routes and travel restrictions that may be applicable during or following wet weather;
- compliance with road rules, laws and regulations, including those relating to OSOM vehicles and dangerous good transport;
- maintaining safe following distances between vehicles, and increasing separation in poor visibility (e.g. dusty conditions on unsealed roads);
- reporting of any unsafe driving practices or incidents; and
- driver behaviour expectations at any specific locations including in the vicinity of any school bus during bus operating hours.

The existing safety issues at the non-compliant access to the rest area at the intersection of Kidman Way and Grain Road may be addressed via closure of the access that permits access directly from the intersection, and provision of appropriate signage to clarify the entry and exit locations, or other measures to the satisfaction of TfNSW and/or Cobar Shire Council. This is an existing issue that is not triggered by the Project traffic.

5 Conclusions

It is concluded that the existing road network has adequate capacity to accommodate the increased traffic demands expected to be generated by the Project. A number of measures are recommended to ensure the safe operation of the roads and intersections in the region:

- widen the Site Access Road at its approach to Glenwood Road to reflect the swept paths of the heavy vehicles expected to use it;
- flatten the existing dip at the edge of Glenwood Road at the Site Access Road to provide adequate ground clearance for vehicles, and to ensure the angle of articulation of articulated vehicles remains satisfactory;
- construct the Site Access Road to a desirable standard of two 3.5m travel lanes with 1.0 m wide shoulders, and the Light Vehicle Access Road to a desirable standard of two 3.0 m wide travel lanes with 0.5 m wide shoulders;
- provide signage on Glenwood Road and Grain Road to alert drivers to the presence of the Site Access Road and Light Vehicle Access Road;
- develop a Traffic Management Plan (TMP) and Driver Code of Conduct for the heavy vehicle transport associated with the Project. The TMP would form part of the employee contract or transport contractual arrangements, and would be prepared in consultation with Cobar Shire Council prior to commencement of construction of the Project, to address such matters as:
  - compliance with access routes and travel restrictions that may be applicable during or following wet weather;
  - compliance with road rules, laws and regulations, including those relating to OSOM vehicles and dangerous good transport;
  - maintaining safe following distances between vehicles, and increasing separation in poor visibility (e.g. dusty conditions on unsealed roads);
  - reporting of any unsafe driving practices or incidents; and
  - driver behaviour expectations at any specific locations including in the vicinity of any school bus during bus operating hours.

Appendix A

Project Information

Table 15
Anticipated Surface Equipment

Item	Number	Purpose
Raise borer drill rig	1	Construction of ventilation rises and escapeway
Hydraulic excavator	1	Excavation of portal box cut
25t crane	1	Installation and removal of raise borer drill rig
Service truck	1	Supply fuel, water and servicing for drill rig
Bulldozer	1	Site preparation
Front-end loader	1	Site preparation
Grader	1	Grading roads
Bobcat	1	Minor earthworks
Water cart	1	Dust suppression
Light vehicles	4-6	Transport of personnel and materials around site
500 KVA generator	1-2	Power generation
Source: Peel Mining Limited		

Source R.W. Corkery & Co, 2022

Table 16
Anticipated Underground Equipment

Item	Number	Purpose
Diamond drill rigs	1-2	Resource definition drilling
Drill jumbos	1	Drill and blast, ground support installation
Shotcreting unit	1	Shotcrete application
Agitator	1	For shotcrete
Integrated tool carrier	1	For charge up and other services
Haul trucks	1-2	Transport waste rock to surface
Front-end loader	1	Loading dump trucks and misc. works
Grader	1	Surface and underground grading
Light vehicles	3-4	Transport to and from decline
Source: Peel Mining Limited		

Source R.W. Corkery & Co, 2022

Appendix B

Photos

Sightline to North from Glenwood Road

Sightline to South from Glenwood Road

Sightline to South from Grain Road

Sightline from the Give Way sign east of the rest area access from Kidman Way, looking across the rest area, truck is approaching on Kidman Way, which lies behind the mid-photo vegetation, refer to following photo.

Aerial View of Grain Road, Kidman Way and Rest Area Access

Grain Road approaching Kidman Way

The rest area access from Kidman Way is located east of the Give Way sign, which is approximately 20 m from Kidman Way.

Sightline to North from Grain Road

Sightline from the Give Way sign east of the rest area access from Kidman Way.

Sightline to South from Site Access Road Location

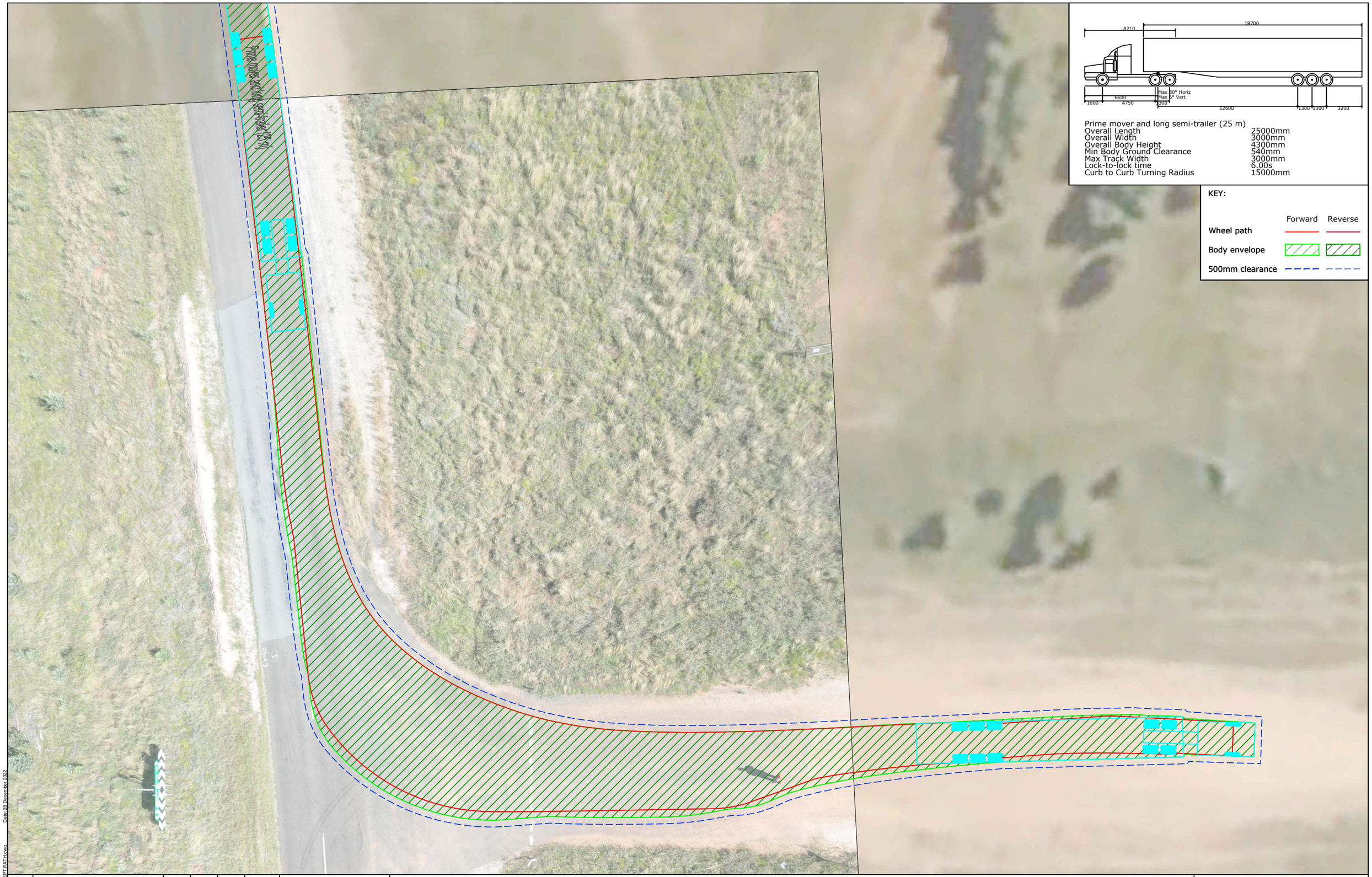
Sightline to North from Site Access Road Location

Sightline to West from Light Vehicle Access Road

Sightline to East from Light Vehicle Access Road

Appendix C

Vehicle Swept Paths



Prime mover and long semi-trailer (25 m)

Overall Length	25000mm
Overall Width	3000mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Max Track Width	3000mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	15000mm

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
500mm clearance		

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	JG	PD	PD	20/12/22

ttpp transport planning

PROJECT

MALLEE BULL EXPLORATION PROJECT

TITLE

SWEPT PATH ANALYSIS - KIDMAN WAY AND GLENWOOD ROAD
AUSTROADS (2013) 25m PRIME MOVER AND LONG SEMI-TRAILER

DWG No. 22510CAD001
FIGURE C1

DATE STAMP 20 DECEMBER 2022

PROJECT No.	SCALE	REV.
22510	1:250 @A3	A

Filename: 22510CAD001-221220-SWEPT PATH.dwg
Date: 20 December 2022

Prime mover and long semi-trailer (25 m)

Overall Length	25000mm
Overall Width	3000mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Max Track Width	3000mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	15000mm

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
500mm clearance		

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	JG	PD	PD	20/12/22

ttpp transport planning

PROJECT

MALLEE BULL EXPLORATION PROJECT

TITLE

SWEPT PATH ANALYSIS - KIDMAN WAY AND GLENWOOD ROAD
AUSTROADS (2013) 25m PRIME MOVER AND LONG SEMI-TRAILER

DWG No. 22510CAD001
FIGURE C2

DATE STAMP 20 DECEMBER 2022

PROJECT No.	SCALE	REV.
22510	1:300 @A3	A

Filename: 22510CAD001-221220-SWEPT PATH.dwg
Date: 20 December 2022

Prime mover and semi-trailer (19 m)

Overall Length	19000mm
Overall Width	2500mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Track Width	2500mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12500mm

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
500mm clearance		

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	JG	PD	PD	20/12/22

ttpp transport planning

PROJECT

MALLEE BULL EXPLORATION PROJECT

TITLE

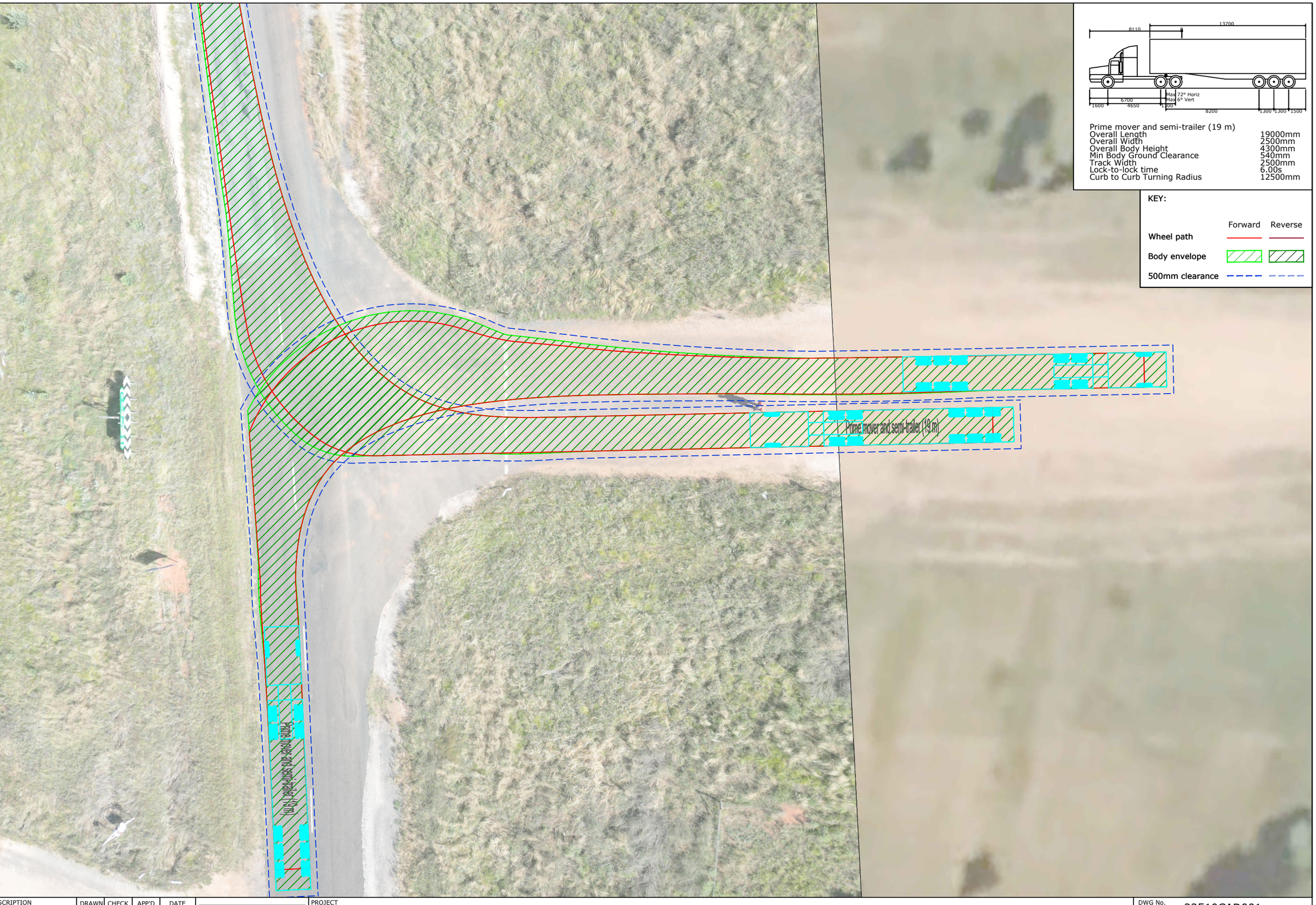
SWEPT PATH ANALYSIS - KIDMAN WAY AND GLENWOOD ROAD
AUSTROADS (2013) 19m PRIME MOVER AND SEMI-TRAILER

DWG No. 22510CAD001
FIGURE C3

DATE STAMP 20 DECEMBER 2022

PROJECT No.	SCALE	REV.
22510	1:250 @A3	A

Filename: 22510CAD001-221220-SWEPT PATH.dwg Date: 20 December 2022



Prime mover and semi-trailer (19 m)

Overall Length	19000mm
Overall Width	2500mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Track Width	2500mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12500mm

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
500mm clearance		

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	JG	PD	PD	20/12/22

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PROJECT

MALLEE BULL EXPLORATION PROJECT

TITLE

SWEPT PATH ANALYSIS - KIDMAN WAY AND GLENWOOD ROAD
AUSTROADS (2013) 19m PRIME MOVER AND SEMI TRAILER

DWG No. 22510CAD001
FIGURE C4

DATE STAMP 20 DECEMBER 2022

PROJECT No.	SCALE	REV.
22510	1:250 @A3	A

Filename: 22510CAD001-221220-SWEPT PATH.dwg
Date: 20 December 2022

B-Double (25.0m)	
Overall Length	25000mm
Overall Width	2500mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Track Width	2500mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	15000mm

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
500mm clearance		

Date: 20 December 2022

Filename: 22510CAD001-22220-SWEPT PATH.dwg

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	JG	PD	PD	20/12/22

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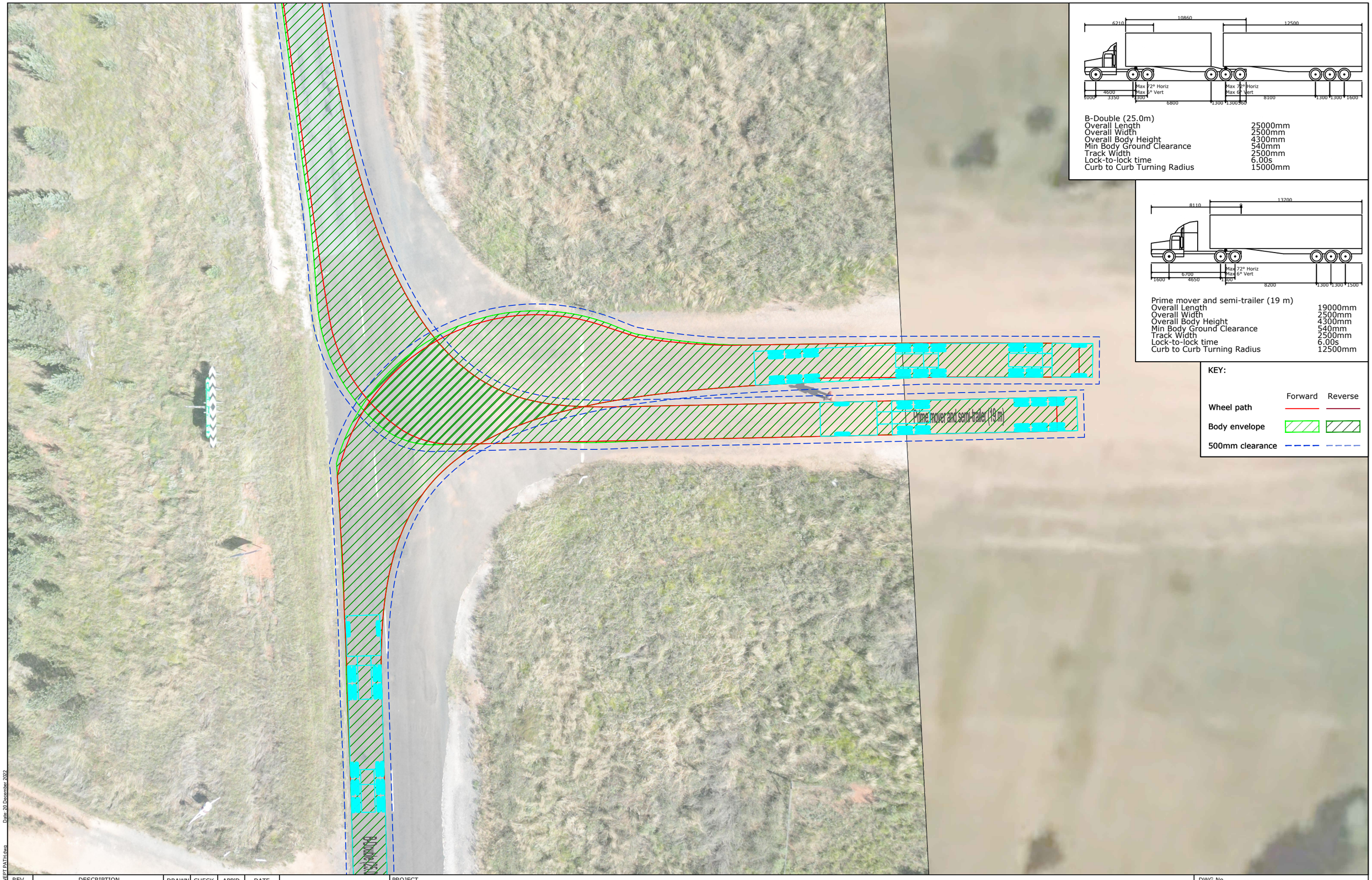
PROJECT

MALLEE BULL EXPLORATION PROJECT

TITLE

SWEPT PATH ANALYSIS - KIDMAN WAY AND GLENWOOD ROAD
AUSTROADS (2013) 25m B-DOUBLE

DWG No.	22510CAD001 FIGURE C5
DATE STAMP	20 DECEMBER 2022
PROJECT No.	22510
SCALE	1:250 @A3
REV.	A



B-Double (25.0m)

Overall Length	25000mm
Overall Width	2500mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Track Width	2500mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	15000mm

Prime mover and semi-trailer (19 m)

Overall Length	19000mm
Overall Width	2500mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Track Width	2500mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12500mm

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
500mm clearance		

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	JG	PD	PD	20/12/22

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PROJECT

MALLEE BULL EXPLORATION PROJECT

TITLE

SWEPT PATH ANALYSIS - KIDMAN WAY AND GLENWOOD ROAD
AUSTROADS (2013) 19m PRIME MOVER AND SEMI TRAILER AND 25m B-DOUBLE

DWG No. 22510CAD001
FIGURE C6

DATE STAMP 20 DECEMBER 2022

PROJECT No.	SCALE	REV.
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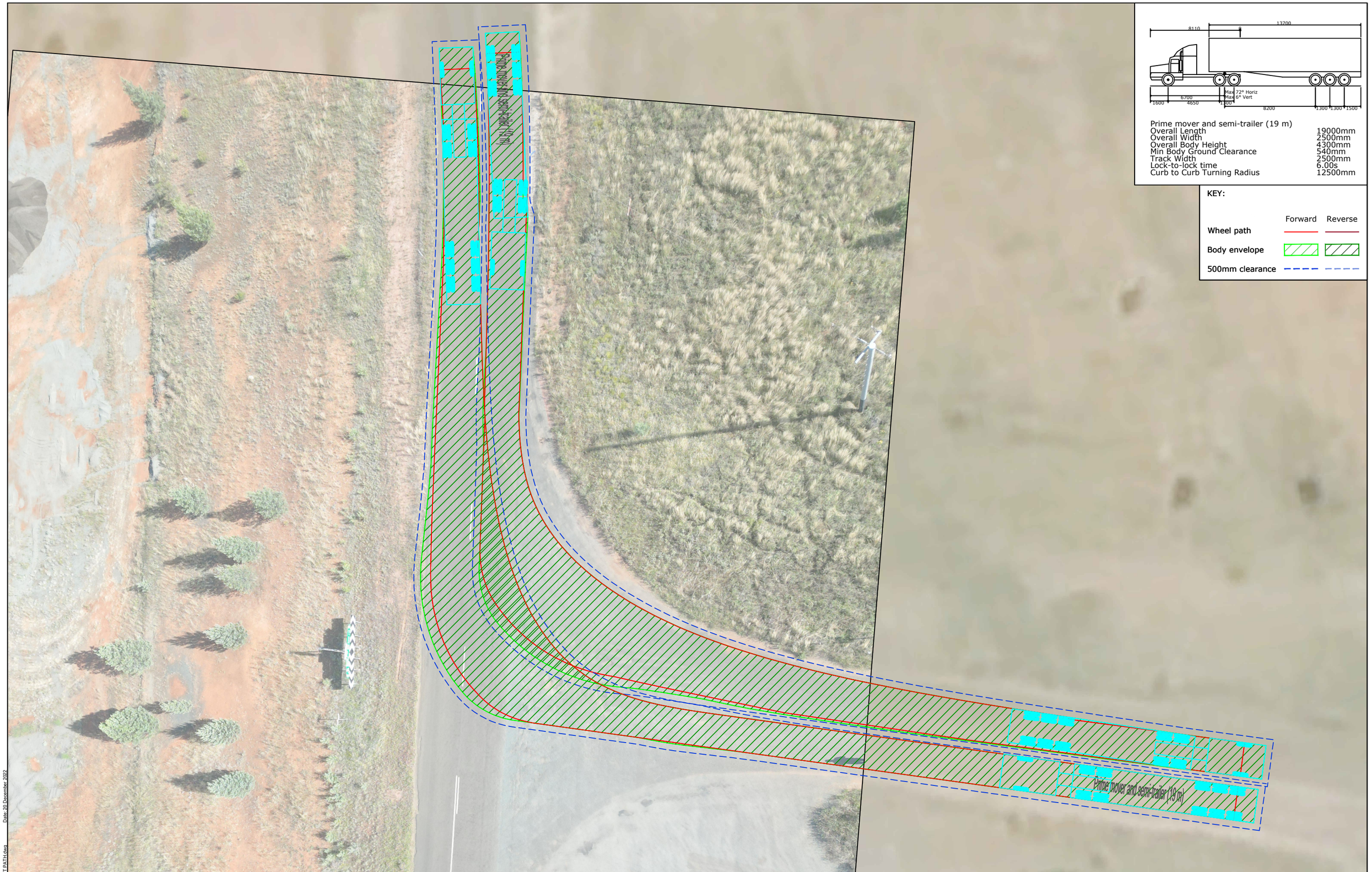
Filename: 22510CAD001-224220-SWEPT PATH.dwg Date: 20 December 2022



Prime mover and semi-trailer (19 m)

Overall Length	19000mm
Overall Width	2500mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Track Width	2500mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12500mm

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
500mm clearance		

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	JG	PD	PD	20/12/22

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PROJECT

MALLEE BULL EXPLORATION PROJECT

TITLE

SWEPT PATH ANALYSIS - KIDMAN WAY AND GRAIN ROAD
AUSTROADS (2013) 19m PRIME MOVER AND SEMI TRAILER

DWG No. 22510CAD001
FIGURE C7

DATE STAMP 20 DECEMBER 2022

PROJECT No.	SCALE	REV.
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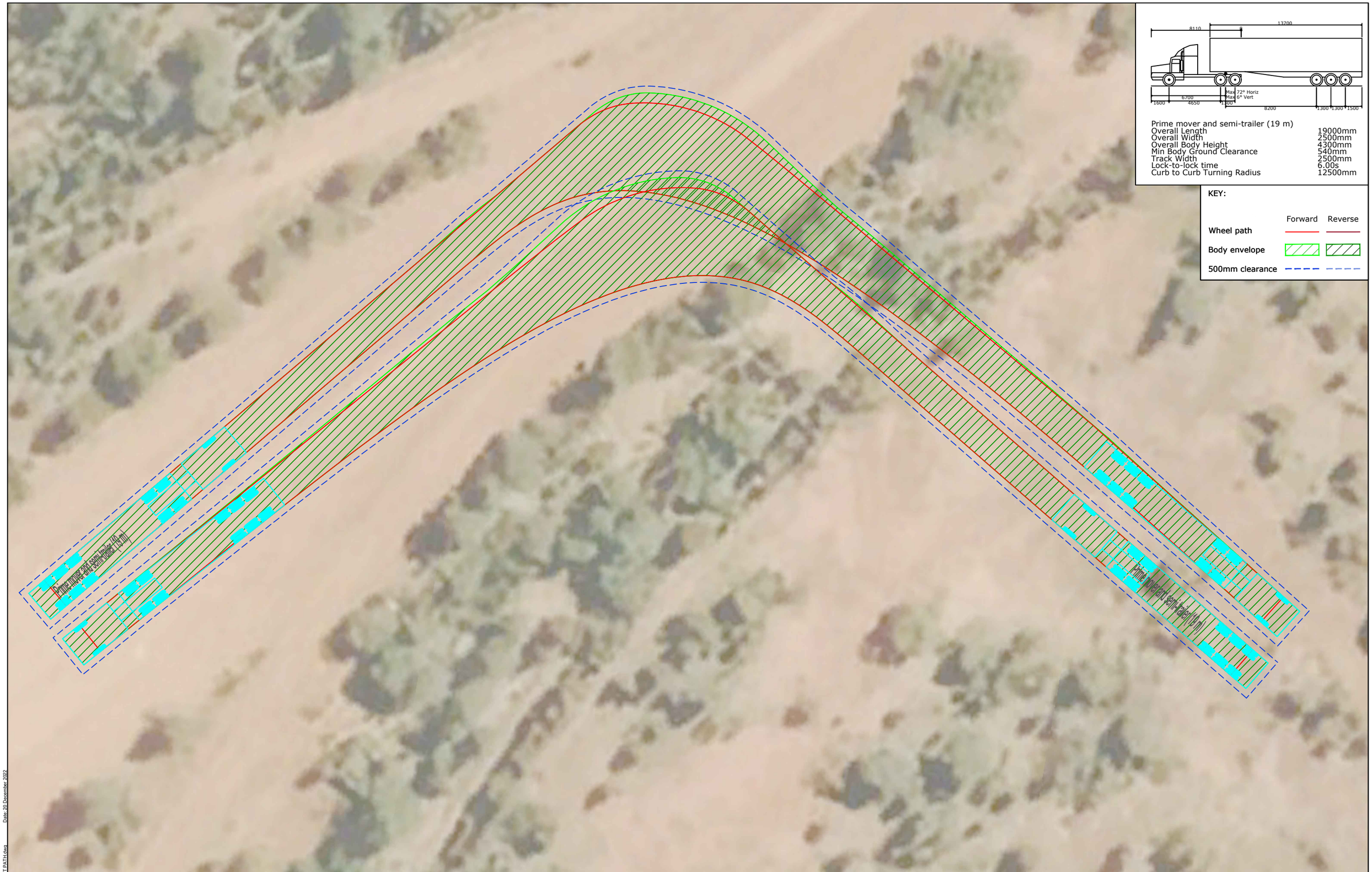
Filename: 22510CAD001-22420-SWEPT PATH.dwg Date: 20 December 2022



Prime mover and semi-trailer (19 m)

Overall Length	19000mm
Overall Width	2500mm
Overall Body Height	4300mm
Min Body Ground Clearance	540mm
Track Width	2500mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12500mm

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
500mm clearance		

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	JG	PD	PD	20/12/22

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PROJECT

MALLEE BULL EXPLORATION PROJECT

TITLE

SWEPT PATH ANALYSIS - GLENWOOD ROAD AND HV ACCESS
AUSTROADS (2013) 19m PRIME MOVER AND SEMI TRAILER

DWG No. 22510CAD001
FIGURE C8

DATE STAMP 20 DECEMBER 2022

PROJECT No.	SCALE	REV.
22510	1:250 @A3	A

Filename: 22510CAD001-221220-SWEPT PATH.dwg
Date: 20 December 2022

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Appendix 9

Agricultural Impact Statement

prepared by
RW Corkery & Co

(Total No. of pages including blank pages = 32)

peel mining LIMITED

Agricultural Impact Statement

for the

Mallee Bull Exploration Project

Prepared by:

RWCorkery&co

January 2023

RWCorkery&co

Agricultural Impact Statement

for the

Mallee Bull Exploration Project

Prepared for:	
Peel Mining Limited ABN: 42 119 343 734 Unit 1, 34 Kings Park Road WEST PERTH WA 6005	Telephone: (08) 9382 3955 Email: info@peelmining.com.au
Prepared by:	
R.W. Corkery & Co. Pty. Limited Geological & Environmental Consultants ABN: 31 002 033 712 Telephone: (02) 9985 8511 Email: admin@rwcorkery.com Postal: PO Box 1796 CHATSWOOD NSW 2057	**Sydney | Orange | Brisbane | Townsville** **Sydney** Suite 12.01, 1-5 Railway Street CHATSWOOD NSW 2067 **Orange** 62 Hill Street ORANGE NSW 2800
Ref No. 847/04	January 2023

RWCorkery&co

CONTENTS

Page

FIGURES

TABLES

PLATES

LIST OF ACRONYMS AND ABBREVIATIONS

AIS	Agricultural Impact Statement
DPI	Department of Primary Industries
EL	Exploration Licence
GHD	GHD Pty Ltd
GVP	Gross Value of Production
LGA	Local Government Area
NSW	New South Wales
REF	Review of Environmental Factors
RWC	R.W. Corkery & Co. Pty Limited

1. Introduction

This *Agricultural Impact Statement* (AIS) has been prepared by R.W. Corkery & Co. Pty. Limited on behalf of Peel Mining Limited ("the Company"). This document accompanies a *Review of Environmental Factors* (REF) prepared to support an application for approval under Part 5 of the *Environment Planning and Assessment Act 1979* for the Mallee Bull Exploration Decline Program. The proposed activities are located within an area referred to hereafter as the Mallee Bull REF Area within Exploration Licence (EL) 7461, located approximately 100km south of Cobar in central New South Wales. A box cut and exploration decline is proposed to be constructed within EL area (**Figure A1**).

This document has been prepared in accordance with the *NSW Strategic Regional Land Use Policy – Guideline for Agricultural Impact Statements at the Exploration Stage* (AIS Guideline) published in August 2015.

Land within the Mallee Bull REF Area is not within 2km of Strategic Agricultural Land or directly on land with a land and Soil Capability Class of 3 or higher. As a result, this AIS is a Level 1 AIS prepared to address the matters identified in Appendix 1 of the AIS Guideline.

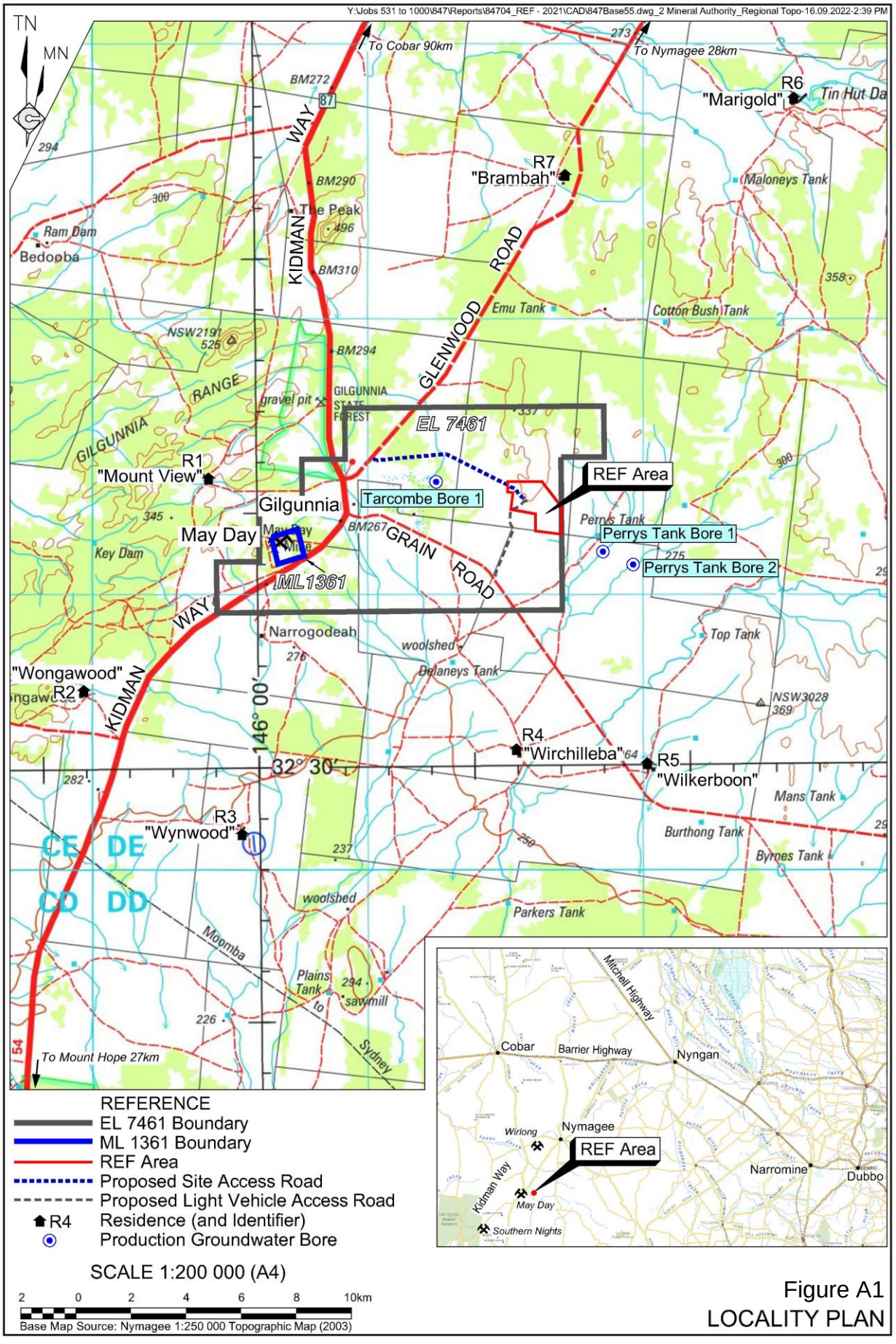

Figure A1
LOCALITY PLAN

2. Proposed Activities and Rehabilitation

2.1 Proposed Activities

Section 3 of the REF presents a detailed description of the proposed exploration activities. However, in summary the proposed Exploration Decline Program would include the following (**Figure A2**).

- Define the mineral resources associated with the deeper portions of the Mallee Bull Prospect, located in the vicinity of Gilgunnia, NSW.
- Provide drill core samples for metallurgical, geotechnical and associated test work.

The proposed exploration program would involve the following activities.

- Construction of a box cut to a maximum depth of approximately 25m below ground level (mbgl).
- Construction of an exploration decline to a maximum depth of approximately 400mbgl.
- Construction of associated surface infrastructure including a:
  - workshop;
  - administration buildings (site office, ablutions facility);
  - core yard and geology block;
  - magazine;
  - potentially acid forming (PAF) waste rock stockpiling area;
  - non-acid-forming (NAF) waste rock stockpiling area;
  - water storage facility;
  - site access road and internal roads; and
  - other ancillary infrastructure (e.g. fuel storage area, water management infrastructure).
- Rehabilitation of the development footprint within the REF Area.

Plates A1 to **A4** present views of the areas proposed to be disturbed.

The proposed duration of the activities would be 5 years from commencement.

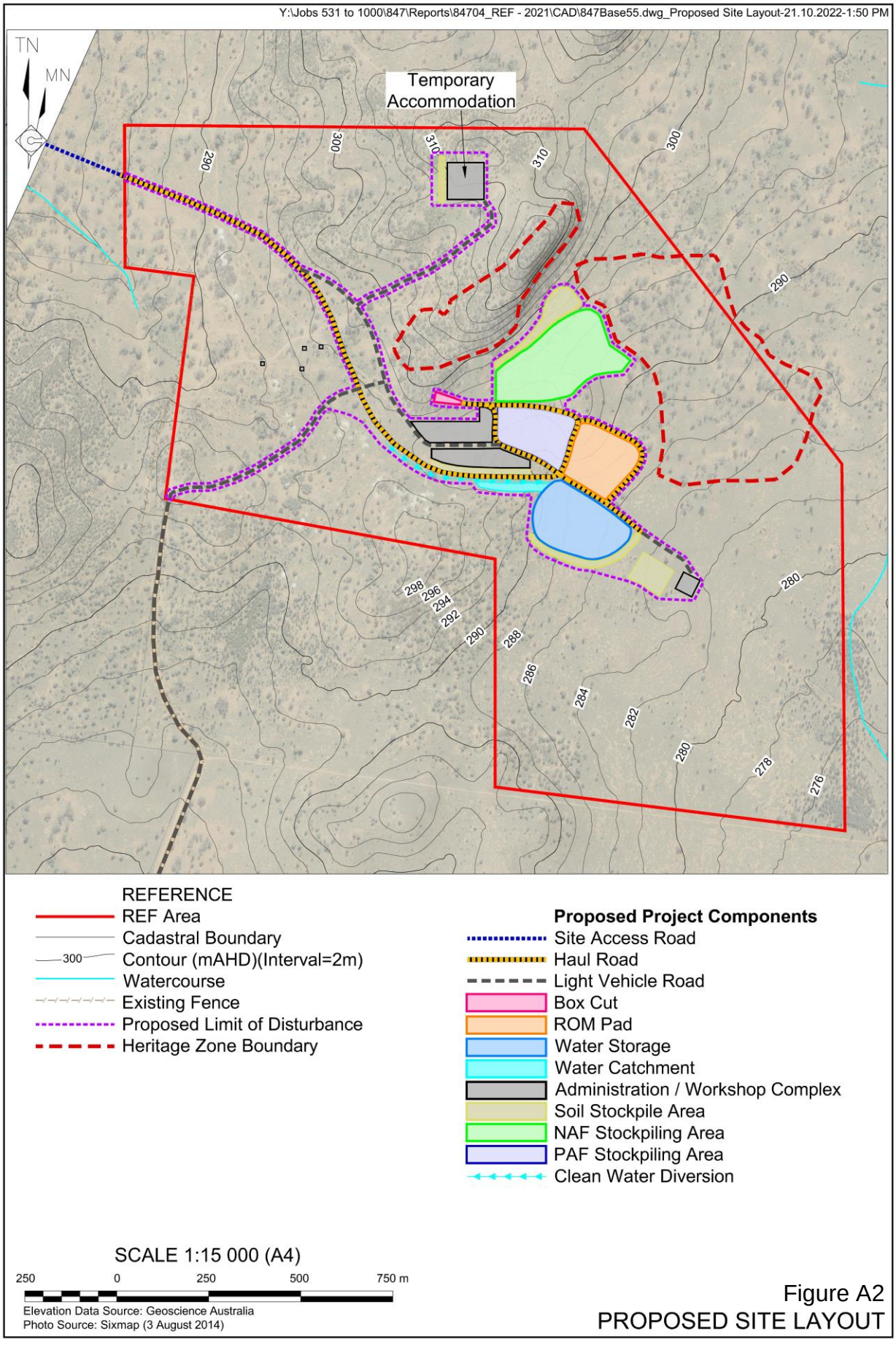

Figure A2
PROPOSED SITE LAYOUT

Table A1 presents the proposed hours of operation for the proposed activities.

Table A1
Proposed Hours of Operation

Activity	Proposed Days of Operation	Proposed Hours of Operation
Site establishment	7 days per week	7:00am – 6:00pm
Box cut excavation		
Exploration decline development	7 days per week	24 hours
Underground exploration / drilling		
Rehabilitation		
Maintenance Activities		
Source: Peel Mining Limited		

2.2 Rehabilitation

2.2.1 Introduction

Peel Mining proposes to seek development consent for a mining operation within the Mallee Bull REF Area during the Exploration Decline Program. Should consent be granted, mining operations would utilise the proposed exploration infrastructure and rehabilitation of the Mallee Bull REF Area would be undertaken in accordance with the *Rehabilitation Management Plan* that would be developed for that operation.

Notwithstanding the above, should development consent not be granted for a subsequent mining operation, Peel Mining Limited would rehabilitate the Mallee Bull REF Area generally in accordance with Section 3.2.15 of the REF. The proposed rehabilitation operations are summarised in the following subsections.

Prior to commencing the Exploration Decline Program, a Rehabilitation Management Plan would be prepared and submitted to the Resources Regulator to describe in detail the rehabilitation operations to be completed.

2.2.2 Post-exploration Land Use

Post-exploration land use within the Mallee Bull REF Area would, in the absence of development consent for a mining operation, be consistent with land uses permissible without development consent under the *Cobar Local Environment Plan 2011*. As the Mallee Bull REF Area is Zoned RU1 under that Plan, land uses permissible without development consent include nature conservation and extensive agriculture.

The proposed post-exploration land use would be consistent with the existing land use, namely nature conservation, with occasional grazing.

2.2.3 Rehabilitation Objectives and Domains

The rehabilitation objectives for the Exploration Decline Program would be as follows. Completion criteria for each rehabilitation objective is presented in Section 3.3.1 of the REF. **Table A2** below details objectives and completion criteria.

Plate A1-View of grassland within Exploration Area
(Source; Peel Mining Limited)

Plate A2-View of shrubland within Exploration Area
(Source Peel Mining Limited)

Plate A3-View of Mallee Bull Resource Area
(Source; Peel Mining Limited)

Plate A4-Existing Station Tracks within the Exploration Area
(Source Peel Mining Limited)

Table A2
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 1 – Decommissioning				
Box Cut and Portal				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Entry portal to the decline blocked.	Install concrete plug to the entry of the portal to block the decline.	Plug consistent with relevant NSW Resources Regulator Guidelines	Engineering report.	Single occurrence following decommissioning (unless follow up actions are identified).
Box cut backfilled with waste rock material	Backfill the box cut with waste rock material. Preference given to placing any remaining PAF waste rock in the deeper parts of the box cut and NAF waste rock in the upper layers.	Backfill consistent with relevant NSW Resources Regulator Guidelines.	Engineering report.	Single occurrence following decommissioning (unless follow up actions are identified).
Mine Rock Storage				
Nil required				
PAF Storage				
PAF waste rock stored separately from NAF waste and used to backfill the decline and box cut	PAF material directed underground placed below the groundwater level to reduce likelihood of oxidation.	Backfill consistent with relevant NSW Resources Regulator Guidelines.	Engineering report.	Single occurrence following decommissioning (unless follow up actions are identified).
Ventilation Rise and Escapeway				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Ventilation rise capped and sealed	Shaft capped and sealed to prevent inadvertent access and ensure long-term stability of the shaft	Cap and seal consistent with relevant NSW Resources Regulator Guidelines	Engineering report	Single occurrence following decommissioning (unless follow up actions are identified).
Prevent inadvertent access	Security fence with lockable gate installed	Security fence with lockable gate installed	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).

Table A2 (Cont'd)
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 1 – Decommissioning (Cont'd)				
Workshop and Administration Area Infrastructure				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Fuel Storage Tanks, Generators, Laydown Areas and Carparks				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Remove concrete pads and footings.	Broken up concrete buried within water storage facility or box cut prior to that facility being backfilled.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Ore Stockpile				
All ore removed from the stockpile pad and processed off site prior to completion of operations.	Ore removed from ROM pad.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Exploration Infrastructure				
All infrastructure and services not suitable for a lawful final land use will be removed.	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
All drill core and collected cuttings removed from the site.		All relevant infrastructure, drill core and cuttings removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Water Storage Facility (including Settling Pond) and Surface Water Diversion Channel				
All infrastructure and services not suitable for a lawful final land use will be removed.	HDPE liner removed from water storage facility. Water storage facility backfilled, and diversion structures removed from around the site. Backfill will be mounded to account for subsidence.	Backfill consistent with relevant NSW Resources Regulator Guidelines.	Engineering report.	Single occurrence following decommissioning (unless follow up actions are identified).
Water Abstraction Bores				
Nil required. Existing water bores will remain post closure of the site.				

Table A2 (Cont'd)
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 1 – Decommissioning (Cont'd)				
Haul and Access Roads				
All infrastructure and services not suitable for a lawful final land use will be removed.	Bund removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).
Phase 2 – Landform Establishment				
Box Cut and Portal				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
NAF Stockpiling Area				
Free draining, stable and non-polluting landform established.	Stockpiled material remaining at surface is NAF material only. Free draining landform reshaped to have outer batter slopes of 18° or less and a final height of 10m. Batters contour ripped and topsoil placed on top.	No pooling of water observed within landform. Water quality is consistent with natural runoff.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
PAF Stockpiling Area				
Free draining, stable and non-polluting landform established.	If additional area is required for final NAF stockpile outside of NAF Stockpiling Area, then indicator is same as outlined for NAF Stockpiling Area. If not required for NAF stockpile, area is free draining and shaped to match natural / surrounding contours.	No pooling of water observed within landform. Water quality is consistent with natural runoff.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Ventilation Rise and Escapeway				
Nil required	Infrastructure not required for final land use removed.	All relevant infrastructure removed.	Relinquishment inspection and report, including photographs.	Single occurrence following decommissioning (unless follow up actions are identified).

Table A2 (Cont'd)
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 2 – Landform Establishment (Cont'd)				
Workshop and Administration Area Infrastructure				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Fuel Storage Tanks, Generators, Laydown Areas and Carparks				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Ore Stockpile				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform. Water quality is consistent with natural runoff.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Exploration Infrastructure				
Nil required.				
Water Storage Facility (including Settling Pond) and Surface Water Diversion Channel				
Free draining, stable and non-polluting landform established.	Free draining landform.	No pooling of water observed within landform. Water quality is consistent with natural runoff.	Inspection and report, including photographs.	Single occurrence following completion of final landform establishment (unless further earthworks required).
Haul and Access Roads				
Nil required.				
Phase 3 – Growth Medium Development				
All Domains				
Growth medium suitable for establishment of pasture communities present.	Compacted surfaces deep ripped along contour.	Photographs of ripped areas.	Inspection and report, including photographs.	Following deep ripping.
	Growth medium placed where required.	Photographs of covered areas.	Inspection and report, including photographs.	Following growth medium placement.

Table A2 (Cont'd)
Rehabilitation Performance Indicators and Completion Criteria

Rehabilitation Objective	Performance Indicator	Completion Criteria	Rehabilitation Monitoring Methodology	Monitoring Frequency
Phase 4 – Ecosystem and Land Use Establishment				
All Domains				
Establish pasture communities	Species assemblages consistent with landholder requirements	Landholder confirms species assemblages acceptable	Inspection and report, including photographs.	Following the revegetation program.
Phase 5 – Ecosystem and Land Use Sustainability				
All Domains				
Land capability and vegetation community similar to pre-mining capability.	Species assemblages consistent with landholder requirements	Landholder confirms species assemblages and survival rate acceptable	Inspection and report, including photographs.	Annually following the initial revegetation program until compliance is demonstrated.
Phase 6 – Land Relinquishment				
All Domains				
Demonstrated compliance with all performance indicators for Phases 1 to 5.	Demonstrated compliance with all completion criteria for Phases 1 to 5.	Demonstrated compliance with all completion criteria for Phases 1 to 5.	Inspection and report, including photographs.	Prior to relinquishment of EL.

3. Existing Agricultural Resources and Industries

3.1 Introduction

The term 'agricultural resources or industries' is used to describe the land on which agriculture is dependent and the associated water resources (quality and quantity) that are associated with the land. The following subsections provide a description of the regional and local agricultural resources/industries and water resources within the locality of the proposed exploration activities.

3.2 Regional Agricultural Resources and Industries

The Mallee Bull REF Area is located within the Cobar Shire Council Local Government Area (LGA). An industry regional profile for the Cobar LGA from the 2016 Census indicates that the mining industry is the largest employer (38.5%) followed by sheep, beef cattle and grain farming (11.5%). The 2021 Census however, breaks down the industries into more specific groups. Mining is still the largest employer, with Copper Ore Mining (15.9%) and Gold Ore Mining (9.8%) representing the largest employment industries. Sheep Farming (Specialised) made up the largest agricultural industry of employment (3.7%), however, other agricultural industry figures were not reported in the available 2021 Census QuickStats.

The document *Agriculture Industry Snapshot for Planning Western Plains Sub Region*, published by the NSW Department of Primary Industries in August 2020 (DPI, 2020) provides a range of information in relation to regional agricultural resources within the Western Plain Sub Region, comprising the Cobar, Bourke, Brewarrina and Walgett LGAs.

Table A3 presents an overview of the Gross Value of Production (GVP) for the Sub Region as a whole during the 2020/2021 financial year across a range of agricultural sectors. In summary, broad acre cropping is the dominant agricultural industry within the Sub Region, with beef, sheep and goat meat production comprising less than 1/3 of the Sub Region's GVP.

Table A3
Gross Value of Production – Western Plains Sub Region

Agricultural Component	Gross Value of Production ($)	% Share of Western Plains Sub Region Total	Number of Businesses	% share of NSW
Broadacre crops	$196.7m	55.3%	172	3.9%
Beef	$66.3m	18.6%	339	2.6%
Sheep meat	$39.3m	11.1%	381	5.4%
Wool	$46.5m	13.1%	-	4.9%
Hay	$2.6m	0.7%	26	0.8%
Goat meat	$1.1m	0.3%	43	16.5%
All other agriculture	$4.1m	0.7%	-	0.09%
Total	$1,772.9m	100%	-	2.7%
Source: DPI (2020)				

Table A4 presents the value of agricultural commodities for the Cobar LGA and NSW as a whole sourced from the Australian Bureau of Statistics for the 2020/2021 financial year. In summary, agricultural products during the 2020/2021 financial year were worth approximately $51.2 million or 0.3% of the total NSW agricultural production. Livestock comprised the most significant component of the agricultural industry, with cattle accounting for $6 million, sheep and lambs $12.1 million and other livestock $0.6 million.

Table A4
Value of Agricultural Commodities - Cobar Local Government Area

	Cobar Gross Value ($ million)	NSW Gross Value ($ million)	Cobar as a % of NSW
Total agriculture	51.2	18,009.5	0.3%
Broadacre crops - Total	24.7	7,791.4	0.004%
Hay - Total	0.08	508.6	0.02%
Livestock products - Total	7.6	1,901.5	0.4%
Livestock - Total	18.8	5.044.6	0.4%
Livestock - Sheep and lambs	12.1	1,262.4	1.0%
Livestock - Cattle and calves	6	2,751.7	0.2%
Livestock - Other	0.6	7,649.2	8%
Source: Australian Bureau of Statistics –https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia/2020-21/VACPDCLGA202021.xlsx– accessed 23 January 2023			

3.3 Local Agricultural Setting

3.3.1 Climate and Weather

Table A5 presents meteorological data from Bureau of Meteorology's Cobar MO Station (Station number 048027).

Table A5
Climate Data

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Temperature (°C)													
Mean maximum temperature	34.5	33.4	30.1	25.4	20.1	16.5	16.0	18.1	22.2	26.3	29.6	32.7	25.4
Mean minimum temperature	20.8	20.2	17.2	13.0	9.0	6.2	5.1	6.2	9.1	12.8	16.0	18.8	12.9
Rainfall (mm)													
Mean rainfall	43.7	42.5	35.2	27.8	32.7	28.8	27.4	26.4	25.0	35.5	37.2	35.0	396.1
Highest rainfall	233.8	188.9	217.6	201.4	144.0	107.6	102.4	76.3	104.6	183.4	157.1	151.6	710.2
Lowest rainfall	0.6	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0	0.4	0.8	101.6
Highest daily rainfall	102.2	89.7	108.8	71.4	59.4	38.8	44.6	56.9	44.4	44.6	56.6	74.8	108.8
Evaporation (mm)[1]													
Mean daily Evaporation	11.4	10.0	8.0	5.3	3.1	2.1	2.3	3.4	5.4	7.5	9.4	11.1	6.6
Mean monthly Evaporation[1]	353.4	280	248	159	96.1	63	71.3	105.4	162	232.5	282	344.1	2,397
Note 1: Calculated from daily average evaporation.													
Source: Bureau of Meteorology Stations – Cobar MO NSW (Station No:0428027) – accessed23/01/2023													

The Cobar locality experiences hot summers, with a mean maximum temperature of 34.5ºC in January, and relatively mild winters, with a mean maximum temperature of 16ºC and a mean minimum temperature of 5.1ºC in July.

Rainfall is relatively low, averaging 396.1mm per annum, but can be highly variable with the highest maximum recorded monthly rainfall between 3 and 5 times the mean monthly rainfall. The highest recorded daily rainfall is between 2 and 3.5 times the mean monthly rainfall.

Mean monthly evaporation exceeds mean monthly rainfall in all months, resulting in a substantial water deficit within the Mallee Bull REF Area and surrounds.

3.3.2 Landownership, Residences and Land Uses

Landownership and surrounding residences are presented on **Figures A3** and **A4**. In summary:

- The Mallee Bull REF Area is contained within a single Western Lands Lease.
- The Mallee Bull REF Area is next to NSW State Government land (PWP310).
- The closest non-project related residence "Mount View" is at least 11km away from the REF Area.

Land uses, as defined by the NSW Land Use and Management database within and adjacent to the REF Area include the following (**Figure A4**).

- Grazing native vegetation – predominately sheep and goat grazing with no pasture modification and widely spaced rural residences / homesteads.
- Other minimal use - areas of land that are largely unused, likely as a result of steep slopes or dense vegetation.
- Nature conservation and forestry – associated with the Balowra State Conservation Area.

Other surrounding land uses include the following.

- Transportation – Grain Road, Kidman Way, and Glenwood Road run through and around EL7461.
- Residential – the township of Nymagee is located approximately 43km to the northeast of the Mallee Bull REF Area.
- Mineral exploration and mining – the Hera Mine is located approximately 42km to the northeast of the Mallee Bull REF Area. The REF Area and surrounds have also been subjected to historic and current mineral exploration.

3.3.3 Topography and Drainage

The topography and drainage surrounding and within the Mallee Bull REF Area is presented in **Figures A5** and **A6**.

The area immediately surrounding the REF Area is typically flat to gently undulating with isolated small hills and peaks. Elevations range from approximately 250m AHD to the south of the REF Area to approximately 524m AHD at Gilgunnia Hill, to the northwest of the REF Area.

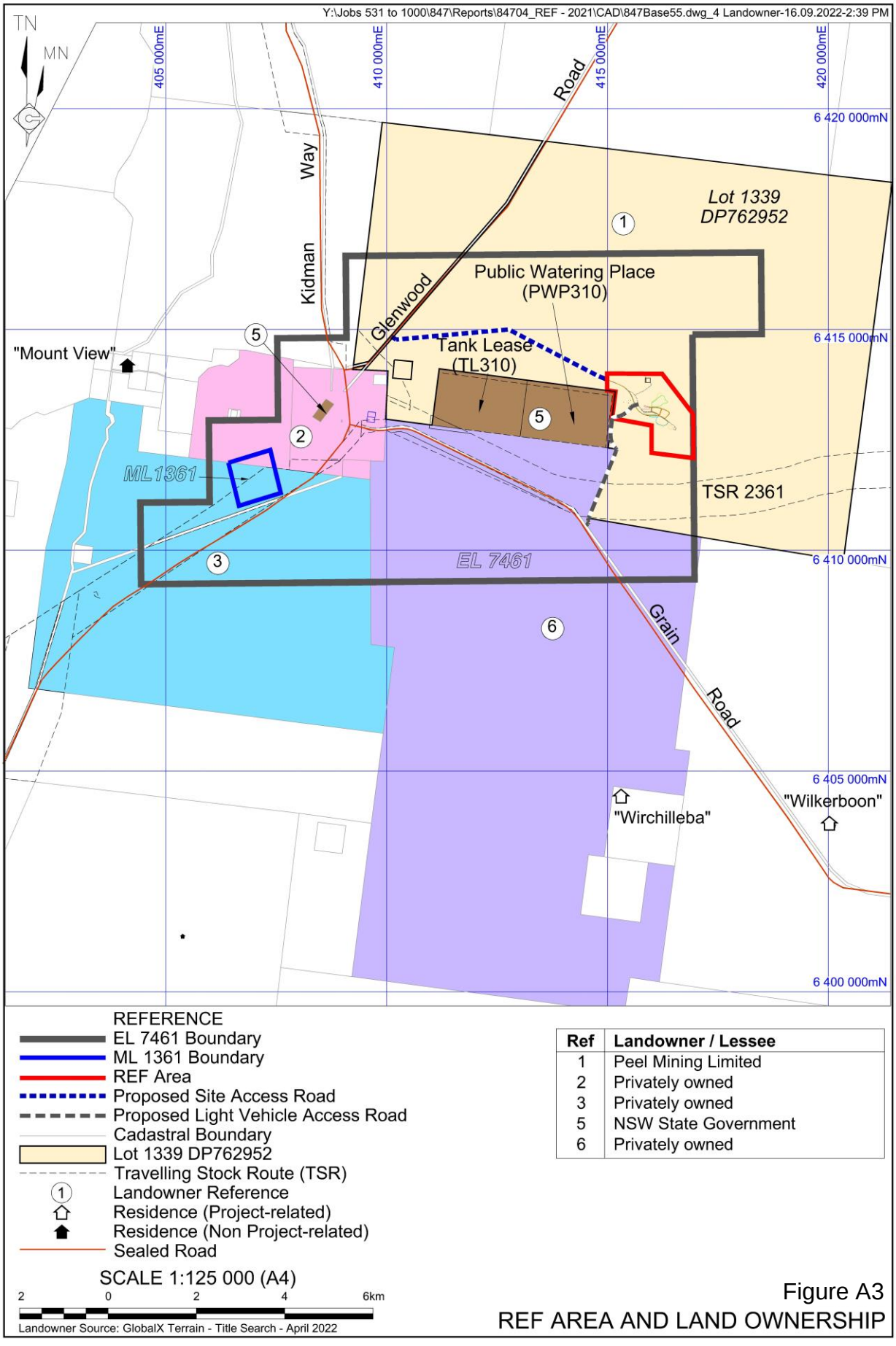

Figure A3
REF AREA AND LAND OWNERSHIP

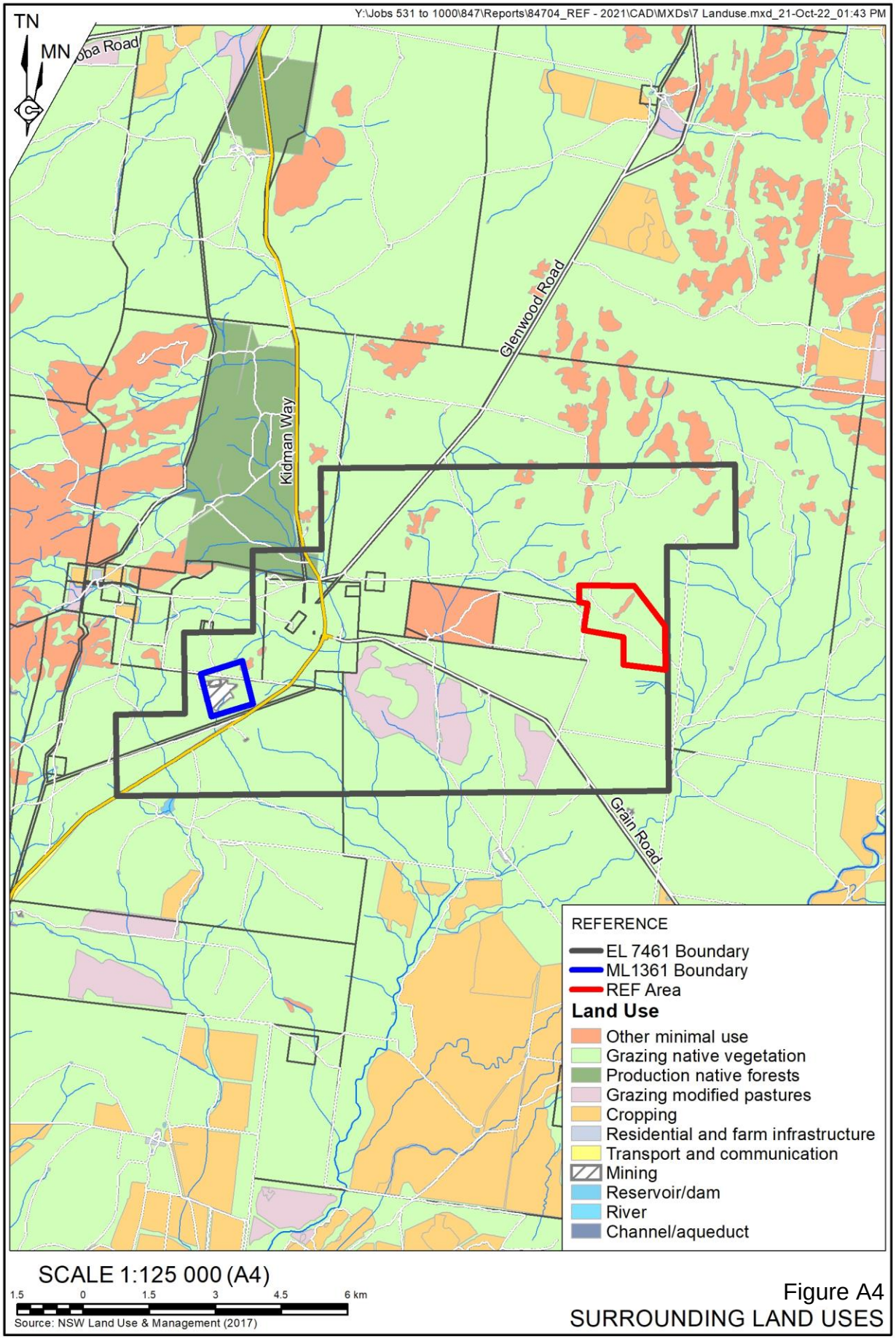

Figure A4
SURROUNDING LAND USES

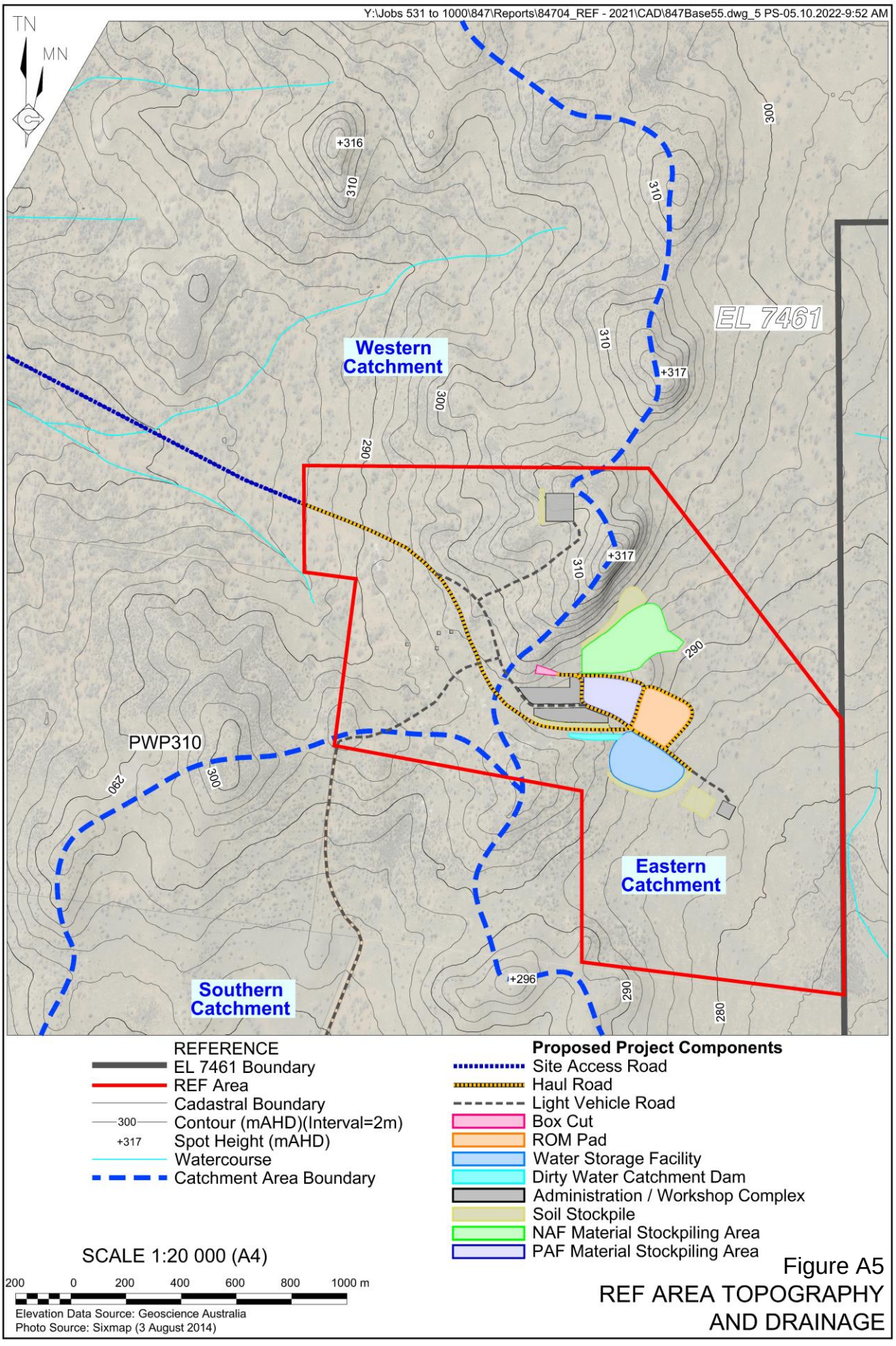

Figure A5
REF AREA TOPOGRAPHY AND DRAINAGE

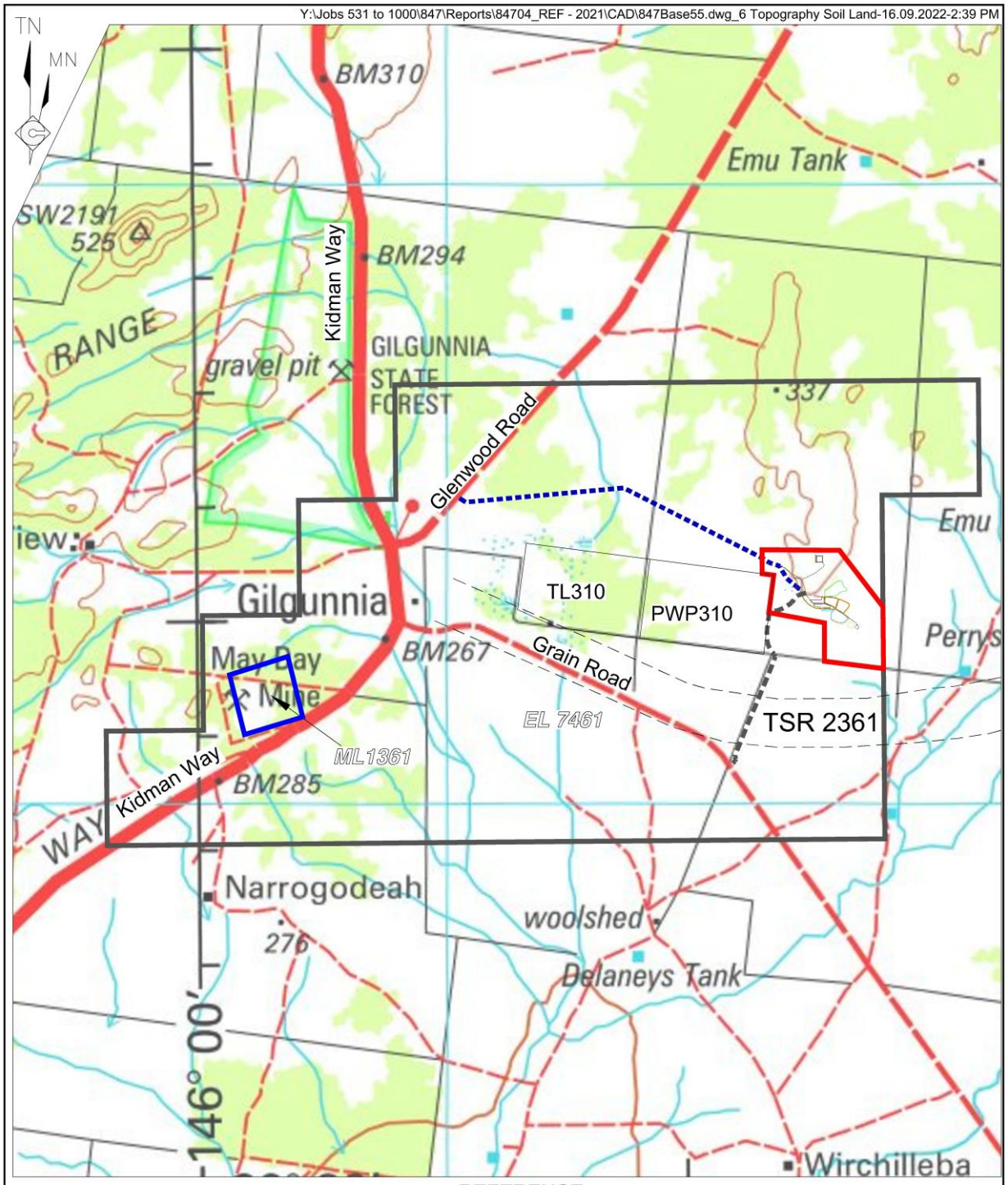

Figure A6
LOCAL TOPOGRAPHY AND DRAINAGE

The REF Area topography is typically flat. Two topographical features on the eastern side of the REF Area form rises of approximately 317m AHD with a general east to west slope.

Surface water drainage within the REF Area is characterised by sheet wash with mapped drainage features limited to indistinct, discontinuous ephemeral watercourses. It is likely that surface water within these watercourses would, with the exception of extreme rainfall, not flow into the Darling River.

The REF Area occupies two small sub-catchments labelled the Western Catchment and the Eastern Catchment. Surface water from the REF Area flows to the west then south, and to the east and south and is dominated by overland flows and sheet wash

3.3.4 Soil Landscapes and Land Capabilities

Figure A7 displays the various soil landscapes located within the Mallee Bull REF Area. Two soil units exist within the Mallee Bull REF Area as follows.

One soil landscape system, namely the Yackerboon Land System, has been identified within the REF Area. Walker (1991) identifies the Yackerboon Land System as occurring on slightly undulating country on Silurian and Siluro-Devonian siltstones and sandstone. It comprises Red Earths and some Lithosols.

The NSW Government SEED database identifies that land within the REF Area is classified as Land Capability Class 5 (**Figure A7**). This class is defined as follows.

- Class 5 – Moderate – low capability land with high limitations for high-impact land uses. Land uses largely restricted to grazing, some horticulture (orchards), forestry and nature conservation.

3.4 Water Resources

3.4.1 Surface Water Environment

The REF Area is located within the area covered by the *Water* Sharing Plan for the Lachlan Unregulated River Water Source 2012, within the Mount Hope Area Water Source. The proposed exploration activities would not trigger the requirements of this water sharing plan. The REF Area is not located within a drinking water catchment, and the local community does not rely upon surface water flows from the REF Area for drinking water supply.

Typically, surface water drainage within the locality is intermittent and responds to infrequent intense rainfall events that occur sporadically. The closest river intersects the southernmost extent of Nombinnie Nature Reserve, approximately 80km south of the REF Area.

Surface water drainage within EL7461 involves a number of 1st order and 2nd order ephemeral streams, generally flowing to the south, however they are not located within the REF Area. Surface water drainage within the REF Area is largely dominated by sheet wash, with mapped drainage features limited to a single 1st order watercourse immediately adjacent to the northwest of the REF Area and terminating at a soak. There are no watercourses traversing the REF Area and there are no riparian corridors within the REF Area.

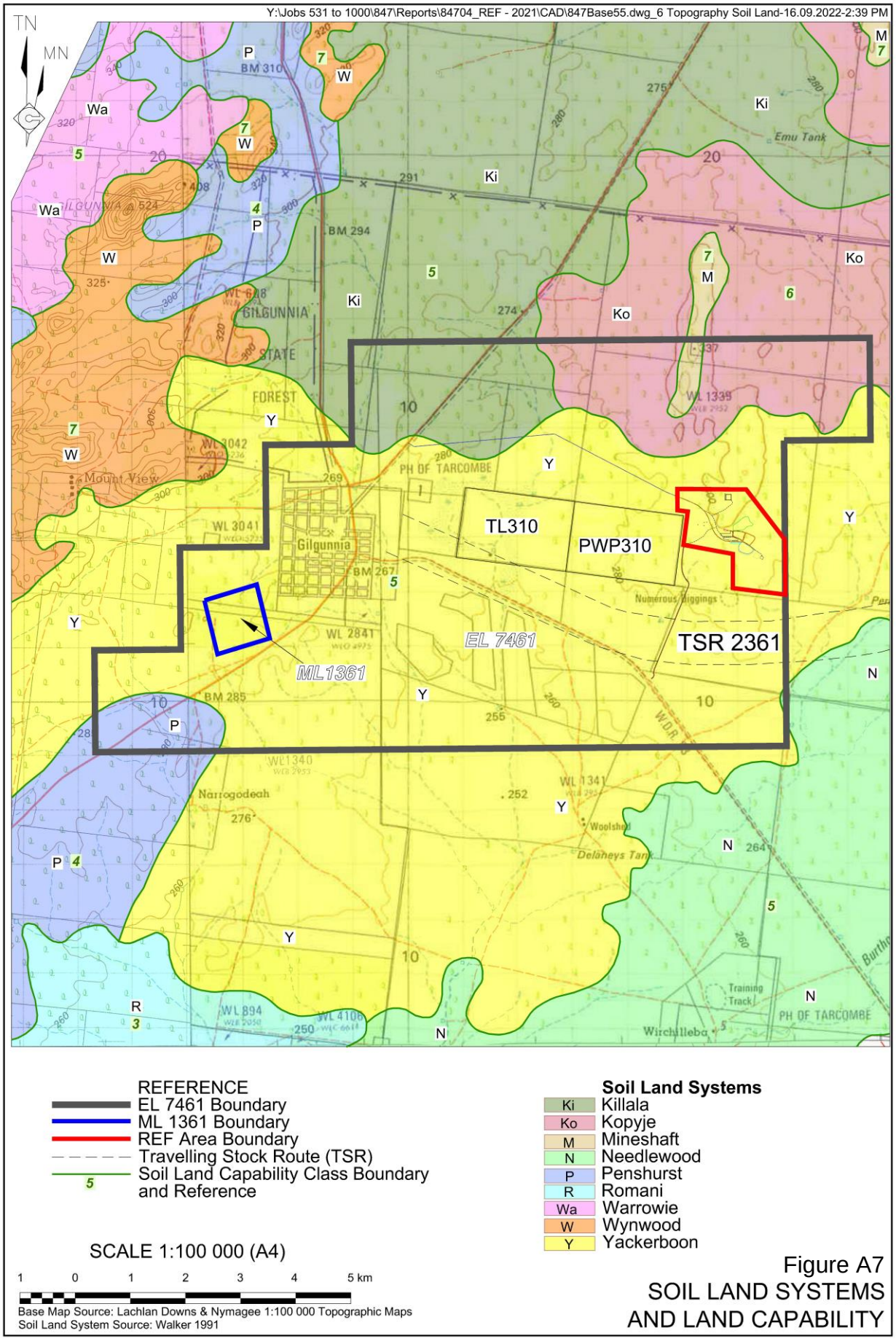

Figure A7
SOIL LAND SYSTEMS
AND LAND CAPABILITY

3.4.2 Groundwater Environment

The REF Area lies within the area covered by the *NSW Murray Darling Basin Fractured Rock Groundwater Sources (2012) Water Sharing Plan* within the Western Management Area. More specifically, the REF Area is located within the Lachlan Fold Belt Murray Darling Basin groundwater source.

GHD Group Pty Ltd (GHD) undertook a Groundwater Impact Assessment in support of the Project to assess the potential impacts on groundwater resources associated with the construction and exploration drive. Groundwater details are included in section 2.5.2 of the REF.

3.5 Agricultural Enterprises

Agricultural enterprises in the vicinity of the Mallee Bull REF Area are typically family-owned and operated grazing enterprises, specialising in goats and sheep. Agricultural productivity is typically low and population densities are also low.

There are no sensitive agricultural enterprises in the vicinity of the Mallee Bull REF Area.

3.6 Biosecurity

There are no particular biosecurity risks relevant to the proposed activities in the vicinity of the Mallee Bull REF Area.

4. Assessment of Impacts

4.1 Mitigation Measures

Sections 3.5 and 7 of the REF provide a detailed description of measure that would be implemented to mitigate potential adverse impacts associated with the proposed exploration activities, including impacts to agricultural activities.

4.2 Anticipated Impacts

The Company anticipates that the proposed exploration activities would have a **negligible** impact on surrounding agricultural enterprises for the following reasons.

- The proposed activities would be limited in scale and duration.
- Soil and water resources within and surrounding the Mallee Bull REF Area permit low intensity agricultural activities only.
- The areas surrounding the Mallee Bull REF Area are sparsely populated.
- The Exploration Decline Program would not result in adverse impacts on surrounding private bores, with the closest private bore located approximately 4.9km from the Mallee Bull REF Area.
- The Exploration Decline Program would not adversely impact on the availability of agricultural workers. Indeed, the proposed Program would provide alternate off-farm income opportunities for surrounding residents.
- The local population is familiar with and intimately involved in mining and exploration operations, with mining employing over four times as many people within the Cobar LGA as agriculture.
- The final landform would be consistent with the current landform and the proposed rehabilitation would result in land capability of the final landform being consistent with the current land capability, namely Class 5.

5. Conclusion

On the basis of the information presented above, it is not anticipated that the proposed exploration activities would have any noticeable or long-term impacts on agricultural lands, resources or enterprises.

6. References

Department of Primary Industry (DPI) (2020) *Agriculture Industry Snapshot for Planning Western Plains Sub Region*, August 2020.

GHD Pty Ltd (2022). *Groundwater Impact Assessment*