Appendix H

Biodiversity development assessment report

EMM
creating opportunities

HUNTER VALLEY OPERATIONS

Biodiversity Development Assessment Report

HUNTER VALLEY OPERATIONS CONTINUATION PROJECT

July 2025

umwelt

HUNTER VALLEY OPERATIONS

HUNTER VALLEY OPERATIONS CONTINUATION PROJECT

Biodiversity Development Assessment Report

FINAL – AMENDED PROJECT

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
HV Operations Pty Ltd

Project Director: Allison Riley
Project Manager: Kate Connolly
Report No. 4948/R01
Date: July 2025

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

Acknowledgement of Country

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

Disclaimer

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
Final Amended Project	Kate Connolly	31 July 2025	Allison Riley	31 July 2025

Certification and Declaration

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: 31 July 2025

BAM Assessor Accreditation No: BAAS17042 BAAS17005

Conflict of Interest Declaration

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: 31 July 2025

BAM Assessor Accreditation No: BAAS17042 BAAS17005

Executive Summary

The Project

Hunter Valley Operations (HVO) is a multi-pit open cut mining complex approximately 24 kilometres (km) north-west of Singleton in the Hunter Valley of New South Wales (NSW). HVO comprises two mine sites separated by the Hunter River, HVO North and HVO South. While the two mine sites are approved under separate development consents, they are operated as one complex with fully integrated environmental management systems. HVO is owned by subsidiary companies of Yancoal and Glencore, as participants in the unincorporated HVO Joint Venture (JV).

The HVO Continuation Project (the Project) broadly comprises the continuation of the life of HVO North and HVO South, from the current approved mining completion dates of 2026 and 2030 respectively, to the end of 2045 at HVO North and the end of 2042 at HVO South. The continuation of mining across the HVO Complex will increase resource recovery from the existing operation, predominantly by mining through previously mined areas and to the extent of existing mining tenements and extracting coal from deeper seams at HVO North.

An Environmental Impact Statement (EIS) for the Project, including the BDAR, was submitted to the (then) NSW Department of Planning and Environment (DPE) and subsequently placed on public exhibition from Monday 30 January 2023 through to Monday 27 February 2023. Following exhibition, the DPE – Biodiversity Conservation Division (BCD) provided advice on the BDAR.

To respond to matters raised in submissions on the Project during the public exhibition period, a Submissions Report (EMM 2023a) was prepared, with an Amendment Report (EMM 2023b) for the HVO North Project to:

- Amend the Lemington Road alignment to avoid all direct impacts to the Warkworth Sands Woodland Endangered Ecological Community (EEC) and avoid impacts to two scarred trees of Aboriginal cultural heritage originto sites of Aboriginal cultural significance.
- Amend the proposed HVO North development consent boundary to reflect the necessary changes to the Lemington Road realignment corridor.
- Propose changes to the construction timing of the low permeability barrier wall within the Carrington West Wing area, with installation of the low permeability barrier wall to be completed prior to mining within 100 m of the remnant western arm of the paleochannel in connection to the Hunter River.

During the subsequent assessment of the Project by the NSW Department of Planning, Housing and Infrastructure (DPHI), a number of requests for information (RFI) were issued to HVO, who provided responses as required. In response to an RFI received 5 July 2024, HVO completed a detailed review of the Project and is subsequently seeking to amend the SSD applications in the following ways:

- Reduce the project mine plan to avoid coal extraction within gas Domain 1 at HVO North and reduce the total ROM coal to be extracted by the Project by approximately 220 Mt.
- Maintain the current approved maximum annual ROM coal production from HVO North of 22 Mtpa but reduce the proposed maximum annual production limit at HVO South from 18 Mtpa to 13 Mtpa.

- Reduce the maximum annual production for the HVO Complex to 26 Mtpa from the current theoretical maximum production of 42 Mtpa.
- Reduce the proposed life of mining operations at HVO North by five years, from the end of 2050 to the end of 2045.
- Reduce the proposed life of mining operations at HVO South by three years from the end of 2045 to the end of 2042.
- Expansion of the HVO North ROM coal stockpile to improve coal management.
- Remove approval for the construction and operation of the LCPP and associated rail facilities, which is currently approved, but not constructed, under the HVO South Project Approval.
- Temporary transport of product coal by truck from the Howick Coal Preparation Plant (CPP) to the Liddell stockpile for transport to market via the Liddell coal handling and train loading facilities during upgrades of the Newdell Load Point (LP).
- Establishment of a levee (Mitchell East Levee) to provide flood protection for the final void in Mitchell Pit.

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt to support a further amendment report (EMM 2025) using the Biodiversity Assessment Method (BAM) (DPIE 2020a) in accordance with the *Biodiversity Conservation Act 2016* (BC Act) to determine the impact of the amended Project on biodiversity values and identify offsetting requirements following the implementation of suitable avoidance and minimisation measures.

Key Biodiversity Impacts

The landscape within and surrounding the HVO North and HVO South Project Area is characterised by extensive historical clearing for agricultural, mining and rural development. As such, much of the land associated with the Project conforms to Category 1 – Exempt Land under the *Local Land Services Act 2013* (LLS Act), being lawfully cleared areas and low conservation vegetation not required to be assessed for credit value under the BAM. Remaining areas of native vegetation and habitat have been surveyed for its biodiversity value and assessed in accordance with the BAM (DPIE 2020a).

The Project proposes to remove approximately 176 ha of native vegetation that meets the offsetting threshold under the Biodiversity Offset Scheme (BOS). Of this, 86.8 ha conforms to Threatened Ecological Communities (TECs) under the BC Act (84.5 ha in HVO North and 2.3 ha in HVO South).

The tables below outline the Plant Community Types (PCTs), TECs and species-credit species recorded or assumed present in the HVO North and HVO South additional disturbance area (i.e. areas that will be disturbed by the Project that are outside of existing and approved disturbance areas) and the areas that require offsetting under the BOS as per the BC Act. Impacts relating to vegetation that do not meet the offsetting threshold under the BAM or impacts not requiring further assessment (cleared land, dams and Category 1 – Exempt Land) are detailed in **Section 7.1** and **Section 7.2**.

Table ES.1 Plant Community Types (PCTs) Impact Areas that Require Offsetting

Plant Community Type (PCT)	BC Act Status	Area (ha)	
		HVO North	HVO South
3431 – Central Hunter Ironbark Grassy Woodland	Some condition zones conform to *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC*	162.7	2.6
3485 – Hunter Valley Footslopes Slaty Gum Forest	Conforms to *Hunter Valley Footslopes Slaty Gum Woodland Vulnerable Ecological Community* (VEC)	7.1	0.0
4015 – Central Hunter Swamp Oak Riparian Forest	-	2.2	0.0
4081 – Northwest River Oak-River Red Gum Forest	-	1.7	0.0
4089 – Namoi-Upper Hunter River Red Gum Forest	Some condition zones conform to *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community (EEC)*	2.15	0.6
TOTAL	**-**	**175.85**	**3.2**

Table ES.2 TECs and Species Credit Species Impact Areas that Require Offsetting

Biodiversity Feature	BC Act Status	Area (ha)	
		HVO North	HVO South
Threatened Ecological Communities			
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	1.2*	0.0
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	EEC	76.2	2.3
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC	7.1	0.0
Species-credit Species			
southern myotis (*Myotis macropus*)	Vulnerable	76.85	2.2
squirrel glider (*Petaurus norfolcensis*)^	Vulnerable	85.2	2.4
eastern pygmy possum (*Cercartetus nanus*)^	Vulnerable	92.8	2.4
Eucalyptus camaldulensis population in the Hunter Catchment	Endangered	1.85*	0.6
Hunter Valley delma (*Delma vescolineata*)	Endangered	174.8	8.6
brush-tailed phascogale (*Phascogale tapoatafa*)	Vulnerable	122.1	2.4

^Assumed present until surveys are undertaken to determine presence or absence.

**Includes impacts associated with the River Red Gum Additional Disturbance Area.*

Following avoidance measures, one TEC identified in the Development Footprint was identified as a candidate for Serious and Irreversible Impacts (SAII) as a result of the Project, being *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC*.

As the Project is located in a highly fragmented and disturbed landscape subject to current extensive mining, indirect impacts such as fugitive light emissions, air quality and noise/vibration associated with mining are not expected to be substantially altered as a result of the Project. Some indirect impacts associated with the Project that have the potential to impact on biodiversity features in the locality include drawdown impacts on groundwater dependent ecosystems (GDEs), edge effects and cumulative impacts. The assessment of indirect impacts described in **Section 6.2** concludes that these potential impacts are unlikely to result in significant impacts on surrounding biodiversity. Identified potential prescribed impacts associated with the Project include impacts on the habitat of Hunter Valley delma (*Delma vescolineata*) in Category 1 – Exempt Land, impacts on connectivity and species movement habitat and impacts of vehicle strikes associated with the Lemington Road realignment.

Avoidance and Minimisation

Targeted avoidance and minimisation measures were implemented to reduce the Project's impact on areas of higher value vegetation and habitat, including (but not limited to):

- Locating impacts predominantly in previously mined and/or disturbed areas, and areas approved to be disturbed.
- Refinement and location selection of the Lemington Road re-alignment to avoid up to 14.7 ha of *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC,* including post-EIS exhibition amendments to the proposed Lemington Road re-alignment location to remove all direct impacts to the community at HVO North.
- Careful consideration of proposed transmission line easement alignments to avoid areas of higher quality vegetation and habitats, and to provide for maximum vegetation and habitat retention in easement corridors.
- Habitat retention following decommissioning of existing transmission lines.
- Removal from the Project of some components previously approved under HVO South's existing Project Approval 06_0261, including coal extraction from the Riverview South East Extension, mining in the South Lemington Pits 1 and 2 and the construction of the short rail loop associated with the Lemington Coal Preparation Plant. These activities have resulted in the avoidance of disturbance of approximately 87 ha of *Central Hunter Grey Box—Ironbark Woodland EEC*.
- Removal of approval to carry out construction and operation of the Lemington Coal Preparation Plant and associated rail spur. These activities have resulted in the avoidance of disturbance of approximately 40 ha of *Central Hunter Grey Box—Ironbark Woodland EEC* and 0.3 ha of *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC* listed under the BC Act resulting in all direct impacts to the *Warkworth Sands Woodland in the Sydney Basin Bioregion EEC* at HVO South being removed. HVO has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Project.

Biodiversity Offset Strategy

Following the application of avoidance and minimisation measures, the BAM-C assessment identified the following biodiversity credits required to offset the impacts of the Project.

Table ES.3 Summary of Biodiversity Credit Obligations

Biodiversity Feature	Credits Required	
	HVO North	HVO South
3431 - Central Hunter Ironbark Grassy Woodland	4056	70
3485 - Hunter Valley Footslopes Slaty Gum Forest	313	0
4015 - Central Hunter Riparian Forest	77	0
4081 - Northwest River Oak-River Red Gum Forest	37	0
4089 - Namoi-Upper Hunter River Red Gum Forest	46	20
southern myotis (*Myotis macropus*)	1972	59
squirrel glider (*Petaurus norfolcensis*)^	2349	65
eastern pygmy possum (*Cercartetus nanus*)^	2679	65
Eucalyptus camaldulensis in the Hunter Catchment*	20	7
Hunter Valley delma (*Delma vescolineata*)#	1977	103
brush-tailed phascogale (*Phascogale tapoatafa*)	3315	65

^Assumed present until surveys are undertaken to determine presence or absence.

**Includes impacts associated with the River Red Gum Additional Disturbance Area.*

 # The Biodiversity Risk Weighting for Delma vescolineata was supplied by CPHR on 29 July 2025 to manually determine the credit liability for the species in lieu of BAM-C application.

HVO is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of biodiversity values and residual impacts of the Project. HVO proposes to stage the retirement of credits to align with main development activities of the Project as defined by three primary stages. The biodiversity offset strategy will be developed in consultation with the DPHI and based on the offset options available under the BC Act and BC Regulation.

Whilst not precluding other options provided under existing legislation, it is HVO's intention that the offset strategy for the Project will focus on purchasing credits on the market both locally and regionally as per the like-for-like offsetting rules outlined in the BC Regulation. Where suitable, paying into the Biodiversity Conservation Fund, which contributes to regionally strategic offset outcomes will also be undertaken.

Acronyms

BAM	Biodiversity Assessment Methodology
BAM-C	BAM Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BCS	Former Biodiversity Conservation and Science (now CPHR)
BCT	Biodiversity Conservation Trust
BC Regulation	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
BOAMS	Biodiversity Offsets and Agreement Management System
BOM	Bureau of Meteorology
CEEC	Critically Endangered Ecological Community
CPHR	Conservation Programs, Heritage and Regulation (formerly Biodiversity Conservation and Science (BCS))
CPP	Coal Preparation Plant
DAWE	Former Commonwealth Department of Agriculture, Water and the Environment
DCCEEW	Commonwealth Department of Climate Change, Energy, Environment and Water
DNG	Derived Native Grasslands
DPE	Former NSW Department of Planning and Environment (now DPHI)
DPHI	Department of Planning, Housing and Infrastructure (formerly DPE)
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP	Endangered Population
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
GIS	Geographical Information System
ha	Hectares
HBT	Hollow bearing tree
HVCPP	Hunter Valley Coal Preparation Plant
HVO	Hunter Valley Operations
HVO Complex	Comprises both HVO North and HVO South operations
HVLP	Hunter Valley Load Point

IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
JV	Joint Venture
km	Kilometres
LCPP	Lemington Coal Preparation Plant
LLS Act	NSW *Local Land Services Act 2013*
LEP	Local Environmental Plan
LGA	Local Government Area
MALD	More Appropriate Local Data
MGA	Map Grid of Australia
MNES	Matters of National Environmental Significance
Mtpa	Million Tonnes Per Annum
Mt	Million Tonnes
NSW	New South Wales
Newdell LP	Newdell Load Point
NP	National Park
NVRM	Native Vegetation Regulatory Map
OEH	Former Office of Environment and Heritage (now CPHR)
PA	Project Approval
PCT	Plant Community Type
PMST	Protected Matters Search Tool
Project	HVO Continuation Project in its entirety, encompassing the continuation of the life of the complex; i.e. both HVO North and HVO South, within their respective proposed development consent boundaries
ROM	Run of Mine
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
SVTM	State Vegetation Type Map
SYB	Sydney Basin Bioregion
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VCD	Vegetation Classification Database
VEC	Vulnerable Ecological Community
VI	Vegetation Integrity
VIS	Vegetation Information System

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1.0 Background

Hunter Valley Operations (HVO) is a multi-pit open cut mining complex approximately 24 kilometres (km) north-west of Singleton in the Hunter Valley of New South Wales (NSW) (refer to **Figure 1.1**).
HVO comprises two mine sites separated by the Hunter River, HVO North and HVO South. While the two mine sites are approved under separate development consents, they are operated as one complex (HVO Complex) with fully integrated environmental management systems.

The existing HVO North operation comprises the approved mining areas of West Pit, Mitchell Pit and Carrington Pit, as shown in **Figure 1.2**. It operates under development consent DA 450-10-2003 which allows extraction of up to 22 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal until 31 December 2026.

HVO South operates under Project Approval (PA) 06_0261 and comprises the approved mining areas of Riverview Pit and Cheshunt Pit, where mining activities currently take place, and the Riverview South East Extension and South Lemington Pits 1 and 2. PA 06_0261 allows the extraction of up to 20 Mtpa of ROM coal until 24 March 2030.

Significant coal resources remain across the HVO Complex beyond what is currently approved for extraction under the existing development consents. HVO is therefore seeking approval for the HVO Continuation Project (the Project) from the NSW Minister for Planning and Public Spaces, or delegate, under the provisions of Part 4 of EP&A Act. The Project broadly comprises the continuation of mining at HVO North and HVO South, beyond the current approved mining completion dates of 2026 and 2030 respectively. The Project will seek to maintain separate development consents for HVO North and South, as is currently the case.

Given that the two mine sites operate as one complex, one environmental impact statement (EIS, EMM 2022a) was prepared to support the two State significant development (SSD) applications for the Project, being:

- SSD-11826681 – HVO North Open Cut Coal Continuation Project
- SSD-11826621 – HVO South Open Cut Coal Continuation Project.

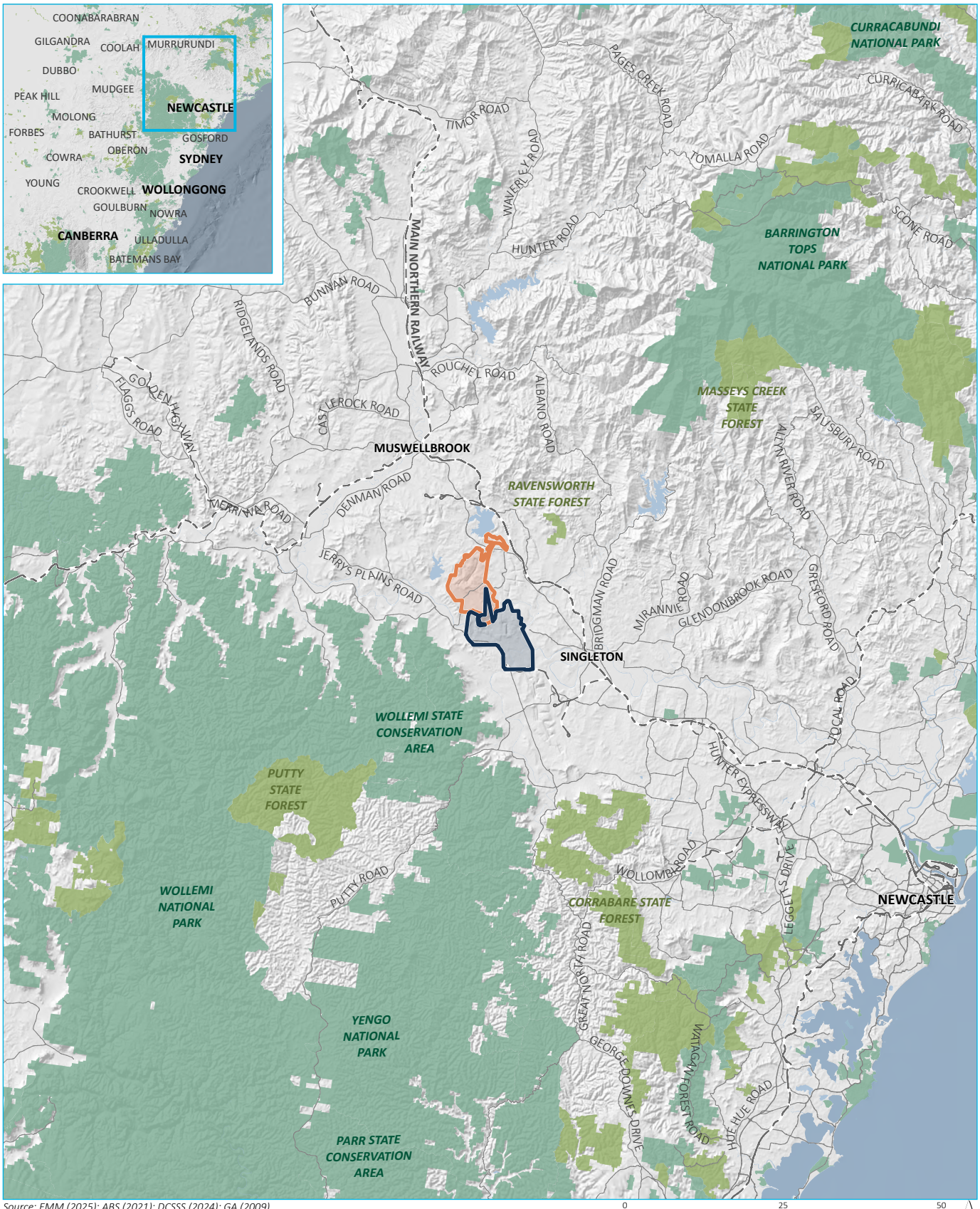
The EIS was subsequently placed on public exhibition from Monday 30 January 2023 through to Monday 27 February 2023. During the public exhibition of the EIS, a total of 1,060 submissions were received by the NSW Department of Planning, Housing and Infrastructure (DPHI) from individuals, organisations, public authorities, councils, and government agencies for the two development applications.

To respond to matters raised in submissions on the Project during the public exhibition period, a Submissions Report (EMM 2023a) was prepared, along with an Amendment Report (EMM 2023b) outlining proposed amendments to the HVO North Project.

During the subsequent assessment of the Project by the NSW Department of Planning, Housing and Infrastructure (DPHI), a number of requests for information (RFI) were issued to HVO, who provided responses as required.

In response to an RFI received 5 July 2024, HVO completed a detailed review of the Project and is subsequently seeking to amend the SSD applications in the following ways:

- Reduce the project mine plan to avoid coal extraction within gas Domain 1 at HVO North and reduce the total ROM coal to be extracted by the amended Project by approximately 220 Mt.
- Propose a maximum annual production limit for the HVO Complex of 26 Mtpa ROM, compared to the current approved maximum annual production of 42 Mtpa.
- Maintain the current approved maximum annual ROM coal production from HVO North of 22 Mtpa but reduce the proposed maximum annual production limit at HVO South from 18 Mtpa to 13 Mtpa.
- Reduce the proposed life of mining operations at HVO North by five years, from the end of 2050 to the end of 2045.
- Reduce the proposed life of mining operations at HVO South by three years from the end of 2045 to the end of 2042.
- Expansion of the HVO North ROM coal stockpile to improve coal management.
- Remove approval for the construction and operation of the LCPP and associated rail facilities, which is currently approved, but not constructed, under the HVO South Project Approval.
- Temporary transport of product coal by truck from the Howick Coal Preparation Plant (CPP) to the Liddell stockpile for transport to market via the Liddell coal handling and train loading facilities during upgrades of the Newdell Load Point (LP).
- Establishment of a levee (Mitchell East Levee) to provide flood protection for the final void in Mitchell Pit.
- Minor alterations to disturbance boundaries to accommodate construction activities such as Lemington Road and electricity transmission lines.



Source: EMM (2025); ABS (2021); DCSSS (2024); GA (2009)

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KEY

- Existing HVO North development consent boundary (DA 450-10-2003)
- Existing HVO South project approval boundary (PA 06_0261)

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody
- NPWS reserve
- State forest
- Local government area

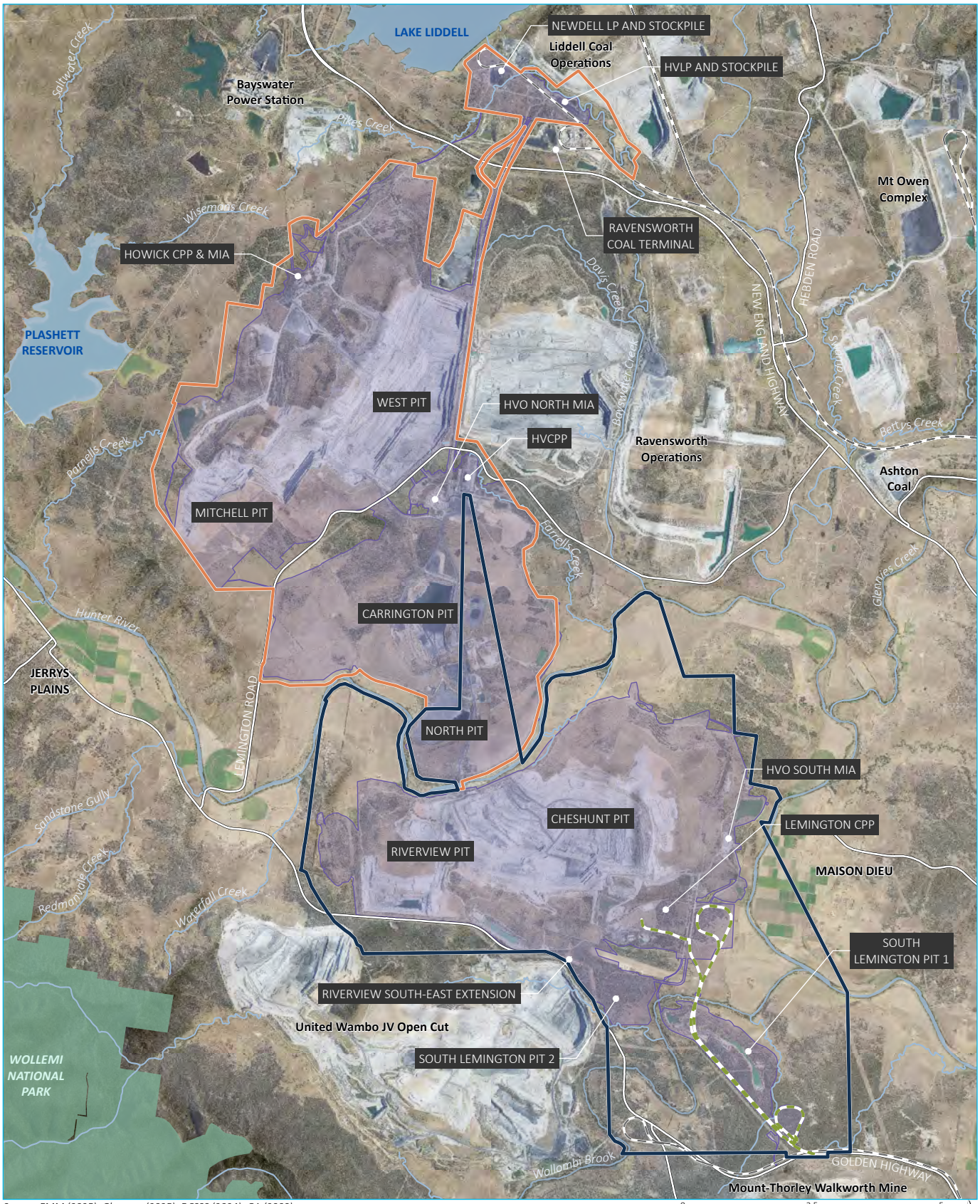
INSET KEY

- NPWS reserve
- State forest

Locality plan

HVO Continuation Project
Biodiversity Development Assessment Report
Figure 1.1

EMM creating opportunities



Source: EMM (2025); Glencore (2025); DCSSS (2024); GA (2009)

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KEY

- Existing HVO North development consent boundary (DA 450-10-2003)
- Existing HVO South project approval boundary (PA 06_0261)
- Existing and approved disturbance area
- South Lemington Rail Loop and haul route (approved, not yet constructed)

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody
- NPWS reserve

HVO local context

HVO Continuation Project
Biodiversity Development Assessment Report
Figure 1.2

EMM creating opportunities

1.1 Project Overview

As noted in **Section 1.0**, the Project broadly comprises the continuation of mining at HVO North and HVO South, beyond the current approved mining completion dates of 2026 and 2030 respectively. The key components of the amended HVO North Continuation Project and HVO South Continuation Project are illustrated on **Figure 1.3** and summarised in in the sections below.

1.1.1 HVO North

The key Project elements at HVO North for which approval is sought include those activities required to carry out open cut coal mining and processing and include:

- changes to the HVO North development consent boundary as illustrated **Figure 1.3**
- continuation of mining operations at HVO North from 1 January 2027 until 31 December 2045
- production of up to 22 Mtpa with no separation of extraction limits between West Pit and Carrington Pit.
- infrastructure upgrades, as listed below:
    - realignment of Lemington Road and construction of a new bridge over the Hunter River
    - relocation of the HVO North site access road off the existing Lemington Road
    - increase in the capacity of Parnells Dam from approximately 1 gigalitre (GL) to approximately 4 GL
    - realignment of transmission and telecommunication lines that are currently within the proposed mining area
    - upgrades to the HVO North Mine Infrastructure Area (MIA)
    - expansion of the HVO North ROM coal stockpile to improve coal management
    - maintenance and ancillary activities as required to facilitate operations, including the replacement of plant and equipment where required
    - Construction of access roads to facilitate service provider access
    - use of demountable/temporary buildings and other ancillary temporary facilities to enable construction activities and mining operations as required
    - access road establishment to an existing mine-owned property east of realigned Lemington Road
- receipt of ROM coal from HVO South via internal haul roads for processing at all CPP facilities approved for HVO North.
- Transport product coal by truck or overland conveyor from all CPPs to loading points (HVLP, Newdell LP and Lemington LP)
- management of tailings in accordance with a Tailings Management Strategy

- upgrade of product coal infrastructure as follows:
    - establishment of a new Newdell product stockpile and upgrade of the existing Newdell train loading facility or an extension of the product coal stockpile footprint at the HVLP to increase the total stockpile capacity of the load point
    - construction of a haul road to enable ROM coal to be transported to the neighbouring Ravensworth Operations ROM pad via haul truck for processing, from where product coal is then transferred to the Ravensworth Coal Terminal for transport to market
    - ability to temporarily transport product coal by truck from the Howick CPP to the Liddell stockpile for transport to market via the Liddell coal handling and train loading facilities during upgrades of the Newdell Load Point (LP).
- implementation of a revised water management system including construction of levees, clean water diversions and the Carrington West Wing low permeability barrier wall
- establishment of a levee (Mitchell East Levee) to provide flood protection for the final void in Mitchell Pit
- continued employment of up to 1,500 full time equivalents (FTE) across the HVO complex.

Other than as modified above, all activities that are currently approved under the existing HVO North development consent are intended to continue. Key aspects and outcomes of the approved development at HVO North (under DA 450-10-2003 as modified) that will remain the same under the Project include the following:

- the maximum allowable annual ROM coal extraction and processing rate of 22 Mtpa
- receipt of ROM coal from HVO South via internal haul road for processing at all CPP facilities approved for HVO North
- approved heights of overburden emplacement areas
- continued avoidance of the Aboriginal heritage site known as CM-CD1
- operating hours, annual workforce numbers and associated operational traffic generation.

1.1.2 HVO South

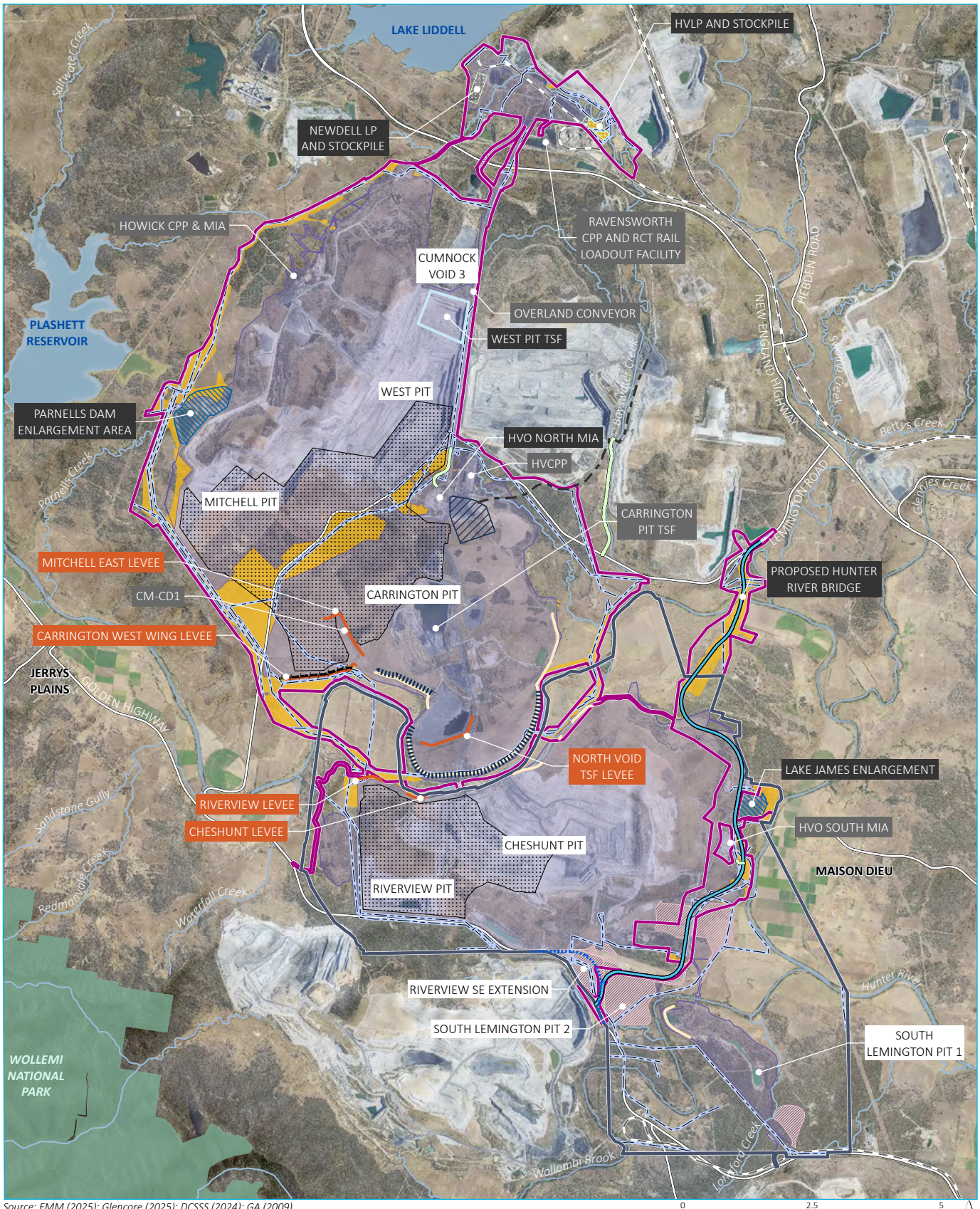
The key Project elements at HVO South for which approval is sought include those activities required to carry out open cut coal mining and processing and include:

- changes to the HVO South development consent boundary as illustrated in **Figure 1.3**
- continuation of mining operations at HVO South from 2030 until 31 December 2042
- a reduction in the approved maximum extraction rate from 20 Mtpa to 13 Mtpa
- removal of coal extraction from the mine plan for the Riverview South East Extension (RSEE), and South Lemington Pit 1 and 2 (SLP 1 and 2)

- infrastructure upgrades including:
    - relocation of some 11 kV and 66 kV Ausgrid transmission lines
    - realignment of internal transmission lines to support mining activities
    - HVO South access road relocation to join the realigned Lemington Road
    - access roads to facilitate service provider access
    - use of demountable/temporary buildings and other ancillary temporary facilities including laydown areas to enable construction activities and mining operations as required
    - removal of the approval for the construction and operation of the Lemington Coal Processing Plant (LCPP) and rail facilities
    - removal of the construction and operation of the approved conveyor from HVO South to the HVCPP at HVO North (the conveyor has not been constructed).
- continuation of integrated water management with HVO North and water transfers with other mining operations (where permitted under the development consents that apply to those other mining operations)
- construction of the Cheshunt and Riverview flood protection levees
- enlargement of Lake James from approximately 0.7 GL to 1.9 GL
- amendments to final landform.

Other than as modified above, all activities that are currently approved under the existing HVO South development consent are intended to continue. Key aspects of the currently approved development at HVO South (under Project Approval (PA) 06_0261as modified) that will remain the same for the Project include:

- no change to the receipt of HVO South coal at all HVO North CPPs via internal haul road for processing
- no change to operating hours
- no change in annual workforce numbers or associated operational traffic generation
- no increase to approved heights of overburden emplacement areas.



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Source: EMM (2025); Glencore (2025); DCSSS (2024); GA (2009)

0 2.5 5 km

GDA2020 MGA Zone 56

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KEY

- Amended proposed HVO North development consent boundary
- Proposed HVO South development consent boundary
- Existing and approved disturbance area
- Additional disturbance area
- Previous approved area not retained
- Existing low permeability barrier wall
- Existing levee

Proposed HVO continuation project element

- Approved barrier wall (not yet constructed)
- Alternative Golden Highway alignment
- Lemington Road realignment
- Levee
- Mine access road
- Proposed haul route to Ravensworth Operations
- Transmission line
- Dam enlargement
- Mining area
- Product stockpile
- ROM coal stockpile enlargement area
- West Pit TSF

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody
- NPWS reserve

Label format

- Existing item
- Levee
- Project related item

Proposed conceptual layout

HVO Continuation Project
Biodiversity Development Assessment Report
Figure 1.3

EMM creating opportunities

1.2 Purpose

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt using the Biodiversity Assessment Method (BAM) (DPIE 2020a) in accordance with the *Biodiversity Conservation Act 2016* (BC Act) to determine the impact of the amended Project on biodiversity values and identify offsetting requirements following the implementation of suitable avoidance and minimisation measures.

While the amended Project does not result in significant changes to the Development Footprints, the extension of the Project's assessment beyond 2024 has resulted in the requirement to address biodiversity data currency as per the requirements of Section 3.4 of the BAM Operational Manual – Stage 1 and update the Plant Community Types (PCTs) in line with the revised East Coast PCT Classification of which transitional arrangements expired on 14 April 2025. This BDAR outlines the additional surveys and assessments undertaken since the November 2023 BDAR to address the above and supersedes previous versions of the BDAR. This BDAR includes updated and or revised mitigation measures for the Amended Project.

1.3 Project Terminology

The following key terms are used throughout this assessment to describe the HVO Continuation Project:

HVO Complex: Comprises both HVO North and HVO South operations.

HVO North Project: Comprises the HVO North Project only as described in Chapter 4 of the EIS and as amended in Chapter 3 of this amendment report.

HVO South Project: Comprises the HVO South Project only as described in Chapter 4 of the EIS and as amended in Chapter 3 of this amendment report.

The Project: The Project in its entirety as described in Chapter 4 of the EIS and as amended in Chapter 3 of the first amendment report (EMM 2023) and Chapter 3 of this second amendment report; encompassing the continuation of the life of the complex, i.e. both HVO North and HVO South, within their respective proposed development consent boundaries.

Project area: The area that is the subject of the two development applications, i.e. the proposed development consent boundary for HVO North and the proposed development consent boundary for HVO South.

Existing and approved disturbance: Areas that are disturbed, previously disturbed and/or approved under the EP&A Act to be disturbed under the current development consents that apply to the HVO Complex.

Approved mining area: The areas within the existing and approved disturbance area that have been previously assessed and approved under the EP&A Act for mining operations.

Additional disturbance area: The areas that will be disturbed by the Project that are outside of the existing and approved disturbance area for the HVO Complex and other neighbouring mines (Ravensworth Operations, United Wambo and Liddell Coal Operations (LCO)). This is the area that is the subject of assessment in accordance with the Biodiversity Assessment Method (DPIE 2020a). Under the BAM (2020) this is defined as the **'Subject Land'**.

For the purposes of this assessment, these areas are hereafter referred to as the:

- HVO North Development Footprint.
- HVO South Development Footprint.

These areas are inclusive of areas to be disturbed for the purposes of mining and ancillary activities, transmission lines and the realigned Lemington Road corridor (as defined below).

Previously approved areas not retained: Areas that are disturbed and/or approved to be disturbed under the current development consents that apply to the HVO Complex, that will no longer be disturbed by the Project, such as the LCPP, the Riverview South East Extension and South Lemington Pit 2 mining areas, and the approved temporary crossing across the Hunter River between HVO North and South.

Project disturbance area: This area is a combination of the existing and approved disturbance area, and the additional disturbance area associated with the Project, minus the areas not being retained by the Project. If the Project is approved, this will become the 'approved disturbance area' under the new SSD development consents.

Proposed mining area – HVO North: Areas where coal extraction will take place for the Project and includes:

- areas already disturbed by mining at HVO North (e.g. West Pit, Wilton Pit, Mitchell Pit and Carrington Pit)
- areas not previously approved for mining (e.g. the area between the Mitchell Pit and Carrington Pit)
- areas approved but not yet disturbed (e.g. the Carrington West Wing area).

Proposed mining area – HVO South: Comprises the Riverview Pit and Cheshunt Pit, where coal extraction will continue under the Project, down to the Bayswater seam. The HVO South proposed mining area does not include the previously approved South Lemington Pit 1, South Lemington Pit 2, or the Riverview South East Extension, as coal extraction is not proposed in these areas as part of the Project.

Amended proposed HVO North development consent boundary: The proposed HVO North development consent boundary as presented in **Figure 1.3**.

Current proposed HVO South development consent boundary: The proposed HVO South development consent boundary as presented in the EIS and illustrated on **Figure 1.3**.

Transmission line corridors: Two categories of transmission line corridors have been defined for the purpose of quantifying the extent of disturbance for the Project:

- realigned transmission lines (i.e. new transmission line easements) – the extent of disturbance will be limited to transmission line pole pads and an access road for maintenance along the alignment, as well as vegetation management to maintain safe transmission line clearance
- existing transmission line easements to be decommissioned – disturbance will be confined to existing access tracks, existing easements and cleared areas required for removal of poles and associated infrastructure.

Realigned Lemington Road corridor: The corridor extends from the existing Comleroi Road intersection with the Golden Highway at the southern end of the new alignment, along the Comleroi Road alignment around the south-eastern side of HVO South and then extends in a northerly direction to join the existing Lemington Road approximately 2.3 km south of the existing New England Highway/Lemington Road intersection. The proposed realigned corridor forms part of the HVO North SSD application.

Mining operations: Includes the removal and placement of overburden, the extraction, processing, handling, storage and transportation of coal, and the emplacement of rejects and tailings.

River red gum additional disturbance area: The area within the existing HVO South Project Approval (PA 06_0261) adjacent to the Hunter River where impacts to the river red gum (*Eucalyptus camaldulensis*) endangered population and *Hunter Floodplain Red Gum Woodland EEC* are expected to occur as a result of the proposed transmission line relocation (refer to **Section 1.5**).

1.4 The Development Footprints

This BDAR includes an assessment of two development footprints for the HVO Continuation Project to support two development consents (refer to **Figure 1.4**). These are the:

- HVO North Development Footprint.
- HVO South Development Footprint.

The HVO North and HVO South Development Footprints are the areas subject to impacts that require assessment under the BC Act.

Areas within the HVO North and HVO South Project Areas that already have approval for disturbance under a NSW development consent (including areas within the HVO, Liddell Coal Operations (DA 305-11-01), United Wambo JV (SSD-7142) and Ravensworth Operations (MP 09_0176) approval areas) are not included in the HVO North and HVO South Development Footprints and do not require further assessment in this report[1].

Table 1.1 provides basic details for the HVO North and HVO South Development Footprints.

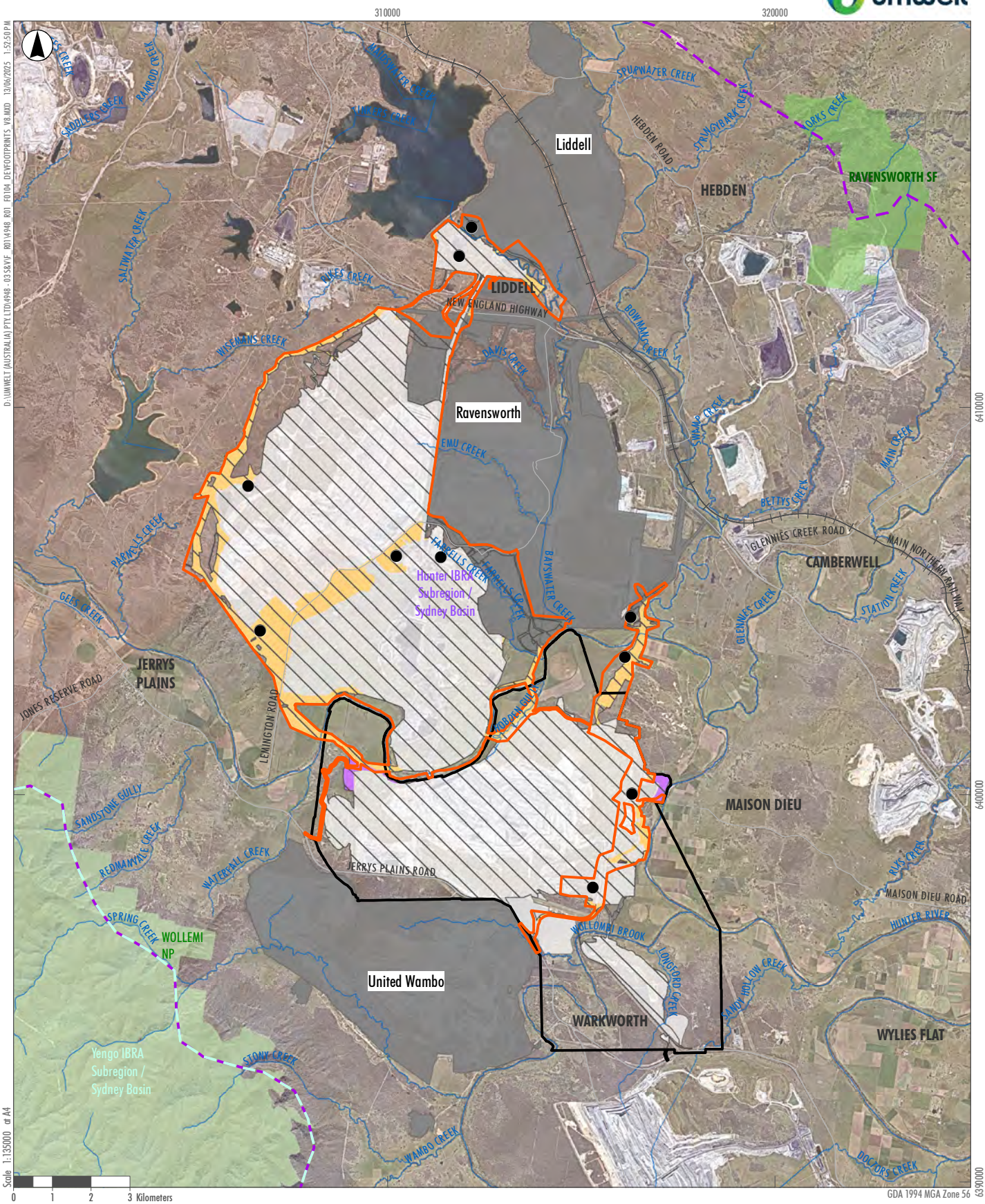
Table 1.1 Development Footprint Details

Site Details	HVO North	HVO South
Name	HVO North Development Footprint	HVO South Development Footprint
Size	903.2 ha	47.2 ha
Current Land Use	Agricultural, mining and power generation	Agricultural and mining
LGA	Singleton Council Muswellbrook Shire Council	Singleton Council

[1] The River Red Gum additional disturbance area is within the HVO South existing development consent boundary and is further discussed in **Section 1.4**.

Site Details	HVO North	HVO South
LEP Zoning	RU1 – Primary Production SP2 – Infrastructure C2 – Environmental Conservation^	RU1 – Primary Production C2 – Environmental Conservation^
Assessment Type	Major Project (Site-based)	Major Project (Site-based)
Assessment ID	00054717/BAAS17005/25/00054718	00054725/BAAS17005/25/00054726

^ A small portion of the realigned Lemington Road corridor is in an area currently zoned C2 under the Singleton LEP. This area is currently subject to subdivision between HVO and Warkworth Mine in accordance with the Warkworth Mine consent SSD 5464 (as modified). This will result in the rezoning of C2 zone land to RU1 zone land at the time of determination of the Project, resulting in no C2 land in the Project area.



Legend

- HVO North Proposed Consent Boundary
- HVO South Proposed Consent Boundary
- HVO North Development Footprint
- HVO South Development Footprint
- HVO Existing and Approved Disturbance Areas
- Project Disturbance Area
- Potential Laydown Area
- Approved Disturbance Area - Other Mine
- Railway Line
- Drainage Line
- Road
- National Parks
- State Forest

IBRA Subregion / Region

- Hunter IBRA Subregion / Sydney Basin
- Yengo IBRA Subregion / Sydney Basin

FIGURE 1.4

The Development Footprints
HVO North and HVO South

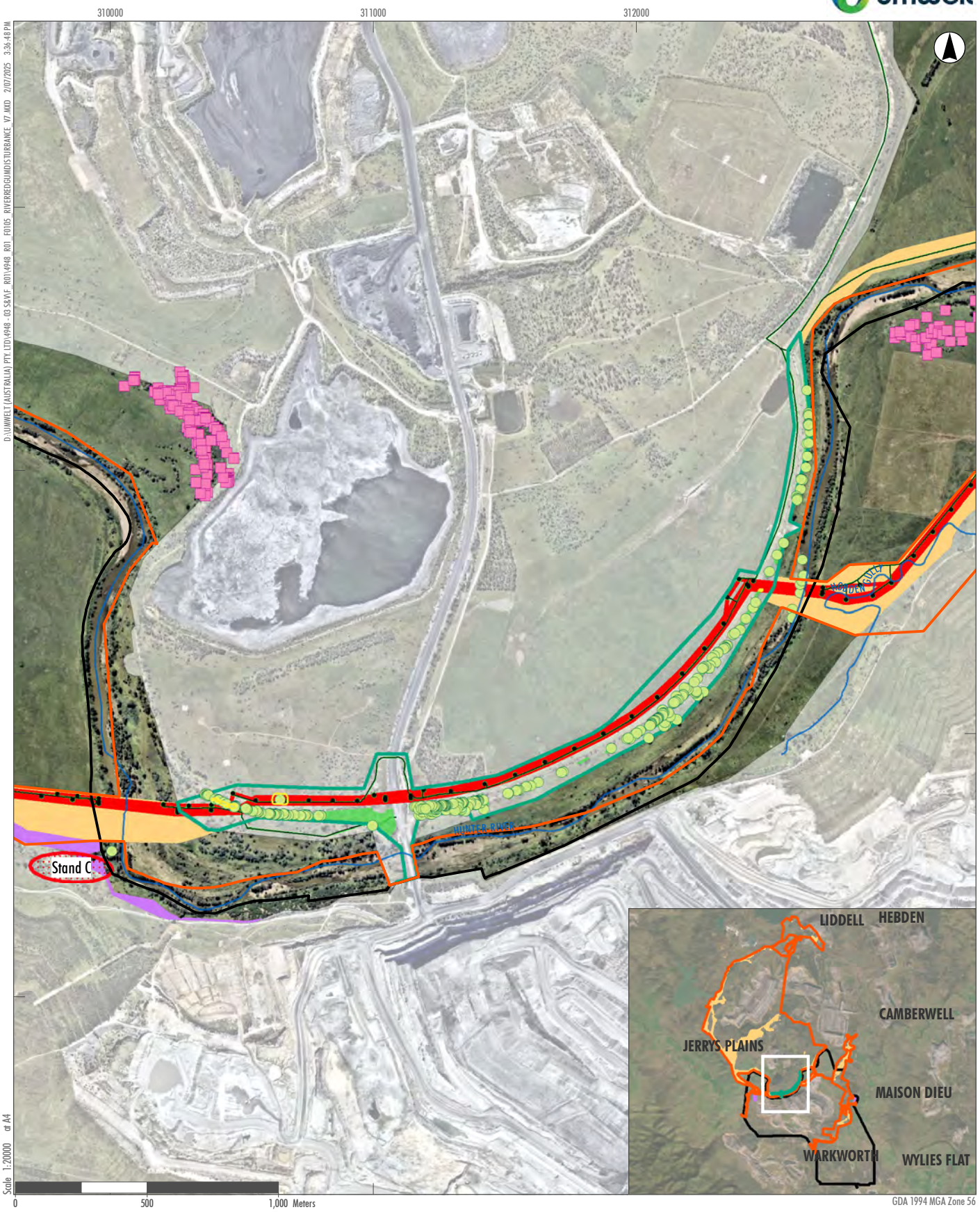
Image Source: Nearmap April 2024) Data source: NSW DFSI (2024)

1.5 River Red Gum Additional Disturbance Area

The River Red Gum Additional Disturbance Area is an area within the existing HVO South Project Approval (PA 06_0261) adjacent to the Hunter River where minor impacts to the river red gum (*Eucalyptus camaldulensis*) endangered population and *Hunter Floodplain Red Gum Woodland EEC* are expected to occur as a result of the proposed transmission line relocation (refer to **Figure 1.5**).

While this area is within an existing disturbance boundary, Condition 31 of PA 06_0261 states that "The Applicant must protect all stands of the Hunter Lowland Red Gum Forest (also identified as Hunter Floodplain Red Gum Woodland Complex in the EA) endangered ecological community within the site, and adjacent lands under the control of the Applicant, as shown in Annexure 8, to the satisfaction of the Planning Secretary."

This area includes part of a stand (Stand C) of river red gums identified in Annexure 8 of the Project Approval where Condition 30 of PA 06_0261 requires a River Red Gum Strategy to be implemented, which conserves and restores the river red gums identified. As a result of this, any impacts in relation to the *Hunter Floodplain Red Gum Woodland EEC* and the river red gum (*Eucalyptus camaldulensis*) endangered population were calculated in this BAM assessment and included in the offsetting obligations for the Project. While the location of the proposed transmission line relocation is indicative, following the identification of river red gums and *Hunter Floodplain Red Gum Woodland EEC* in this area, the footprint of the transmission line was designed to minimise impacts on these threatened entities (refer to **Section 5.2.3**).



Legend

- HVO North Proposed Consent Boundary
- HVO South Proposed Consent Boundary
- HVO North Development Footprint
- HVO South Development Footprint
- HVO Existing and Approved Disturbance Areas
- River Red Gum Additional Disturbance Area
- Stand C
- Drainage Line
- ETL Power Pole
- Access Track
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Impacted River Red Gums and Impacted Hunter Floodplain Red Gum Woodland EEC

NSW Bionet Atlas Threatened Species Records (2022)

- *Eucalyptus camaldulensis* (River Red Gum)

Umwelt Threatened Species Records (2020 - 2022)

- *Eucalyptus camuldulensis* (River Red Gum)

FIGURE 1.5

River Red Gum Additional Disturbance Area

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

1.6 Entry into the Biodiversity Offsets Scheme

The Biodiversity Offsets Scheme (BOS) applies to all SSD and State Significant Infrastructure (SSI), unless the Environment Agency Head and Secretary of the Planning Agency Head determine that the project is not likely to have an impact on biodiversity.

Consequently, an assessment under the BAM (2020) is required for the Project, being SSD, as outlined in this BDAR.

1.7 Assessment Requirements

This BDAR has been prepared following the appropriate guidelines, policies and industry requirements, and following consultation with stakeholders including relevant government agencies.

Key guidelines, policies and legislation referenced are as follows:

- Biodiversity Assessment Methodology 2020.
- Biodiversity Assessment Method Operational Manuals – Stage 1 and Stage 2.
- Guidance and Criteria to assist a decision maker to determine a serious and irreversible impact.
- Assessing partial loss of biodiversity values Biodiversity Assessment Method guide – consultation draft.
- NSW *Biodiversity Conservation Act 2016*.
- NSW Biodiversity Conservation Regulation 2017.
- NSW *Local Land Services Act 2013*.
- NSW *Environmental Planning and Assessment Act 1979*.
- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Annexure A includes a checklist of the components required and recommended in a BDAR as per Table 41 of the Biodiversity Development Assessment Report Template.

This assessment has also been prepared in accordance with requirements of DPHI as set out in the Secretary's Environmental Assessment Requirements (SEARs) for the HVO North Project (SSD-11826681) and HVO South Project (SSD-11826621), issued on 11 March 2021.

Table 1.2 lists individual requirements relevant to this BDAR and where they are addressed in this report. Note the biodiversity-related SEARs were identical for both the HVO North and HVO South Projects.

Table 1.2 Biodiversity Related SEARs

Assessment Requirements for HVO North and HVO South Projects	Section Addressed	
	HVO North	HVO South
The EIS must address the following key issues: • Biodiversity – including:		
o accurate predictions of any vegetation to be cleared on site	**Table 6.1**	**Table 6.1**
o an assessment of the likely biodiversity impacts of the development, paying particular attention to threatened species, populations and ecological communities and groundwater dependent ecosystems, undertaken in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report; and	Throughout Aquatic Ecology and GDE Assessment (refer to Appendix L of the EIS)	Throughout Aquatic Ecology and GDE Assessment (refer to Appendix L of the EIS)
o a strategy to offset any residual impacts of the development in accordance with the offset rules under the Biodiversity Offsets Scheme.	**Section 9.0**	**Section 9.0**

To inform the preparation of the SEARs, DPHI invited other government agencies to recommend matters to be addressed in the EIS. The (then) BCS, Regional NSW – Mining, Exploration and Geoscience (MEG), Singleton Council and Muswellbrook Shire Council raised matters relevant to the biodiversity assessment. It is noted that BCS did not provide any Project-specific assessment requirements for the Project, rather, included their Standard Environmental Assessment Requirements. The matters raised are listed in **Table 1.3** and have been taken into account in preparing this assessment, as indicated in the table.

Table 1.3 Agency Project-Specific Assessment Recommendations

Agency Assessment Recommendations for HVO North and HVO South Projects	Section Addressed	
	HVO North	HVO South
BCD Standard Environmental Assessment Requirements		
• Biodiversity impacts related to the proposed development (SSD 11826681 and SSD 11826621) are to be assessed in accordance with the Biodiversity Assessment Method and documented in a Biodiversity Development Assessment Report (BDAR). The BDAR must include information in the form detailed in the *Biodiversity Conservation Act 2016* (s6.12), *Biodiversity Conservation Regulation 2017* (s6.8) and Biodiversity Assessment Method.	Throughout	Throughout
1. The BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the Biodiversity Assessment Method.	**Section 5.0, Section 6.0 and Section 9.0**	**Section 5.0, Section 6.0 and Section 9.0**
2. The BDAR must include details of the measures proposed to address the offset obligation as follows;	-	-
• The total number and classes of biodiversity credits required to be retired for the development/project	**Table 8.1**	**Table 8.1**
• The number and classes of like-for-like biodiversity credits proposed to be retired	**Section 9.0**	**Section 9.0**

Agency Assessment Recommendations for HVO North and HVO South Projects	Section Addressed	
	HVO North	HVO South
• The number and classes of biodiversity credits proposed to be retired in accordance with the variation rules	Not proposed	Not proposed
• Any proposal to fund a biodiversity conservation action	Not proposed	Not proposed
• Any proposal to conduct ecological rehabilitation (if a mining project)	Not proposed	Not proposed
• Any proposal to make a payment to the Biodiversity Conservation Fund. • If seeking approval to use the variation rules, the BDAR must contain details of the reasonable steps that have been taken to obtain requisite like-for-like biodiversity credits.	Offsetting options outlined in **Section 9.0**	Offsetting options outlined in **Section 9.0**
3. The BDAR must be prepared by a person accredited in accordance with the Accreditation Scheme for the Application of the Biodiversity Assessment Method Order 2017 under s6.10 of the *Biodiversity Conservation Act 2016*.	**Section 1.8**	**Section 1.8**
Regional NSW – Mining, Exploration and Geoscience (MEG)		
MEG requests that the Proponent consider potential resource sterilisation in relation to any proposed biodiversity offsets areas. Biodiversity offsets have the potential to preclude access for future resource discovery and extraction and could also potentially permanently sterilise access to mineral resources. The EIS must therefore clearly illustrate the location (including offsite locations) of any biodiversity offsets being considered for the project and their spatial relationship to known and potential mineral and construction material resources and existing mining & exploration titles. MEG requests consultation with both the Geological Survey of NSW – Land Use Assessment team and holders of existing mining and exploration authorities affected by planned biodiversity offsets. Evidence of consultation should be included in the EIS.	Consideration of mining and exploration licences are included in the feasibility of any stewardship site.	Consideration of mining and exploration licences are included in the feasibility of any stewardship site.
Singleton Council		
The EIS should include the preferred option for securing offsets required for the Project, where land-based offsets would (or could) be located (including current and future tenure), the area and location of proposed ecological rehabilitation and communities to be reinstated, the long-term tenure of ecological rehabilitation, and whether the required credits are available for purchase. It is important to note that in perpetuity conservation of land has an economic impact on the community wherever that offset is secured. Offset land is not rateable and the impact on council's with significant offset land can be significant, and outside the area of immediate benefit. That is, offsets can be secured in other council areas where the benefits of the project are not realised.	Offset locations available under the like-for-like offset rules in accordance with the BC Regulation outlined in **Table 8.1**	Offset locations available under the like-for-like offset rules in accordance with the BC Regulation outlined in **Table 8.1**

Agency Assessment Recommendations for HVO North and HVO South Projects	Section Addressed	
	HVO North	HVO South
Muswellbrook Shire Council		
Identify how Biodiversity impacts will be managed Council considers that there is a nationally significant biodiversity corridor within this locality, connecting Mt Royal/Barrington Tops World Heritage Area with the Wollemi World Heritage Area via Lake Liddell. Council requests that if there are credit obligations identified for this project that the applicant provide an offset strategy indicating how any credit obligations will be acquitted with Council's preference being that the credits are sourced from within the locality to improve the conservation of this corridor.	Connectivity corridors shown on **Figure 6.4**	Connectivity corridors shown on **Figure 6.4**

1.8 Amendments Following Public Exhibition of EIS

Table 1.4 provides a summary of key revisions to the BDAR made following public exhibition in response to the BCS submission dated 13 March 2023.

Table 1.5 provides a summary of key updates to the BDAR and additional surveys undertaken in response to subsequent submissions on the revised BDAR from BCS dated 19 June 2024.

Annexure H provides the details of the BCS submissions, the proponent's response and cross references to relevant sections in the BDAR.

Table 1.4 Summary of Updates to the BDAR in Response to BCS Submission Dated 13 March 2023

Update	Section Reference
Amendments to the assessment following changes to a portion of the proposed Lemington Road re-alignment to avoid impacts to *Warkworth Sands Woodland EEC*	Throughout **Section 3.1.6** **Section 5.2.1.1**
Additional flora transect surveys undertaken in September and November 2023	**Section 4.1.3.1** **Figure 4.1** **Annexure C – Detailed Figure Set**
Additional habitat constraints surveys for a range of fauna species undertaken in August 2023	**Section 4.1.3.2** **Figure 4.2** **Annexure C – Detailed Figure Site** **Table D.2 in Annexure D**
Additional Spot Assessment Technique (SAT) surveys and thermal drone surveys for the koala in accordance with the Koala (*Phascolarctos cinereus*) BAM Survey Guide (DPE 2022b) undertaken in June and July 2023	**Section 4.1.3.2** **Figure 4.2** **Annexure C – Detailed Figure Set** **Table D.2 in Annexure D**
Additional pitfall trapping surveys targeting common planigale (*Planigale maculata*) undertaken in May, June, July and August 2023	**Section 4.1.3.2** **Figure 4.2** **Annexure C – Detailed Figure Set** **Table D.2 in Annexure D**
Addressing recommendations from BCS	**Throughout** **Annexure H**

Table 1.5 Summary of Updates to the BDAR in Response to BCS Submission Dated 19 June 2024

Update	Section Reference
Updated surveys to account for data currency (i.e. replacement of surveys taken prior to September 2020) utilising updated survey requirements under the BAM.	**Section 3.1.4** **Section 4.1.3** **Annexure C – Detailed Figure Set** **Annexure D**
Updates to the PCT classification following the expiry of the transitional arrangements for the East Coast PCT Classification. This includes changes to candidate species-credit species.	**Section 3.1** **Section 3.2.2**
Amendments to the Development Footprint resulting in complete avoidance of impacts to *Warkworth Sands Woodland EEC*	**Section 5.2.1**
Identification of additional offsetting measures for *Hunter Floodplain Red Gum Woodland EEC* to address SAII	**Section 9.2**
Addressing recommendations from BCS	**Throughout** **Annexure H**

1.9 Contributing Accredited Assessors

Table 1.6 below outlines the details of the Accredited BAM Assessors involved in the survey, calculations and reporting for the BDAR.

Table 1.6 Accredited BAM Assessors and their Role on this Project

Name *Position*	Assessor ID	Tasks Performed	Qualifications/Experience
Allison Riley ***Senior Principal Ecologist***	BAAS17042	**BDAR author** (primary BDAR author and technical review, site inspection)	B/Science 26 years' experience in ecological consulting, flora and fauna surveys and biodiversity assessments.
Kate Connolly ***NSW Ecology Manager***	BAAS17005	**BAM-C analysis** (BAM-C analysis and credit reports) **BDAR contributor** (contributing author of report, site inspections)	B/Environmental Science and Management 18 years' experience in ecological consulting flora and fauna surveys and biodiversity assessments.
Travis Peake ***National Ecology Leader***	BAAS17081	**BAM contributor** (BDAR review, site inspection, Warkworth Sands Woodland (WSW) mapping)	B/Natural Resources (Hons) 29 years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.
Ryan Parsons ***Principal Ecologist – Botanist***	BAAS17048	**BAM contributor** (technical review of PCT allocation, vegetation mapping, WSW site inspections) **Targeted species survey** (threatened flora surveys)	B/Environmental Science and Management (Hons) 18 years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.

Name *Position*	Assessor ID	Tasks Performed	Qualifications/Experience
Trish Robinson ***Principal Ecologist – Botanist***	BAAS18123	**BAM contributor** (vegetation mapping, PCT allocation, vegetation descriptions and BDAR preparation) Detailed vegetation survey (BAM plots) **Targeted species survey** (threatened flora surveys)	B/Environmental Science (Hons) 16 years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.
Shaun Corry ***Principal Ecologist***	BAAS17041	**Targeted species survey** (threatened flora surveys)	B/ Science (Biology) 18 years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.
Adam Cavallaro ***Principal Restoration Ecologist***	BAAS18056	**BAM contributor** (vegetation mapping, PCT allocation, vegetation descriptions and BDAR preparation) **Detailed vegetation survey** (BAM plots)	B/Environmental Science (Conservation Ecology) 22 years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.
Bill Wallach ***Principal Ecologist***	BAAS17068	**Detailed vegetation survey** (BAM plots)	Bachelor of Biological Sciences (Hons) 15 years' experience in ecological consulting, flora and fauna surveys, vegetation mapping and biodiversity assessments.
James Garnham ***Principal Ecologist***	BAAS19021	**Targeted species survey** (herpetological, bird, koala and nocturnal spotlighting surveys)	B/Environmental Science and Management (Hons) Doctor of Philosophy – PhD, Conservation Biology 15 years' experience in ecological consulting, flora and fauna surveys, herpetological surveys and biodiversity assessments.
Rhys Osborne ***Senior Ecologist***	BAAS20026	**Targeted species survey** (herpetological surveys)	B/Environmental Science and Management (Hons) 10 years' experience in ecological consulting, flora and fauna surveys and biodiversity assessments.
Philippa Fagan ***Senior Ecologist***	BAAS18117	**Targeted species survey** (herpetological and bird surveys)	B/Biodiversity and Conservation Masters of Environmental and Business Management 13 years' experience in ecological consulting, flora and fauna surveys and biodiversity assessments.

2.0 Landscape Context

2.1 Site Context

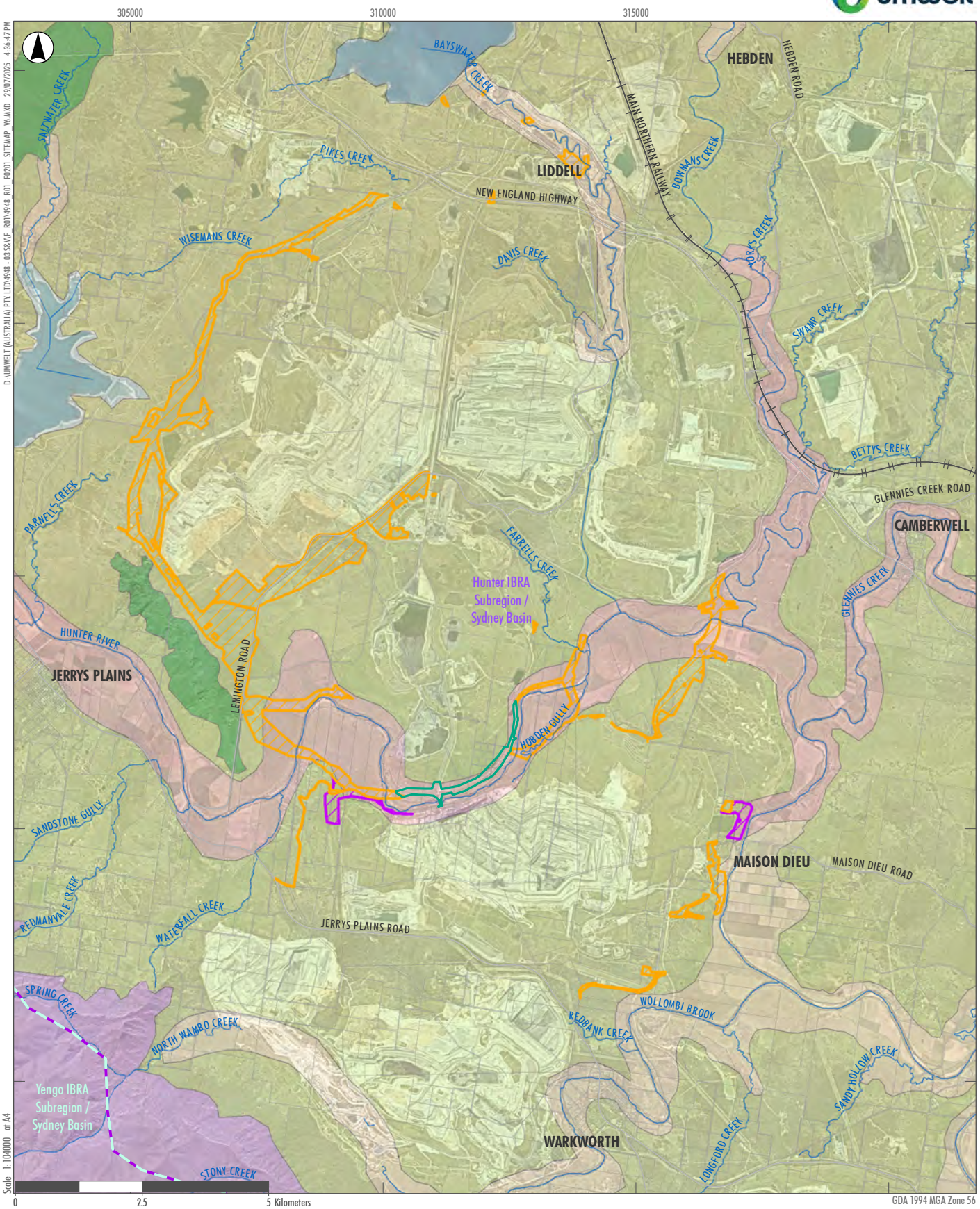
The central Hunter Valley has been largely cleared of intact native vegetation, primarily for agriculture but also other land uses, such as mining and urban development. Similar land use patterns occur in the vicinity of the HVO North and HVO South Development Footprints, which are predominantly surrounded by coal mining operations and agricultural land, with small and scattered patches of native vegetation.

The most significant intact vegetation occurring in the wider locality is within Wollemi National Park (NP), which is located approximately 4 km to the southwest at the nearest point to the HVO South Development Footprint and represents a significant refuge area between remnant patches of vegetation in the central Hunter Valley. Ravensworth State Forest is also located in the wider locality, 7 km to the northeast at the nearest point to the HVO North Development Footprint (refer to **Figure 1.1**). The vegetation in Wollemi NP and Ravensworth State Forest is important for its functionality as a fauna refuge in an otherwise widely cleared landscape. The Hunter River, which broadly divides the HVO North and HVO South Project Areas, provides a narrow corridor across the landscape for fauna which utilise riparian vegetation as movement habitat.

The HVO North and HVO South Development Footprints occur entirely in the Sydney Basin IBRA Bioregion and the Hunter subregion. The Hunter Valley is considered to be of great ecological significance given that it represents the only major break in the Great Dividing Range (linking coastal and inland areas of NSW) and includes an overlap between tropical and temperate climate zones.

The Hunter Valley is also characterised by extensive areas of agriculture and coal mining operations. The landscape within and surrounding the HVO North and HVO South Development Footprints has been shaped by historical clearing for agricultural, mining and rural development. As such, much of the land associated with the Project conforms to Category 1 – Exempt Land under the *Local Land Services Act 2013* (LLS Act), being lawfully cleared areas and/or low conservation vegetation (refer to **Section 2.3**).

Figure 2.1 shows the Site Map and relevant contextual boundaries as required by the BAM (DPIE 2020a). Other relevant landscape features are discussed in **Section 2.2** and shown in **Figure 2.2A** and **Figure 2.2B.**



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Hunter IBRA Subregion / Sydney Basin
- Yengo IBRA Subregion / Sydney Basin
- Cadastre
- Railway Line
- Road
- Drainage Line

Mitchell Landscape

- Central Hunter Alluvial Plains
- Central Hunter Foothills
- Estuary/Water Added
- Hunter River Basalts
- Upper Hunter Channels and Floodplain
- Yengo Plateau

FIGURE 2.1

Site Map

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

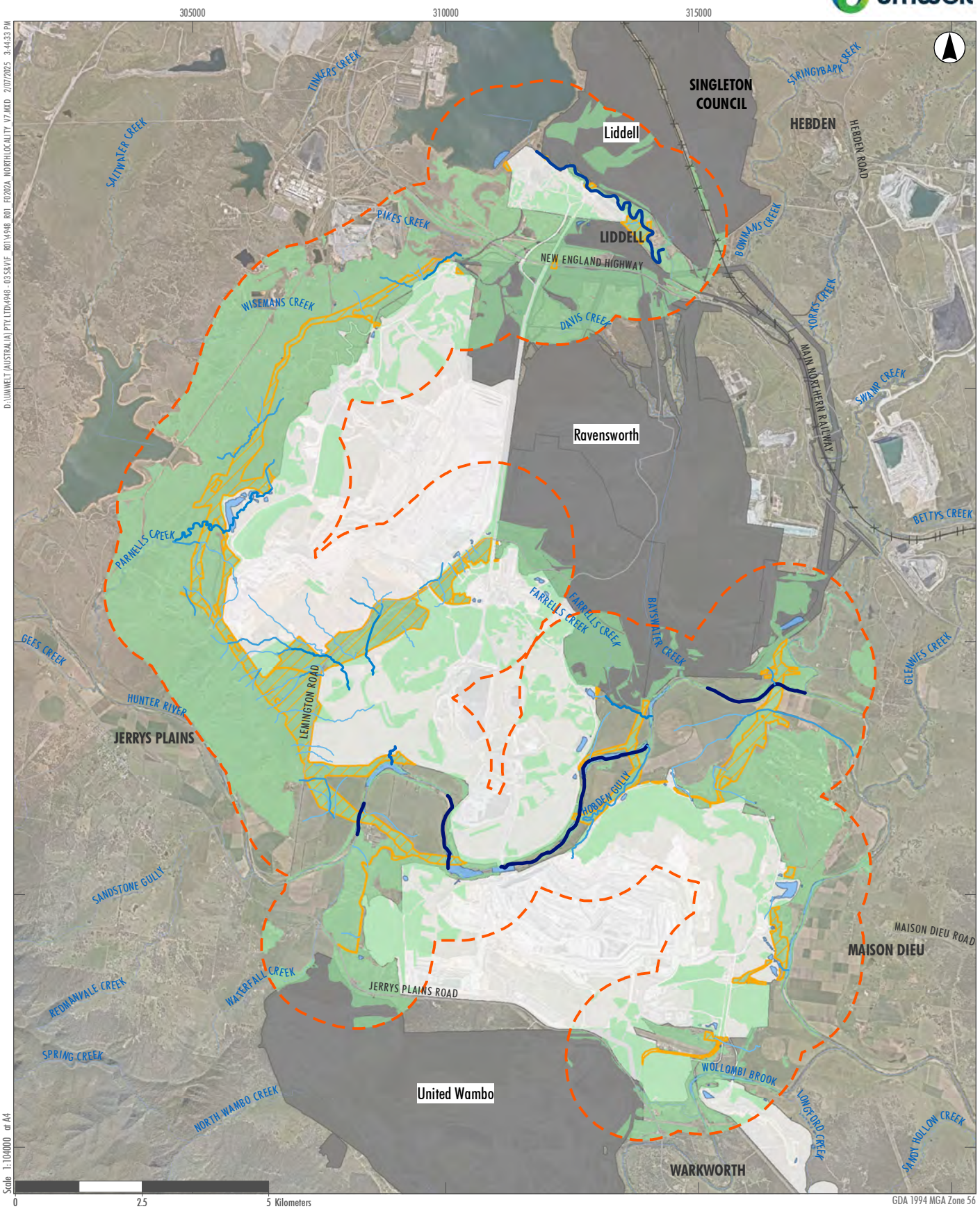
2.2 Landscape Features

Refer to **Table 2.1** for a summary of the other relevant landscape features that pertain to the BAM assessment. Relevant landscape features are shown in **Figure 2.1**, **Figure 2.2A** and **Figure 2.2B.**

Throughout all field surveys and investigations, reconnaissance observations were undertaken to confirm the extent and condition of landscape features and native vegetation cover in the locality. Refer to **Section 3.1** and **Section 4.1** for further detail on survey effort and timing.

Table 2.1 Landscape Features within the Development Footprints

Landscape Features	HVO North	HVO South
IBRA Bioregion	Sydney Basin	Sydney Basin
IBRA Subregion	Hunter	Hunter
NSW (Mitchel) Landscape (dominant)	Central Hunter Foothills	Central Hunter Foothills
Native Vegetation Cover	45.4%	38.1%
Strahler (1952) Streams	9th Order – Hunter River 5th Order – Bayswater Creek 4th Order – Unnamed tributary of the Hunter River southwest of Carrington Billabong 3rd Order – Parnells Creek and Farrells Creek Numerous unnamed 1st and 2nd Order creeks	9th Order – Hunter River 8th Order – Wollombi Brook 4th Order – Unnamed tributary of the Hunter River north of Riverview Pit Several 1st, 2nd and 3rd Order creeks intersecting the HVO South Development Footprint
Important and Local Wetlands	Not present	Not present
Areas of Geological Significance and Soil Hazard Features	None identified	None identified
Areas of Outstanding Biodiversity Value	Not present	Not present
Connectivity Features	Hunter River	Hunter River
Priority Investment Areas	None identified	None identified



Legend

- HVO North Development Footprint
- 1500m Buffer
- Native Vegetation in the 1500m Buffer
- HVO Existing and Approved Disturbance Areas
- Approved Disturbance Area - Other Mine
- Waterbodies
- Drainage Line
- Railway Line
- Road

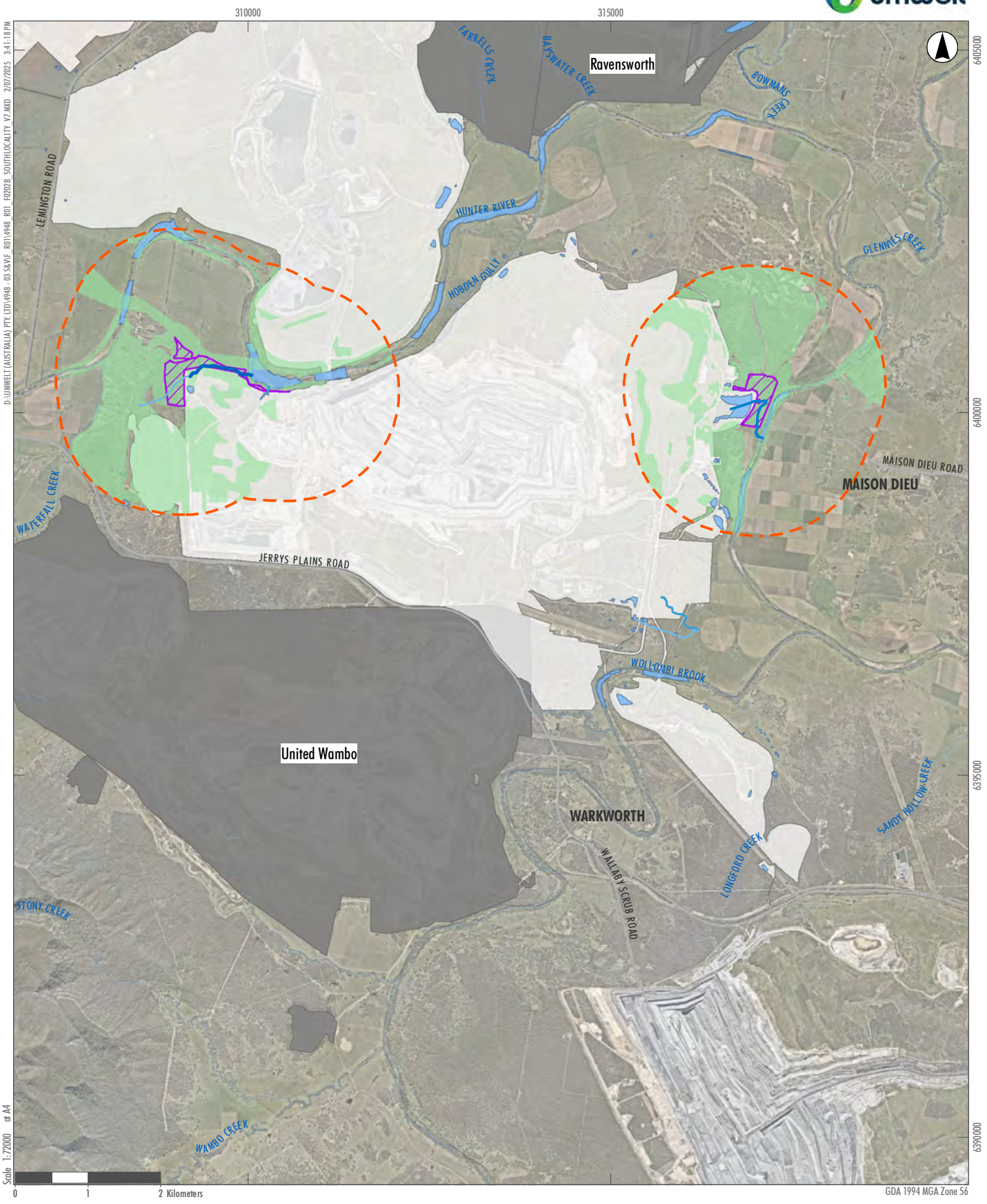
Strahler Stream Order Intersecting Development Footprint

- 1
- 2
- 3
- 4
- 5
- 9

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

FIGURE 2.2A

HVO North Location Map



Legend

- HVO South Development Footprint
- 1500m Buffer
- Native Vegetation in the 1500m Buffer
- HVO Existing and Approved Disturbance Areas
- Approved Disturbance Area - Other Mine
- Waterbodies
- Drainage Line
- Road

Strahler Stream Order Intersecting Development Footprint

- 1
- 2
- 3
- 4

FIGURE 2.2B

HVO South Location Map

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

2.3 Category 1 – Exempt Land

Section 6.12 of the BC Act requires the BDAR to be prepared in accordance with the BAM which is established under Section 6.8 of the BC Act.

Relevantly, section 6.8(3) of the BC Act provides:

> *(3) The biodiversity assessment method is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of the Local Land Services Act 2013), other than any impacts prescribed by the regulations under section 6.3.*

The staged release of the draft Native Vegetation Regulatory Map (NVR Map) commenced in October 2022 and is now complete. The draft NVR Map is now available for all areas of NSW, however the map does not have legal effect, and it does not impose any new legal obligations and is not binding. While the draft NVR map is under review, land categories remain defined by the criteria in the *Local Land Services Act 2023* (LLS Act). Category 1 – Exempt Land is defined in Part 5A, Division 2 of the LLS Act. Subject to certain exceptions, Category 1 – Exempt Land is broadly defined as being:

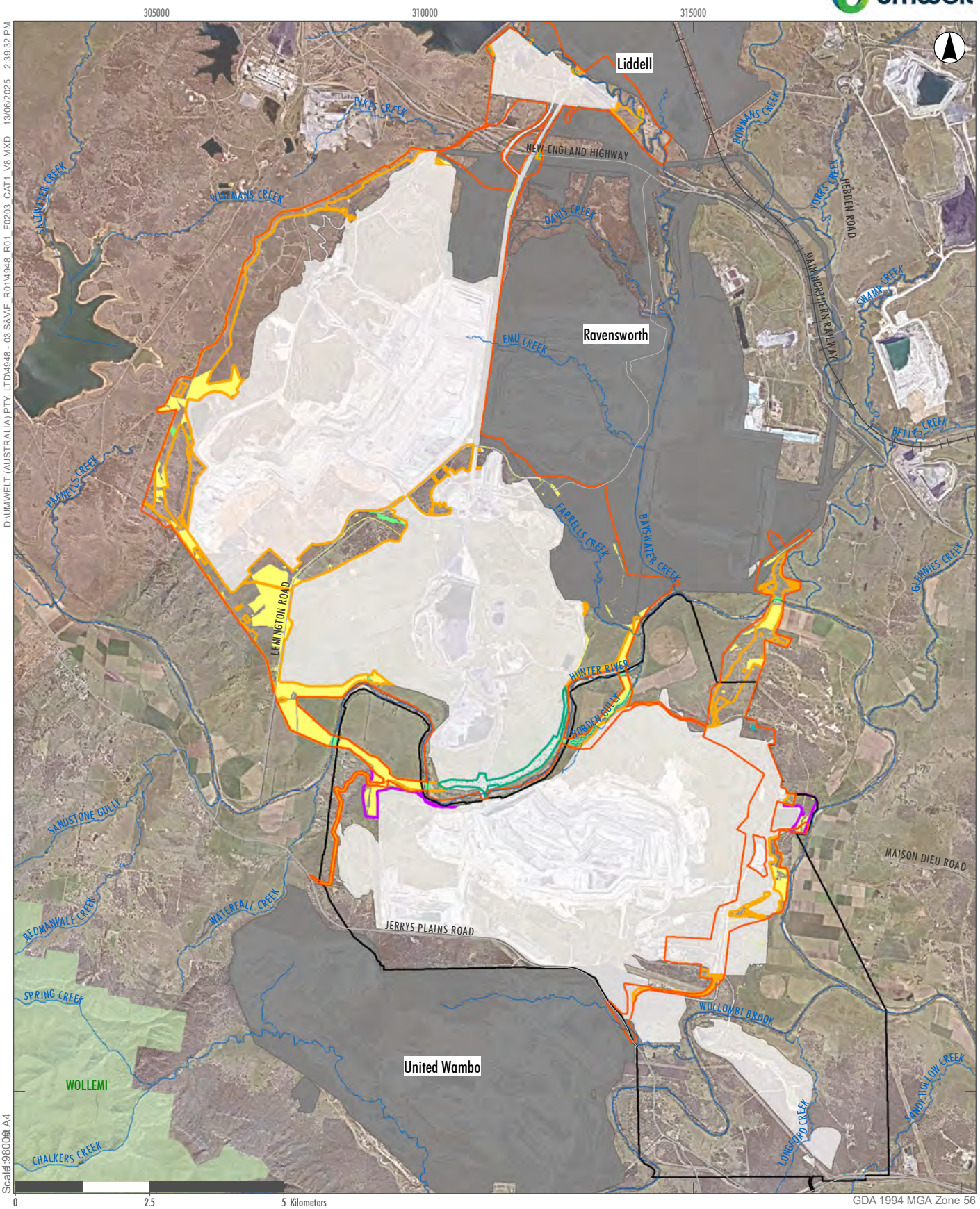
- Land cleared of native vegetation as at 1 January 1990 or lawfully cleared after 1 January 1990 (but before 25 August 2017).
- Low conservation grasslands.
- Land containing only low conservation groundcover (not being grasslands).
- Native vegetation identified as regrowth in a Property Vegetation Plan under the repealed *Native Vegetation Act 2003*.
- Land bio-certified under the BC Act.

Some areas noted as Category 2 – Vulnerable Land or Category 2 – Regulated Land in the draft NVR Map have been found to no longer support this land category (i.e. former watercourses now reclaimed land or active mining areas). An application to amend the NVR Map, to reflect outcomes of this BDAR, will be submitted to the NVR Map Team for review.

Annexure B contains a summary of the process used to identify the Category 1 – Exempt Land within the Project Areas and addressing the recommendations provided by DPE in August 2021 (also provided in **Annexure B**). Following the release of the draft NVR Map, Umwelt reviewed the Category 1 – Exempt Land map against Umwelt's analysis. No significant changes have been made from the original Category 1 – Exempt Land map.

The Category 1 – Exempt Land to be impacted by the Project is shown on **Figure 2.3**. In accordance with the LLS Act mine rehabilitation at HVO is Category 1- Exempt Land as outlined in **Section 2.4**.

Impacts to biodiversity values on Category 1 – Exempt Land are not assessed further in this BDAR, other than prescribed impacts (refer to **Section 6.3**), as per the intent of this mapping category.



Legend

- HVO North Proposed Consent Boundary
- HVO South Proposed Consent Boundary
- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Approved Disturbance Area - Other Mine
- HVO Existing and Approved Disturbance Areas
- Category 1 - Exempt Land

Draft Native Vegetation Regulatory (NVR) within Development Footprints

- Category 2 - Vulnerable Regulated Land
- Excluded Land
- National Parks
- Railway Line
- Road
- Drainage Line

FIGURE 2.3

Category 1 – Exempt Land

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

2.4 Mine Rehabilitation

Mining operations and related activities have been undertaken at the HVO Complex since the 1950s. Active mining continues at HVO North and HVO South in accordance with existing development consents, which also include areas of previous disturbance that is currently in various stages of rehabilitation. Rehabilitation at HVO is undertaken progressively over the life of the mine, with overburden emplacements and backfilled pits shaped and rehabilitated once dumping is complete. Areas of mine rehabilitation within the HVO Complex do not require formal assessment under the BAM, as discussed below.

All rehabilitation at HVO has been undertaken within areas of historical development consents that are subject to the conditions under the HVO North Consent (DA 450-10-2003 as modified) and the HVO South Project Approval (PA 06_0261 as modified). None of these rehabilitation areas have been relinquished or as yet meet the completion criteria as outlined in the Rehabilitation Management Plan (RMP) and both consents acknowledge that further disturbance of these areas may still be required for ongoing rehabilitation maintenance to reach completion criteria.

Approximately 2,856 ha of previously mined land will be subject to rehabilitation within the HVO Complex, at the commencement of the Project in accordance with the HVO Forward Work Program (HVO 2022), which includes areas of native woodland or grazing pasture and grasslands (refer to **Figure 2.4**). Approximately 1,315 hectares of varying stages of rehabilitation will be re-disturbed by the Project. The oldest area of formally recorded woodland rehabilitation at HVO is approximately 25 years old (established in 1999), however it is likely that vegetation around the West Pit northern and southern emplacement areas and Wilton Pit emplacement area (all at HVO North) may have been planted in the 1980s and 1990s. While the HVO North Consent includes a specific commitment to rehabilitate 4 hectares to Central Hunter Grey Box Ironbark Woodland in relation to the Carrington West Wing Extension (approved under Mod 3), mining in this area as approved has not yet commenced. Furthermore, while the requirement to revegetate an area of at least 0.14 hectares using trees representative of the Swamp Oak Floodplain Forest community has been completed as per Schedule 3 Condition 31A of DA 450-10-2003, this area will not be re-disturbed by the Project.

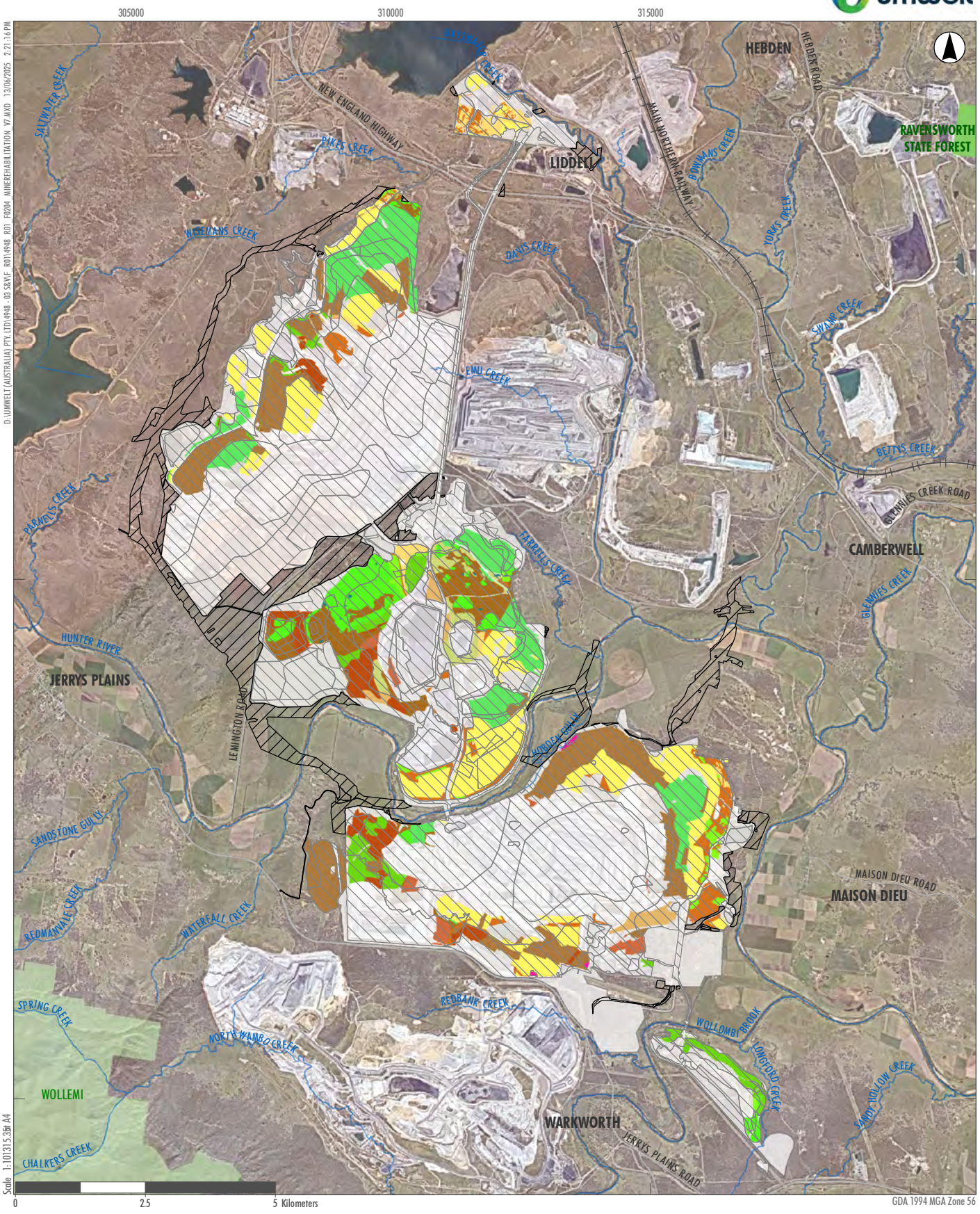
The HVO North Consent and HVO South PA only show the conceptual location of the proposed final rehabilitation and final landform plans, and none of these areas have been formally 'set aside' for conservation purposes, nor are they required to be set aside. The rehabilitation strategy for the Project has reviewed the requirements of the HVO North Consent and HVO South PA and developed a final landform strategy that is generally consistent with its requirements. Further detail on the rehabilitation strategy for the Project is outlined in **Section 5.6.1** and further detailed in the Mine Closure and Rehabilitation Strategy (Appendix T of the EIS).

In summary, the rehabilitated areas at HVO that will be re-disturbed by the Project do not require formal assessment under the BAM due to the following:

- All mine rehabilitation areas are already approved for disturbance.
- None of the these areas have been relinquished or meet the completion criteria as outlined in the Rehabilitation Management Plan (RMP) and the existing consent documents acknowledge that further disturbance to rehabilitated areas may still be required.

- None of the rehabilitation established at HVO that will be disturbed by the Project is required to conform to a PCT or TEC.
- The location of the rehabilitation is only shown conceptually by the consent documents and does not represent areas that have been formally 'set aside' for nature conservation, re-vegetation of native vegetation or as a native vegetation offset.
- The obligation to rehabilitate the areas that are currently approved for disturbance under the HVO North Development Consent (DA 450-10-2003) and HVO South Project Approval (PA 06_0261) will be incorporated into the proposed new consents.
- The mine rehabilitation areas that will be disturbed by the Project can be classified as Category 1 – Exempt Land as they were cleared prior to 1990 or lawfully cleared after 1 January 1990 and:
    - have not been "notified to the Environment Agency Head"; and
    - are not required to have been "set aside" by any condition of any of the Consents "for nature conservation, for re-vegetation of native vegetation or as a native vegetation offset" which forms part of the definition of Category 2 -sensitive regulated land.

Section 4.63 of the EP&A Act provides that if a development consent is to be surrendered as a condition of a new development consent and the development to be authorised by that new development consent includes the continuation of any of the development authorised by the consent to be surrendered, the consent authority is not required to re-assess the likely impact of the continued development, to the extent that it could have been carried out but for the surrender of the consent. As the existing Consents will be required to be surrendered as a condition of the proposed new consents for HVO North and HVO South and currently authorise disturbance of the mine rehabilitation areas, any impacts related to that disturbance are not required to be assessed by the consent authority, and therefore in the BDAR.



Legend

- HVO Development Footprints
- Mine Rehabilitation Domains
- HVO Existing and Approved Disturbance Areas
- Railway Line
- Road
- Drainage Line
- National Parks
- State Forest

Rehabilitation

- Interim
- Mixed
- Pasture
- Water Management
- Woodland

Plant Community Types

- Cleared
- Dam
- Mine Rehabilitation - Cooba Woodland
- Mine Rehabilitation - Exotic Grassland
- Mine Rehabilitation - Plantation

FIGURE 2.4

Mine Rehabilitation at HVO Complex

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

3.0 Native Vegetation

3.1 Methods

3.1.1 Literature and Database Review

A review of previous documents and reports relevant to the Project was undertaken. This included regional vegetation mapping reports, site-specific monitoring surveys, ecological surveys undertaken within and in the vicinity of the Development Footprints and also relevant ecological database searches. The information obtained was used to inform survey design and assist in the assessment of potentially occurring threatened species and TECs. Relevant documents included:

- NSW State Vegetation Type Map (Current release C2.0.M2.1) (State Government of NSW and NSW DCCEEW 2024).
- The Vegetation of the Central Hunter Valley, NSW (Peake 2006).
- Greater Hunter Native Vegetation Mapping (Sivertsen *et al* 2011).
- Upper Hunter State Vegetation Map (OEH 2018b).
- Plot to PCT Assignment Tool, accessed April 2025 (DPHI 2025)
- BioNet Vegetation Information System (VIS) Classification Database (DPHI 2025), accessed March 2025.
- Hunter Valley Operations Integrated Biodiversity Management Plan (EMM 2018).
- United Wambo Open Cut Coal Mine Biodiversity Assessment Report (Umwelt 2017).
- Warkworth Sands Woodland Integrated Management Plan (Rio Tinto 2017).
- Preliminary Documentation Report for EPBC 2016/7640 (EMM 2016).
- River Red Gum Monitoring Report 2020 – Carrington Billabong and a reference site (Ecoplanning 2021).
- Upper Hunter Strategic Assessment – Hunter Valley Operations Biodiversity Certification Assessment Report (Niche 2015).
- Upper Hunter Strategic Assessment – Greater Ravensworth Biodiversity Certification Assessment Report (Umwelt 2015a).
- Upper Hunter Strategic Assessment – United Collieries Biodiversity Certification Assessment Report (Umwelt 2015b).
- Review of Ecological Assessments for Warkworth Extension EA and HVO South Modification Projects (Umwelt 2011)a
- Hunter Valley Operations – Vegetation Mapping Report (Niche 2011).
- HVO North Modification 3, Carrington West Wing Ecology Assessment (Biosis Research Pty Ltd 2010).

3.1.2 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Footprints was viewed prior to and after vegetation survey to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment, and vegetation community mapping of the Development Footprints.

Vegetation communities in the Development Footprints were mapped on-screen overlaying the June 2021 high resolution aerial photographs. Aerials dated January 2025 were reviewed for any substantial changes to vegetation since the initial review. Mapping was undertaken using the Manifold System 8.0 Enterprise Edition GIS in a 64-bit mode. Use of GIS allowed zooming to a relatively large scale, generally at a scale between 1:1,000 and 1:4,000.

3.1.3 Mapping Vegetation and Native Vegetation Extent

Vegetation mapping was undertaken using best-practice techniques to delineate vegetation communities across the Development Footprint. Vegetation mapping involved the following key steps:

- review of digital airborne imagery (as described in **Section 3.1.2**) to explore vegetation distribution patterns as dictated by change in canopy texture, tone and colour, as well as topography
- review of the modelled distribution of vegetation communities within relevant regional mapping projects and ecological studies related to previous development applications
- predicting the distribution of particular vegetation communities based on understanding the distribution of plant community types (PCTs)
- preparation of a draft vegetation community map based on interpretation of digital airborne imagery and preliminary delineation of vegetation community floristics
- ground-truthing of the vegetation map based on survey effort
- revision of vegetation community floristic delineations based on plot data
- revision of the vegetation map based on ground-truthing.

Vegetation communities were delineated through the identification of repeating patterns of plant species assemblages in each of the identified strata.

The Project utilised the PCT Classification available at the time of commencing the BAM assessment. Following the release of the Revised East Coast PCT Classification Project in April 2023, proponents of SSD projects had two years of transitional arrangements to finalise BAM assessments to continue using the legacy PCTs. These transitional arrangements expired on 14 April 2025. Noting the change to the Project in amending the mine plan, the need to re-submit the EIS and the requirement to re-collect vegetation integrity plots (refer to **Section 3.1.4** below), HVO has elected to apply the Revised East Coast PCT Classification for the BAM assessment moving forward.

3.1.4 Floristic and Vegetation Integrity Survey

A total of 134 vegetation integrity plots have been conducted by Umwelt across the Development Footprints over 29 survey days in March, June, August, September, and October 2020, April 2021, September 2023 and February and March 2025. Plot data was collected in accordance with requirements under the BAM (DPIE 2020a). Plots undertaken in March, June and August 2020 are subject to data currency considerations, noting these were undertaken more than 5 years before this current assessment. These plots, while important for contextual purposes, are not included in the BAM-C and are not relied on for minimum plot requirements in accordance with the BAM or for calculating vegetation integrity scores. Furthermore, some plots are now irrelevant due to vegetation zones no longer proposed to be subject to disturbance. All relevant plots conducted from September 2020 to March 2025, totalling 86, are included in the reporting henceforth. Where plots are contextual only, this is noted.

Rapid assessments were also completed at 101 locations across the Development Footprints during the field surveys, including additional rapid assessments undertaken in October 2021, June, July, August 2022 and May 2023. Each rapid assessment comprised the recording of the dominant canopy and understorey species. The data from the rapid assessments were primarily used to aid in the delineation and refinement of vegetation mapping.

Table 3.1 outlines the floristic plot survey effort and areas of the vegetation zones across the Development Footprints and this is shown on **Figure 3.1** (vegetation mapping and vegetation integrity survey locations are also provided in finer detail in **Annexure C**). It is acknowledged that some BAM plots and rapid assessments were undertaken outside the Development Footprints. This is due to the ongoing refinement of the proposed additional disturbance area and avoidance of biodiversity features throughout the assessment process (refer to **Section 5.0** for detail on avoided impacts). In most cases, plots are located proximate to the Development Footprint. The surveys in these locations are considered representative of the vegetation zones they have been assigned to.

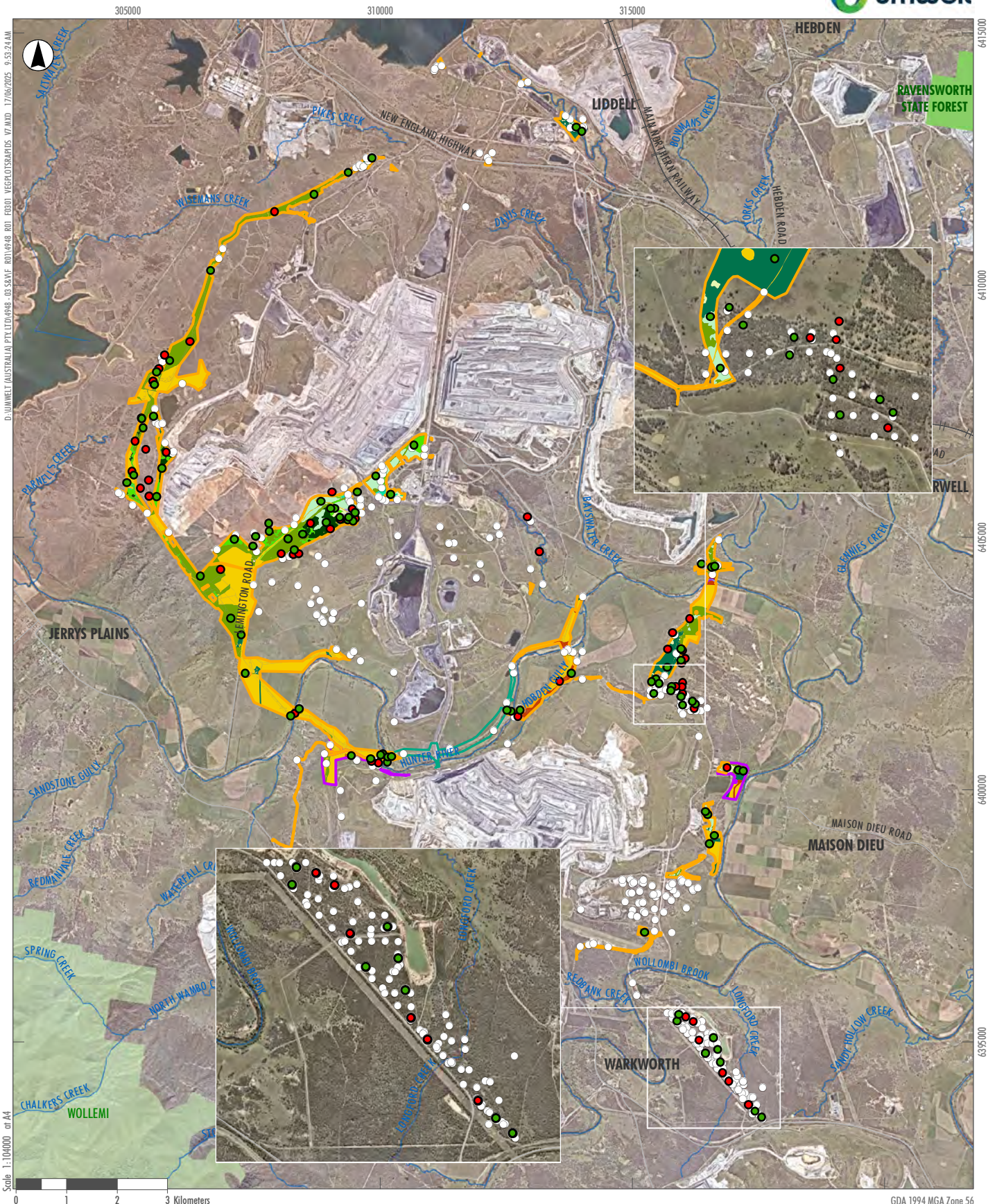
Reference was made to the VIS Classification Database to identify PCTs, as well as reviews of other regional and local vegetation mapping and reporting (refer to **Section 3.1.1**) when designing the field survey. PCTs were stratified into condition states following the initial field survey to determine the appropriate number of transect/plots required in accordance with the BAM (DPIE 2020a).

Table 3.1 Summary of Vegetation Survey in the Development Footprints

Plant Community Type	Vegetation Zone No. and Condition	Development Footprint Area (ha)			Number of BAM Plots Undertaken				
		HVO North	HVO South	Total	HVO North Footprint	HVO South Footprint	Proximate to Footprints	Total Used in BAM-C	Contextual Plots^
3431 - Central Hunter Ironbark Grassy Woodland	1. *Moderate*	64.5	0.5	65.0	7	0	12	19	2
	2. *Thinned Woodland*	11.3	1.9	13.2	3	0	2	5	2
	3. *Woodland with Exotic Understorey*	1.9	0.0	1.9	1	0	1	2	3
	4. *Plantation*	8.2	0.0	8.2	3	0	1	4	3
	5. *Scattered Regeneration*	48.7	0.0	48.7	4	0	1	5	5
	6. *Cooba Woodland*	12.8	0.2	13.0	3	0	2	5	0
	7. *Poor Condition Derived Native Grassland*	284.3	7.1	291.4	9	0	0	9	5
	8. *Exotic Grassland*	58.0	7.4	65.4	6	2	0	8	2
	9. *Bulloak Variant*	35.2	0.0	35.2	3	0	5	8	5
	TOTAL for PCT 3431	**524.9**	**17.1**	**542.0**	**39**	**2**	**24**	**65**	**27**
3485 - Hunter Valley Footslopes Slaty Gum Forest	10. *Moderate*	7.1	0.0	7.1	4	0	0	4	2
	TOTAL for PCT 3485	**7.1**	**0.0**	**7.1**	**4**	**0**	**0**	**4**	**2**
4015 - Central Hunter Swamp Oak Riparian Forest	11. *Moderate*	3.0	0.0	3.0	1	0	1	2	2
	TOTAL for PCT 4015	**3.0**	**0.0**	**3.0**	**1**	**0**	**1**	**2**	**2**
4081 - Northwest River Oak-River Red Gum Forest	12. *Moderate*	4.0	0.0	4.0	2	0	0	2	1
	TOTAL for PCT 4081	**4.0**	**0.0**	**4.0**	**2**	**0**	**0**	**2**	**1**
4089 - Namoi-Upper Hunter River Red Gum Forest	13. *Moderate*	1.0	0.0	1.0	1	0	0	1	2
	14. *Low to Moderate*	0.7	0.1	0.8	1	0	0	1	1
	15. *Cooba Woodland*	0.2	0.6	0.8	1	0	0	1	1
	16. *Derived Native Grassland*	5.0	0.0	5.0	3	0	1	4	1
	17. *Exotic Grassland*	24.6	4.7	29.3	4	1	1	6	1

Plant Community Type	Vegetation Zone No. and Condition	Development Footprint Area (ha)			Number of BAM Plots Undertaken				
		HVO North	HVO South	Total	HVO North Footprint	HVO South Footprint	Proximate to Footprints	Total Used in BAM-C	Contextual Plots^
	TOTAL for PCT 4089	**31.5**	**5.4**	**36.9**	**10**	**1**	**2**	**13**	**6**
Total		**570.5**	**22.5**	**593.0**	**56**	**3**	**27**	**86**	**38**
Category 1 – Exempt Lands	-	330.2	24.7	354.9	-	-	-	-	-
Cleared and non-vegetated land	Non-vegetated	1.2	0.0	1.2	-	-	-	-	-
	Waterbodies/dams	1.3	0.0	1.3	-	-	-	-	-
Total Category 1 and cleared lands		**332.7**	**24.7**	**357.4**	**-**	**-**	**-**	**-**	**-**
TOTAL DEVELOPMENT FOOTPRINT		**903.2**	**47.2**	**950.4**	**-**	**-**	**-**	**-**	**-**

^ Plots undertaken prior to September 2020 (i.e. greater than five years old). Not used in BAM-C assessment.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- Road
- Railway Line
- Drainage Line
- National Parks
- State Forest

Plant Community Types

- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Cleared
- 0 - 0 | Water
- 0 - 0 | Dam
- 1 - 3431 | Moderate
- 2 - 3431 | Thinned Woodland
- 3 - 3431 | Woodland with Exotic Understorey
- 4 - 3431 | Plantation
- 5 - 3431 | Scattered Regeneration
- 6 - 3431 | Cooba Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 9 - 3431 | Bullook Variant
- 10 - 3485 | Moderate
- 11 - 4015 | Moderate
- 12 - 4081 | Moderate
- 13 - 4089 | Moderate
- 14 - 4089 | Low to Moderate
- 15 - 4089 | Cooba Woodland
- 16 - 4089 | Derived Native Grassland
- 17 - 4089 | Exotic Grassland

FIGURE 3.1

Vegetation Integrity Plots and Rapid Assessment Points

Refer to Appendix C for Finer Detail

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

3.1.5 Additional Assessments for *Warkworth Sands Woodland EEC*

As part of the biodiversity assessments undertaken for this Project, *Warkworth Sands Woodland EEC* was identified in areas around Archerfield Road and the South Lemington Pit 1 (SLP1) and highlighted as an important biodiversity feature in the HVO Complex. Specific geomorphological and soil investigations and detailed surveys to determine the extent of the community was undertaken to assist with avoidance, ultimately resulting in complete avoidance of all direct impacts on the community Avoidance is further outlined in **Section 5.2.1** and a summary of the areas of *Warkworth Sands Woodland EEC* avoided as part of the Project is provided in **Table 5.7**.

3.1.5.1 Geomorphological and Soil Investigations

Geomorphological field investigations were undertaken on 24 and 25 February 2021 to assess the likely extent of aeolian sand near Archerfield Road and South Lemington Pit 1 (SLP1) to assist in the determination of *Warkworth Sands Woodland EEC* in the Development Footprints and the locality following soil investigations by Minesoils (2020). Whilst the field surveys provided information about soil profile forms, indicative grain size and mineral composition at test pits established in a variety of geomorphic contexts, this information was not sufficient to confirm which profiles are aeolian, fluvial sand or part of a Permian soil profile, because of the potential for bioturbation (mixing) of sand from various sources at any one location. Furthermore, the Final Determination for the *Warkworth Sands Woodland EEC* refers to its presence on sand dunes generally 1–6 m high, but does not rule out adjacent areas that contain sand on a shallow A horizon or thin veneers of sand where characteristic species are recorded.

For the purposes of this assessment, as the soil sampling and geomorphological investigations did not conclusively determine that the sand present in the locality was of aeolian origin, where the sand could not be proven to be non-aeolian, the precautionary principle was applied and it was considered to be aeolian.

3.1.5.2 Additional Investigations Delineating *Warkworth Sands Woodland EEC* around Archerfield Road

Following the public exhibition of the EIS, further avoidance measures were investigated in relation to the location of the proposed Lemington Road re-alignment relevant to impacts on *Warkworth Sands Woodland EEC*. Previous *Warkworth Sands Woodland EEC* mapping undertaken by Umwelt identified ecotonal (transition) zones to the west of the original proposed alignment (shown as 'possible WSW' on the original BDAR figures (Umwelt 2022), where the depth of potential aeolian sandy substrate varies and floristic characteristics appear to favour box-ironbark woodland associations.

In further effort to minimise impacts of the Project, HVO conducted additional detailed investigations to move the proposed Lemington Road re-alignment further to the west with the aim of avoiding the HVO North Project's overall impacts to areas of known/accepted *Warkworth Sands Woodland EEC*.
The additional design review sought an alignment that considered:

- Adopting an alignment further away (west) on land that transitions away from known/accepted *Warkworth Sands Woodland EEC.*
- Adopting an alignment further away from existing biodiversity offset areas where *Warkworth Sands Woodland EEC* is present.

- Further minimising the Project disturbance footprint of the proposed road corridor through remnant vegetation utilising areas of existing disturbance or rehabilitation areas at HVO.

- Maintaining the already established principle design requirements.

Following consideration of the above, a revised portion of the Lemington Road re-alignment was developed that was then subject to ecological assessment for verification of predicted impacts.

As part of additional vegetation surveys for the revised re-alignment of Lemington Road, a review of areas previously considered to have the potential to contain *Warkworth Sands Woodland EEC* were inspected by Travis Peake (Umwelt's National Ecology Leader), Adam Cavallaro (Umwelt Principal Restoration Ecologist) and Clayton Richards (Soil Scientist, Minesoils) on 5 September 2023. The aim of the works was to confirm the extent of the EEC within and adjacent to the new alignment of the road to support additional avoidance measures. Previous assessments had focused on areas that were part of earlier iterations of the proposed Development Footprint, therefore any assessments outside these areas were rapid without detailed vegetation mapping carried out.

The site inspection focused on areas where the new alignment is proposed to be situated and areas previously assigned as possible *Warkworth Sands Woodland EEC.* The previously mapped possible *Warkworth Sands Woodland EEC* adopted a conservative approach based on the presence of a sandy substrate that could not conclusively be ruled out as aeolian sands. During the site inspection some areas previously assigned to be possible *Warkworth Sands Woodland EEC* were assessed by undertaking a rapid field inspection of vegetation focusing on areas with a canopy and recording domain species across the canopy, shrub layer and groundlayer stratums. Focus areas were selected generally to coincide with the location of previous soil sampling areas undertaken by Minesoils (2023) (refer to **Annexure I**).

An additional floristic / vegetation integrity plot (Q92) was collected within the new alignment to inform the PCT selection in this area. Vegetation composition was assessed in areas that were confirmed to have a sand dominant substrate and where a thin veneer of sand over clay was present. The areas were re-excavated by Minesoils at the time of the inspection and vegetation was assessed to determine the species composition within a 30 m radius of the point.

The rapid assessment data and visual inspection information was analysed with data from previously collected vegetation integrity data (ten plots including the new plot) in areas previously mapped as possible *Warkworth Sands Woodland EEC* and accepted/known *Warkworth Sands Woodland EEC*. The analysis focused on diagnostic species from the two PCTs regarded as likely to occur in the area containing PCT3431 and PCT3636. In addition, emphasis was placed on determining the association of the vegetation with TECs from the area. An analysis of characteristic species as listed in the Final Determination (NSW Scientific Committee 2011a) of *Warkworth Sands Woodland EEC* was undertaken. Where data had a weak association with the *Warkworth Sands Woodland EEC* an analysis against characteristic species for the *Central Hunter Grey Box—Ironbark Woodland EEC* was undertaken as this TEC has been confirmed through the presences of the associated PCT3431 in the road alignment.

As a result of the avoidance measures, no areas of *Warkworth Sands Woodland EEC* are expected to be impacted by the revised Lemington Road re-alignment. Further details on the results of the assessment are included in **Section 5.2.1.1**.

3.1.6 Threatened Ecological Community Delineation Techniques

Vegetation communities identified in the Development Footprints were compared to TECs listed under the NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations was undertaken. The following approach was used:

- full-floristic quadrat assessment, rapid assessments and meandering survey to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the NSW Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the NSW DPE
- comparison with other assessments of TECs in the region.

3.1.7 PCT Allocation

PCT allocation across the whole of the Subject Land adopts the new east coast PCT classification, which includes PCT numbers above 3000. The east coast classification covers the coast and tablelands bioregions of eastern NSW.

Assignment of vegetation within the Subject Land to 'best fit' PCTs involved following key steps:

- initial PCT allocation with reference to: rapid field data points, regional mapping, PCT profiles and the PCT filter tool in the BioNet VCD
- Quantitative analysis of floristic plot data using the Plot to PCT Tool to further refine PCT allocation.

In early stages, qualitative vegetation data recorded during field surveys was reviewed to allow for preliminary allocation of PCTs across the Subject Land. The rapid vegetation points were sampled across the landscape with the intent to capture all vegetation types and condition zones, and included information such as dominant species in each strata, landscape position, soils, and proportion of exotic species. This information was used to compare against the descriptive attributes of likely PCTs known from within the region. For more accurate allocation of PCTs, where sufficient floristic data was available, dominant species were entered into the PCT filter tool in the BioNet VCD to identify appropriate matches.

A total of 61 plots sampled within the Subject Land were uploaded to the Eastern NSW Plot to PCT Assignment Tool for analysis (DPHI 2025). This included plots sampled in woodland zones that contained multiple stratum (i.e. Moderate, Thinned, Woodland with Exotic Understorey, Scattered Regeneration) only. Derived Native Grassland plots were not included in the analysis as it is anticipated the results of these would be weaker due to the floristic and structural modifications.

The Plot to PCT tool allows for standardised, quantitative analysis of floristic plot data sampled within the east coast classification area. The tool was utilised to interrogate the relative similarity of each plot uploaded against similar PCTs. The analysis outputs contribute to confidence in PCT selection and strengthening justifications, particularly for PCTs that are difficult to split from qualitative assessment.

The most effective analysis output from the tool is the top ten 'centroid' matches linked with environmental variables including rainfall, elevation and temperature. The centroid matching method determines how floristically related each plot is to PCTs based on the species present and their cover abundance scores. The smaller the 'distance to centroid' value is, the stronger the match is. Ideally, a good match is below the specified threshold of 0.695. The top centroid matches can be filtered by the environmental variables (such that you remove any PCTs that do not fit within the environmental variables at the plot sampling location) to close in on the best fit PCT. The outputs from the centroid matching analysis can be complemented by looking at the 'Characteristic Species' method, which provides the top ten PCTs based on similarity in floristics, not considering relative abundance. The tool suggests that the Characteristic species matching method should not be used in isolation from the centroid matching method, as it is still under development. However, it can still be useful, particularly where the results of the centroid matching are weak. The tool also provides a map of publicly available plots from the BioNet Atlas, which allows you to view and compare the PCT allocation for plots nearby to your sampled plots.

A comprehensive review of the Plot to PCT Tool outputs was undertaken for all 61 plots analysed. Multiple plots were considered together if sampled in vegetation from the same patch or otherwise having similar floristic, structural and landscape characters. The analysis considered all PCTs in the Plot to PCT Tool output, then refined that to a short list of two or three for more detailed comparison. The centroid values, characteristic species matches, environmental variables thresholds, the descriptive attributes/species by growth form from the PCT profiles as well as the SVTM were all considered thoroughly before determining the best fit PCT to allocate to each individual plot or group of plots.

3.2 Results

3.2.1 Native Vegetation Extent

As outlined in **Table 3.2**, the Development Footprints are substantially (78.8%) dominated by derived and modified vegetation types (i.e. native and exotic grasslands) and Category 1 – Exempt Land (refer to **Section 2.3**). Only approximately 21.2% of the combined Development Footprints are covered by native (woody) vegetation.

Furthermore, a large area (approximately 313.1 ha) occurs within the wider easement area, not currently proposed for impacts, but included in the Development Footprint until the final design is determined.

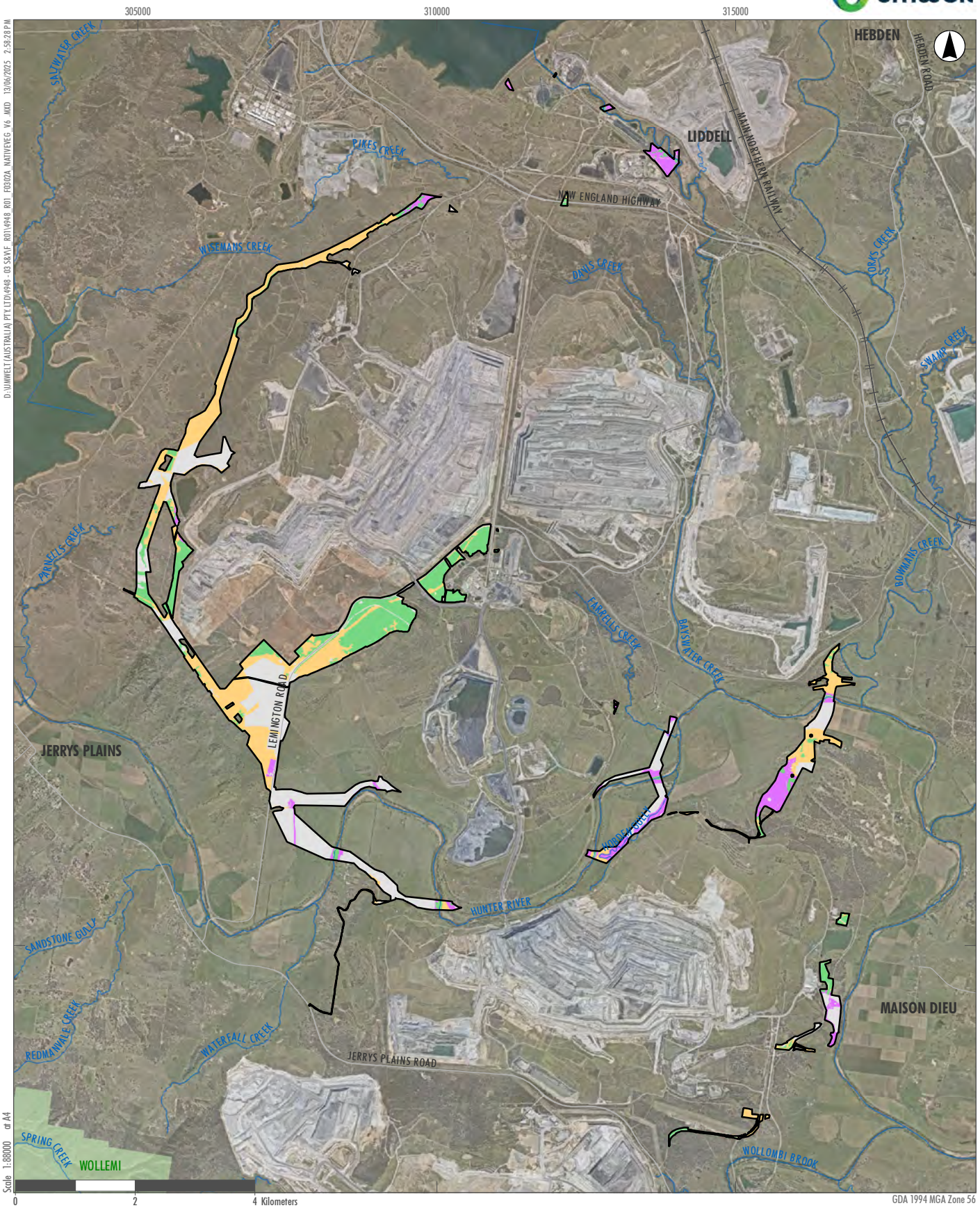
Where native vegetation extent mapping was undertaken outside the Disturbance Footprints (and therefore access was not always available for on-ground verification), reference was made to the non-native vegetation mapping provided in the Greater Hunter Vegetation Map (Sivertsen *et al* 2011), the SVTM (NSW DCCEEW 2024) and cross-referenced with digital aerial photography.

Figure 3.2A and **Figure 3.2B** shows the native vegetation extent in the Development Footprints and **Figure 2.2A** and **Figure 3.2B** shows the native vegetation extent the 1500 m buffer.

Table 3.2 Vegetation and Non-Native Cover in the Development Footprints

Cover Type	Condition Types	Area (ha)			Overall % Cover
		HVO North	HVO South	Total	
Native vegetation cover	Native vegetation (woody)	198.6	3.3	201.9	21.2%
	Derived native grassland (non-woody)	289.2	7.1	296.3	31.2%
Total native cover		**487.8**	**10.4**	**498.2**	**52.4%**
Non-native vegetation and excluded lands	Exotic vegetation*	82.6	12.1	94.7	10.0%
	Category 1 – Exempt Land under the LLS Act	330.3	24.7	355.0	37.3%
	Cleared land (roads, infrastructure, dams)	2.5	0.0	2.5	0.3%
Total non-native/excluded lands cover		**415.4**	**36.8**	**452.2**	**47.6%**

** Includes Exotic Grassland condition types (Vegetation Zones 8 and 17). While it is acknowledged these areas include some native species, they are primarily dominated by exotic vegetation (i.e. on average greater than 50% exotic cover and less than 15% native cover). Furthermore, these zones are below the minimum offsetting threshold in this BAM assessment.*



Legend

- HVO North Development Footprint
- Railway Line
- Road
- Drainage Line
- National Parks

Native Vegetation Extent

- Native Vegetation (Woody)
- Native Vegetation (Non-Woody)
- Exotic Vegetation
- Cleared Land
- Category 1 - Exempt Land

FIGURE 3.2A

HVO North Native Vegetation Extent

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

Legend

- HVO South Development Footprint
- Road
- Drainage Line

Native Vegetation Extent

- Native Vegetation (Woody)
- Native Vegetation (Non-Woody)
- Exotic Vegetation
- Cleared Land
- Category 1 - Exempt Land

FIGURE 3.2B

HVO South Native Vegetation Extent

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

3.2.2 Plant Community Types and Vegetation Zones

Surveys of the HVO North and HVO South Development Footprints identified five PCTs across 17 condition zones as outlined in **Table 3.3** below. These communities were aligned with PCTs in accordance with the Revised East Coast PCT classification as described in the BioNet Vegetation Classification. The PCTs were then stratified into broad condition states (vegetation zones).

Refer to **Figure 3.3A** and **Figure 3.3B** for PCT and vegetation zone mapping across the Development Footprints. Noting the large size of the Development Footprints, **Annexure C** provides vegetation zone mapping in finer detail. In accordance with the BAM, digital files of PCT and vegetation zone boundaries have been provided at submission.

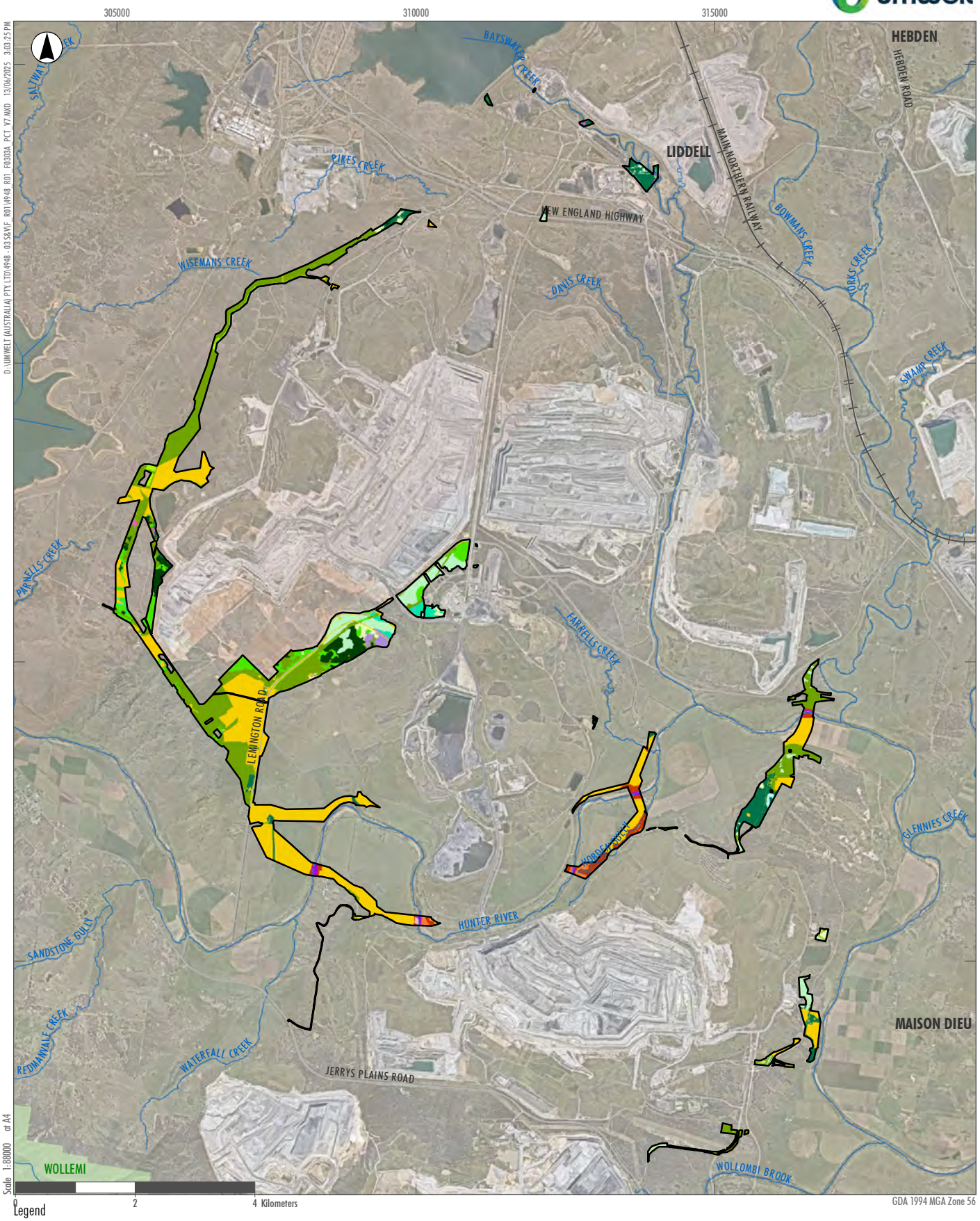
All assessments of PCTs and vegetation zones used in the BAM-C referred to the standard benchmark data provided by the BioNet Vegetation Classification.

Note that the areas quoted in **Table 3.3** include all vegetation within the Development Footprints. This includes all native woody and non-woody vegetation and exotic vegetation as outlined in **Table 3.2**.

Table 3.3 Plant Community Types and Vegetation Zones

Plant Community Type	Vegetation Zone and Condition	Area (ha)			Patch Size Class
		HVO North	HVO South	Total	
3431 - Central Hunter Ironbark Grassy Woodland	1. *Moderate*	64.5	0.5	65.0	>100 ha
	2. *Thinned Woodland*	11.3	1.9	13.2	>100 ha
	3. *Woodland with Exotic Understorey*	1.9	0.0	1.9	>100 ha
	4. *Plantation*	8.2	0.0	8.2	>100 ha
	5. *Scattered Regeneration*	48.7	0.0	48.7	>100 ha
	6. *Cooba Woodland*	12.8	0.2	13.0	>100 ha
	7. *Poor Condition Derived Native Grassland*	284.3	7.1	291.4	>100 ha
	8. *Exotic Grassland*	58.0	7.4	65.4	< 5 ha
	9. *Bulloak Variant*	35.2	0.0	35.2	>100 ha
	TOTAL for PCT 3431	**524.9**	**17.1**	**542.0**	
3485 - Hunter Valley Footslopes Slaty Gum Forest	10. *Moderate*	7.1	0.0	7.1	>100 ha
	TOTAL for PCT 3485	**7.1**	**0.0**	**7.1**	
4015 - Central Hunter Swamp Oak Riparian Forest	11. *Moderate*	3.0	0.0	3.0	>100 ha
	TOTAL for PCT 4015	**3.0**	**0.0**	**3.0**	
4081 - Northwest River Oak-River Red Gum Forest	12. *Moderate*	4.0	0.0	4.0	>100 ha
	TOTAL for PCT 4081	**4.0**	**0.0**	**4.0**	

Plant Community Type	Vegetation Zone and Condition	Area (ha)			Patch Size Class
		HVO North	HVO South	Total	
4089 - Namoi-Upper Hunter River Red Gum Forest	13. *Moderate*	1.0	0.0	1.0	>100 ha
	14. *Low to Moderate*	0.7	0.0	07	>100 ha
	15. *Cooba Woodland*	0.2	0.6	0.8	>100 ha
	16. *Derived Native Grassland*	5.0	0.0	5.0	>100 ha
	17. *Exotic Grassland*	24.6	4.7	29.3	< 5 ha
	TOTAL for PCT 4089	**31.5**	**5.3**	**36.8**	
Total Vegetation		**570.5**	**22.4**	**592.9**	



Legend

- HVO North Development Footprint
- Railway Line
- Road
- Drainage Line
- National Parks

Plant Community Types

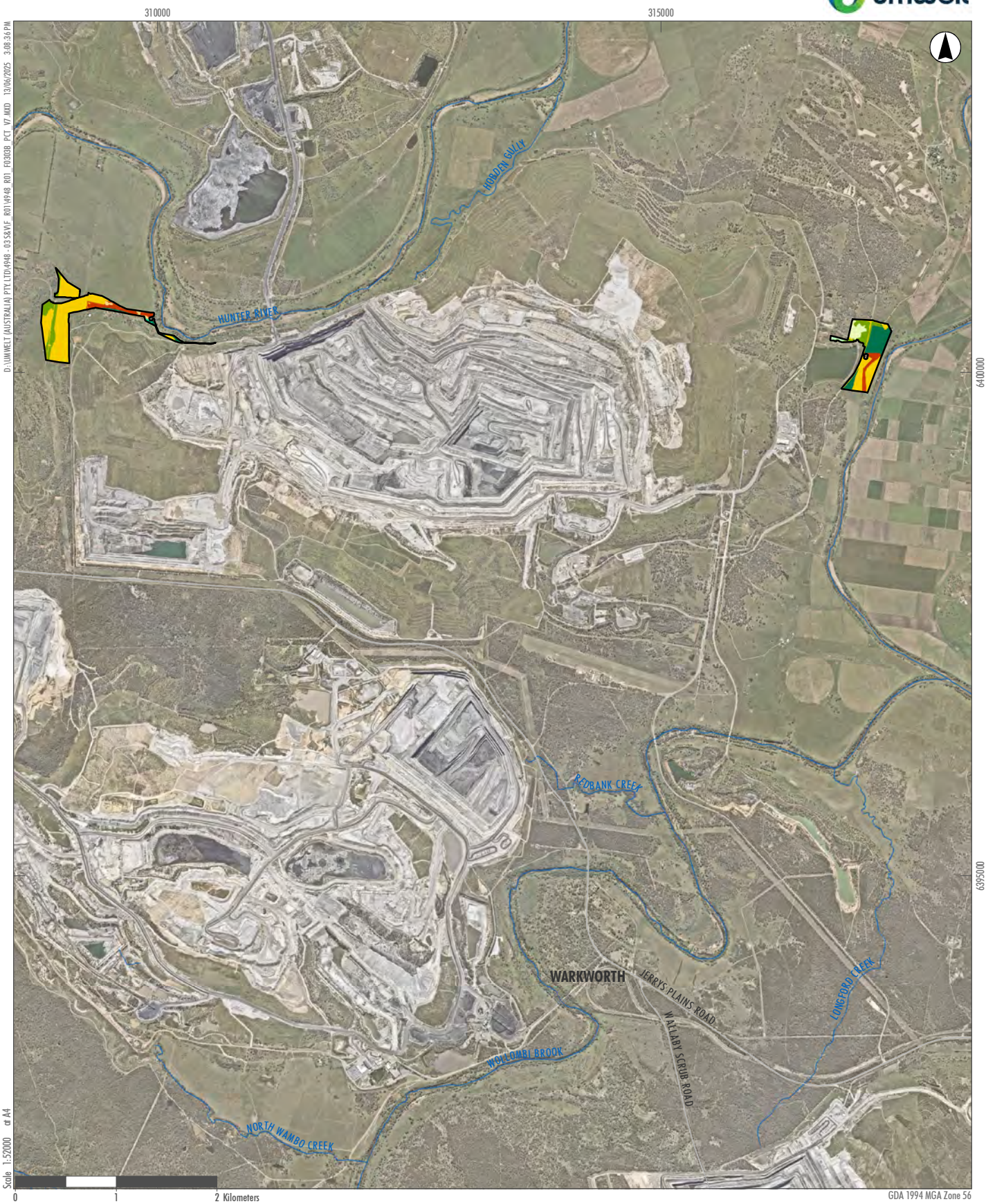
- 0 - 0 I Category 1 - Exempt Land
- 0 - 0 I Cleared
- 0 - 0 I Water
- 0 - 0 I Dam
- 1 - 3431 I Moderate
- 2 - 3431 I Thinned Woodland
- 3 - 3431 I Woodland with Exotic Understorey
- 4 - 3431 I Plantation
- 5 - 3431 I Scattered Regeneration
- 6 - 3431 I Cooba Woodland
- 7 - 3431 I Poor Condition Derived Native Grassland
- 8 - 3431 I Exotic Grassland
- 9 - 3431 I Bulloak Variant
- 10 - 3485 I Moderate
- 11 - 4015 I Moderate
- 12 - 4081 I Moderate
- 13 - 4089 I Moderate
- 14 - 4089 I Low to Moderate
- 15 - 4089 I Cooba Woodland
- 16 - 4089 I Derived Native Grassland
- 17 - 4089 I Exotic Grassland

FIGURE 3.3A

HVO North PCT and Vegetation Zone Mapping

Refer to Appendix C Figure for detailed vegetation mapping

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)



Legend

- HVO South Development Footprint
- Road
- Drainage Line

Plant Community Types

- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Cleared
- 1 - 3431 | Moderate
- 2 - 3431 | Thinned Woodland
- 6 - 3431 | Cooba Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 17 - 4089 | Exotic Grassland
- 16 - 4089 | Derived Native Grassland
- 15 - 4089 | Cooba Woodland

FIGURE 3.3B

HVO South PCT and Vegetation Zone Mapping

Refer to Appendix C Figure for detailed vegetation mapping

Image Source: Nearmap (April 2025)) Data source: NSW DFSI (2024)

3.2.2.1 PCT 3431 – Central Hunter Ironbark Grassy Woodland

PCT 3431: Central Hunter Ironbark Grassy Woodland	
Legacy PCTs (as per allocations in Umwelt 2023)	1691: Grey Box – Narrow-leaved ironbark – Grey Box grassy woodland of the central and upper Hunter PCT 1692: Bull Oak grassy woodland of the central Hunter Valley
Vegetation Formation	Dry Sclerophyll Forests (Shrub/grass sub-formation)
Vegetation Class	Hunter-Macleay Dry Sclerophyll Forests
Percent Cleared	86.47%
VCD Description for PCT 3431 A tall sclerophyll open forest or woodland with a sparse cover of dry shrubs and a mid-dense grassy ground layer that occurs mainly on the undulating floor of the central Hunter valley with scattered areas on adjoining ranges. The canopy very frequently includes *Eucalyptus crebra* with a high foliage cover, either exclusively or occasionally in association with *Eucalyptus moluccana* (and or its hybrid with *Eucalyptus albens*). *Allocasuarina luehmannii* is common, either in the mid-stratum or as a member of the canopy where eucalypt species are regenerating. The mid-stratum very frequently includes only a sparse cover, with occasional *Notelaea microcarpa* or *Maireana microphylla* and rarely the lower growing chenopod shrub *Enchylaena tomentosa*. Taller species of Acacia, such as *Acacia salicina* and *Acacia falcata*, are rare. The mid-dense ground layer is mainly comprised of a high diversity of grasses and forbs with some graminoids, twiners, hardy ferns, low-growing shrubs and sedges. The layer very frequently includes *Aristida ramosa, Glycine tabacina, Cymbopogon refractus, Cheilanthes sieberi* subsp*. sieberi, Dichondra repens* and the prostrate shrub *Eremophila debilis*. Other common grasses include *Eragrostis leptostachya, Microlaena stipoides, Austrostipa scabra* and *Bothriochloa decipiens* var*. decipiens*. This PCT is most extensively distributed on low-gradient Permian sediments across the central Hunter valley between the Rothbury, Muswellbrook and Wybong districts, where it primarily occurs in small, often disturbed patches in a landscape dominated by agriculture and coal mining. It is also found in small areas on the low hills that rise north-east from Muswellbrook on Carboniferous sediments but only on exposed slopes and crests below around 400 metres asl. Across its range the PCT occupies warm, dry environments with a mean annual rainfall typically below 750 mm. This PCT is related both floristically and spatially to several other grassy forest and woodland PCTs in the central Hunter. PCT 3314 also is widespread on the Permian sediments but is associated with rises and areas of greater relief, is generally shrubbier and only rarely includes *Eucalyptus crebra*. PCT 3485 shares many of the ground cover species in a similar topographic position however differs in that *Eucalyptus dawsonii* is very frequently recorded with a high foliage cover and is almost absent from this PCT. On the Carboniferous sediments it grades into PCT 3525.	
PCT Description within the Development Footprints	
Landscape position	This vegetation zone is diffused throughout the Development Footprints.
Overall Description	Across the Subject Land, there are numerous condition zones of PCT 3431, attributed to the history of disturbance across the Subject Land. The moderate condition zone is characterised by an open canopy up to 22 m in height and dominated by narrow-leaved ironbark (*Eucalyptus crebra*), with occurrences of grey box (*Eucalyptus moluccana*) and bulloak (*Allocasuarina luehmannii*). A range of other shrub/small tree species may also be present at low density. The mid-dense ground stratum supports a variety of native grasses and forbs. Condition zones have been stratified to reflect the variation across this vegetation type, including exotic understorey, natural regeneration and plantings.
Upper stratum species (Characteristic species from the higher condition zones VZ1 and VZ2)	*Eucalyptus crebra, Eucalyptus moluccana, Eucalyptus blakelyi, Angophora floribunda, Allocasuarina luehmannii, Brachychiton populneus*

PCT 3431: Central Hunter Ironbark Grassy Woodland	
Mid-stratum species (Characteristic species from the higher condition zones VZ1 and VZ2)	*Acacia salicina, Acacia amblygona, Breynia oblongifolia, Geijera salicifolia, Notelaea microcarpa, Solanum cinereum*
Ground stratum species (Characteristic species from the higher condition zones VZ1 and VZ2)	*Aristida ramosa, Austrostipa verticillata, Bothriochloa decipiens, Brunoniella australis, Cheilanthes sieberi subsp. sieberi, Chrysocephalum apiculatum, Cymbopogon refractus, Cynodon dactylon, Digitaria diffusa, Einadia hastata, Eremophila debilis, Enchylaena tomentosa, Glycine tabacina, Hibbertia linearis, Lomandra multiflora subsp. multiflora, Microlaena stipoides*
Introduced Species	A range of introduced species were recorded throughout the various condition states of this PCT. The most commonly recorded introduced shrubs were African olive (*Olea europaea* subsp. *cuspidata*), African boxthorn (*Lycium ferocissimum*), black-berry nightshade (*Solanum nigrum*) and Paddy's lucerne (*Sida rhombifolia*). Common ground cover weeds were galenia (*Galenia pubescens*), perennial ryegrass (*Lolium perenne*), fireweed (*Senecio madagascariensis*), lamb's tongues (*Plantago lanceolata*) and Coolatai grass (*Hyparrhenia hirta*).
Alignment with BC Act TECs	The higher condition zones of this PCT were found to be consistent with the *Central Hunter Grey Box – Ironbark Woodland* EEC, however VZ5, VZ6, VZ7 and VZ8 were excluded owing to their disturbed state and therefore absence of key characters of the TEC. VZ9 (Bulloak Variant) does not conform to this TEC due to the high dominance of bulloak. A very small area (0.05 ha) of PCT3431 Poor Condition DNG (VZ7) conforms to *Weeping Myall Woodland in the Sydney Basin Bioregion CEEC* due to patches of *Acacia pendula* occurring within the grassland. This area is not within the area of proposed impact and therefore has not been entered into the BAM-C. Refer to **Section 3.2.4** for further justification.
Justification for PCT selection	This vegetation type was aligned with PCT 3431 as it supports a number of the species and stratum specifics identified for the PCT as listed on the VCD (DCCEEW 2025). Its canopy is dominated by narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*Eucalyptus moluccana*), being the two key diagnostic canopy species of PCT 3431. PCT 3431 is most extensively distributed on low-gradient Permian sediments across the central Hunter valley between the Rothbury, Muswellbrook and Wybong districts which aligns with the location and geology of the Subject Land. PCT 3431 is widely mapped on the SVTM in and around the Subject Land. This vegetation was originally allocated to PCT 1691 in the legacy classification system, with the lineage history showing that PCT has now been split to 3314 and 3431 which are both closely aligned. Note that VZ9 (Bulloak Variant) was allocated to PCT 1692 in the legacy system, which is now also aligned with PCT 3431 under the new classification. Detailed analysis for the plot data from the PCT 1692 plots was undertaken separately from the PCT 1691 plots to ensure PCT 3431 is the best fit for VZ9. Under the new classification, there is no PCT for a bulloak dominated veg type, and as such this zone is now included with PCT 3431, as a separate condition zone (Bulloak variant). An analysis using the VCD filter tool and the Plot to PCT tool was undertaken to determine the best fit PCT. A total of 42 plots sampled in this vegetation type (using contextual plots undertaken prior to September 2020 and more recently completed plots included in the BAM-C, but not including highly degraded condition zones and DNG) were entered to the Plot to PCT tool, 41 of which were matched with PCT 3431. Of these, 24 plots had 3431 as the top match and 34 plots had a distance to centroid value of <0.695 (indicating a strong relationship).

PCT 3431: Central Hunter Ironbark Grassy Woodland				
	PCT 3314 was the top match for only four of the 43 plots in this vegetation type. As a result of a detailed analysis, PCT 3431 was determined the best fit for this vegetation type within the Subject Land. Of the other PCTs matched from the tool, those further considered are listed below, however all were discounted for various reasons as stated. **Other PCTs Considered** **3314 Central Hunter Slopes Grey Box Forest** PCT 3314 and 3431 are closely aligned. The key differing factors between the two, as described in the VCD is that PCT 3314 is associated with rises and areas of greater relief (i.e. higher elevation areas off the valley floor), is generally shrubbier and only rarely includes narrow-leaved ironbark (*Eucalyptus crebra*). Where this vegetation type was mapped within the Subject Land, narrow-leaved ironbark (*Eucalyptus crebra*) is dominant in the canopy and is very sparsely shrubby (except in some disturbed condition states where colonising shrubs such as cooba (*Acacia salicina*) may be in higher density). The VCD describes PCT 3431 as very frequently including narrow-leaved ironbark (*Eucalyptus crebra*) with a high foliage cover, either exclusively or occasionally in association with grey box (*Eucalyptus moluccana*) (and or its hybrid with *Eucalyptus albens*). As stated above, the Plot to PCT tool outputs provide further validation that this vegetation is more closely aligned with PCT 3431 than 3314. **3485 Central Hunter Slaty Gum Grassy Forest** PCT 3485 is closely aligned with PCT 3431, comprising a number of similar understorey species and sharing the same landscape position somewhat. However, PCT 3485 differs in that slaty box (*Eucalyptus dawsonii*) is the characteristic tree species, whereas PCT 3431 is characterised by a dominance of narrow-leaved ironbark (*Eucalyptus crebra*), which is consistent with this vegetation. As such, PCT 3431 is considered to be a better fit for this vegetation type.			
Vegetation Zone (VZ)	**Condition**	**Area (ha)**	**Plots Used in BAM-C**	**VI Score**
VZ1	Moderate	HVO North - 64.5 HVO South – 0.5	P47, P50, P59, P69, P70, P71, P72, P74, P75, P76, P77, P78, P83, P84, P88, P92, P114, P129, P132	57.9
VZ2	Thinned Woodland	HVO North - 11.3 HVO South – 1.9	P55, P60, P85, P130, P145	53.8
VZ3	Woodland with Exotic Understorey	HVO North - 1.9 HVO South – 0.0	P116, P117	22.1
VZ4	Plantation	HVO North - 8.2 HVO South – 0.0	P58, P147, P148, P150	47.0
VZ5	Scattered Regeneration	HVO North - 48.7 HVO South – 0.0	P56, P120, P133, P141, P153	46.5
VZ6	Cooba Woodland	HVO North - 12.8 HVO South – 0.2	P64, P65, P66, P126, P127	47.8

PCT 3431: Central Hunter Ironbark Grassy Woodland				
VZ7	Poor Condition Derived Native Grassland	HVO North - 284.2 HVO South – 7.1	P48, P63, P111, P123, P128, P142, P146, P149, P154	16.2
VZ8	Exotic Grassland	HVO North - 58.0 HVO South – 7.4	P49, P51, P62, P112, P113, P115, P144, P155	12.9
VZ9	Bulloak Variant	HVO North - 35.2 HVO South – 0.0	P57, P73, P82, P89, P90, P125, P151, P152	41.4
VZ1 Moderate This vegetation zone is in good condition with tree canopy present, mid stratum present but sparse (as is typical for this PCT) and a ground layer dominated by native grasses and a small component of native forbs.				
VZ2 Thinned Woodland This vegetation zone is similar in floristics and structure to VZ1 (Moderate), however has a more open canopy due to previous clearing and disturbance.				

PCT 3431: Central Hunter Ironbark Grassy Woodland	
VZ3 Woodland with Exotic Understorey This vegetation zone, similar to VZ2, has a sparse canopy due to previous clearing. This zone differs in that the ground cover is dominated by exotic species such as *Eragrostis curvula*, *Galenia pubescens*, *Sida rhombifolia* and *Senecio madagascariensis*. Occasionally the native *Cynodon dactylon* is in higher abundance. Regenerating Eucalypts may be present.	
VZ4 Plantation This vegetation zone has an open canopy which reaches up to 18 m in height and is comprised of mixed planted eucalypts, including *Corymbia maculata*, *Eucalyptus blakleyii, Eucalyptus camaldulensis*, *Eucalyptus saligna* and river red gum x flooded gum hybrid (*Eucalyptus camaldulensis–grandis*). The mid-storey is generally absent, or occasionally sparse.	
VZ5 Scattered Regeneration This vegetation zone has scattered occurrences of *Acacia salicina* and *Allocasuarina luehmannii* up to 10 m high. The sparse mid-storey reaches up to 4 m in height and is comprised of *Geijera salicifolia*, *Notelaea microcarpa* var. *microcarpa* and regenerating canopy species. The mid-dense ground stratum is dominated by native grasses.	

PCT 3431: Central Hunter Ironbark Grassy Woodland	
VZ6 Cooba Woodland This vegetation zone has a sparse canopy of *Acacia salicina*, generally up to 6 m in height, occasionally taller. Other native shrubs characteristic of PCT 3431 may occasionally present. The mid-dense to dense ground stratum comprises native grasses and forbs.	
VZ7 Poor Condition Derived Native Grassland A canopy layer is absent from this vegetation zone, however occasional low trees/shrubs may be present. The dense ground stratum is dominated by native grasses and forbs.	
VZ8 Exotic Grassland This zone is largely characterised by a dense grassy layer dominated by exotics such as *Eragrostis curvula*), *Cenchrus clandestinus*, *Chloris gayana* and *Galenia pubescens*. Areas of native couch (*Cynodon dactylon*) and *Imperata cylindrica* are occasionally interspersed within this zone. Occasional scattered and widely spaced mature paddock trees (characteristic of PCT 3431) occur in this zone.	

PCT 3431: Central Hunter Ironbark Grassy Woodland	
VZ9 Bulloak Variant This vegetation zone has a dense canopy dominated by *Allocasuarina luehmannii* with occurrences of *Eucalyptus crebra*. Occasional native shrubs/low trees may be present. The sparse ground stratum is dominated by native grasses and herbs.	

3.2.2.2 PCT 3485 – Grey Box – Hunter Valley Footslopes Slaty Gum Forest

PCT 3485: Central Hunter Slaty Gum Grassy Forest	
Legacy PCT (as per allocations in Umwelt 2023)	1655: Grey Box – Slaty Box shrub-grass woodland on sandstone slopes of the upper Hunter and Sydney Basin
Vegetation Formation	Forested Wetlands
Vegetation Class	Eastern Riverine Forests
Percent Cleared	89.57%
VCD Description for PCT 3485 A tall to very tall sclerophyll open forest with a sparse shrub layer and a patchy, grassy ground cover occurring on Permian sediments on gentle slopes and rises in a restricted region between Warkworth and Wybong in the central Hunter valley. The canopy very frequently includes a high cover of *Eucalyptus dawsonii*, either exclusively or occasionally in association with *Eucalyptus moluccana*. The sparse mid-stratum very frequently includes scattered chenopods (*Einadia nutans*, *Enchylaena tomentosa* or *Maireana microphylla*) and commonly *Notelaea microcarpa*. One or more Acacia species may also be present, but individual species such as *Acacia salicina* are only occasional to rare. The sparse ground layer is typically comprised of low shrubs, grasses, forbs and a ground fern, and very frequently includes *Eremophila debilis*, *Glycine tabacina*, *Sporobolus creber*, *Aristida ramosa*, *Sida corrugata*, *Austrostipa scabra* and *Dichondra repens*. This PCT occurs in a warm, dry environment with a mean annual rainfall typically below 650 mm. It is related both floristically and spatially to several other grassy forest and woodland PCTs in the central Hunter valley. It shares a strong floristic overlap with both PCT 3314 and PCT 3431 as the ground cover species and shrubs are very similar and both occur on Permian sediments. *Eucalyptus dawsonii* is rarely recorded in these PCTs. However, this eucalypt is a characteristic species of other PCTs in the region (PCT 3497 and PCT 3490) which occur on poorer soils and with a diverse shrub layer with a less diverse assemblage of grasses and forbs.	
PCT Description within the Development Footprint	
Landscape position	This vegetation zone occurs in the central part of the Development Footprint at HVO North, on the slopes to the south of the existing Lemington Road.

PCT 3485: Central Hunter Slaty Gum Grassy Forest	
Overall Description	This vegetation zone has an open canopy of up to 20 metres in height, dominated by slaty gum (*Eucalyptus dawsonii*) and grey box (*Eucalyptus moluccana*). The low tree layer, dominated by bulloak (*Allocasuarina luehmannii*), is generally sparse and reaches up to 12 m in height. The sparse ground stratum is dominated by native herbs, rushes and grasses.
Upper stratum species	*Eucalyptus dawsonii, Brachychiton populneus, Eucalyptus moluccana, Allocasuarina luehmannii*
Mid-stratum species	*Acacia salicina, Notelaea microcarpa, Geijera salicifolia, Teucrium junceum*
Ground stratum species	*Bothriochloa decipiens, Aristida ramosa, Enteropogon acicularis, Chloris ventricosa, Paspalidium distans, Cymbopogon refractus, Lomandra filiformis, Arthropodium milleflorum, Brunoniella australis, Glycine tabacina, Rytidosperma monticola, Dichondra repens, Elymus scaber, Oxalis perennans, Austrostipa verticillata, Calotis lappulacea, Phyllanthus virgatus, Sida corrugata*
Introduced Species	Exotic species generally occur in low to moderate abundance. African olive (*Olea europaea* subsp. *cuspidata*) occurs sporadically in the mid-storey of this vegetation zone, while the ground stratum contains small amounts of exotic including guinea grass (*Megathyrsus maximus* var. *maximus*).
Justification for PCT selection	Vegetation Zone 10 was aligned with PCT 3485 as it supports a number of the species and structural specifics identified for the PCT as listed on the VCD (DCCEEW 2025). Its canopy is dominated by slaty gum (*Eucalyptus dawsonii*) and grey box (*Eucalyptus moluccana*), being the two key diagnostic canopy species of PCT 3485. This vegetation was originally allocated to PCT 1655 in the legacy classification system. Under the new classification system, there are two PCTs in the Hunter Valley that have a characteristic dominance of slaty gum (*Eucalyptus dawsonii*), being 3485 and 3490. An analysis using the VCD filter tool and the Plot to PCT tool was undertaken to determine the best fit PCT. Six plots sampled in this vegetation type (contextual plots undertaken prior to September 2020 and plots included in the BAM-C) were entered to the Plot to PCT tool, resulting in 3485 as the top match for five plots and the second match for the remaining plots (at distance to centroid values of 0.5938-0.64, indicating a strong match). PCT 3490 was matched for only two plots, however these were not as strong a match at 0.624 and 0.692. As a result of a detailed analysis, PCT 3485 was determined the best fit for this vegetation type within the Subject Land. Of the other PCTs matched from the tool, those further considered are listed below, however all were discounted for various reasons as stated. **Other PCTs Considered** **3490 Hunter Valley Footslopes Slaty Gum Forest** As stated above, PCT 3490 was matched for these plots using the Plot to PCT tool, however the similarity was weaker compared to the outputs for PCT 3485. Furthermore, the landscape position of this vegetation type within the Subject Land aligns more closely with PCT 3485, compared with PCT 3490. The VCD states that PCT 3490 occurs on the footslopes below the Triassic sandstone escarpment in a restricted area from Bulga to Baerami Creek in the central Hunter Valley, which is locational to the Subject Land. The VCD notes that in nearby footslopes on undulating terrain on the floor on the Hunter Valley PCT 3490 grades into PCT 3485, which would explain some of the similarities between the PCTs. The SVTM maps PCT 3490 closer to Wollemi National Park which is approximately 7 km from the Subject Land. Based on the above, PCT 3485 is a better match based on location in the landscape.

PCT 3485: Central Hunter Slaty Gum Grassy Forest				
	3431 Central Hunter Ironbark Grassy Woodland and **3314 Central Hunter Slopes Grey Box Forest** The Plot to PCT tool outputs show PCT 3314 and 3431 as closely aligned PCTs based on the characteristics of the plot data entered. PCT 3431 occurs widely throughout the subject land, often adjacent to this vegetation type, therefore it is expected that there would be a number of species consistently recorded in both PCTs. PCT 3485 however is considered a better fit as it represents the dominance of slaty box (*Eucalyptus dawsonii*) that was recorded here, compared with PCT 3314 which is characterised by a dominance of grey box (*Eucalyptus moluccana*) and 3431 which is characterised by a dominance of narrow-leaved ironbark (*Eucalyptus crebra*).			
Alignment with BC Act TECs	This vegetation zone is consistent with the *Hunter Valley Footslopes Slaty Gum Woodland Vulnerable Ecological Community* (VEC). Refer to **Section 3.2.4** for details. It is noted that PCT3485 is not formally associated with the *Hunter Valley Footslopes Slaty Gum Woodland VEC* in the VCD, and therefore this TEC could not be selected in the BAM-C for this assessment. This limitation will not impact the generation of applicable ecosystem credits as the PCT is >90% cleared and therefore in the highest category of Sensitivity to Loss which dictates the Biodiversity Risk Weighting in the BAM-C.			
Vegetation Zone (VZ)	**Condition**	**Area (ha)**	**Plots**	**VI Score**
VZ10	Moderate	HVO North - 7.1 HVO South – 0.0	P61, P122, P124, P131	88.1
VZ10 Moderate The moderate condition zone is the only zone stratified for this PCT. The vegetation displays the typical structural and floristic characters of this PCT.				

3.2.2.3 PCT 4015 – Central Hunter Riparian Forest

PCT 4015: Central Hunter Riparian Forest	
Legacy PCT (as per allocations in Umwelt 2023)	1731: Swamp Oak – Weeping Grass grassy riparian forest of the Hunter Valley
Vegetation Formation	Forested Wetlands
Vegetation Class	Coastal Floodplain Wetlands

PCT 4015: Central Hunter Riparian Forest	
Percent Cleared	87.87%
VCD Description for PCT 4015 A tall Casuarina open forest or occasionally a eucalypt forest or woodland with a mid-stratum with chenopods and acacias and a grassy ground layer that occurs on creek flats in the undulating terrain of the central and upper Hunter valley. The canopy commonly consists of a high cover of *Casuarina glauca* either exclusively or in combination with a sparse cover of eucalypts that commonly include red gums *Eucalyptus blakelyi* or *Eucalyptus tereticornis*. Occasionally *Casuarina glauca* may be absent altogether. The mid-stratum is sparse and almost always includes chenopods such as *Maireana microphylla* and *Enchylaena tomentosa* or occasionally a taller Acacia such as *Acacia salicina*. The mid-dense ground layer is mainly comprised of grasses and forbs with some twiners, hardy ferns and low-growing shrubs, almost always including *Dichondra repens* and *Austrostipa verticillata* with *Glycine tabacina, Microlaena stipoides* and *Cheilanthes sieberi* subsp. *sieberi*. This PCT occurs in a restricted area of the Hunter valley from the Singleton district north to Dartbrook and west toward Sandy Hollow. It occurs in warm, dry environments with a mean annual rainfall typically below 710 mm. The strong association with drainage channels makes this PCT distinguishable from other PCTs. It has only moderate floristic overlap with PCT 3431 which occurs on the gentle hills and rises. *Eucalyptus crebra*, *Eucalyptus moluccana* and a diverse grass and forb ground cover are characteristic of that PCT. However, a related riparian forest occurs immediately to the east in higher rainfall areas of the Hunter valley. Here it grades into PCT 4023 which is also commonly dominated by *Casuarina glauca* however typically lacks the shrubby chenopods that are almost always present in PCT 4015.	
PCT Description within the Development Footprint	
Landscape position	Small patches of the vegetation community occur in the riparian corridor on the far western and far eastern edges of the Development Footprint.
Overall Description	This vegetation zone has a moderately dense canopy which reaches up to 15 m in height and is dominated by swamp oak (*Casuarina glauca*). A sparse mid-storey of native shrubs may be present. The mid-dense ground stratum reaches up to 1 m in height and is dominated native grasses, rushes and herbs.
Upper stratum species	*Casuarina glauca*
Mid-stratum species	*Acacia salicina, Allocasuarina luehmanii, Geijera salicifolia*
Ground stratum species	*Austrostipa verticillata, Eremophila debilis, Brunoniella australis, Glycine tabacina, Microlaena stipoides, Dichondra repens, Solanum cinereum, Lomandra multiflora subsp. multiflora, Bothriochloa decipiens, Cheilanthes distans, Cheilanthes sieberi subsp. sieberi, Aristida ramosa, Chloris ventricosa, Enchylaena tomentosa, Oxalis perennans, Einadia nutans*
Introduced Species	Introduced species occur in very low densities in this vegetation zone, with the most dominant being blue heliotrope (*Heliotropium amplexicaule*) and *Setaria parviflora*.
Alignment with BC Act TECs	This community was compared to the *Swamp Oak Floodplain Forest of the NSW North Coast Sydney Basin and South East Corner Bioregions EEC* listed under the BC Act. The Development Footprint is at an elevation greater than 20 m above sea level and as such this community does not conform to this TEC which is restricted to lower elevations.

PCT 4015: Central Hunter Riparian Forest				
Justification for PCT selection	Vegetation Zone 11 was aligned with PCT 4015. This vegetation was originally allocated to PCT 1731 in the legacy classification system, with the lineage history showing that PCT has now been split to 4015 and 4023 which are both closely aligned. PCT4023 occurs on the Cumberland Plain and north to Rothbury, which is south-east of the Subject Land and therefore is not considered appropriate for further consideration. According to the VIS, PCT 4015 occurs in a restricted area of the Hunter Valley from the Singleton district north to Dartbrook and west toward Sandy Hollow. Situated within the Central Hunter Valley between Singleton and Muswellbrook, the Subject Land falls within this range. Four plots from this vegetation zone (contextual plots undertaken prior to September 2020 and plots included in the BAM-C) were entered into the Plot to PCT tool, with the outputs showing the strongest centroid match to PCT 4015 for all (0.556 and 0.678). Two of the four plots also showed a characteristic species match of 100%. As PCT 4015 is the only riparian community in the Hunter Valley characterised by a dominance of swamp oak, and the Plot to PCT tool outputs showed strong alignment, no further PCTs were considered.			
Vegetation Zone (VZ)	**Condition**	**Area (ha)**	**Plots**	**VI Score**
VZ11	Moderate	HVO North – 3.0 HVO South – 0.0	P140, P156	69.8
VZ11 Moderate There is only one condition zone for this PCT. This zone represents the PCT in moderate condition with a tree canopy present, mid stratum present but sparse (as is typical for this PCT) and a ground layer dominated by native grasses typical of riparian communities.				

3.2.2.4 PCT 4081 – Northwest River Oak-River Red Gum Forest

PCT 4081: Northwest River Oak-River Red Gum Forest	
Legacy PCT (as per allocations in Umwelt 2023)	485: River Oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion)
Vegetation Formation	Forested Wetlands
Vegetation Class	Eastern Riverine Forests
Percent Cleared	89.57%
VCD Description for PCT 4081 A tall to very tall Casuarina and sclerophyll open forest with a mid-stratum that is either absent or comprises sparse, soft-leaved small trees and a mid-dense, grassy ground layer that is widespread on river flats between Gulgong and the Queensland border on the North-west Slopes and the upper Hunter River catchment. The canopy very frequently includes river red gum (*Eucalyptus camaldulensis*) with a high cover of rive oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*), and rarely scattered individuals of rough-barked apple (*Angophora floribunda*). Where present, the mid-stratum comprises scattered individuals of velvet mock olive (*Notelaea microcarpa* var. *microcarpa*) and rive bottlebrush (*Callistemon sieberi*). The mid-dense ground layer is mainly comprised of grasses and forbs, very frequently including common couch (*Cynodon dactylon*), slender bamboo grass (*Austrostipa verticillate*) and swamp dock (*Rumex brownii*), commonly *Commelina cyanea*, and occasionally stinging nettle (*Urtica incisa*), weeping grass (*Microlaena stipoides* var. *stipoides*) and purple wiregrass (*Aristida ramosa*). This PCT primarily occurs in narrow bands within an agricultural landscape, at medium elevations between 200 and 700 metres asl in locations that receive between 500 and 750 mm mean annual rainfall. This PCT is weakly related floristically to PCT 4088, a riverine forest on the South-west Slopes which also includes *Eucalyptus camaldulensis*. Its distribution overlaps with PCT 4080, a riverine forest with a canopy that includes river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) however lacks river red gum (*Eucalyptus camaldulensis*).	
PCT Description within the Development Footprint	
Landscape position	This vegetation zone occurs sporadically on the banks of the Hunter River.
General Description	This vegetation zone has a moderately dense canopy dominated by river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) which reaches up to 22 m in height. The sparse mid-storey reaches up to 12 m in height and is dominated by regenerating river oaks. The very sparse ground stratum is dominated by couch (*Cynodon dactylon*).
Upper stratum species	*Casuarina cunninghamiana*
Mid-stratum species	*Acacia salicina*
Ground stratum species	*Cynodon dactylon, Cyperus* sp.
Introduced Species	The mid-storey contains an abundance of balloon vine (*Cardiospermum grandiflorum*), while exotics commonly occur in the ground stratum and include perennial ryegrass (*Lolium perenne*), trad (*Tradescantia fluminensis*) and panic veldtgrass (*Ehrharta erecta*).
Alignment with BC Act TECs	This vegetation zone is not consistent with any TECs listed under the BC Act.

PCT 4081: Northwest River Oak-River Red Gum Forest	
Justification for PCT selection	Within the Development Footprint, this vegetation occurs on the alluvial channel and floodplains of the Hunter River. It is characterised by a closed canopy of river oak (*Casuarina cunninghamiana*), an absence of Eucalypts and a very sparse grassy understorey the most abundant native being couch (*Cynodon dactylon*). This vegetation was originally allocated to PCT 485 in the legacy classification system, for which the VCD notes a very strong split to 4081. An analysis using the VCD filter tool and the Plot to PCT tool was undertaken to determine the best fit PCT. Three plots sampled in this vegetation type (contextual plots undertaken prior to September 2020 and plots included in the BAM-C) were entered into the Plot to PCT tool, resulting in a range of matched PCTs, most of which were not at or below the distance to centroid threshold of 0.695. PCT 4081 was consistently matched for all plots entered (although at relatively weak values of 0.742 and 0.804). The lack of strong matches likely reflects the history of disturbance across the Subject Land and consequently deviation from the relatively better condition examples used for the SVTM classification. Of the other PCTs matched from the tool, those further considered (due to being riparian/floodplain communities occurring in the Hunter region) are listed below, however all were discounted for various reasons as stated. PCT 4081 is described in the VCD as containing a high cover of river oak (*Casuarina cunninghamiana* subsp*. cunninghamiana*) with very frequent *Eucalyptus camaldulensis*. While plots in this vegetation zone contain river oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) but not river red gum (*Eucalyptus camaldulensis*)*,* the latter is known in the immediate locality on associated waterways. While the two plots sampled in this zone had a very sparse ground cover, the most abundant native ground cover was common couch (*Cynodon dactylon*), which is consistent with the PCT 4081 description. **<u>Other PCTs Considered</u>** **4015 Central Hunter Riparian Forest** PCT 4015 is characterised by a dominance of *Casuarina glauca* and Eucalypts are relatively infrequent, but if present may include *Eucalyptus blakelyi* and *E. teretecornis.* This PCT is not the best fit for this vegetation, however has been allocated to VZ11, where *Casuarina glauca* is dominant. **4072 Hunter River Oak Mesic Forest** This PCT is almost always characterised by a canopy of *Casuarina cunninghamiana*, with a range of mesic species such as white cedar (*Melia azedarach*), (*Clerodendrum tomentosum*), (*Backhousia myrtifolia*), (*Breynia oblongifolia*) and (*Phyllanthus gunnii*). These mesic species were not recorded in plots sampled within this vegetation type, and therefore this PCT is not considered appropriate. **4073 Lower North Hinterland River Oak Forest** This PCT was returned in the centroid matches for one of the two plots in this vegetation type, however with relatively weak values of 0.769-0.789 (noting matches with PCT 4081 were also weak). River red gum (*Eucalyptus camaldulensis*) is not listed for PCT 4073, however this species was recorded in this vegetation type. PCT 4073 typically includes rough-barked apple (*Angophora floribunda*) which was not recorded in this vegetation zone. PCT 4081 is considered a better fit to capture the presence of the river red gum in the canopy.
Alignment with BC Act TECs	This vegetation zone is not consistent with any TECs listed under the BC Act and EPBC Act.

PCT 4081: Northwest River Oak-River Red Gum Forest				
Vegetation Zone (VZ)	**Condition**	**Area (ha)**	**Plots**	**VI Score**
VZ12	Moderate	HVO North - 4.0 HVO South – 0.0	P45, P134	34.6
VZ12 Moderate The moderate condition zone is the only zone stratified for this PCT. The vegetation displays the typical structural and floristic characters of this PCT.				

3.2.2.5 PCT4089 - Namoi-Upper Hunter River Red Gum Forest

PCT 4089: Namoi-Upper Hunter River Red Gum Forest	
Legacy PCT (as per allocations in Umwelt 2023)	42: River Red Gum/ River Oak riparian woodland wetland in the Hunter Valley
Vegetation Formation	Forested Wetlands
Vegetation Class	Inland Riverine Forests
Percent Cleared	94.33%
VCD Description for PCT 4089 PCT 4089 is a very tall sclerophyll and Casuarina forest to open forest or woodland with a mid-stratum that is absent or sparse and a grassy ground layer, found on alluvial floodplains of the upper Hunter and Namoi river catchments. The canopy almost always includes Eucalyptus camaldulensis, rarely with *Casuarina cunninghamiana* subsp. *cunninghamiana*. There is usually no mid-stratum in this PCT. The dense ground layer is mainly comprised of grasses and forbs, almost always including *Cynodon dactylon* with high cover, and occasionally *Rumex brownii, Alternanthera denticulata, Austrostipa verticillata, Urtica incisa* and *Paspalidium constrictum*. This PCT primarily occurs along the Hunter River and its tributaries between Singleton and Scone, and tributaries of the Namoi River around Gunnedah and Tamworth including the Peel and Mooki rivers.	

PCT 4089: Namoi-Upper Hunter River Red Gum Forest	
This PCT occurs in hot, dry climates receiving less than 650 mm mean annual rainfall. The riverine forests in this region have been extensively cleared and this PCT occurs in small patches in an agricultural landscape. Surviving patches are frequently disturbed and subject to ongoing weed invasion and grazing pressure. The median native species richness of the plots comprising this PCT is less than ten species, which is lower than comparable riverine PCTs. In the Hunter catchment, the riverine forest PCT 4073 which includes *Casuarina cunninghamiana* subsp. *cunninghamiana* however lacks *Eucalyptus camaldulensis* is present in reasonably close proximity to this PCT. In the Namoi catchment, riverine forests that also include *Eucalyptus camaldulensis*, however lack *Casuarina cunninghamiana* subsp. *cunninghamiana* generally occur downstream of this PCT.	
PCT Description within the Development Footprint	
Landscape position	This vegetation zone occurs on the banks and floodplain of the Hunter River (and in some cases minor its tributaries), and a small patch along the Wollombi Brook. Disturbed condition zones of this PCT have been allocated where occurring in the same landscape position as the moderate condition zones, and where present evidence of the pre-disturbance vegetation type, such as stags.
General Description	In the moderate condition state, PCT 4089 on the Subject Land has an open canopy up to 25 m in height dominated by yellow box (*Eucalyptus melliodora*), with grey box (*Eucalyptus moluccana*) around the upslope edge of the zone. A mid-storey is generally absent from the vegetation zone, however when present it is dominated by cooba (*Acacia salicina*). The dense ground stratum is dominated by native grasses and forbs.
Upper stratum species (Characteristic species from the higher condition zones VZ13 and VZ14)	*Eucalyptus melliodora, Eucalyptus moluccana, Eucalyptus camaldulensis*
Mid-stratum species (Characteristic species from the higher condition zones VZ13 and VZ14)	*Acacia salicina*
Ground stratum species (Characteristic species from the higher condition zones VZ13 and VZ14)	*Cynodon dactylon, Eucalyptus melliodora, Enchylaena tomentosa, Galenia pubescens, Enteropogon acicularis, Maireana microphylla, Paspalidium distans, Bothriochloa decipiens, Einadia nutans, Sida corrugata, Eriochloa pseudoacrotricha, Atriplex semibaccata, Digitaria divaricatissima, Austrostipa verticillata, Oxalis perennans*.
Introduced Species	The better condition zones of this PCT have a relatively low abundance of introduced species, commonly recorded species including galenia (*Galenia pubescens*), fireweed (*Senecio madagascariensis*), Paddy's lucerne (*Sida rhombifolia*), creeping pear (*Opuntia humifusa*) and lambs tongues (*Plantago lanceolata*). In the more disturbed condition states, introduced species were also observed in the mid-stratum, in particular African olive (*Olea europaea* subsp. *cuspidata*) and castor oil plant (*Ricinnus communis*). Ground stratum weeds recorded in the disturbed condition zones included guinea grass (*Megathyrsus maximus* var. *maximus*), kikuyu (*Cenchrus clandestinus*), balloon vine (*Cardiospermum grandiflorum*), cobblers pegs (*Bidens pilosa*), black-berry nightshade (*Solanum nigrum*) and common vetch (*Vicia sativa*).
Alignment with BC Act TECs	The Moderate and Low to Moderate condition zones of this PCT were found to be consistent with the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC, however VZ15, VZ16 and VZ17 were excluded owing to their disturbed state and absence of key characteristic features of the TEC. Refer to **Section 3.2.4** for further justification.

PCT 4089: Namoi-Upper Hunter River Red Gum Forest	
Justification for PCT selection	Within the Development Footprint, this vegetation occurs on the alluvial channel and floodplains of the Hunter River and its tributaries. In the more intact condition zones, it is characterised by an open canopy of yellow box (*Eucalyptus melliodora*) and/or river red gum (*Eucalyptus camaldulensis*). This vegetation was originally allocated to PCT 42 in the legacy classification system, for which the VCD notes a very strong split to either 3397 or 4089. Justifications for discounting PCT 3397 (and other PCTs considered) and selecting 4089 as the best fit for this vegetation are below. An analysis using the VCD filter tool and the Plot to PCT tool was undertaken to determine the "best fit PCT". Five plots sampled in the better condition zones of this vegetation type (including contextual plots undertaken prior to September 2020 and more recently completed plots included in the BAM-C) were entered to the Plot to PCT tool, resulting in two of the five with a first match of PCT 4089 (at distance to centroid values of 0.47 and 0.567). For the other three of five plots sampled, range of matched PCTs was returned, most of which were not at or below the distance to centroid threshold of 0.659. The lack of strong matches likely reflects the history of disturbance across the Subject Land and consequently deviation from the relatively better condition examples used for the SVTM classification. PCT 4089 consistently matched for all plots entered, with two plots returning a 100% character match and a distance to centroid match of 0.567 and 0.47 respectively. Of the other PCTs matched from the tool, those further considered (due to being riparian/floodplain communities occurring in the Hunter region) are listed below, however all were discounted for various reasons as stated. PCT 4089 is described as occurring along the Hunter River and its tributaries between Singleton and Scone, with an absent or sparse mid-storey (which is consistent with the Development Footprint) and almost always containing *Eucalyptus camaldulensis*. The dense ground layer is mainly comprised of grasses and forbs, almost always including *Cynodon dactylon* with high cover, consistent with this vegetation on the Subject Land. PCT 4089 is associated with the *Hunter Floodplain Red Gum Woodland EEC* (and is the only PCT associated with this TEC). The SVTM shows PCT 4089 along the Hunter River surrounding the Subject Land. **<u>Other PCTs Considered</u>** **3397 Northwest Yellow Box Grassy Woodland** PCT 3397 is described as occurring on the lower slopes and flats in undulating to hilly landscapes of the upper Hunter valley and is not associated with Hunter Floodplain Red Gum Woodland EEC. While the description states that the canopy for 3397 almost always contains *Eucalytpus melliodora* it also includes a defined mid-storey which is generally absent within these vegetation zones. Furthermore, the understorey of PCT 3397 does not have a characteristically high cover of *Cynodon dactylon* in the ground stratum. While some characters of PCT 3397 fit with this vegetation type, it is not considered to be as closely aligned as PCT 4089. **4015 Central Hunter Riparian Forest** PCT 4015 is characterised by a dominance of *Casuarina glauca* and Eucalypts are relatively infrequent, but if present may include *Eucalyptus blakelyi* and *E. teretecornis.* This PCT has been allocated to VZ11, where *Casuarina glauca* is dominant. **4081 Northwest River Oak-River Red Gum Forest** PCT 4081 frequently includes a high cover of *Eucalyptus camaldulensis*, a high cover of *Casuarina cunninghamiana* and occasionally *Angophora floribunda*.

PCT 4089: Namoi-Upper Hunter River Red Gum Forest				
	While *Eucalyptus camaldulensis* was recorded in some locations of this vegetation type on the Subject Land, *Casuarina* or *Angophora* were never recorded. PCT 4081 also does not reflect the strong presence of *Eucalyptus melliodora* in this vegetation type. The characteristic species match for the plots sampled in this vegetation type was 40-60% for PCT 4081, slightly lower than that for PCT 4089 which was 50-100%. The analysis revealed that while there are some similarities in landscape and floristic characteristics with PCT 4081 and this vegetation type, PCT 4089 is a stronger match and more closely reflects the floristics recorded across the Subject Land.			
Vegetation Zone (VZ)	**Condition**	**Area (ha)**	**Plots**	**VI Score**
VZ13	Moderate	HVO North - 1.0 HVO South – 0.0	P121	65.0
VZ14	Low to Moderate	HVO North - 0.7 HVO South – 0.1	P137	29.4
VZ15	Cooba Woodland	HVO North - 0.2 HVO South – 0.6	P138	54.5
VZ16	Derived Native Grassland	HVO North - 5.0 HVO South - 0.0	P43, P46, P119, P135	21.8
VZ17	Exotic Grassland	HVO North - 24.6 HVO South – 4.7	P44, P53, P54, P118, P136, P139	9.3
VZ13 Moderate This vegetation zone is in good condition with tree canopy present, mid stratum absent (as is typical for this PCT) and a ground layer dominated by native grasses and a small component of native forbs.				

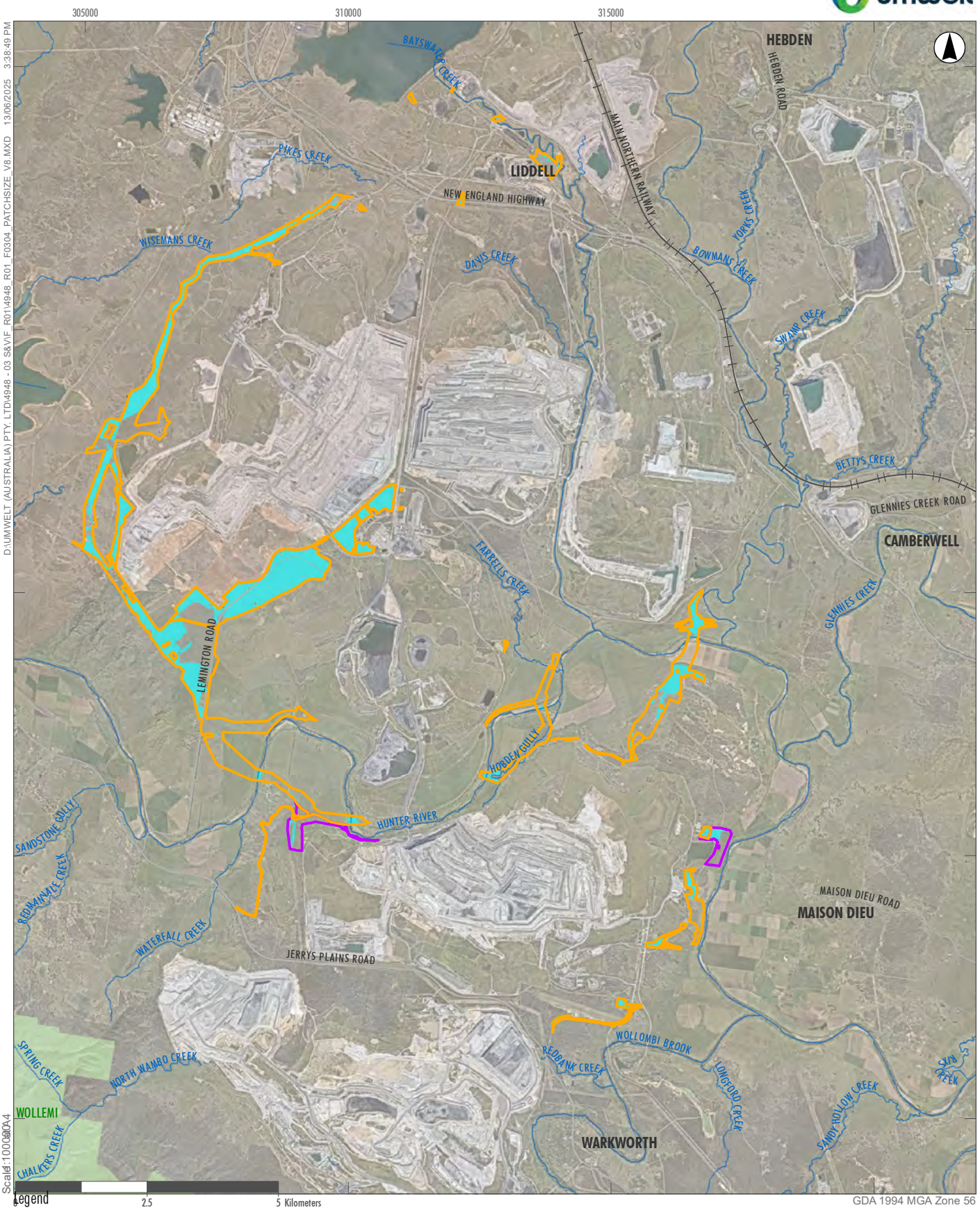
PCT 4089: Namoi-Upper Hunter River Red Gum Forest	
VZ14 Low to Moderate This zone is similar in floristic composition to VZ1, however is highly modified from weed invasion and native species occur infrequently in the understorey.	
VZ15 Cooba Woodland This vegetation zone is characterised by a dominance of the tall shrub cooba (*Acacia salicina*), while a tree canopy is absent. This zone features stags considered likely to have been river red gum (*Eucalyptus camaldulensis*) trees based on landscape position and proximity to the Hunter River and remnant river red gums.	
VZ16 Derived Native Grassland The canopy is absent from this zone, however a sporadic low tree layer of cooba (*Acacia salicina*) is present. The moderately dense ground stratum is dominated by native grasses.	

PCT 4089: Namoi-Upper Hunter River Red Gum Forest	
VZ17 Exotic Grassland This vegetation zone is dominated by introduced species (mostly grasses and annual weeds) and lacks any tree or shrub species. Native species occur in low abundance in this zone.	

3.2.3 Patch Size

A patch is an area of native vegetation that occurs in the Development Footprint 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. The patch size class for each vegetation zone is used in the BAM-C to assess habitat suitability on the subject land for threatened species.

Table 3.3 outlines the patch size class for each vegetation zone. **Figure 3.4** shows the patch size mapping across the Development Footprints.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Railway Line
- Road
- Drainage Line
- National Parks

PatchSize

- >100 Ha

FIGURE 3.4

Patch Size Map

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

3.2.4 Threatened Ecological Communities

Eight of the vegetation zones described above and mapped within the Development Footprints conform to TECs under the BC Act. Four TECs occur within the HVO North Development Footprint and one BC Act-listed TECs occurring in the HVO South Development Footprint.

A summary of the TECs recorded in the Development Footprints is provided in **Table 3.4**. An analysis of consistency with the Final Determination for each TEC was undertaken, with consideration of the advice provided by the NSW Scientific Committee guidelines for interpreting listed ecological communities. This assessment is provided in **Table 3.5**.

BC Act listed TECs occurring in the Development Footprints are shown on **Figure 3.5A** and **Figure 3.5B**.

Table 3.4 Summary of TECs listed under the NSW BC Act

Threatened Ecological Community listed under the NSW BC Act	Vegetation Zone	Area (ha) in Development Footprint	
		HVO North	HVO South
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	1. PCT 3431 – *Moderate*	64.5	0.5
	2. PCT 3431 – *Thinned Woodland*	11.3	1.9
	3. PCT 3431 – *Woodland with Exotic Understorey*	1.9	0.0
	4. PCT 3431 – *Plantation*	4.7	0.0
	TOTAL EEC	**82.4**	**2.4**
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC	10. PCT 3485 – *Moderate*	7.1	0.0
	Total VEC	**7.1**	**0.0**
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	13. PCT 4089 – *Moderate*	1.0	0.0
	14. PCT 4089 – *Low to Moderate*	0.7	0.0
	Total EEC	**1.7**	**0.0**
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion CEEC	7. PCT3431 – *Poor Condition DNG*	0.05	0.0
	Total CEEC	**0.05**	**0.0**

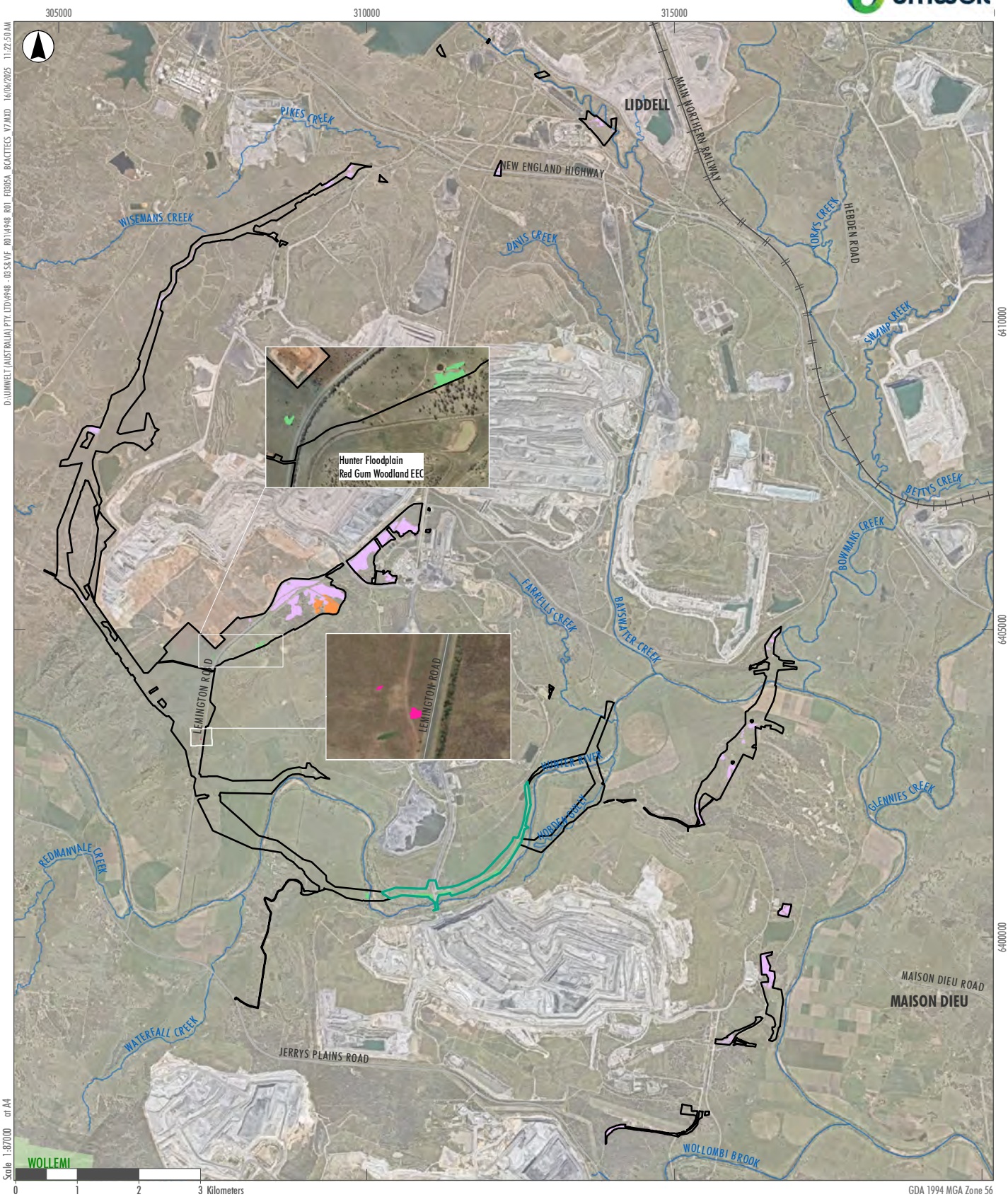
Table 3.5 Threatened Ecological Communities listed under the NSW BC Act within the Development Footprints

Threatened Ecological Community	Vegetation Zone	Area (ha) in Development Footprint		Assessment of Similarity – Proportion of Species in the list of Characteristic species for the TEC	TEC Diagnostic Characteristics as per Final Determination
		HVO North	HVO South		
Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	1. PCT3431 – *Moderate*	64.5	0.5	• contains both characteristic canopy species • contains 69% of the characteristic species for the EEC.	The vegetation zones are consistent with the Final Determination of the EEC (NSW Scientific Committee 2010a) with regard to the following attributes: • occurs on Permian sediments within the NSW Sydney Basin Bioregion • occurs in the Singleton LGA where the EEC has previously been recorded • dominated by the characteristic canopy species narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*Eucalyptus moluccana*) • supports a reasonable proportion of species that are in the list of characteristic species for the EEC. It should be noted that Vegetation zones 5, 6, 7, 8 and 9 (scattered regeneration, cooba woodland, derived native grassland, exotic grassland and bulloak forms of PCT 3431) do not form part of the *Central Hunter Grey Box – Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC as they lack a eucalypt-dominated woodland structure which is characteristic of the TEC. The final determination does not list modified versions such as derived native grassland as conforming to the TEC. VZ9 is characterised by a bulloak-dominated canopy with sporadic occurrences of *Eucalyptus crebra*.
	2. PCT3431 – *Thinned Woodland*	11.3	1.9	• contains both characteristic canopy species • contains 59% of the characteristic species for the EEC.	
	3. PCT3431 – *Woodland with Exotic Understorey*	1.9	0.0	• dominated by characteristic canopy species *Eucalyptus crebra* • contains two of the characteristic species for the EEC • considered a low condition representation of the EEC due to the low number of native species in the understorey.	
	4. PCT3431 – *Plantation*	4.7	0.0	• does not contain characteristic canopy species but is dominated in portions by spotted gum (*Corymbia maculata*) blakely's red gum (*Eucalyptus blakelyi*) which is known to occasionally occur in the community • contains 45% of the characteristic species for the EEC	

Threatened Ecological Community	Vegetation Zone	Area (ha) in Development Footprint		Assessment of Similarity – Proportion of Species in the list of Characteristic species for the TEC	TEC Diagnostic Characteristics as per Final Determination
		HVO North	HVO South		
				• considered a low condition representation of the EEC due to lack of characteristic canopy species.	
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC	10. PCT3485 – *Moderate*	7.1	0.0	• contains both characteristic canopy species • contains 55% of the characteristic species for the VEC.	The vegetation zones are consistent with the Final Determination of the VEC (NSW Scientific Committee 2010c) with regard to the following attributes: • Generally occurs at the interface of Narrabeen Sandstone and Permian sediments in the Hunter Valley. Noting the location of the TEC within the Subject Land being on the valley floor rather than the interface between the Triassic and Permian geology. • Typically forms a low to mid-high woodland. • Tree canopy is typically dominated by *Eucalyptus dawsonii* (slaty gum) and/or *Eucalyptus moluccana* (grey box). • Supports a reasonable proportion of species that are in the list of characteristic species for the VEC.
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion CEEC	7. PCT3431 – *Poor Condition DNG*	0.05	0.0	• Contains the characteristic canopy species *Acacia pendula* (Weeping Myall) • Contains 12%of the characteristic species for the CEEC.	The minor patch of vegetation is consistent with the Final Determination of the CEEC (NSW Scientific Committee 2016) With regards to the following attributes: • Occurs within the Sydney Basin Bioregion. • Occurs on soils derived from Quaternary alluvium and sedimentary rocks of Permian age, including lithic sandstone, shale, siltstone, mudstone, conglomerate and coal bearing seams. The location of the vegetation is within the Hunter Valley floor on Permian sediments.

Threatened Ecological Community	Vegetation Zone	Area (ha) in Development Footprint		Assessment of Similarity – Proportion of Species in the list of Characteristic species for the TEC	TEC Diagnostic Characteristics as per Final Determination
		HVO North	HVO South		
					• Typically a mid-high (to 15 m) open forest or woodland with a dense to mid-dense canopy dominated by Weeping Myall (*Acacia pendula*) depending on disturbance and regrowth history. The vegetation has undergone significant modification which has resulted in the weeping myall being a short, stunted patch of trees that have been impacted by agricultural resulting in a lower growing patch off grazed trees. All tree species in the patch were identified as Weeping myall with an estimate of 136 living stems counted in one patch and 60 in the other. • Supports a small proportion of characteristic species listed in the Final Determination.
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	13. PCT4089 – *Moderate*	1.0	0.0	• contains 10% of the characteristic species for the EEC.	The vegetation zones are consistent with the Final Determination of the EEC (NSW Scientific Committee 2010b) with regard to the following attributes: • occurs within the NSW North Coast and Sydney Basin Bioregions • occurs on floodplains and associated floodplain rises along the Hunter River and tributaries • generally dominated by *Eucalyptus camaldulensis* (river red gum) in combination with *Eucalyptus tereticornis* (forest red gum), *Eucalyptus melliodora* (yellow box) and *Angophora floribunda* (rough-barked apple) • supports a reasonable proportion of species that are in the list of characteristic species for the EEC.
	14. PCT4089 – *Low to Moderate*	0.7	0.0	• contains characteristic canopy species *Eucalyptus camaldulensis* • contains 10% of the characteristic species for the EEC.	

Threatened Ecological Community	Vegetation Zone	Area (ha) in Development Footprint		Assessment of Similarity – Proportion of Species in the list of Characteristic species for the TEC	TEC Diagnostic Characteristics as per Final Determination
		HVO North	HVO South		
					It should be noted that the cooba woodland, derived native grassland and exotic grassland forms of PCT 4089 (VZ15, VZ16 and VZ17, respectively) do not form part of the *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions* EEC given the absence of characteristic canopy species. The final determination does not list modified versions such as derived native grassland as conforming to the TEC.



Legend

- HVO North Development Footprint
- River Red Gum Additional Disturbance Area
- Railway Line
- Road
- Drainage Line
- National Parks

BC Act

- Central Hunter Grey Box - Ironbark Woodland EEC
- Hunter Floodplain Red Gum Woodland EEC
- Hunter Valley Footslopes Slaty Gum Woodland VEC
- Hunter Valley Weeping Myall Woodland CEEC

FIGURE 3.5A

HVO North - Threatened Ecological Communities under the NSW BC Act

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

Legend

- HVO South Development Footprint
- Road
- Drainage Line

BC Act

- Central Hunter Grey Box - Ironbark Woodland EEC

FIGURE 3.5B

HVO South - Threatened Ecological Communities under the NSW BC Act

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

3.2.4.1 Summary of TECs within the Development Footprints

Table 3.6 provides a summary of the TECs and the area they occupy within the Development Footprints.

Table 3.6 Summary of TECs within the Development Footprint

Threatened Ecological Community	Listing Status	Area (ha) in Development Footprint	
		HVO North	HVO South
Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	82.4	2.4
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	1.7	0.0
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC	7.1	0.0
Hunter Valley Weeping Myall Woodland in the Sydney Basin Bioregion	CEEC	0.05	0.0

3.2.5 Vegetation Integrity Score

The vegetation integrity (VI) data for each of the vegetation zones is provided in **Table 3.7**.

Table 3.7 Vegetation Integrity Scores

Vegetation Zone	Composition	Structure	Function	VI Score	Hollow-bearing Trees?
1. PCT3431 – *Moderate*	67.1	43.6	66.4	**57.9**	Yes
2. PCT3431 – *Thinned Woodland*	72.8	37.7	56.9	**53.8**	Yes
3. PCT3431 – *Woodland with Exotic Understorey*	15.2	14.7	48.5	**22.1**	Yes
4. PCT3431 – *Plantation*	71.2	34.1	42.9	**47.0**	No
5. PCT3431 – *Scattered Regeneration*	63.7	44.8	35.4	**46.5**	No
6. PCT3431 – *Cooba Woodland*	65.0	44.2	38.0	**47.8**	No
7. PCT3431 – *Poor Condition Derived Native Grassland*	37.3	40.6	2.8	**16.2**	No
8. PCT3431 – *Exotic Grassland*	21.0	13.7	7.5	**12.9**	No
9. PCT3431 – *Bulloak Variant*	55.1	26.2	49.2	**41.4**	Yes
10. PCT3485 – *Moderate*	93.3	73.3	100.0	**88.1**	Yes
11. PCT4015 – *Moderate*	68.3	81.0	61.5	**69.8**	No
12. PCT4081 – *Moderate*	16.5	42.5	58.9	**34.6**	No
13. PCT4089 – *Moderate*	95.7	66.5	43.3	**65.0**	No
14. PCT4089 – *Low to Moderate*	19.2	27.2	48.5	**29.4**	No
15. PCT4089 – *Cooba Woodland*	48.8	60.2	55.2	**54.5**	Yes
16. PCT4089 – *Derived Native Grassland*	27.6	39.0	9.7	**21.8**	No
17. PCT4089 – *Exotic Grassland*	9.5	7.3	11.5	**9.3**	No

4.0 Threatened Species

4.1 Methods

4.1.1 Identification of Threatened Species for Assessment

The identification of threatened species that are likely to occur on or use the Development Footprints was undertaken primarily using the Threatened Biodiversity Data Collection (TBDC) and the BAM-C using the following information relevant to the predicted species:

- IBRA subregion
- Geographic limitations
- PCT associations
- Patch size classes
- Native vegetation cover.

Furthermore, a review of previous documents and reports relevant to the Project was undertaken. This included previous surveys undertaken within and in the vicinity of the Development Footprints and other relevant ecological database searches. Relevant resources included:

- Biodiversity Assessment Methodology 2020 and BAM-C (Version 1.3.0.00).
- DPHI BioNet Atlas of NSW Wildlife (DPHI 2025) search, accessed April 2025.
- Protected Matters Search Tool (DCCEEW 2025) for known/predicted EPBC Act-listed species, accessed April 2025.
- National Flying Fox Monitoring Viewer – https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf accessed April 2025.
- River Red Gum Monitoring Report 2020 – Carrington Billabong and a reference site (Ecoplanning 2021).
- Bird Assemblage Monitoring – Wandewoi, Mitchell hill and Hook Biodiversity Areas (Ecoplanning 2019).
- Hunter Valley Operations Integrated Biodiversity Management Plan (EMM 2018).
- Ten Year Monitoring of River Red Gums at Carrington Billabong and Hunter Valley Operations (Umwelt 2018).
- United Wambo Open Cut Coal Mine Biodiversity Assessment Report (Umwelt 2017).
- Upper Hunter Strategic Assessment – Hunter Valley Operations Biodiversity Certification Assessment Report (Niche 2015).
- Upper Hunter Strategic Assessment – Greater Ravensworth Biodiversity Certification Assessment Report (Umwelt 2015a).

- Upper Hunter Strategic Assessment – United Collieries Biodiversity Certification Assessment Report (Umwelt 2015b).
- Review of Ecological Assessments for Warkworth Extension EA and HVO South Modification Projects (Umwelt 2011).
- HVO North Modification 3, Carrington West Wing Ecology Assessment (Biosis Research Pty Ltd 2010).

Based on the above resources, a candidate species list was developed for threatened species with the potential to use the habitats within the Development Footprint.

4.1.2 Assessment of Habitat Constraints, Limitations and Vagrant Species

A review of the candidate species list was undertaken to determine whether any species were unlikely to be impacted by the Project due to habitat constraints, geographic limitations or the presence of vagrant records of threatened species. The species list was then refined to ecosystem credit species predicted to occur on the site and species-credit species that required further assessment (survey or expert report, refer to **Section 4.1.3** below).

This constraints assessment is provided in Table D.1 in **Annexure D**.

4.1.3 Species-credit Species Surveys

Following the refinement of the species list (refer to **Section 4.1.2**), targeted field surveys and opportunistic searches were undertaken for those species-credit species considered to have the potential to occur within the Development Footprints. Species-credit species surveys were undertaken over multiple years and seasons, as summarised in **Table 4.1** and **Table 4.2** and shown on **Figure 4.1** and **Figure 4.2**.

Specific details of these surveys are provided in Table D.2 in **Annexure D**.

4.1.3.1 Threatened Flora Transect Surveys

Targeted threatened flora surveys following the two-phase grid-based systematic approach was undertaken across all suitable habitat areas within the Development Footprints as outlined in Section 4.4.1 of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Due to the size of the impact area and varying condition of PCTs (i.e. mosaic of vegetation zones) across the Development Footprints, it was determined that undertaking the two-phase grid method across all suitable habitat for all predicted species was the most effective way to cover the site (rather than assess habitat discretely by vegetation zone). The NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e) does not specify a requirement to undertake the two-phase grid-based approach by a vegetation zone-basis.

The guide states that *"Large areas of suitable habitat can be assessed using a two-phase grid-based systematic survey approach. The approach provides a practical method for designating survey locations and ensures uniform, consistent coverage of the suitable habitat for a target species on the subject land"* and *"Surveys are undertaken where the 100-square-metre gridlines intersect within suitable habitat for a target species."* The guide defines suitable habitat as *"an area(s) of the subject land that support PCT(s) where the species is expected to occur or periodically use. To be classified as suitable at least one habitat constraint, where these are listed for the species in the TBDC, is present and constraint(s) or any particular microhabitats are not significantly degraded".*

Areas not targeted by the transect surveys included:

- Category 1 Exempt land
- Exotic condition zones (vegetation zones 8 and 17).

Exotic condition zones within the Development Footprints are dominated by exotic vegetation (i.e. on average greater than 50% exotic cover and less than 15% native cover) and VI scores are below the minimum offsetting threshold. While some survey effort was undertaken in these areas, they were determined to be substantially degraded and highly unlikely to contain threatened flora species. Furthermore, if threatened flora species were identified in other (higher) condition vegetation condition zones, further investigation into these areas may have been warranted, however this was not required.

For all remaining predicted PCTs and subsequent condition zones, a grid spaced at 100 m^2 was overlayed onto the Development Footprints using GIS. Walking transect surveys were undertaken where the 100 m^2 gridlines intersect within potentially suitable habitat. At each survey location (grid intersect), an estimated 40-metre diameter area (1256-square-metre circular area) were surveyed for the target species and an estimate of a 5 m buffer from walking transect lines (as indicated in Table 1 of DPIE 2020e in relation to the maximum distance between traverses for herbs and forbs). Survey locations were pre-loaded onto a GPS or tablet/phone application.

If a target species is located, finer-scale grid surveys are required to locate population extent, which assists to define species polygons. This phase was not required during this assessment as surveys did not record any threatened flora species as per DPIE (2020e) *"If the initial 100 m grid survey (nested within a one-square-kilometre topographic map grid) fails to detect the target species, no further surveys are required in that location."*

The grid-based approach resulted in an estimated survey coverage of 951.6 ha and 761 individual grid locations across the Development Footprints and immediate locality. This area assumes a conservative estimate of a 5 m visual extent from transect lines, however it is likely to be greater than this in open and sparse vegetation zones.

These surveys were undertaken over multiple years and seasons as the Development Footprint as evolved for the Project. Targeted threatened flora surveys were undertaken during the following survey periods:

- 12–16 October 2020
- 19–23 October 2020
- 14 October 2021
- 11 August 2022
- 18 September 2023
- 1 November 2023.

Table 4.1 below outlines the number of grid centre points by vegetation zone resulting from the two-phase grid method and the approximate area of survey of the two-phase grid and parallel transects.

Table 4.1 Species-credit Species Flora Surveys

Associated Threatened Flora Species	Vegetation Zone and Condition	Area (ha)	Count of Grid Centre Points	Approximate Area of Survey (ha) (assuming 5 m buffer)
3431 - Central Hunter Ironbark Grassy Woodland				
Acacia pendula* – endangered population** ***Cymbidium canaliculatum* – endangered population** ***Diuris tricolor ***Diuris tricolor* – endangered population** ***Eucalyptus glaucina*** ***Ozothamnus tesselatus*** ***Persoonia pauciflora*** ***Pomaderris queenslandica*** ***Prasophyllum petilum*** ***Prasophyllum* sp. *Wybong*** ***Pterostylis chaetophora***	1. *Moderate*	65.0	59	14.16
	2. *Thinned Woodland*	13.2	15	4.0
	3. *Woodland with Exotic Understorey*	1.9	2	0.62
	4. *Plantation*	8.2	6	1.56
	5. *Scattered Regeneration*	48.7	44	15.38
	6. *Cooba Woodland*	13.0	11	3.11
	7. *Poor Condition Derived Native Grassland*	291.4	34	11.03
	8. *Exotic Grassland*	65.4	292	70.4
	9. *Bulloak Variant*	35.2	45	11.68
	TOTAL for PCT 3431	**542.0**	**508**	**131.94**
3485 - Hunter Valley Footslopes Slaty Gum Forest				
Acacia pendula* – endangered population** ***Cymbidium canaliculatum* – endangered population** ***Diuris tricolor ***Diuris tricolor* – endangered population** ***Eucalyptus pumila*** ***Prasophyllum petilum*** ***Prasophyllum* sp. *Wybong*** ***Pterostylis chaetophora***	10. *Moderate*	7.1	7	5.91
	TOTAL for PCT 3485	**7.1**	**7**	**5.91**
4015 - Central Hunter Swamp Oak Riparian Forest				
Persoonia pauciflora	11. *Moderate*	3.0	5	0.74
	TOTAL for PCT 4015	**3.0**	**5**	**0.74**
4081 - Northwest River Oak-River Red Gum Forest				
***Cymbidium canaliculatum* – endangered population**	12. *Moderate*	4.0	0	0.05
	TOTAL for PCT 4081	**4.0**	**0**	**0.05**
4089 - Namoi-Upper Hunter River Red Gum Forest				
***Cymbidium canaliculatum* – endangered population**	13. *Moderate*	1.0	1	1.04
	14. *Low to Moderate*	0.9	0	0.49

Associated Threatened Flora Species	Vegetation Zone and Condition	Area (ha)	Count of Grid Centre Points	Approximate Area of Survey (ha) (assuming 5 m buffer)
	15. *Cooba Woodland*	0.8	0	0.47
	16. *Derived Native Grassland*	5.0	3	3.88
	17. *Exotic Grassland*	29.3	3	0.94
	TOTAL for PCT 4089	**36.8**	**7**	**6.82**
TOTAL for all PCTs		**592.9**	**-**	**-**
Other (non-PCT areas, areas eventually allocated as Cat 1 land or areas removed from the Development Footprint)		**358.7**	**234**	**60.9**
Total		**951.6**	**761**	**206.36**

4.1.3.2 Threatened Fauna Species Surveys

Table 4.2 outlines the targeted threatened fauna species survey effort undertaken for this assessment. It is noted that some of the survey effort was undertaken more than five years ago. While these surveys cannot be relied on for the purposes of a BAM assessment, they provide important context in relation to habitat suitability and for any notable species records.

Further detail for individual species is included in Section D.2 of **Annexure D**.

Table 4.2 Species-credit Species Fauna Surveys

Survey Methods	Species Targeted	Survey Dates
Diurnal bird surveys Undertaken during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded.	• gang-gang cockatoo (*Callocephalon fimbriatum*) • glossy black-cockatoo (*Calyptorhynchus lathami*) • white-bellied sea-eagle (*Haliaeetus leucogaster*) • little eagle (*Hieraaetus morphnoides*) • square-tailed kite (*Lophoictinia isura*) • eastern osprey (*Pandion cristatus*) • bush stone-curlew (*Burhinus grallarius*).	3–6 June 2019 12–15 August 2019 6–10 July 2020 14–18, 29 August 2023
Searches for hollow-bearing trees and nesting/roosting habitat constraints Searches were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Suitable nest trees and stags were recorded and inspected for large nests.	• gang-gang cockatoo (*Callocephalon fimbriatum*) • glossy black-cockatoo (*Calyptorhynchus lathami*) • white-bellied sea-eagle (*Haliaeetus leucogaster*) • little eagle (*Hieraaetus morphnoides*) • square-tailed kite (*Lophoictinia isura*) • barking owl (*Ninox connivens*) • powerful owl (*Ninox strenua*) • masked owl (*Tyto novaehollandiae*) • eastern osprey (*Pandion cristatus*) • southern greater glider (*Petauroides volans*) • squirrel glider (*Petaurus norfolcensis*) • eastern pygmy possum (*Cercartetus nanus*) • southern myotis (*Myotis macropus*).	23–26 March 2020 12–16 October 2020 19–23 October 2020 14–18, 29 August 2023 9-11, 14–15 April 2025
Nocturnal spotlighting surveys Undertaken at sites located in suitable habitat between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.	• green and golden bell frog (*Litoria aurea*).	23–26 March 2020 3–6, 10–13, 24–27 March 2025
	• eastern pygmy-possum (*Cercartetus nanus*) • barking owl (*Ninox connivens*)	23–26 March 2020 6–9 July 2020

Survey Methods	Species Targeted	Survey Dates
	• powerful owl (*Ninox strenua*) • masked owl (*Tyto novaehollandiae*) • greater glider (*Petauroides volans*) • squirrel glider (*Petaurus norfolcensis*) • brush-tailed phascogale (*Phascogale tapoatafa*) • koala (*Phascolarctos cinereus*) • common planigale (*Planigale maculata*).	23–26 October 2023 27 November 2023 5, 11 December 2023
Nocturnal call playback surveys Conducted with a period of quiet listening for approximately 5 minutes. Species calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.	• green and golden bell frog (*Litoria aurea*).	23–26 March 2020 23-28 October 2023 24-28 February 2025 3–6, 10–13, 24–27 March 2025
	• barking owl (*Ninox connivens*) • powerful owl (*Ninox strenua*) • masked owl (*Tyto novaehollandiae*) • squirrel glider (*Petaurus norfolcensis*) • koala (*Phascolarctos cinereus*).	6–9 July 2020
Dip netting for tadpoles/*Gambusia* Diurnal dip netting for tadpoles and presence of Gambusia holbrooki as per targeted survey requirements in the NSW survey guidelines for frogs (DPIE 2020d).	• green and golden bell frog (*Litoria aurea*).	3–6, 10–13, 24–27 March 2025
Acoustic Recorder Surveys A minimum detector spacing of 800 m covering all associated vegetation zones containing living or dead trees with a hollow >20 cm diameter that occurs >4 metres above the ground, reflecting a 400 m recording radius per detector. Detectors will be set to record from 30 minutes before sunset to 30 minutes after sunrise, every night while deployed.	• barking owl (*Ninox connivens*) • powerful owl (*Ninox strenua*) • masked owl (*Tyto novaehollandiae*).	Acoustic recorders deployed 11–13 June 2025
Anabat echolocation	• southern myotis (*Myotis macropus*).	23–27 March 2020

Survey Methods	Species Targeted	Survey Dates
A Titley Scientific Anabat Express was positioned at an approximate 30 degree angle one metre above the ground in waterproof housing. Each detector was positioned towards potential micro-bat flyaways along areas of suitable habitat. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise.		22–24 October 2023
Remote camera surveys At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected.	• eastern pygmy-possum (*Cercartetus nanus*) • southern greater glider (*Petauroides volans*) • squirrel glider (*Petaurus norfolcensis*) • brush-tailed phascogale (*Phascogale tapoatafa*) • common planigale (*Planigale maculata*).	24 March–8 July 2020 14 August–30 October 2023 Additional surveys proposed in October-December 2025, targeting squirrel glider and eastern pygmy possum.
Koala Spot Assessment Technique (SAT) Koala SATs were undertaken on and around the base of 30 trees at each survey site. The searches focused on signs of presence including scats at the base of trees and characteristic scratches on tree trunks. Surveys focused on areas containing koala feed trees according to the Approved Recovery Plan for the Koala (DECC 2008).	• koala (*Phascolarctos cinereus*).	6–10 July 2020 29 May–2 June 2023 5–9 June 2023 9–11, 14–15 April 2025 11–13 June 2025
Thermal drone surveys Thermal drone flight paths were undertaken in areas of suitable koala habitat in accordance with the BAM (2020). Detection methods included hot spot alert, shape detection, characteristic trait, drone infra-red thermal and colour zoom imagery with spotlight. Survey times were between 21:00–06:00 each night/morning at suitable temperatures. Over 900 km of drone transects were undertaken across the HVO site.	• koala (*Phascolarctos cinereus*) • southern greater glider (*Petauroides volans*) • squirrel glider (*Petaurus norfolcensis*) • brush-tailed phascogale (*Phascogale tapoatafa*).	12–20 July 2023
Pitfall trap arrays 64 pitfall trap arrays were installed in suitable habitat. Each trap array comprised of 10 m of drift-fence with a 20 L bucket with a lid at either end. The lid was elevated 2 to 3 cm (using sticks) above the lip of the bucket. Leaf litter and small twigs were placed in the bottom of each bucket to provide shelter for trapped animals. Traps were checked and reset daily over 4 consecutive days.	• common planigale (*Planigale maculata*).	29 May–2 June 2023 5–9 June 2023 10–14 July 2023 17–21 July 2023 24–28 July 2023

Survey Methods	Species Targeted	Survey Dates
Funnel traps 17 collapsible funnel trap arrays were installed in suitable habitat. Each trap array comprised of a 10 m drift fence with 10 collapsible funnel traps positioned equidistantly along each side of the drift fence. Collapsible funnels were positioned so that they were flush with the ground.		7–11 August 2023
***Delma* sp. artificial habitat surveys** Tile grids consisted of 50 tiles, at 5 m spacing between tiles, arranged in a grid of 10 tiles by five. This survey was undertaken in consideration of the methods outlined in the *EPBC Act Referral Guidelines for the vulnerable striped legless lizard Delma impar* (DSWPC 2011).	• Hunter Valley delma (*Delma vescolineata*).	**2020 Survey** 10 tile grids installed in August 2020. Six of these tile grids were relocated in November 2020. 4 additional tile grids were also installed in November 2020. **2021 Survey** 4 tile grids installed in July 2021. Refer to **Annexure D** for further details.
Daytime searches for grey-headed flying-fox breeding camps Conducted concurrently with threatened flora surveys undertaken comprehensively across the Development Footprint.	• Grey-headed flying-fox (*Pteropus poliocephalus*).	12–16 October 2020 19–23 October 2020 14 October 2021 9–11, 14–15 April 2025

4.1.3.3 Key Resources

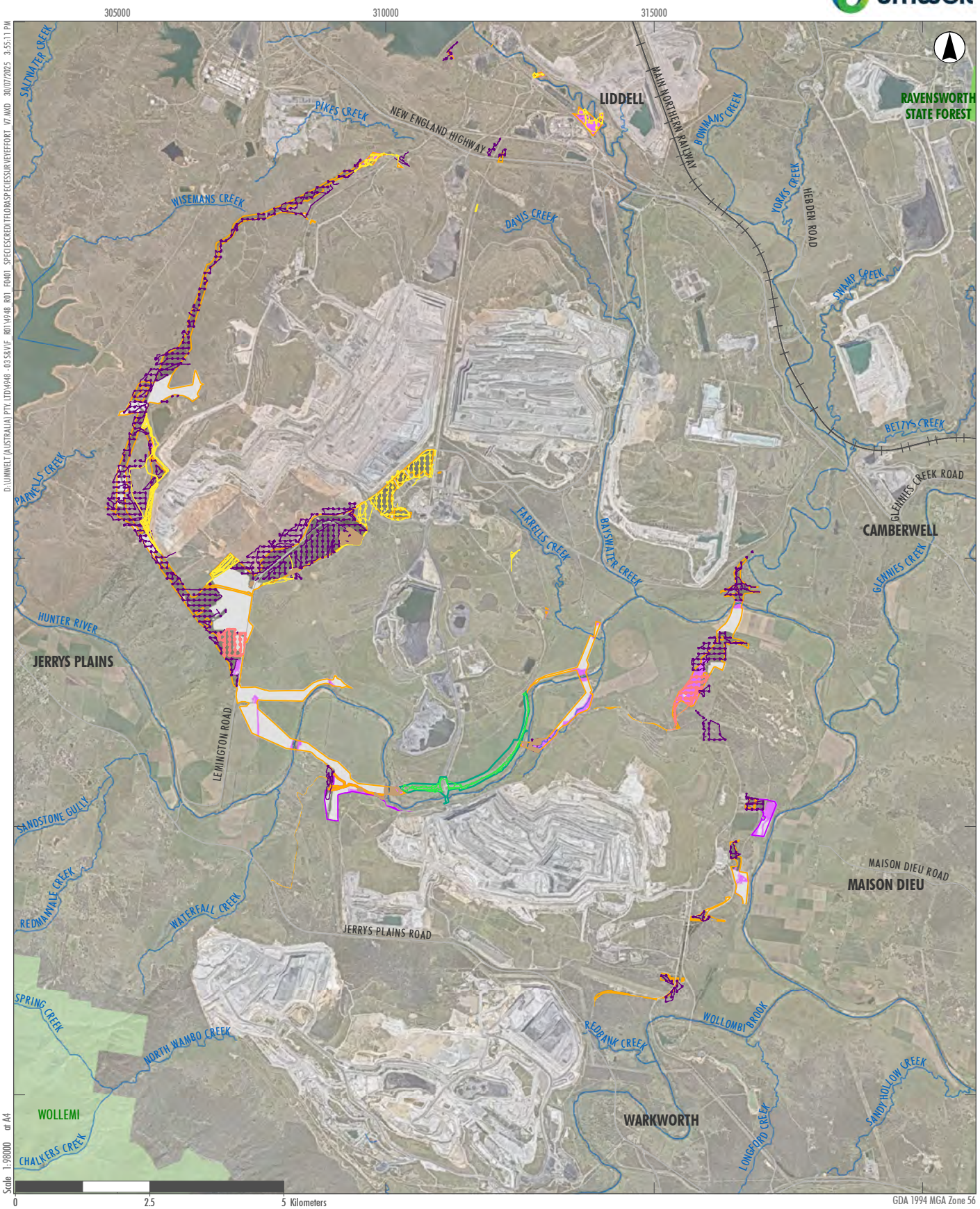
The following key threatened species survey guidelines and resources were considered when undertaking species-credit species surveys for this assessment:

- Species-specific survey information in the TBDC (DPHI 2025).
- NSW Survey Guide for Threatened Frogs (DPIE 2020d).
- 'Species credit' threatened bats and their habitats (DPHI 2021).
- Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method (DPIE 2020e).
- Important habitat mapping for the regent honeyeater, swift parrot and migratory shorebirds available on the Biodiversity Offsets and Agreement Management System (BOAMS).
- EPBC Act Referral Guidelines for the vulnerable striped legless lizard *Delma impar* (DSEWPC 2011b).
- Phillips, S., and Callaghan, J. 2011. The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. Australian Zoologist 35(3): 774–780.
- Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide (DPE 2022b).
- Threatened reptiles Biodiversity Assessment Method Survey Guide (DPE 2022c).

Where appropriate, Commonwealth species survey guidelines were also considered.

4.1.3.4 Weather Conditions and Survey Limitations

Weather conditions and survey limitations for all survey periods are provided in **Annexure D**.



Legend

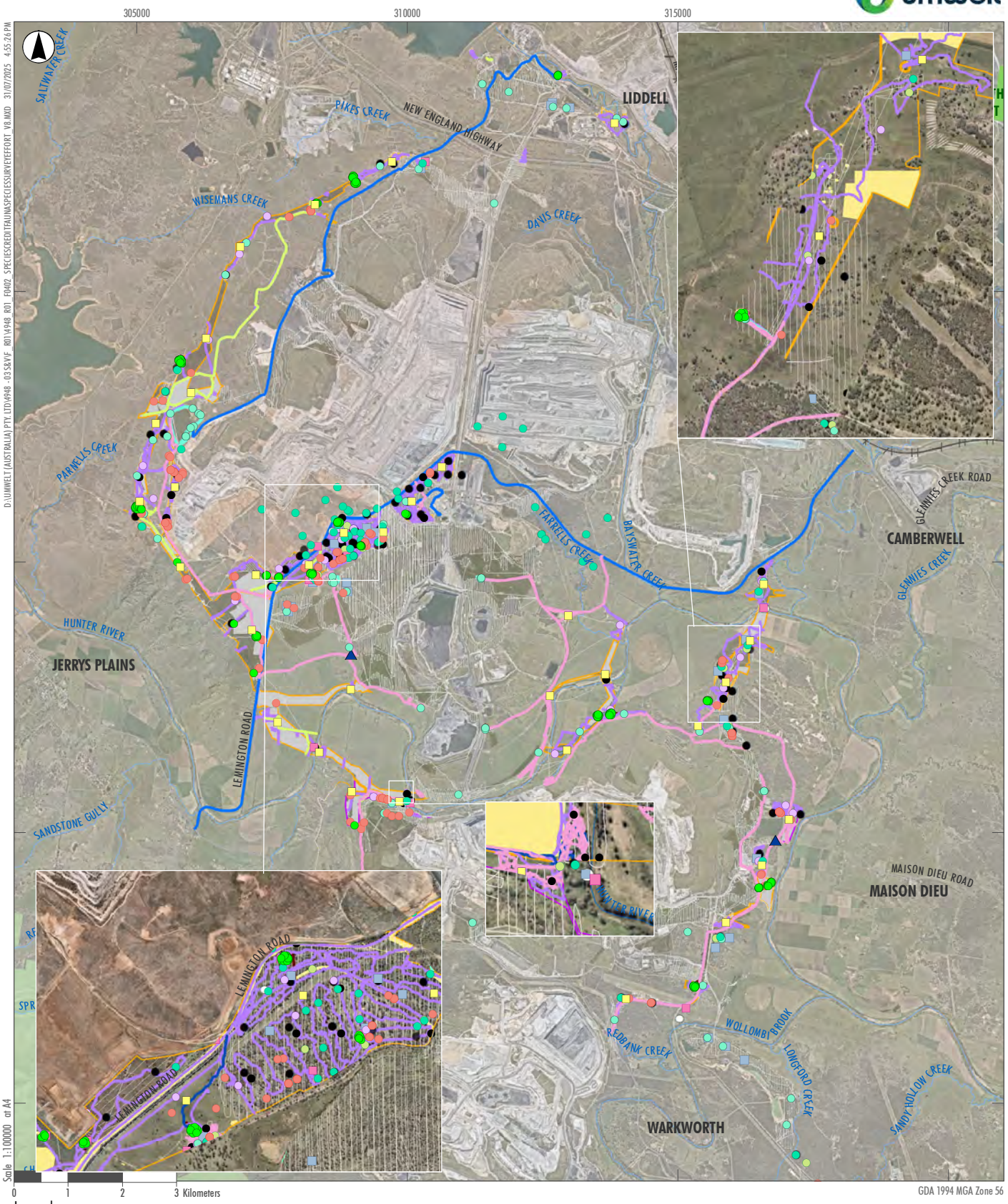
- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Targeted Flora Traverses (October 2020)
- Targeted Flora Traverses (October 2021)
- Targeted RRG Traverses (August 2022)
- Targeted Flora Traverses (September 2023)
- Targeted Flora Traverses (November 2023)
- Category 1 - Exempt Land
- Cleared Land
- Exotic Vegetation
- Railway Line
- Road
- Drainage Line
- National Parks
- State Forest

FIGURE 4.1

Species-credit Flora Species Survey Effort

Refer to Appendix C for Finer Detail

Image Source: Nearmap (April 2025)) Data source: NSW DFSI (2024)



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Targeted Forest Owl Acoustic Recorder Survey (June-July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Echolocation Detection Survey (March 2020)
- Koala SAT Survey (July 2020; May-June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019-2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- *Delma sp.* Tile Sites (2020-2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Search for Microbat Roosting in Culverts (October 2023)
- Pitfall Trap Locations (May - August 2023)
- Spotlighting Transects (October - December 2023)
- Hollow-bearing Tree and Nest Tree Searches (March-April 2025)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Green and golden bell frog call playback and spotlighting surveys for Commonwealth Assessment
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Thermal Drone Flight Path (July 2023)
- Railway Line
- Road
- Drainage Line

FIGURE 4.2

Species-Credit Fauna Species Survey Effort

Refer to Appendix C for Finer Detail

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

4.1.4 Use of Experts Accredited under the BAM

Dr David Sharpe (approved expert in the squirrel glider under the BAM) was engaged to provide advice on the likely suitable habitat for the squirrel glider and eastern pygmy possum and (in the absence of formal guidance in BAM documents or the TBDC) proposed suitable survey methods for the species. This is further discussed in **Section 4.2.2**.

4.2 Results

4.2.1 Ecosystem-credit Species

A range of ecosystem-credit species were recorded during the surveys undertaken for this assessment, including:

- woodland birds – speckled warbler (*Chthonicola sagittata*), varied sittella (*Daphoenositta chrysoptera*), scarlet robin (*Petroica boodang*), grey-crowned babbler (*Pomatostomus temporalis temporalis*), dusky woodswallow (*Artamus cyanopterus cyanopterus*), Lathams snipe (*Gallinago hardwickii*) and white-throated needletail (*Hirundapus caudacutus*)
- bat species – eastern freetail bat (*Micronomus norfolkensis*), little bent-winged bat (*Miniopterus australis*), yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) and grey-headed flying fox (*Pteropus poliocephalus*)
- ground-dwelling mammals – spotted-tailed quoll (*Dasyurus maculatus*)
- birds of prey – spotted harrier (*Circus assimilis*) and white-bellied sea eagle (*Haliaeetus leucogaster*).

A list of the ecosystem-credit species predicted to occur by the BAM-C and included in the BAM-C assessment for the Project is provided in **Table 4.3**. Note: no predicted ecosystem-credit species were excluded from the BAM-C on the basis of habitat constraints for this assessment (refer to **Annexure D**) Where woodland dependant species were predicted, derived native grassland and exotic grassland vegetation zones were de-selected.

Ecosystem species records from the surveys undertaken for this assessment are shown in **Figure 4.3**.

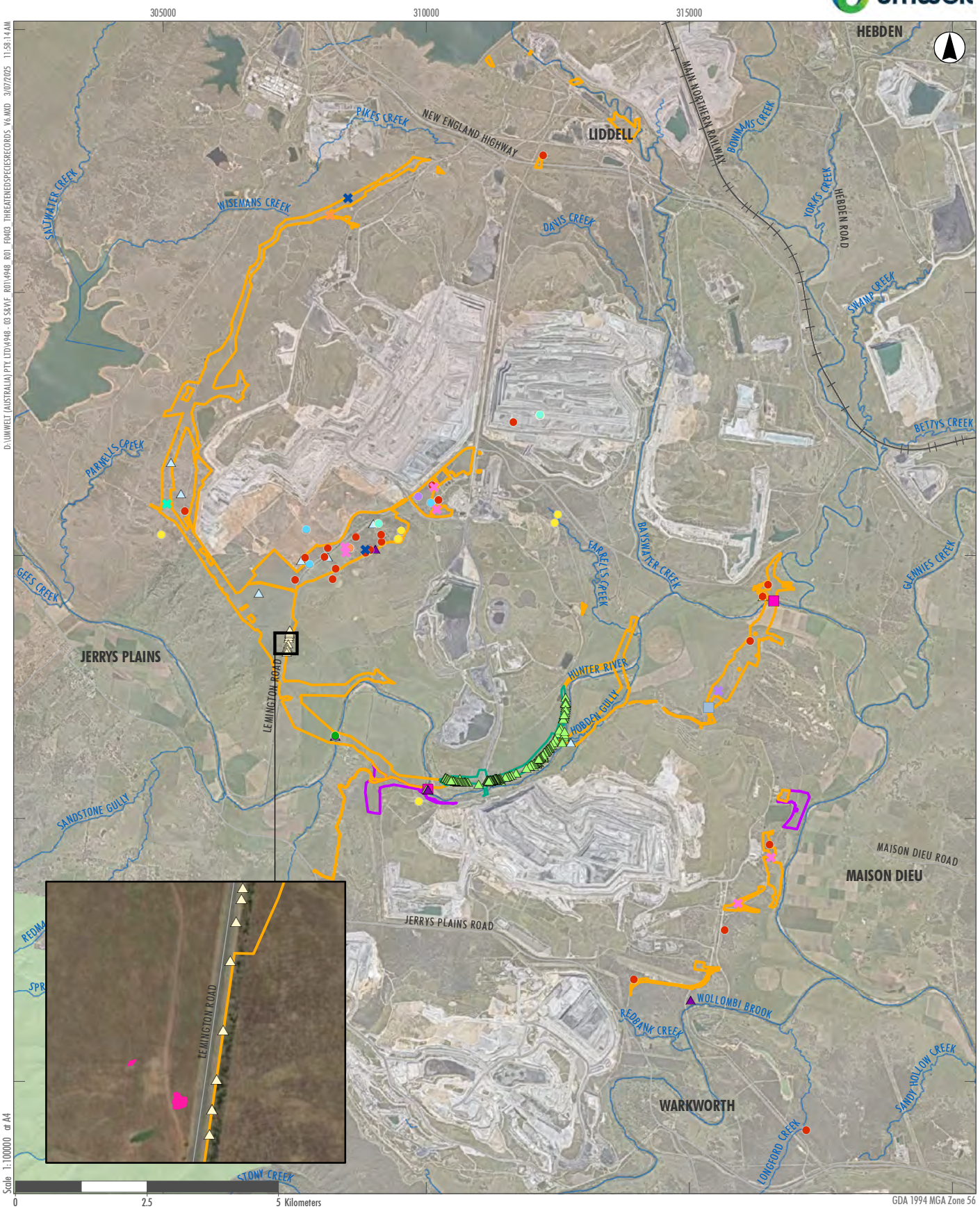
Table 4.3 Ecosystem-credit Species Predicted to Occur in the Development Footprints

Species Name	Sensitivity to Gain	Predicted Occurrence in PCTs by BAM-C	Predicted by BAM-C Assessment	
			HVO North	HVO South
Australasian bittern *Botaurus poiciloptilus*	Moderate	4015, 4081, 4089	✓	✓
Australian painted snipe *Rostratula australis*	Moderate	4015, 4081, 4089	✓	✓
black bittern *Ixobrychus flavicollis*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓
black falcon *Falco subniger*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓

Species Name	Sensitivity to Gain	Predicted Occurrence in PCTs by BAM-C	Predicted by BAM-C Assessment	
			HVO North	HVO South
black-chinned honeyeater *Melithreptus gularis gularis*	Moderate	3431, 3485, 4081, 4089	✓	✓
black-necked stock *Ephippiorhynchus asiaticus*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓
broad-billed sandpiper^ *Limicola falcinellus*	High	3431	✓	✓
brown treecreeper *Climacteris picumnus victoriae*	High	3431, 3485, 4015, 4081, 4089	✓	✓
diamond firetail *Stagonopleura guttata*	Moderate	3431, 3485, 4089, 4089	✓	✓
dusky woodswallow *Artamus cyanopterus cyanopterus*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓
eastern coastal free-tailed bat *Micronomus norfolkensis*	High	3431, 3485, 4015	✓	✓
eastern false pipistrelle *Falsistrellus tasmaniensis*	High	3431	✓	✓
eastern grass owl *Tyto longimembris*	Moderate	4015	✓	-
eastern osprey *Pandion cristatus*	Moderate	3431, 4015, 4081, 4089	✓	✓
flame robin *Petroica phoenicea*	Moderate	3431, 3485, 4089, 4089	✓	✓
gang-gang cockatoo *Callocephalon fimbriatum*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓
greater broad-nosed bat *Scoteanax rueppellii*	High	3431	✓	✓
grey-crowned babbler *Pomatostomus temporalis temporalis*	Moderate	3431, 4015, 4081, 4089	✓	✓
grey-headed flying-fox *Pteropus poliocephalus*	High	3431, 3485, 4081, 4089	✓	✓
large bent-winged bat *Miniopterus orianae oceanensis*	High	3431, 3485, 4015	✓	✓
little bent-winged bat *Miniopterus australis*	High	3431	✓	✓
little eagle *Hieraaetus morphnoides*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓

Species Name	Sensitivity to Gain	Predicted Occurrence in PCTs by BAM-C	Predicted by BAM-C Assessment	
			HVO North	HVO South
little lorikeet *Glossopsitta pusilla*	High	3431, 3485, 4015, 4081, 4089	✓	✓
magpie goose *Anseranas semipalmata*	Moderate	4089	✓	-
painted honeyeater *Grantiella picta*	Moderate	3485, 4015	✓	-
regent honeyeater *Anthochaera phrygia*	High	3431, 3485, 4089, 4089	✓	✓
scarlet robin *Petroica boodang*	Moderate	3431, 3485, 4089, 4089	✓	✓
south-eastern glossy black-cockatoo *Calyptorhynchus lathami lathami*	High	3431, 3485, 4015, 4081, 4089	✓	✓
south-eastern hooded robin *Melanodryas cucullata cucullata*	Moderate	3485, 4015	✓	-
speckled warbler *Chthonicola sagittata*	High	3431, 3485, 4015, 4081, 4089	✓	✓
spotted harrier *Circus assimilis*	Moderate	3431, 3485, 4081, 4089	✓	✓
spotted-tailed quoll *Dasyurus maculatus*	High	3431, 3485, 4081, 4089	✓	✓
square-tailed kite *Lophoictinia isura*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓
swift parrot *Lathamus discolor*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓
turquoise parrot *Neophema pulchella*	High	3431, 3485	✓	✓
varied sittella *Daphoenositta chrysoptera*	Moderate	3431, 3485, 4015, 4081, 4089	✓	✓
white-bellied sea-eagle *Haliaeetus leucogaster*	High	3431, 3485, 4015, 4081, 4089	✓	✓
white-throated needletail *Hirundapus caudacutus*	High	3431, 3485, 4015, 4081, 4089	✓	✓
yellow-bellied sheathtail-bat *Saccolaimus flaviventris*	High	3431, 3485	✓	✓

^The broad-billed sandpiper has been retained in the BAM-C assessment as a predicted ecosystem credit species as it makes no material difference to the assessment outcome. However, we strongly question its inclusion as a coastal wetland specialist species being associated with a Central Hunter box-ironbark woodland community.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Railway Line
- Road
- Drainage Line
- National Parks
- River Red Gum Additional Disturbance Area

Umwelt Threatened Species Records (2025)

- *Acacia pendula* Endangered Population

Species-credit species

- Southern Myotis

Ecosystem-credit species

- GH flying fox
- Grey Crowned Babbler
- Lathams Snipe
- White-throated Needletail

Umwelt Threatened Species Records (2019-2023)

Ecosystem-credit species

- Eastern Freetail-bat
- Grey-crowned Babbler
- Scarlet Robin
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll
- Varied Sittella
- Yellow-bellied Sheathtail-bat
- Little Bent-winged Bat
- Dusky woodswallow

Species-credit species

- *Acacia pendula*
- *Eucalyptus camuldulensis*
- Brush-tailed Phascogale
- Hunter Valley *Delma*
- Large-eared Pied Bat

Image Source: Nearmap (April 2025)) Data source: NSW DFSI (2024)

FIGURE 4.3

Threatened Species Records

4.2.2 Species-credit Species

Targeted species-credit surveys were undertaken across the Development Footprints as outlined in **Section 4.1.3** and detailed in Section D.2 of **Annexure D**. Four species-credit species that will generate credits as part of the Project were recorded in the Development Footprints, and three species have been assumed present for this assessment based on the prevalence of records in the local area and region.

Assumed Present:

- southern myotis (*Myotis macropus*)
- squirrel glider (*Petaurus norfolcensis*)
- eastern pygmy possum (*Cercartetus nanus*).

Recorded:

- *Eucalyptus camaldulensis* – River Red Gum endangered population in the Hunter catchment
- *Acacia pendula* – population in the Hunter catchment
- Hunter Valley delma (*Delma vescolineata*)
- brush-tailed phascogale (*Phascogale tapoatafa*).

Large-eared pied bat (*Chalinolobus dwyeri*) and little bent-winged bat (*Miniopterus australis*) were also positively recorded during Anabat surveys, however no areas containing breeding habitat occur in or within 2 km of the Development Footprints and therefore habitat polygons are not required for these species (refer to **Section 6.4.2** for further discussion). Offsetting for these species is captured for foraging habitat as part of the ecosystem credit requirement. No expert reports were sourced for this assessment, however Dr David Sharpe (squirrel glider approved expert) was consulted on the preliminary species polygon and proposed additional survey requirements for squirrel glider and eastern pygmy possum.

The sections below provide a discussion of the seven species generating credits for this assessment. Species polygons have been prepared for these species as outlined in **Table 4.6** and shown in **Figure 4.4** to **Figure 4.10.**

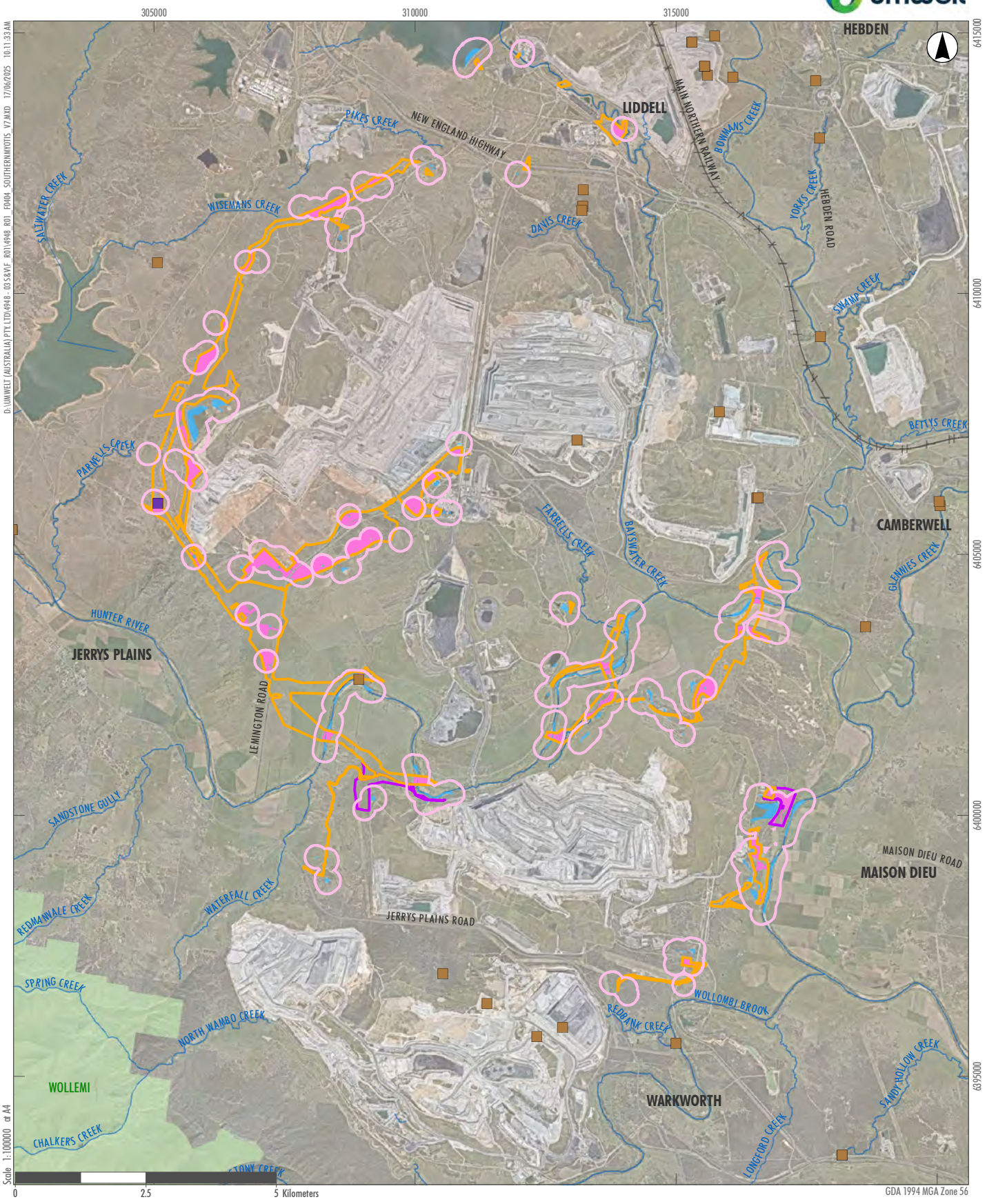
4.2.2.1 Southern myotis (*Myotis macropus*)

The southern myotis (*Myotis macropus*) has been assumed present based on the prevalence of records in the local area and region. In particular, the species was recorded near Ravensworth West Mine in 2008 (DPE 2022a). The species has been regularly recorded along waterbodies in the locality including along Glennies Creek in 2009 and 2018, Bowmans Creek in 2008 and 2014 and adjacent to the Hunter River near the Carrington West Wing Extension in 2009 (DPE 2022a). A record from 2009 also occurs at the Wollombi Brook and Redbank Creek junction near HVO South (DPE 2022a). A likely southern myotis was recorded in March 2025 during the nocturnal green and golden bell frog surveys, swooping and fishing over a dam in the western section of the HVO North Development Footprint.

The species is known to roost in intact vegetation close to water, where they forage for insects and small fish by raking their feet across the water surface. Habitat for this species that generates credits includes associated PCTs within 200 m of a waterbody with pools/stretches 3 m or wider including rivers, creeks, billabongs, lagoons, or dams. For the purposes of this assessment all areas of woody native vegetation (PCTs where the species is predicted to occur by the TBDC) surrounding major waterbodies and large dams have been mapped for the southern myotis habitat polygon (refer to **Figure 4.4**).

This includes:

- PCT3431 – Central Hunter Ironbark Grassy Woodland (*Moderate*, *Thinned Woodland*, *Plantation* and *Bulloak* condition).
- PCT4089 – Namoi-Upper Hunter River Red Gum Forest (*Moderate*, *Low to Moderate* and *Cooba* condition).



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- 200m Buffer (around water)
- Railway Line
- Road
- Drainage Line
- Waterbodies
- National Parks

Umwelt Record

- Southern Myotis Species Polygon
- Southern Myotis

NSW Bionet Atlas Threatened Species Records (2023)

- Southern Myotis

FIGURE 4.4

Southern myotis (*Myotis macropus*) Records and Habitat Polygon

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024), NSW Bionet Atlas TS Records (2025)

4.2.2.2 Squirrel glider (*Petaurus norfolcensis*)

The squirrel glider has not been recorded within the Development Footprints, but has been previously recorded in habitats west of the Hunter Valley Glider Club (BioNet 2025). These habitats have since been disturbed as a result of mining development and are currently being rehabilitated. The squirrel glider is known to occur in the Central Hunter, despite the fragmented and disturbed habitats.

For the purposes of this report, the species has been assumed present until surveys can be undertaken to determine the presence or absence of the species within the Development Footprint. Approved species expert, Dr David Sharpe, was consulted on refining the likely suitable habitat on the site and the most appropriate survey methods and effort. Habitat refinement was undertaken by removing any non-associated PCTs, any PCTs in unsuitable condition (e.g. derived native grassland, exotic grasslands, cooba woodlands), isolated patches that were <3 ha (that were not embedded in a larger patch with non-associative PCTs). **Figure 4.5** shows the suitable habitat and patches of habitat considered suitable by Dr David Sharpe that has been used to assume presence and for targeting future survey effort. Vegetation zones include:

- PCT3431 – Central Hunter Ironbark Grassy Woodland (*Moderate*, *Thinned Woodland*, *Scattered Regeneration* condition)
- PCT4015 – Central Hunter Riparian Forest (*Moderate* condition).

It is proposed that baited remote camera surveys for the species will commence in spring 2025.

4.2.2.3 Eastern pygmy possum (*Cercartetus nanus*)

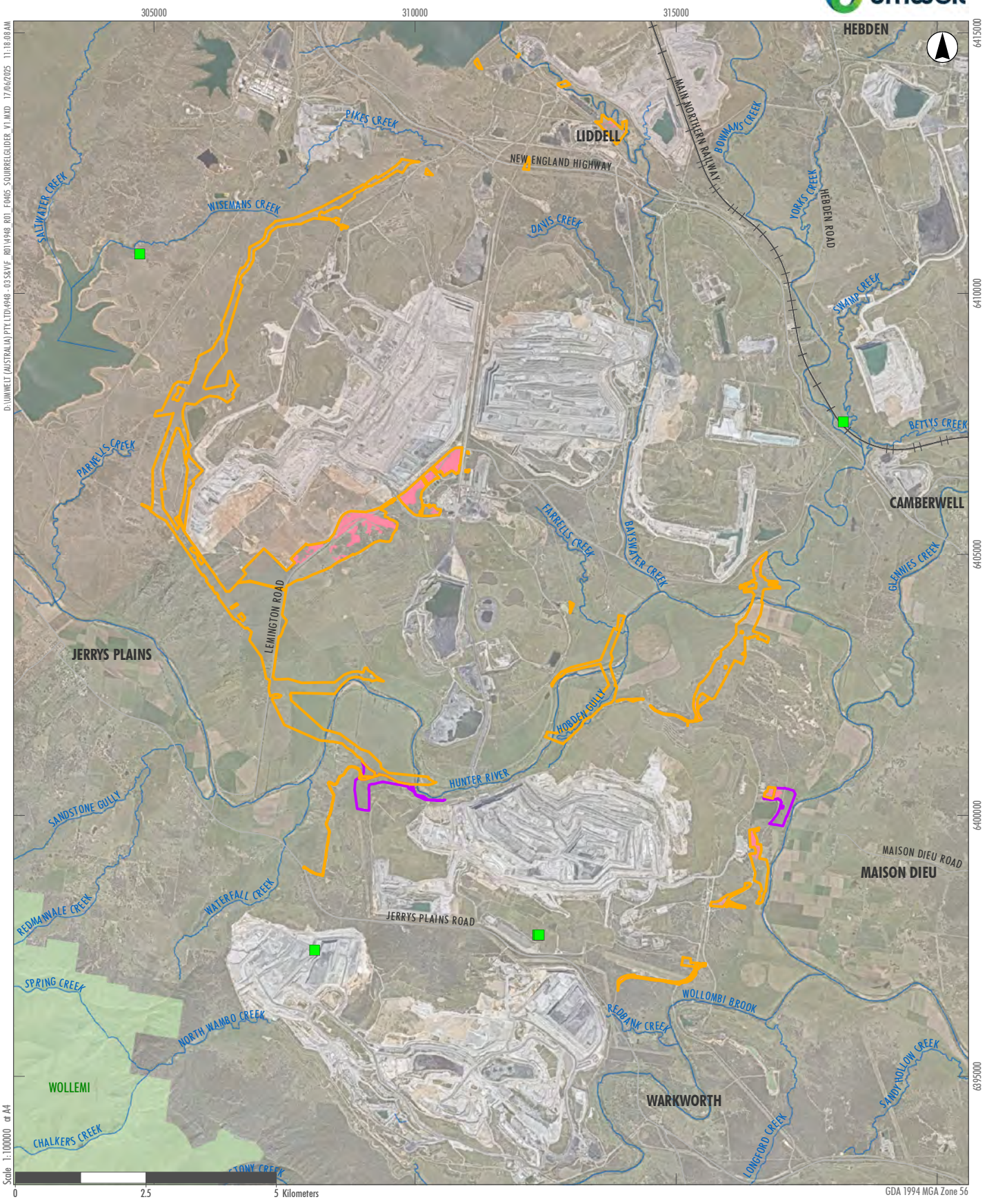
The eastern pygmy possum has not been recorded within the Development Footprints, or within proximity of the Development Footprint. The species is not known to have been recorded in the Central Hunter Valley outside of areas associated with intact habitats in National Parks (e.g. Yengo and Mount Royal National Park). While the species is known to prefer habitats containing a distinct shrubby or heathy midstorey, particularly containing banksias. These habitats do not occur in the Development Footprints, however no habitat constraints are listed in the TBDC for the species.

For the purposes of this report, the species has been assumed present until surveys can be undertaken to determine the presence or absence of the species within the Development Footprint. Dr David Sharpe was consulted on refining the likely suitable habitat on the site and the most appropriate survey methods and effort. Habitat refinement was undertaken by removing any non-associated PCTs, any PCTs in unsuitable condition (e.g. derived native grassland, exotic grasslands, cooba woodlands), isolated patches that were <3 ha (that were not embedded in a larger patch with non-associative PCTs).

Figure 4.6 shows the suitable habitat and patches of habitat considered suitable by Dr David Sharpe that has been used to assume presence and for targeting future survey effort. Vegetation zones include:

- PCT3431 – Central Hunter Ironbark Grassy Woodland (*Moderate*, *Thinned Woodland*, *Scattered Regeneration* condition)
- PCT3485 – Central Hunter Slaty Gum Grassy Forest (*Moderate* condition)
- PCT4015 – Central Hunter Riparian Forest (*Moderate* condition).

It is envisaged that baited remote camera surveys for the species will commence in spring 2025.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Squirrel Glider Species Polygon

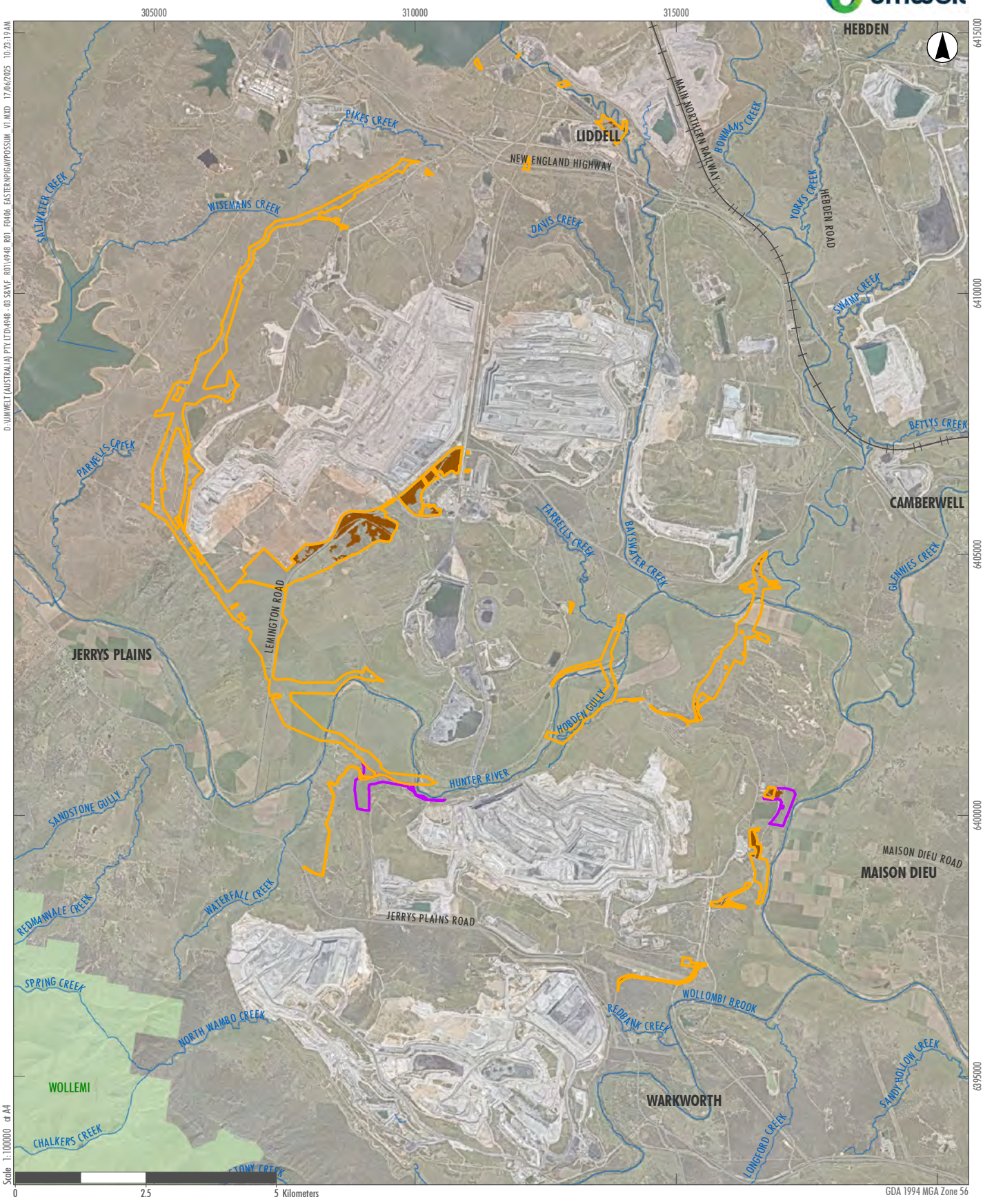
NSW Bionet Atlas Threatened Species Records (2023)

- Squirrel Glider
- Railway Line
- Road
- Drainage Line
- National Parks

FIGURE 4.5

Squirrel Glider Records and Habitat Polygons

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024), NSW Bionet Atlas TS Records (2025)



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Eastern Pygmy Possum Species Polygon
- Railway Line
- Road
- Drainage Line
- National Parks

FIGURE 4.6

Eastern Pygmy Possum Habitat Polygons

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024), NSW Bionet Atlas TS Records (2025)

4.2.2.4 *Eucalyptus camaldulensis* – River Red Gum Endangered Population in the Hunter Catchment

A population of river red gum (*Eucalyptus camaldulensis*) is known to occur along the Hunter River around HVO and Carrington Billabong, to the east near the confluence of Glennies Creek and further south along Wollombi Brook. Where the HVO North Development Footprint intersects the Hunter River east of the Carrington Billabong and north of Cheshunt Pit, individuals of river red gum were recorded on the banks of the Hunter River in association with PCT4089 Namoi-Upper Hunter River Red Gum Forest and PCT4081 Northwest River Oak-River Red Gum Forest. A large number of river red gums were recorded within the River Red Gum Additional Disturbance Area (refer to **Figure 4.7**).

At the time of survey, the stands of river red gum within the Development Footprint and River Red Gum Additional Disturbance Area contained mature trees and signs of recruitment. Noting the strong link between flood water retention and natural recruitment of river red gum, this recruitment is likely in response to substantial rainfall events that occurred in the region from early 2020. Despite these signs of recruitment, the remnants along the Hunter River are generally highly degraded due to historic agricultural practices, vegetation clearance, weed invasion and subsequent fragmentation and isolation.

The location of the river red gum endangered population and habitat polygon mapping in relation to the HVO North and HVO South Development Footprints (and the River Red Gum Additional Disturbance Area) is shown in **Figure 4.7**. This was calculated on the direct impacts to the population by buffering all recorded individuals by 30 m (except where the buffer extended to onto the artificial bund). Direct impacts to the population are expected at the locations where the proposed realignment of the transmission line crosses the Hunter River. Where possible, river red gum individuals will be avoided through careful placement of poles and access tracks, however it is acknowledged that necessary maintenance of the transmission line easement will require trimming of canopy species.

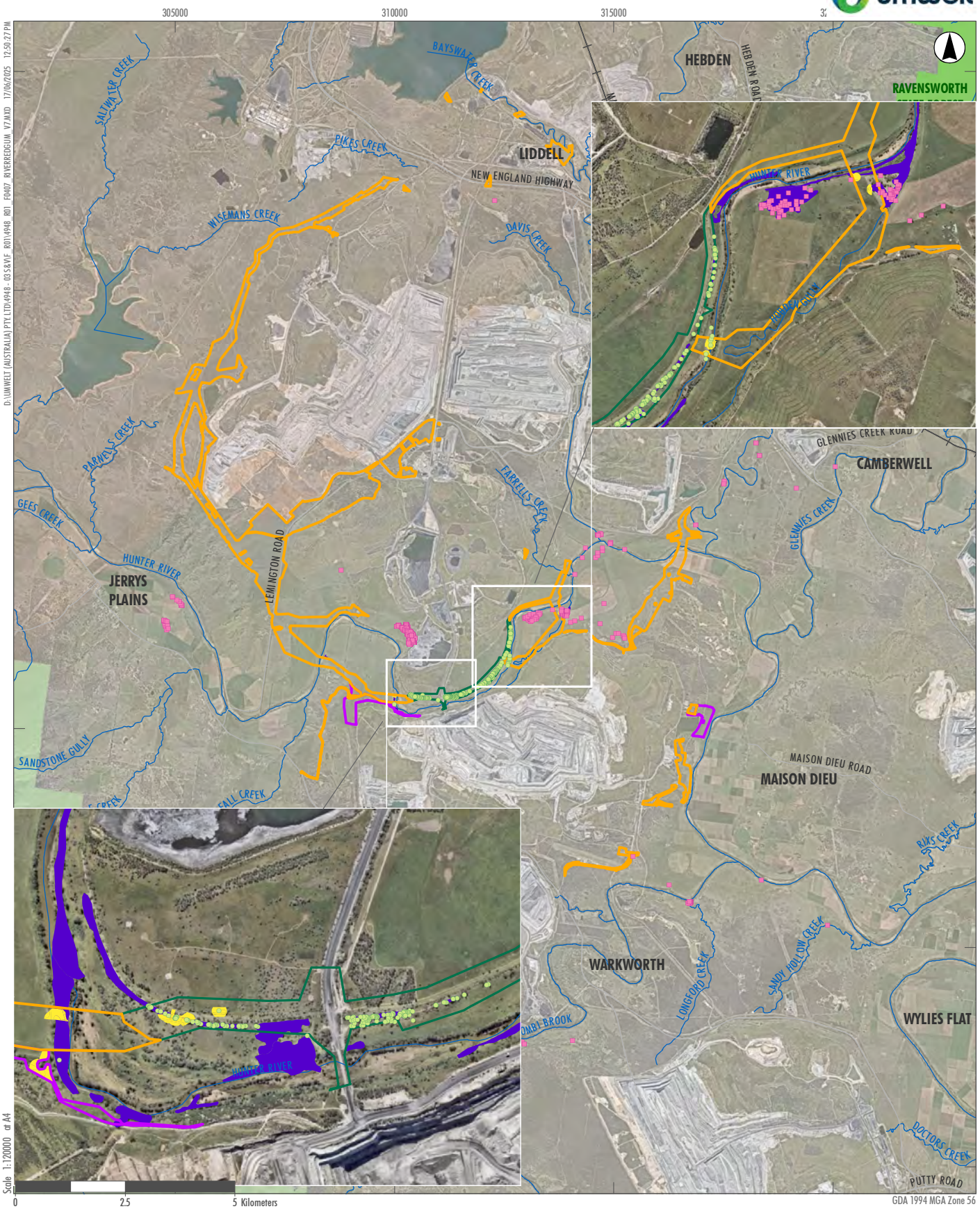
A comprehensive Rehabilitation and Restoration Strategy for the nearby Carrington Billabong and its river red gum population was prepared as part of the previous approval to extend open-cut mining in the Carrington Pit, located in HVO North in 2006. The Strategy set up a monitoring program of river red gum subpopulations and vegetation communities in Carrington Billabong and priority sites on the Hunter River and Wollombi Brook in HVO North and South. The program prescribed six monitoring events over a ten year period between 2007 to 2017. The key results of this monitoring indicated that recruitment was limited to areas on the floodplain where water is retained for several weeks following flooding events. Furthermore, the areas containing river red gums are low in native flora species diversity with high herbaceous weeds species present, with native species typically comprising 30% or less of total species recorded. These results are consistent with the conditions recorded during the surveys undertaken for this assessment.

A revision of the Strategy was required as part of the project approval for the HVO South Project (PA 06_0261) to include stands of river red gums on the Hunter River and Wollombi Brook, which occurred within the HVO South project approval boundary. The revised Strategy addressed requirements to restore and rehabilitate the Carrington Billabong and to manage stands of river red gums occurring along the Hunter River and Wollombi Brook at HVO South.

The potential for indirect impacts to the population due to groundwater and surface water changes as a result of the Project are further discussed in **Section 6.2** and **Section 6.3**. Key findings from the groundwater assessment undertaken by ERM for the Carrington Pit Extension Statement of Environmental Effects (ERM 2005), shows that connectivity between Carrington Billabong and the groundwater aquifer was confirmed. These findings also indicated that reductions to water table levels were at least partially attributable to both drought and mining activities. Consequently, it is likely that local mining activities have interfered with the water usage regime of the river red gums at Carrington Billabong.

The groundwater dependent ecosystem assessment undertaken for the Project (Eco Logical 2022) does not predict significant impacts on the river red gum population (refer to Appendix L of the EIS). EcoLogical (2022) states that "*Modelling predicts some drawdown in the Quaternary alluvium of the Hunter River near the riparian river red gum sites, however, the incremental drawdown is predicted to be less than 0.5 m and no widespread dewatering will occur. Minor drawdown of 0.2–0.5 m is modelled for below Carrington Billabong (AGE 2022). Any decline in the water table due to mining activities in other parts of the aquifer is likely to be replaced by the leakage of surface water through the bed of the Hunter River (AGE 2022). River red gum populations close to the Hunter River will continue to have access to groundwater due to drainage from the Hunter River, and no significant impact is expected.*"

Photo 4.1 **River red gum (*Eucalyptus camaldulensis*) Endangered Population (September 2020 near the Hunter River)**



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Railway Line
- Road
- Drainage Line
- River Red Gum Additional Disturbance Area
- National Parks
- State Forest
- River Red Gum Species Polygon
- River Red Gum Areas in the 'HVO River Red Gum Rehabilitation and Restoration Strategy'

NSW Bionet Atlas Threatened Species Records (2022)

- *Eucalyptus camaldulensis* (River Red Gum)

Umwelt Threatened Species Records (2020 - 2022)

- *Eucalyptus camuldulensis* (River Red Gum)

FIGURE 4.7

River Red Gum Endangered Population Records and Habitat Polygons

Image Source: Nearmap (September 2020), Data source: NSW DFSI (2024), NSW Bionet Atlas TS Records (2025)

4.2.2.5 *Acacia pendula* – population in the Hunter Catchment

Acacia pendula individuals were recorded near an access track adjacent to Lemington Road, within the Development Footprint. Samples were collected and confirmed as *Acacia pendula* by the NSW Royal Botanic Gardens (refer to **Annexure J**). The recorded individuals are naturally regenerating in a grassy paddock within proximity of known mature planted individuals occurring along the edge of Lemington Road (refer to **Photo 4.2**). It is expected the individuals in the Development Footprint have propagated from these plantings. The plants are small and under-developed, potentially as a result of cattle grazing.

Acacia pendula is an endangered population in the Hunter Catchment. Successful fruiting has never been observed in the Hunter population, and all populations appear sterile (Bell and Driscoll 2014). According to Bell and Driscoll (2014) it is reasonable to assume that many of the plants found in the Hunter originate from plantings. The species has commonly been used throughout the region in avenue and screen plantings. Within the Hunter Valley, examples include areas along the New England Highway at Ravensworth and within planted screens on Glencore mine sites.

The individuals recorded in the Development Footprint occur outside the impact areas of the proposed realigned easement (i.e. the Wider Easement Area) and are proposed to be avoided (refer to **Figure 4.8**).

Photo 4.2 ***Acacia pendula*** **Individuals Recorded within the Development Footprint (Wider Easement Area) Adjacent to Lemington Road**

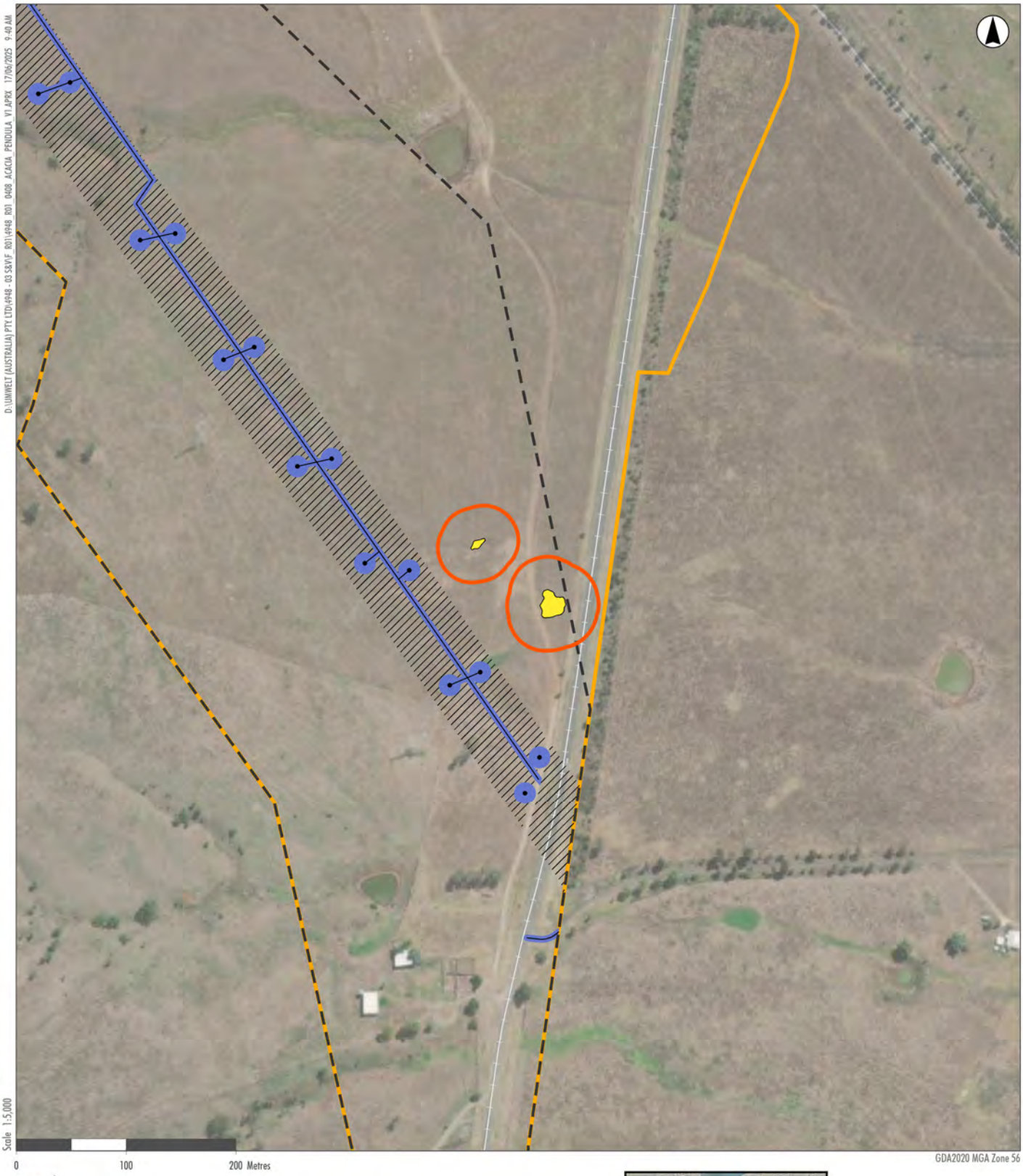


FIGURE 4.8

Acacia pendula Records and 30m Buffers

Image Source: ESRI Basemap Data source: DFSI (2024)

4.2.2.6 Hunter Valley delma (*Delma vescolineata*)

The BAM-C predicted the potential occurrence of striped legless lizard (*Delma impar*), which is better known for its populations in the southern tablelands and south west slopes of NSW and listed as vulnerable under the BC and EPBC Acts. Records of a legless lizard attributed to *Delma impar* have been previously recorded in the Hunter Valley at the Maxwell and Mt Pleasant mine sites and Bayswater Power Station, north and northwest of the HVO Complex. It has been recently determined that a newly-described species of legless lizard occurs in the Hunter, being the Hunter Valley delma (*Delma vescolineata*) (Mahony *et al.* 2022). Mahony *et al*. (2022) states that the new species is divergent from *Delma impar* in both nuclear and mitochondrial analysis and differing facial scalation and colour patterning. The species appears to be a grassland specialist, similar to *Delma impar*, but has also been recorded on the edge and within open and sparse grassy woodlands.

On 11 October 2024, the Hunter Valley delma (*Delma vescolineata*) was listed as endangered under the BC Act. The final determination states:

"Delma vescolineata has been recorded in secondary native grassland remaining after the removal or dieback of previous woody canopy vegetation (Benson 1996) in association with sparse box-gum or ironbark woodland (Mahony et al. 2022). The primary canopy species consists of Eucalyptus melliodora and E. crebra, with a diverse ground cover layer containing multiple grasses including Austrostipa spp., Bothriochloa spp., and Chloris spp. (Mahony et al. 2022)."

As surveys were undertaken prior to the identification of the new species, Umwelt undertook a comparison of the photos of legless lizards that were recorded at HVO to identify if they demonstrated the morphological features of the newly described Hunter Valley delma and compared these with features of striped legless lizard (*Delma impar*). This assessment focused on photos that clearly showed the scalation of the head due to the main distinguishing morphological features of *Delma vescolineata* compared with other *Delma* sp. is that the third labial scale occurs directly under the eye opposed to occurring before the eye towards the snout. Of the images of legless lizards taken at HVO, the photos that showed the side profile of the individuals head were confirmed to be *Delma vescolineata*. Using the precautionary principle, it is assumed that the legless lizards attributed to striped legless lizard (*Delma impar*) at HVO prior to identification of the newly-described Hunter Valley delma, will be considered as *Delma vescolineata.*

Targeted artificial shelter surveys were undertaken for this assessment in consideration of the survey guidance in the Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011a), EPBC Act Referral Guidelines for the Striped Legless Lizard (*Delma impar*) (DSEWPC 2011b) and the SPRAT Profile for the species (DAWE 2021). Surveys identified the species in seven locations across grassland and thinned grassy woodland habitats. The location of the Hunter Valley delma records and habitat polygon mapping in relation to the HVO North and HVO South Development Footprints is shown in **Figure 4.9**.
Despite extensive survey, the species was not recorded in highly degraded, exotic grasslands or areas of intact woodlands. While the species was only recorded in and adjacent to the HVO North Development Footprint, it has been assumed that it also occurs in the similar habitats in the HVO South Development Footprint despite not being confirmed to occur there. **Table 4.4** below outlines the records of the species for this assessment.

At the time of writing, the species is not predicted by the BAM-C. Following advice from the BOS Helpdesk, received on 29 July 2025, credit calculations have been manually calculated using the equation 2, Section 10.1.3 of the BAM (2020) and the following species information provided by the BOS Helpdesk:

Hunter Valley delma (*Delma vescolineata*)

- Biodiversity Credit Class - Species
- Biodiversity Risk Weighting (BRW) - 2.00
- Unit of measure - Area
- Sensitivity to loss - High
- Sensitivity to gain – High.

The Hunter Valley delma habitat polygon includes all vegetation zones across the Development Footprint where the species was recorded, being:

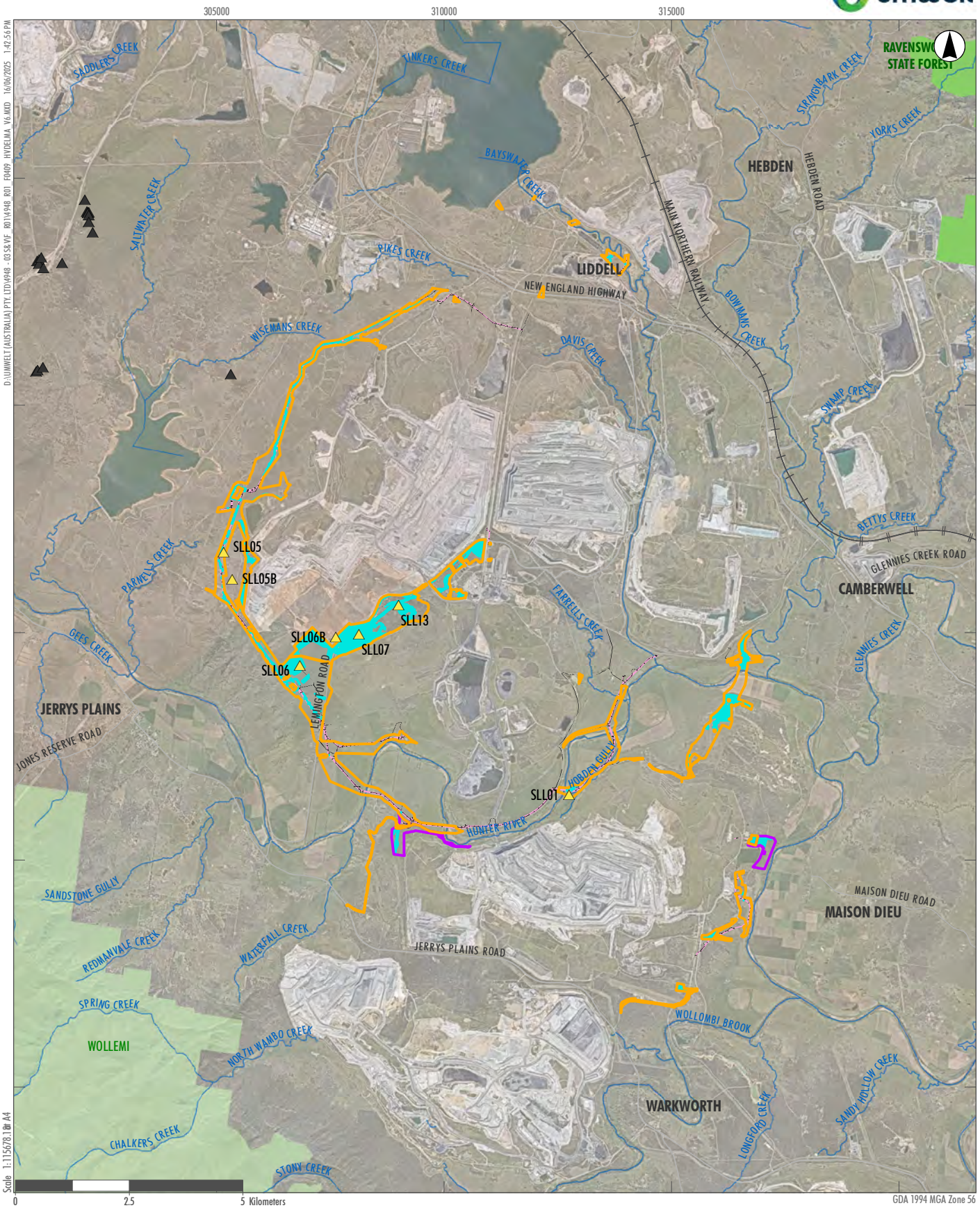
- PCT3431 – Central Hunter Ironbark Grassy Woodland (*Derived Native Grassland, Thinned Woodland, Scattered Regeneration* condition).
- PCT4089 – Namoi-Upper Hunter River Red Gum Forest (*Derived Native Grassland* condition).

No impact to the Hunter Valley delma was assessed for Management Zone (MZ) 2 (New transmission line Easement) for the purposes of the BAM assessment (refer to **Section 6.1** for management zone descriptions). Areas outside the proposed installation disturbance (restricted to tracks and pole pads) for the proposed new easement (MZ2) will be managed in accordance with *ISSC 20 Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure* (ISSC 2012) and will remain in grassland condition.

Table 4.4 Hunter Valley Delma Records

Tile Grid Reference	Vegetation Zone	Relevant Development Footprint	Number Recorded	Date Recorded
SLL01	PCT4089 *DNG*	HVO North	2	9/10/2020
SLL05	PCT3431 *DNG*	HVO North	3	30/09/2020
			2	8/10/2020
			2	15/10/2020
SLL05B	PCT3431 *Scattered Regeneration*	HVO North	1	11/11/2020
SLL06	PCT3431 *DNG*	HVO North	6	30/09/2020
			3	8/10/2020
			1	15/10/2020
SLL06B	PCT3431 *Scattered Regeneration*	HVO North	1	11/11/2020
SLL07	PCT3431 *DNG*	HVO North	1	22/09/2020
			15	30/09/2020
			3	9/10/2020
			3	15/10/2020
			4	5/11/2020
SLL13	PCT3431 *Thinned Woodland*	HVO North	1	17/11/2020

Photo 4.3 Hunter Valley delma (*Delma vescolineata*) Recorded During Tile Grid Surveys (30 September 2020 in PCT3431 DNG Habitat)



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Railway Line
- Road
- Drainage Line
- National Parks
- State Forest
- Management zone 1 – full impact
- Management zone 2 – partial impacts
- Hunter Valley *Delma* Species Polygon

NSW Bionet Atlas Threatened Species Records (2022)

- Striped Legless Lizard (likely Hunter Valley *Delma*)

Umwelt Threatened Species Records (2022)

- Hunter Valley *Delma*

FIGURE 4.9

Hunter Valley Delma (*Delma vescolineata*) Records and Habitat Polygons

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024), NSW Bionet Atlas TS Records (2025)

4.2.2.7 Brush-tailed phascogale (*Phascogale tapoatafa*)

The brush-tailed phascogale (*Phascogale tapoatafa*) is known to occupy dry sclerophyll open forests with a sparse groundcover of herbs, grasses, shrubs or leaf litter. This generally cryptic species has been recently recorded regularly in the woodlands of the Hunter Valley with the use of baited remote camera surveys. The species has been recorded annually at the Ashton Coal Mine offset site between 2015 and 2019 located approximately 1.8 km from the eastern extent of the HVO North Development Footprint.

The species was recorded on four occasions from one location outside the HVO North Development Footprint near the confluence of the Hunter River and Bowmans Creek in moderate condition PCT1691 Narrow-leaved Ironbark – Grey Box grassy woodland of the central and upper Hunter during the surveys undertaken for this assessment. The species was not captured on any other cameras across the Development Footprint, however noting the species populations are known to fluctuate and the species' ability to occupy a range of PCTs, for the purposes of this assessment all associated PCTs (in accordance with the TBDC) in woody condition have been included in the species polygon (refer to **Figure 4.10**). This includes:

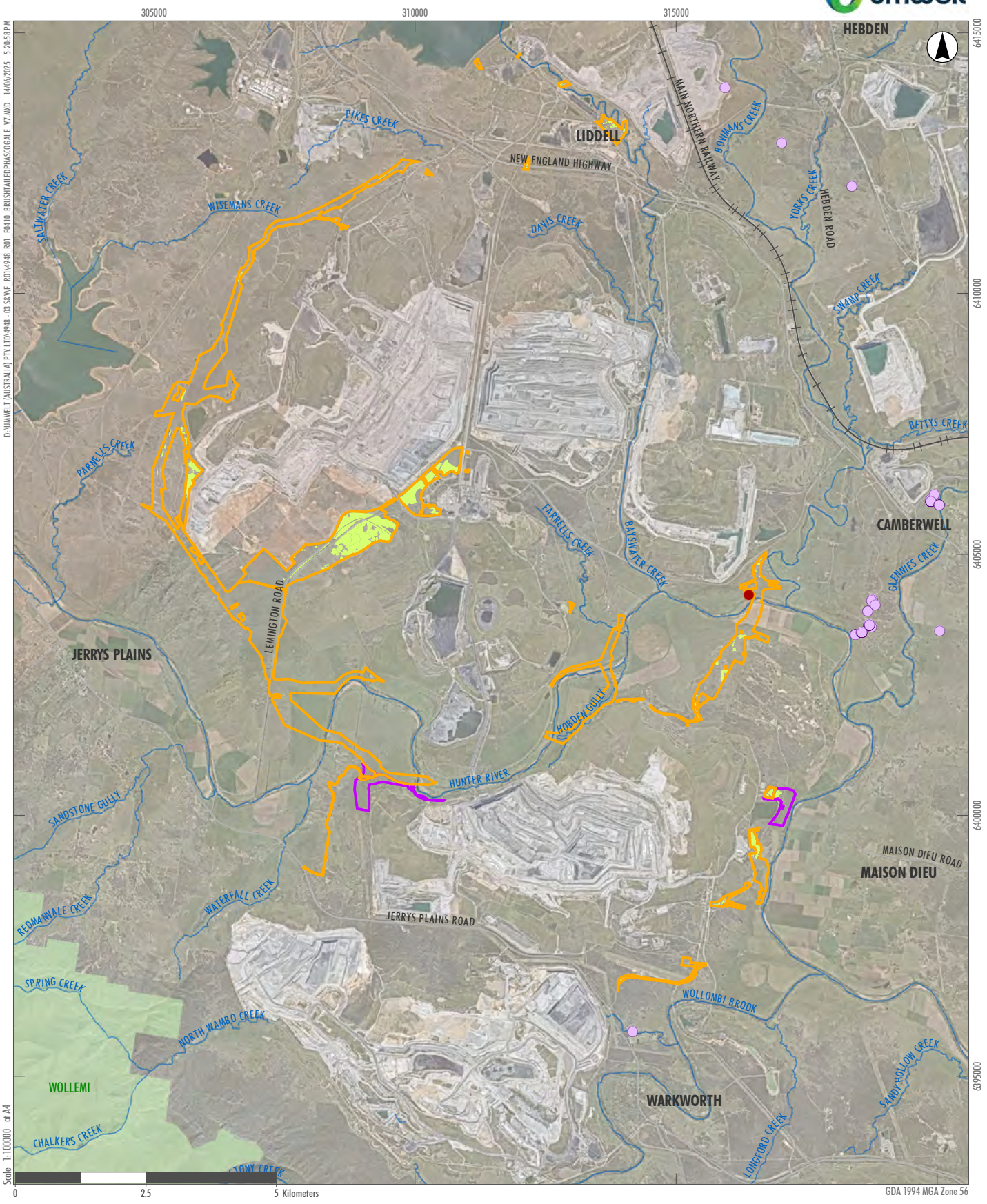
- PCT3431 – Central Hunter Ironbark Grassy Woodland (*Moderate*, *Thinned Woodland*, *Woodland with Exotic Understorey* and *Plantation* condition).
- PCT3485 – Hunter Valley Footslopes Slaty Gum Forest (*Moderate* condition)
- PCT4015 – Central Hunter Swamp Oak Riparian Forest Valley (*Moderate* condition).
- PCT4089 – Namoi-Upper Hunter River Red Gum Forest (*Moderate* and *Low to Moderate* condition).

Table 4.5 below outlines the records of the species for this assessment.

Table 4.5 Brush-tailed Phascogale Records

Remote Camera Reference	Number Recorded	Date Recorded	Vegetation Zone	Relevant Development Footprint
CAM23	1	8/5/2020	1. PCT3431 *Moderate*	HVO North
	1	26/5/2020		
	1	14/6/2020		
	1	19/6/2020		

Photo 4.4 **Brush-tailed phascogale (*Phascogale tapoatafa*) Recorded on Remote Cameras (8 May 2020, CAM23 Location Refer to Figure 4.10)**



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Brush-tailed Phascogale Species Polygon
- Railway Line
- Road
- Drainage Line
- National Parks

NSW Bionet Atlas Threatened Species Records (2022)

- Brush-tailed Phascogale

Umwelt Threatened Species Records (2020)

- Brush-tailed Phascogale

FIGURE 4.10

Brush-tailed Phascogale (*Phascogale tapoatafa*) Records and Habitat Polygons

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024), NSW Bionet Atlas TS Records (2025)

Table 4.6 Species-credit Species Recorded or Assumed Present in the Development Footprints

Species Name	Biodiversity Risk Weighting	SAII	Habitat and/or Geographic Constraint	HVO North		HVO South	
				Records	Unit of Measure	Records	Unit of Measure
southern myotis ***Myotis macropus***	2.0	No	Potential roosting habitat (i.e. hollow-bearing trees, bridges, caves or artificial structures) within 200 m of riparian zone or waterbodies with pools greater than 3 m wide.	Assumed present – in potential roosting habitat in intact vegetation close to water.	76.8 ha	Assumed present – in potential roosting habitat in intact vegetation close to water.	2.2 ha
squirrel glider ***Petaurus norfolcensis***	2.0	No	N/A	Assumed present – associated PCTs in suitable woody condition, >3 ha patches or adjoining large patches.	85.2 ha	Assumed present – associated PCTs in suitable woody condition, >3 ha patches or adjoining large patches.	2.4 ha
eastern pygmy possum ***Cercartetus nanus***	2.0	No	N/A	Assumed present – associated PCTs in suitable woody condition, >3 ha patches or adjoining large patches.	92.8 ha	Assumed present – associated PCTs in suitable woody condition, >3 ha patches or adjoining large patches.	2.4 ha
Eucalyptus camaldulensis **– River Red Gum endangered population in the Hunter catchment**	2.0	No	Floodplains of watercourses, including rivers, creeks, intermittent streams or billabongs.	**Recorded** – remnant stands recorded along Hunter River, in particular at the crossing of the proposed transmission line realignment north of Cheshunt Pit.	0.45 ha	**Recorded** – small area along Hunter River at the crossing of the proposed transmission line realignment north of Riverview Pit.	0.6 ha

Species Name	Biodiversity Risk Weighting	SAII	Habitat and/or Geographic Constraint	HVO North		HVO South	
				Records	Unit of Measure	Records	Unit of Measure
				River Red Gum Additional Disturbance Area **Recorded –** remnant stands recorded along Hunter River, in particular at the crossing of the proposed transmission line realignment north of Cheshunt Pit.	0.8 ha	N/A	0.0 ha
Hunter Valley delma ***Delma vescolineata***	2.0*	No	-	**Recorded** – in seven locations in DNG and open grassy woodland areas.	174.9 ha	Assumed present – in the same vegetation zones recorded in HVO North.	8.6 ha
brush-tailed phascogale ***Phascogale tapoatafa***	2.0	No	-	**Recorded** – in one location in woodland habitats immediately adjacent the HVO North Development Footprint.	122.1 ha	Assumed present – in woodland habitats.	2.4 ha

* The Biodiversity Risk Weighting for *Delma vescolineata* was supplied by CPHR on 29 July 2025 to manually determine the credit liability for the species in lieu of BAM-C application.

5.0 Avoidance and Minimisation

HVO has sought to avoid and minimise potential impacts on biodiversity values through Project design. This included targeted avoidance and minimisation of disturbance of key high conservation value vegetation communities and fauna habitats through designing the Project to maximise use of existing mining facilities and existing and approved disturbance areas, reducing the mining footprint and relocating infrastructure, where possible and implementing a range of biodiversity mitigation measures.

HVO undertook a detailed biodiversity constraints study as part of the Project's pre-feasibility assessment to guide the development and detailed design of the Project. Through this process alternative mining options were considered, and HVO has sought to minimise the biodiversity impacts associated with the Project whilst maximising the economic resource recovery.

5.1 Project Location and Site Selection

5.1.1 Impacts Targeted to Previously Impacted Areas

The continuation of mining across the HVO Complex is proposed to be predominantly undertaken through previously mined and disturbed areas, and areas previously approved to be disturbed (approximately 72% of the Project disturbance area occurs as re-disturbance). While this approach provides significant resource recovery largely through the extraction of coal from deeper seams and mining efficiency advantages it also provides improved final landform outcomes and minimises impacts on remnant vegetation and higher quality habitat in the locality.

The majority of the proposed development consent boundaries are within areas previously cleared and disturbed by mining operations, agricultural practices and rural development, or subject to an existing project approval. Only 4% of the proposed development consent boundaries for HVO North and HVO South contain native vegetation cover in the form of remnant forest/woodland and derived native grasslands. **Table 5.1** outlines the approximate proportion of the impacts proposed for areas across the proposed development consent boundaries.

Table 5.1 Disturbance Areas Across the Proposed Development Consent Boundary

Site Context	Area (ha)		
	HVO North	HVO South	Total
Approved Disturbance Area (existing consents)			
Existing and approved disturbance area	4963	3242	8205
Other approved disturbances^	263.5	0.0	263.5
River Red Gum Additional Disturbance Area	44	0	44
Areas to be Relinquished*	6.7	267#	273.7
Additional Disturbance Areas			
Category 1 – Exempt Land, cleared land, non-vegetated land and exotic vegetation	415.3	36.8	452.1
Remnant forest/woodland and derived native grasslands (native cover)	487.8	10.4	498.2
Total Area (ha) in Development Footprint	**903.1**	**47.2**	**950.3**

^ Includes areas within other site consents (i.e. Liddell Coal Operations and Ravensworth Operations).

** Lemington Short Rail Loop, Riverview SE Extension, South Lemington Pit 2,* LCPP and rail.

 # 46 ha of this occurs within the United Wambo JV approved disturbance area.

5.1.2 Alternative Options Considered

To meet Project objectives, detailed concept and pre-feasibility studies considering mining options and infrastructure arrangements were carried out as outlined in the Mine Plan Options Report (HVO 2022a) and the Infrastructure Options and Avoidance Report (HVO 2022b) (refer to Appendix D of the EIS).
These studies evaluated potential environmental and social impacts to inform the Project design.
The preferred Project mine and infrastructure design was chosen as they provide the best balance between optimal resource recovery and financial return, and reducing environmental and social impacts, through the implementation of appropriate mitigation measures. The preferred Project mine design has been continually optimised as further information has been made available via exploration drilling and the completion of environmental and infrastructure studies.

These options are further detailed in Section 2.7 of the EIS and summarised in **Table 5.2** below.

Table 5.2 Summary of Alternative Options

Alternative Options	Justification
Alternative Mine Options	
Alternative option 2 – No Project – mining ends at the complex as per the HVO North consent (December 2026).	This option would forego the approximately 430 Mt of ROM coal proposed to be extracted at HVO South and HVO North, and would mean cessation of employment and the associated flow-on benefits to the approximate 1,500 full time equivalent (FTE) HVO workforce.
Alternative option 3 – Maximise resource recovery – mining in several additional locations around and in addition to the preferred mine design localities	A total of six alternative mining locations were considered and are documented in the Mine Plan Options Report (refer to Annexure D in EIS). These options were considered not reasonable and feasible due to their proximity to community receptors, geotechnical constraints, heritage features, natural features and/or existing infrastructure.
Alternative option 4 – No final void remaining at the end of the preferred mine design	This option includes the mining voids being progressively backfilled and rehabilitated as soon as practicable as mining progresses. This option was not considered reasonable and feasible and did not best meet Project objectives due to the ongoing noise and dust generation, potential significant removal of established rehabilitation, delays in establishing final landform and associated land use, and associated costs that significantly affects the Project's viability.
Alternative option 5 – Impacting the CM-CD1 Aboriginal cultural heritage site	Mining through the identified CM-CD1 Aboriginal cultural heritage site was considered as a mine plan alternative due to the coal resources present and was included within the initial mine plan presented in the Scoping Report for the Project. Mining in this area was not considered reasonable and feasible and did not best meet Project objectives due to the disturbance of the CM-CD1 site, once the high significance of the site was understood, and as part of the Project HVO has committed to not disturbing this site.
Alternative option 6 – Excluding Lemington Road from the mining footprint	No disturbance of the existing Lemington Road alignment was not considered reasonable and feasible and did not best meet Project objectives. Furthermore, the proposed Lemington Road realignment benefits to the community from the upgrade of the road, such as improved flood immunity, as per the preferred Project option, would not be realised.
Alternative option 7 – Underground extraction of target seams	As an alternative to the open cut mining methodology, the extraction of resources in the Project area using underground mining methods was considered. The benefit of this option is that it would reduce the impact on the surface; however, underground mining is not considered economically viable for resource extraction in this area.

Alternative Options	Justification
Alternative Infrastructure Options	
Realignment path of Lemington Road	Alternative routes considered for the Lemington Road realignment included: • Lemington Road realignment south of HVO North – option to realign Lemington Road south of HVO North but north of the Hunter River. This would not require the construction of new intersections with the New England Highway or Golden Highway nor a bridge over the Hunter River; however, safe separation between the public traffic, mining operations and the Hunter River would be difficult. Mining would be highly visible from the relocated section of Lemington Road. This alignment would also be partly located over an area of rehabilitated mine overburden, which could present challenging geotechnical conditions and associated potential construction difficulties. • Pikes Gully Road Extension – option to upgrade and extend of the existing Pikes Gully Road along the western side of the HVO Complex and construction of a new Hunter River crossing and Golden Highway intersection in the vicinity of Jerrys Plains. This option would rely upon the purchase of private land, and the location of an intersection with the Golden Highway would increase traffic movements in the vicinity of Jerrys Plains Village and the surrounding equine industry. • Close Lemington Road – Approximately 8% of road users rely on Lemington Road to travel between the New England and Golden Highways as a through road, providing a thoroughfare for the community of Jerry Plains to access the north of Singleton. This option was not considered reasonable and feasible and did not best meet Project objectives. Lemington Road is subject to significant closure periods due to the flooding of Moses Crossing, which will be negated by the proposed Lemington Road alignment and new Hunter River bridge. • Following exhibition of the EIS in January 2023, HVO revised a portion of the proposed location of the Lemington Road re-alignment further to the west of the originally proposed location to further avoid impacts to *Warkworth Sands Woodland EEC*. This is further discussed in **Section 5.2.1** below.
Realignment path of transmission and telecommunication lines	The Project involves the realignment of transmission and telecommunication lines. The most significant of the realignments is the Ausgrid 132 kV transmission line, for which several alternatives were considered. Given the nature of transmission and telecommunication infrastructure in which connection points are fixed locations, direct alternatives are often not achievable. As such the following design practice was implemented to minimise potential indirect and direct Project impacts. The design process of the realignment routes for power transmission and telecommunication linear assets, both 3rd party and HVO owned, has been the same regardless of the asset. The process relied upon to ensure reasonable and feasible mitigation measures have been adopted whilst ensuring Project outcomes is defined below. • Identify the Project interaction point with transmission or telecommunication line item. • Identify the nearest reasonable connection points each side of the interaction.

Alternative Options	Justification
	• Identify areas or points of avoidance such as sensitive biodiversity matters, heritage items and or landownership constraints. • Understand potential amenity impacts. • Plan a minimum length alignment between available connection points whilst recognising outcomes of Steps 3 and 4. • Consult with the asset owner on the appropriateness of the alignment. • Adjust if necessary. Through this process implementing reasonable and feasible impact avoidance and mitigation whilst achieving Project outcomes, the potential impacts of the Project as it relates to transmission and telecommunication line infrastructure is kept to a minimum.
Product stockpile and train loading facility upgrades	Rather than progressing the design of new coal handling and processing facilities for the Project, the primary objective of the CPP design process was to utilise existing facilities where possible, and to re-evaluate the implementation of facilities already approved but not yet constructed. This approach to maximise the efficiency of the existing facilities was driven by the objectives of achieving maximum operational efficiencies and reduced capital and operating costs. As such, existing stockpile areas are proposed to be upgraded to increase capacity, reduce costs and impacts to new areas.
Improvements to HVO North MIA	The Project proposes to upgrade the HVO North MIA to include a new workshop suitable for ultra-class haul trucks and incorporate modern maintenance facilities. This option was chosen over new facilities as the existing MIA is already the principal HVO facility and works are achievable without additional disturbance, the MIA and HVCPP combined are centrally located without near neighbours and close to mining operations, minimising potential impact to sensitive receivers; and as mining progress further south upgrading and or refurbishment of the Howick MIA represents an impractical long term solution.
Lemington CPP and associated rail loop	Construction of the LCPP, and the trucking of ROM coal from the Riverview and Cheshunt Pits for processing there, was approved in an earlier development application for HVO South (PA 06_0261) and remains approved under the current consolidated project approval. In reviewing the approved LCPP and associated rail loop in consideration of the Project, a range of constraints were identified should it be moved outside the existing approved location including impacts on biodiversity features. Following review of the Project, Construction of the LCPP and associated rail loop is no longer proposed to be constructed.

5.2 Project Design

5.2.1 Avoidance of *Warkworth Sands Woodland EEC*

5.2.1.1 Lemington Road Realignment

Lemington Road currently travels between the West/Mitchell Pits and the Carrington area. As this area is proposed to be mined, the Project seeks to realign part of Lemington Road.

The Lemington Road realignment presents an opportunity to improve the accessibility and reliability of the road as the primary access point between the Golden Highway and New England Highway. It includes the construction of a new bridge over the Hunter River which will meet the requirements of a 1 in 10 average recurrence interval (ARI) flood protection design. This will improve accessibility and safety of the crossing compared to the existing Moses Crossing low level bridge, which often results in closure of the road during times of heavy rainfall.

The proposed alignment of Lemington Road was carefully considered to avoid or minimise impacts to areas of environmental sensitivity, in particular *Warkworth Sands Woodland EEC* and *Central Hunter Grey Box – Ironbark Woodland EEC*. As outlined in **Section 3.1.5.2**, following public exhibition of the EIS in January and February 2023, HVO revised the portion of the proposed Lemington Road re-alignment that traversed areas of 'known' *Warkworth Sands Woodland EEC* further to the west, where the depth of potential aeolian sandy substrate varies and floristic characteristics appear to favour box-ironbark woodland associations.

The additional design review sought an alignment that considered:

- Adopting an alignment further away (west) on land that transitions away from known/accepted *Warkworth Sands Woodland EEC*.
- Adopting an alignment further away from existing biodiversity offset areas where *Warkworth Sands Woodland EEC* is present.
- Further minimising the Project disturbance footprint of the proposed road corridor through remnant vegetation Utilising areas of existing disturbance or rehabilitation areas at HVO.
- Maintaining the already established principle design requirements.

Table 5.3 below outlines the key biodiversity features avoided by the proposed alignment presented in the exhibited BDAR (Umwelt 2022b) and following further avoidance measures undertaken during the Response to Submissions phase. Overall avoidance features are shown on **Figure 5.1**.

Table 5.3 Impacts Avoided following Lemington Road Realignment Design Refinement

Biodiversity Feature	Area (ha) Avoided^	
	Exhibited EIS	Following Exhibition
Native forest and woodland habitat	19.5	25.4
Native and exotic grasslands	6.3	18.8
BC Act-Listed Features		
Warkworth Sands Woodland EEC	7.2	9.8

Biodiversity Feature	Area (ha) Avoided^	
	Exhibited EIS	Following Exhibition
Central Hunter Grey Box – Ironbark Woodland EEC	9.1	12.7
Hunter Valley Footslopes Slaty Gum Woodland VEC	2.6	1.1

^ Areas not cumulative.

The field inspection carried out on 5 September 2023 by Umwelt and Minesoils focused on areas within the new alignment and adjacent areas previously and conservatively assigned as possible *Warkworth Sands Woodland EEC*. The information collected during this inspection was combined with rapid floristic data and vegetation integrity plot data previous collected in the Archerfield Road locality. The analysis of this information indicated there were areas previously identified as possible *Warkworth Sands Woodland EEC* that had a greater similarity to the *Central Hunter Grey box Ironbark Woodland EEC*. Floristic composition of these areas often shared some key characteristic species from both TECs, with the *Central Hunter Grey box Ironbark Woodland EEC* having a higher species richness in comparison to the *Warkworth Sands Woodland EEC*. Key characteristic canopy species for both TECs are shared with a persistent cover of *Eucalyptus crebra* (narrow-leaved ironbark) across many of the re-assessed areas with localised patches of *Angophora floribunda* (rough-barked apple). The canopy in some areas also consists of *Eucalyptus tereticornis/blakelyi* (red gum hybrids) which is a characteristic species of *Warkworth Sands Woodland EEC* but can occur extensively within *Central Hunter Grey box Ironbark Woodland EEC*. The dominance of *E. crebra* (single species canopy) in most areas with some lower stratum characteristic species supported the assignment to *Central Hunter Grey box Ironbark Woodland EEC*, even in areas that had some sandy influence within the substrate, as the floristic composition pointed strongly to these areas no longer supporting *Warkworth Sands Woodland EEC* despite the persistence of a shallow sandy veneer.

Where there was a higher portion of *E. tereticornis*/*blakelyi* with *A. floribunda* further consideration was given to soil profile. Soil test pits from earlier assessments by Minesoils (as described in Minesoils 2023) were reviewed where data was available, and these areas had been determined to be a Shallow Duplex soils (Chromosol, Sodosol or Kurosol). This soil type has been mapped by Minesoils (2023) throughout vegetation immediately north of Archerfield Road and vegetation adjacent to the spoilic arthoposols south of Archerfield Road. These soils have been described to have very minimal to no sand present in the upper layers. The area appeared to have been subject to extensive sheet erosion, as the drainage lines were infilled with coarse sand, presumed to be washed off the surrounding land. This sand was coarse and gritty in texture and did not appear to be of aeolian origin (Minesoils 2023).

These areas have since been assigned to PCT 1691 based on the recent floristics and soil analysis, therefore are consistent with the *Central Hunter Grey box Ironbark Woodland EEC*. All areas that have been re-assigned to the *Central Hunter Grey box Ironbark Woodland EEC* not only considered the canopy but also the lower stratum species to support the assignment of the TEC. In general, the plot data and rapid data points indicated a higher presence of characteristic species from *Central Hunter Grey box Ironbark Woodland EEC* with between 6 and 14 species (listed in the final determination) at each location. Up to 40% of the characteristic species in some plots were shared with *Warkworth Sands Woodland EEC*, with a smaller number (4–8) of characteristic species specific to this TEC only.

For the areas outside the Development Footprints, where data was either insufficient or inconclusive to assign either of the TECs, they have been conservatively revised as transitional *Warkworth Sands Woodland EEC* (refer to **Figure 5.2**) as they were not reviewed in detail during the inspection. The areas are likely to share characteristics of both TECs due to the ecotonal nature of the areas between confirmed *Warkworth Sands Woodland EEC*, the Yancoal Northern Offset Area and areas mapped as *Central Hunter Grey box Ironbark Woodland EEC* during the vegetation surveys for this Project. The transitional vegetation like most of the area has been modified by historic land management activities which has contributed to the changes in the composition and structure of the vegetation making it increasingly difficult to determine the boundary of best fit between the TECs.

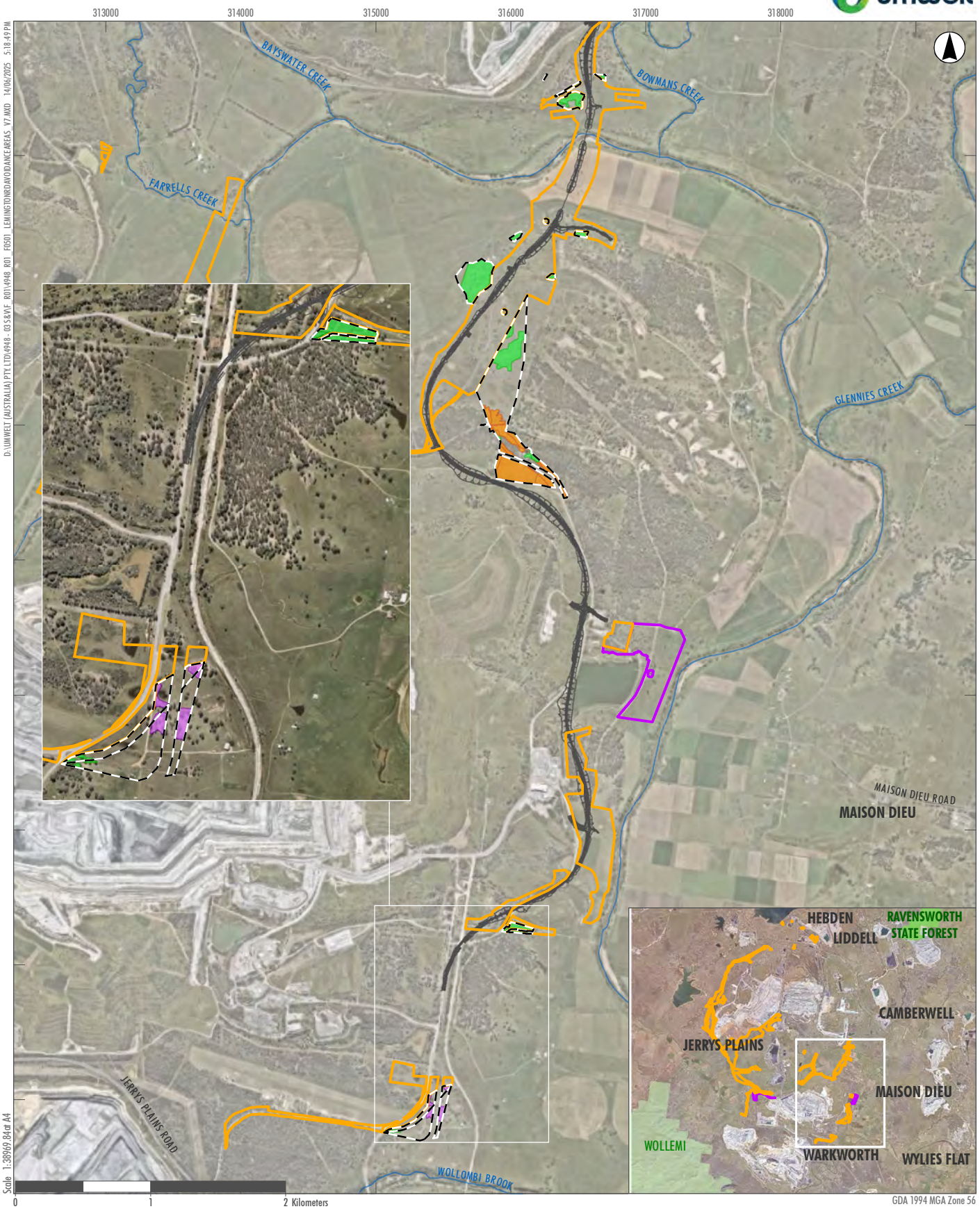
As a result of the further detailed investigations, the revised Lemington Road re-alignment has subsequently avoided all direct impacts to confirmed *Warkworth Sands Woodland EEC* in the HVO North Development Footprint (see **Figure 5.2**) and located impact further away from existing offset sites (Yancoal's Northern Offset Area).

5.2.1.2 Removal of the Impacts around the South Lemington Rail Loop

The construction of the approved LCPP and rail infrastructure is no longer being sought as part of the Project. Accordingly, the residual impact to the small area (0.3 ha) of *Warkworth Sands Woodland EEC* identified near the South Lemington Rail Loop will not occur as a result of the project and has been removed from the Development Footprint.

This amendment, along with the avoidance of *Warkworth Sands Woodland EEC* associated with the Lemington Road Realignment (as outlined in **Section 5.2.1.1** above), represents complete avoidance of direct impacts to the EEC.

Other vegetation communities and species habitats were further avoided as part of the most recent amendment to the Project. These are summarised in **Table 5.7**.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Road
- Drainage Line
- Proposed Lemington Road Alignment
- Areas Avoided following Lemington Road Realignment Design Refinement

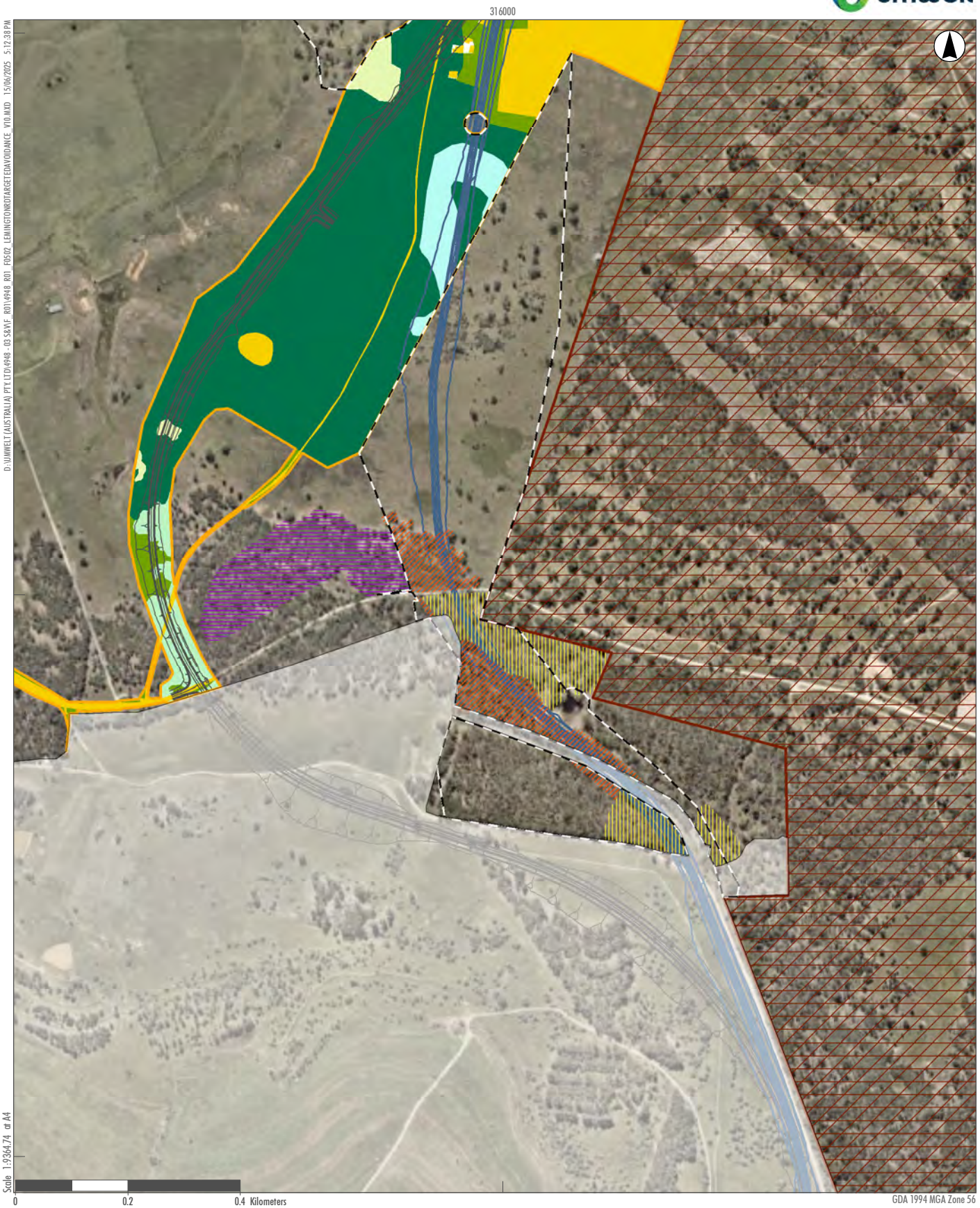
BC Act TEC

- Central Hunter Grey Box - Ironbark Woodland EEC
- Hunter Valley Footslopes Slaty Gum Woodland VEC
- Warkworth Sands Woodland EEC

FIGURE 5.1

Areas Avoided following Lemington Road Realignment Design Refinement

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)



Legend

- HVO North Development Footprint
- Proposed Lemington Road Alignment
- Former location of Proposed Lemington Road Alignment
- HVO Existing and Approved Disturbance Areas
- Areas Avoided following Lemington Road Realignment Design Refinement
- Yancoal's Northern Biodiversity Area

Warkworth Sands Woodland EEC

- Accepted/known WSW
- Possible WSW - uncertainty regarding soil and/or floristic alignment with TEC
- Transitional Zone

Plant Community Types

- 0 - 0 I Category 1 - Exempt Land
- 0 - 0 I Cleared
- 1 - 3431 I Moderate
- 2 - 3431 I Thinned Woodland
- 3 - 3431 I Woodland with Exotic Understorey
- 7 - 3431 I Poor Condition Derived Native Grassland
- 8 - 3431 I Exotic Grassland

FIGURE 5.2

Targeted Avoidance of Warkworth Sands Woodland and Re-alignment of Lemington Road

Image Source: Nearmap (April 2025)Data source: NSW DFSI (2024)

5.2.2 Electricity and Telecommunications Realignment Paths

The Project requires the realignment of several transmission lines, as well as some telecommunication lines. New access points to realigned electricity and communication infrastructure will also be established to avoid interaction with mining activities. As part of the Project design phase, the preferred realignment path of this infrastructure was carefully considered to avoid areas of higher quality vegetation and habitats, and to provide for maximum vegetation and habitat retention, wherever possible.

While this report calculates the impacts of the preferred alignment path and proposed locations of maintenance tracks, pole pads and transmission line paths, these are currently indicative only and subject to detailed design. The final footprint of the easements will be located within the wider additional disturbance boundary. For the purposes of this assessment, impacts are calculated on the indicative footprints, with the intention of updating these impact calculations following the final design.

Table 5.4 outlines the impacts and avoided areas within the proposed easement corridors and these are illustrated in **Figure 5.3**. Where appropriate, these avoidance and vegetation retention measures have been accounted for in the BAM-C through the application of management zones (e.g. where easement vegetation management requires the removal of tall shrub and canopy species).

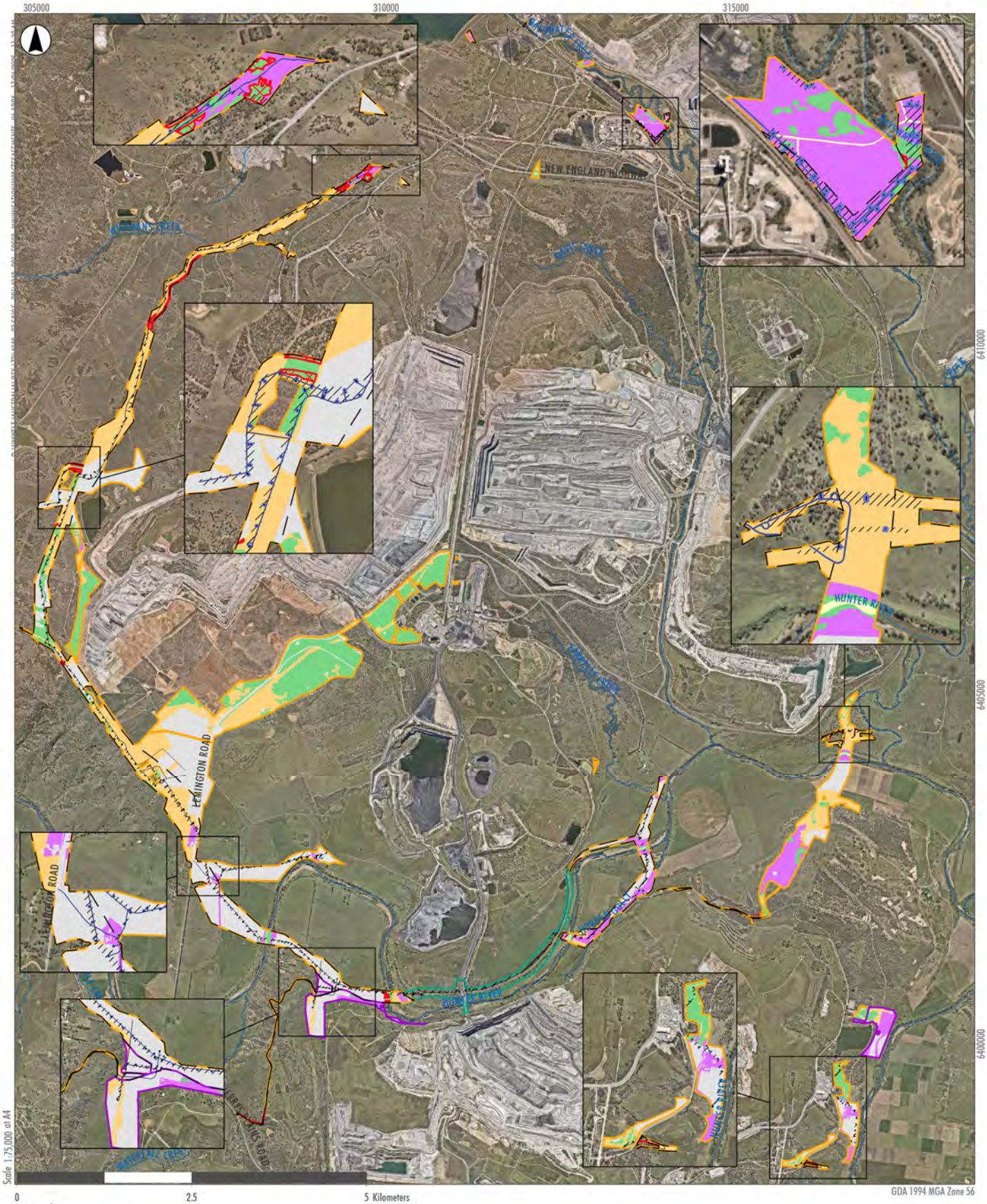
An estimate of around 145 ha of suitable habitat for the Hunter Valley delma, in particular, is not expected to be impacted by the establishment of the new electricity transmission lines (i.e. in the wider easement area). Approximately 34 ha of native vegetation in the easement maintenance area (MZ2) will be maintained as grassland during the operation of the easement, likely providing suitable habitat for the Hunter Valley delma.

Mitigation and management strategies identified for the easement realignment design are considered to be well known and routinely implemented, minimising the risk of failure.

Table 5.4 Impacts and Avoided Impacts in Easement Realignment Design

Impact	Description of Impacts and Vegetation Management	Vegetation/Habitat Impacts Avoided
Maintenance tracks and pole pads (MZ1 – refer to **Section 6.1**)	• Complete disturbance assumed for transmission line poles (10 m buffer around each pole). • Complete disturbance assumed for 6 m wide access tracks for construction and operational maintenance.	• The access tracks have been designed to be contained within the easement (MZ2) to minimise unnecessary encroachment into the wider easement area.
Easement vegetation maintenance (MZ2 refer to **Section 6.1**)	• No impact to grassland vegetation within easements unless impacted by access tracks/pole pads as above. • Any woody vegetation zones will be retained as grassland in accordance with ISSC 20 *Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure* (ISSC 2012).	• 34 ha of existing native vegetation (grassland, woodland and shrubland) to be maintained as grassland during operational phase. No impact to Hunter Valley delma in these areas. • Targeted avoidance of river red gum stands through careful placement of pole locations where possible along the Hunter River.

Impact	Description of Impacts and Vegetation Management	Vegetation/Habitat Impacts Avoided
Wider easement area	• No impact currently proposed, however changes to the final easement alignment may result in minor changes and impacts. Current areas avoided.	• 145 ha of Hunter Valley delma habitat unimpacted. • Avoidance of 23.6 ha of native forest and woodland habitat including 4.6 ha of *Central Hunter Grey Box – Ironbark Forest EEC* and 0.3 ha of *Hunter Floodplain Red Gum Woodland EEC.* • Avoidance of 161 ha of exotic and native grassland habitat.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Railway Line
- Road
- Drainage Line
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- BC Act TEC Mapping
- ETL Power Pole
- Access Track
- ETL MZ1 – full impact
- ETL MZ2 – partial impact

Native Vegetation Extent

- Native Vegetation (Woody)
- Native Vegetation (Non-Woody)
- Exotic Vegetation
- Cleared Land
- Category 1 - Exempt Land

FIGURE 5.3

Minimisation of Impacts in Electricity and Telecommunication Easements

Refer to Appendix C Figure for detailed vegetation mapping

Image Source: Nearmap (April 2024)Data source: NSW DFSI (2024)

5.2.3 Avoidance of *Hunter Floodplain Red Gum Woodland EEC*

5.2.3.1 Avoidance within the Development Footprint

As previously assessed (Umwelt 2023) the Project was expected to impact approximately 1.6 ha of *Hunter Floodplain Red Gum Woodland EEC*, comprising 1.1 ha due to mining operations (1 ha at HVO North and 0.1 ha at HVO South), and 0.5 ha during construction (associated with the relocation of a transmission line across the Hunter River).

Since submission of the Amendment Report (EMM 2023), further work has been undertaken to avoid Project impacts to the *Hunter Floodplain Red Gum Woodland EEC*. As a result, the anticipated direct impact of the Project on this EEC has been reduced to 1.05 ha, as summarised in **Table 5.5**. Avoided areas are detailed in the insert in **Figure 5.4**. The residual impact of the Project reflects the significant work already undertaken to avoid impacts to areas containing *Hunter Floodplain Red Gum Woodland EEC*. All impacts to the EEC are anticipated to occur in Stage 1 of the Project (refer to **Section 8.1**).

Table 5.5 Avoided Impacts to *Hunter Floodplain Red Gum Woodland EEC*

	Area (ha)			
	EIS Avoidance	EIS Impact	Post-EIS Avoidance	Residual Impact
HVO North	6.2	1.5	0.45	1.05
HVO South	1.3	0.1	0.1	0.0
Total	**7.5**	**1.6**	**0.55**	**1.05**

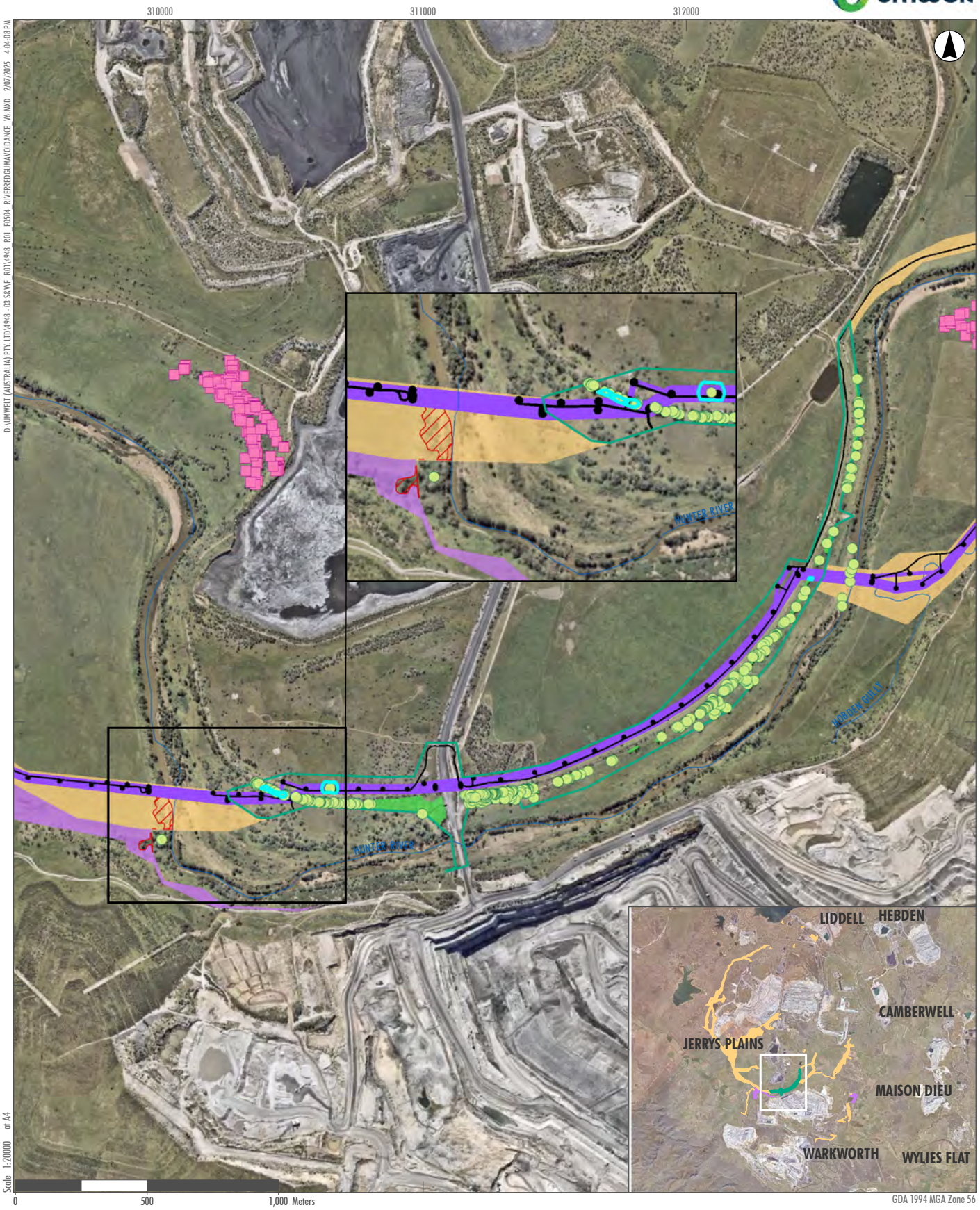
5.2.3.2 Avoidance within the River Red Gum Additional Disturbance Area

As outlined in **Section 1.5** and shown in **Figure 1.5**, the River Red Gum Additional Disturbance Area is an area within the existing HVO South Project Approval (PA 06_0261) adjacent to the Hunter River where impacts to the river red gum (*Eucalyptus camaldulensis*) endangered population and Hunter Floodplain Red Gum Woodland EEC are expected to occur as a result of the proposed transmission line relocation.

While the location of the proposed transmission line relocation is indicative, following the identification of river red gums and *Hunter Floodplain Red Gum Woodland EEC* in this area, the footprint of the transmission line was changed to minimise impacts on these threatened entities. The surveys of the River Red Gum Additional Disturbance Area identified approximately 5.9 hectares of *Hunter Floodplain Red Gum Woodland EEC* and 269 individual river red gums ranging from saplings to mature trees (refer to **Figure 5.4**).

Changes to the proposed alignment have avoided approximately 5.8 ha of *Hunter Floodplain Red Gum Woodland EEC* and 255 river red gums, resulting in an expected impact of 0.15 ha of the EEC and 9 River Red Gum individuals. Impacts to the remaining TEC and river red gums are calculated in accordance with the BAM (refer to **Section 6.1**). Impacts will be avoided and minimised through the following measures:

- Pre-clearance surveys and clear delineation of easement boundaries avoiding river red gums during construction.
- Information signage to assist long-term management of the easement without impacting surrounding river red gums.
- Ongoing monitoring of river red gum in this area as outlined in the HVO River Red Gum Rehabilitation and Restoration Strategy (HVO 2020) with a recommendation to change this area from a low priority site to a 'priority site'.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Drainage Line
- Hunter Floodplain Red Gum Woodland EEC
- Access Tracks and New Pole Pad (MZ1) – indicative only
- Easement Vegetation Maintenance (MZ2) – indicative only
- Impacted River Red Gums and Impacted Hunter Floodplain Red Gum Woodland EEC
- Avoided Hunter Floodplain Red Gum Woodland EEC

NSW Bionet Atlas Threatened Species Records (2022)

- *Eucalyptus camaldulensis* (River Red Gum)

Umwelt Threatened Species Records (2020 - 2022)

- *Eucalyptus camuldulensis* (River Red Gum)

FIGURE 5.4

Avoidance of River Red Gums and Hunter Floodplain Red Gum Woodland EEC

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

5.2.4 Relinquishment of Previously Approved Impacts

Throughout the Project design process, a range of refinements and improvements have been incorporated into the design of the Project that has resulted in the minimisation of impacts to vegetation and habitats. The final Project design includes the relinquishment of the following components that are currently approved at HVO South under PA 06_0261:

- coal extraction from the Riverview South East Extension (SEE)
- coal extraction in the SLP1 and SLP2
- construction of the short rail loop associated with the Lemington Coal Preparation Plant
- construction of the long rail loop including the associated Lemington Coal Preparation Plant.

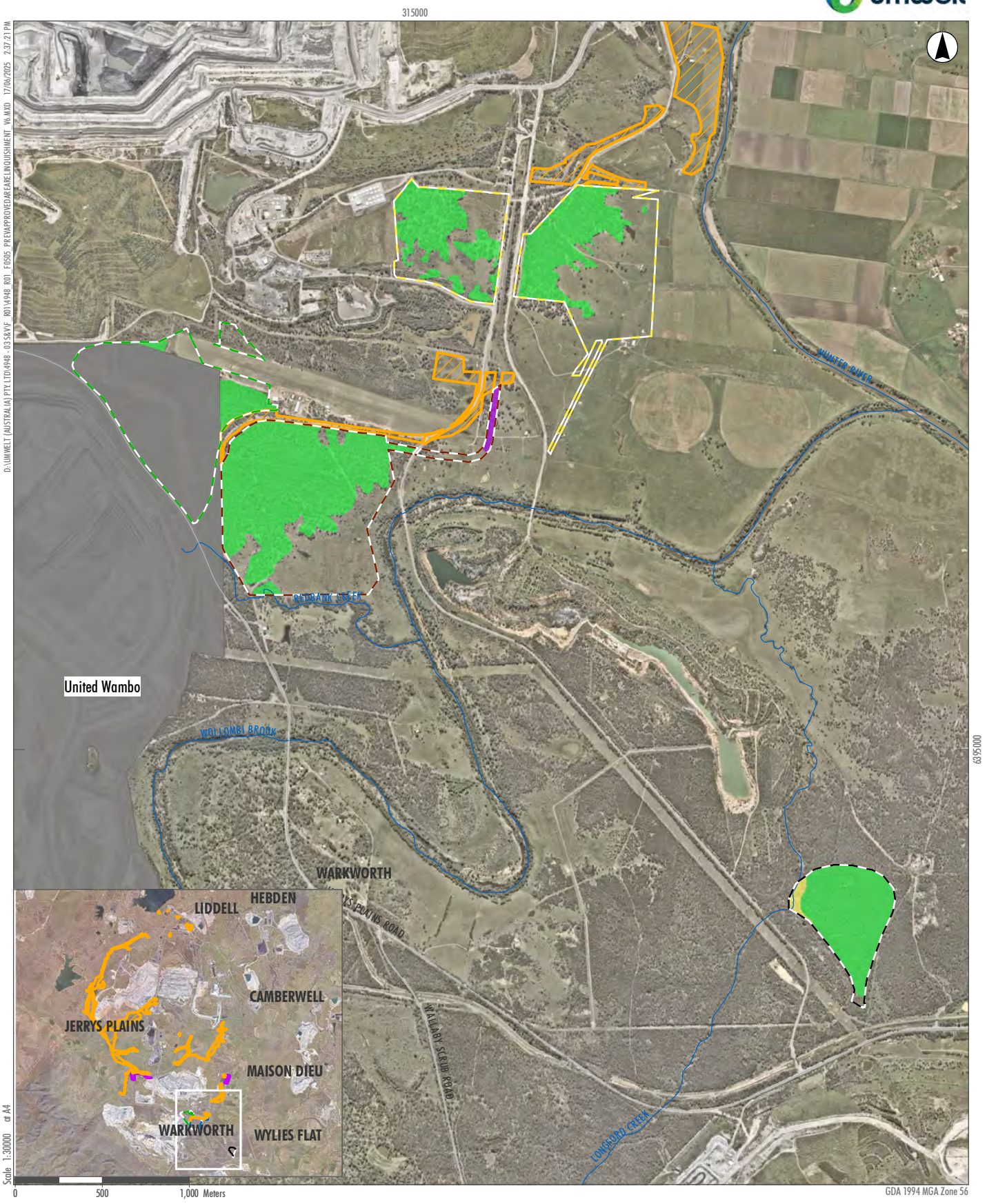
Table 5.6 below provides an estimate of the areas avoided for each biodiversity feature avoided in the Project design as outlined above. These areas are no longer captured in the Development Footprint. Note: areas in the table are not cumulative. Previously approved areas that are proposed for relinquishment are shown on **Figure 5.5**.

Table 5.6 Key Biodiversity Features Avoided Through Removal of Previously Approved Impacts

Biodiversity Feature	Project Component Area (ha)			
	Riverview SEE^	SLP2	Short Rail Loop	Long rail loop and LCPP
Native forest and woodland habitat	5.7	58.4	90.2	40.7
Native and exotic grasslands	4.0	29.7	0.0	51.3
BC Act-Listed Features				
Central Hunter Grey Box – Ironbark Woodland EEC	5.7	56.9	24.8	40.3
Hunter Valley Footslopes Slaty Gum Woodland VEC	0.0	1.5	0.0	0.0
Hunter Lowland Redgum Forest EEC	0.0	0.0	1.3	0.0

^ Does not include areas within the United Wambo JV approval boundary.

While coal extraction will no longer take place at SLP1, some disturbance will still be required for the purposes of rehabilitation works and therefore this area has not been included in the avoidance calculations in **Table 5.6**. It should be noted that approximately 9 ha of disturbance of *Warkworth Sands Woodland EEC* was approved for disturbance under PA 06_0261.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Road
- Drainage Line
- Riverview SEE
- Short Rail Loop
- South Lemington Pit 2
- Long Rail Loop and LCPP
- Approved Disturbance Area - United Wambo

BC Act TEC

- Central Hunter Grey Box - Ironbark Woodland EEC
- Hunter Lowland Redgum Forest EEC
- Hunter Valley Footslopes Slaty Gum Woodland VEC

FIGURE 5.5

Relinquishment of Previously Approved Areas

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

5.3 Summary of Avoidance

Table 5.7 below provides a summary of the avoidance measures for key biodiversity features undertaken for the Project.

Table 5.7 Key Biodiversity Features Avoided Through Project Design and Refinement

Biodiversity Feature	Project Component Area Avoided (ha)						Total Area Avoided Since EIS (ha)
	Lemington Road Realignment (exhibited EIS)+	Lemington Road Realignment (current)	Transmission Line Alignment	RRG Additional Disturbance Area	Removal of Previous Impacts	Post-RTS Project Amendments	
Native forest and woodland habitat	19.5	25.4	23.6	5.8	90.2	9.8	**154.8**
Native and exotic grasslands	6.3	18.8	161.2	N/A	33.7	5.8	**219.5**
Hunter Valley delma (*Delma vescolineata*) habitat^	4.7	4.8	145.4	N/A	0.0	5.7	**155.9**
BC Act-listed Features							
Warkworth Sands Woodland EEC	7.2	9.8#	0.0	0.0	0.0	0.3	**10.1**
Central Hunter Grey Box – Ironbark Woodland EEC	9.1	12.7	4.6	0.0	87.4	49.5	**154.2**
Hunter Floodplain Red Gum Woodland EEC	0.0	0.0	0.4	5.8	1.3	0.6	**8.1**
Hunter Valley Footslopes Slaty Gum Woodland VEC	2.6	1.1	0.0	0.0	1.5	0.0	**2.6**
River Red Gum (*Eucalyptus camaldulensis*)	0	0	5 individuals	255 individuals	0	0	**260 individuals**

^ PCT3431 DNG, Thinned Woodland, Scattered Regeneration and PCT4089 DNG.

+ Not included in total (ha).

 # Not inclusive of approximately 2.3 ha of possible WSW EEC included in original impact calculations.

5.4 Construction and Operation Phase Impact Mitigation Strategies

HVO has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Project. The following specific control measures, as detailed in the existing approved HVO Integrated Biodiversity Management Plan and Biodiversity Offset Strategy, are considered to be integral to the mitigation of impacts on the biodiversity features by the Project:

- salvage of biodiversity features, including habitat resources (e.g. hollow logs, tree hollows, fallen timber and rocks/boulders) and material for mine rehabilitation (e.g. seed collection and topsoil collection), where practicable
- a pre-clearing procedure to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow bearing trees
- weed management
- pest animal control
- pathogen management
- fencing and access control
- bushfire management
- erosion and sedimentation control
- providing appropriate environmental management measures as part of the mining operations to minimise the potential for indirect impacts.

Each of these control measures will contribute to the maintenance of habitat quality in proximity to the Development Footprint. It is considered that these measures are suitable to minimise impacts on direct, indirect and prescribed impacts. The measures described below are considered to represent a suitable suite of management strategies that are well known and routinely implemented in biodiversity management plans for mining projects in the Hunter Valley and elsewhere and therefore are considered to represent a low risk of failure.

Should the Project be approved, HVO will review and revise the existing approved HVO Integrated Biodiversity Management Plan in accordance with any additional development consent requirements. The revised plan will guide the implementation of the mitigation steps and will be reviewed and adapted in response to new information.

5.4.1 Salvage of Biodiversity Features

Action	Outcome	Timing	Responsibility
Salvage of biodiversity features – timber, rocks, topsoil, mulch	Minimise impacts to fauna species. Minimise the clearance of fauna habitat.	During clearance works	HVO
Installation of salvaged features in rehabilitation zones	Increase habitat complexity for fauna and flora species in rehabilitation zones.	Operation	

Action	Outcome	Timing	Responsibility
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any issues with current actions or approaches.	Construction and operation	

Salvaged habitat resources include tree hollows, fallen timber and rocks/boulders that provide foraging and refuge habitat for a number of key threatened species, particularly insectivorous woodland birds and terrestrial mammal species. The microclimates provided around fallen timber and rocks/boulders can assist in the establishment of flora species and the decomposing woody material from fallen timber can assist in soil conditioning.

The relocation of salvaged habitat resources is proposed for rehabilitation areas according to the HVO Integrated Biodiversity Management Plan (EMM 2018). The use of these materials is dependent upon availability and opportunities for safe and practical collection and reuse. Where salvaged materials are to be used they would be implemented in a way that is consistent with rehabilitation completion criteria. This will increase habitat complexity for fauna species sooner than when they would naturally develop.

5.4.2 Pre-Clearance and Tree-Felling

Action	Outcome	Timing	Responsibility
Pre-clearance surveys	Identification of potential translocation opportunities.	Construction and operation	HVO
Tree felling process and supervision	Minimisation of potential harm, injury and death of fauna occupying habitat. Identification and salvage of habitat features.	During clearance works	
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any issues with current actions or approaches.	Construction and operation	

Pre-clearance surveys and tree-felling supervision recommendations will be implemented to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees.

5.4.2.1 Pre-Clearance Surveys

Pre-clearance surveys are to be undertaken prior to tree felling works, be undertaken by suitably qualified and experienced person and include:

- The demarcation of areas approved for clearing to reduce risk of accidental clearing.
- Habitat resources and habitat trees should be identified and marked.
- The potential presence of threatened flora and fauna species, endangered populations and TECs should be identified.

- The identification of threatened species or habitat features that are suitable for translocation or salvage. This includes native plant species containing seed for collection and propagation purposes and habitat features to be used in habitat augmentation.

- Disturbance activities should be targeted to specific times of the year to minimise impacts to threatened species usage of habitat features for breeding and roosting, where practicable.

5.4.2.2 Tree-Felling

Tree felling will be completed as close to the completion of pre-clearance surveys as practicable. Tree felling supervision will be undertaken after pre-clearance surveys have identified potential habitat features.

The tree-felling process will include the following:

Prior to Felling Habitat Trees

- Removal of non-habitat trees/vegetation as close to the habitat tree felling date as possible in order to create disturbance to discourage fauna usage of the habitat trees.

- Shaking of habitat trees (with heavy machinery) as appropriate to encourage fauna to abandon trees.

On the Day of Felling Habitat Trees

- All habitat trees will be subject to a visual ground inspection to examine for threatened, or resident species.

- Trees identified as containing fauna will be shaken and then felled, providing no threatened species are identified.

- The lowering of hollow-bearing trees will be done as gently as possible with heavy machinery.

- If a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, soft-felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats.

- Uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time.

- Injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment.

- Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised.

- All felled habitat trees should remain in place for a least one night to allow any remaining fauna to escape.

- Habitat features identified for translocation or salvage operations should be extracted and stored appropriately.

5.4.3 Weed Management

Action	Outcome	Timing	Responsibility
Weed management actions	Minimisation of Weeds of National Significance (WoNS), priority weeds under NSW Biosecurity Act 2015 and/or environmental weeds in the final Development Footprint. Minimisation of weed spread from and into the wider locality.	Construction Operation	HVO
Monitoring and adaptive management strategies	Identification of emerging weed infestations Identification of successful weed management techniques Adaptive management recommendations to ensure best practice and improvements	Post completion of management actions	

The presence of weed species has the potential to be an impediment to revegetation and regeneration activities and native vegetation regeneration. In addition, the presence of weed species has the potential to decrease the value of vegetation for native species, particularly threatened species.

Existing weed management controls as specified in the HVO Integrated Biodiversity Management Plan will be applied to the Project.

5.4.4 Pest Animal Control

Action	Outcome	Timing	Responsibility
Pest animal control actions	Management and reduction of pest animal species.	Construction Operation	HVO
Monitoring and adaptive management strategies	Identification of emerging pest invasion. Identification of successful pest animal management techniques. Adaptive management recommendations to ensure best practice and improvements.	Post completion of management actions	

Introduced fauna species such as deer, foxes, rabbits, pigs, wild dogs and feral cats could change in distribution and abundance as future areas are cleared, mined and then rehabilitated. Clearing, thinning of vegetation and the creation of tracks through existing dense vegetation could assist the penetration of introduced fauna species such as pigs, cats and foxes, and allow them to establish in new areas.

Pest and feral animal control will be undertaken in accordance with current mine practices and as outlined in the HVO Integrated Biodiversity Management Plan.

5.4.5 Pathogen Management

Action	Outcome	Timing	Responsibility
Pathogen management actions – checking, cleaning equipment, vehicles, footwear and tools, following frog handling procedures as per HVO Vegetation Clearance Plan (EMM 2016)	Management and reduction of pathogens impacting biodiversity.	Operation	HVO
Monitoring and adaptive management strategies	Identification of emerging pathogen issues. Identification of successful pathogen management techniques. Adaptive management recommendations to ensure best practice and improvements.	Post completion of management actions	

It is important to reduce the risks of introducing pathogens (*Phytophthora cinnamomi*, myrtle rust and chytrid fungus) into new areas in NSW, especially those with susceptible threatened species and threatened ecological communities. Basic hygiene procedures (in accordance with the *Hygiene guidelines – Protocols to protect priority biodiversity areas in NSW from Phytophthora cinnamomi, myrtle rust, amphibian chytrid fungus and invasive plants* (DPIE 2020b)) can include checking, cleaning equipment, vehicles, footwear and tools of soil materials prior to entering and leaving the site.

5.4.6 Fencing and Access Control

Action	Outcome	Timing	Responsibility
Demarcation of impact footprints	Ensuring the extent of clearance is understood and visible. Minimisation of unnecessary and accidental impacts to surrounding vegetation and habitats. Ensuring impact thresholds identified for the Project are not compromised.	Construction and operation	HVO
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any issues with current actions or approaches.	Construction and operation	

Access control is an important feature in protecting and demarcating areas outside the Project disturbance area from vehicle access, human access and accidental disturbance. Measures include:

- appropriate fencing and signposting of areas to prevent the uncontrolled entry of people, accidental disturbance and to minimise vehicular and human traffic
- clear and visible signage is to be appropriately located to inform the workforce and others of the restricted access or otherwise of areas outside the Project disturbance area
- locking of gates to prevent unwanted vehicle, person access and disturbance.

5.4.7 Bushfire Management

Action	Outcome	Timing	Responsibility
Bushfire management actions – maintain equipment, management of fuel loads, maintenance of fire breaks and access roads	Protect life and property, while supporting appropriate conditions for the existing ecological features.	Construction and operation	HVO
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any fire, fuel load issues with current actions or approaches.	Construction and operation	

The vegetation that will be retained within areas adjoining the Development Footprint will require appropriate bushfire management to protect life and property, while supporting appropriate conditions for the significant ecological features identified. This will be achieved through the implementation of a range of measures, including:

- maintaining a suitably equipped response to any fires on site and assisting the Rural Fire Service and emergency services on site in the event of a fire within the Development Footprint
- where permitted, appropriate grazing management regimes to reduce ground fuel loads and fuel hazard reduction burns
- maintaining strategically positioned fire breaks and access roads.

Bushfire management measures are detailed in the HVO Bushfire Management Plan (available on the HVO website).

5.4.8 Erosion and Sediment Control

Action	Outcome	Timing	Responsibility
Erosion and sedimentation control measures	Minimise sediment pollution. Minimise erosion of soils. Minimise impacts to waterways and habitats.	Construction and operation	HVO
Monitoring and adaptive management strategies	Document key learnings and improve or alter actions throughout the Project to ensure best practice. Early identification and rectification of any erosion issues with current actions or approaches.	Construction and operation	

Erosion and sediment control is critical to the long term stability of the land surface and downstream water quality, with the main objective being to protect soil resources and maintain local water course quality. The HVO Integrated Biodiversity Management Plan outlines the requirements for erosion and sediment control that will be implemented for the Project, including:

- Where possible, clean water diversion structures are employed to divert clean water away from the active pits.
- A Ground Disturbance Permit (GDP) is required for all disturbance activities.
- Prior to disturbance, appropriate erosion and sediment controls will be established.
- Where ground conditions allow, erosion and sediment controls will be designed generally in accordance with the 'Blue Book': Managing Urban Stormwater: soils and construction (Volume 1 and 2E – Mines and Quarries).
- Areas will be rehabilitated and stabilised as soon as possible following disturbance.

5.4.9 Other Environmental Management Measures

Appropriate environmental management measures will be used as part of the mining operations to minimise the potential for indirect impacts through currently approved management plans, including:

- Appropriate lighting controls to minimise impacts will continue to be implemented as part of the Project as necessary (providing that these actions do not compromise site safety issues). This is proposed to include the use of unidirectional light techniques, the use of shielding fittings to limit the spill of light and directing lights downwards (as outlined in the Visual Impact Assessment in Appendix S of the EIS). There is not expected to be any substantial change to lighting impacts on adjacent habitats given that the Project is part of an existing operation with existing impacts.
- Blasting and noise control systems to minimise noise impacts will continue to be implemented as part of the Project. There is not expected to be any substantial change to noise impacts on adjacent habitats given that the Project is part of an existing operation with existing impacts.
- Dust suppression measures to minimise impacts to the surrounding landscape will continue to be implemented at HVO. In regard to potential impacts on biodiversity, there will be no substantial change to dust impacts given that the Project is part of an already existing operation with existing impacts. Similar levels of impact would be expected for the Project, particularly given the increased focus by regulators on reducing dust impacts associated with mining and other operations, and given that the Project is not proposing an increase in the approved annual ROM coal production rate (with a reduction proposed at HVO South).

5.5 Managing Risk of Failure

The mitigation measures are considered to represent a suitable suite of management strategies that are well known and routinely implemented in biodiversity management plans for mining projects in the Hunter Valley and elsewhere and therefore are considered to represent a low risk of failure.

HVO's existing Integrated Biodiversity Management Plan (HVO 2025) includes a risk framework and adaptive management measures to ensure successful implementation of management measures and actions. This includes specific monitoring, annual review processes and updating of plans on a regular basis to ensure best practice mitigation and improvements once new information is available or changed circumstances arise. **Table 5.8** outlines the potential risks to the mitigation measure strategy and the response proposed in the event of a trigger.

Table 5.8 Risks to Achieving Key Mitigation Measure Objectives and Response

Key Objectives	Potential Failure Event or Circumstance^	Likelihood	Consequence	Risk Level	Trigger	Response	Revised Risk Level
Salvage of biodiversity features							
Minimise impacts on fauna species.	Structural integrity of salvaged resources unable to be retained for future use and relocation/accidental damage during clearance works	Possible	Moderate	Medium	Loss of habitat features	Review salvage methods and undertake preventative actions where appropriate.	Low
Increase habitat complexity in rehabilitation zones.	Low availability of habitat features in impacted zones	Possible	Minor	Low	Rehabilitation areas contain no roosting or sheltering habitat features for fauna.	Source artificial habitat features.	Low
Pre-clearance and tree-felling							
Minimisation of potential harm, injury and death of fauna occupying habitat	Death or serious injury to threatened fauna	Possible	Moderate	Medium	Death or serious injury to threatened fauna	Injured fauna to be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment. Review tree-felling and clearance methods and amend as per ecologist advice.	Low
Weed management							
Minimisation of Weeds of National Significance (WoNS), priority weeds under *NSW Biosecurity Act 2015* and/or environmental weeds.	Seasonal conditions result in increase in weeds within the Development Footprints (e.g. high rainfall).	Possible	Minor	Low	Monitoring shows weed increase in the Development Footprints.	Review weed management actions and undertake preventative actions where appropriate.	Low

Key Objectives	Potential Failure Event or Circumstance^	Likelihood	Consequence	Risk Level	Trigger	Response	Revised Risk Level
Minimisation of weed spread from and into the wider locality	Seasonal conditions result in increase in weeds within the wider locality (e.g. high rainfall).	Possible	Minor	Low	Monitoring shows weed spread into the wider locality resulting from proposed impacts and disturbance works.	Review weed management actions and undertake preventative actions where appropriate.	Low
Identification of emerging weed infestations	Monitoring does not identify emerging weeds prior to significant weed establishment.	Possible	Minor	Low	New weed species become established in surrounding areas.	Increase monitoring locations and/or frequency.	Low
Pest animal control							
Management and reduction of pest animal species	Disturbance results in increase in pest animal species.	Possible	Minor	Low	Monitoring shows pest animal increase in the Development Footprints.	Review pest management actions and undertake preventative actions where appropriate.	Low
Management and reduction of pest animal species	Seasonal conditions result in increase in pest animal species within the wider locality (e.g. high rainfall).	Possible	Minor	Low	Monitoring shows pest animal increase in surrounding areas.	Review pest management actions and undertake preventative actions where appropriate.	Low
Identification of emerging pest invasion	Monitoring does not identify emerging pest invasion prior to significant establishment.	Possible	Minor	Low	New and emerging pest species become established in surrounding areas.	Increase monitoring locations and/or frequency.	Low
Pathogen management							
Management and reduction of pathogens impacting biodiversity	Disturbance results in identification of *Phytophthora cinnamomi*, myrtle rust or chytrid fungus in Development Footprints.	Unlikely	Minor	Low	Monitoring shows pathogen increase in the Development Footprints.	Review pathogen management procedures and undertake preventative actions where appropriate.	Low

Key Objectives	Potential Failure Event or Circumstance^	Likelihood	Consequence	Risk Level	Trigger	Response	Revised Risk Level
Identification of emerging pathogen issues	Monitoring does not identify emerging pathogen prior to significant establishment.	Unlikely	High	Medium	New and emerging pathogen species become established in surrounding areas.	Increase monitoring locations and/or frequency.	Low
Fencing and access control							
Minimisation of unnecessary and accidental impacts to surrounding vegetation and habitats	Fence, signposting, demarcation or lock failure.	Unlikely	Moderate	Low	Disturbance in areas outside approved impact areas.	Review adaptive management procedures and disturbance impacts and report impacts to authorities.	Low
Bushfire management							
Protect life and property, while supporting appropriate conditions for the existing ecological features.	Uncontrollable fire following extreme weather and seasonal conditions.	Possible	High	Medium	Loss in vegetation, habitats and/or significant fauna death or injury.	Review adaptive management procedures for bushfire management in consultation with Rural Fire Service (RFS).	Low
Erosion and sediment control							
Minimise sediment pollution. **Minimise erosion of soils.** **Minimise impacts to waterways and habitats**	Weather events (e.g. high rainfall) that result in a failure of erosion and sedimentation controls	Possible	Minor	Low	Disturbance in areas outside approved impact areas (i.e. pollution of water resulting from unlicenced discharge)	Review adaptive management procedures for erosion and sediment control and undertake preventative actions where appropriate.	Low

^Assumes effective implementation of mitigation measures, as described in the to-be-updated HVO Integrated Biodiversity Management Plan.

Table 5.9 Risk Framework

Likelihood		Consequence				
		Minor	Moderate	High	Major	Critical
	Highly likely	Medium	High	High	Severe	Severe
	Likely	Low	Medium	High	High	Severe
	Possible	Low	Medium	Medium	High	Severe
	Unlikely	Low	Low	Medium	High	High
	Rare	Low	Low	Low	Medium	High

Table 5.10 Criteria to Determine Likelihood

Qualitative measure of likelihood (how likely is it that this event/circumstances will occur after management actions have been put in place/are being implemented)	
Highly likely	It is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May only in exceptional circumstances

Table 5.11 Criteria to Determine Consequence

Qualitative measure of consequences (what will be the consequence/result if the issue does occur)	
Minor	Minor incident of environmental damage that can be reversed
Moderate	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts
High	Substantial instances of environmental damage that could be reversed with intensive efforts
Major	Major loss of environmental amenity and real danger of continuing
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

5.6 Minimisation of Indirect and Prescribed Impacts

It is considered that the measures outlined in **Section 5.3** above will mitigate the impacts on indirect and prescribed impacts. Additional measures are outlined below using particular consideration for impacts on connectivity and vehicle strike.

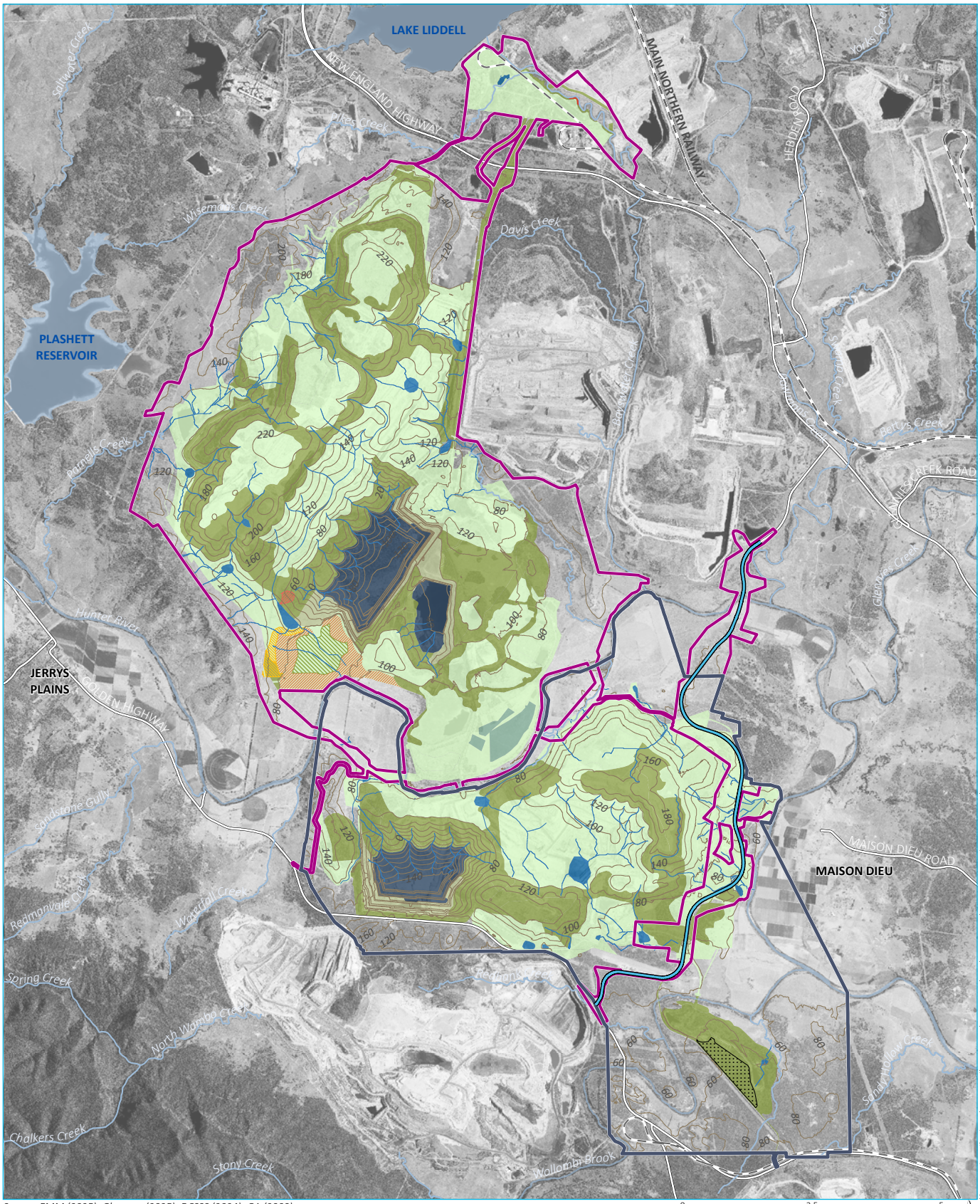
5.6.1 Long-Term Rehabilitation Strategy for Connectivity

All disturbance areas across HVO Noth and HVO South will be rehabilitated in accordance with an approved Rehabilitation Management Plan. Rehabilitation will comprise a mix of grazing land and native woodland habitat. Establishment of native woodland habitat will aim to be consistent with the remnant vegetation communities and the vegetation communities that are likely to have existed pre-agricultural and mining disturbance and be consistent with the native ecosystem rehabilitation works approved at the neighbouring mines. The proposed rehabilitation strategy has been designed to facilitate long-term connectivity across the landscape with Domain A (native ecosystem) to be established connecting habitats in a broad north/south and east-west direction.

Previously approved rehabilitation focused on establishing between approximately 30 to 40% native vegetation. The percent of native vegetation to be established for the Project is designed to achieve a similar percentage of land being returned to what has previously been approved. Existing HVO North commitments to rehabilitate specific areas representative of Swamp Oak Floodplain Forest community and Central Hunter Box - Ironbark Woodland are proposed to be continued under the Project. Highwalls will be revegetated to achieve partial revegetation on highwall benches with appropriate habitat species. This revegetation will provide some habitat values and will assist to soften the geometric visual form of the highwalls.

Rehabilitation at HVO is undertaken progressively over the life of the mine, with overburden emplacements shaped and rehabilitated once dumping is complete.

Conceptual final land use domains for the Project are illustrated on **Figure 5.6**.



Source: EMM (2025); Glencore (2025); DCSSS (2024); GA (2009)

0 2.5 5 km

GDA2020 MGA Zone 56

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KEY

- Amended proposed HVO North development consent boundary
- Proposed HVO South development consent boundary
- Proposed South Lemington offset
- Predicted drainage
- Predicted 20 m contour
- Lemington Road realignment

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

Final landform land use domain

- Domain A | Native ecosystem
- Domain A- Sub domain Ka | Other- Native ecosystem- partial vegetation on highwall benches
- Domain B | Agriculture- grazing
- Domain B- Sub domain Kb | Other- Agriculture- alluvial land
- Domain G | Water storage
- Domain J | Pit Lake

Existing commitments maintained by the Project (indicative location)

Rural land capability

- Class 2- DA 450-10-2003 MOD3
- Class 3- DA 450-10-2003 MOD3
- Class 4- DA 450-10-2003 MOD3

Native ecosystem

- Central Hunter Box-Ironbark Woodland - DA 450-10-2003 MOD3
- Swamp Oak Floodplain Forest - DA 450-10-2003 MOD5

Land use domains

HVO Continuation Project
Biodiversity Development Assessment Report
Figure 5.6

EMM creating opportunities

5.6.2 Measures to Reduce Vehicle Strike on Local Fauna

To reduce potential impacts as a result of changed traffic conditions along the Lemington Road realignment, the following measure is proposed:

- Wildlife warning signs and 'Injured Native Wildlife' signs will be installed in likely high impact locations as a reminder to take care when driving.

Other measures relevant for the maintenance of roadsides that may mitigate fauna strikes, such as clearance of roadsides to improve visibility for adjacent fauna is the responsibility of local council (Singleton Council).

5.6.3 Adaptive Management Plan for Potential Drawdown Impacts

The BDAR addresses cumulative impacts in **Table 6.5** in relation to potential drawdown impacts and cumulative impacts on biodiversity in the wider locality. It should be noted that all drawdown impact predictions are cumulative – that is they take into account drawdown predictions from surrounding developments in the locality.

It is considered that the measures outlined in **Section 5.4** above will mitigate the impacts on indirect and prescribed impacts including those on man-made structures and non-native vegetation.

Table 5.12 below provides a draft adaptive management plan for potential drawdown impacts which includes mitigation and adaptive management measures for hydrological processes.

Table 5.12 Adaptive Management Strategy Details for Drawdown Impacts

Impact Description	Impacted threatened species and TECs	Base Line Data Required and Monitoring Method	Monitoring Frequency and Reporting Schedule	Performance Indicators for Management Intervention	Management Response	Risk of Monitoring Failure
Changes to vegetation structure and floristic composition resulting from modifications to the hydrological regime	*Hunter Floodplain Red Gum Woodland EEC* River red gum (*Eucalyptus camaldulensis*) population in the Hunter Catchment Other alluvial PCTs (PCT4015 – Swamp Oak and PCT4081 River Oak)	BAM Vegetation Integrity Plots in retained potential areas of impact	Annual	>30% reduction in vegetation integrity score sustained over 3 consecutive years, attributable to Project.	Provision of BAM credits proportional to the vegetation integrity loss over the area affected.	Low
Changes to vegetation structure and floristic composition resulting from groundwater drawdown	*Hunter Floodplain Red Gum Woodland EEC* River red gum (*Eucalyptus camaldulensis*) population in the Hunter Catchment Other GDEs (PCT4015 – Swamp Oak and PCT4089 River Oak)	BAM Vegetation Integrity Plots in retained potential areas of impact and additional survey and investigation work to determine nature and extent of GDE groundwater dependency in the drawdown zone.	Annual (to be commenced at least 2 years prior to predicted drawdown impacts outside the Development Footprint)	To be developed in accordance with the recommendation of the GIA and any approval conditions. Suggest >30% reduction in vegetation integrity score sustained over 3 consecutive years, attributable to the Project.	Provision of BAM credits proportional to the vegetation integrity loss over the area affected.	Low

5.7 Management of Potential Serious and Irreversible Impacts

The potential for Serious and Irreversible Impacts (SAII) are outlined in **Section 6.4**. Following recommendations from the BCD in relation to the potential SAII on *Hunter Floodplain Red Gum Woodland EEC* as a result of the Project, it is proposed that the development of an Ecological Restoration Plan (ERP) for the TEC is undertaken. HVO propose to review and update the existing HVO River Red Gum and Restoration Strategy (RRGRS) to include the ERP. The plan would provide a framework for the management of the vegetation community during and post-development of the Project. The ERP would include management actions to inform specific weed control, re-establishment of vegetation, security /protection measures and a trigger response plan to ensure the continued improvement of the TEC.

While all direct impacts to *Warkworth Sands Woodland EEC* have been avoided, the community occurs in proximity to the proposed Lemington Road Re-alignment. It is proposed that any potential indirect impacts will be managed through implementation of the measures outlined below. Further, no impacts are predicted to occur on *Weeping Myall Woodland CEEC*, however management measures are recommended to ensure surrounding impacts do not encroach on the extent of the community in the Wider Easement Area. Key management actions that would be implemented will include:

Weed Management

Weed management should be a staged program to facilitate the restoration of ecological attributes associated with the TECs through natural recruitment and revegetation where appropriate and reduce the opportunity for new and emerging weeds. Key weed control task would include:

- Use of best practice weed control methods in sensitive areas from hand removal of targeted weeds through to slashing of tussock grasses and direct application of herbicide to remaining tussocks or manual removal (crowning out of biomass).
- Focused weed management targeting high threat weeds and transformer weeds to limit their spread and allow for natural recruitment of native species associated with the TECs.
- Development of a weed control program to ensure all target weeds are treated during optimal times while reducing further spread.
- Inclusion of inspection schedule to coincide with high growth periods of target species to develop an action plan for priority weeds.
- Weed management to occur to meet performance criteria set around maintain and improve from baseline data.

Protection and Habitat Restoration

Where natural resources from the TECs are generated such as logs, topsoil and native mulch from the Project areas (refer to **Section 5.4.1**), these should be used as part of the restoration and enhancement works. Resource utilisation would include:

- Large logs used as natural barriers to limit human access to TEC, timber would also limit (in part) the movement of weed species into remnant areas (hard barrier).

- Use of logs in remnants to create small niches to facilitate the establishment of characteristic species associated with each of the TEC.
- Usage of topsoils from TECs into areas of disturbance (post ground preparation) to re-establish the target community.

Establishment of Native Vegetation

The following measures will provide options to allow for the re-establishment of the TECs in degraded areas or areas impacted by the Project:

- Establish vegetation buffers between remnants of *Warkworth Sands Woodland EEC* and adjacent infrastructure or disturbance boundaries. vegetation buffers would be created by undertaking revegetation works with characteristic species from the TEC and would be planted in a manner that would create a natural barrier with various species creating layered effect to help limit (not stop) the movement of weeds into remnants.
- Use of topsoils from areas previous weed free or low weed present in areas degraded that will help re-establish the target community.
- Enhancement planting of degraded areas of *Hunter Floodplain Red Gum Woodland EEC* in priority sites particularly to increase presences of characteristic species and improve overall biodiversity values for the TEC.
- All planting works would be undertaken in accordance with a revegetation plan (incorporated into the ERP) that detail target species, seed collecting strategy, appropriate lead in times for revegetation works, performance criteria and adequate maintenance program to ensure compliance with the criteria.
- Demarcation of TECs within proximity to direct impacts to inform environmental sensitivity.
- Removal of cattle grazing in areas of *Weeping Myall Woodland CEEC*.

Monitoring and Adaptive Management

To ensure the condition of the *Hunter Floodplain Red Gum Woodland EEC* is maintained through construction and post operation a monitoring and inspection program will be developed to maintain and improve the TEC. The program will be developed based on collection of baseline data with the aim to maintain and improve the overall condition of the TEC.

The program would identify threats to the TEC with appropriate triggers to ensure any threat is reduced/ controlled in a timely manner and where appropriate identify adaptive management strategies.

6.0 Assessment of Residual Impacts

6.1 Direct Impacts

Following the application of avoidance and minimisation measures (as outlined in **Section 5.0**) the Project will result in residual direct impacts on biodiversity values within the Development Footprints. Direct impacts include the loss of native vegetation and fauna habitats as a result of clearance works and subsequent mining activity.

Table 6.1 and **Table 6.2** below outlines these impacts as they were entered into the BAM-C for ecosystem and species credits respectively. **Table 6.3** outlines the specific impacts on BC Act listed TECs (note: these impacts are not additional to those outlined in **Table 6.1**).

Table 6.1 also includes the areas associated with management zones (MZ) relevant for this assessment. These are:

- **Management Zone 1** – full clearance assumed, Vegetation Integrity (VI) score following impact is 0.
- **Management Zone 2** – newly proposed transmission line easement vegetation maintenance (i.e. areas within the new transmission line easement under transmission lines and excluding access tracks will be managed to remove canopy and shrub species and retain understorey/grassland species). In the BAM-C this involved reducing tree and shrub species structure and composition to zero and the removal of any large trees, hollows, stem classes or regeneration functions. All other Vegetation Integrity (VI) components were retained.
- **Wider Easement Area** – wider transmission line easement. Not currently identified for impact, however the location of the transmission line is indicative only and subject to final detailed design hence the area's inclusion in the Development Footprints. This area is not currently entered into the BAM-C or included in direct impact areas in **Table 6.1**.

Management zones are shown in the detailed figures in **Annexure C**.

Avoidance and mitigation measures associated with minimising the effects of these direct impacts are discussed in **Section 5.1** and **Section 5.2** above.

Table 6.1 Direct Impacts of the Project on PCTs

Plant Community Type	MZ	Vegetation Zone No. and Condition	Area (ha)		
			HVO North	HVO South	Total
3431 - Central Hunter Ironbark Grassy Woodland	MZ1	1. *Moderate*	63.1	0.5	64.6
	MZ2		1.0	0.0	
	MZ1	2. *Thinned Woodland*	9.0	1.9	11.5
	MZ2		0.6	0.0	
	MZ1	3. *Woodland with Exotic Understorey*	1.9	0.0	1.9

Plant Community Type	MZ	Vegetation Zone No. and Condition	Area (ha)		
			HVO North	HVO South	Total
	MZ1	4. *Plantation*	2.1	0.0	3.1
	MZ2		1.0	0.0	
	MZ1	5. *Scattered Regeneration*	36.8	0.0	39.2
	MZ2		2.4	0.0	
	MZ1	6. *Cooba Woodland*	11.5	0.2	12.0
	MZ2		0.3	0.0	
	MZ1	7. *Poor Condition DNG*	128.7	6.7	161.1
	MZ2		25.4	0.3	
	MZ1	8. *Exotic Grassland*	44.1	7.4	55.3
	MZ2		3.8	0.0	
	MZ1	9. *Bulloak Variant*	32.1	0.0	33.0
	MZ2		0.9	0.0	
	TOTAL for PCT 3431		**364.7**	**17.0**	**381.7**
3485 - Hunter Valley Footslopes Slaty Gum Forest	MZ1	10. *Moderate*	7.1	0.0	7.1
	TOTAL for PCT 3485		**7.1**	**0.0**	**7.1**
4015 - Central Hunter Swamp Oak Riparian Forest	MZ1	11. *Moderate*	2.2	0.0	2.2
	TOTAL for PCT 4015		**2.2**	**0.0**	**2.2**
4081 - Northwest River Oak-River Red Gum Forest	MZ1	12. *Moderate*	0.7	0.0	1.7
	MZ2		1.0	0.0	
	TOTAL for PCT 4081		**1.7**	**0.0**	**1.7**
4089 - Namoi-Upper Hunter River Red Gum Forest	MZ1	13. *Moderate*	1.0	0.0	1.0
	MZ1	14. *Low to Moderate*	0.05	0.0	0.05
	MZ2		0.0	0.0	
	MZ1	15. *Cooba Woodland*	0.0	0.6	0.7
	MZ2		0.1	0.0	
	MZ1	16. *Derived Native Grassland*	0.3	0.0	1.0
	MZ2		0.7	0.0	
	MZ1	17. *Exotic Grassland*	3.0	4.7	12.4
	MZ2		4.7	0.0	
	TOTAL for PCT 42		**9.85**	**5.3**	**15.15**
	Total Vegetation		**385.55**	**22.3**	**407.85**

Table 6.2 Direct Impacts of the Project on Species-credit Species

Species Name	SAII Entity	Vegetation Zone No. PCT and Condition	Area (ha)			
			HVO North	HVO South	RRG Dist. Area	Total
southern myotis ***Myotis Macropus***	No	1. PCT3431 – *Moderate*	26.2	0.5	-	26.7
		2. PCT3431 – *Thinned Woodland*	4.0	1.4	-	5.4
		4. PCT3431 – *Plantation*	0.7	0.0	-	0.7
		5. PCT3431 – *Scattered Regeneration*	13.8	0.0	-	13.8
		6. PCT3431 – *Cooba Woodland*	5.8	0.1	-	5.9
		7. PCT3431 – *Bulloak Variant*	19.2	0.0	-	19.2
		10. PCT3485 - *Moderate*	3.1	0.0	-	3.1
		11. PCT4015 - *Moderate*	1.3	0.0	-	1.3
		12. PCT4081 - *Moderate*	1.7	0.0	-	1.7
		13. PCT4089 – *Moderate*	0.9	0.0	-	0.9
		14. PCT4089 – *Low to Moderate*	0.05	0.0	-	0.05
		15. PCT4089 – *Cooba Woodland*	0.1	0.2	-	0.3
	Total southern myotis species polygon		**76.85**	**2.2**	**-**	**79.05**
***Eucalyptus camaldulensis* – River red gum endangered population in the Hunter catchment**	No	6. PCT3431 – *Cooba Woodland*	0.0	0.1	0.0	0.1
		8. PCT3431 – *Exotic Grassland*	0.0	0.2	0.0	0.2
		12. PCT4081 – *Moderate*	0.1	0.0	0.0	0.1
		13. PCT4089 - *Moderate*	0.0	0.0	0.4	0.4
		14. PCT4089 – *Low to Moderate*	0.05	0.0	0.0	0.05
		15. PCT4089 – *Cooba Woodland*	0.0	0.1	0.0	0.1
		16. PCT4089 – *Derived Native Grassland*	0.1	0.0	0.0	0.1
		17. PCT4089 – *Exotic Grassland*	0.2	0.2	0.4	0.8
	Total river red gum species polygon		**0.45**	**0.6**	**0.8**	**1.85**
Hunter Valley delma ***Delma vescolineata***	No	2. PCT3431 – *Thinned Woodland*	9.0	1.9	-	10.9
		5. PCT3431 – *Scattered Regeneration*	36.8	0.0	-	36.8
		8. PCT3431 - *Poor Condition DNG*	128.7	6.7	-	135.4
		16. PCT4089 – *Derived Native Grassland*	0.3	0.0	-	0.3
	Total Hunter Valley delma species polygon		**174.8**	**8.6**	**-**	**183.4**
brush-tailed phascogale ***Phascogale tapoatafa***	No	1. PCT3431 - *Moderate*	64.1	0.5	-	64.6
		2. PCT3431 – *Thinned Woodland*	9.6	1.9	-	11.5
		3. PCT3431 -*Woodland with Exotic Understorey*	1.9	0.0	-	1.9

Species Name	SAII Entity	Vegetation Zone No. PCT and Condition	Area (ha)			
			HVO North	HVO South	RRG Dist. Area	Total
		4. PCT3431 – *Plantation*	3.1	0.0	-	3.1
		7. PCT3431 – *Bulloak Variant*	33.0	0.0	-	33.0
		10. PCT3485 - *Moderate*	7.1	0.0	-	7.1
		11. PCT4015 - *Moderate*	2.2	0.0	-	2.2
		13. PCT4089 - *Moderate*	1.0	0.0	-	1.0
		14. PCT4089 - *Low to Moderate*	0.05	0.0	-	0.05
	Total brush-tailed phascogale species polygon		**122.05**	**2.4**	**-**	**124.45**
squirrel glider ***Petaurus norfolcensis^***	No	1. PCT3431 - *Moderate*	61.4	0.5	-	61.9
		2. PCT3431 – *Thinned Woodland*	7.9	1.9	-	9.8
		5. PCT3431 – *Scattered Regeneration*	15.9	0.0	-	15.9
	Total squirrel glider species polygon		**85.2**	**2.4**	**-**	**87.6**
eastern pygmy possum ***Cercartetus nanus^***	No	1. PCT3431 - *Moderate*	61.4	0.5	-	61.9
		2. PCT3431 – *Thinned Woodland*	7.9	1.9	-	9.8
		5. PCT3431 – *Scattered Regeneration*	15.9	0.0	-	15.9
		10. PCT3485 - *Moderate*	7.1	0.0	-	7.1
		11. PCT4015 - *Moderate*	0.5	0.0	-	0.5
	Total eastern pygmy possum species polygon		**92.8**	**2.4**	**-**	**95.2**

^Assumed present

Table 6.3 Direct Impacts of the Project on TECs

Threatened Ecological Community	Listing Status	SAII Entity	Area (ha)		
			HVO North	HVO South	RRG Dist. Area
Central Hunter Grey Box-Ironbark Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	No	76.2	2.3	0.0
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	EEC	Yes	1.05	0.0	0.15
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion	VEC	No	7.1	0.0	0.0
Total TEC Impacts	**-**	**-**	**84.35**	**2.3**	**0.15**

6.1.1 Partial Loss in Electricity Easement

Management Zone 2, as outlined above includes areas associated with the newly proposed transmission line where temporary or permanent clearance is not required and vegetation within the easement will be managed to remove any emerging canopy and shrub species. Existing operational transmission lines in the Development Footprint demonstrate the likely long-term condition of this Management Zone as demonstrated by plot P149 located in PCT3431 – Poor Condition DNG. This plot was undertaken adjacent to an existing transmission line in commensurate vegetation conditions. **Table 6.4** shows the composition, structure and function and overall VI score for P149, demonstrating the likely future condition of vegetation managed in the easement.

Table 6.4 P145 – Example of Managed Easement Vegetation

Plot	Composition	Structure	Function	VI Score	Hollow-bearing Trees?
P149 – PCT3431 – *Poor Condition Derived Native Grassland*	49.0	21.5	2.8	**14.0**	No

The future value of each vegetation composition, structure and function attribute for MZ2 was amended in the BAM-C to reflect both the impacts from partially clearing the vegetation zone and associated future management to retain biodiversity values. For MZ2, this involved reducing tree and shrub species structure and composition to zero and the removal of any large trees, hollows, stem classes or regeneration functions. All other Vegetation Integrity (VI) components were retained. The future VI scores in MZ2 were compared to the current VI score generated by P149, and manipulated to be 14.0 as per the VI score associated with P149.

Photo 6.1 Example of existing long-term condition of electricity easement management zone

6.2 Indirect Impacts

Indirect impacts are those that occur when the Project affects native vegetation and threatened species habitat beyond the Development Footprint in an indirect manner. The potential indirect impacts are considered to be well known, due to a long history of mining in the Hunter Valley and the extensive biodiversity monitoring that has been undertaken across the Hunter Valley over the last 20 years. As a result, the assessment of indirect impacts has not been hampered by limitations, assumptions or predictions that are not supportable by evidence or extensive knowledge. Whilst Section 8.2 of the BAM identifies a range of potential indirect impacts to be considered, upon review only those relevant to the Project are discussed below.

Some indirect impacts associated with the Project that have the potential to impact on biodiversity features in the locality. These include:

- Drawdown impacts on surrounding groundwater dependent ecosystems, in particular the River Red Gum (*Eucalyptus camaldulensis*) endangered population in the Hunter (also a prescribed impact discussed in **Section 6.3**).
- Rubbish dumping along the re-aligned Lemington Road.
- Edge effects (weeds and other disturbances) reducing the viability of surrounding habitats.
- Cumulative impacts of the Project for biodiversity in the wider locality.
- Fugitive light emissions, noise and dust impacts into surrounding habitats.

Table 6.5 below outlines the potential for indirect impacts on biodiversity as a result of the Project. **Section 5.4** discusses the mitigation measures proposed to limit the impacts of indirect impacts.

As outlined in Section 2.2 of the BAM Operational Manual – Stage 2, indirect impacts may be harder to predict spatially and have unclear boundaries. Predictions of drawdown effects are well understood and are not considered to be significant and are illustrated in **Figure 6.1A**, **Figure 6.1B** and **Figure 6.2**, however the extent of indirect impacts associated with rubbish dumping, edge effects, fugitive light emissions, noise and dust impacts are not readily measurable and presentable on a map. **Figure 6.3** shows the potential extent of roadside litter (10 m buffer) associated with the realignment of Lemington Road and the areas where the Development Footprints adjoin broadly intact (woody) vegetation in relation to edge effects such as weeds and the maximum extent of noise and dust impacts. Fugitive light emissions cannot be shown on figures as this has not been specifically mapped in the relevant specialist report (Visual Impact Assessment, Appendix S of the EIS).

Table 6.5 Assessment of Indirect Impacts

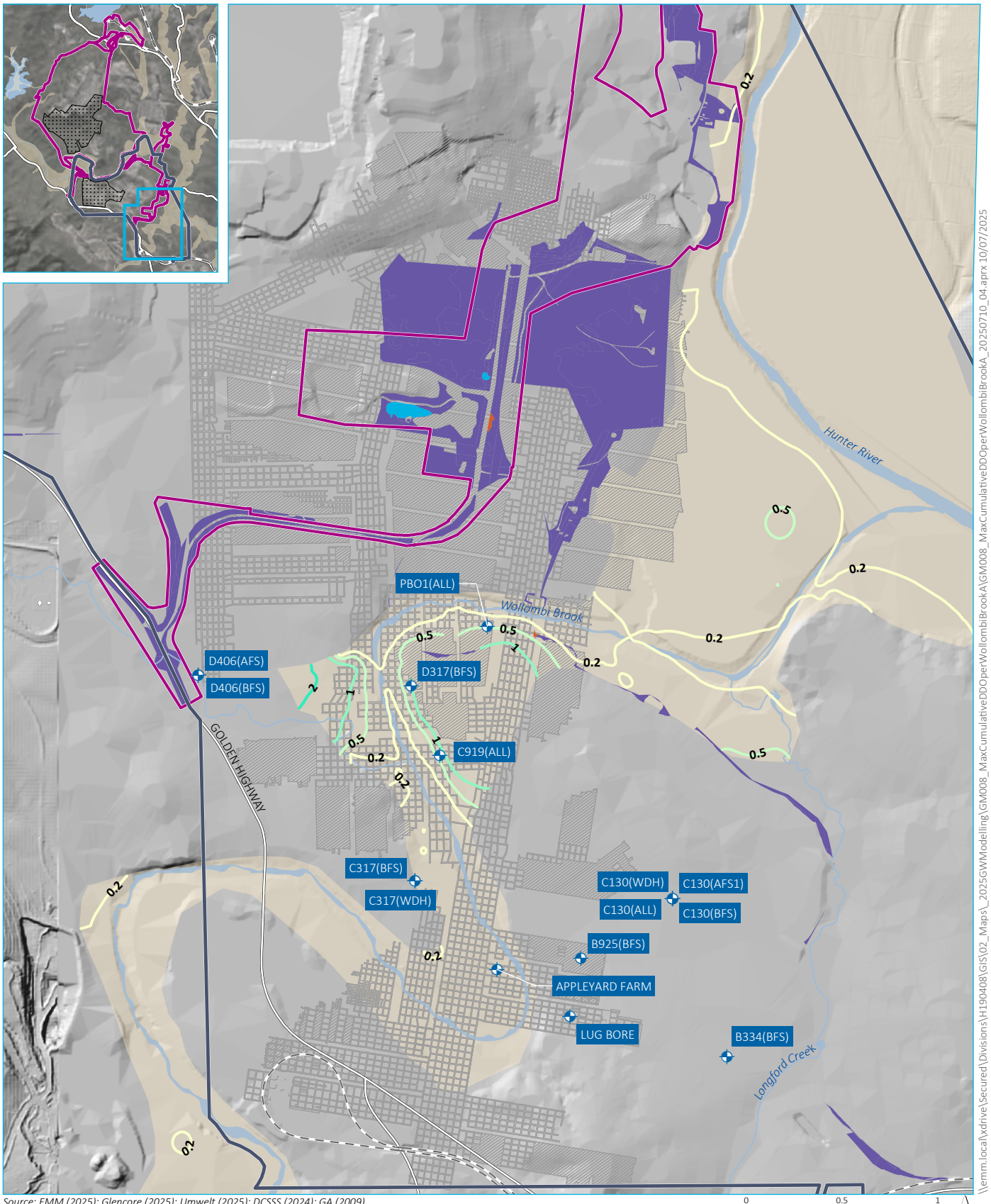
Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Drawdown impacts on surrounding groundwater dependent ecosystems	✓	✓	River red gum endangered population *Hunter Floodplain Red Gum Woodland EEC* Other GDEs (PCT4015 – Swamp Oak and PCT4089 River Oak)	**Nature:** Groundwater modelling (EMM 2025) predicts potential incremental drawdown (i.e. drawdown related to the Project) in only small parts of the Hunter River alluvial aquifer. Potential for drawdown in the alluvium along the main channel of the Hunter River is largely buffered from drawdown by low permeability barrier walls installed along sections of the aquifer (at the HVO North pit boundaries) and because infiltration from the Hunter River is a dominant recharge source to the aquifer and flows are regulated by releases from Glenbawn Dam. As a result, impacts to this aquifer ecosystem and the river red gum populations due to the Project are predicted to be minor or negligible (refer to **Figure 6.1A**). Approved Conservation Advice states that the soil that supports WSW EEC is "rapidly drained and has a low available water-holding capacity" and that the EEC "probably extracts groundwater from the underlying shallow aquifer and hence is at risk from activities that impact the sand sheet". Groundwater monitoring and associated studies indicate these vegetation communities may access groundwater associated with an ephemeral perched watertable that is replenished during high rainfall periods (refer to **Figure 6.2**). **Extent**: The Aquatic Ecology and GDE Assessment (Eco Logical 2022) states that *"Modelling predicts some drawdown in the Quaternary alluvium of the Hunter River near the riparian river red gum sites, however, the incremental drawdown is predicted to be less than 0.5 m and no widespread dewatering will occur. Minor drawdown of 0.2–0.5 m is modelled for below Carrington Billabong (AGE 2022). Any decline in the water table due to mining activities in other parts of the aquifer is likely to be replaced by the leakage of surface water through the bed of the Hunter River (AGE 2022).*	Potential decline in health of river red gum stands and *Hunter Floodplain Red Gum Woodland EEC* along the Hunter River and decline in health of other GDEs in the locality. However, a significant impact is not considered likely (EMM 2025, Eco Logical 2025). Drawdown impacts are not predicted for areas of *Warkworth Sands Woodland EEC*.

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				River red gum populations close to the Hunter River will continue to have access to groundwater due to drainage from the Hunter River, and no significant impact is expected". **Timing:** Operation. **Duration**: Long-term.	
Rubbish dumping along the re-aligned Lemington Road	✓	-	All threatened fauna species in the locality. *Warkworth Sands Woodland EEC* *Central Hunter Grey Box - Ironbark Woodland EEC*	**Nature**: The realignment of Lemington Road will be located to along the eastern side of the HVO Complex, linking back to the Golden Highway near Warkworth. The establishment of the new Lemington Road corridor will introduce road traffic and human access to an area not previously subject to regular vehicle movements. It is likely that this will introduce road side rubbish and litter to surrounding habitats. **Extent**: The Lemington Road realignment will introduce 12.1 km of new road. This will traverse adjacent to *Warkworth Sands Woodland EEC* and through areas identified as *Central Hunter Grey Box – Ironbark Woodland EEC.* The extent of litter damage to surrounding lands is variable across the country depending on the location, use of the road and proximate amenities. National litter monitoring usually extends 10 m from the roads' edge (refer to **Figure 6.3**), however rubbish dumping along the existing Lemington Road is considered to be minimal and not known to be a significant problem. The risk is expected to be low for the realigned road. **Timing**: Operation. **Duration**: Long-term.	Injury or death of threatened species through entanglement or ingestion of litter. Reduction in threatened species and TEC resilience in the locality due to damage to vegetation and habitat condition.

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Edge effects (weeds and other disturbances) reducing the viability of surrounding habitats	✓	✓	All adjacent plant communities and locally-occurring threatened species.	**Nature**: Edge effects occur in lands adjoining direct disturbances and can involve weed invasion, feral animal encroachment, restrictions in animal movements and can ultimately alter the species assemblage of a community. Clearing, thinning of vegetation and the creation of tracks have the ability to assist the establishment and spread of feral fauna species, as well as invasive weed species. **Extent**: The majority of edge effects is likely to be captured in the proposed Development Footprint, as the footprint allows for buffers around the actual area subject to direct impacts. Further mitigation measures are proposed in **Section 5.6** to acknowledge potential edge effects into surrounding sensitive receptors. **Timing**: Construction and operation. **Duration**: During vegetation clearing and creation of new tracks.	Reduction in threatened species and TEC resilience in the locality due to damage to vegetation and habitat condition. Further fragmentation of already small patches of intact vegetation and habitats.
Cumulative impacts of the Project for biodiversity in the wider locality	✓	✓	All locally-occurring plant communities and threatened species.	**Nature:** The Development Footprints are situated in a landscape that is characterised by agricultural land and mining land. The history of land clearing, agriculture and mining development has resulted in an incremental loss of vegetation and fauna habitat surrounding the Development Footprints, and within the Hunter Valley more generally. The Project will remove vegetation and further increase fragmentation and isolation of habitats in the vicinity of the Project, and thus contribute to cumulative habitat loss and vegetation clearance in the locality.	Reduction in threatened species and plant community resilience in the locality due to fragmentation and isolation of patches of intact vegetation and habitats. Loss of fauna refuges in an already highly cleared landscape.

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				Extent: The Project will result in a loss of approximately 178 ha of native woodland and forest vegetation in a highly fragmented and disturbed landscape. It is expected that up to approximately 191 ha of grassland habitats suitable for the recently-discovered Hunter Valley delma (*Delma vescolineata*) will be removed as part of the Project. The HVO Complex is expected to have cleared over 7,100 ha of land at the commencement of the Project and other recently approved projects in the locality contribute to the removal of native habitats such as United Wambo Open Cut (approx. 530 ha), Mt Pleasant Optimisation Project (approx. 475 ha) and Warkworth Continued Operations Project (approx. 700 ha). **Timing:** Construction and operation. **Duration:** Medium-term (proposed rehabilitation strategy will restore habitats and connectivity in the locality in the long-term).	
Fugitive light emissions, noise and dust impacts into surrounding habitats	✓	✓	All locally-occurring plant communities and threatened species.	**Nature:** Fugitive light emissions resulting from the construction and operation of the Project may result in adverse impacts on adjacent habitats and fauna species, such as reduction in the navigational signal ability for some nocturnal animals and delaying bats from emerging from roost access points and shortening the amount of time available to them for foraging. Construction and operational noise impacts have the potential to adversely impact native species such as noise disturbing the roosting and foraging behaviour of fauna species and noise reducing the occupancy of areas of suitable habitat. Construction and operational dust impacts have the potential to adversely impact native species during ground disturbing works, including blasting. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth.	Reduction in threatened species and plant community resilience in the locality. Disruption of faunal behaviours and health.

Potential Indirect Impact	Project Applicability		Impacted Biodiversity Features	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				Extent: Figure 6.3 shows the indicative maximum envelope 40 db $L_{Aeq, 15\ min}$ noise contours for the Project which represents the maximum envelope predicted for all stages, and all time periods. **Figure 6.3** also shows days above 25 µg/m3 PM2.5 (increment) contour in relation to particle/dust impacts relating solely to the HVO Project. No modelling of fugitive light emissions is available to represent on a figure It should be noted that the Noise Impact Assessment (EMM 2022) and Air Quality Impact Assessment (Jacobs 2022) was undertaken focusing on human-related, not biodiversity-related, receptors. It is expected that as the Project is located in a highly fragmented and disturbed landscape subject to current extensive mining areas, indirect impacts such as fugitive light emissions, air quality and noise/vibration associated with mining will not be substantially altered in the locality as a result of the Project (ERM 2022 and Jacobs 2022). Much of the new pit areas and ancillary facilities occur in areas surrounded by existing mining operations and not near intact vegetation and habitats. **Timing:** Construction and operation. **Duration:** Long-term.	



Source: EMM (2025); Glencore (2025); Umwelt (2025); DCSS (2024); GA (2009)

0 0.5 1 km

GDA2020 MGA Zone 56

N

KEY

- Amended proposed HVO North development consent boundary
- Proposed HVO South development consent boundary
- Groundwater monitoring location (HVO)
- Lemington underground mine plan
- Alluvium extent
- Mining area

Drawdown contour (m)

- 0.2
- 0.5
- 1
- 2

Plant community type (PCT) (Umwelt, 2025)

- PCT 3431 | Central Hunter Ironbark Grassy Woodland
- PCT 4015 | Central Hunter Riparian Forest
- PCT 4089 | Namoi-Upper Hunter River Red Gum Forest

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

Maximum predicted cumulative drawdown during operations in the Wollombi Brook alluvium

HVO Continuation Project
Biodiversity Development Assessment Report
Figure 6.1A

EMM creating opportunities

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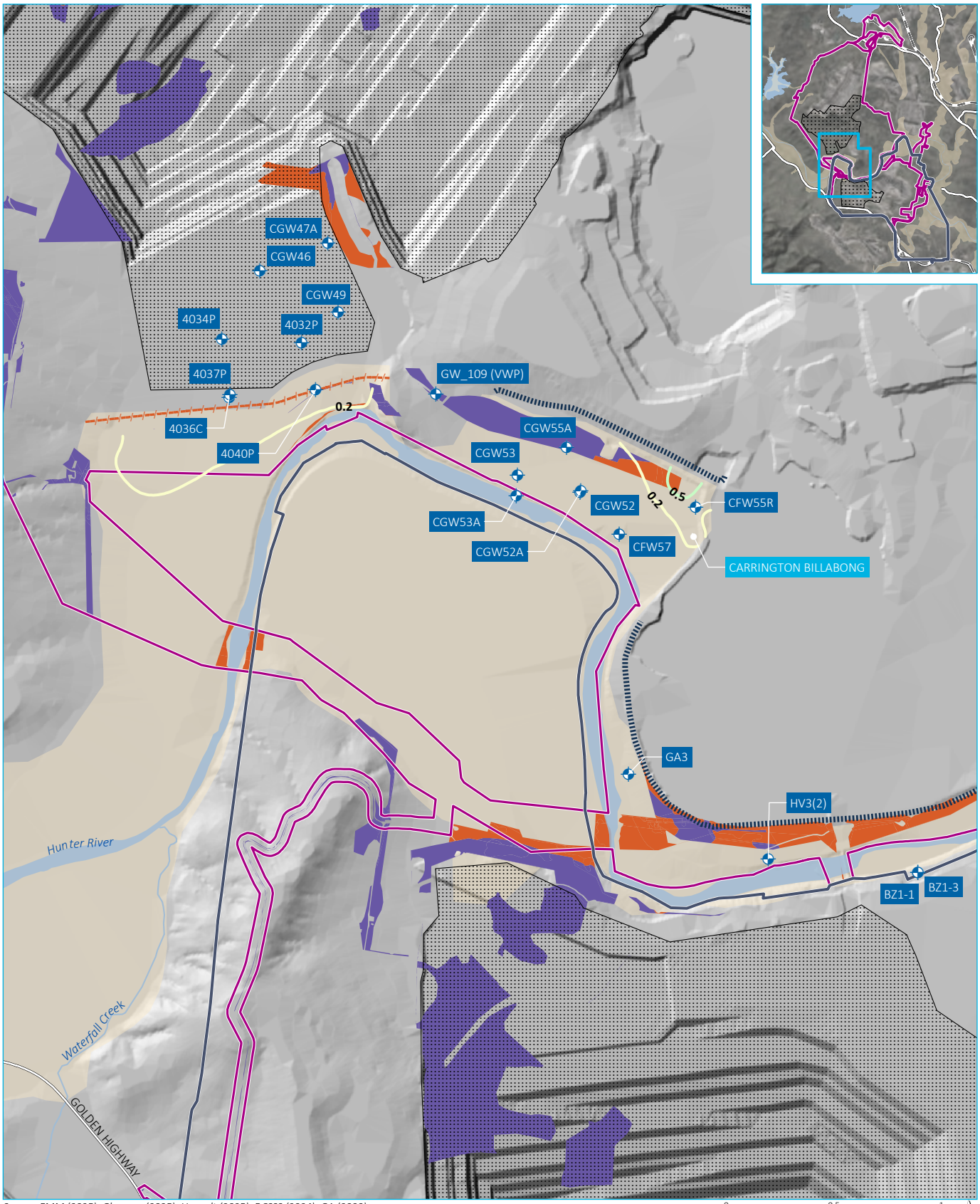

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Source: EMM (2025); Glencore (2025); Umwelt (2025); DCSSS (2024); GA (2009)

0 0.5 1 km

GDA2020 MGA Zone 56

N

KEY

- Amended proposed HVO North development consent boundary
- Proposed HVO South development consent boundary
- Groundwater monitoring location (HVO)
- Carrington West Wing LPBW
- Existing low permeability barrier wall
- Alluvium extent
- Mining area

Drawdown contour (m)

- 0.2
- 0.5

Plant community type (PCT) (Umwelt, 2025)

- PCT 3431 | Central Hunter Ironbark Grassy Woodland
- PCT 4015 | Central Hunter Riparian Forest
- PCT 4089 | Namoi-Upper Hunter River Red Gum Forest

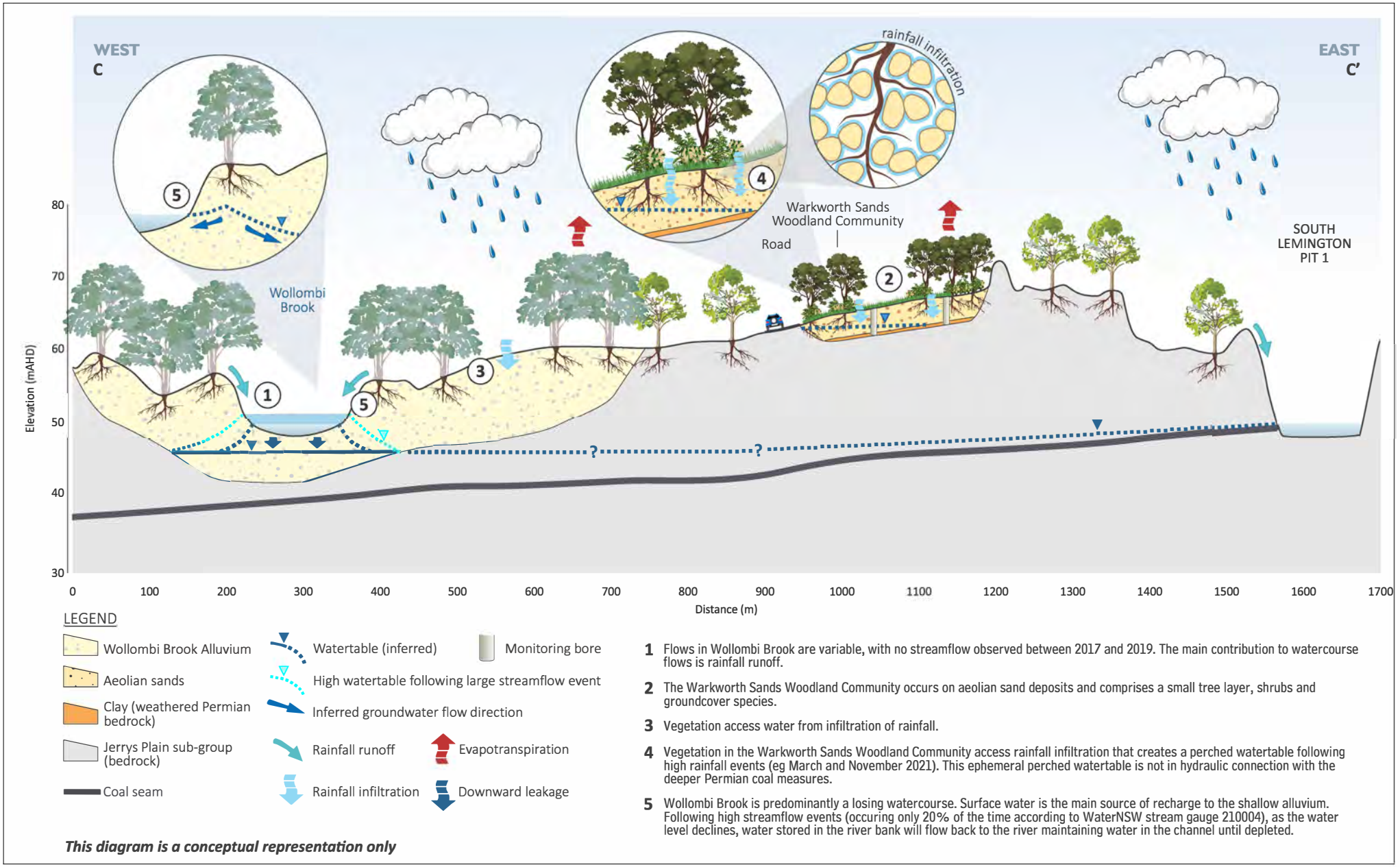
Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

Maximum predicted cumulative drawdown during operations in the Hunter River alluvium

HVO Continuation Project
Biodiversity Development Assessment Report
Figure 6.1B

EMM creating opportunities



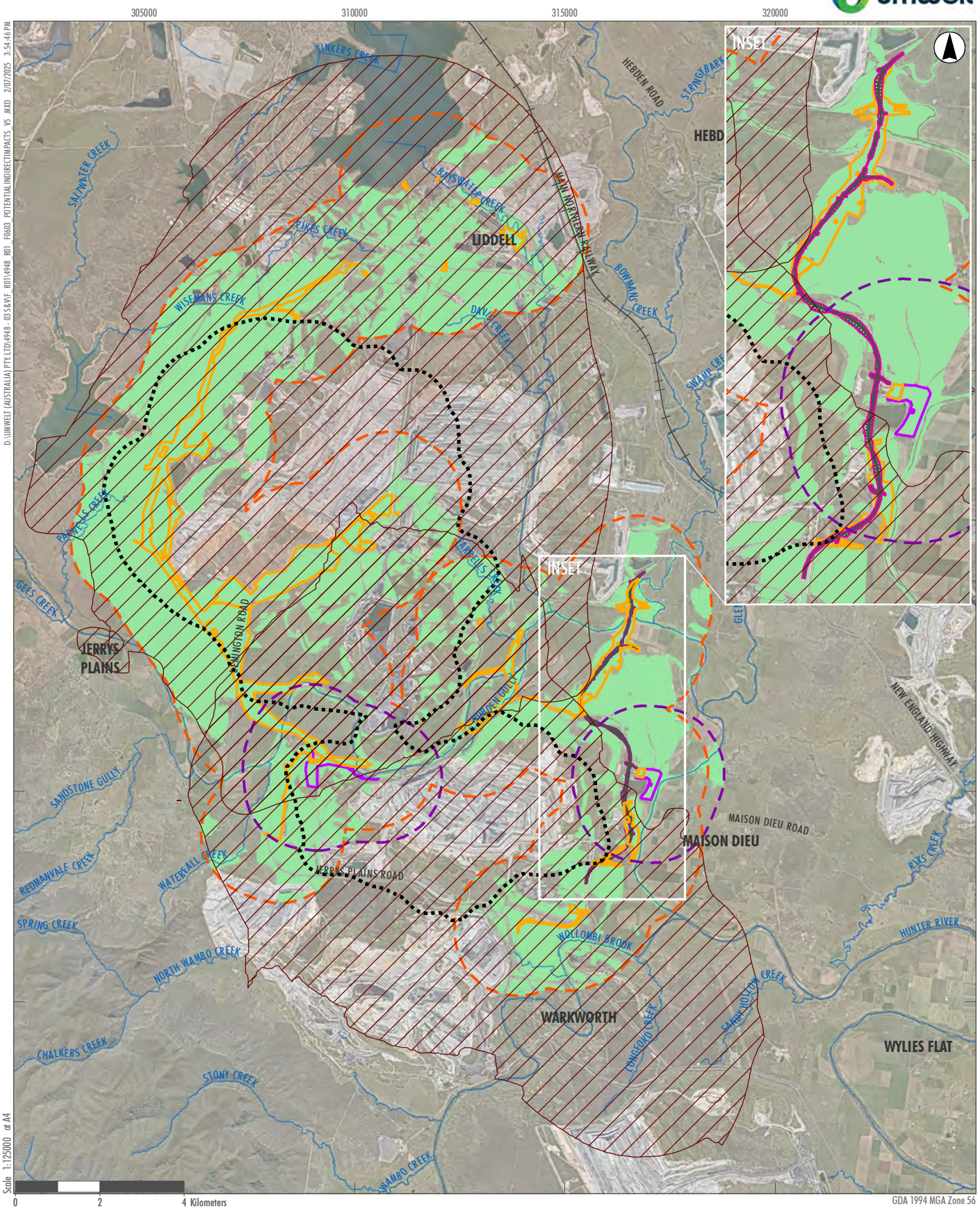
Receptor Conceptual Diagram – Warkworth Sands and Wollombi Brook

HVO Continuation Project

Biodiversity Development Assessment Report

Figure 6.2

EMM
creating opportunities



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- 1500m North Buffer
- 1500m South Buffer
- Native Vegetation in the 1500m Buffer
- Railway Line
- Road
- Drainage Line
- Proposed Lemington Road Alignment
- Potential Roadside Litter Zone
- 40 dB noise contour
- Days above 25 µg/m3 PM2.5 (increment)

FIGURE 6.3

Potential Indirect Impacts – Rubbish dumping, Edge effects, Light, Noise and Dust

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

6.3 Prescribed Impacts

Prescribed impacts have been considered for the HVO North and HVO South Development Footprints for the Project, which includes those areas mapped as Category 1 – Exempt Land.

Table 6.6 outlines the 'prescribed impacts' under the BC Regulation and their applicability to the Project. **Table 6.7** assesses any applicable prescribed impacts in detail as required in Section 8.3 of the BAM (DPIE 2020a). **Figure 6.4** illustrates the location of potential prescribed impacts.

Table 6.6 Prescribed Impacts Identified at HVO North and HVO South

Prescribed Impact	Applicable to Project?		Potential Impact
	HVO North	HVO South	
Impacts on the habitat of threatened species or ecological communities associated with: • karst, caves, crevices, cliffs and other geological features of significance, rocks, human-made structures or non-native vegetation	**Yes**	**Yes**	Category 1 – Exempt Land mapped in the Development Footprints may provide suitable habitat for the Hunter Valley delma.
• the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	**Yes**	**Yes**	Removal of vegetation and habitats associated with movement corridors.
• movement of threatened species that maintains their life cycle.	No	No	No impacts on movement habitat important for maintaining species life cycles. Impacts on connectivity captured above in **Table 6.5**.
• Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities.	**Yes**	**Yes**	Drawdown of groundwater in the locality – no significant impact predicted. Refer to **Table 6.5** and Groundwater Assessment (AGE 2022). Impacts on dams and waterbodies suitable for southern myotis.
• Impacts of wind turbine strikes on protected animals.	No	No	N/A – not a wind farm project.
• Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	**Yes**	No	Establishment of Lemington Road realignment.

Table 6.7 Prescribed Impacts Assessment

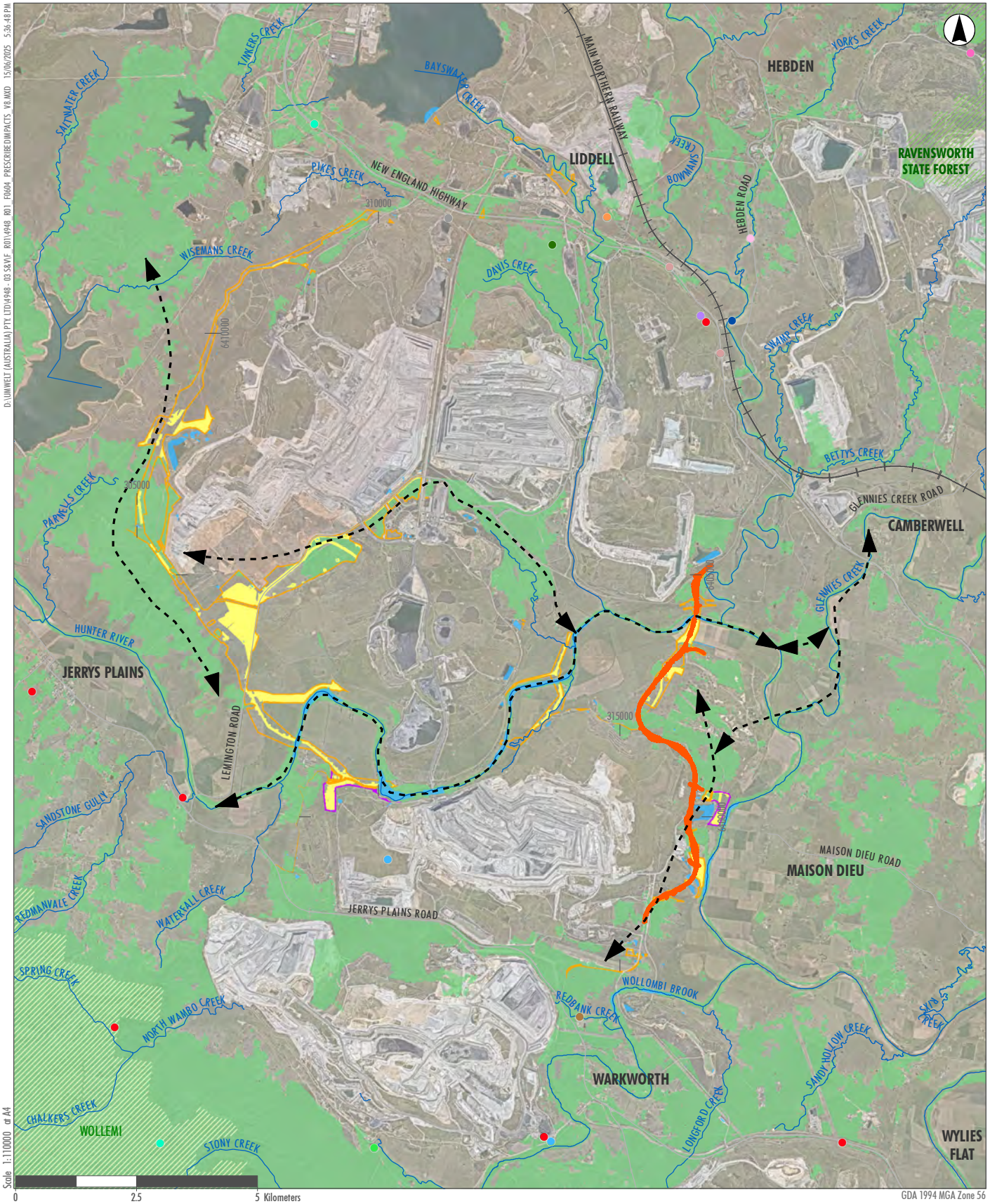
Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Impacts on the habitat of threatened species or ecological communities associated with: **- non-native vegetation associated with suitable grassland habitat**	✓	✓	Hunter Valley delma (*Delma vescolineata*)	**Nature**: As per the requirements of Section 6.12 of the BC Act, the BAM assessment has excluded impacts relating to native vegetation and habitat loss on Category 1 – Exempt Land. This primarily includes land that was cleared prior to 1990 or lawfully cleared after 1990. In the Hunter Valley this most often relates to clearance from agricultural practices or historic mining consents. As such, these areas are usually characterised by derived native or exotic grasslands, which may be suitable for the occupation of Hunter Valley delma. This species has been recorded in the native grassland and thinned woodland habitats of the Disturbance Footprints. The Development Footprints also include land that has been subject to mine disturbance with subsequent rehabilitation. Mine rehabilitation includes areas of exotic grassland, shrublands dominated by cooba and plantations dominated by sugar gum. **Extent**: Approximately 356 ha of Category 1 – Exempt Land has been mapped across the Development Footprints with 226 ha expected to be cleared for the purposes of the Project. This includes areas previously disturbed or cleared for agriculture, mining or other purposes, that has the potential to provide suitable grassland habitat for the Hunter Valley delma (refer to **Figure 6.4**). Approximately 145 ha will be retained as grasslands during the operation of the newly proposed electricity easements. **Timing**: Construction and operation. **Duration**: Ongoing during the life of the Project.	The loss of additional areas of potentially suitable habitat for the Hunter Valley delma. Due to the nature of the disturbance, it is expected that a large proportion of the Category 1 – Exempt Land is characterised by exotic grasslands which represents less suitable habitat for the species, as evidenced by the targeted survey results. Nonetheless the species may utilise this habitat for movement between areas of higher quality native grassland.

Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Impacts on the habitat of threatened species or ecological communities associated with the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	✓	✓	All threatened fauna species, but particularly ground-dwelling or arboreal species known to occur such as spotted-tailed quoll and brush-tailed phascogale. Threatened ecological communities including: *Hunter Floodplain Red Gum Woodland EEC* *Central Hunter Grey Box—Ironbark Woodland EEC* *Hunter Valley Footslopes Slaty Gum Woodland VEC*	**Nature:** The removal of native vegetation from within the Development Footprints could affect the ability of some local fauna species and TECs to move and extend throughout the landscape by removing patches of native vegetation that provide a fragmented 'stepping-stone' corridor in an already highly disturbed landscape. The loss of 'stepping stone' habitat areas for some species could result in an increased level of isolation of populations where species are unable or unwilling to travel across the increased distance between habitat areas. **Extent:** A potential fauna movement corridor occurs in highly fragmented remnant woodland and rehabilitation between the Mitchell Pit and Carrington Pit, as well as the riparian corridor of the Hunter River to the south (refer to **Figure 6.4**). While the Project will remove approximately 178.2 ha of native woody vegetation, the majority of the woodland is already highly fragmented and disturbed. Intact (moderate condition) woodland vegetation represents approximately 19% of the Development Footprints, with the remainder of the area being derived native grassland, exotic grassland or previously cleared Category 1 – Exempt Land. This represents lower value habitat when compared with native vegetation in a remnant state, of which very little is present within the Disturbance Footprints due to historical and ongoing clearing for mining and agriculture in the area.	The loss of connectivity and movement corridors for native flora and fauna.

Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
				HVO is centrally located in the Hunter Valley. The central Hunter Valley has been widely cleared of remnant vegetation primarily for agriculture and since the 1980s for mining. Review of historic aerial photographs demonstrates the lack of remnant vegetation and corridors. The Hunter River forms the most significant east-west trending corridor and the vegetation associated with Ravenworth State Forest to the north of HVO provides a moderate sized remnant through which a highly fragmented, 'stepping stone' corridor occurs trending generally north-south. Due to the location of HVO in the landscape, the Project is not expected to 'sever or interfere with corridors connecting different areas of habitat and migratory flight paths, to important habitat or local movement pathways.' It is acknowledged that habitat corridors may include networks of habitat patches or scattered paddock trees. The retention of habitat connectivity may help to reduce some of the adverse effects of habitat fragmentation by facilitating dispersal of individuals between patches of remaining habitat. Broadly, the habitats of the locality are already fragmented in a largely agricultural and mining landscape. A potential larger regional corridor in the locality, connecting Mt Royal/Barrington Tops World Heritage Area with the Wollemi World Heritage Area via Lake Liddell is not likely to be severed as a result of the Project. **Timing:** Construction and operation. **Duration:** Ongoing during the life of the Project.	

Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities **(impacts on dams and waterbodies suitable for southern myotis)**	✓	✓	southern myotis	**Nature**: The removal of waterbodies located within the Development Footprint could affect the extent of suitable foraging habitat for the southern myotis. The species is known to forage over streams and pools catching insects and small fish by raking their feet across the water surface. Southern myotis has been regularly recorded on several waterways in the vicinity of the Project including Glennies Creek, Bowmans Creek, and adjacent to the Hunter River near the Carrington West Wing Extension. As outlined in Section 4.2.2.1, the species was not recorded during the surveys undertaken for the assessment however noting the known records in the locality, has been assumed present. **Extent**: Waterbodies within the Development Footprint contain open water which provides approximately 11.3 ha of potentially suitable foraging habitat for the southern myotis. Some of these waterbodies will not be removed or materially affected in a way to prevent foraging by the species (i.e. sections of the Hunter River and dams traversed above by proposed transmission line realignments). The likely area of impact on waterbodies for the Project is approximately 5.7 ha. **Timing**: Construction and operation **Duration**: Ongoing during the life of the Project	The reduction of potentially suitable foraging habitat for the southern myotis in the locality.
Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	✓	-	All threatened fauna species, but particularly ground-dwelling species known to occur such as spotted-tailed	**Nature**: The HVO North Project includes the realignment of Lemington Road from its existing location between Mitchell Pit/West Pit and Carrington Pit to along the eastern side of the HVO Complex, linking back to the Golden Highway near Warkworth. Approximately 16 km of the existing Lemington Road will be decommissioned as a result of the extension of the HVO North mining area.	Injury and death of threatened species in the locality resulting in reduced populations and resilience.

Prescribed Impact (BC Regulation)	Applicable to Project?		Likely Impacted Threatened Entities	Nature, Extent, Timing and Duration of Impact	Consequences
	HVO North	HVO South			
			quoll and brush-tailed phascogale.	The establishment of the new Lemington Road will introduce road traffic to an existing disturbed landscape (primarily due to agricultural clearing and mining operations). Millions of native animals are injured and killed each year when they are struck by vehicles while trying to cross the road. Hotspots are likely to occur where a road cuts through habitat that serves as a corridor for movement of wildlife (DPIE 2020c). BioNet Atlas data for the Hunter IBRA Subregion indicates that road kill records span across almost all fauna categories (mammals, reptiles, amphibians, birds). Within the locality of HVO, the spotted-tailed quoll and brush-tailed phascogale have both been recorded as road kill (DPE 2022a). **Extent**: The Lemington Road realignment will introduce 11.5 km of new road (refer to **Figure 6.4**). **Frequency**: Traffic movements associated with Lemington Road are not expected to increase as part of the Project, however the location of the road will introduce a higher frequency of vehicles in an area not previously subject to regular vehicle movements (as detailed in the Traffic Impact Assessment in Appendix R of the EIS). The proposed speed limit along the re-aligned Lemington Road is 100 km/hr, consistent with the existing alignment. **Duration**: Ongoing following the completion of construction of the realignment.	



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Railway Line
- Road
- Drainage Line
- Lemington Road realignment - potential area of high vehicle strike
- Habitat Connectivity
- Habitat Connectivity (SVTM Native Vegetation Extent)
- Open Water Habitat Impact (Southern Myotis)
- Potential Hunter Valley *Delma* Habitat in Category 1 Land

Roadkill Species Records (NSW Bionet Atlas Records 2022)

- Bare-nosed Wombat
- Brush-tailed Phascogale
- Dingo, domestic dog
- Eastern Brown Snake
- Eastern Grey Kangaroo
- Eastern Snake-necked Turtle
- Fox
- Koala
- Masked Owl
- Red-bellied Black Snake
- Short-beaked Echidna
- Southern Boobook
- Spotted-tailed Quoll
- Stubble Quail

FIGURE 6.4

Location of Prescribed Impacts

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

6.4 Serious and Irreversible Impacts

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with four principles prescribed in the BC Regulation. The principles have been designed to capture those impacts that are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in NSW. These are impacts that:

- will cause a further decline of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline, or
- will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size, or
- impact on the habitat of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution, or
- impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

Two TECs, one endangered population and two species-credit species recorded within the Development Footprints are listed as potential serious and irreversible impact (SAII) entities on the DPE website and the TBDC (at the time of writing). These are:

- *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC*
- *Weeping Myall Woodland in the Sydney Basin Bioregion CEEC*
- *Acacia pendula* endangered population in the Hunter Catchment
- large-eared pied bat (*Chalinolobus dwyeri*)
- little bent-winged bat (*Miniopterus australis*).

While the Development Footprints are likely to contain foraging habitat for the above micro-bat species, no areas containing caves, overhangs or crevices, or old tunnels or culverts, for breeding habitat occur within the Development Footprints or in the immediate locality. These species are listed as SAII entities for breeding habitat only and therefore the Project is not expected to result in a serious and irreversible impact on these fauna species (refer to **Section 6.4.2** for further detail).

Similarly, the *Acacia pendula* CEEC/EP will not be directly impacted by the Project and is therefore not at risk of SAII. Further assessment of the impact of the Project against the principles prescribed in the regulation is not required.

6.4.1 *Hunter Floodplain Red Gum Woodland EEC*

Table 6.8 outlines the principles relevant for the SAII entity *Hunter Floodplain Red Gum Woodland EEC* subject to further assessment (as determined by DPHI). A detailed assessment of the SAII entity subject to impacts by the Project is provided in **Table 6.9**. While not all principles are relevant to the SAII entity, information relating to each principle is provided in **Table 6.9**.

CPHR was contacted during the assessment and provided the data and information available on these SAII entities. Where suitable, this has been incorporated in the SAII assessments below.

Table 6.8 SAII Principles for *Hunter Floodplain Red Gum Woodland EEC*

SAII Principle	Applicable?
1. The impact will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.	✓
2. The impact will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.	✓
3. The impact is made on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.	-
4. The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.	-

Table 6.9 Impact Assessment for SAII Entities – *Hunter Floodplain Redgum Woodland EEC*

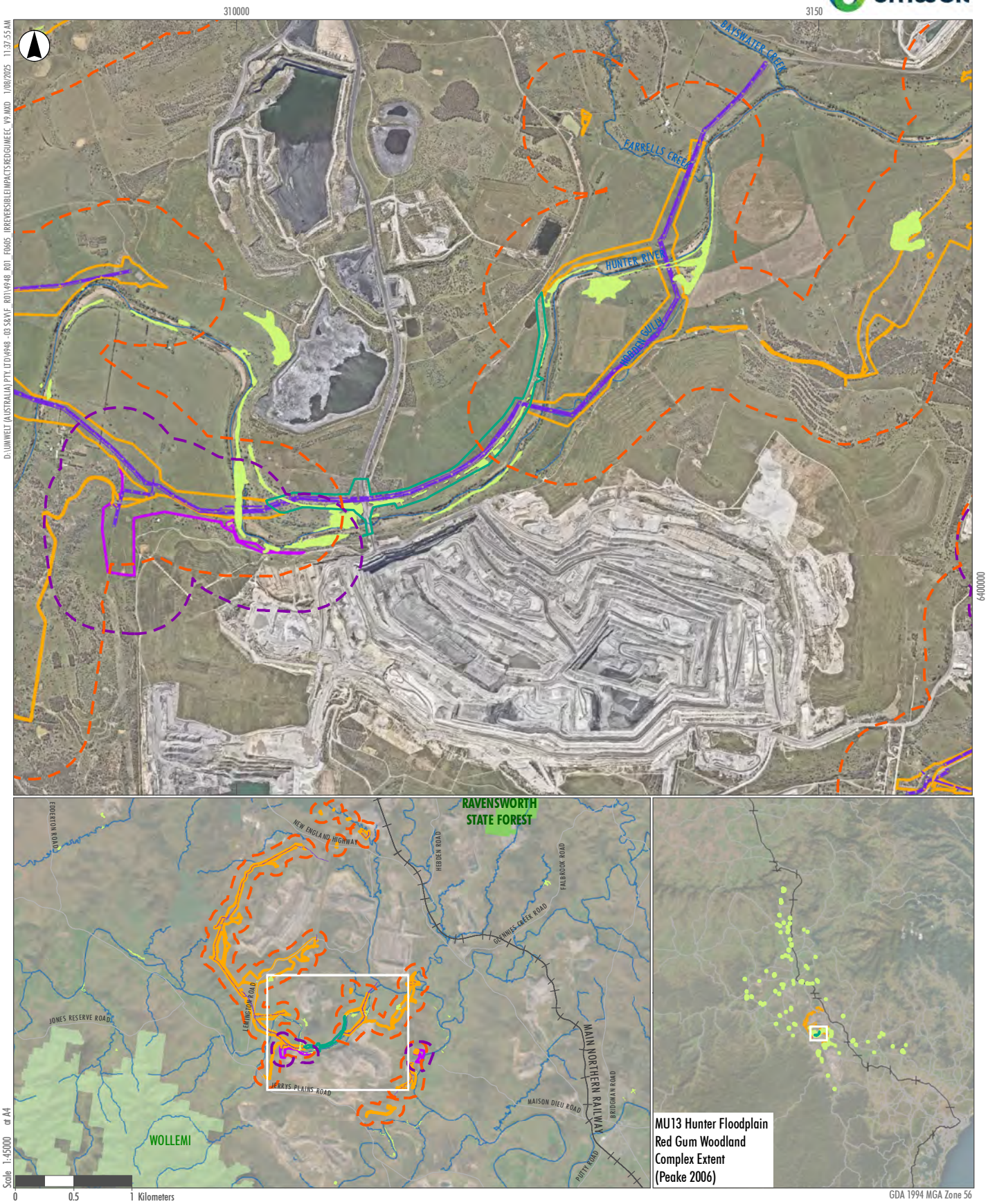
Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community	
Current Status of the TEC in relation to SAII Principles	
Principle 1 – further decline of TEC Evidence of reduction in geographic distribution as the current total geographic extent of the TEC in NSW and the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)	The TBDC associates three approved PCTs to this EEC, being PCT42, PCT1698 and PCT4089. Of these, only PCT4089 is located in the Sydney basin IBRA region and is assessed for community extent in the VIS (DCCEEW 2025). PCT 4089 is noted in the VIS (DCCEEW 2025) with a pre-European extent of 45,694 ha, and with a current estimated extent of 2589 ha. It is acknowledged that the EEC is likely to occur in PCTs other than PCT4089. According to the Final Determination for this EEC (NSW Scientific Committee 2011b) Hunter Floodplain Red Gum Woodland occupies an area of less than 500 km^2 based on 2 x 2 km grid cells, the scale of assessment recommended for species by IUCN (2008). This EEC has been recorded from the local government areas of Maitland, Mid-Western, Muswellbrook, Singleton, and Upper Hunter but may occur elsewhere within the NSW North Coast and Sydney Basin Bioregions (NSW Scientific Committee 2011b). The Hunter Remnant Vegetation Project (Peake 2006) described MU13 Hunter Floodplain Red Gum Woodland Complex, which informed the listing of this EEC under the (now repealed) TSC Act. Mapped occurrences of the community include a few remnants greater than 10 ha and many small remnants less than 10 ha indicating severe fragmentation. Within the central Hunter Valley it is estimated that the geographic distribution of the community has been reduced by more than 90% of its pre-European extent (Peake 2006). Insufficient data exists to accurately determine the reduction in geographic extent of this EEC since 1970 (approximately 52 years), however Peake (2006) estimates the pre-European extent of MU13 Hunter Floodplain Red Gum Woodland Complex to be 41,142 ha and at the time of writing (2006) the extant area was considered to be 436 ha. Peake (2006) states that after direct clearing, floodplain alteration is likely to be the most important threatening process for this community along with weed invasion, grazing and fertiliser/herbicide application. Clearance and disturbance since 1970 is likely to be most attributable to agricultural practices in the central Hunter Valley, but also impacts associated with mining and other rural development. It is considered likely that this community has undergone further decline since 1970.

Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community	
Principle 2 – further reduce size of TEC Extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes indicated by: i. change in community structure ii. change in species composition iii. disruption of ecological processes iv. invasion and establishment of exotic species degradation of habitat, and v. fragmentation of habitat	Factors contributing to a reduction in the ecological function of this community include increased fragmentation, weed invasion, feral animals and changes to floodplain hydrology. While this community likely exhibited a degree of natural fragmentation prior to European settlement due to its fidelity to floodplains and their margins, patches have been further fragmented as a consequence of clearing, with small, narrow remnants often the only vegetation left in a cleared landscape (i.e. linear strips along waterways). Invasive species are a serious threat to this EEC due to the fertile and productive nature of floodplains making them conducive to the invasion of weeds. The community's proximity to and association with water also makes it vulnerable to invasive fauna such as feral pigs, foxes, rabbits and deer. Many of the floodplains that provide habitat for this EEC have undergone major transformation following systematic hydrological engineering for the development of agricultural land, surrounding coal mining operations and creek and river diversions. Water extraction for agriculture diminishes flows, especially during dry periods and reduces the frequency of small and medium-sized flood events, which can affect the recruitment of *Eucalyptus camaldulensis*. The HVO River Red Gum Rehabilitation and Restoration Strategy (HVO 2020) notes that historical vegetation clearance has meant that most remnants, including Carrington Billabong and other HVO sites, are ecologically denuded: most have effectively no ecological connectivity to nearby remnants; their area of coverage are mostly small; most have a high edge to area ratio, resulting in a small 'core' and large 'edge' habitats; and their structural and floristic compositions have been heavily modified over time through human activities, which has continued to suppress the natural recovery of the remnants.
Principle 3 – further limit distribution of TEC Evidence of restricted geographic distribution, based on the TEC's geographic range in NSW according to the: i. extent of occurrence ii. area of occupancy, and iii. number of threat-defined locations	According to the Final Determination for this EEC (NSWSC 2011), Hunter Floodplain Red Gum Woodland generally occurs on floodplains and floodplain rises, indicating a restricted distribution. In NSW, it is estimated that the community's area of occupancy is likely an area of less than 500 km^2 in the Sydney Basin and NSW North Coast Bioregions. The EEC has undergone at least a 90% reduction in distribution following European settlement with the current extent of the ecological community estimated to be in the order of 436 ha (Peake 2006). The extant distribution of the community has few remnants greater than 10 ha and many small remnants less than 10 ha, indicating severe fragmentation and isolation from other patches. These small remnants are likely to be threatened by disturbance from agricultural activities, rural, industrial and urban development.

Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community		
Principle 4 – ability to respond to management i. Evidence that the TEC is unlikely to respond to management	The TBDC does not contain information in relation to this TEC's ability to respond to management, however management of the community at Carrington Billabong by HVO in accordance with DA 450-10-2003 and the Hunter Valley Operations River Red Gum Rehabilitation and Restoration Strategy (HVO 2020) and monitoring reports (Umwelt 2018, Ecoplanning 2025) demonstrates some level of understanding of this community's ability to respond to management. A 10-year monitoring program was completed in 2017 and a revised strategy (HVO 2020) recommended further monitoring at Carrington Billabong and priority sites across the Hunter. Actions to manage the community (in particular river red gum stands) include the exclusion of grazing, fencing, weed management and active planting of native species. Monitoring of the Carrington Billabong site and other reference sites in the Hunter indicated similar trends in community recruitment, health and decline, depending on the prevailing conditions (weed prevalence, flooding/inundation events, etc). Recent monitoring (Ecoplanning 2025) indicated that the overall health of the community had improved at Carrington Billabong. It is generally accepted that appropriate weed management would improve the community's ability to successfully recruit, however it is acknowledged that recruitment events are likely to be tied to flooding and inundation events. Artificial inundation has not been introduced to this site, but may be an option for future management (Ecoplanning 2021). The community is likely to respond to appropriate management of weeds and the exclusion of grazing, however it is dependent on flooding and inundation to promote germination and recruitment of canopy species.	
Potential Impacts on the SAII	**HVO North**	**HVO South**
The impact on the geographic extent of the TEC (Principles 1 & 3) Estimate the total area of the TEC to be impacted by the proposal: i. in hectares, and ii. as a percentage of the current geographic extent of the TEC in NSW.	The direct impacts on this EEC as a result of the HVO North Project will be up to approximately 1.2 ha (1.05 ha in HVO North and 0.15 ha associated with the Additional River Red Gum Disturbance Area). This represents 0.28% of the current estimated geographic extent of the TEC in NSW being 436 ha (Peake 2006). As outlined in **Table 6.5** and AGE (2022), no significant impact from groundwater drawdown impacts is predicted to occur. Drawdown impacts are expected to be less than 0.5 m in the area where this TEC occurs and no widespread dewatering is expected. The HVO North Project is not expected to result in substantial indirect impacts such as inappropriate fire regimes, invasive species or pathogens. The Project will manage these in accordance with the measures outlined in **Section 5.5** and the HVO Integrated Biodiversity Management Plan and Bushfire Management Plan.	No direct impacts on this EEC are expected as a result of the HVO South Project. As outlined in **Table 6.5** and AGE (2022), no significant impact from groundwater drawdown impacts is predicted to occur. Drawdown impacts are expected to be less than 0.5 m in the area where this TEC occurs and no widespread dewatering is expected. The HVO South Project is not expected to result in substantial indirect impacts such as inappropriate fire regimes, invasive species or pathogens. The Project will manage these in accordance with the measures outlined in **Section 5.5** and the HVO Integrated Biodiversity Management Plan and Bushfire Management Plan.

Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community		
iii. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by: a. distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND b. the average distance if the remnant is removed as proposed, and	The distances between patches of this community in the locality are highly variable due to the linear nature of the community. This ranges from >100 m (minimum distance to determine separate patches) and up to 2 km. The loss of up to approximately 1.2 ha of this community will have a negligible impact on the average distances between remaining patches of the EEC.	No direct impacts on this EEC are expected as a result of the HVO South Project. The distances between patches of this community in the locality are highly variable due to the linear nature of the community. This ranges from >100 m (minimum distance to determine separate patches) and up to 2 km.
iv. estimated maximum dispersal distance for native flora species characteristic of the TEC, and	Insufficient data available.	Insufficient data available.
v. other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development.	This community exhibits a natural degree of fragmentation due to its fidelity to floodplains and their margins and therefore an assessment using an area to perimeter ratio is unlikely to demonstrate the true nature of the impacts associated with this Project. While the Project is not likely to substantially fragment this community in a manner that will reduce the community's ability to function, it is noted that any impacts to highly restricted TECs such as this will contribute to the overall decline of the TEC in the locality.	No direct impacts on this EEC are expected as a result of the HVO South Project. This community exhibits a natural degree of fragmentation due to its fidelity to floodplains and their margins and therefore an assessment using an area to perimeter ratio is unlikely to demonstrate the true nature of the impacts associated with this Project. The Project is not likely to substantially fragment this community in a manner that will reduce the community's ability to function.

Hunter Floodplain Redgum Woodland in the NSW North Coast and Sydney Basin Bioregions Endangered Ecological Community					
vi. describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s).	**Veg Zone**	**Comp**	**Stru**	**Fun**	**VI**
	13. PCT4089 *Moderate*	95.7	66.5	43.3	**65.0**
	14. PCT4089 *Low to Moderate*	19.2	27.2	48.5	**29.4**
	As per the VI scores of the PCT4089 vegetation zones that conform to the EEC in the Development Footprints, the *Moderate* condition of PCT4089 (VZ13) would be considered in relatively good condition as it contains relatively intact canopy, midstorey and understorey strata with relatively low/moderate weed abundance. The *Low to Moderate* condition of PCT4089 (VZ14) is a highly modified version of VZ13 with a sparse canopy cover of *Eucalyptus camaldulensis* and dominance of the midstorey and understorey with weeds. This is reflected in the low VI score, particularly for species diversity. Despite this, due to the presence of characteristic canopy species, this zone conforms to the EEC.				



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- 500m North Buffer
- 500m North Buffer
- Road
- Drainage Line
- National Parks
- State Forest
- Potential Extent of Hunter Floodplain Red Gum Woodland EEC in the locality

FIGURE 6.5

Potential Serious and Irreversible Impacts – Hunter Floodplain Red Gum Woodland EEC

Image Source: Nearmap (April 2025), ESRI Basemap Data source: NSW DFSI (2024), Peake 2006, HVO River Red Gum Areas, Umwelt (2022) HVO Project vegetation mapping.

6.4.2 Threatened Micro-bat Species

The BDAR does not require further assessment of SAII entity microbats if the Accredited Assessor determines that there is not going to be an impact on breeding habitat of the candidate SAII bat species, (DPIE 2019). For the reasons set out below, as the Accredited Assessor has determined that there will not be an impact on the breeding habitat of the candidate SAII bat species, the BDAR does not require an assessment on these SAII species.

Two candidate SAII bat species were recorded during the surveys for the assessment as outlined in **Table 6.10**.

Table 6.10 SAII Principles for Recorded Microbats

SAII Principle	Applicable?	
	Large-eared pied bat	Little bent-winged bat
1. The impact will cause a further decline of a species or ecological community that is currently observed, estimated, inferred or reasonably suspected to be in a rapid rate of decline.	-	-
2. The impact will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very small population size.	-	-
3. The impact is made on the habitat of the species or ecological community that is currently observed, estimated, inferred or reasonably suspected to have a very limited geographic distribution.	-	-
4. The impacted species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.	✓	✓

6.4.2.1 Large-eared Pied Bat

The '*Species credit' threatened bats and their habitats NSW guide for the Biodiversity Assessment Method* (DPIE 2021) states that potential breeding habitat is "*All potential habitat on the subject land where the subject land is within 100 metres of caves, scarps, cliffs, rock overhangs and disused mines*." The Project will not have any direct impacts on irreplaceable habitat features like karst, caves, cliffs, crevices, and other formations that are essential for cave-dependent bat species such as the large-eared pied bat, or any habitat within 100 m of these features. The broader HVO mining area is not known to support mine shafts or workings, being an open cut mine. While it is noted that the Threatened Biodiversity Data Collection (TBDC) includes "derelict concrete buildings" in the general notes section, these details are not included in the Habitat Constraint section of the TBDC or in the formal *'Species credit' threatened bats and their habitats - NSW guide for the Biodiversity Assessment Method* (DPIE 2021). Umwelt is not aware of published literature that identifies buildings as suitable breeding habitat for the species. While the species may roost in habitats other than caves and clifflines, it is unlikely that maternity colonies would occur within building structures. Furthermore, the Commonwealth Conservation Advice (DCCEEW 2023) for *Chalinolobus dwyeri* provides information on the specific habitat conditions required for suitable breeding habitat for the species:

"The structure of maternity roosts appears to be very specific, and the number of known maternity roosts is small (3–6). Caves need to have indentations in the roof and be high and deep enough to allow juvenile bats to learn to fly inside. Roosting bats cluster in the indentations, which most likely allow the capture of heat. These physical characteristics are uncommon in the landscape and their scarcity poses another limiting factor in the distribution of the large-eared pied bat (Pennay 2008)."

The relevant SAII Principle for this species is the lack of responsiveness to measures to improve its habitat and vegetation integrity (Principle 4). The features of suitable maternity roosts for the large-eared pied bat such as caves and clifflines cannot be re-created and are considered irreplaceable. As outlined in the '*Species credit threatened bats and their habitats'* (DPIE 2021), any potential SAII for this species is related to impacts to its breeding habitat only and therefore requires a focus on any impacts to the irreplaceable aspect of the habitat, which is the physical structures containing the maternity roosts (e.g. caves and cliffs). No caves or cliffs were identified within the Development Footprint and therefore no irreplaceable breeding habitat will be impacted by the Project.

In the absence of any published literature that identifies buildings as suitable breeding habitat, it is considered that there is no potential for breeding habitat for the large-eared pied bat to occur within old buildings in the Development Footprint. A SAII assessment is not required for large-eared pied bat as the habitat constraint related to SAII impacts is not present within, or in proximity to, the Development Footprint. The requirements of Section 9.1 of the BAM are met for this species in Section 6.4 of the BDAR.

6.4.2.2 Little Bent-winged Bat

The *'Species credit' threatened bats and their habitats NSW guide for the Biodiversity Assessment Method* (DPIE 2021) states that potential breeding habitat for little bent-winged bat is *"Caves, tunnels, mines or other structures known or suspected to be used by M. australis including species records in the NSW BioNet Atlas with microhabitat code 'IC – in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or from the scientific literature"*. No records occur in, or within proximity to, the Development Footprint in the NSW BioNet Atlas with microhabitat code 'IC– in cave'; observation type code 'E nest-roost'; with numbers of individuals >500; or indicated from the scientific literature. The records of the species following anabat detection surveys undertaken during this assessment did not indicate large numbers or intense activity usually associated with roosting or breeding colonies. Umwelt is not aware of any scientific literature that would lead the assessor to consider actively used buildings and structures within the Development Footprint to be suspected of containing roosting or breeding little bent-winged bat. As per the TBDC, foraging habitat is broad ranging but breeding habitat is highly specific.

The SAII nomination for little bent-winged bat noted that *"The species is restricted to one threat-defined location at Willi Willi Caves Nature Reserve"* being the only maternity colony known in NSW. The species has very specific temperature and humidity requirements for maternity / breeding cave roosts. It is therefore highly unlikely that there is active breeding habitat for this species within either the natural habitat on site, or in the disused or used buildings in the Development Footprints due to these specific requirements.

Similar to the large-eared pied bat, the relevant SAII Principle for this species is the lack of responsiveness to measures to improve its habitat and vegetation integrity (Principle 4). The features of suitable maternity roosts for the little bent winged-bat such as caves and clifflines cannot be re-created and are considered irreplaceable. As outlined in the '*Species credit threatened bats and their habitats*' (DPIE 2021), any potential SAII for this species is related to impacts to its breeding habitat only and therefore requires a focus on any impacts to the irreplaceable aspect of the habitat, which is the physical structures containing the maternity roosts (e.g. caves).

As per the above, there is no breeding habitat for these species in the Development Footprint and therefore no SAII assessment is required. The requirements of Section 9.1 of the BAM are met for this species in Section 6.4 of the BDAR.

6.5 Uncertain Impacts

There are no uncertain impacts predicted to occur as a result of the Project. It is considered that the potential impacts associated with the Project are well known, as outlined in the sections above, and particularly noting the history of mining and similar operations in the Hunter Valley.

HVO has an existing Integrated Biodiversity Management Plan which includes a risk framework and adaptive management measures to ensure successful implementation of management measures and actions, many of which are specifically proposed in **Section 5.3** of this report. This includes specific monitoring, annual review processes and updating of plans on a regular basis to ensure best practice mitigation and improvements once new information is available or changed circumstances arise.

7.0 Impact Summary

7.1 Impacts Not Requiring Assessment

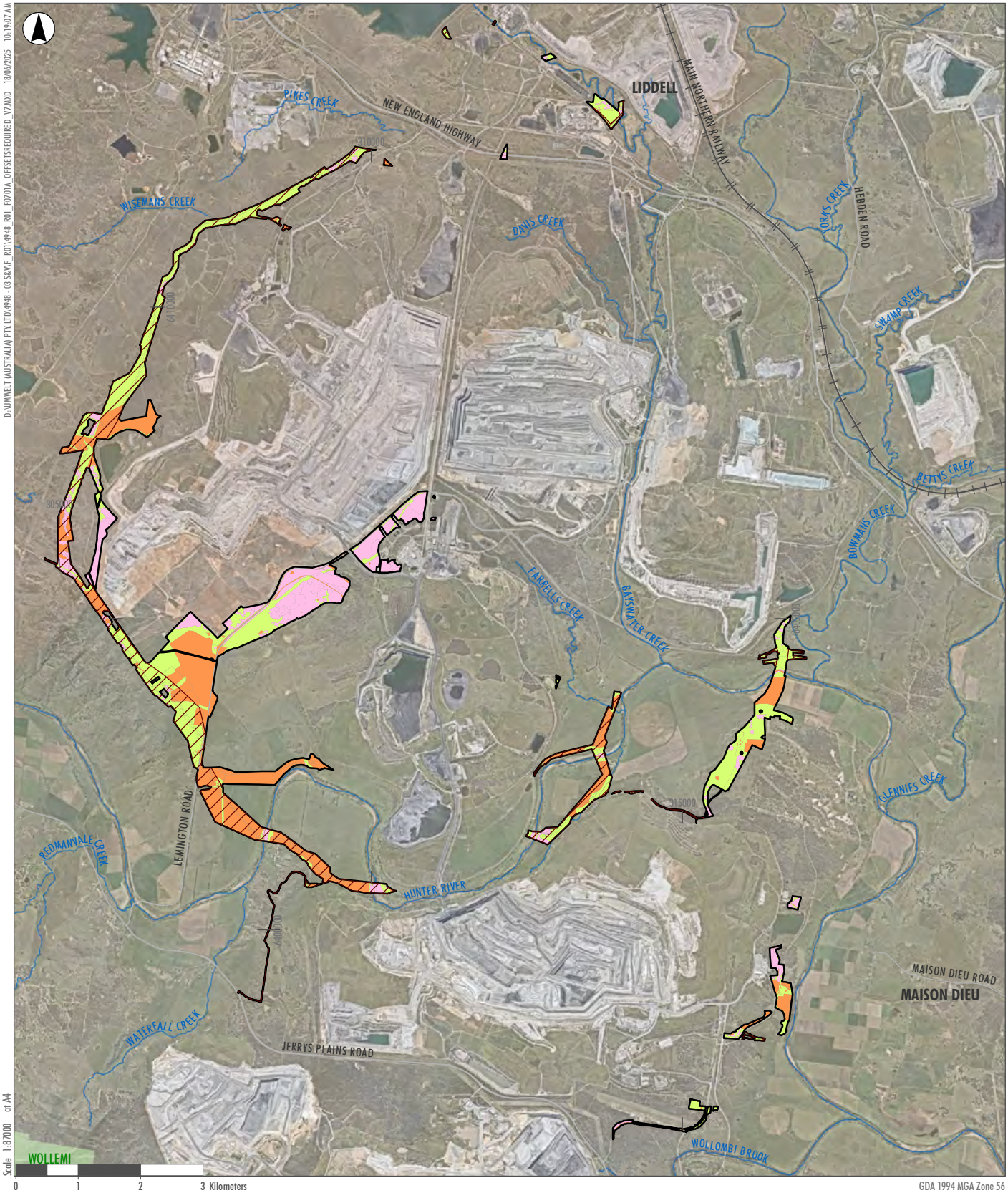
Impacts not requiring further assessment under the BAM include areas of land without native vegetation. The Development Footprints contain approximately 229.3 ha of cleared land (containing disturbed land and dams) and Category 1 – Exempt Land that will be impacted as a result of the Project. This impact does not require further assessment under the BAM (other than for prescribed impacts).

Table 7.1 summarises and **Figure 7.1A** and **Figure 7.1B** illustrate these areas in the Development Footprints.

Section 2.3 discusses the areas of mine rehabilitation located in already approved disturbance areas, which are not within the Development Footprints and do not require assessment.

Table 7.1 Impacts Not Requiring Assessment

Areas Not Requiring Assessment	Area (ha)	
	HVO North	HVO South
Category 1 – Exempt Land under the LLS Act	202.8	24.7
Cleared land (non-vegetated, roads, infrastructure)	1.0	0.0
Waterbodies/dams	0.7	0.0



Legend

- HVO North Development Footprint
- Wider Easement Area - no impacts currently proposed
- Railway Line
- Road
- Drainage Line
- National Parks

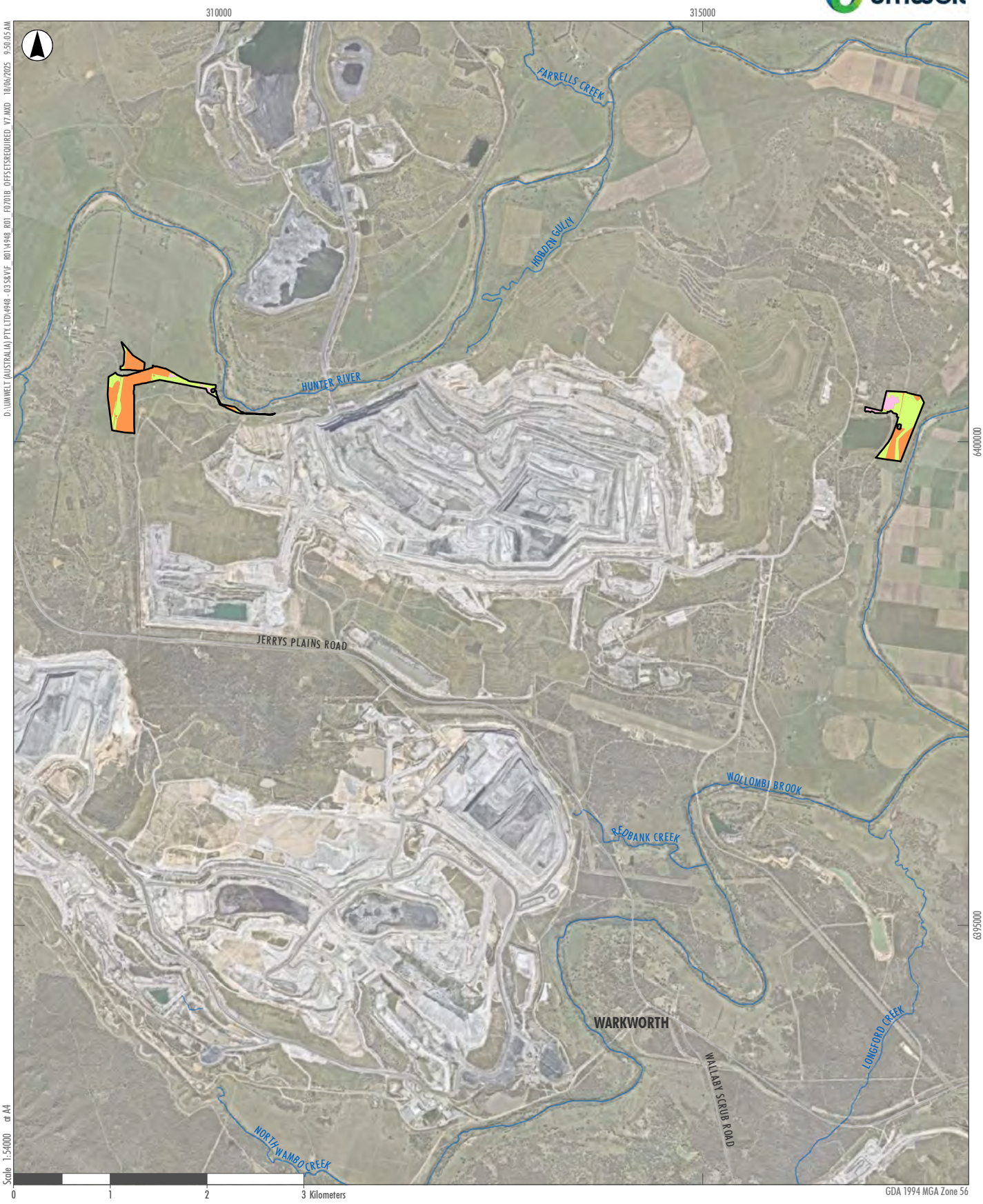
Offset

- Areas not requiring assessment
- Impacts that do not require offset (below offset threshold)
- Residual Impacts that require offsets

FIGURE 7.1A

HVO North – Summary of Impacts and Offsets Required

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)



Legend

- HVO South Development Footprint
- Road
- Drainage Line

Offset

- Areas not requiring assessment
- Impacts that do not require offset (below offset threshold)
- Residual Impacts that require offsets

FIGURE 7.1B

HVO South - Summary of Impacts and Offsets Required

Image Source: Nearmap (April 2025) Data source: NSW DFSI (2024)

7.2 Impacts Not Requiring Offset

Impacts on native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of:

- <15, where the PCT is representative of an EEC or a CEEC
- <17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community
- <20, where the PCT does not represent a TEC and is not associated with threatened species habitat.

Three vegetation zones identified within the Development Footprint have a vegetation integrity score lower than the stated thresholds and consequently, do not require offsetting. The vegetation zones not requiring an offset are outlined in **Table 7.2** and illustrated in **Figure 7.1A** and **Figure 7.1B**.

Table 7.2 Vegetation Zones Not Requiring Offset

Veg Zone	Plant Community Type Condition	Area (ha)		Vegetation Integrity Score	Credits Required
		HVO North	HVO South		
7.	3431 - Central Hunter Ironbark Grassy Woodland *Poor Condition Derived Native Grassland*	154.1	7.0	13.9	0
8.	3431 - Central Hunter Ironbark Grassy Woodland *Exotic Grassland*	47.9	7.4	12.9	0
17.	4089 - Namoi-Upper Hunter River Red Gum Forest *Exotic Grassland*	7.7	4.7	9.3	0
Total		**209.7**	**19.1**	**-**	**0**

7.3 Residual Impacts Requiring Offset

The vegetation zones that require offsetting as part of the Project are outlined in **Table 7.3** and illustrated in **Figure 7.1A** and **Figure 7.1B**. Credits for species-credit species are outlined in **Table 7.4** and species polygons are shown in **Figure 4.4** to **Figure 4.10**.

Table 7.3 Vegetation Zones Requiring Offset and Ecosystem Credits

Vegetation Zone No. and Condition	HVO North				HVO South			
	VI Score	VI Loss	Area (ha)	Credits	VI Score	VI Loss	Area (ha)	Credits
PCT 3431 - Central Hunter Ironbark Grassy Woodland								
Conforming to Central Hunter Grey Box-Ironbark Woodland EEC								
1. *Moderate*	57.9	-57.9	64.1	1856	57.9	-57.9	0.5	14
2. *Thinned Woodland*	53.8	-53.0	9.6	254	53.8	-53.8	1.9	51

Vegetation Zone No. and Condition	HVO North				HVO South			
	VI Score	VI Loss	Area (ha)	Credits	VI Score	VI Loss	Area (ha)	Credits
3. *Woodland with Exotic Understorey*	22.1	-22.1	1.9	21	-	-	0.0	0
4. *Plantation*	47.0	-35.9	0.5	9	-	-	0.0	0
Non-threatened vegetation								
4. *Plantation*	47.0	-43.8	2.6	57	-	-	0.0	0
5. *Scattered Regeneration*	46.5	-46.5	39.2	896	-	-	0.0	0
6. *Cooba Woodland*	47.8	-47.4	11.8	280	47.8	-47.8	0.2	5
9. *Bulloak Variant*	41.4	-41.4	33.0	683	-	-	0.0	0
TOTAL for PCT 3431	**-**	**-**	**162.7**	**4056**	**-**	**-**	**2.6**	**70**
PCT 3485 - Hunter Valley Footslopes Slaty Gum Forest								
Conforming to Hunter Valley Footslopes Slaty Gum Woodland VEC								
10. *Moderate*	88.1	-88.1	7.1	313	-	-	0.0	0
TOTAL for PCT 3485	**-**	**-**	**7.1**	**313**	**-**	**-**	**0.0**	**0**
PCT 4015 - Central Hunter Swamp Oak Riparian Forest								
Non-threatened vegetation								
11. *Moderate*	69.8	-69.8	2.2	77	-	-	0.0	0
TOTAL for PCT 4015	**-**	**-**	**2.2**	**77**	**-**	**-**	**0.0**	**0**
PCT 4081 - Northwest River Oak-River Red Gum Forest								
Non-threatened vegetation								
12. *Moderate*	34.6	-34.6	1.7	37	-	-	0.0	0
TOTAL for PCT 4081	**-**	**-**	**1.7**	**37**	**-**	**-**	**0.0**	**0**
PCT 4089 - Namoi-Upper Hunter River Red Gum Forest								
Conforming to Hunter Floodplain Red Gum Woodland EEC								
13. *Moderate*	65.0	-65.0	1.0	33	-	-	0.0	0
14. *Low to Moderate*	29.4	-29.4	0.05	1	-	-	0.0	0
Non-threatened vegetation								
15. *Cooba Woodland*	54.5	-40.5	0.1	3	54.5	-54.5	0.6	20
16. *DNG*	21.8	-14.8	1.0	9	-	-	0.0	0
TOTAL for PCT 4089	**-**	**-**	**2.15**	**46**	**-**	**-**	**0.6**	**20**
Total	**-**	**-**	**175.85**	**4529**			**3.2**	**90**

*Note: Vegetation zones 7, 8 and 17 are not included in this table as they do not meet the minimum offset threshold as outlined in **Section 7.2**.*

Table 7.4 Species-credit Species Requiring Offset

Species	Biodiversity Risk Weighting	HVO North		HVO South	
		Area (ha)	Credits	Area (ha)	Credits
southern myotis *Myotis macropus*	2.0	76.85	1972	2.2	59
squirrel glider *Petaurus norfolcensis*^	2.0	85.2	2349	2.4	65
eastern pygmy possum *Cercartetus nanus*^	2.0	92.8	2679	2.4	65
Eucalyptus camaldulensis –population in the Hunter catchment	2.0	0.45	5	0.6	7
brush-tailed phascogale *Phascogale tapoatafa*	2.0	122.05	3315	2.4	65
Hunter Valley delma *Delma vescolineata*#	2.0	174.8	1977	8.6	103

^Assumed present until surveys are undertaken to determine presence or absence.

 # The Biodiversity Risk Weighting for Delma vescolineata was supplied by CPHR on 29 July 2025 to manually determine the credit liability for the species in lieu of BAM-C application.

Table 7.5 Impacts and Credits Associated with the Additional River Red Gum Disturbance Area

Species	Biodiversity Risk Weighting	RRG Additional Disturbance Area	
		Area (ha)	Credits*
Hunter Floodplain Red Gum Woodland EEC	-	0.15	3
Eucalyptus camaldulensis –population in the Hunter catchment	2.0	0.8	15

*Credit requirements extrapolated from HVO North credit outcomes.

7.4 Offsets for Indirect and Prescribed Impacts

Table 7. below outlines the indirect and prescribed impacts considered likely to occur as a result of the Project and whether additional offset strategies are suitable or proposed for these impacts.

Table 7.6 Offset Measures for Indirect and Prescribed Impacts

Impact	Biodiversity Feature Impacted	Offsets Proposed
Indirect Impacts		
Drawdown impacts	River red gum endangered population *Hunter Floodplain Red Gum Woodland EEC* Other GDEs	As no significant impacts are expected to occur in relation to drawdown impacts, no specific offset measures are proposed.
Edge effects (weeds, light emissions, noise, dust, rubbish dumping along Lemington Road realignment)	All adjacent plant communities and locally-occurring threatened species	As discussed in **Section 6.2**, the majority of indirect impacts associated with edge effects are likely to be captured in the proposed Development Footprint, as the footprint allows for appropriate buffers around the actual area proposed for direct impacts and clearance. No additional offsets proposed.
Cumulative impacts of HVO North and South	All locally-occurring plant communities and threatened species.	The cumulative impacts of HVO North and South are captured with the combined credit assessments. No additional offsets proposed.
Prescribed Impacts		
Impacts on the habitat of threatened species associated with Category 1 – Exempt Land	Hunter Valley delma (*Delma vescolineata*)	As outlined in **Table 6.7**, Category 1 – Exempt Land may provide habitat for the Hunter Valley delma, which was recorded relatively consistently across the native grasslands in the wider Development Footprints. Targeted survey was not conducted in Category 1 areas, as per the intent of the BAM. It is likely that the majority of these areas contain exotic grassland where the species was not recorded in other areas of the Development Footprints. It is acknowledged that the species does appear to occur across a large area within and around the Development Footprints and the species is likely to occur in the appropriate habitats of the Category 1 land even in low numbers or as movement habitat to areas of better condition. HVO will consider the suitability of additional contributions to the offsetting strategy acknowledging the potential impacts to the species on Category 1 – Exempt Land in the Development Footprint.
Impacts on the habitat of threatened species or ecological communities associated with the connectivity	Ground-dwelling species such as spotted-tailed quoll and brush-tailed phascogale	The proposed rehabilitation strategy outlined in **Section 5.6.1** and Appendix F of the EIS is proposed to result in long-term connectivity around the HVO Complex. The Project will be undertaken in stages, which will allow the continued rehabilitation of decommissioned areas and reduction in immediate loss of habitats in the Development Footprints. No additional offsets are proposed.

Impact	Biodiversity Feature Impacted	Offsets Proposed
Impacts of development on water quality, water bodies and hydrological processes – drawdown impacts	River red gum endangered population *Hunter Floodplain Red Gum Woodland EEC* Other GDEs	As no significant impacts are expected to occur in relation to drawdown impacts, no specific offset measures are proposed.
Impacts of vehicle strikes on threatened species – Lemington Road realignment	Ground-dwelling species such as spotted-tailed quoll and brush-tailed phascogale	Mitigation and minimisation measures are proposed in **Section 5.6.2** to address the impact of vehicle strike on local fauna following the establishment of the Lemington Road realignment. Offsetting this impact (the extent of which is not currently measurable) is unlikely to appropriately alleviate the impacts. Road kill has been recorded along many of the major road networks in the locality (refer to **Figure 6.4**) and is known to occur across all road networks in NSW. It is considered that the mitigation measures outlined in **Section 5.6.2** provide practical measures for reducing this impact as a result of the Project. No additional offsets are proposed.

8.0 Biodiversity Credit Report

The full Biodiversity Credit Reports for HVO North and HVO South are included in **Annexure F**.

Table 8.1 below provides a summary of the ecosystem and species credits and their credit classes required to offset the Project under the "Like-for-like" rules under the Biodiversity Offsets Scheme. The credits are divided into offset areas that must include hollow-bearing trees (HBTs) and areas that do not require HBTs. A total credit requirement is also provided.

Under the like-for-like rules, all ecosystem credit offsets are required to be located in the Hunter, Ellerston, Karuah Manning, Kerrabee, Liverpool Range, Peel, Tomalla, Upper Hunter, Wyong or Yengo IBRA subregions or in any IBRA subregion that is within 100 km of the outer edge of the Development Footprints. Species credits are able to be offset in any IBRA subregion in NSW.

Table 8.1 Ecosystem and Species Credits Required to Offset the Project

Name	Credit Class	HVO North		HVO South		TOTAL
		With HBTs	Without HBTs	With HBTs	Without HBTs	
3431 - Central Hunter Ironbark Grassy Woodland						
Conforming to *Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC*	Any PCT conforming to *Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC.* This includes PCTs: 1603, 1605, 1691, 1692, 3314, 3431, 3485	2131	9	65	0	2205
Non-TEC	Hunter-Macleay Dry Sclerophyll Forests ≥ 70% - <90% cleared group (including Tier 2 or higher threat status). This includes PCTs: 3431, 3442, 3446	683	1233	0	5	1921
3485 - Hunter Valley Footslopes Slaty Gum Forest						
Conforming to *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC*	Any PCT in the *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC.* May include PCTs 1176, 1655, 3490.	313	0	0	0	313
4015 - Central Hunter Swamp Oak Riparian Forest						
Non-TEC	Coastal Floodplain Wetlands - ≥ 70% - <90% cleared group (including Tier 2 or higher threat status). This includes PCTs: 4015, 4023, 4024, 4025, 4026, 4027, 4029, 4034, 4035, 4036, 4037, 4041, 4042, 4044, 4046, 4049, 4050, 4051, 4055, 4059	0	77	0	0	77
4081 - Northwest River Oak-River Red Gum Forest						
Non-TEC	Eastern Riverine Forests - ≥ 90% cleared group (including Tier 1 or higher threat status). This includes PCTs: 42, 4081	0	37	0	0	37

Name	Credit Class	HVO North		HVO South		TOTAL
		With HBTs	Without HBTs	With HBTs	Without HBTs	
4089 - Namoi-Upper Hunter River Red Gum Forest						
Conforming to *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC*	Any PCT conforming to *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions VEC* This includes PCTs: 42, 1698, 4089	33 (plus 3 credits associated with the Additional RRG Dist. Area)	1	0	0	37
Non-TEC	Inland Riverine Forests ≥ 90% cleared group (including Tier 1 or higher threat status). This includes PCTs: 4088, 4089	3	9	20	0	32
Eucalyptus camaldulensis – endangered population in the Hunter catchment	*Eucalyptus camaldulensis* – endangered population in the Hunter catchment species credits anywhere in NSW.	5 (plus 15 credits associated with the Additional RRG Dist. Area)		7		27
Hunter Valley delma *Delma vescolineata*	Hunter Valley delma species credits anywhere in NSW.	1977		103		2080
southern myotis *Myotis macropus*	Southern myotis species credits anywhere in NSW.	1972		59		2031
brush-tailed phascogale *Phascogale tapoatafa*	Brush-tailed phascogale species credits anywhere in NSW.	3315		65		3380
squirrel glider *Petaurus norfolcensis*^	Squirrel glider species credits anywhere in NSW.	2349		65		2414
eastern pygmy possum *Cercartetus nanus*^	Eastern pygmy possum species credits anywhere in NSW.	2679		65		2744

^Assumed present until surveys are undertaken to determine presence or absence.

8.1 Staged Credit Requirements

HVO proposes to stage the retirement of credits as clearing of the Development Footprint occurs to be consistent with the staging of the Rehabilitation Management Plan for the Project. Broadly, the stages of the Project includes the following:

- **Stage 1** – areas to be disturbed associated with the additional disturbance areas (i.e. additional mining area, Lemington Road realignment and infrastructure construction). Stage 1 activities will generally be undertaken in the first few years post approval (HVO North and HVO South).
- **Stage 2** – disturbance required associated with the HVLP product stockpile extension (if constructed) (HVO North only).

Table 8.2 and **Table 8.3** outlines the credit requirement for the relevant stages of the HVO North and HVO South Projects, respectively.

Figure 8.1A and **Figure 8.1B** show the staged impacts for the Project.

Table 8.2 HVO North – Staged Credit Retirement Requirements

Biodiversity Feature	Stage 1		Stage 2	
	Area (ha)	Credits	Area (ha)	Credits
TEC Ecosystem Credits				
Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions EEC	1.2*	37	0.0	0
Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion VEC	7.1	313	0.0	0
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	74.9	2103	1.3	37
Non-TEC Ecosystem Credits				
3431 - Central Hunter Ironbark Grassy Woodland	86.5	1913	0.1	3
4015 - Central Hunter Riparian Forest	1.6	58	0.6	19
4081 - Northwest River Oak-River Red Gum Forest	1.7	37	0.0	0
4089 - Namoi-Upper Hunter River Red Gum Forest	1.1	12	0.0	0
Species Credits				
Eucalyptus camaldulensis – endangered population in the Hunter catchment	1.85*	20	0.0	0
squirrel glider *Petaurus norfolcensis*^	83.9	2313	1.3	36
eastern pygmy possum *Cercartetus nanus*^	91.0	2627	1.8	52
Hunter Valley delma *Delma vescolineata*	174.5	1973	0.3	4
southern myotis *Myotis macropus*	75.75	1944	1.1	28

Biodiversity Feature	Stage 1		Stage 2	
	Area (ha)	Credits	Area (ha)	Credits
brush-tailed phascogale *Phascogale tapoatafa*	120.3	3266	1.8	49

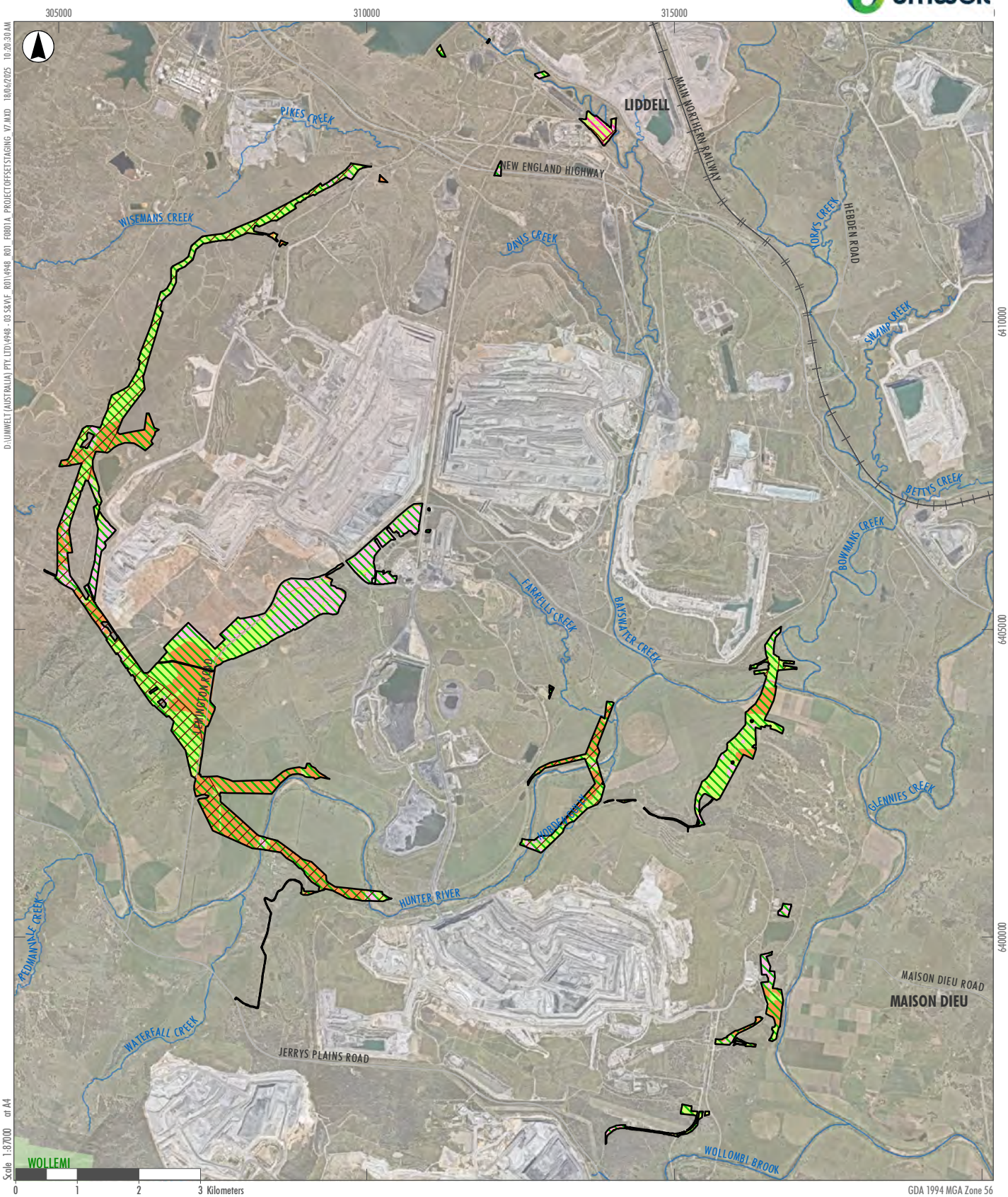
**Includes impacts in the RRG Additional Disturbance Area.*

^Assumed present until surveys are undertaken to determine presence or absence.

Table 8.3 HVO South – Staged Credit Retirement Requirements

Biodiversity Feature	Stage 1	
	Area (ha)	Credits
TEC Ecosystem Credits		
Central Hunter Grey Box—Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions EEC	2.3	65
Non-TEC Ecosystem Credits		
3431 - Central Hunter Ironbark Grassy Woodland	0.2	5
4089 - Namoi-Upper Hunter River Red Gum Forest	0.6	20
Species Credits		
Eucalyptus camaldulensis – endangered population in the Hunter catchment	0.6	7
squirrel glider *Petaurus norfolcensis*^	2.4	65
eastern pygmy possum *Cercartetus nanus*^	2.4	65
Hunter Valley delma *Delma vescolineata*	8.6	103
southern myotis *Myotis macropus*	2.2	59
brush-tailed phascogale *Phascogale tapoatafa*	2.4	65

^Assumed present until surveys are undertaken to determine presence or absence.



Legend

- HVO North Development Footprint
- Wider Easement Area - no impacts currently proposed
- Railway Line
- Road
- Drainage Line
- National Parks

Offset

- Areas not requiring assessment
- Impacts that do not require offset (below offset threshold)
- Residual Impacts that require offsets

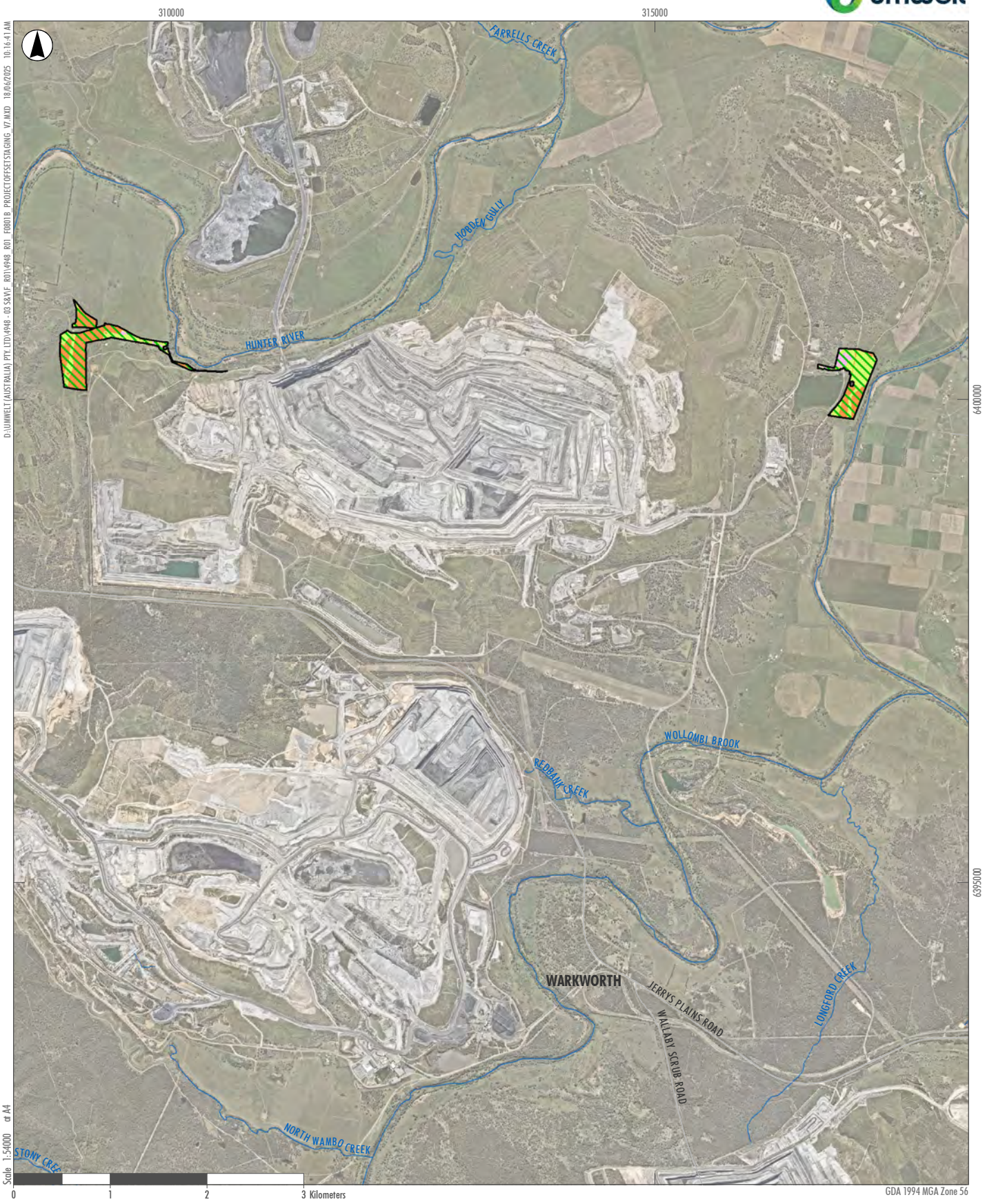
Proposed Offset Staging

- Stage 1
- Stage 2 HVLP

FIGURE 8.1A

HVO North Proposed Project and Offset Staging

Image Source: Nearmap (April 2025)Data source: NSW DFSI (2024)



Legend

- HVO South Development Footprint
- Road
- Drainage Line

Offset

- Areas not requiring assessment
- Impacts that do not require offset (below offset threshold)
- Residual Impacts that require offsets

Proposed Offset Staging

- Stage 1

FIGURE 8.1B

HVO South Proposed Project and Offset Staging

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019)

9.0 Biodiversity Offset Strategy

HVO is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project. As discussed in **Section 5.0**, HVO has, where possible, altered the Project to avoid and minimise biodiversity impacts in the Project planning stage, and a range of impact mitigation strategies have been included to mitigate the impact on ecological values prior to the consideration of offsetting requirements. The offset requirements for the Project, as calculated in accordance with the BAM are identified in **Section 8.0** of this BDAR.

Yancoal and Glencore, as participants in the HVO JV, have a strong record in preparing and implementing biodiversity offset strategies that address significant biodiversity matters and adequately counterbalance impacts on them. HVO is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project. The offset strategy will be implemented in consideration of the process outlined in the BC Act and the final composition of the offset strategy may evolve as the Project progresses.

A biodiversity offset strategy will be developed in consultation with the DPHI and based on the credits required to be retired to offset the impacts of the Project as specified in **Table 8.1**. The biodiversity offset strategy will be established in accordance with the offset options available under the BC Act and BC Regulation including:

- land based offsets (HVO would retire the required number and class of credits determined in accordance with the BDAR and the offset rules in the BC Regulation through the establishment of new Stewardship Sites (and the subsequent retirement of credits) or by retiring credits from existing Stewardship Sites)
- purchasing credits from the market, and/or
- paying into the Biodiversity Conservation Fund.

It is HVO's intention that the offset strategy for the Project will focus on purchasing credits on the market both locally and regionally as per the like-for-like offsetting rules outlined in the Biodiversity Conservation Regulation 2017 as the primary means to meet offset requirements for the Project. HVO is currently actively seeking the purchase of biodiversity credits on the market. Where suitable, paying into the Biodiversity Conservation Fund, which contributes to regionally strategic offset outcomes will also be undertaken.

HVO has investigated land-based offsetting options targeting the *Hunter Floodplain Red Gum Woodland EEC* subject to impacts in Stage 1 of the Project (refer to **Section 8.0**). This is outlined in **Section 9.1** below.

9.1 Desktop Offset Investigations

Umwelt has undertaken a detailed desktop review of HVO landholdings to understand the suitability of habitats in the locality of the Project for the key biodiversity features subject to residual impacts requiring offsetting. This was undertaken across approximately 1,600 ha and included a review of the following resources:

- State Vegetation Type Map (DPE 2022) Upper Hunter v1.0. VIS_ID 4894.
- HVO Continuation Project Vegetation Mapping (this assessment).
- Vegetation mapping for the United/Wambo Project (Umwelt 2019).
- Peake (2006) The Vegetation of the Central Hunter Valley, NSW.
- Atlas of NSW Wildlife (DPHI 2025a).

The sites investigated include areas likely containing *Hunter Floodplain Redgum Woodland EEC*, *Central Hunter Grey Box-Ironbark Woodland EEC* and suitable habitat for southern myotis, brush-tailed phascogale and potentially the Hunter Valley delma. In some cases, the sites are locational to existing offset sites established for previously approved projects, which would provide a long-term habitat connectivity gain in the region. These sites have been identified as High, Medium or Low priority for future investigations.

On-ground investigations will continue to further refine and determine the suitability of these sites for inclusion in the HVO Project biodiversity offset strategy.

9.2 Preliminary Offset Strategy for *Hunter Floodplain Red Gum Woodland EEC* – SAII Considerations

The Project is currently proposing to impact 1.2 ha of the *Hunter Floodplain Red Gum Woodland EEC* (1.05 ha in HVO North and 0.15 ha in the RRG Additional Disturbance Area). The EEC is also listed as a potentially Serious and Irreversible Impact (SAII) entity under the Biodiversity Offset Scheme (BOS). Following substantial efforts to avoid and mitigate impacts through Project design and site location selection (refer to **Section 5.1**), this impact is acknowledged as a key impact on a restricted TEC. HVO has been proactive in seeking a suitable local offset or additional measures to mitigate impacts to the EEC that adds to the conservation of an existing patch of *Hunter Floodplain Red Gum Woodland EEC* as well as the management and improvement of surrounding land to restore this community in the locality.

Accordingly, HVO has identified an area approximately 6.6 ha in size that will require restoration of the EEC adjacent to a remnant patch of river red gum with areas of existing supplementary plantings.

HVO propose to review and update the existing HVO River Red Gum and Restoration Strategy (RRGRS) to include the additional Proposed Hunter Floodplain Red Gum Woodland Restoration Site illustrated on **Figure 9.1**.

9.2.1 Site Inspection

On 11 April 2024, Travis Peake (National Ecology Lead) and Adam Cavallaro (Principal Restoration Ecologist) from Umwelt inspected the proposed restoration site which included:

- General walk across and around the nominal site area, including driving around areas proximate to the site, where possible.
- Assessment of general existing fauna habitat features, common and dominant flora species and weed species.
- General assessment of landform, soil and access for management.
- General assessment of adjoining areas and their likely influence on site management and restoration opportunities.
- The area assessed comprised an existing 'Priority Site', as part of the HVO River Red Gum Rehabilitation and Restoration Strategy, and an area adjoining this (Proposed Restoration Site). Broadly, both of these areas occur on the top of the main floodplain terrace, with minor flood runners present.
- The Priority Site is being managed at a low level of intervention and this comprises:
    - Weed management.
    - Slashing.
    - Selective planting of river red gum saplings (low density). In addition, several small (approx. 2 x 2 m) fenced clumps of native trees and shrubs have been previously protected.

An additional site inspection was carried out on 2 June 2025 by Kate Connolly (Ecology NSW Manager) and Adam Cavallaro (Principal Restoration Ecologist) to assess the conditions of vegetation within the proposed restoration areas and the likelihood of success for the proposed restoration works as requested by BCS in June 2024.

9.2.2 Vegetation Condition of Proposed Restoration Site

The Proposed Restoration Site was inspected and a rapid assessment of the vegetation conditions carried out with a formal BAM floristic plot collected to demonstrate the general condition. There are three distinct vegetation condition zones across the floodplain which are proposed to be restored to the EEC, these zones being:

- PCT 4089 Native grassland (5.7 ha)
- PCT 4089 Exotic mixed vegetation (0.7 ha)
- PCT 4089 Revegetation (0.2 ha).

As determined in the previous site inspection, the Proposed Restoration Site comprises a predominantly cleared floodplain supporting largely weeping grass (*Microlaena stipoides*) Couch grass (*Cynodon dactylon*) and slender bamboo grass (*Austrostipa verticillata*) (refer to **Photo 9.1**), with a smaller part of the area comprising a range of exotic and native groundcover species. It does not support any notable tree cover apart from a small number of river oak (*Casuarina cunninghamiana*) and a single river red gum (*Eucalyptus camaldulensis*). A description of each of the vegetation conditions zones has been provided in the following sub-sections.

9.2.2.1 PCT 4089 Native Grassland

The native grassland areas are the dominant vegetation within the proposed restoration site. There are two variants of the grassland that are separated based on areas of where grazing has been excluded (refer to **Photo 9.1**) and areas of recent grazing (refer to **Photo 9.2**). The species composition between the two variants was observed to be relative similar with a high presences of slender bamboo grass (*Austrostipa verticillata*) in the grazed paddocks (possibly due to the low palatability of this species to cattle).

A review of the floristic plot data indicated 13 of the 20 species observed are native with 10 species characteristic of the EEC. Key species recorded include weeping grass (*Microlaena stipoides*) Couch grass (*Cynodon dactylon*), slender bamboo grass (*Austrostipa verticillata*), purple wiregrass (*Aristida ramosa*), poison pratia (*Lobelia concolor*), saltbush (*Einadia hastata*) and swamp dock (*Rumex brownii*) All native species are groundcover species with a single shrub species *Rhagodia parabolica*. The native groundcover projected foliage cover (PFC) is approximately 75%. The native groundcover provides these areas with an ideal baseline to support any future restoration works by supporting native species that are consistent with the EEC and limit the spread and colonisation of weed species.

The main weed species observed in low density (<4% PFC) were a mix of low priority weed such as variegated thistle (*Silybum marianum*), cleavers (*Galium aparine*), fireweed (*Senecio madagascariensis*) and the high threat weed (HTW) Rhodes grass (*Chloris gayana*). These species were scattered and not observed at a level that would significantly reduce the presences of the high native cover observed.

A section of the vegetation has recently been prepared for revegetation works with the groundlayer being treated with herbicides (refer to **Photo 9.1**).

9.2.2.2 PCT 4089 Exotic

There is a narrow band of vegetation that borders the native grassland along the top of the riverbank that is predominantly exotic vegetation. This vegetation was observed to contain exotic species such as Rhodes grass, Guinea grass (*Megathyrsus maximus*), balloon vine (*Cardiospermum grandiflorum*), *Galenia pubescens* and castor oil plant (*Ricinus communis*). Native groundcover species were observed at low density they include weeping grass (*Microlaena stipoides*), slender bamboo grass (*Austrostipa verticillata*) and couch grass (*Cynodon dactylon*) all characteristic species of the EEC. These areas do have overhanging native canopy species that include river red gum *(Eucalyptus camaldulensis*) and River oak (*Casuarina cunninghamiana*). The close proximity to the native grassland areas will benefit the restoration of this area through native recruitment from the existing native groundcover.

9.2.2.3 PCT 4089 Revegetation

There is a small area of planted river red gum that are approximately 3–4 years of age. The understorey in the patch is consistent with the native grassland vegetation zone, with very few exotic species present at a density that would have a determinant impact to restoration of the existing river red gum individuals. This vegetation zone is an example of a small patch of revegetation that has been successful in re-establishing native canopy and retaining a predominantly native groundcover.

Photo 9.1 Proposed Restoration Site – Native Grassland Vegetation Zone

Photo 9.2 Proposed Restoration Site – Native Grassland Vegetation Zone (Grazed Variant)

Photo 9.3 Proposed Restoration Site – Exotic Zone (right of the fence)

9.2.3 Comparison to the *Hunter Floodplain Red Gum Woodland EEC* Final Determination

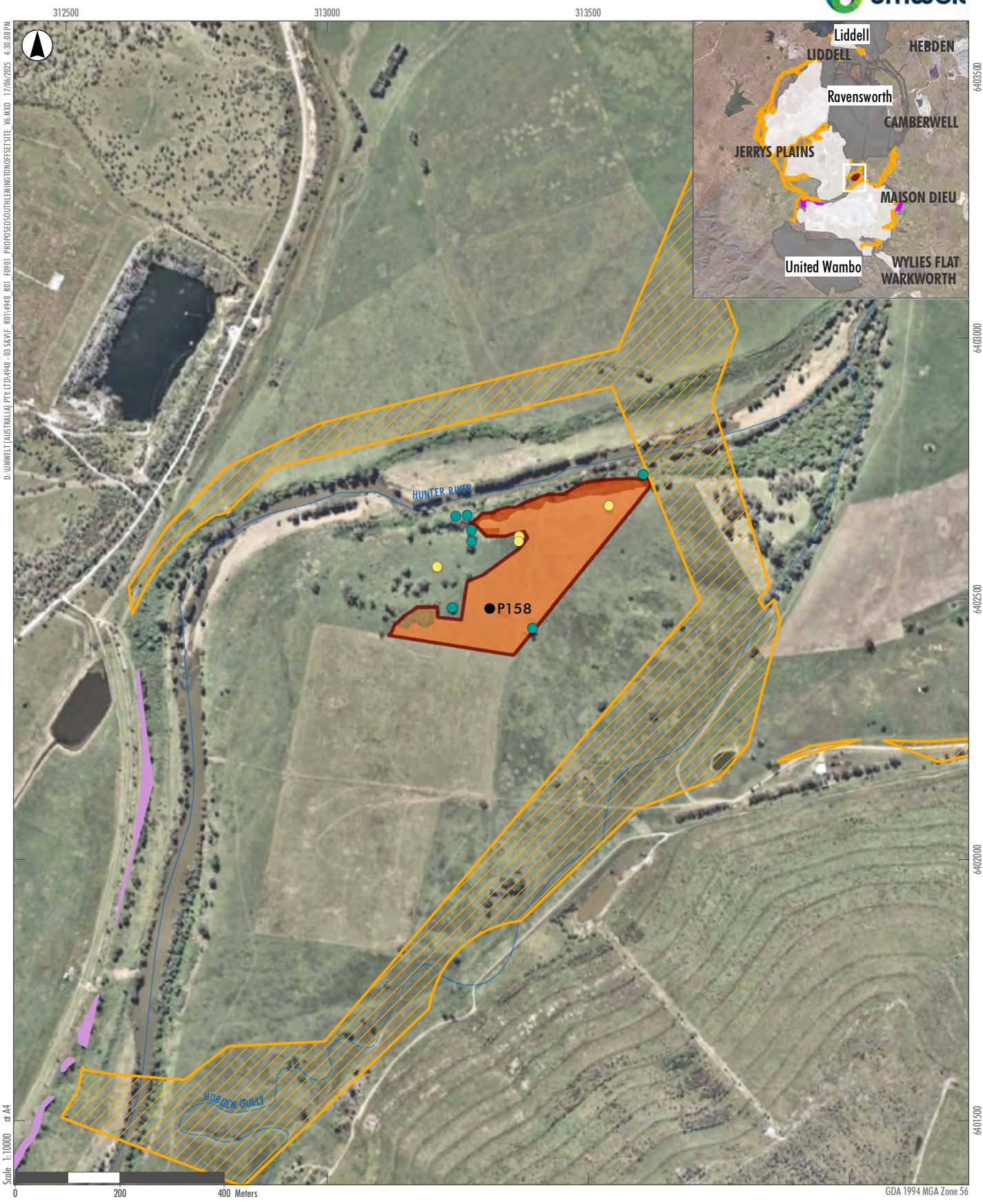
The previous section provides a high-level description of the vegetation proposed to be restored as the EEC. To ensure the proposed restoration site is a suitable candidate site to undertake the proposed works the following comparison to the EEC Final Determination (NSW Scientific Committee 2011b) has been provided to give the consent authority further certainty the restoration site is suitable and the appropriate and additional measures for the EEC can be considered adequately to eliminate the SAII on the EEC.

Table 9.1 Comparison of Proposed Restoration Site to EEC Final Determination

NSW Final Determination for Hunter Floodplain Red Gum Woodland EEC	Proposed Restoration Site and adjacent Priority Sites
Occurs within the NSW North Coast and Sydney Basin Bioregions	The proposed Restoration Site is located within the Sydney Basin Bioregion.
Occurs on floodplains and associated floodplain rises along the Hunter River and tributaries	The Proposed Restoration Site is located on the floodplains and associated rises along the Hunter River, The Hunter River runs along the northern boundary of the Proposed Site.
Generally dominated by *Eucalyptus camaldulensis* (river red gum) in combination with *Eucalyptus tereticornis* (forest red gum), *Eucalyptus melliodora* (yellow box) and *Angophora floribunda* (rough-barked apple)	The current location of the Proposed Restoration Site only contains a single river red gum (*Eucalyptus camaldulensis*) in the south-west corner of the site. The site is surrounded by river red gum with a significant patch of large old remnant trees located directly adjacent to western boundary (refer to **Photo 9.4**), individuals along the northern boundary bordering the Hunter River and a moderately aged patch 300 m to the east, all within a contiguous floodplain. In additional, the adjacent HVO priority site has been the target of on-going restoration work to increase the extent of the EEC with additional revegetation works focusing on the re-establishment of river red gum (refer to **Photo 9.5**).
Supports a reasonable proportion of species that are in the list of characteristic species for the EEC	A single floristic plot was carried out in the native grassland within the Proposed Restoration Site. A total of 10 groundcover species characteristic of the EEC were recorded within the 400 m^2 plot. This represents 27% of species listed in the Final determination and does not include species such as the river red gum or River oak (*Casuarina cunninghamiana*) recorded outside the plot which if included would increase the characteristic species 32%. Further survey or inventory of the 6 ha would likely see an increase in characteristic species.
Conclusion	The Proposed Restoration Site contains species characteristic of the EEC and is located within landscape features described in the Final Determination. Combined with the location being adjacent to a patch of large old remnant river red gum it is likely the Proposed Restoration Site will be suitable for the re-establishment of the EEC.

Photo 9.4 **Successful Revegetation Works in Existing Priority Site Adjacent the Proposed Restoration Site**

Photo 9.5 **Remnant Trees and Revegetation (Background) in Existing Priority Site**



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Proposed Hunter Floodplain Red Gum Woodland Restoration Area (6.6ha)
- Hunter Floodplain Red Gum Woodland EEC
- River Oak
- River Red Gum
- BAM Plot
- Drainage Line

Vegetation Zone

- 4089 I Exotic
- 4089 I Grassland Native
- 4089 I Revegetation

FIGURE 9.1

Hunter Floodplain Red Gum Woodland Restoration Area

Image Source: Nearmap (April 2025)) Data source: NSW DFSI (2024)

9.2.4 Hunter Red Gum Woodland Restoration Measures

This site provides a reasonable baseline to commence restoration works and with a detailed management plan and schedule to improve and maintain the site it would result in the successful re-establishment of the EEC adjacent to the existing remnants. The presence of a primarily native groundcover is likely to reduce the effort required to prepare and maintain the site to re-establish a canopy and shrub layer.
The groundlayer does represent a low to moderate diversity of characteristic species from the EEC but with ongoing management the diversity may increase through natural recruitment such that further augmentation of the groundlayer may not be required. There is capacity to increase diversity through the establishment of other characteristic canopy species such as yellow box (*Eucalyptus melliodora*), river oak and rough-barked apple (*Angophora floribunda*) and the inclusion of river red gum where this species is not present.

The adjacent HVO Priority Site has some existing canopy tree planting (refer to **Photo 9.3**) which demonstrates that with on-going management the proposed restoration of the site is likely to succeed in a similar manner as the existing revegetation works. In addition, the significant patch of old river red gum trees in relatively good condition, which support extensive hollows (refer to **Photo 9.4**) would provide further opportunity for recruitment of this species (the endangered population in the Hunter catchment) and provide protection to increase establishment of lower strata species commensurate with the EEC.

The additional measures to restore this EEC would also benefit the remnant patch of the EEC through revegetation and management would see an increase in the extent of the EEC (over time) in areas that without the help of revegetation would not be possible. It also provides an additional buffer to the remnant from edge effects.

The Proposed Restoration Site is the adjacent land to the east of the remnant woodland and covers approximately 6 ha (refer to **Figure 9.1**). The aim would be to not only increase the extent of the EEC but through additional and appropriate measure:

- increase land management focus on the existing HVO priority site (Remnant and existing revegetation) above and beyond existing commitments
- protection and management of the additional area to the east (including revegetation)
- provide higher level of protection of a significant patch of mature river red gums and improve its resilience through revegetation and site management of the adjoining area to the east.

HVO propose to review and update the existing HVO River Red Gum and Restoration Strategy (RRGRS) to include the additional Proposed Restoration Site illustrated on **Figure 9.1**. The RRGRS focuses on long term conservation gains for the community through improved condition and connectivity of habitat.

Key target actions that are likely to contribute to the improvement of the Hunter Floodplain Red Gum Woodland EEC, as outlined in the current RRGRS and are proposed to continue include:

- Fencing and access control: Establish and maintain fencing to exclude stock and support the expansion of the EEC over time.
- Passive regeneration: Passive regeneration actions will be carried out to support the natural recruitment of river red gums. This includes removal of stock, restriction of access by stock, vehicles and people, weeding and control of feral animals.

- Assisted revegetation: Assisted regeneration is necessary to establish a diverse, native understorey and groundcover in the river red gum woodland. This includes supplementary planting of native grasses, forbs and shrubs tubestock and seeds. It may also include ripping the soil and weed control.
- Weed and pest control: Implementation of an appropriate weed and pest control program, with selection of targeted species informed by the results of ecological monitoring.
- Ecological Monitoring: Design and implement an updated ecological monitoring program that will assess the success of the rehabilitation and restoration strategy going forward, as well as inform ongoing management actions. This would include benchmarking success against references sites currently used for monitoring.
- The Restoration of the EEC will also contribute to increasing the population of river red gum (*Eucalyptus camaldulensis*) in the Hunter catchment which is listed as an endangered population under the BC Act.

10.0 References

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Appendix A

Minimum Information Requirements Checklist

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It is acknowledged that the Guidance for the Biodiversity Development Assessment Report Template (DPE 2022) was released in April 2022. This BDAR was substantially progressed at the time of its release and is modelled on the minimum reporting and information requirements as outlined in Appendix K of the BAM (DPIE 2020a). For clarity**, Table A.1** below provides a checklist of the components required and recommended in a BDAR as per Table 41 of the Biodiversity Development Assessment Report Template.

Table A.1 Assessment of Compliance with BDAR Minimum Information Requirements

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Introduction	**Chapters 2 and 3**	**Information**	
		Introduction to the biodiversity assessment including:	–
		☒ brief description of the proposal	**Section 1.1**
		☒ identification of subject land boundary, including: ☒ operational footprint ☒ construction footprint indicating clearing associated with temporary/ancillary construction facilities and infrastructure	**Section 1.3** **Section 1.4**
		☒ general description of the subject land	**Section 4.0**
		☒ sources of information used in the assessment, including reports and spatial data	**Section 1.7** **Section 3.1.1** **Section 4.1.1** **Section 4.1.3.3**
		☒ identification and justification for entering the BOS	**Section 1.6**
		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	**Figure 1.3** **Figure 7.1A and Figure 7.1B**

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
Landscape	**Sections 3.1 and 3.2, Annexure E**	**Information**	
		Identification of site context components and landscape features, including:	–
		☒ general description of subject land topographic and hydrological setting, geology and soils	**Section 2.1**
		☒ per cent native vegetation cover in the assessment area (as described in BAM Section 3.2)	**Table 2.1**
		☒ IBRA bioregions and subregions (as described in BAM Subsection 3.1.3(2.))	**Table 2.1**
		☒ rivers and streams classified according to stream order (as described in BAM Subsection 3.1.3(3.) and Annexure E)	**Table 2.1**
		☒ wetlands within, adjacent to and downstream of the site (as described in BAM Subsection 3.1.3(3.))	**Table 2.1** (None identified for this project)
		☒ connectivity of different areas of habitat (as described in BAM Subsection 3.1.3(5–6.))	**Table 2.1**
		☒ 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.))	**Table 2.1** (None identified for this project)
		☒ areas of outstanding biodiversity value occurring on the subject land and assessment area (as described in BAM Subsection 3.1.3(8–9.))	**Table 2.1** (None identified for this project)
		☒ any additional landscape features identified in any SEARs for the proposal	None identified in SEARs for this project
		☒ NSW (Mitchell) landscape on which the subject land occurs	**Table 2.1**
		☒ 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 2.2**
		Maps and tables	
		☒ Site Map ☒ Property boundary ☒ Boundary of subject land	**Figure 2.1** *(Note: landscape features are presented across Site Map and*

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ Cadastre of subject land (including labelling of Lot and DP or section plan if relevant) ☒ Landscape features identified in BAM Subsection 3.1.3	*Location Maps for ease of viewing)*
		☒ Location Map ☒ Digital aerial photography at 1:1,000 scale or finer ☒ Boundary of subject land ☒ 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	**Figure 2.2A** **Figure 2.2B** *(Note: landscape features are presented across Site Map and Location Maps for ease of viewing).*
		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 **N/A for this project** ☒ connectivity of different areas of habitat ☐ karst, caves, crevices, cliffs, rocks and other geological features of significance and if required, soil hazard features **N/A for this project** ☒ areas of outstanding biodiversity value occurring on the subject land and assessment area ☐ any additional landscape features identified in any SEARs for the proposal **N/A for this project** ☒ NSW (Mitchell) landscape on which the subject land occurs	**Figure 2.1** **Figure 2.2A** **Figure 2.2B** *(Note: landscape features are presented across Site Map and Location Maps for ease of viewing)*
		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	–

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ areas of native vegetation cover	–
		☒ landscape features	–
Native vegetation	**Chapter 4, Annexure A and Annexure 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)	**Section 3.2.1**
		☒ Provide justification for all parts of the subject land that do not contain native vegetation (as described in BAM Subsection 4.1.2)	**Section 3.2.1**
		☒ 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)	**Section 3.1.1** **Section 3.1.3**
		☒ Describe the systematic field-based floristic vegetation survey undertaken in accordance with BAM Section 4.2	**Section 3.1.4**
		☐ 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 Annexure A)	**N/A for this Project**
		For each PCT within the subject land, describe:	–
		☒ PCT name and ID	**Section 3.2.2**
		☒ vegetation class	**Section 3.2.2**
		☒ extent (ha) within subject land	**Section 3.2.2**
		☒ evidence used to identify a PCT including any analyses undertaken, references/sources, existing vegetation maps (BAM Section 4.2(1–3.))	**Section 3.2.2**
		☒ plant species relied upon for identification of the PCT and relative abundance of each species	**Section 3.2.2**
		☒ if relevant, TEC status including evidence used to determine vegetation is the TEC (BAM Subsection 4.2.2(1–2.))	**Section 3.2.2** **Section 3.2.4**
		☒ estimate of per cent cleared value of PCT (BAM Subsection 4.2.1(5.))	**Section 3.2.2**
		Describe the vegetation integrity assessment of the subject land, including:	–

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ identification and mapping of vegetation zones (as described in BAM Subsection 4.3.1)	**Section 3.2.2**
		☒ description of vegetation zones within the subject land (as described in Operational Manual Stage 1 Table 2 and Subsection 3.3.2)	**Section 3.2.2**
		☒ area (ha) of each vegetation zone	**Section 3.2.2**
		☒ assessment of patch size (as described in BAM Subsection 4.3.2)	**Section 3.2.2** **Section 3.2.2.4**
		☒ survey effort (i.e. number of vegetation integrity survey plots) as described in BAM Subsection 4.3.4(1–2.)	**Table 3.1** **Section 3.2.2**
		☒ use of relevant benchmark data from BioNet Vegetation Classification (as described in BAM Subsection 4.3.3(5.))	**Section 3.2.2**
		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 Annexure 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 for this Project – only standard benchmark data used.**
		☐ provide justification for use of local data rather than BioNet Vegetation Classification benchmark values	
		☐ provide written confirmation from the decision-maker that they support the use of local benchmark data	
		Maps and tables	
		☒ Map of native vegetation extent within the subject land at scale not greater than 1:10,000 including identification of all areas of native vegetation including areas that are ground cover only, 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) ***Due to the size of the Development Footprints, the figures are presented at a greater scale than 1:10,000. As per Section 1.2 of the BAM Operations Manual (DPIE 2020f) the appropriate capture scale is provided in the digital dataset. All GIS layers will be provided on submission for interrogation. Annexure C shows vegetation mapping across the Development Footprints at 1:10,000 scale.***	**Figure 3.2A** **Figure 3.2B**

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ Map of PCTs within the subject land (as described in BAM Section 4.2(1.))	**Figure 3.3A** **Figure 3.3B** **Annexure C** – Detailed Figure Set
		☒ Map of vegetation zones within the subject land (as described in BAM Subsection 4.3.1)	**Figure 3.3A** **Figure 3.3B** **Annexure C** – Detailed Figure Set
		☒ Map the location of floristic vegetation survey plots and vegetation integrity survey plots relative to PCT boundaries	**Figure 3.1** **Annexure C** – Detailed Figure Set
		☒ Map of TEC distribution on the subject land and table of TEC listing, status and area (ha)	**Figure 3.5A** and **Figure 3.5B** **Table 3.4**
		☒ 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 3.4** **Section 3.2.2**
		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 3.7**
		Data	
		☒ All report maps as separate jpeg files	–
		☒ Plot field data (MS Excel format)	-
		☒ Plot field datasheets	-
		Digital shape files of:	
		☒ PCT boundaries within subject land	–

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ 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.))	**Table 4.3**
		☐ 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)	**N/A – none excluded**
		☐ justification for addition of any ecosystem credit species to the list	**N/A – none added**
		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 D.2, Annexure D**
		☒ 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)	**Table D.1, Annexure D**
		☒ 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)	**Table D.1, Annexure D**
		☒ justification for addition of any species credit species to the list	**Table D.2, Annexure D**
		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.))	**Section 4.2.2** **Table D.2, Annexure D**
		☐ 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.)) **N/A – none for this assessment**	
		☒ 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.)) **N/A – none for this assessment**	

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		Present the outcomes of species credit species assessments from:	–
		☒ threatened species survey (as described in BAM Section 5.2.4)	**Section 4.2.2**
		☐ 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 – none for this assessment**
		Where survey has been undertaken include detailed information on:	–
		☒ survey method and effort (as described in BAM Section 5.3)	**Table 4.2** **Table D.2, Annexure D**
		☒ 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	**Table D.2, Annexure D**
		☒ 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 D.2, Annexure D**
		☒ survey personnel and relevant experience	**Section 1.9** **Table 1.6**
		☒ describe any limitations to surveys and how these were addressed/overcome	**Annexure D**
		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 – no expert reports have been used to replace field surveys.**
		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 – none for this assessment**
		☐ provide written confirmation from the decision-maker that they support the use of local data	

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		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	**Table 4.6**
		for species assessed by area:	–
		☒ the polygon includes the extent of suitable habitat for the target species within the subject land (as described in BAM Subsection 5.2.5)	**Section 4.2.2** **Table 4.6** **Figure 4.4, Figure 4.7, Figure 4.9, Figure 4.10** **Figure 4.8, Figure 4.9, Figure 4.10**
		☒ 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	**Section 4.2.2** **Table 4.6**
		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 – none for this assessment**
		☐ the method used to derive this number (i.e. threatened species survey or expert report) and evidence-based justification for the approach taken	
		☐ 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	
		☒ Identify the biodiversity risk weighting for each species credit species identified as present within the subject land (as described in BAM Section 5.4)	**Table 4.6**
		Maps and tables	
		☒ Table showing ecosystem credit species in accordance with BAM Subsection 5.1.1, and identifying:	**Table 4.3**
		☐ the ecosystem credit species removed from the list	**N/A**
		☒ the sensitivity to gain class of each species	**Table 4.3**
		☒ Table detailing species credit species in accordance with BAM Section 5.2 and identifying:	**Table D.1, Annexure D**

BDAR Section	BAM ref.	BAM requirement		Section reference(s) in the BDAR
		☒	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 D.1, Annexure D**
		☒	the candidate species credit species not recorded on the subject land as determined by targeted survey, expert report or important habitat map	**Table D.2, Annexure D**
		☒	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)	**Table 4.6**
		☒	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)	**Figure 4.4**, **Figure 4.7**, **Figure 4.9**, **Figure 4.10** **Figure 4.8, Figure 4.9, Figure 4.10**
		Data		
		☒	Digital shape files of suitable habitat identified for survey for each candidate species credit species	–
		☒	Survey locations including GPS coordinates of any plots, transects, grids	–
		☒	Digital shape files of each species polygon including GPS coordinates of located individuals	–
		☒	Species polygon map in jpeg format	–
		☐	Expert reports and any supporting data used to support conclusions of the expert report	**N/A for this Project**
		☒	Field datasheets detailing survey information including prevailing conditions, date, time, equipment used, etc.	-
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) **N/A – none for this assessment**	**Section 6.3**
		☒	occurrences of human-made structures and non-native vegetation (as described in BAM Subsection 6.1.2)	

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ 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)	
		☐ 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 for this Project**
		☒ 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)	**Section 6.3**
		☒ Identify a list of threatened entities that may be dependent upon or may use habitat features associated with any of the prescribed impacts	**Section 6.3**
		☐ 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)	**N/A – none identified for this assessment**
		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.)	
		☐ 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.))	
		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 6.7**
		Maps and tables	
		☒ Map showing location of any prescribed impact features (i.e. karst, caves, crevices, cliffs, rocks, human-made structures, etc.)	**Figure 6.4**
		☒ Map showing location of potential vehicle strike locations	**Figure 6.4**

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☐ 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 – none identified for this assessment**
		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	**N/A**
		☒ routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route	**Section 5.1.1** **Section 5.1.2** **Section 5.2.1**
		☒ alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location	**Section 5.1.2**
		☒ 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	**Section 5.1.2**
		☒ 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)	**Section 5.0**
		☒ 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.))	**Section 5.1.2** **Table 5.2**
		☒ Detail measures or options considered but not implemented because they are not feasible and/or practical (e.g. due to site constraints)	**Section 5.1.2** **Table 5.2**
		Maps and tables	
		☒ Table of measures to be implemented to avoid and minimise the impacts of the proposal, including action, outcome, timing and responsibility	**Section 4.0** **Table 5.7**

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ Map of alternative footprints considered to avoid or minimise impacts on biodiversity values; and of the final proposal footprint, including construction and operation	**Figure 5.1**
		☒ Maps demonstrating indirect impact zones where applicable	**Figure 6.3**
		Data	
		Digital shape files of:	–
		☒ alternative and final proposal footprint	–
		☒ direct and indirect impact zones	**N/A for indirect impacts**
		☒ 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)	**Section 6.1**
		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	**Section 6.2** **Table 6.5**
		☒ documenting the consequences to vegetation and threatened species and their habitat including evidence-based justifications	**Table 6.5**
		☒ reporting any limitations or assumptions, etc. made during the assessment	**Section 6.2**
		☒ identification of the threatened entities and their habitat likely to be affected	**Table 6.5**
		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	**N/A**
		☐ human-made structures	**N/A**

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ non-native vegetation	**Section 6.3** **Table 6.7**
		☒ connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	**Section 6.3** **Table 6.7**
		☐ movement of threatened species that maintains their life cycle	**N/A**
		☒ water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities	**Section 6.3** **Table 6.7**
		☐ 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	**Section 6.3** **Table 6.7**
		☒ evaluate the consequences of prescribed impacts	**Table 6.7**
		☒ describe impacts that are uncertain	**Section 6.4.2**
		☒ document limitations to data, assumptions and predictions	**Section 6.0** **Annexure D**
		Maps and tables	
		☒ Table showing change in vegetation integrity score for each vegetation zone as a result of identified impacts	**Table 7.3**
		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	**Section 5.4** **Section 5.5** **Table 5.8**
		☒ document any adaptive management strategy proposed	**Section 5.4**

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
			Section 5.5 **Section 5.6.3** **Section 5.7**
		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)	**Section 5.4** **Section 5.6**
		☒ Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain (BAM Section 8.5)	**Section 6.5**
		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	**Section 5.4**
		Data	
		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	**Section 6.4**
		☒ for each TEC, report the extent of the TEC in NSW	**Section 3.2.4**
		☐ addressing all criteria in Subsection 9.1.2 for each threatened species at risk of an SAII present on the subject land	**Section 6.4**
		☐ for each threatened species, report the population size in NSW	**Table 6.1**
		☒ 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	**Table 6.9**

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ Identification of impacts requiring offset in accordance with BAM Section 9.2	**Section 7.3**
		☒ Identification of impacts not requiring offset in accordance with BAM Subsection 9.2.1(3.)	**Section 7.2**
		☒ Identification of areas not requiring assessment in accordance with BAM Section 9.3	**Section 7.1**
		Maps and tables	
		☒ Map showing the extent of TECs at risk of an SAII within the subject land	**Figure 6.5**
		☐ 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 7.1A** **Figure 7.1B**
		☒ impacts not requiring offset	
		☒ areas not requiring assessment	
		Data	
		Digital shape files of:	–
		☒ extent of TECs at risk of an SAII within the subject land	–
		☐ location of threatened species at risk of an SAII within the subject land	–
		☒ boundary of impacts requiring offset	–
		☒ boundary of impacts not requiring offset	–
		☒ boundary of areas not requiring assessment	–
		☒ 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 Annexure H) ☒ change in vegetation integrity score (BAM Subsection 8.1.1)	**Table 7.3**

BDAR Section	BAM ref.	BAM requirement	Section reference(s) in the BDAR
		☒ 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)	
		☒ biodiversity risk weighting for each	**Table 7.4**
		☒ number of required species credits for each candidate threatened species that is directly impacted on by the proposal (BAM Subsection 10.1.3)	**Table 7.4**
		Maps and tables	
		☒ Table of PCTs requiring offset and the number of ecosystem credits required	**Table 7.3** **Table 8.1**
		☒ Table of threatened species requiring offset and the number of species credits required	**Table 7.4** **Table 8.1**
		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 8.1**
		☒ BAM credit report in pdf format	**Annexure F** (and submitted separately)
		Maps and tables	
		☒ Table of credit class and matching credit profile	**Table 8.1**
		Data	
		☒ BAM credit report in pdf format	**Annexure F** (and submitted separately)

Appendix B

Category 1 – Exempt Land Mapping

umwelt
Environmental & Social Consultants

APPENDIX B – CATEGORY 1 – EXEMPT LAND MAPPING

FINAL

November 2022

APPENDIX B – CATEGORY 1 – EXEMPT LAND MAPPING

FINAL

Prepared by
Umwelt (Australia) Pty Limited

Project Director:	Allison Riley
Project Manager:	Kate Connolly
Report No.	4948/R01/Appendix B
Date:	November 2022

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

Acknowledgement of Country

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

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Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
V1	Allison Riley	27 October 2022	Allison Riley	27 October 2022
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1.0 Category 1 – Exempt Land

1.1 Background

Umwelt has been commissioned to undertake a biodiversity assessment for the Hunter Valley Operations (HVO) Continuation Project (the Project) under the *Biodiversity Conservation Act 2016* (BC Act) and in accordance with the Biodiversity Assessment Method (BAM). Section 6.8(3) of the BC Act states that:

"the biodiversity assessment method is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of the Local Land Services Act 2013)".

This exclusion means the Biodiversity Offsets Scheme (BOS) and credit obligations under the BC Act does not apply to areas identified as *Category 1 – exempt land* and therefore formal biodiversity surveys under the BAM are not required. An assessment of prescribed impacts is required on *Category 1 – exempt land* for clearing or development proposals when the BOS applies (refer to Section 6.3 of the BDAR).

At the time of writing, the Native Vegetation Regulatory (NVR) Map and related Guidance Document have not yet been finalised and the mapping of *Category 1 – exempt land* in and around the Project has not been released to the public. A transitional NVR Map has been published however this map doesn't include *Category 1 – exempt land* and only partly includes *Category 2 – regulated land*. As such, landholders are responsible for determining the categorisation of their land in accordance with the *Local Land Services Act 2013* (LLS Act).

1.2 BCD Advice – August 2021

In December 2020, Umwelt provided the draft Category 1 – Exempt Land mapping layer and methods for the Project for comment to the Biodiversity and Conservation Division (BCD) of the NSW Department of Planning and Environment (DPE). Advice from the BCD was received in August 2021 including a range of recommendations which are subsequently addressed in this report. This advice included:

- Category 2 – Vulnerable Regulated land shown on the Transitional NVR Map on the Project Area should be updated through a Map Review Request – addressed in **Section 3.1**.
- Excluded Land should be shown on the map for the Project Area. It should not be grouped with Category 1 land as it has its own rules for biodiversity assessment – addressed on **Figure 3.1** in this report and Figure 2.3 of the BDAR.
- A summary table should be prepared that summarising how much land of each NVR map category occurs in the Project area, and how much of that land is covered by existing development consents - refer to **Table 3.1** of this report.
- The proponent should follow the approach to estimating NVR map categories as closely as possible to BCD's approach, and the briefing note and GIS shapefile are updated to summarise the revised work - addressed in **Section 2.0** of this report.

1.3 Land Categories

1.3.1 Category 1 – Exempt land

Areas of *Category 1 – exempt land* includes those where vegetation was cleared as at 1 January 1990 or there has been a lawful removal of all native vegetation (all strata) prior to the commencement of Part 5A of the LLS Act, being 25 August 2017. 'Cleared as at 1990' has been interpreted as areas where there is clear evidence of the complete removal of all vegetation or evidence of compositional change in the grassland prior to 1990 and in which shrubs or trees had not regrown prior to 1990.

Complete removal of native vegetation has been interpreted as being areas where complete removal of ground cover has occurred, namely areas:

- that have been cropped/ploughed or significantly disturbed (as per clause 114 of the LLS Regulation) for agricultural purposes,
- extensively disturbed through land contouring works, and/or
- disturbed by approved mining, road construction or other approved activities.

Land is also considered *Category 1 – exempt land* if it contains low conservation value grasslands, however, at the time of mapping, the Project occurs in an area that was drought declared from mid-2017 up until October 2020 (DPI 2020). Drought conditions limited the ability to assess the conservation value of grasslands during field surveys, and therefore this criterion was not considered in the process. Since vegetation integrity (VI) data has already been collected as part of the Project, these potential low conservation grasslands were included in the BAM assessment.

1.3.2 Category 2 – Regulated Land

Areas of *Category 2 – regulated land* (that is not Vulnerable or Sensitive) includes land that has not been cleared of native vegetation before 1 January 1990 or was unlawfully cleared of native vegetation after 1 January 1990. This can include areas containing:

- native vegetation grown or preserved using public funds
- land in the proximity area of a coastal wetland or littoral rainforest areas
- land subject to (or previously subject to) a private native forestry plan
- medium conservation value grasslands
- low conservation grasslands beneath the canopy or drip line of woody vegetation and
- a travelling stock reserve (unless the land is located in the Western Division).

1.3.3 Category 2 – Vulnerable Regulated Land

Areas of *Category 2 – vulnerable regulated land* includes those where clearing of native vegetation may not be permitted under the Land Management (Native Vegetation) Code 2018 and includes:

- steep or highly erodible land
- protected riparian areas
- land susceptible to erosion, or land that is otherwise environmentally sensitive.

1.3.4 Category 2 – Sensitive Regulated Land

Areas of *Category 2 – sensitive regulated land* is land where clearing is not permitted under the Land Management Code (Native Vegetation) Code 2018, and a limited range of allowable activities is permitted. These areas include (but are not limited to):

- Land subject to private land conservation agreements, biocertification conservation measures, offsets under a Property Vegetation Plan (PVP), Biodiversity Stewardship sites.
- Coastal wetlands and littoral rainforests.
- Critically endangered communities and plants.
- High conservation grasslands.

1.3.5 Excluded Land

Excluded land are areas to which Part 5A of the LLS Act and the Land Management (Native Vegetation) Code 2018 do not apply, which includes:

- areas of the state to which the Vegetation SEPP applies
- national park estate and other conservation areas
- state forestry land.

2.0 Methodology

The method used to map *Category 1 – exempt land* was based on advice from the BCD in June 2020 and in August 2021. This advice included an overview of the process of mapping *Category 1 – exempt land* and draft text from the forthcoming Guidance Document which is currently in preparation and BCD's response to the draft *Category 1 – exempt land* mapping provided by Umwelt, respectively.

The draft *Category 1 – exempt land* mapping provided to BCD in December 2020 included an assessment across a wider Project Area for the Project that included existing and approved disturbance areas for HVO, Ravensworth Operations, Liddell Coal Operations and United Wambo JV mines. These areas were included in the assessment to document the extent of current and historical removal of native vegetation within the wider Project Area, however it is acknowledged that only areas of *Category 1 – exempt land* mapped outside of approved disturbance areas are relevant to the BAM assessment for the Project.

Following a range of Project updates and evolution of the project boundaries, the final *Category 1 – exempt land* mapping presented in this report covers the relevant HVO North and South Development Footprints only (i.e. areas subject to impacts that require development approval under the NSW EP&A Act assessment).

Areas confidently identified as meeting the criteria for *Category 1 – exempt land* were mapped directly into GIS and categorised as either:

- Agricultural Disturbance – Pre 1990
- Agricultural Disturbance – Post 1990
- Other Disturbance – Pre 1990
- Other Disturbance – Post 1990.

Later revisions to the mapping also included areas categorised as roads and access tracks, buildings, or farm dams, which were established prior to 25 August 2017.

Table 2.1 outlines the BCD's advice on the correct method for determining *Category 1 – exempt land* in August 2021 and the corresponding method undertaken by Umwelt. **Figure 2.1** illustrates this process.

Table 2.1 Methodology for Determining Category 1 – exempt land

BCD Advice (August 2021)	Umwelt Method and Resources
Identifying rural areas where the NVR map applies by compiling layers representing land that becomes excluded areas in the map and therefore no further analysis or mapping is done – used to identify excluded land	Review of Transitional NVR Map for areas categorised as *Excluded land* sourced from SEED portal.
Identifying and mapping existing and historical agricultural land use – used to identify category 1 land	Review of the 2017 land use layer showing Australian land use and management land classes (DPIE 2020).

BCD Advice (August 2021)	Umwelt Method and Resources
Supplementing the mapping of agricultural land use by applying a tool that is a time series analysis of satellite imagery and identifies non-woody vegetation that has been significantly disturbed or modified for agricultural use since 1 January 1990 – used to identify category 1 land	Potential *Category 1 – exempt land* areas were identified using geo-rectified aerial imagery over several years between 1958 and May 2020, in addition to online historical imagery contained in Google Earth and Nearmap and several non-geo-rectified aerial images. Images were reviewed to determine areas which were identified as having been completely cleared or extensively disturbed through land contouring works or ploughing. The process included the identification of areas which showed clear terrain changes between two images evidencing clearance of any vegetation which may have existed in that area. An example of this process is provided below (**Photo 2.1**).
Identifying and mapping woody vegetation cleared since 1 January 1990, based on satellite images and circa 1990 aerial photographs – used to identify category 1 land	Review of the *NSW Native Vegetation Extent 5m Raster v1.2* available from the SEED Portal.
Applying any additional prescribed area criteria listed in the LLS Act that allocate land to either category 1 or category 2	Assessment of likelihood of occurrence of critically endangered ecological communities (CEECs) and critically endangered flora species (refer to **Section 3.2**).
Applying any additional prescribed area criteria listed in the LLS Act that allocate land to category 2 - sensitive regulated land	Review of Transitional NVR Map for areas identified as *Category 2 – vulnerable regulated land* or *sensitive regulated land* (DPIE 2019) except where those areas have been mapped based on data that predated approved mining related disturbance which has since changed the terrain such as the features driving the Category 2 classification (as mapped) are no longer present. In this case, a request for a Map Review will be submitted to DPE to ensure the *Category 1 – exempt land* mapping is updated for future use.
Applying any additional prescribed area criteria listed in the LLS Act that allocate land to category 2 - vulnerable regulated land	

2.1 Example of Review Methods for Geo-rectified Aerial Imagery

An area in the north-west of the HVO North Development Footprint was identified as *Category 1 – exempt land* and rather than evidence coming from aerial imagery taken shortly after the disturbance occurred, the justification for *Category 1 – exempt land* mapping came from the identification of tillage in grassland (refer to **Photo 2.1**). Evidence of tillage was not in other aerial imagery and it is hypothesised that historic tillage became more evident during the drought conditions in 2018.

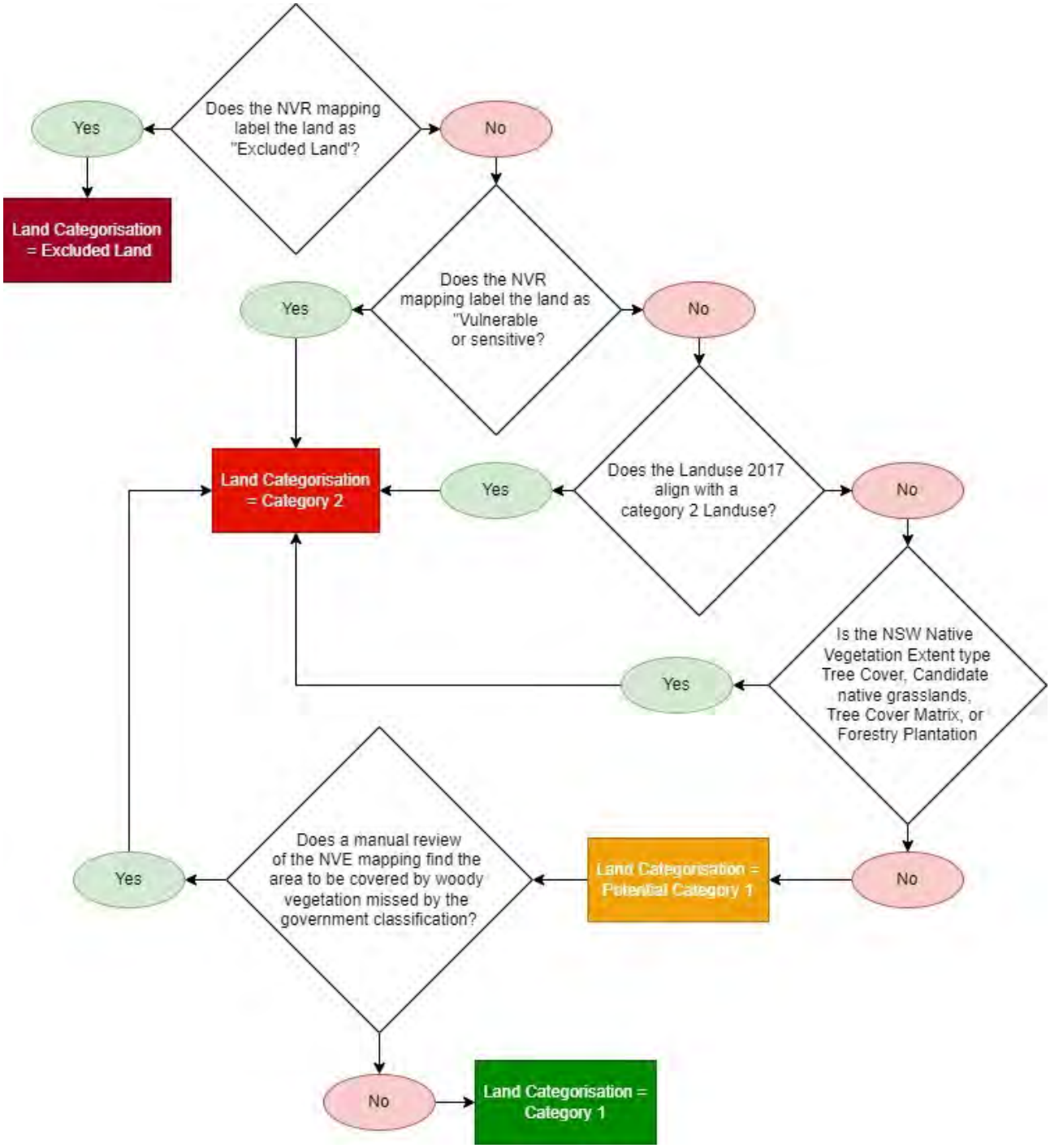


Figure 2.1 Land Category Mapping Process

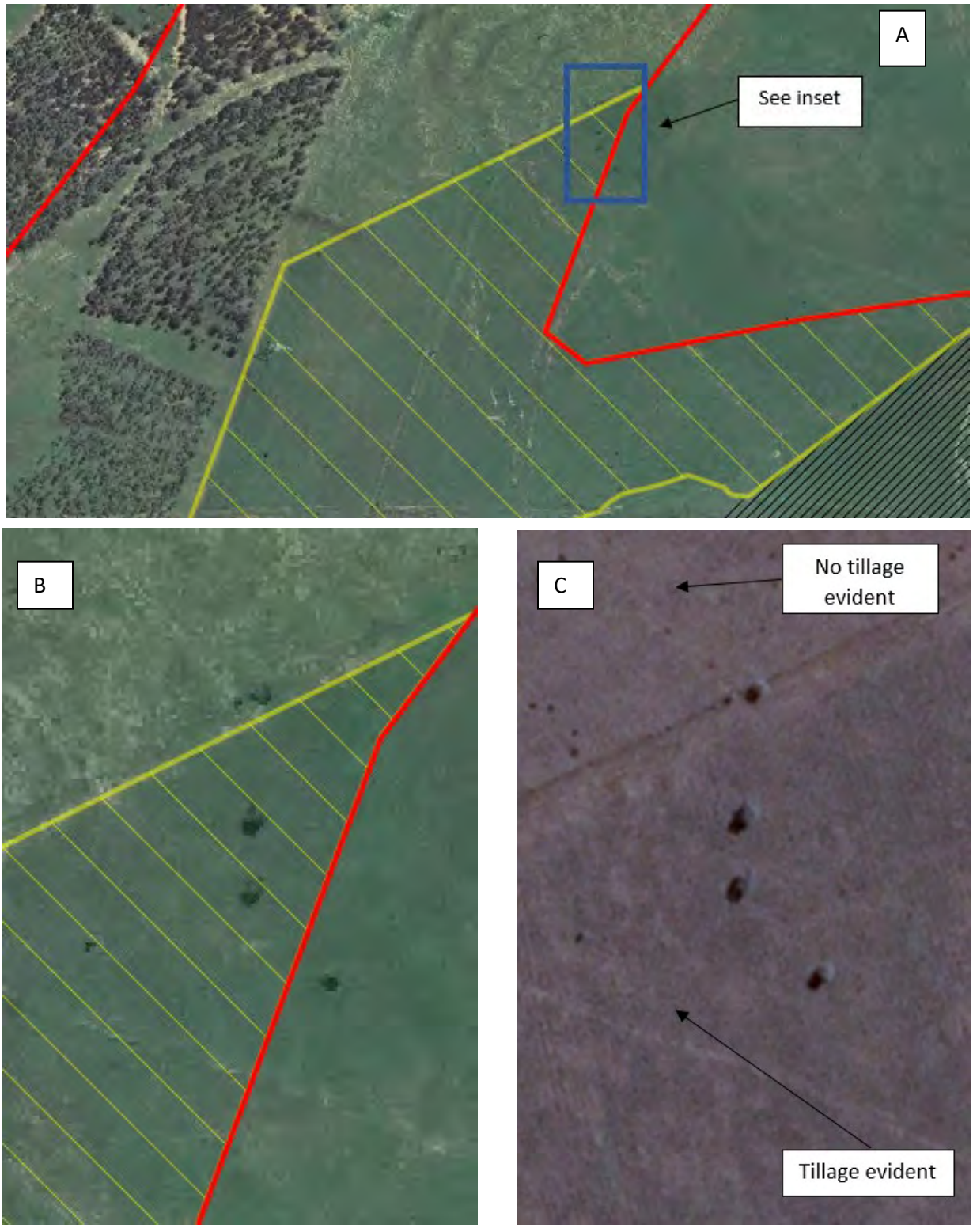


Photo 2.1 Justification for mapping of Category 1 – exempt land in north-west of HVO North Development Footprint

Comparison is shown between a) and b) aerial imagery taken in February 2020 (image "HVO_RGB_ECW_Mosaic_1m") and c) imagery taken on 9 September 2018 (source: Google Earth).

3.0 Results

3.1 Category 1 – Exempt Land Mapping

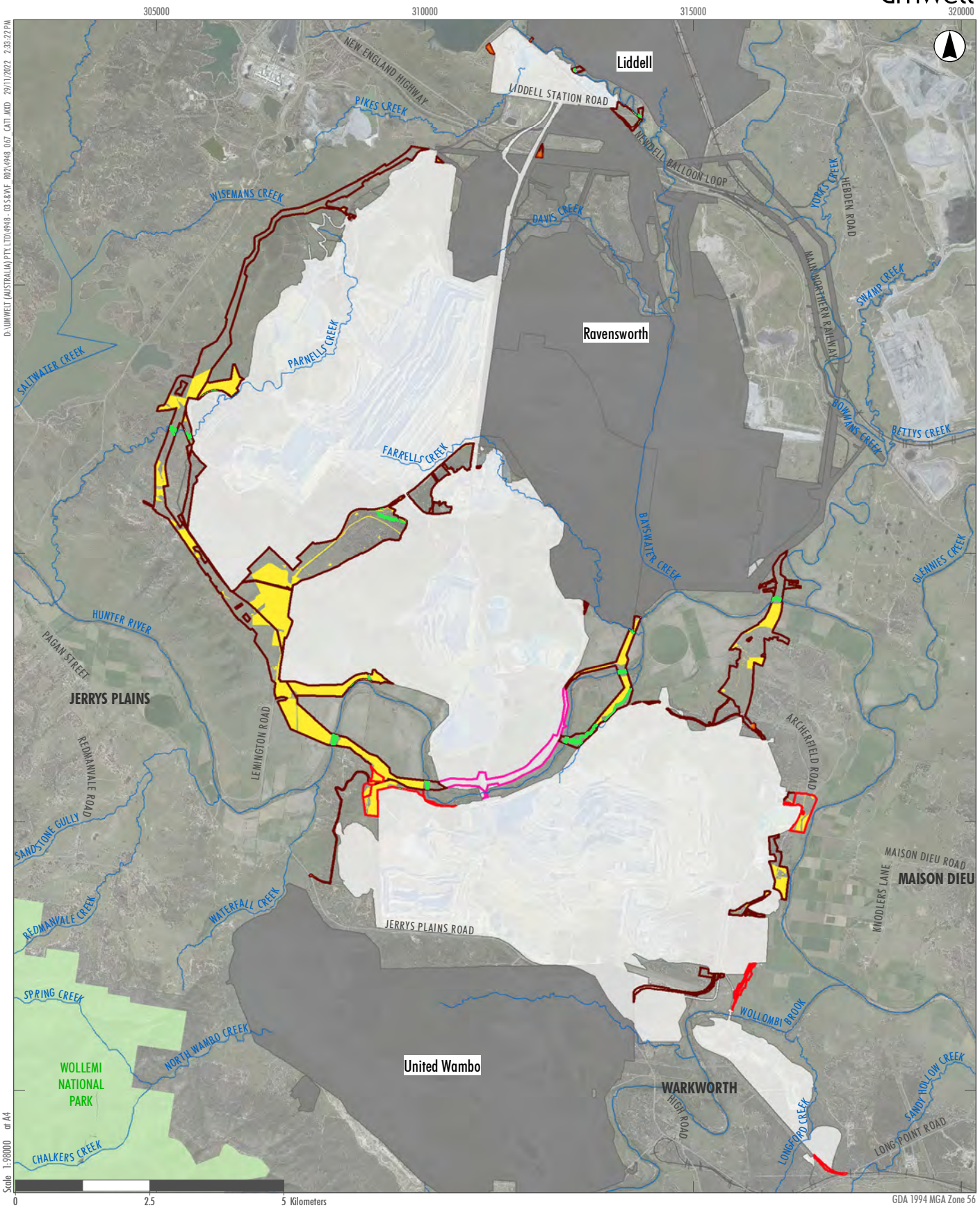
The mapping identified a total of approximately 360 ha of *Category 1 – exempt land* within the Development Footprints (refer to **Figure 3.1** below – replicated from Figure 2.3 in the BDAR). The majority of *Category 1 – exempt land* mapped areas include those that have undergone agricultural disturbance, particularly in proximity to the Hunter River, or historical disturbance associated with road works or mining related disturbance.

The review of the NVR Map components identified approximately 26 ha of *Category 2 – vulnerable regulated land*, and approximately 3.5 ha of *Excluded land* within the Development Footprints (refer to **Table 3.1** below).

Table 3.1 Land Map Categories in the Development Footprints

Land Category	HVO North (ha)	HVO South (ha)	Total
Category 1 – exempt land	334.6	25.0	359.6
Category 2 – regulated land	0.0	0.0	0.0
Category 2 – vulnerable regulated land	26.0	0.1	26.1
Category 2 – sensitive regulated land	0.0	0.0	0.0
Excluded land	3.3	0.2	3.5
Total	**363.9**	**25.3**	**389.2**

Approximately 1 ha of land mapped on the NVR Map as *Category 2 – vulnerable regulated land* was determined to be incorrect due to previously approved mining disturbance. A request for a Map Review will be submitted to DPE for these areas.



Legend

- HVO North Development Footprint
- HVO South Development Footprint
- HVO Existing and Approved Disturbance Areas
- Approved Disturbance Area - Other Mine
- River Red Gum Additional Disturbance Area
- Category 1 - Exempt Land

Native Vegetation Regulatory (NVR) within Development Footprints

- Category 2 - Vulnerable Regulated Land
- Excluded Land

- Drainage Line
- Road
- Railway Line
- National Parks (NPWS Estate)

FIGURE 3.1

Category 1 – Exempt Land

Image Source: HVO (2021) Data source: NSW DFSI (2021), Geoscience Australia; Forestry Corporation of NSW (2019), NPWS Estate (2019), © State Government of NSW and Department of Planning and Environment 2022

3.2 Assessment for Critically Endangered Ecological Communities and Flora Species

Critically endangered ecological communities (CEECs) and critically endangered flora species are designated as *Category 2-sensitive regulated land* on the NVR Map. No State-wide comprehensive mapping of all CEECs and critically endangered species of plants is available. During the NVR Map transitional period, it is expected that the proponent provides an assessment to demonstrate whether a CEEC and/or critically endangered plants are present or absent.

No critically endangered flora species have been recorded in or in proximity to the Development Footprints. No CEECs listed under the BC Act have been recorded in the Development Footprints however three CEECs listed under the Commonwealth EPBC Act have been recorded in the Development Footprints being:

- *Central Hunter Valley Eucalypt Forest and Woodland CEEC*
- *Warkworth Sands Woodland of the Hunter Valley CEEC*
- *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC.*

Following the detailed review of geo-rectified aerial imagery it is expected that only grassland components of CEECs would have the potential to occur in *Category 1 - exempt land* mapping. Of the CEECs recorded in the Development Footprints *Central Hunter Valley Eucalypt Forest and Woodland CEEC* and *White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC* include a derived native grassland component subject to condition thresholds as per the relevant listing and conservation advices. 88 vegetation integrity plots and 72 rapid vegetation assessment were undertaken across the Development Footprints, with an additional 203 rapid vegetation assessments undertaken in the wider locality.

Table 3.2 below provides justification for the *Category 1 - exempt land* mapping and evidence to demonstrate these areas do not contain CEECs.

Table 3.2 Justification for Category 1 – exempt land mapping

Critically Endangered Ecological Community	Derived Native Grassland Component Description	Justification
Central Hunter Valley Eucalypt Forest and Woodland CEEC	Derived native grasslands and shrublands are included in the CEEC where they are situated in a gap in, or at the edge of a patch, or between two patches where they are separated by a distance up to 30 m (TSSC 2015).	A review of the mapping of the CEEC locational to the proposed *Category 1 - exempt land* mapping indicates that there are no areas of potentially CEEC-conforming DNG mapped as *Category 1 – exempt land*. Areas where *Category 1 – exempt land* occurs near the CEEC in the Development Footprint represent cleared areas such as dams, tracks and roads. DNG areas that conform to the CEEC in gaps or on the edge of a patch have not been included in the *Category 1 – exempt land* mapping.

Critically Endangered Ecological Community	Derived Native Grassland Component Description	Justification
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC	Grasslands that conform to this CEEC must occur in an area where the characteristic canopy species have been removed and native species-rich understorey remains. It must have a predominately native understorey (i.e. more than 50% of the perennial vegetative groundlayer must comprise native species). The patch must be greater than 0.1 ha and contain 12 or more native understorey species (excluding grasses), including one or more 'important' species as per the Listing Advice (TSSC 2006).	A DNG component of this community has not been recorded within the Development Footprints primarily due to a lack of characteristic and 'important' native species in the understorey. The community was recorded in one discrete location in the HVO North Development Footprint. Areas of *Category 1 -exempt land* mapped in proximity to this patch represents cleared areas consisting of dams.

3.3 Relevant Prescribed Impacts

As per the requirements of Section 6.12 of the BC Act, the BAM assessment has excluded impacts relating to native vegetation and habitat loss on *Category 1 – exempt land*. In the Hunter Valley and within the Development Footprints this most often relates to clearance from agricultural practices or historic mining consents. As such, these areas are usually characterised by derived native or exotic grasslands, which may be suitable for the occupation of Hunter Valley delma (*Delma vescolineata*). This species has been recorded in the native grassland and thinned woodland habitats of the Development Footprints.

Due to the nature of the historic disturbance, it is expected that a large proportion of the Category 1 – exempt land is characterised by exotic grasslands which represents less suitable habitat for the species, as evidenced by the targeted survey results. Nonetheless the species may utilise this habitat for movement between areas of higher quality native grassland. Prescribed impacts on the Hunter Valley delma in relation to *Category 1 – exempt land* are assessed in Table 6.6 of the BDAR.

4.0 References

Department of Planning, Industry and Environment (DPIE) (2015). NSW Woody Vegetation Extent & FPC 2011. Available at https://datasets.seed.nsw.gov.au/dataset/nsw-woody-vegetation-extent-fpc-20119bb42, accessed June 2020.

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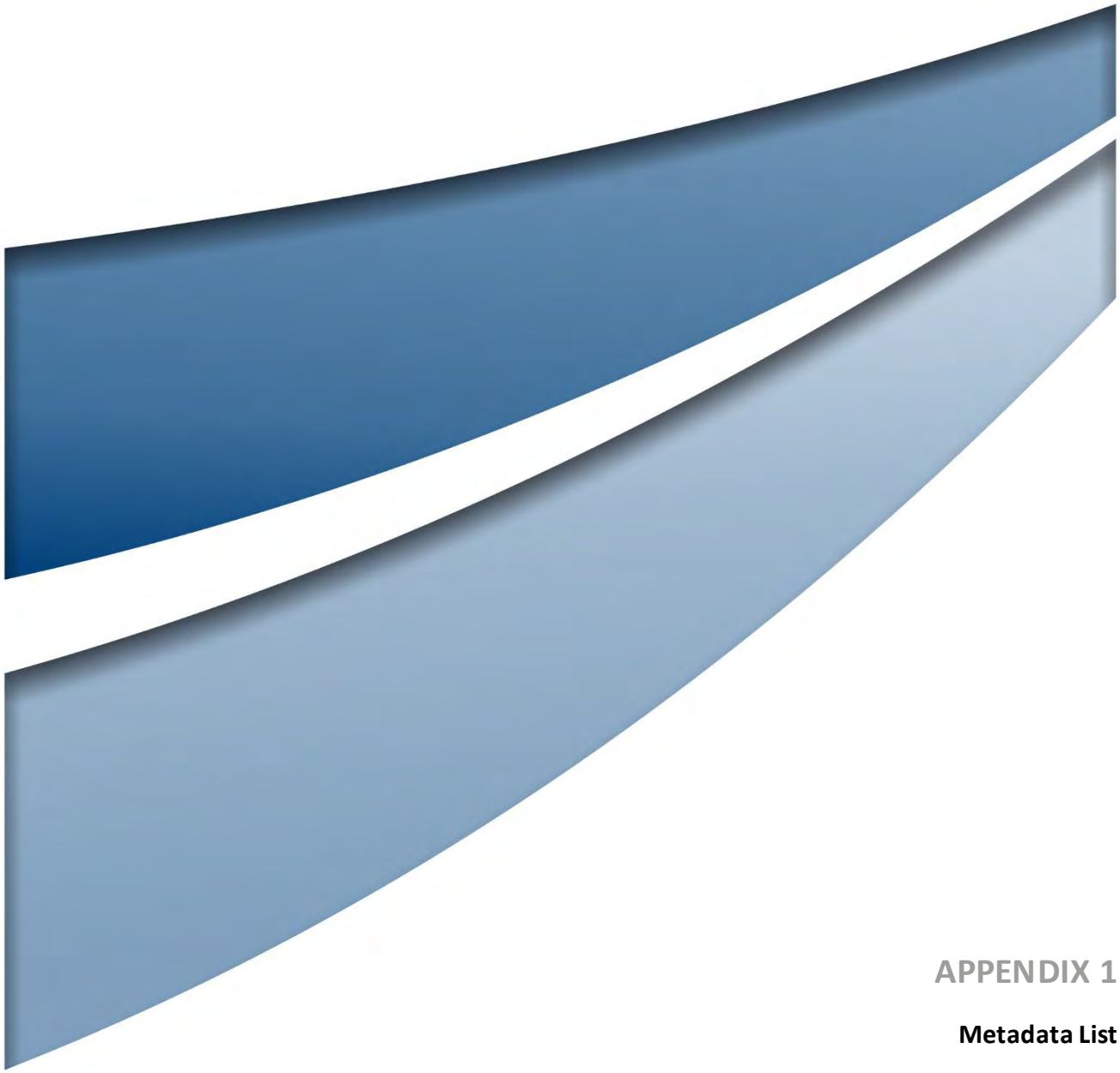
Native vegetation regulatory map land categorisation and the Biodiversity Offsets Scheme - Native vegetation regulatory map land categorisation and the Biodiversity Offsets Scheme | NSW Environment and Heritage accessed October 2022.

Office of Environment and Heritage (OEH) (2017). Interim Grasslands and other Groundcover Assessment Method Calculator: User Guide. Available at: https://www.lmbc.nsw.gov.au/gamcalc/app/assets/GGAMTools_UserGuide.pdf

Threatened Species Scientific Committee (TSSC) (2006). Commonwealth Listing Advice on White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Available from: http://www.environment.gov.au/system/files/pages/dcad3aa6-2230-44cb-9a2f-5e1dca33db6b/files/box-gum.pdf

Threatened Species Scientific Committee (TSSC) (2015). Approved Conservation Advice (including listing advice) for the Central Hunter Valley eucalypt forest and woodland ecological community. Available from: http://www.environment.gov.au/biodiversity/threatened/communities/pubs/130-conservation-advice.pdf



APPENDIX 1

Metadata List

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1993_4170_11_123_MGA56	1993	NSW LPI Historical Aerial Photography
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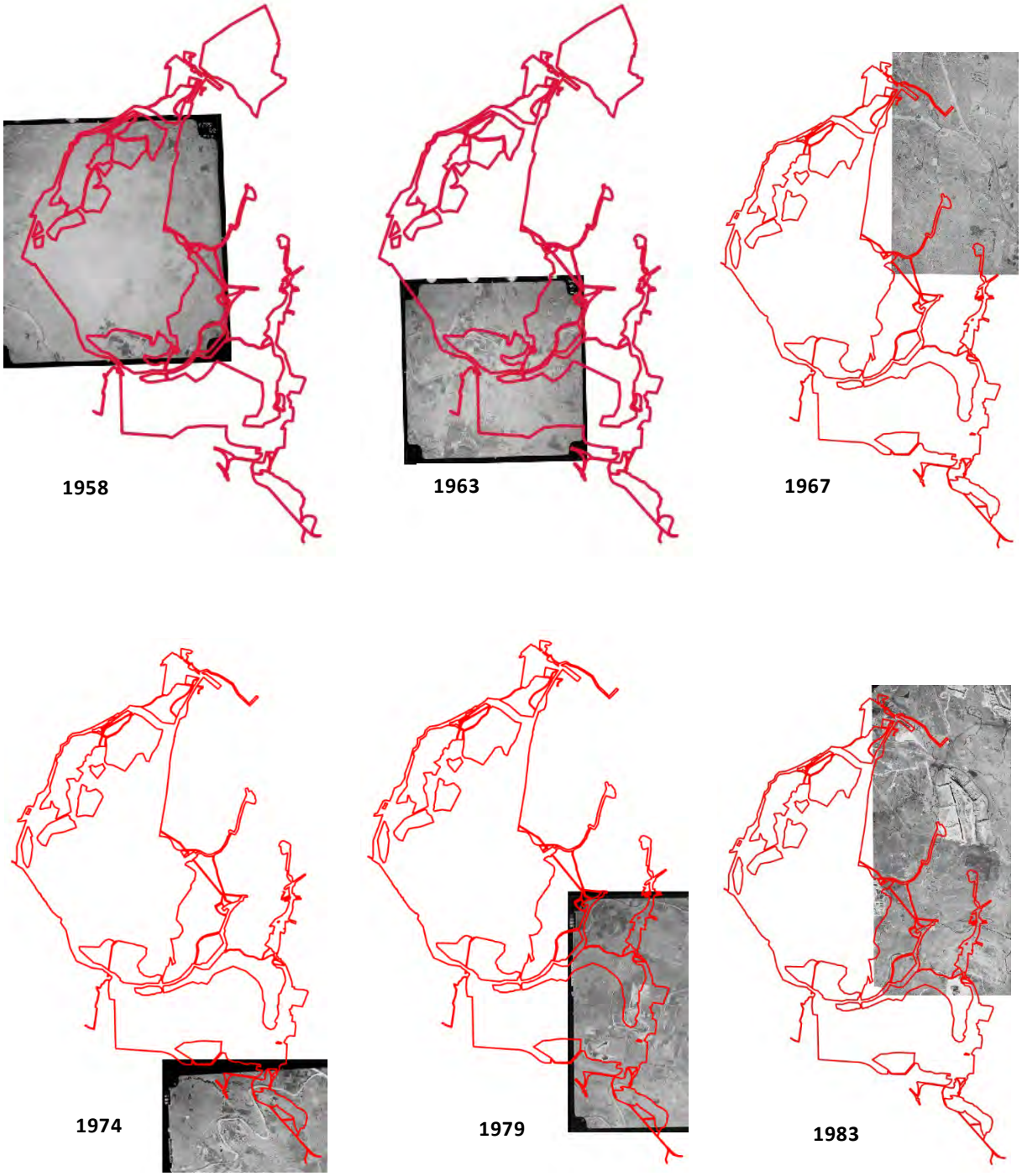
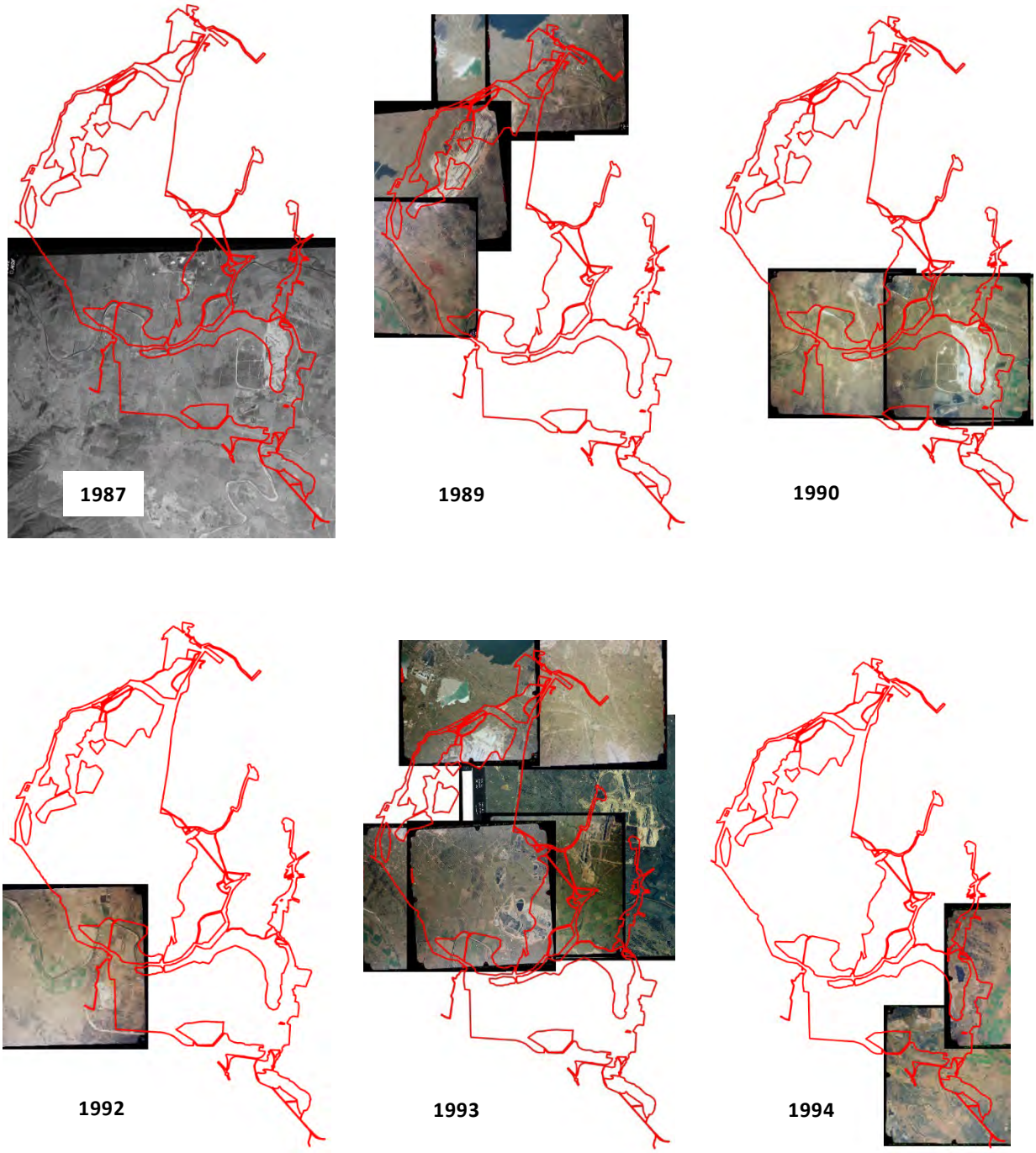
http://maps.six.nsw.gov.au/arcgis/services/public/NSW_Imagery/MapServer/WMSServer	multiple	NSW LPI Imagery Best

APPENDIX 2

Coverage of Historical Aerial Imagery



Project Footprint (V12) and coverage of aerial imagery from 1958, 1963, 1967, 1974, 1979 and 1983



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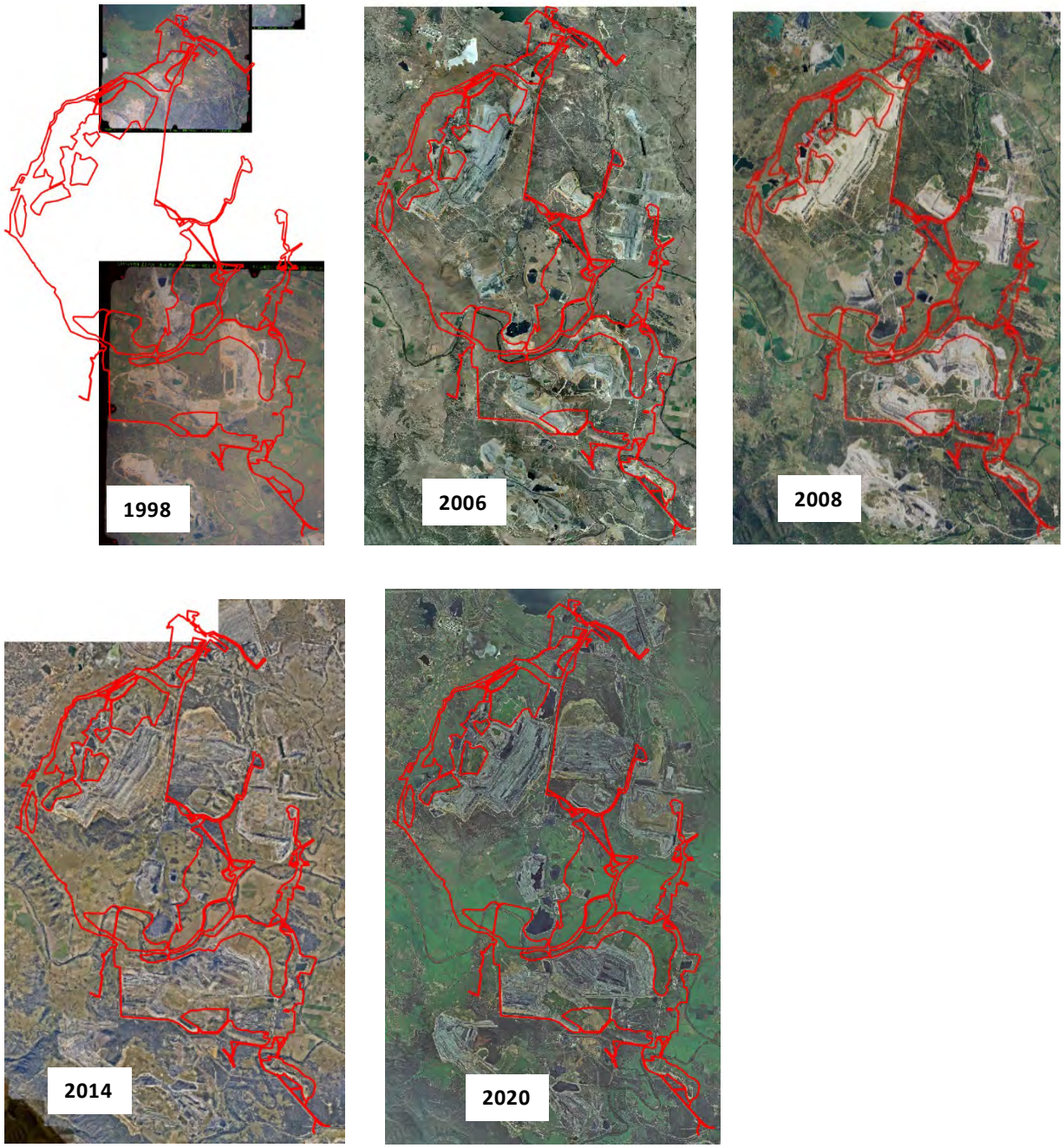

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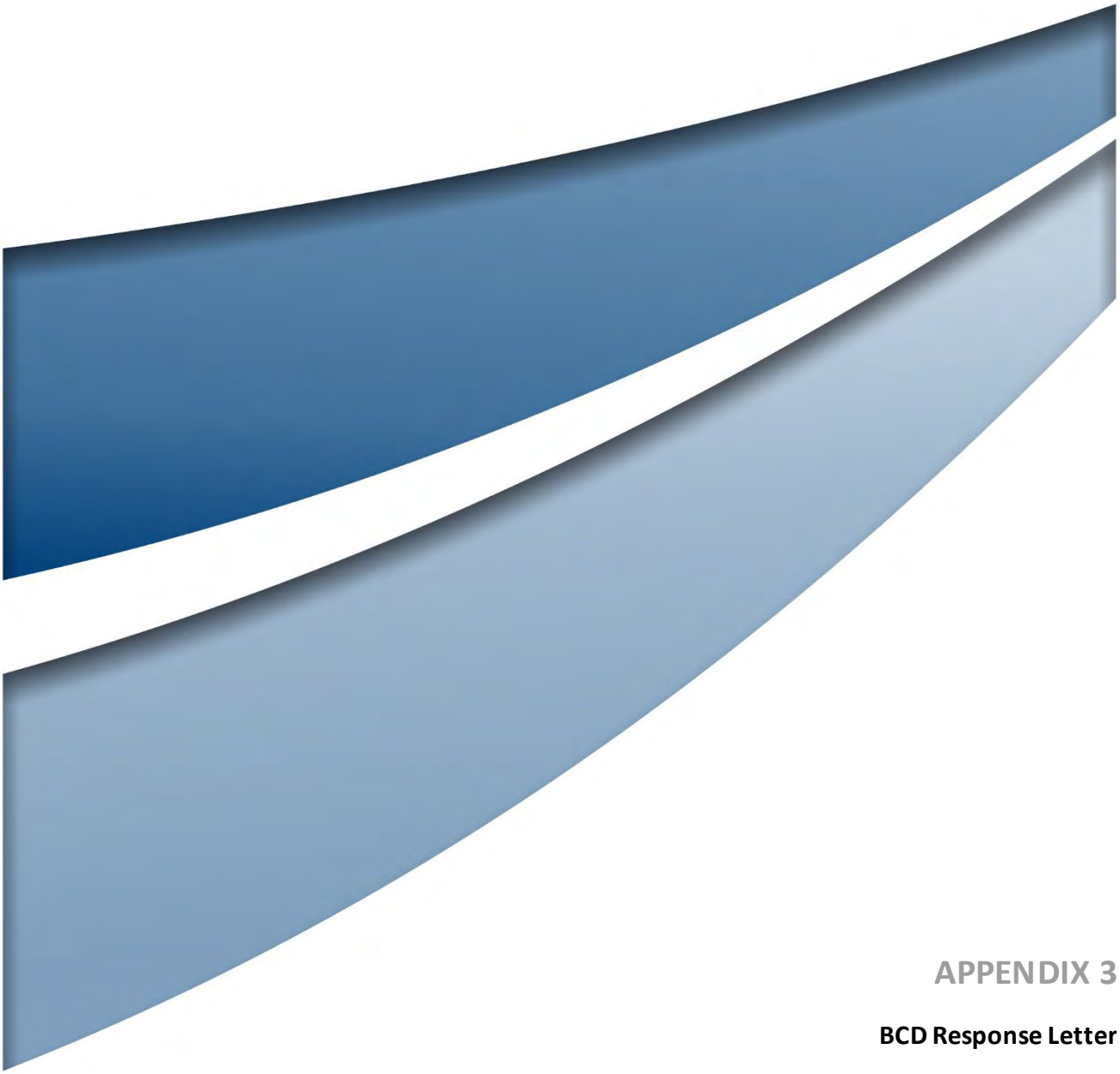

APPENDIX 3

BCD Response Letter

Our ref: DOC20/954523-11
Your ref: 4948_R02_HVO_Armit_20201211a_bn.docx

Ms Nicole Armit

Director
EMM Consulting
narmit@emmconsulting.com.au

Dear Ms Armit

Hunter Valley Operations Continuation Project (SSD-11826621) – Category 1 - exempt land mapping

I refer to your e-mail dated 23 December 2020, which included a Briefing Note (dated 11 December 2020) that describes how Umwelt (Australia) Pty Limited has estimated the extent of Category 1 – exempt land (Cat-1 land) mapped for the proposed Hunter Valley Operations Continuation Project (SSD-11826621). You also provided a copy of the Geographic Information System (GIS) shapefiles of the estimated Cat-1 land. Biodiversity and Conservation Division (BCD) has reviewed the Briefing Note and shapefiles and provides comments below.

Your inquiry arises from the Native Vegetation Regulatory (NVR) Map, which is a product of Division 2 or Part 5A of the *Local Land Services Act 2013* (LLS Act). The NVR map has five classes of land (all but one triggers a Biodiversity Assessment Method (BAM) assessment):

- Category 1 – exempt land (no BAM assessment required)
- Category 2 – regulated land (BAM assessment required)
- Category 2 – vulnerable regulated land (BAM assessment required)
- Category 2 – sensitive regulated land (BAM assessment required)
- Excluded Land – land that is excluded from Part 5 of the LLS Act (BAM assessment required)

The Transitional NVR Map [available at https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap] does not show Category-1 land or Category 2-regulated land, which instead must be estimated. The Transitional NVR Map shows Category 2 – vulnerable regulated land and land excluded from the operation of the LLS Act within the Project area. Umwelt (Australia) Pty Limited's map (provided as GIS shapefiles) only has Category-1 land, but it includes Category 2- regulated land and Excluded Land. The Briefing Note states that this approach was taken due to existing development consents for mining operations that cover most of the Project area, however, this is a separate factor to the categories in the NVR map.

BCD has reviewed the Briefing Note and GIS shapefiles provided. BCD's recommendations are provided in **Attachment A** and detailed comments are provided in **Attachment B**. A summary of how the NVR categories are determined for a property is provided in **Attachment C**.

If you require any further information regarding this matter, please contact Robert Gibson, Regional Biodiversity Conservation Officer, on 4927 3154 or via email at huntercentralcoast@environment.nsw.gov.au

Yours sincerely

STEVEN CRICK
Acting Senior Team Leader Planning
Hunter Central Coast Branch
Biodiversity and Conservation Division

Date: 5 August 2021

Enclosure: Attachments A, B and C

Attachment A

BCD's recommendations

Hunter Valley Operations Continuation Project (SSD-11826621)

1. Category 2 - vulnerable regulated land shown on the Transitional NVR Map on the Project area should be updated through a map review request.

2. Excluded Land should be shown on the map for the Project area. It should not be grouped with Category 1 land as it has its own rules for biodiversity assessment.

3. A summary table should be prepared that summarises how much land of each NVR map category occurs in the Project area, and how much of that land is covered by existing development consents.

4. The proponent should follow the approach to estimating NVR map categories as closely as possible to BCD's approach, and that the Briefing Note and GIS shapefiles are updated to summarise the revised work.

Attachment B

BCD's detailed comments

Hunter Valley Operations Continuation Project (SSD-11826621)

Biodiversity

1. Mapped Category 2 land in the Project area needs to be addressed

The Transitional Native Vegetation Regulatory (NVR) Map shows Category 2 - vulnerable regulated land mapped in the Project area, and this needs to be addressed. BCD notes that in the Project area Category 2 - vulnerable regulated land appears to be associated with steep slopes on waste dumps and on streams. Mining activities have changed most of those features since the date of the satellite image on which the NVR mapping is based was taken. To update the NVR map, a map review is be required. An application for this can be made at: https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/native-vegetation-regulatory-map/review If approved, such a review would update the NVR map for the project area. Any Category 2 - vulnerable regulated land removed from the Project area by the map review would then need to be reassigned to a different NVR map category.

The Geographic Information Sydney (GIS) shapefile of Category 2 – vulnerable land is available on the SEED portal [https://www.seed.nsw.gov.au/] at https://datasets.seed.nsw.gov.au/dataset/vulnerable-land-protected-riparian73a9e. Check the SEED portal for any other available Category 2 land mapping.

Recommendation 1

Category 2 - vulnerable regulated land shown on the Transitional NVR Map on the Project area should be updated through a map review request.

2. Excluded land must be shown for the Project area and considered in accordance with its own requirements

The Transitional NVR Map shows 'Excluded Land' mapped in the Project area, and this needs to be addressed. Areas of Excluded Land need to be shown on the map for the Project area. This data layer is available on the SEED portal [https://datasets.seed.nsw.gov.au/dataset/nvr-map-excluded-land-clone-63f7-clone-4927]. BCD recommends that Excluded Land is removed from the estimated Category 1 land layer for the project area.

Recommendation 2

Excluded Land should be shown on the map for the Project area. It should not be grouped with Category 1 land as it has its own rules for biodiversity assessment.

3. A table is required that summarises areas of each NVR map category for the Project area

The Briefing Note does not include a summary table of the areas of each of the NVR map category lands in the Project area. The GIS shapefiles provided do not show all NVR map categories. It is therefore difficult to reconcile the data provided. BCD recommends that a summary table is prepared following the format below, to summarise the findings of the NVR map exercise.

NVR Map Category	In Study Area (ha)	In Project area (ha)	Area covered by current consents (ha)
Category 1 – exempt land			
Category 2 – regulated land			
Category 2 – vulnerable regulated land			
Category 2 – sensitive regulated land			
Excluded land			
TOTAL			

Recommendation 3

A summary table should be prepared that summarises how much land of each NVR map category occurs in the Project area, and how much of that land is covered by existing development consents.

4. The process for estimating NVR land categories requires consideration of all factors stipulated in the *Local Land Services Act 2013*

The process by which BCD determined categories in the NVR map is summarised in **Attachment C.** Until the publication of the NVR map that shows all categories, the transitional arrangements described in Section 60F of the LLS Act apply, including consideration of low conservation value grasslands. NVR map categories are not affected by existing consents. BCD recommends that the process that Umwelt (Australia) Pty Limited uses to estimate the NVR map follows the approach used by BCD, with data sets from the SEED portal, and that the Briefing Note, and GIS shapefiles are revised to reflect this new approach.

Recommendation 4

The proponent should follow the approach to estimating NVR map categories as closely as possible to BCD's approach, and that the Briefing Note and GIS shapefiles are updated to summarise the revised work.

Attachment C

Summary of BCD's approach to determining the Native Vegetation Regulatory Map categories

The process for assigning a land category in the Native Vegetation Regulatory (NVR) Map involves combining and analysing multiple data layers and products, and the application of the various data sets specified in the *Local Land Services Act 2013* (LLS Act). It is not a linear process, as some layers will take precedence over others to develop the final map product for publication.

The NVR categorisation of land is done by the following steps:

- Identifying rural areas where the NVR map applies by compiling layers representing land that becomes excluded areas in the map and therefore no further analysis or mapping is done – used to identify excluded land

- Identifying and mapping existing and historical agricultural land use – used to identify category 1 land

- Supplementing the mapping of agricultural land use by applying a tool that is a time series analysis of satellite imagery and identifies non-woody vegetation that has been significantly disturbed or modified for agricultural use since 1 January 1990 – used to identify category 1 land

- Identifying and mapping woody vegetation cleared since 1 January 1990, based on satellite images and circa 1990 aerial photographs – used to identify category 1 land

- Applying any additional prescribed area criteria listed in the LLS Act that allocate land to either category 1 or category 2

- Applying any additional prescribed area criteria listed in the LLS Act that allocate land to category 2 - sensitive regulated land

- Applying any additional prescribed area criteria listed in the LLS Act that allocate land to category 2 - vulnerable regulated land

umwelt
Environmental & Social
Consultants

Umwelt (Australia) Pty Limited

T| 1300 793 267 E| info@umwelt.com.au www.umwelt.com.au

Appendix C

Detailed PCT and Surveys Figure Set

umwelt

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Scale 1:10,000 at A4

GDA2020 MGA Zone 56

Legend

- HVO North Development Footprint
- Road
- Drainage Line
- BAM Plots (included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Cleared
- 1 - 3431 | Moderate
- 2 - 3431 | Thinned Woodland
- 5 - 3431 | Scattered Regeneration
- 6 - 3431 | Cooba Woodland
- 8 - 3431 | Exotic Grassland
- 11 - 4015 | Moderate

APPENDIX C1-1

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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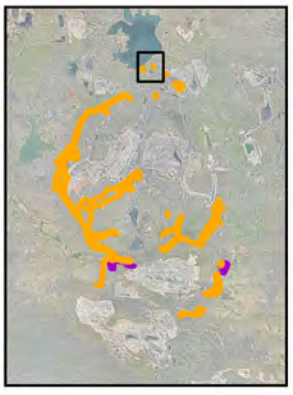
0 200 400 Metres

GDA2020 MGA Zone 56

Legend

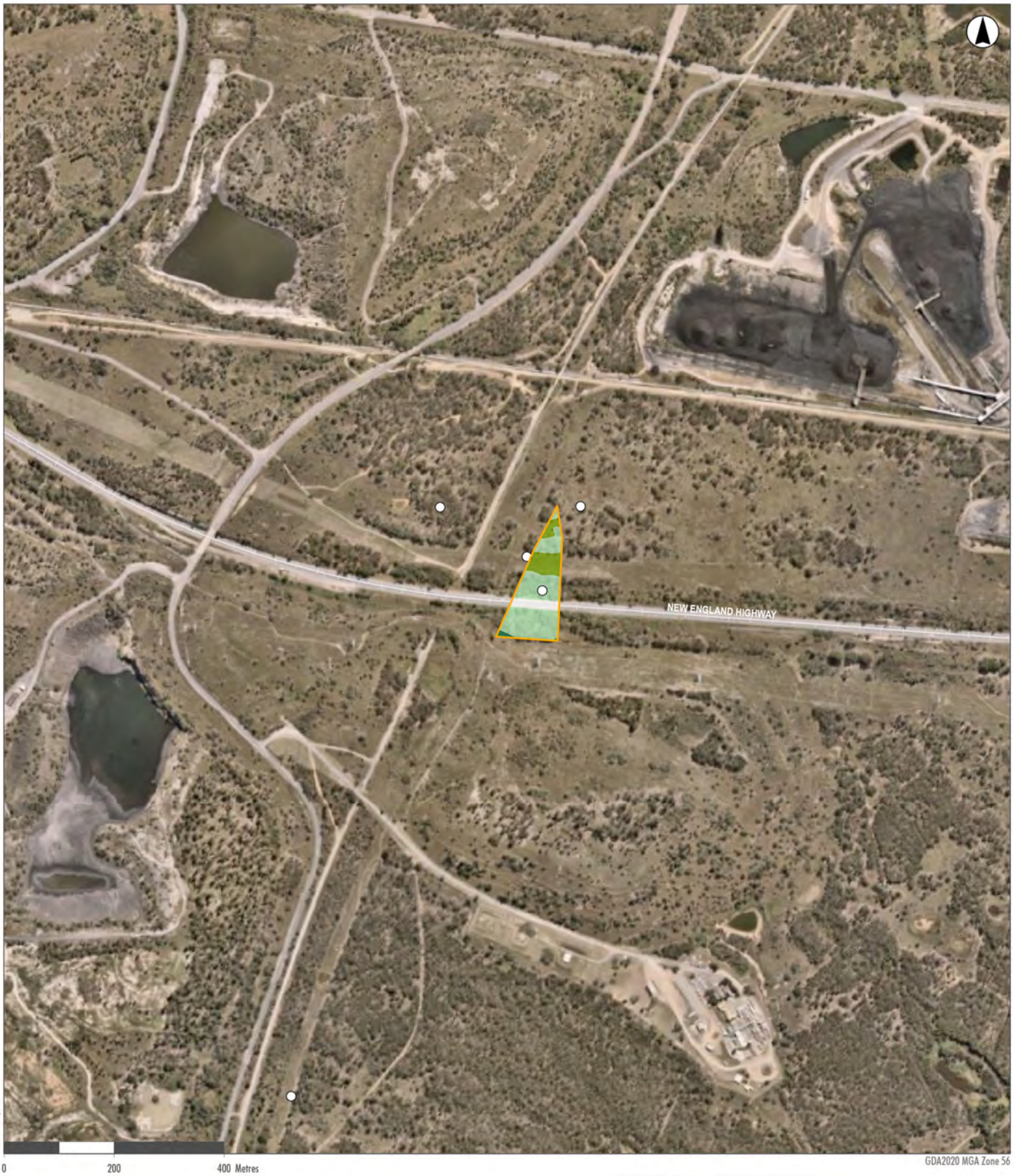
- HVO North Development Footprint
- Drainage Line
- Rapid Assessment Location
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Cleared
- 4 - 3431 | Plantation
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland



APPENDIX C1-2

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

0 200 400 Metres

GDA2020 MGA Zone 56

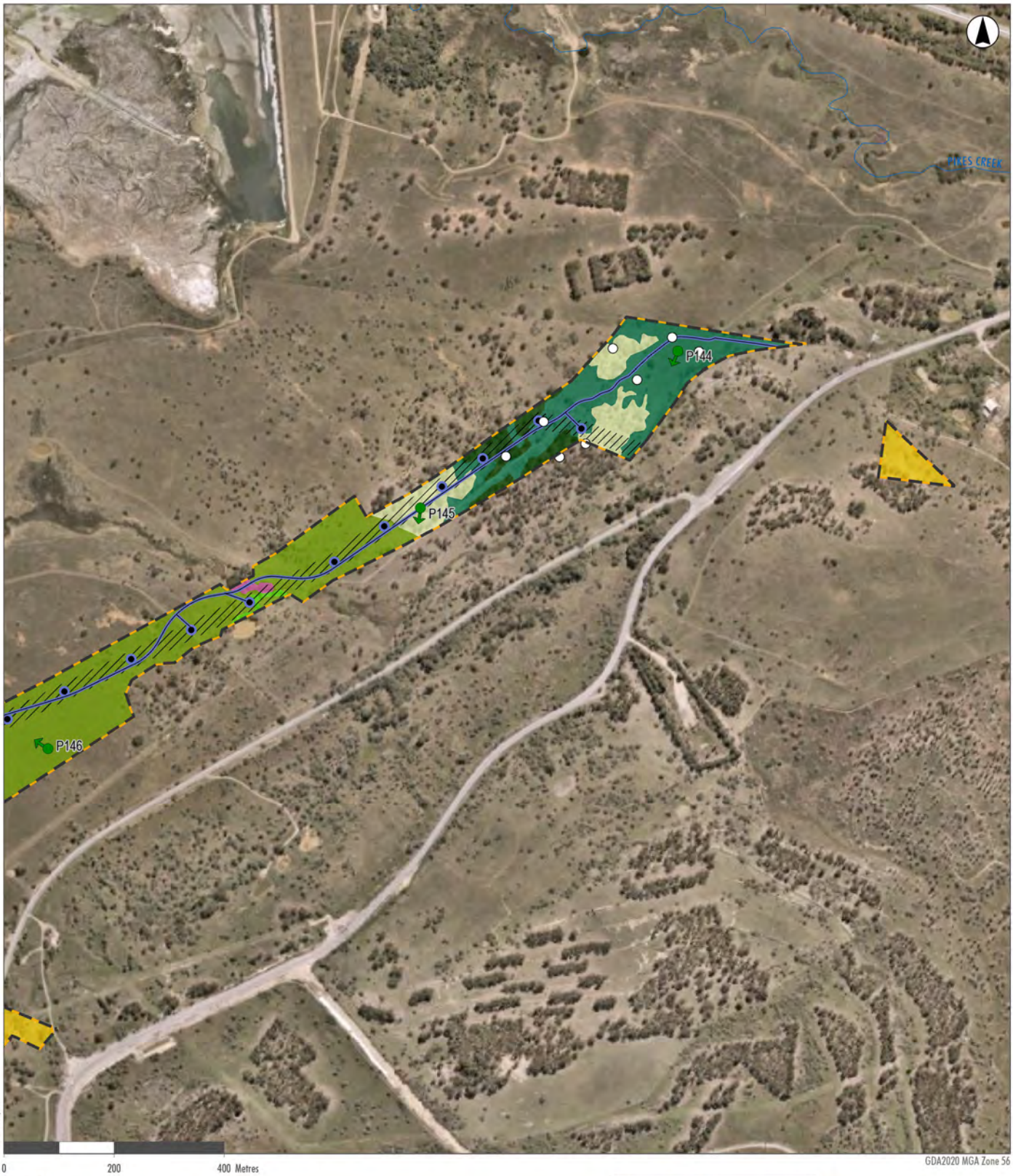
Legend

- HVO North Development Footprint
- Road
- Rapid Assessment Location
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 1 - 3431 | Moderate
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland

APPENDIX C1-3

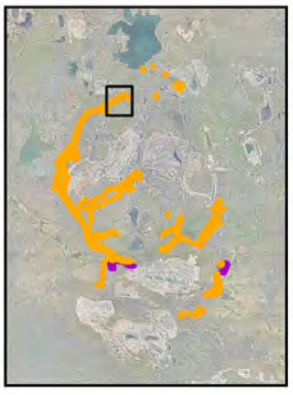
Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



Legend

- HVO North Development Footprint
- Road
- Drainage Line
- BAM Plots (included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Category 1 - Exempt Land
- 2 - 3431 | Thinned Woodland
- 5 - 3431 | Scattered Regeneration
- 6 - 3431 | Cooba Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 9 - 3431 | Bullaok Variant
- 11 - 4015 | Moderate



APPENDIX C1-4

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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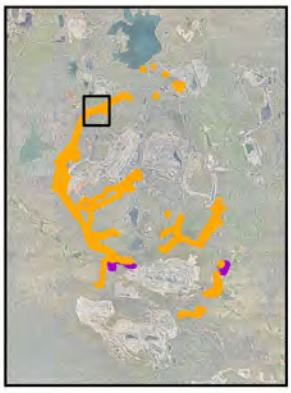
Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Drainage Line
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 2 - 3431 | Thinned Woodland
- 4 - 3431 | Plantation
- 7 - 3431 | Poor Condition Derived Native Grassland



APPENDIX C1-5

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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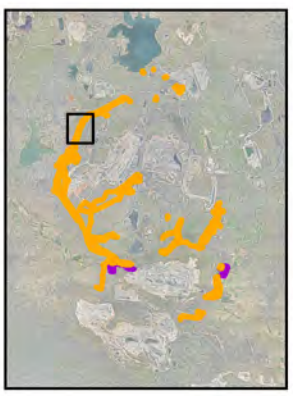
Scale 1:10,000 at A4

GDA2020 MGA Zone 56

Legend

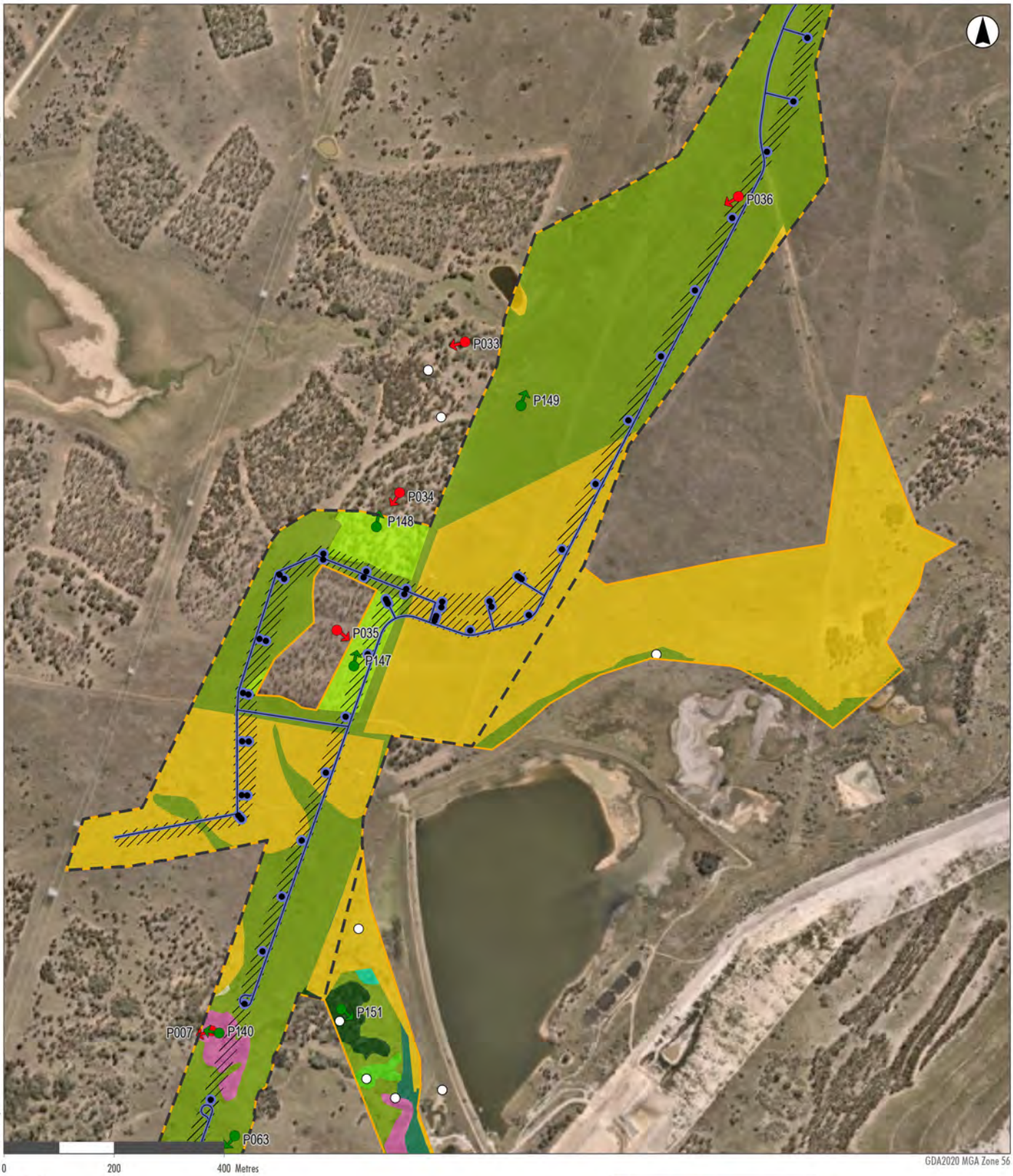
- HVO North Development Footprint
- Drainage Line
- BAM Plots (included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 I Category 1 - Exempt Land
- 4 - 3431 I Plantation
- 7 - 3431 I Poor Condition Derived Native Grassland



APPENDIX C1-6

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

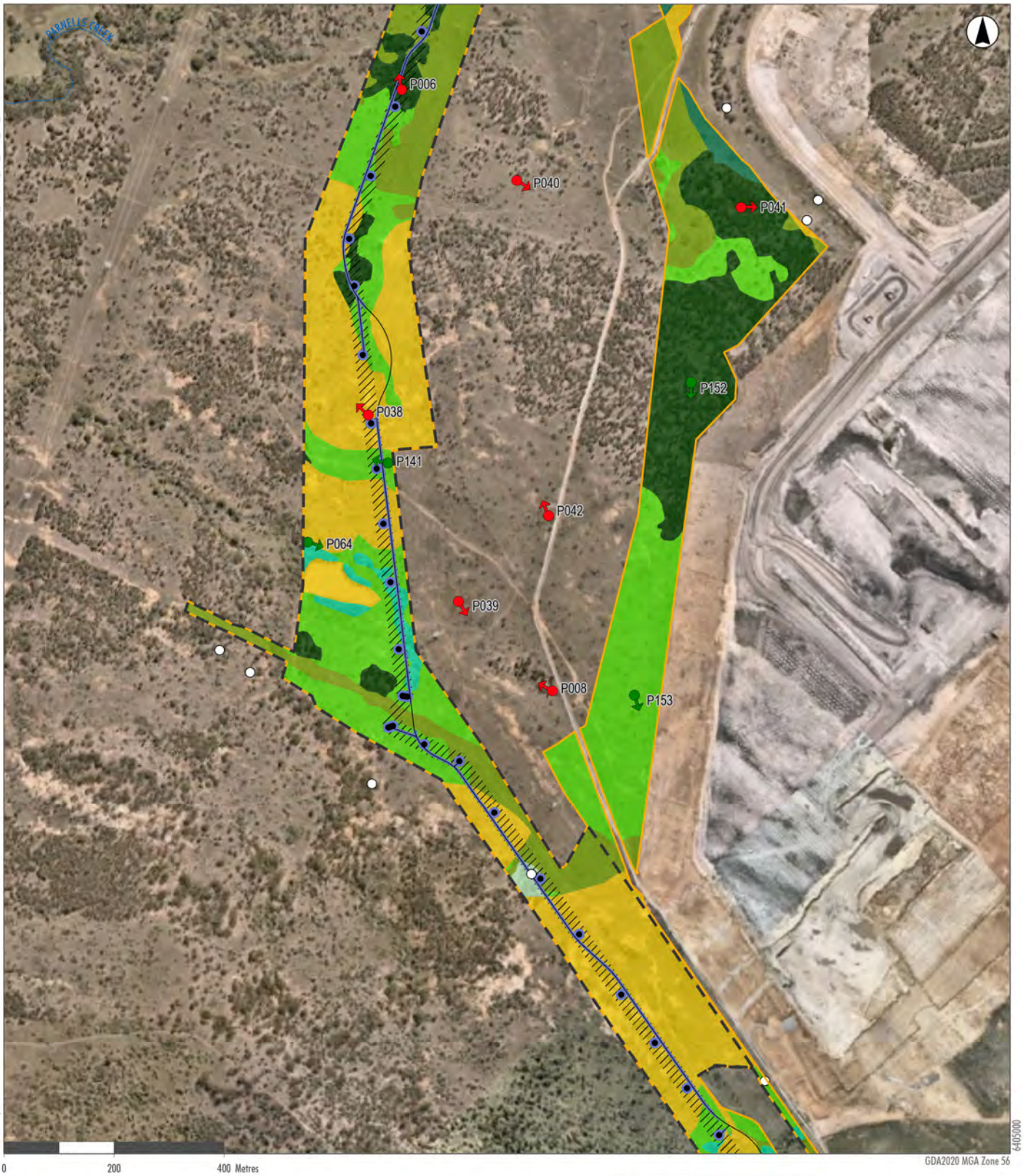
- HVO North Development Footprint
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)

- 0 - 0 I Category 1 - Exempt Land
- 2 - 3431 I Thinned Woodland
- 4 - 3431 I Plantation
- 5 - 3431 I Scattered Regeneration
- 6 - 3431 I Cooba Woodland
- 7 - 3431 I Poor Condition Derived Native Grassland
- 8 - 3431 I Exotic Grassland
- 9 - 3431 I Bulloak Variant
- 11 - 4015 I Moderate

APPENDIX C1-7

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



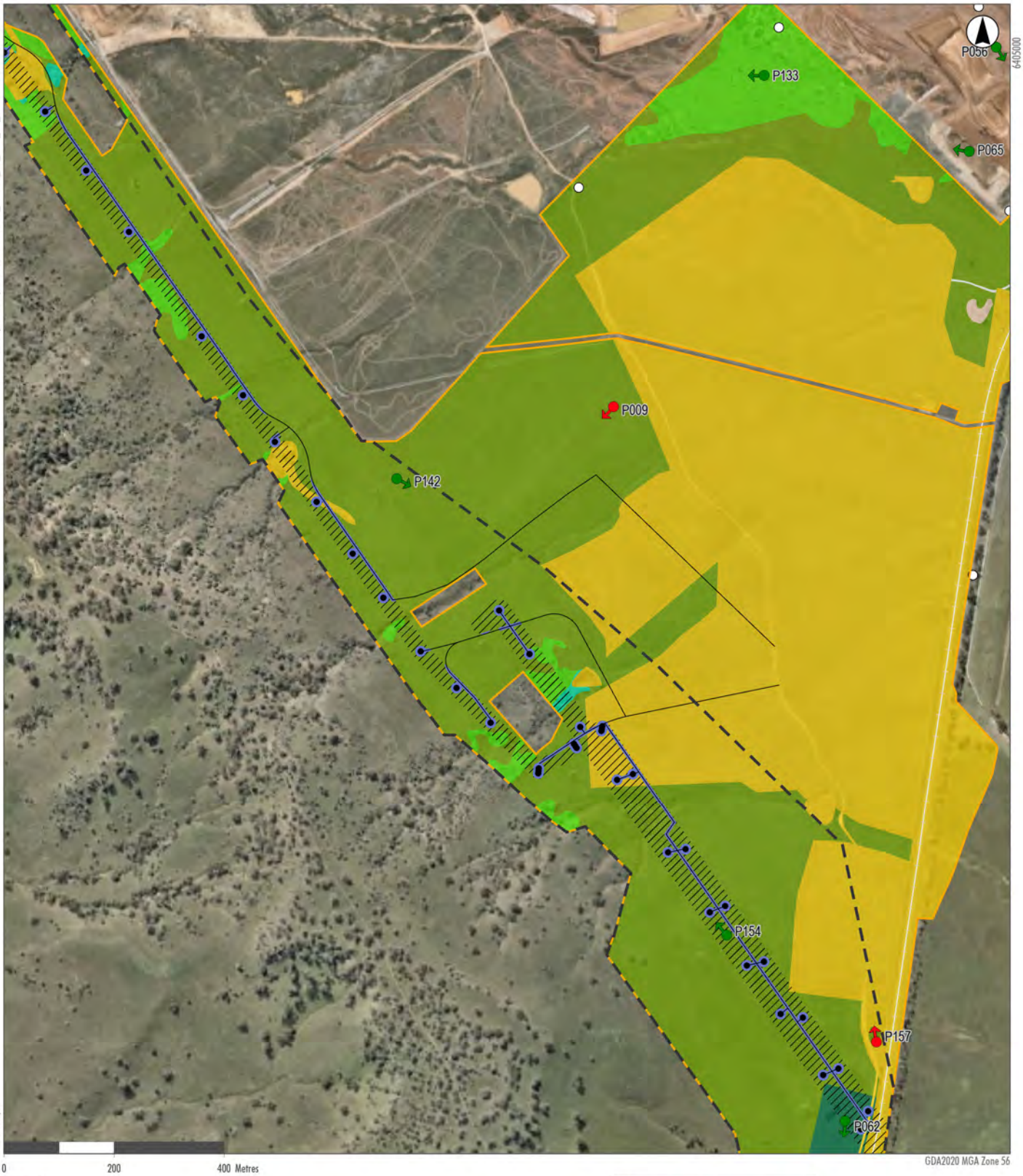
Legend

- HVO North Development Footprint
- Drainage Line
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Category 1 - Exempt Land
- 1 - 3431 | Moderate
- 5 - 3431 | Scattered Regeneration
- 6 - 3431 | Cooba Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 9 - 3431 | Bulloak Variant

APPENDIX C1-8

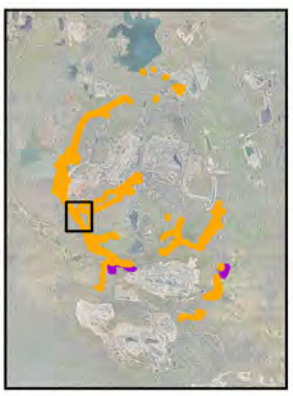
Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



Legend

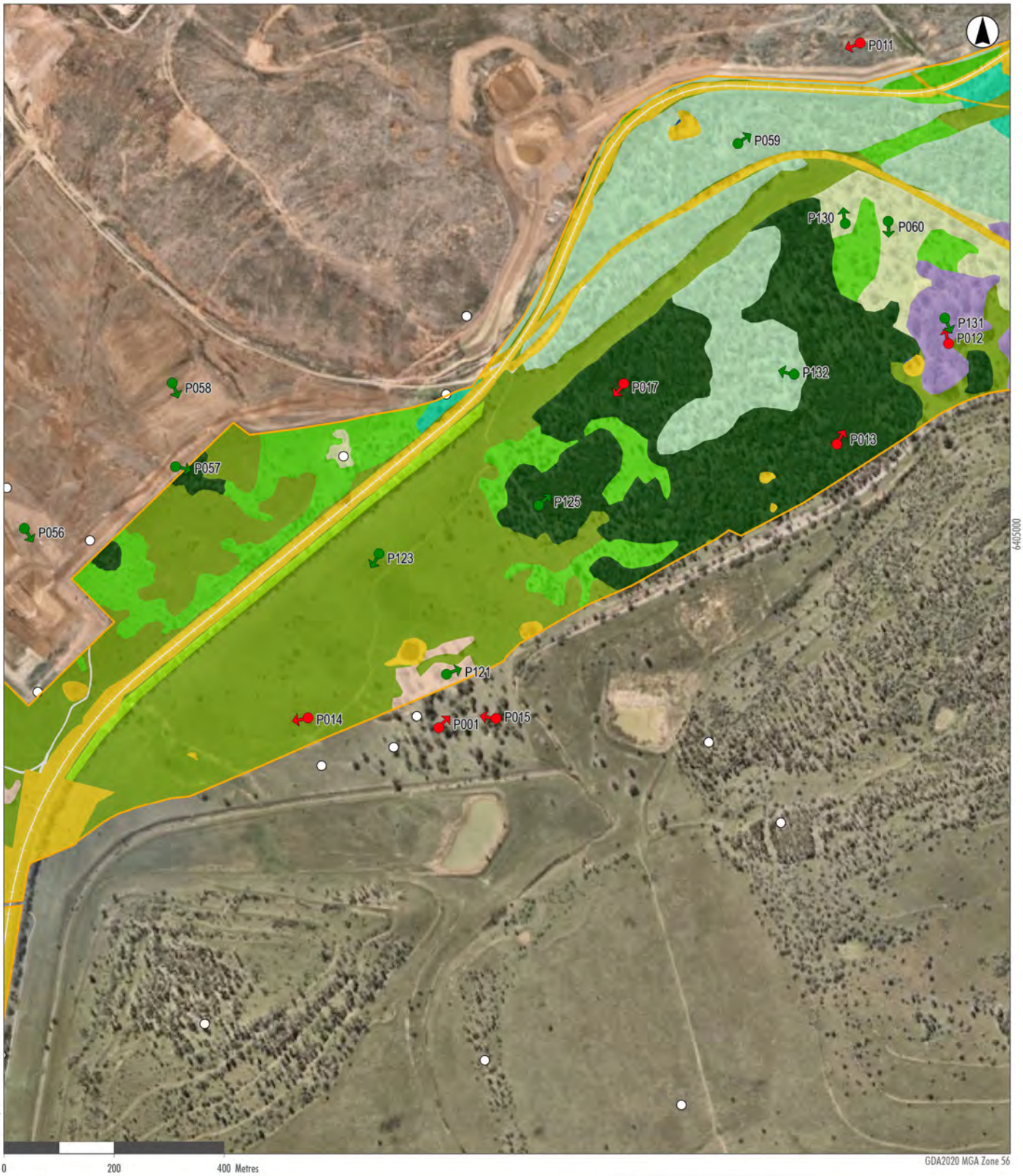
- HVO North Development Footprint
- Road
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 5 - 3431 | Scattered Regeneration
- 6 - 3431 | Cooba Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 13 - 4089 | Moderate



APPENDIX C1-9

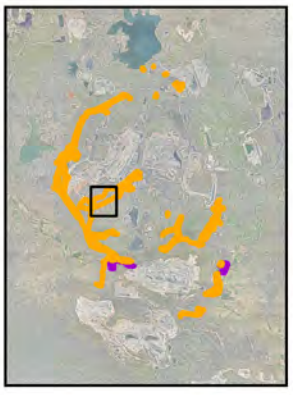
Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



Legend

- HVO North Development Footprint
- Road
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Dam
- 1 - 3431 | Moderate
- 2 - 3431 | Thinned Woodland
- 4 - 3431 | Plantation
- 5 - 3431 | Scattered Regeneration
- 6 - 3431 | Cooba Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 9 - 3431 | Bullaok Variant
- 10 - 3485 | Moderate
- 13 - 4089 | Moderate



APPENDIX C1-10

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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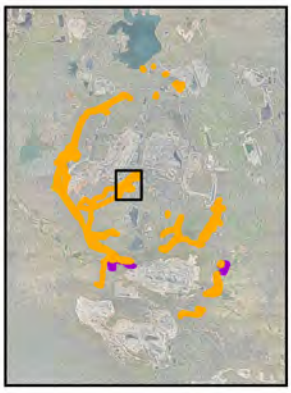
Scale 1:10,000 at A4

GDA2020 MGA Zone 56

Legend

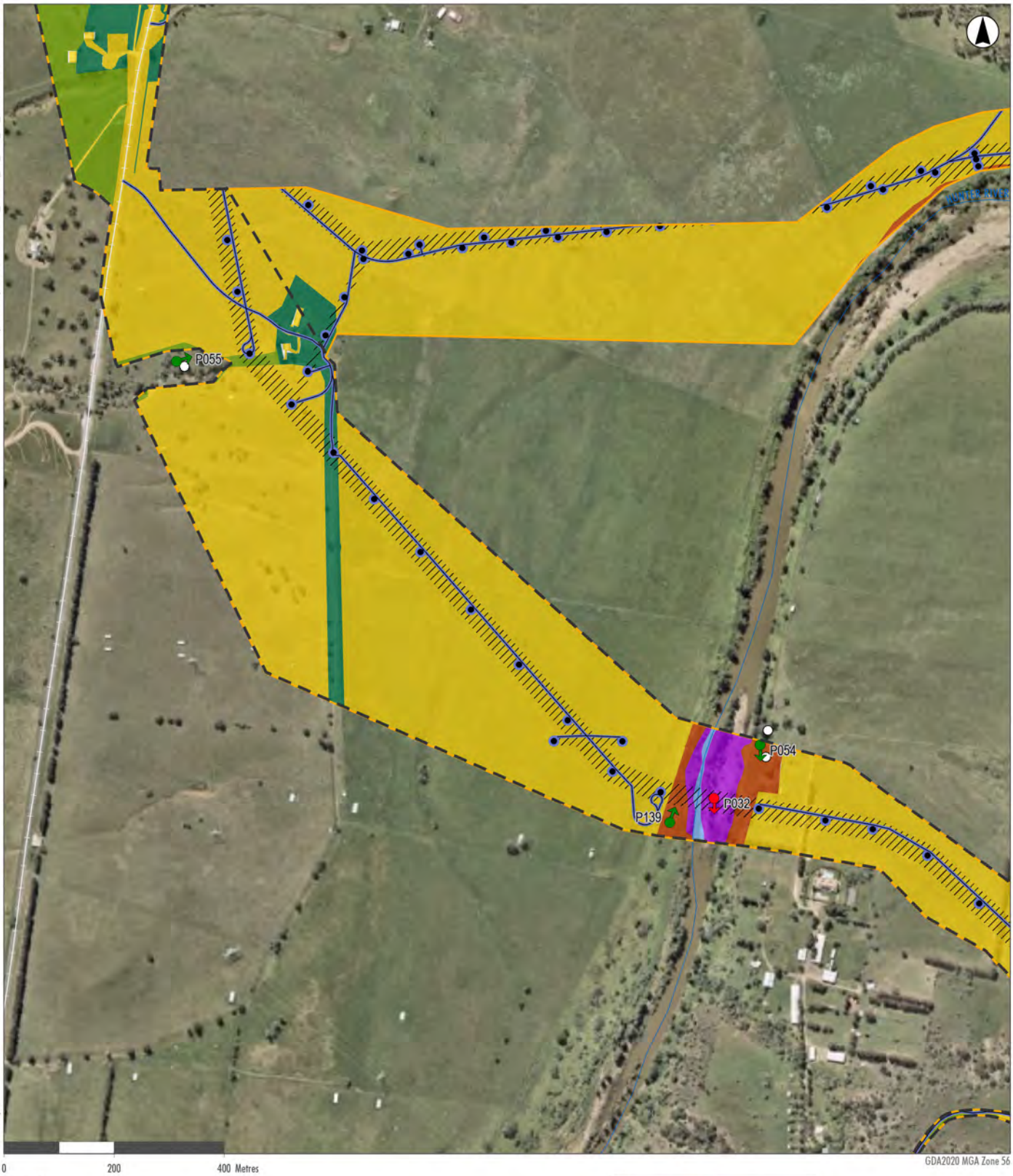
- HVO North Development Footprint
- Road
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ2 – partial impact
- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Water
- 1 - 3431 | Moderate
- 2 - 3431 | Thinned Woodland
- 5 - 3431 | Scattered Regeneration
- 6 - 3431 | Cooba Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 9 - 3431 | Bullaok Variant
- 10 - 3485 | Moderate



APPENDIX C1-11

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Road
- Drainage Line
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Water
- 2 - 3431 | Thinned Woodland
- 5 - 3431 | Scattered Regeneration
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 12 - 4081 | Moderate
- 17 - 4089 | Exotic Grassland

APPENDIX C1-12

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

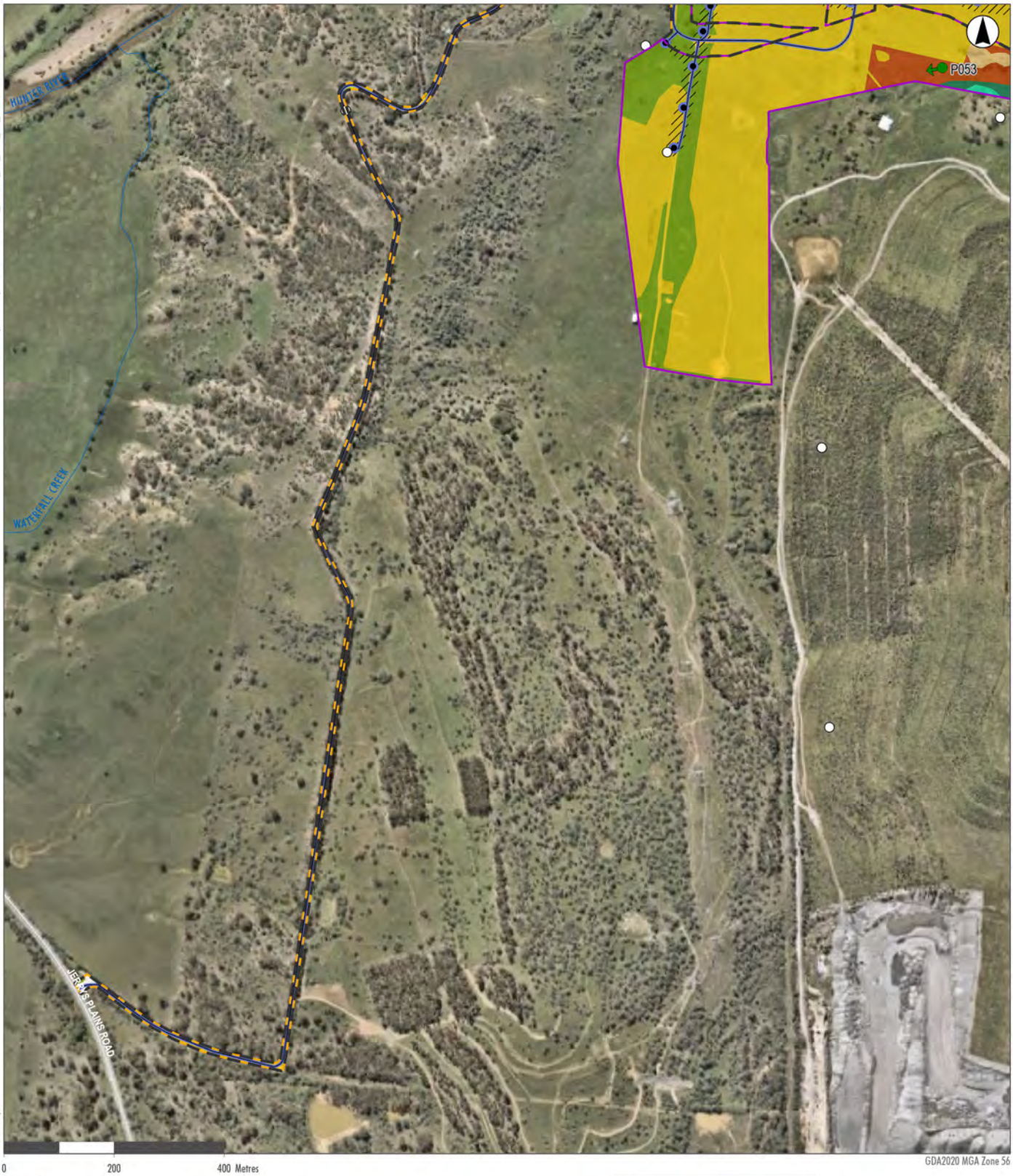
Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Drainage Line
- BAM Plots (included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Water
- 5 - 3431 | Scattered Regeneration
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 12 - 4081 | Moderate
- 15 - 4089 | Cooba Woodland
- 16 - 4089 | Derived Native Grassland
- 17 - 4089 | Exotic Grassland

APPENDIX C1-13

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



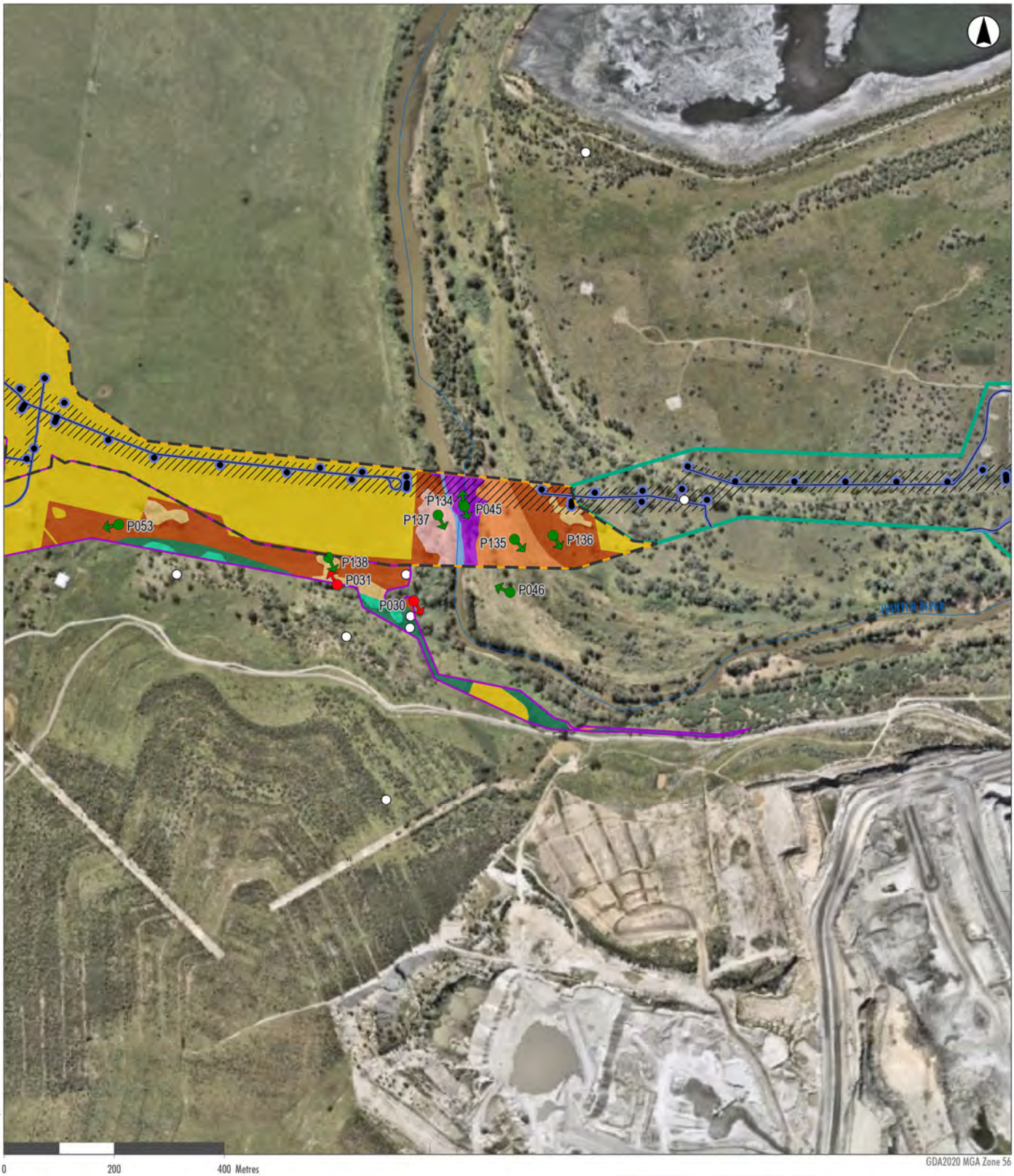
Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Road
- Drainage Line
- BAM Plots (included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 1 - 3431 | Moderate
- 4 - 3431 | Plantation
- 5 - 3431 | Scattered Regeneration
- 6 - 3431 | Cooba Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 15 - 4089 | Cooba Woodland
- 17 - 4089 | Exotic Grassland

APPENDIX C1-14

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

GDA2020 MGA Zone 56

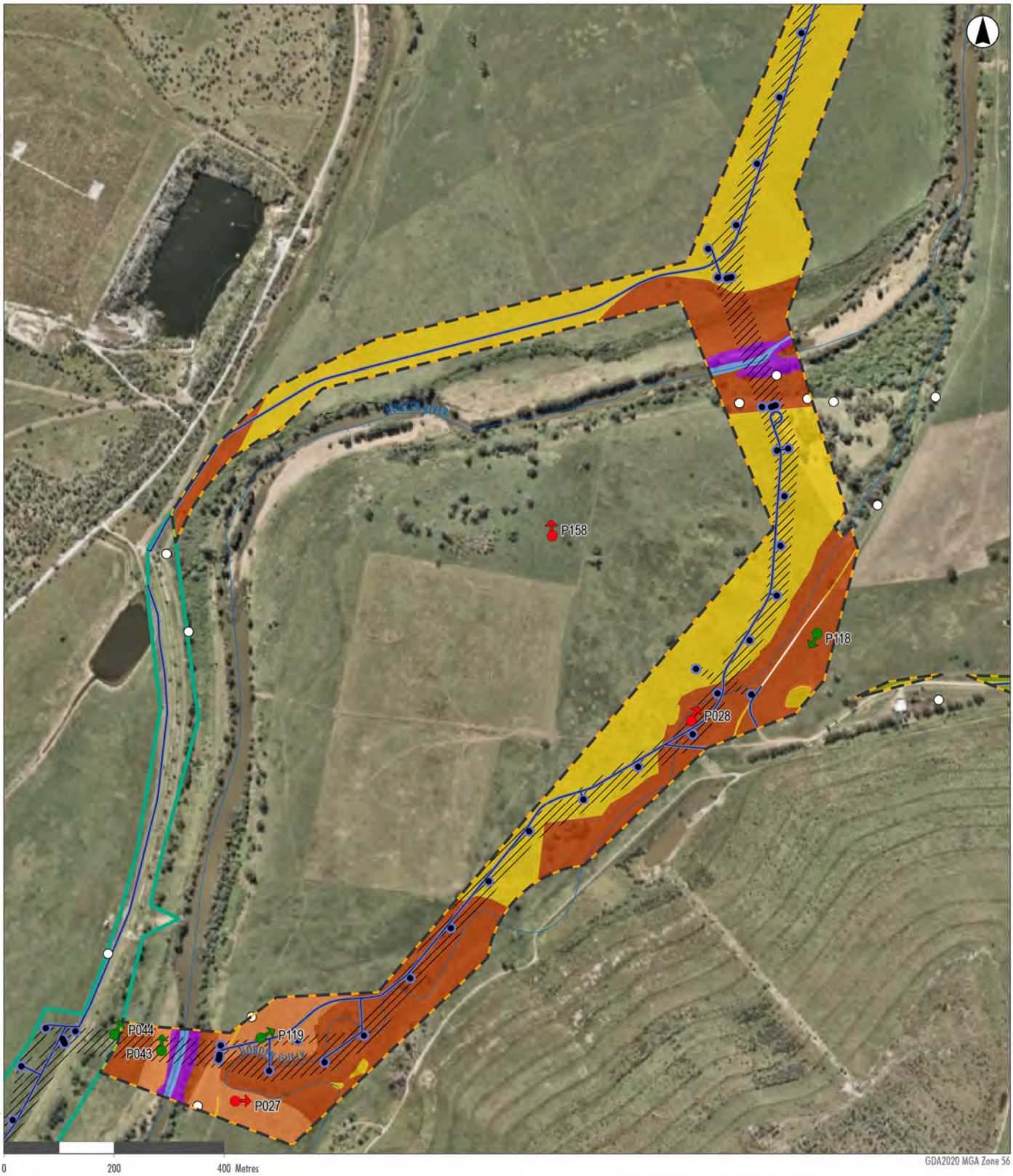
Legend

- HVO North Development Footprint
- HVO South Development Footprint
- River Red Gum Additional Disturbance Area
- Drainage Line
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Water
- 6 - 3431 | Cooba Woodland
- 8 - 3431 | Exotic Grassland
- 12 - 4081 | Moderate
- 14 - 4089 | Low to Moderate
- 15 - 4089 | Cooba Woodland
- 16 - 4089 | Derived Native Grassland
- 17 - 4089 | Exotic Grassland

APPENDIX C1-15

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



Legend

- HVO North Development Footprint
- River Red Gum Additional Disturbance Area
- Drainage Line
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Water
- 0 - 0 | Dam
- 7 - 3431 | Poor Condition Derived Native Grassland
- 12 - 4081 | Moderate
- 16 - 4089 | Derived Native Grassland
- 17 - 4089 | Exotic Grassland

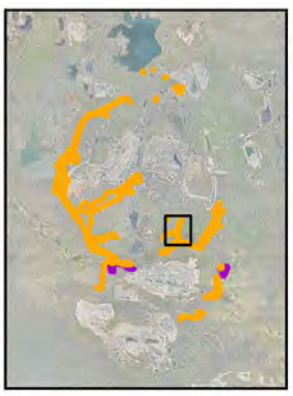
APPENDIX C1-16

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

Legend

- HVO North Development Footprint
- Drainage Line
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Water
- 0 - 0 | Dam
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 12 - 4081 | Moderate
- 17 - 4089 | Exotic Grassland



APPENDIX C1-17

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

Legend

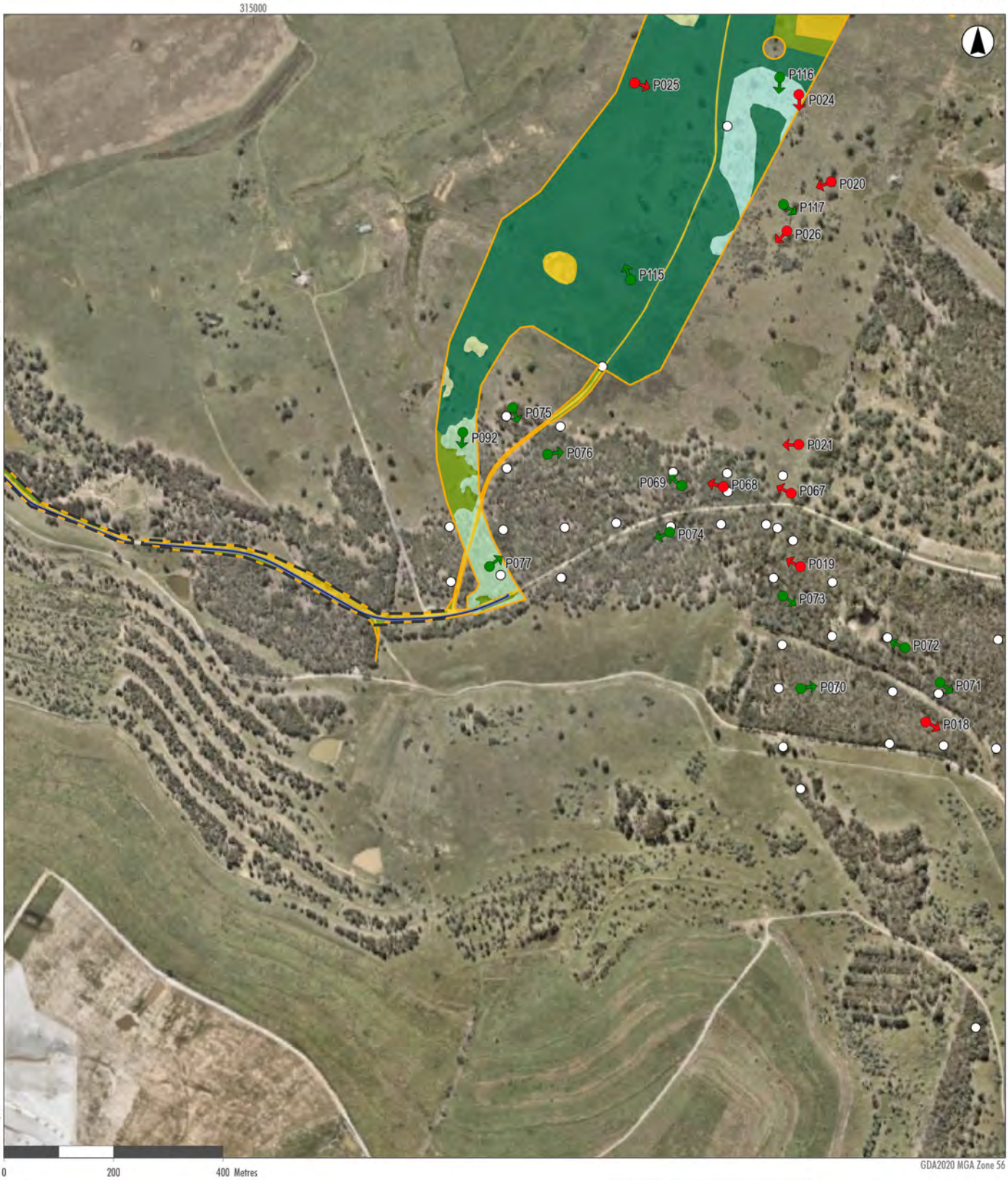
- HVO North Development Footprint
- Drainage Line
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)

- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 0 - 0 | Water
- 1 - 3431 | Moderate
- 2 - 3431 | Thinned Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 11 - 4015 | Moderate
- 12 - 4081 | Moderate
- 17 - 4089 | Exotic Grassland

APPENDIX C1-18

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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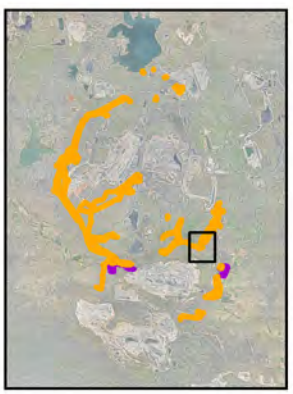
Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- Access Track
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 I Category 1 - Exempt Land
- 1 - 3431 I Moderate
- 2 - 3431 I Thinned Woodland
- 3 - 3431 I Woodland with Exotic Understorey
- 7 - 3431 I Poor Condition Derived Native Grassland



APPENDIX C1-19

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Drainage Line
- BAM Plots (included in BAM-C)
- BAM Plots (not included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- ETL Power Pole
- 0 - 0 | Cleared
- 0 - 0 | Category 1 - Exempt Land
- 1 - 3431 | Moderate
- 2 - 3431 | Thinned Woodland
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 17 - 4089 | Exotic Grassland

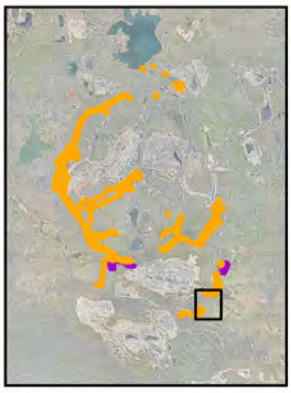
APPENDIX C1-20

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

Legend

- HVO North Development Footprint
- Drainage Line
- BAM Plots (included in BAM-C)
- Rapid Assessment Location
- ETL MZ1 – full impact
- ETL MZ2 – partial impact
- Access Track
- ETL Power Pole
- Wider Easement Area (no proposed impact outside of MZ1 and MZ2)
- 0 - 0 | Category 1 - Exempt Land
- 1 - 3431 | Moderate
- 7 - 3431 | Poor Condition Derived Native Grassland
- 8 - 3431 | Exotic Grassland
- 10 - 3485 | Moderate



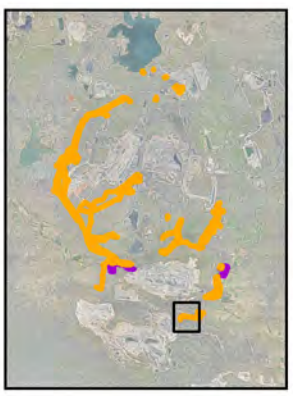
APPENDIX C1-21

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

Legend

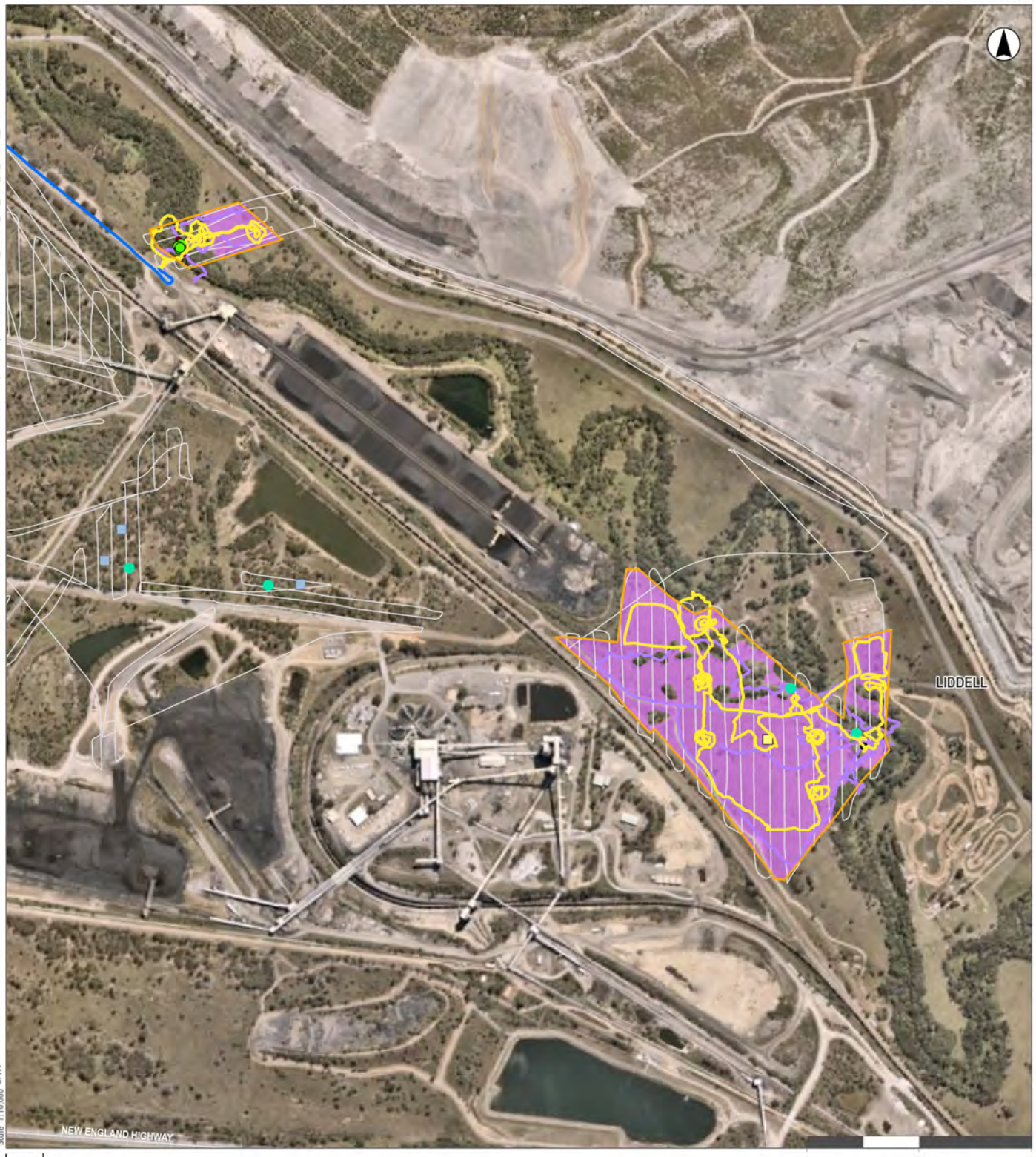
- HVO North Development Footprint
- Road
- Drainage Line
- BAM Plots (included in BAM-C)
- Rapid Assessment Location
- 0 - 0 I Cleared
- 0 - 0 I Category 1 - Exempt Land
- 1 - 3431 I Moderate
- 7 - 3431 I Poor Condition Derived Native Grassland
- 9 - 3431 I Bulloak Variant



APPENDIX C1-22

Vegetation Zones/Plant Community Types in the HVO North and South Development Footprints

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Exotic Vegetation
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2021)

Targeted Threatened Fauna Surveys

- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Opportunistic Driving Spotlighting (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-23

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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Scale 1:10,000 at A4

0 200 400 Metres

Legend

- HVO North Development Footprint
- Exotic Vegetation

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-24

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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Scale 1:10,000 at A4

0 200 400 Metres

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2021)
- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

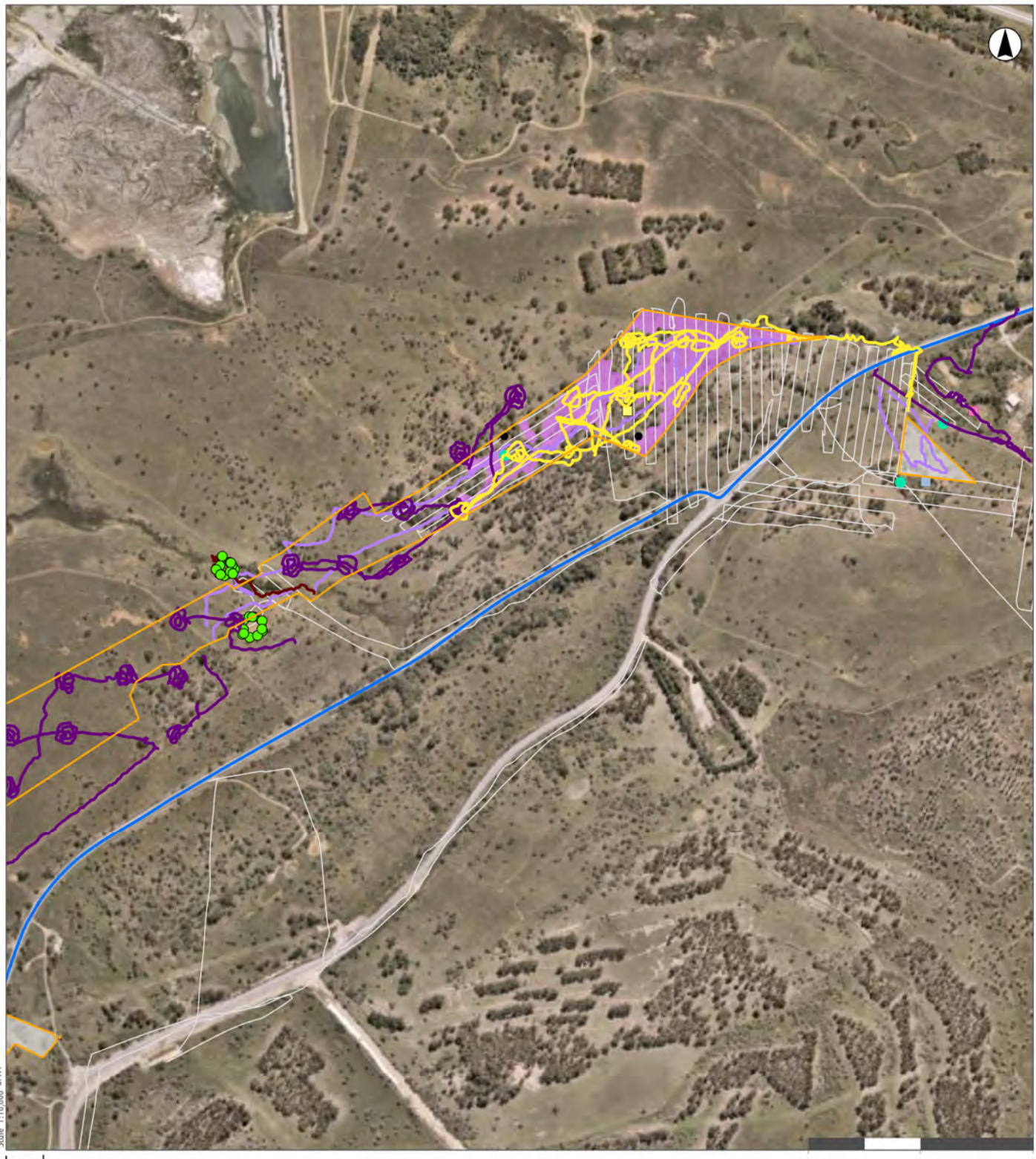
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-25

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2021)
- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Opportunistic Driving Spotlighting (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-26

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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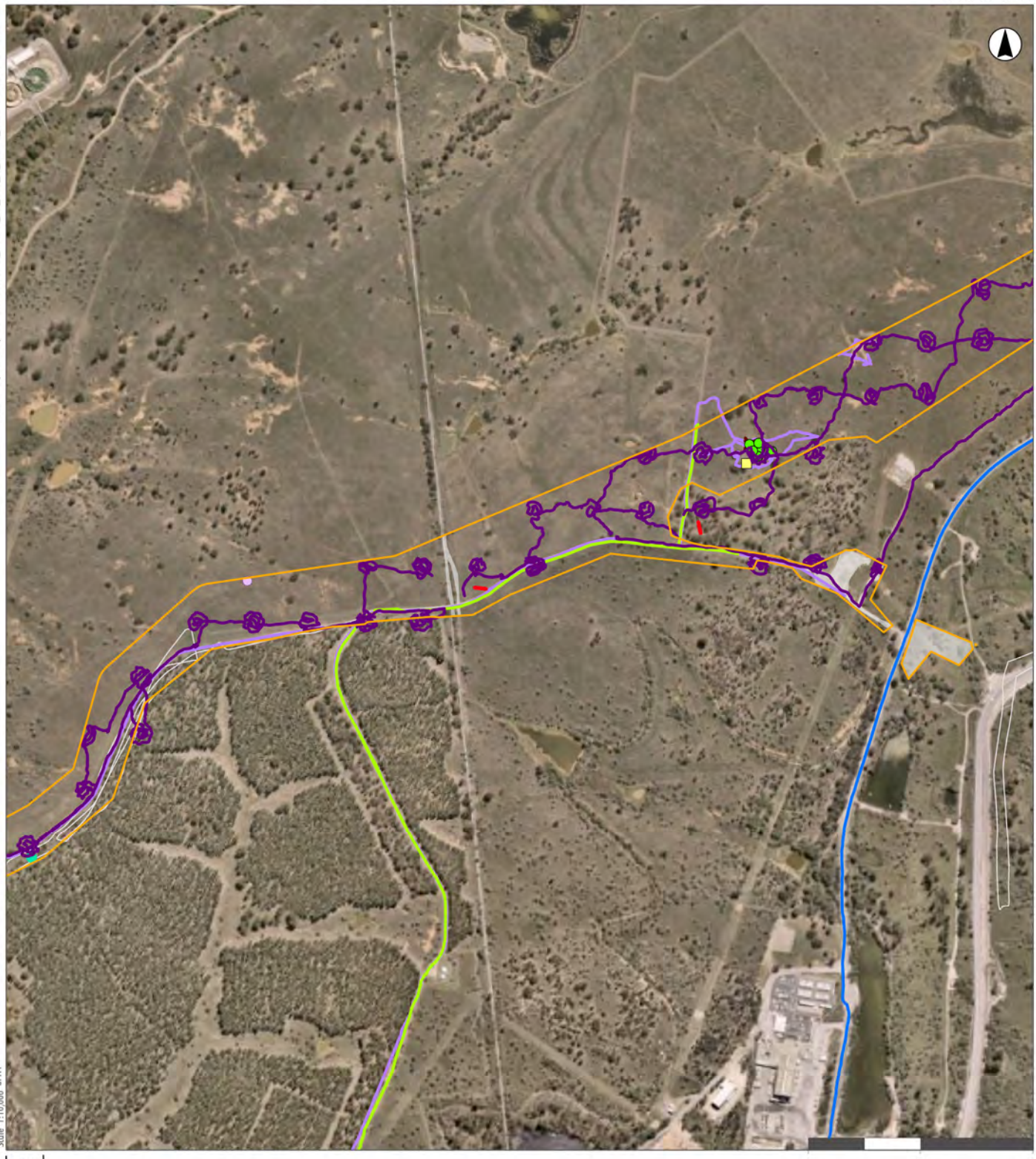

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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

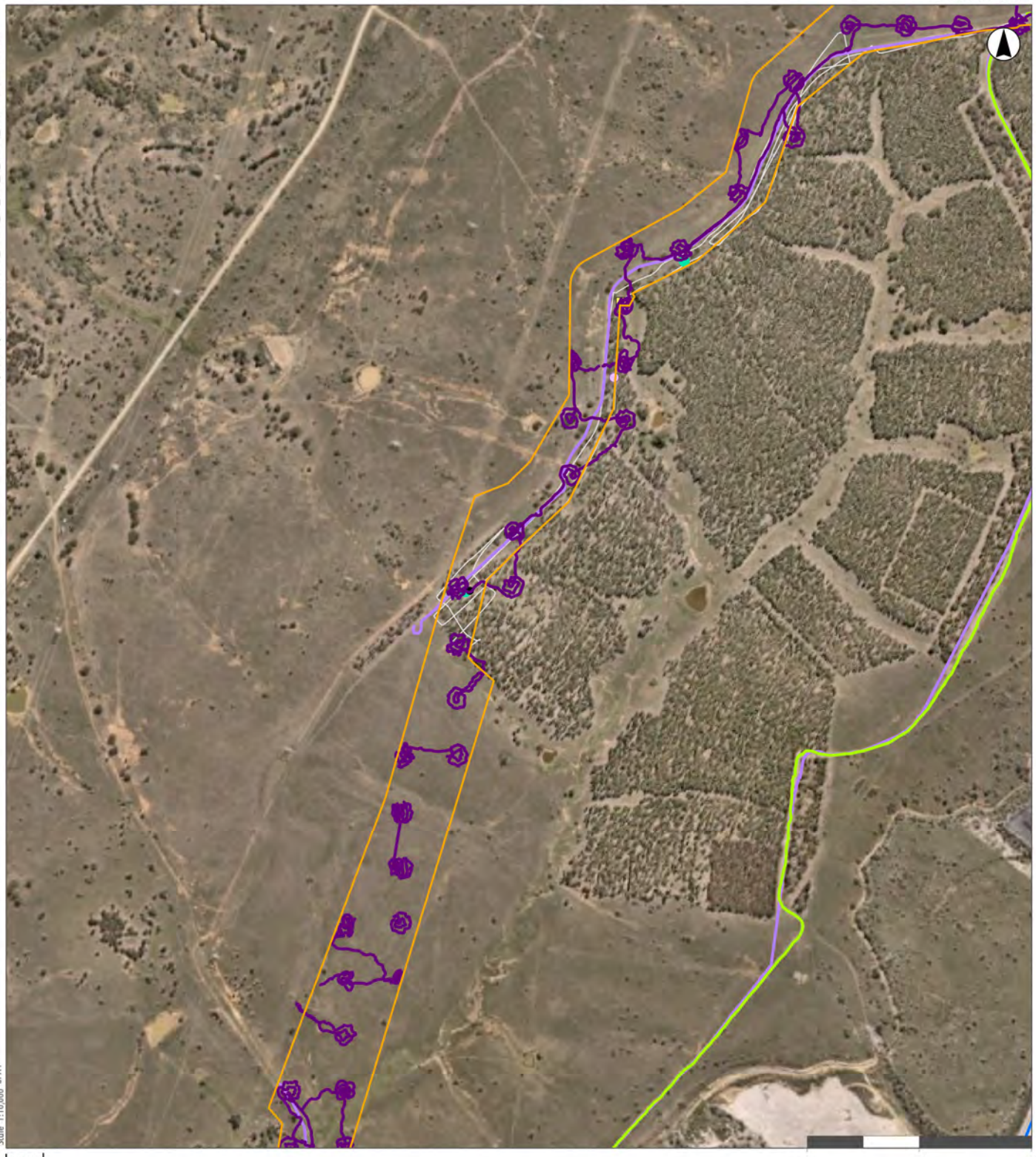
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-27

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

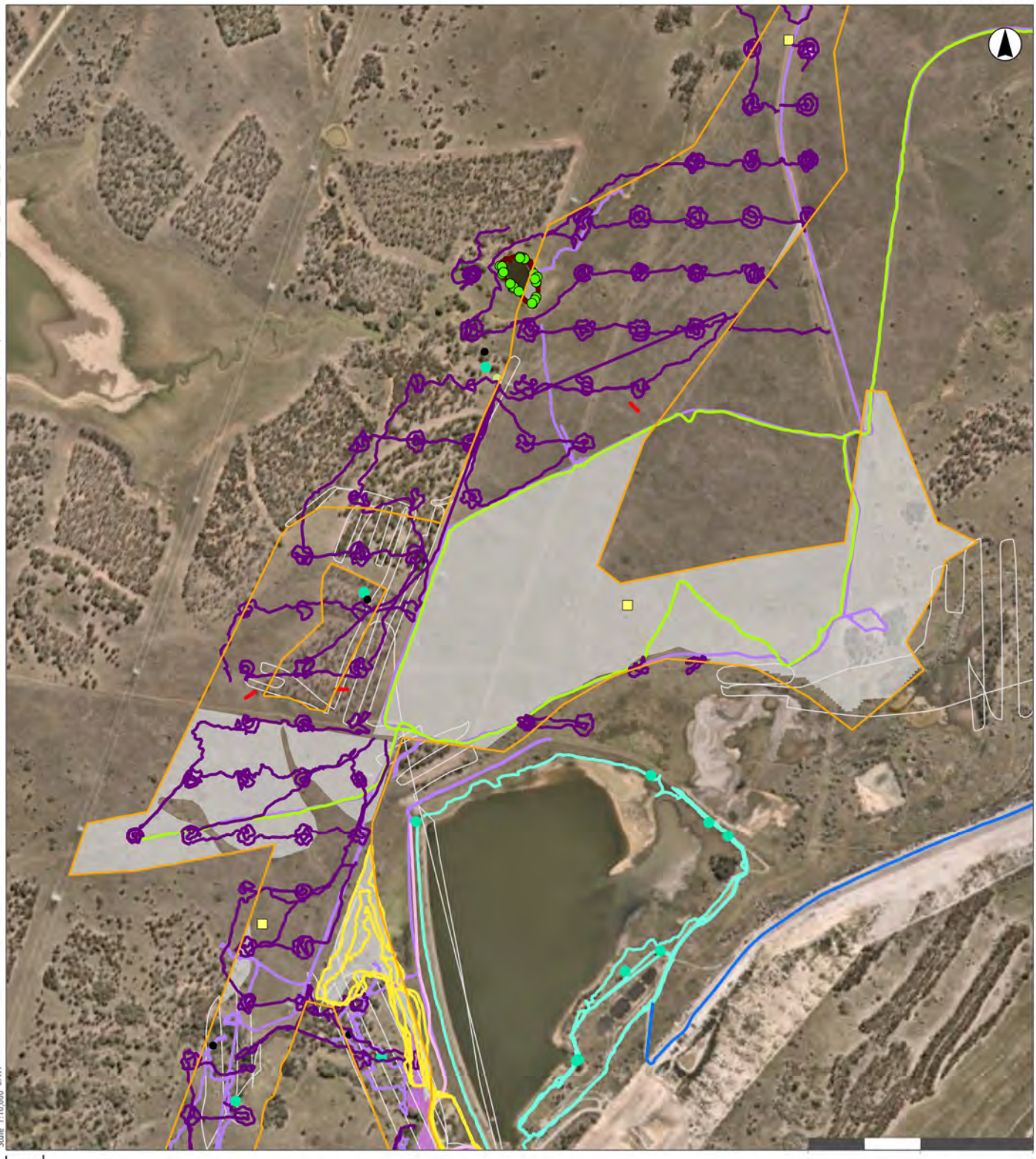
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-28

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2021)
- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Green and golden bell frog call playback and spotlighting surveys for Commonwealth Assessment
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-29

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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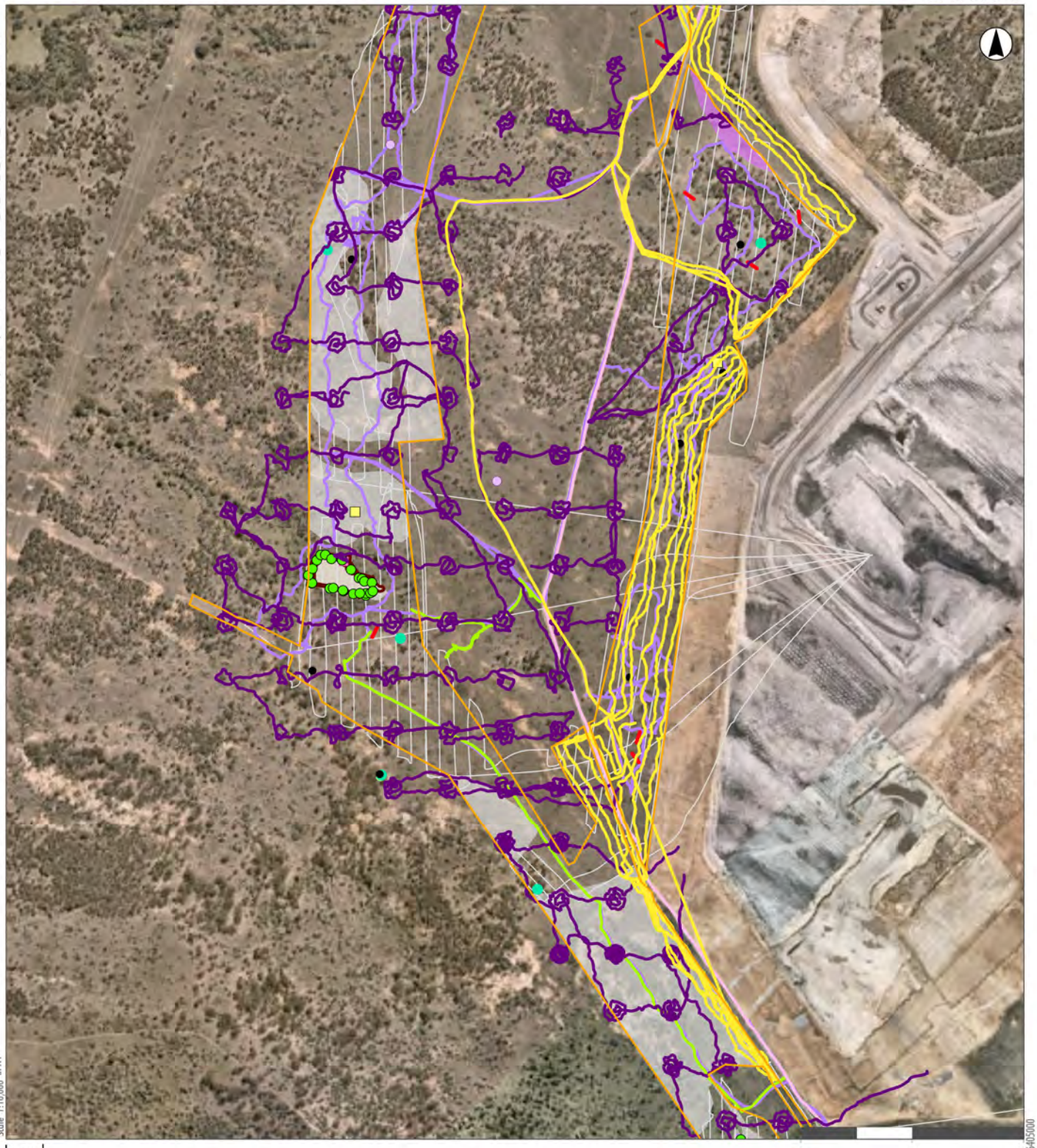

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Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2021)
- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

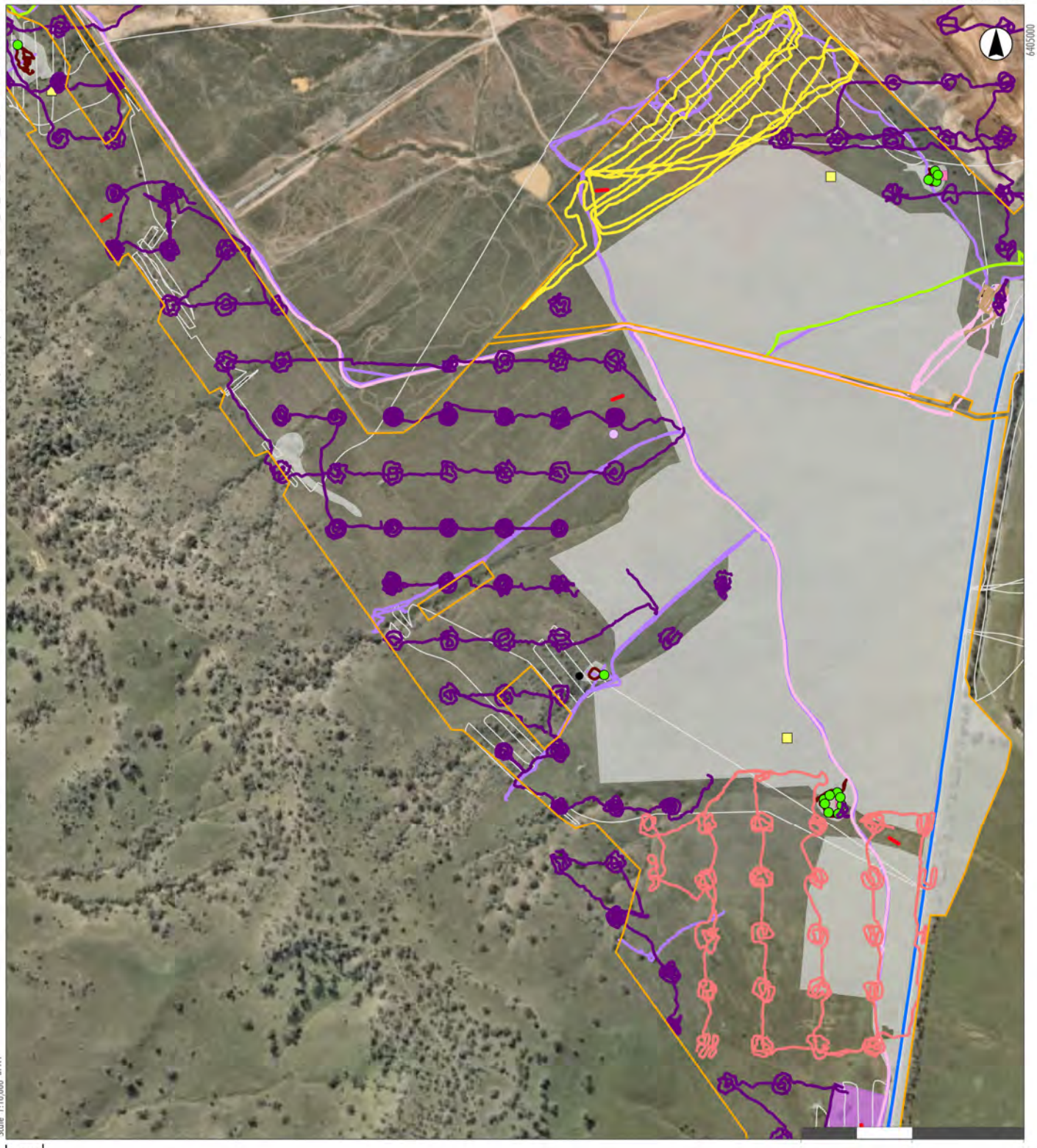
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-30

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2021)
- Targeted Flora Traverses (October 2020)
- Targeted Flora Traverses (November 2023)
- Targeted Flora Traverses (September 2023)

Targeted Threatened Fauna Surveys

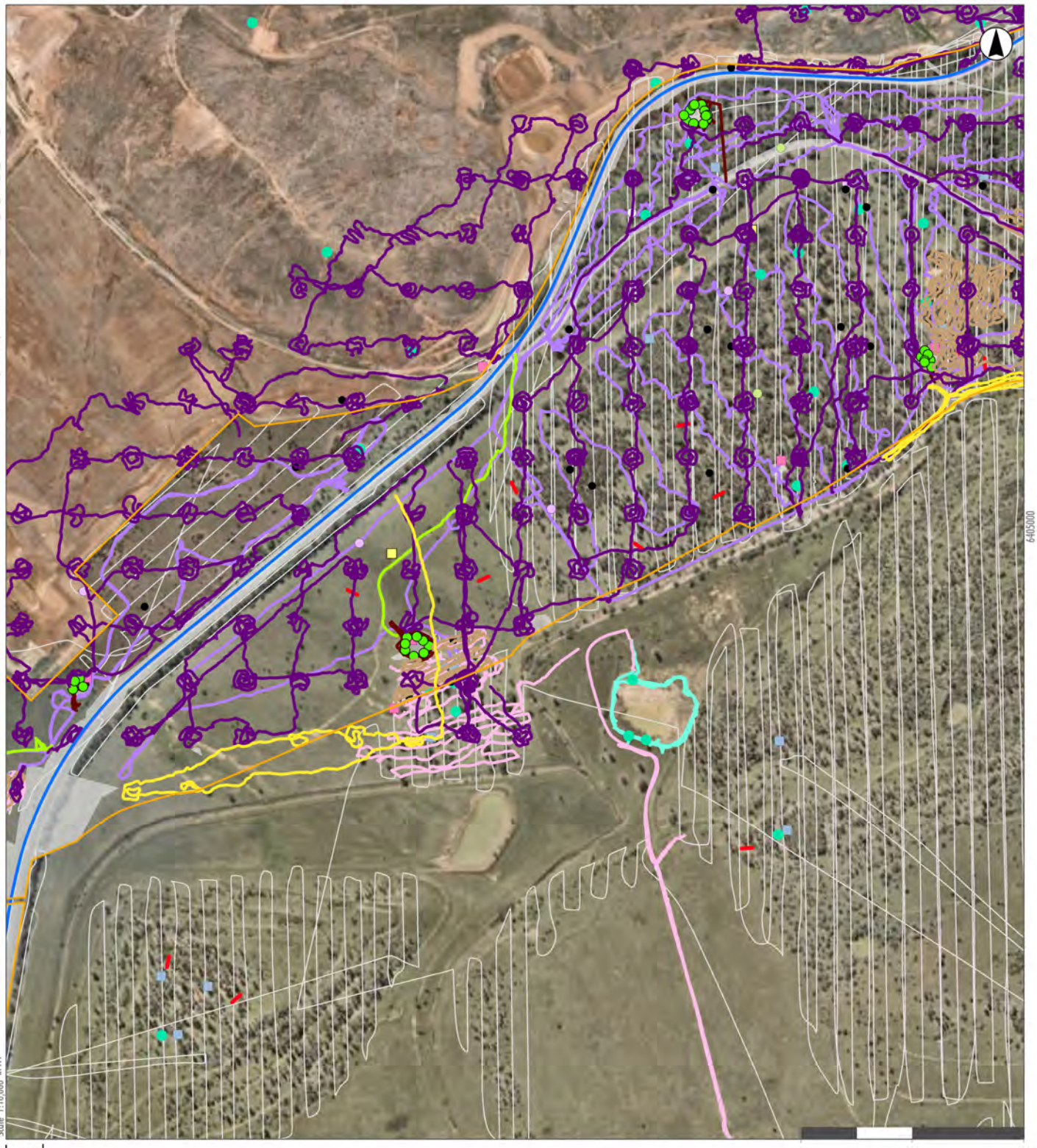
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-31

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2021)
- Targeted Flora Traverses (October 2020)
- Targeted Flora Traverses (November 2023)

Targeted Threatened Fauna Surveys

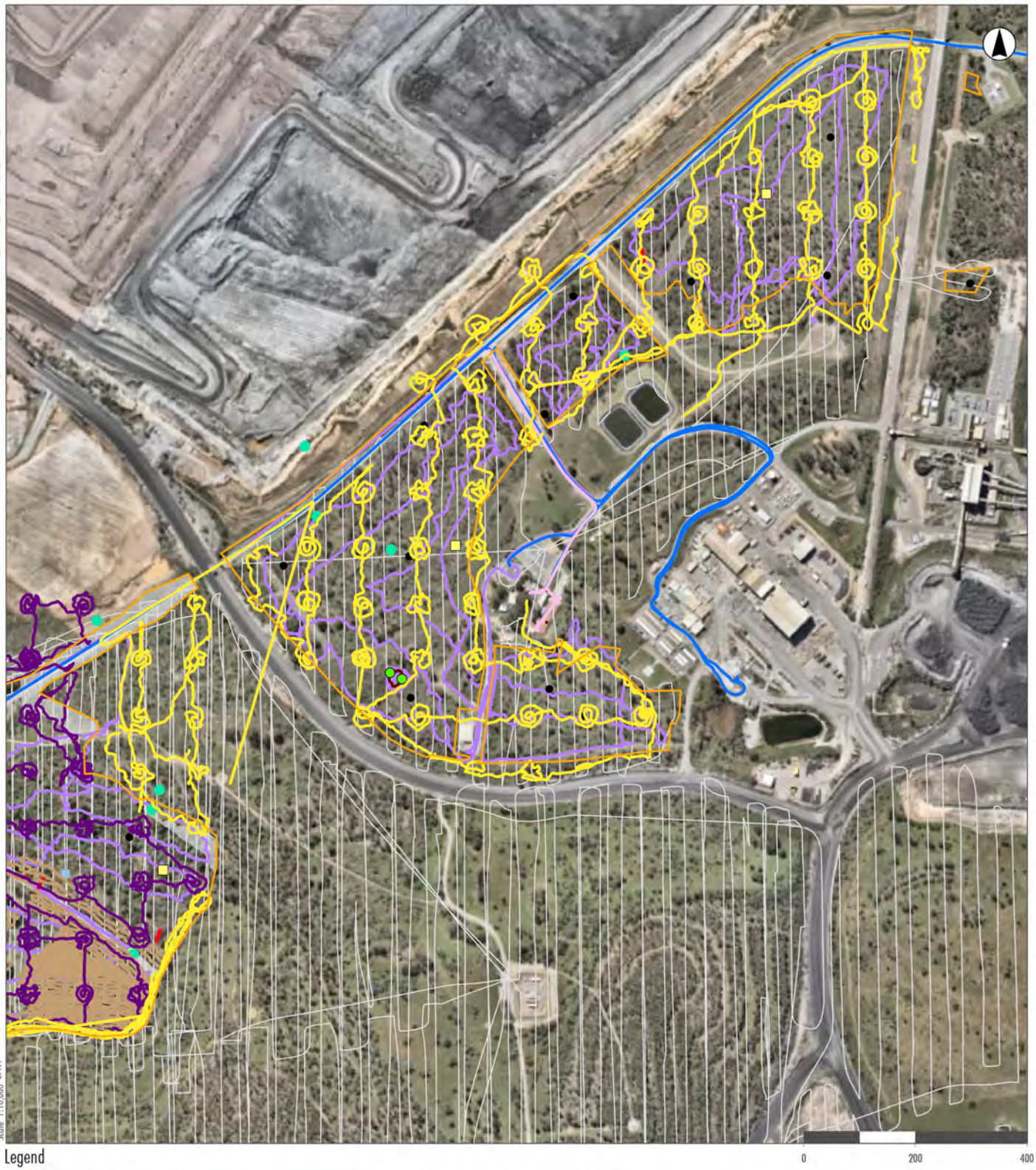
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Echolocation Detection Survey (March 2020)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Green and golden bell frog call playback and spotlighting surveys for Commonwealth Assessment
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-32

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2021)
- Targeted Flora Traverses (October 2020)
- Targeted Flora Traverses (November 2023)

Targeted Threatened Fauna Surveys

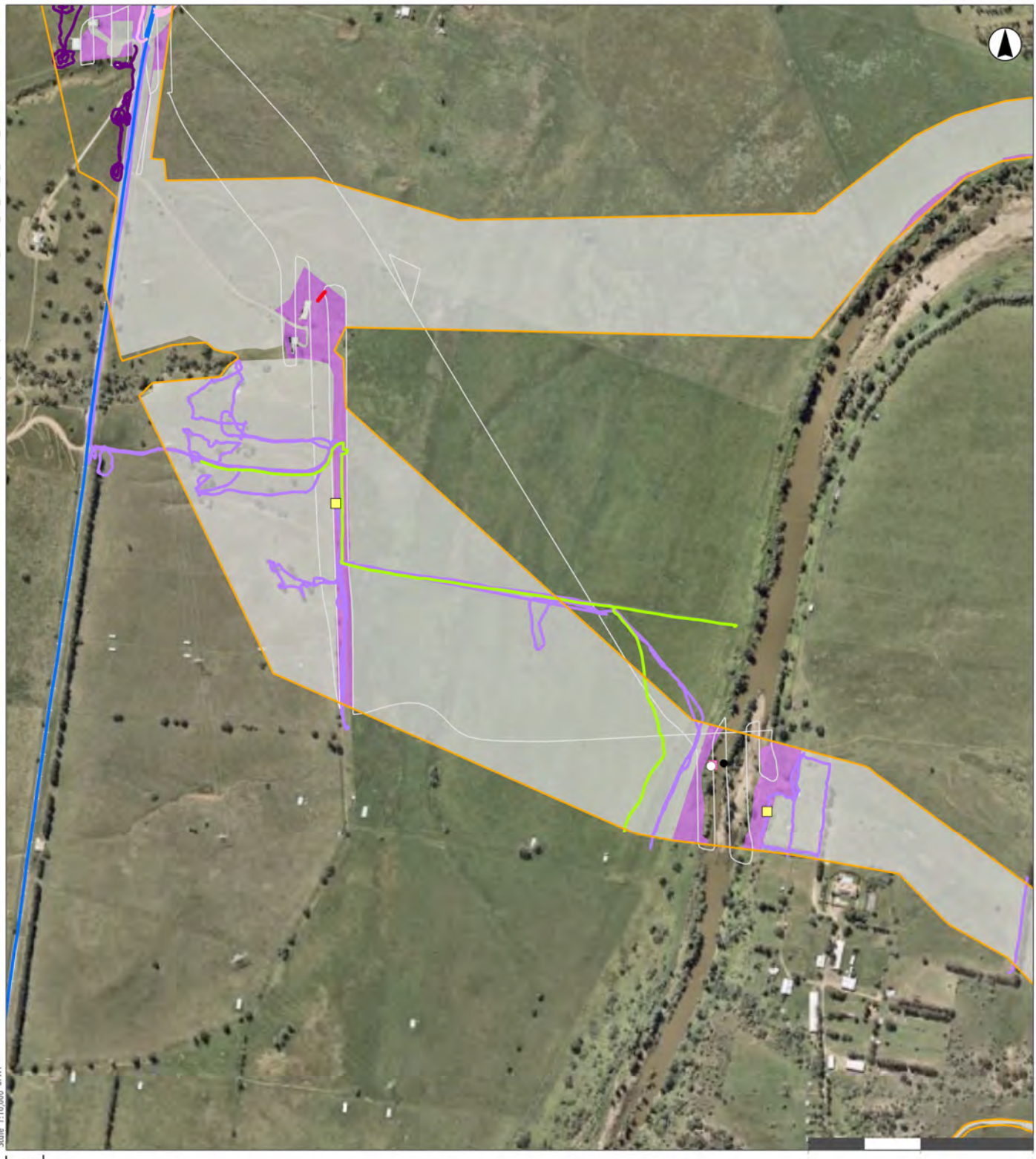
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-33

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Echolocation Detection Survey (March 2020)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Pitfall Trap Locations (May - August 2023)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-34

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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Scale 1:10,000 at A4

0 200 400 Metres

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation
- River Red Gum Additional Disturbance Area

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

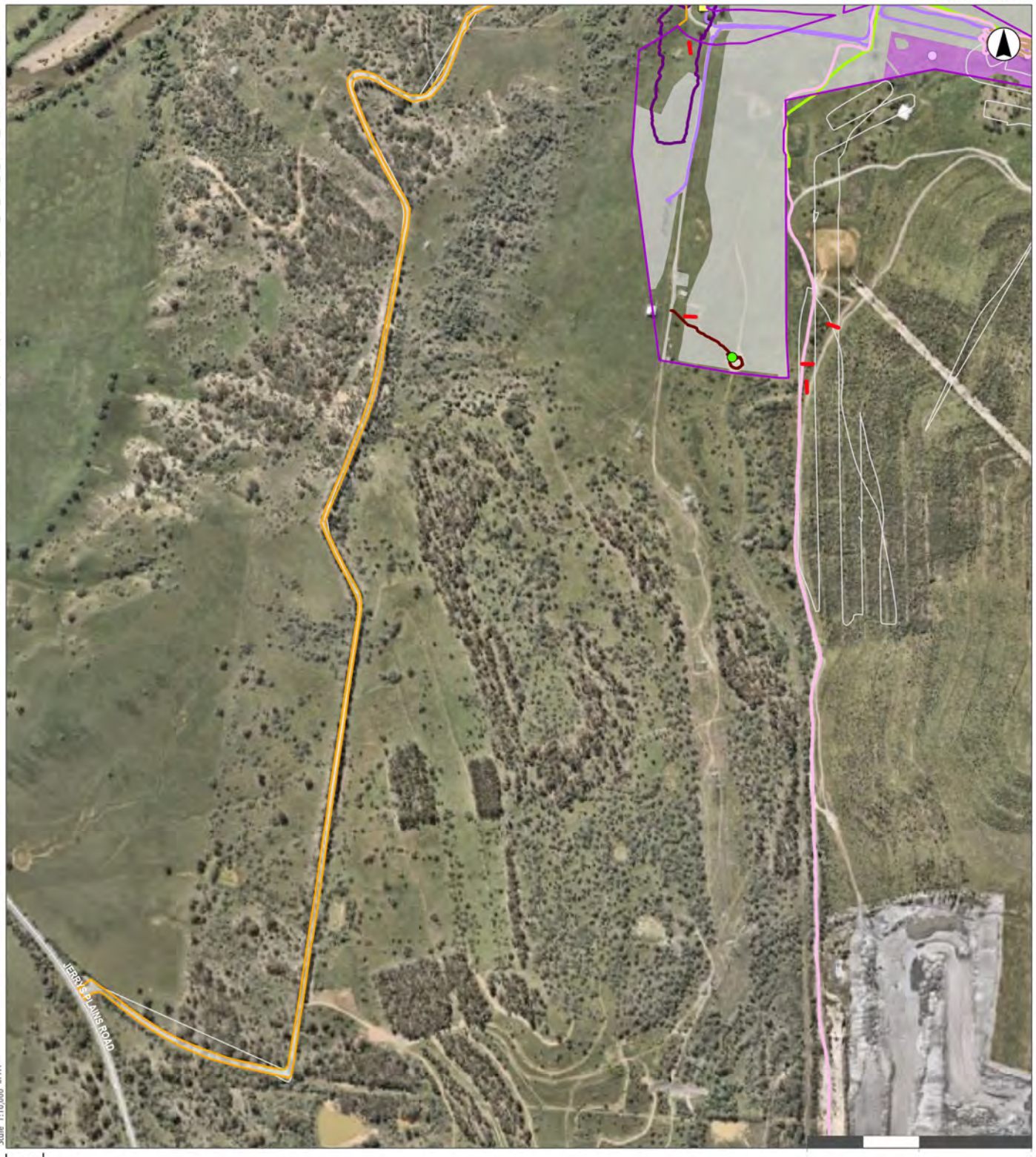
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-35

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

0 200 400 Metres

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)
- Targeted Flora Traverses (November 2023)

Targeted Threatened Fauna Surveys

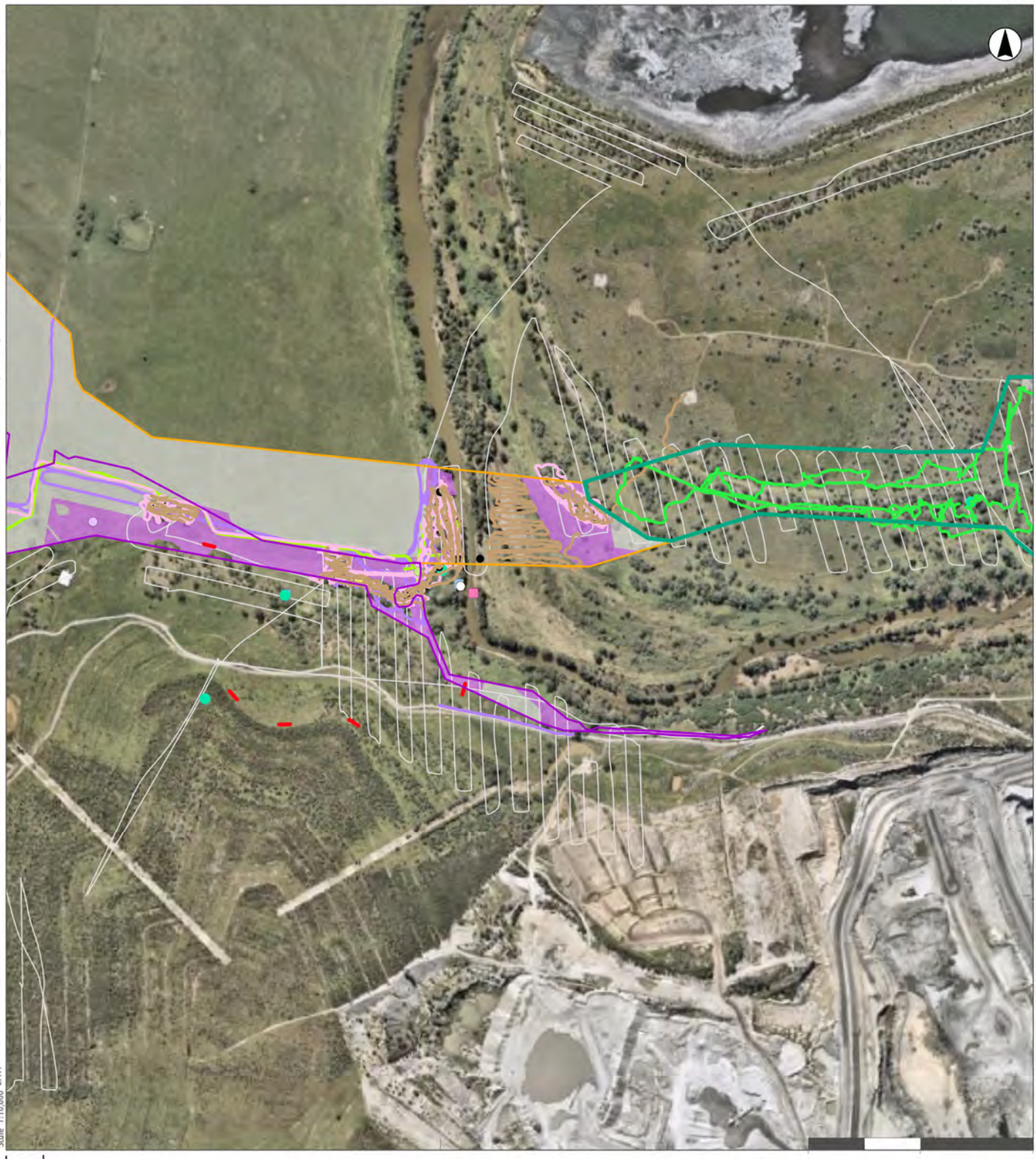
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- *Delma sp.* Tile Sites (2020 - 2021)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-36

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation
- River Red Gum Additional Disturbance Area

Targeted Threatened Flora Surveys

- Targeted RRG Traverses (August 2022)
- Targeted Flora Traverses (November 2023)

Targeted Threatened Fauna Surveys

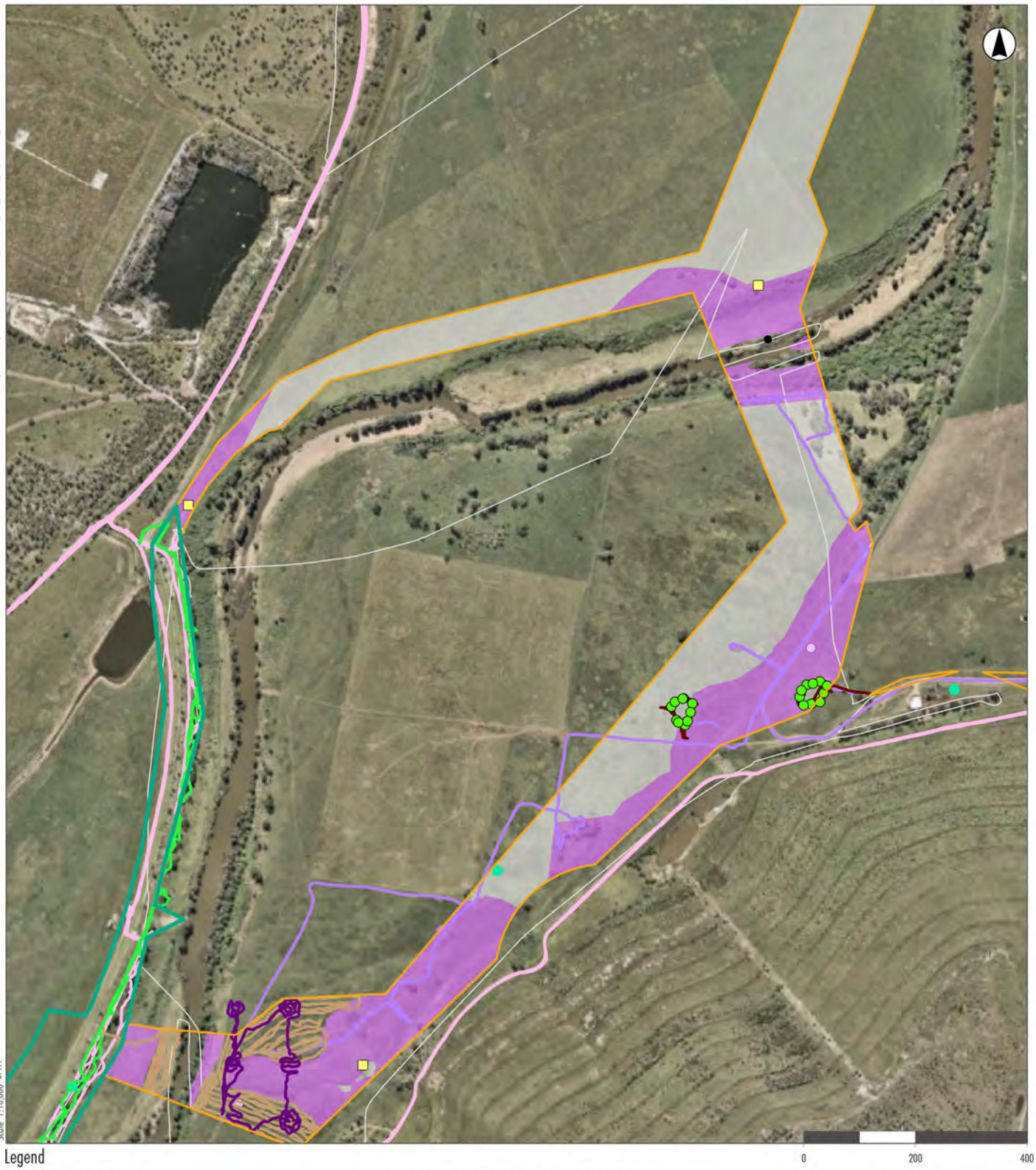
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Echolocation Detection Survey (March 2020)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Pitfall Trap Locations (May - August 2023)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Opportunistic Driving Spotlighting (February - March 2025)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-37

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation
- River Red Gum Additional Disturbance Area

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)
- Targeted RRG Traverses (August 2022)
- Targeted Flora Traverses (November 2023)

Targeted Threatened Fauna Surveys

- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-38

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation

Targeted Threatened Fauna Surveys

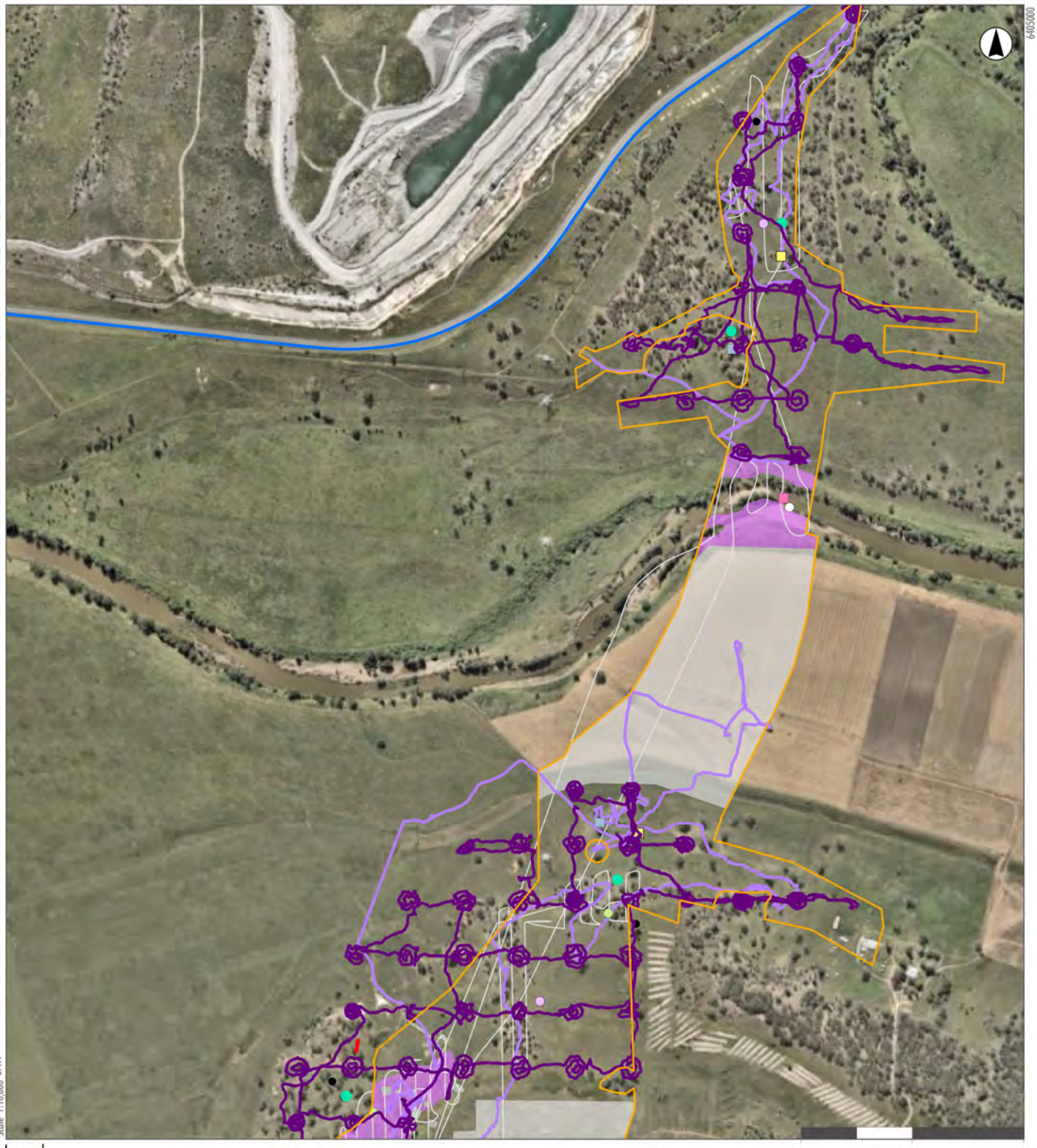
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-39

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

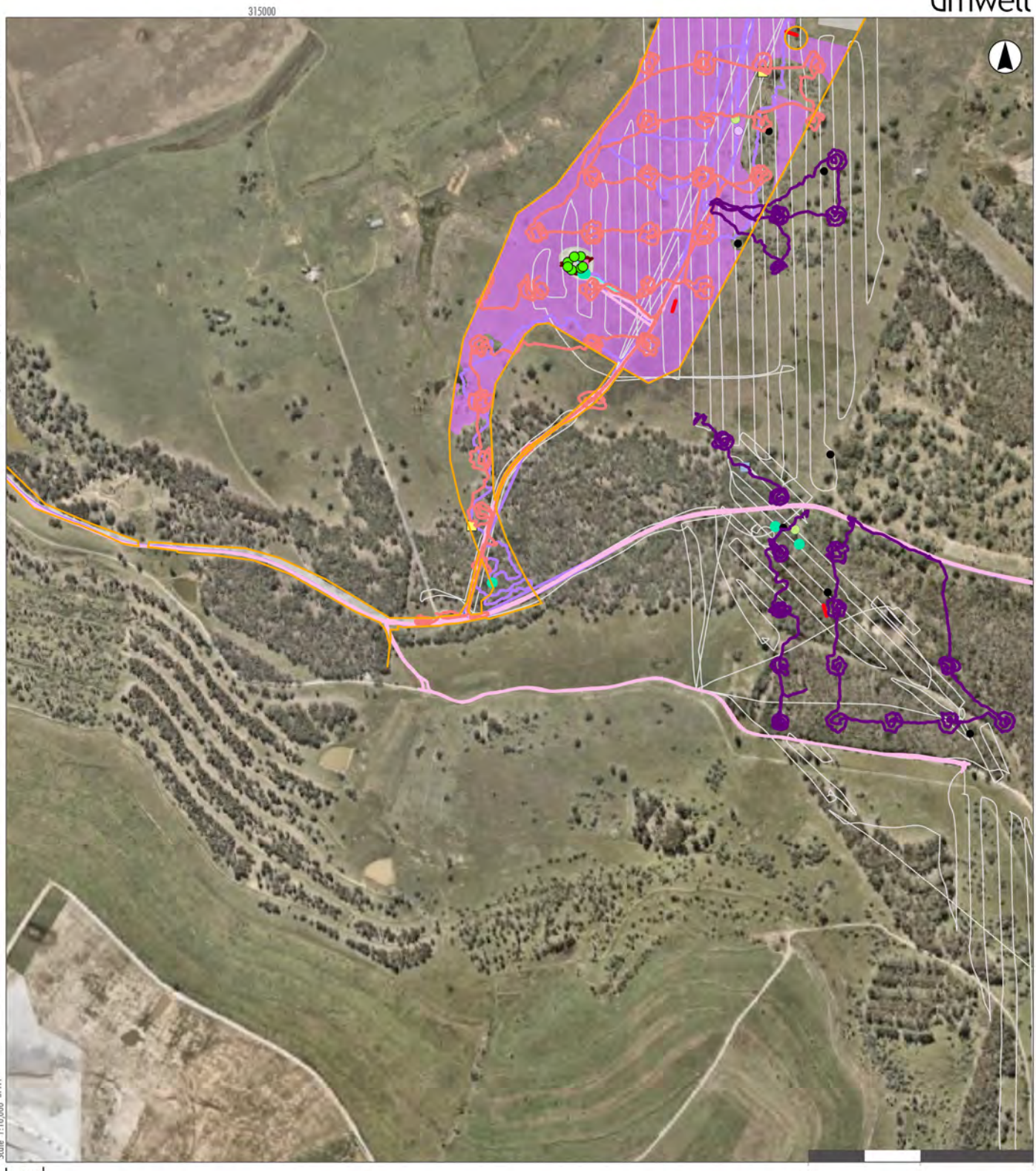
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Echolocation Detection Survey (March 2020)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Pitfall Trap Locations (May - August 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-40

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)
- Targeted Flora Traverses (September 2023)

Targeted Threatened Fauna Surveys

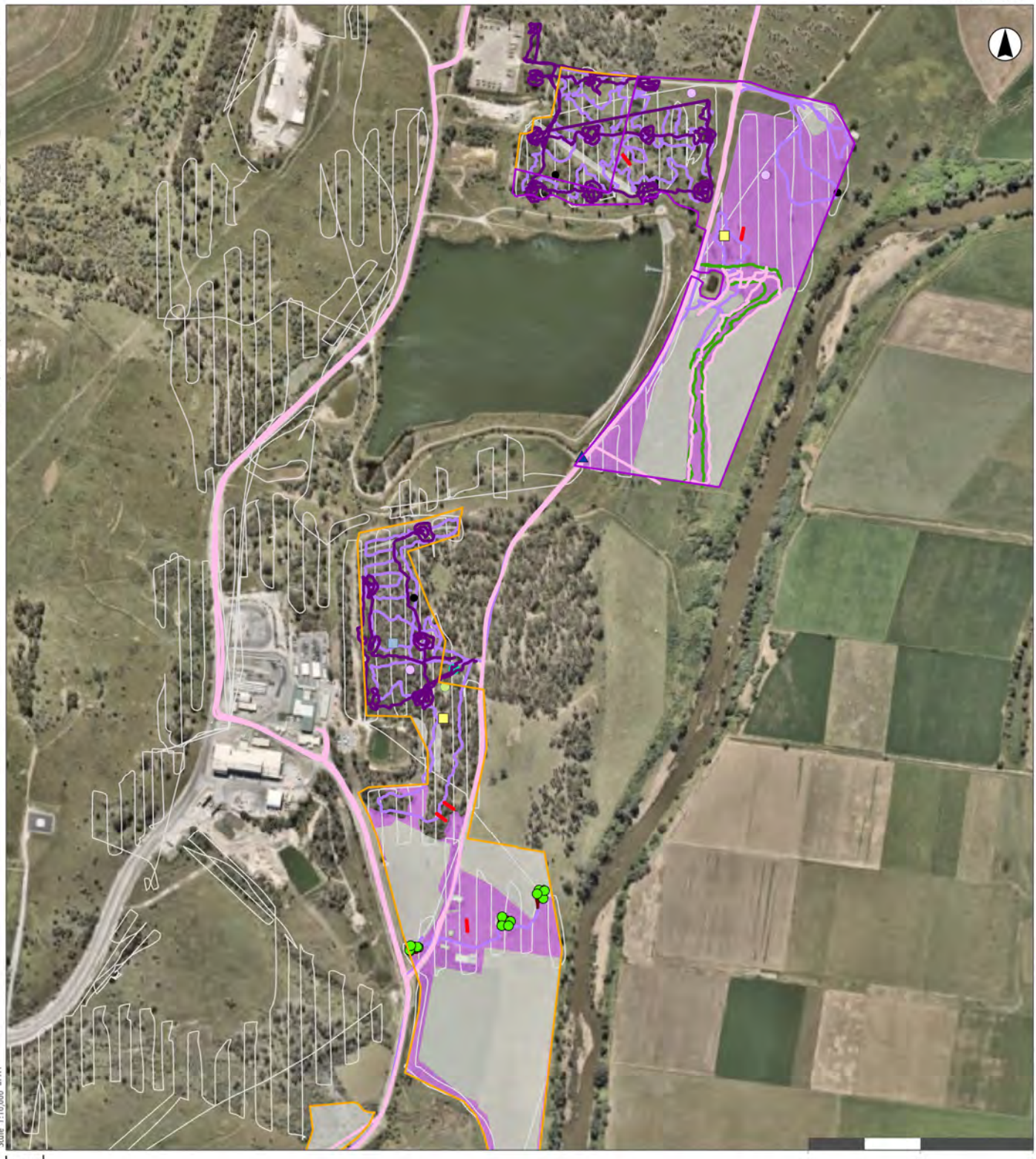
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Green and golden bell frog call playback and spotlighting surveys for Commonwealth Assessment
- Opportunistic Driving Spotlighting (October 2023)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-41

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- HVO South Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

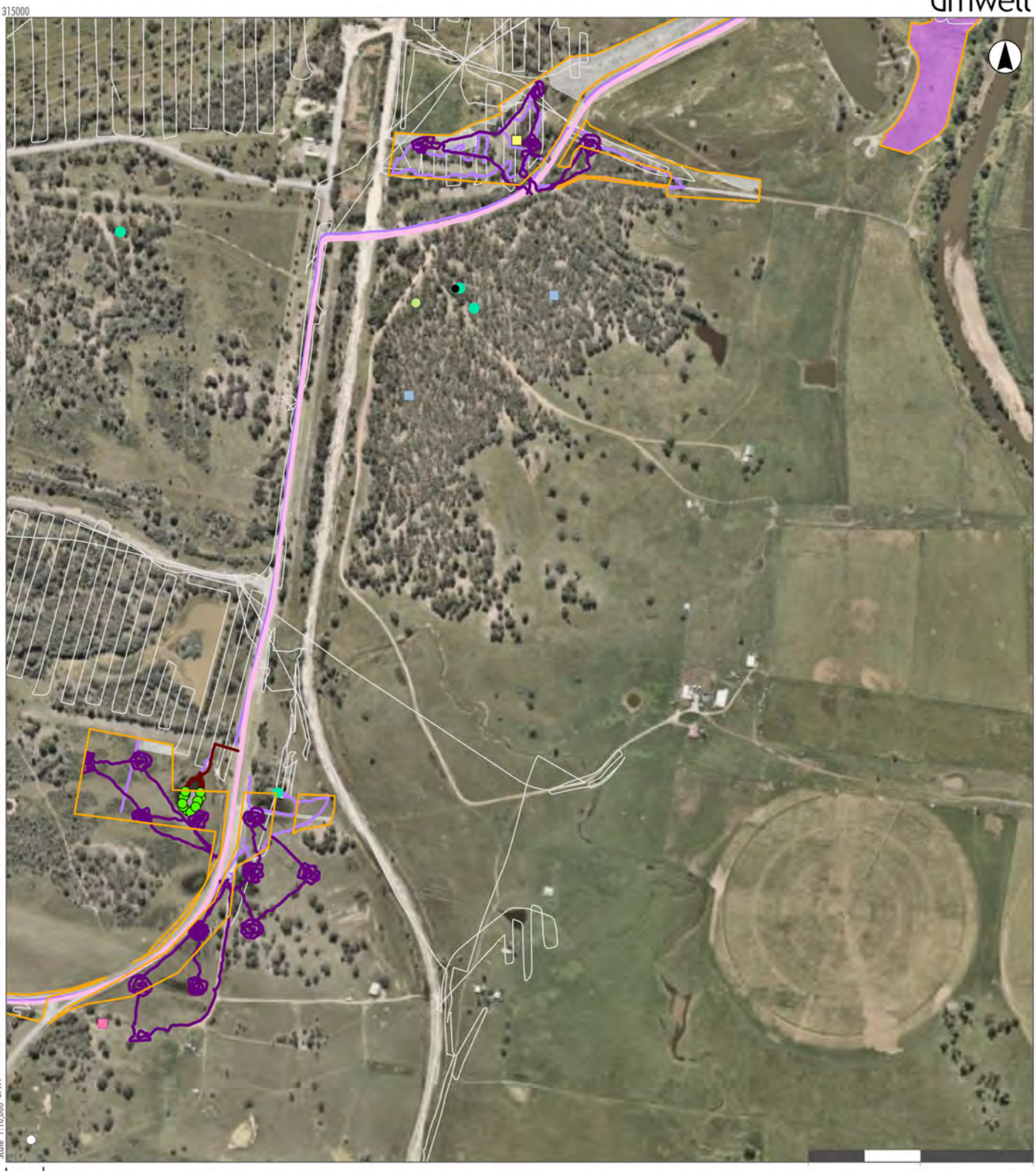
- Search for Microbat Roosting in Culverts (October 2023)
- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- *Delma sp.* Tile Sites (2020 - 2021)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Pitfall Trap Locations (May - August 2023)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Targeted Arboreal Spotlighting PCT4089 (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-42

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)



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Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Exotic Vegetation

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Targeted GGBF Call playback and Spotlight Point (February - March 2025)
- Echolocation Detection Survey (March 2020)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Remote Camera Surveys (March 2020; October 2023)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Mammals - nocturnal spotlighting and call playback (July 2020)
- Targeted GGBF Visual and Aural Spotlighting Walking Traverses (February - March 2025)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-43

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

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Scale 1:10,000 at A4

Legend

- HVO North Development Footprint
- Category 1 - Exempt Land
- Road

Targeted Threatened Flora Surveys

- Targeted Flora Traverses (October 2020)

Targeted Threatened Fauna Surveys

- Targeted Forest Owl Acoustic Recorder Survey (June - July 2025)
- Echolocation Detection Survey (March 2020)
- Koala SAT Survey (July 2020; May - June 2023; 2025)
- Diurnal Call-playback and Bird Survey (2019 - 2020; August - October 2023)
- Amphibians - nocturnal spotlighting and call playback (March 2020)
- Pitfall Trap Locations (May - August 2023)
- Spotlighting Transects (October - December 2023)
- Opportunistic Driving Spotlighting (October 2023)
- Hollow-bearing Tree and Nest Tree Searches (March - April 2025)
- Thermal Drone Flight Path (July 2023)

ANNEXURE C1-44

Species-Credit Species Survey Effort

GDA2020 MGA Zone 56

Image Source: Nearmap (April 2015) Data source: DFSI (2024)

Appendix D

Threatened Species Assessment and Survey Methodology

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D.1 Habitat Suitability Assessment

Table D.1 below provides an evidence-based justification for the exclusion of threatened species from the predicted BAM-C list and literature review due to geographic limitations, habitat constraints, microhabitats or where the species is considered vagrant. The remaining species-credit species that required further assessment (i.e. targeted survey) are outlined in **Table D.1.**

Note: no predicted ecosystem-credit species were excluded from the BAM-C for this assessment.

Table D.1 Threatened Species Excluded from Assessment

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Justification for Exclusion
Flora Species				
North Rothbury persoonia ***Persoonia pauciflora***	CE	CE	BAM-C	According to the TBDC, this species has an "extremely restricted distribution; all but one of the plants which make up the only known population occur within a 2.5 km radius of the original specimen at North Rothbury in the Cessnock local government area. Within this range, there are three main sub-populations which comprise approximately 90% of the total population. The other 10% of the population occurs as scattered individuals in what is a relatively disturbed landscape." This population occurs approximately 40 km south-east of the Development Footprint.
Fauna Species (Species-credit)				
brush-tailed rock wallaby ***Petrogale penicillata***	E	V	BAM-C, Atlas	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC: 'Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines'. The species is highly unlikely to occur in the Development Footprint or be impacted by the Project. No further assessment is required.
regent honeyeater ***Anthochaera phrygia***	CE	CE	PMST, BAM-C	This species is a dual ecosystem and species credit species. It only generates credits for impacts in areas specifically mapped as 'important areas' by the DPE. At the time of writing, the Development Footprint was not located within or near any mapped 'important areas' for the regent honeyeater. As this habitat constraint is absent from the Development Footprint, no further assessment is required. Note: targeted surveys were undertaken for the regent honeyeater in August 2019 and July 2020 for the purposes of informing the EPBC Act Referral assessment. This species was not recorded during these surveys or any other surveys undertaken for this assessment.
swift parrot ***Lathamus discolor***	E	CE	PMST, BAM-C	This species is a dual ecosystem and species credit species. It only generates credits for impacts in areas specifically mapped as 'important areas' by the DPE. At the time of writing, the Development Footprint was not located within or near any mapped 'important areas' for the swift parrots. As this habitat constraint is absent from the Development Footprint, no further assessment is required. Note: targeted surveys were undertaken for the swift parrot in August 2019 and July 2020 for the purposes of informing the EPBC Act Referral assessment. This species was not recorded during these surveys or any other surveys undertaken for this assessment.

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Justification for Exclusion
large-eared pied bat ***Chalinolobus dwyeri***	E	E	BAM-C, PMST, Atlas	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC and the '*Species credit' threatened bats and their habitats survey guide*': 'within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or old mines or tunnels'. The broader HVO mining area is not known to support mine shafts or workings, being an open cut mine, and the Project area is not known to support old buildings that would provide roosting or maternity habitat for this species. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. Additional habitat constraints surveys across the Development Footprint were undertaken in April 2025, confirming the outcomes of original surveys. Furthermore, targeted searches of culverts in October 2023 (undertaken as part of the Commonwealth assessment for the Project) did not result in the identification of roosting microbats. Further discussion is provided in **Section 6.4.2.1.** No further assessment is required.
little bent-winged bat ***Miniopterus australis***	V	-	BAM-C, Atlas	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC and the '*Species credit' threatened bats and their habitats survey guide*': 'cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding'. The broader HVO mining area is not known to support mine shafts or workings, being an open cut mine, and the Project area is not known to support old buildings that would provide roosting or maternity habitat for this species. Maternity colonies are restricted to specific maternity caves of which only five nursery sites are known in Australia (OEH 2020). Targeted surveys undertaken from 2018 to 2021 of the flood gates and flood pipes in the Hunter Valley Flood Mitigation Scheme (HVFMS) recorded *Miniopterus australis* calls and approximately 10 individuals identified in one flood pipe near Woodville NSW, approximately 70 km east of the Development Footprints (Umwelt 2021). Thus, although the targeted surveys did find *Miniopterus australis* roosts, no maternity roosts were identified during the surveys. A BioNet database search revealed numerous records of the species within the Hunter region, although there are no details outlining any maternity roosts for this species among the records (DCCEEW 2025).

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Justification for Exclusion
				There is currently no literature which documents known maternity roosts of *Miniopterus australis* within the Hunter. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. Additional habitat constraints surveys across the Development Footprint were undertaken in April 2025, confirming the outcomes of original surveys. Furthermore, targeted searches of culverts in October 2023 (undertaken as part of the Commonwealth assessment for the Project) did not result in the identification of roosting microbats. Further discussion is provided in **Section6.4.2.2.** No further assessment is required.
large bent-winged bat ***Miniopterus orianae oceanensis***	V	-	BAM-C, Atlas	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC and the '*Species credit' threatened bats and their habitats survey guide*': 'cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding'. The broader HVO mining area is not known to support mine shafts or workings, being an open cut mine, and the Project area is not known to support old buildings that would provide roosting or maternity habitat for this species. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. Additional habitat constraints surveys across the Development Footprint were undertaken in April 2025, confirming the outcomes of original surveys. Furthermore, targeted searches of culverts in October 2023 (undertaken as part of the Commonwealth assessment for the Project) did not result in the identification of roosting microbats. No further assessment is required.
eastern cave bat ***Vespadelus troughtoni***	V	-	BAM-C	The Development Footprint is not within areas that constitute the following habitat constraint as noted in the TBDC and the '*Species credit' threatened bats and their habitats survey guide*': 'within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds'. The broader HVO mining area is not known to support mine shafts or workings, being an open cut mine, and the Project area is not known to support old buildings that would provide roosting or maternity habitat for this species. Habitat searches undertaken in March and October 2020 did not record the habitat constraints required for the species. Additional habitat constraints surveys across the Development Footprint were undertaken in April 2025, confirming the outcomes of original surveys. No further assessment is required.

Common Name *Scientific Name*	BC Act	EPBC Act	Source	Justification for Exclusion
***Dromaius novaehollandiae* - endangered population** **Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area**	E	-	BAM-C	According to the TBDC, this "species was formerly widespread in north-eastern NSW, but is now restricted to coastal and near-coastal areas between Evans Head and Red Rock and a small isolated population further west in the Bungawalbin area. The range of the species continues to contract in recent years. It now appears to be absent from Broadwater National Park, there are few recent sightings from its former stronghold in Bundjalung National Park and it is not known whether a natural population continues to persist in the Port Stephens area." The Development Footprint does not fall within the known distribution of this population. No further assessment is required.
broad-billed sandpiper ***Limicola falcinellus***	V	-	BAM-C	This species is a dual ecosystem and species credit species. It only generates credits for impacts in areas specifically mapped as 'important areas' by the DPE. At the time of writing, the Development Footprint was not located within or near any mapped 'important areas' for the broad-billed sandpiper. As this habitat constraint is absent from the Development Footprint, no further assessment is required.
striped legless lizard ***Delma impar***	V	V	BAM-C	The BAM-C predicted the potential occurrence of striped legless lizard (*Delma impar*), which is better known for its populations in the southern tablelands and south west slopes of NSW. It has been recently determined that a newly-described species of legless lizard occurs in the Hunter, being the Hunter Valley delma (*Delma vescolineata*) (Mahony et al. 2022). On 11 October 2024, the Hunter Valley delma (*Delma vescolineata*) was listed as endangered under the BC Act. At the time of writing, the *Delma vescolineata* is not yet predicted by the BAM-C and *Delma impar* is still predicted as the data has not been updated to reflect the new listing. As it has been determined that it is *Delma vescolineata* that occurs on the site, not *Delma impar*, *Delma impar* has been removed as a candidate species from the BAM-C and credits for the Hunter Valley Delma have been calculated in accordance with advice from the BOS Helpdesk received on 29 July 2025.

D.2 Targeted Species-credit Species Surveys Effort

The following tables identify the candidate species-credit species predicted by the BAM-C or identified in the literature review and outlines the surveys undertaken within the Development Footprint for each species.

All TBDC information is correct as of 24 June 2025.

Table D.2 Species-credit Species Survey Effort

Survey details – *Acacia pendula* – endangered population in the Hunter catchment	
Credit Type	Species
Biodiversity Risk Weighting	3
Source	BAM-C, Bionet Atlas
Potential Habitat Description	**TBDC:** Within the Hunter catchment the species typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations. It is not known to occur within any conservation areas.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431 3485
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Identification requires voucher confirmation from RBG. Seed pods are to be used to identify, as easily confused with closely related arid Acacia species, and to assess seed alignment. Successful fruiting has never been observed in the Hunter population, and all populations appear sterile. The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	<u>Survey method:</u> Following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). <u>Survey dates:</u> 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023 1 November 2023. <u>Survey effort:</u> Total of 515 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 137.85 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	<u>Survey method:</u> Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**).

Survey details – *Acacia pendula* – endangered population in the Hunter catchment	
	Survey dates: September 2020 February and April 2021 September 2023 February and March 2025 2 June 2025 Survey effort: Estimate of 140 person hours of sampling within and around 70 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot). Estimate of 172 person hours across all 86 BAM integrity plots (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	Yes
Justification	*Acacia pendula* individuals were recorded near an access track adjacent to Lemington Road, within the Development Footprint. Samples were collected and confirmed as *Acacia pendula* by the NSW Royal Botanic Gardens (refer to **Annexure J**). The recorded individuals are naturally regenerating in a grassy paddock within proximity of known mature planted individuals occurring along the edge of Lemington Road (refer to **Photo 4.2**). It is expected the individuals in the Development Footprint have propagated from these plantings.
Species Polygon Required?	Yes The individuals recorded in the Development Footprint occur outside the impact areas of the proposed realigned easement (i.e. the Wider Easement Area) and are proposed to avoided (refer to **Figure 4.8**).

Survey details – *Cymbidium canaliculatum* – endangered population in the Hunter catchment	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C, Bionet atlas
Potential Habitat Description	**TBDC:** Typically grows in the hollows, fissures, trunks and forks of trees in dry sclerophyll forest or woodland, where its host trees typically occur on Permian Sediments of the Hunter Valley floor. It usually occurs singly or as a single clump, which can form large colonies on trees, between two and six metres from the ground. Recruitment, germination and persistence is reliant on rotting wood and mycorrhizal fungal associations. Within the Hunter Catchment, *Cymbidium canaliculatum* is most commonly found in *Eucalyptus albens* (White Box) dominated woodlands (including those dominated by the intergrade *E. albens-moluccana*, much of which may constitute the endangered ecological community (EEC) 'White Box Yellow Box Blakely's Red Gum Woodland'. It has been found, less commonly, to grow on *E. dawsonii* (Slaty Box), *E. crebra* (Narrow-leaved Ironbark), *E. moluccana* (Grey Box), *Angophora floribunda* (Rough-barked Apple), *Acacia salicina* (Cooba) and on some other species, including dead stags. It is also known to use man-made structures, such as fence posts and wooden bridges as its host. *Cymbidium canaliculatum* flowers from September to November.

Survey details – *Cymbidium canaliculatum* – endangered population in the Hunter catchment	
Habitat Constraints or Geographic Limitations	Epiphytic in a range of Eucalypt and Angophora species. Cut stumps or logs on ground.
Associated PCTs	3431 3485 4081 4089
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Plants are usually found between 2 m and 15 m above the ground but can persist on fallen trees if protected from grazing. Recruitment has only been reported in intact vegetation, but plants persist in trees in thinned woodland and in scattered trees in derived grassland. Grazed or otherwise damaged plants can resprout, flower and set seeds, but only if the pseudobulbs are intact. The unit of measure for this species is count of individuals. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 13 July 2022 18 September 2023 1 November 2023 Survey effort: Total of 522 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 144.72 ha.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 February and April 2021 September 2023 February and March 2025 Survey effort: Estimate of 142 person hours of sampling within and around 71 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot). Estimate of 172 person hours across all 86 BAM integrity plots (based on an average of 2 person hours per plot).

Survey details – *Cymbidium canaliculatum* – endangered population in the Hunter catchment	
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded.
Species Polygon Required?	No

Survey details – pine donkey orchid *(Diuris tricolor)*	
Credit Type	Species
Biodiversity Risk Weighting	1.5
Source	BAM-C
Potential Habitat Description	**TBDC:** The Pine Donkey Orchid grows in sclerophyll forest among grass, often with native Cypress Pine (*Callitris* spp.). It is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431 3485
Required Survey Period	September–October
Survey Requirements	As noted in the TBDC (DCCEEW 2025): This species is known to grow in disturbed areas/grassland. The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in A**nnexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023 1 November 2023. Survey effort: Total of 515 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 137.85 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**).

Survey details – pine donkey orchid *(Diuris tricolor)*	
	Survey dates: September 2020 September 2023 Survey effort: Estimate of 32 person hours of sampling within and around 16 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded.
Species Polygon Required?	No

Survey details – *Diuris tricolor* – endangered population in the Muswellbrook LGA	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Found in sclerophyll woodland and derived grassland on flats or small rises, on a range of substrates including sandy or loamy soils. The habitat of *Diuris tricolor* in the Muswellbrook LGA has been fragmented by past land clearing.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431 3485
Required Survey Period	September–October
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Flowers are to be used to locate and identify. May require multiple surveys. Surveys should first be conducted in September, and if not found during survey, survey again in October. Flowering usually peaks in early October. The unit of measure for this species is area.
Targeted Surveys	Survey method: Following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023 1 November 2023.

Survey details – *Diuris tricolor* – endangered population in the Muswellbrook LGA	
	Survey effort: Total of 515 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 137.85 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 September 2023 Survey effort: Estimate of 32 person hours of sampling within and around 16 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded.
Species Polygon Required?	No

Survey details – *Eucalyptus camaldulensis* – endangered population in the Hunter catchment	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C, Bionet Atlas
Potential Habitat Description	**TBDC:** May occur with *Eucalyptus tereticornis, Eucalyptus melliodora, Casuarina cunninghamiana* subsp. *cunninghamiana* and *Angophora floribunda*. Most of the occurrences are on private land and there are no known occurrences in conservation reserves.
Habitat Constraints or Geographic Limitations	Floodplains of watercourses, including rivers, creeks, intermittent streams or billabongs.
Associated PCTs	4089
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Seeds are spread by floodwaters. The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Targeted threatened flora surveys following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**).

Survey details – *Eucalyptus camaldulensis* – endangered population in the Hunter catchment	
	Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023. Survey effort: Total of 7 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 6.82 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 February and March 2025 Survey effort: Estimate of 26 person hours of survey within 13 plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	Yes
Justification	A population of river red gum (*Eucalyptus camaldulensis*) is known to occur along the Hunter River around HVO and Carrington Billabong, to the east near the confluence of Glennies Creek and further south along Wollombi Brook. Where the HVO North Development Footprint intersects the Hunter River east of the Carrington Billabong and north of Cheshunt Pit, individuals of river red gum were recorded on the banks of the Hunter River in association with PCT4089 Namoi-Upper Hunter River Red Gum Forest and PCT4081 Northwest River Oak-River Red Gum Forest. A large number of river red gums were recorded within the River Red Gum Additional Disturbance Area (refer to **Figure 4.7**). At the time of survey, the stands of river red gum within the Development Footprint and River Red Gum Additional Disturbance Area contained mature trees and signs of recruitment.
Species Polygon Required?	Yes The location of the river red gum endangered population and habitat polygon mapping in relation to the HVO North and HVO South Development Footprints (and the River Red Gum Additional Disturbance Area) is shown in **Figure 4.7**. This was calculated on the direct impacts to the population by buffering all recorded individuals by 30 metres (except where the buffer extended to onto the artificial bund). Direct impacts to the population are expected at the locations where the proposed realignment of the transmission line crosses the Hunter River. Where possible, river red gum individuals will be avoided through careful placement of poles and access tracks, however it is acknowledged that necessary maintenance of the transmission line easement will require trimming of canopy species.

Survey details – slaty red gum *(Eucalyptus glaucina)*	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C, Bionet Atlas, PMST
Potential Habitat Description	**TBDC:** Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Use buds and/or juvenile growth to detect and identify. The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Targeted threatened flora surveys following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023. Survey effort: Total of 508 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 131.94 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 February and April 2021 September 2023 February and March 2025 Survey effort: Estimate of 130 person hours of survey within 65 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – Pokolbin mallee *(Eucalyptus pumila)*	
Credit Type	Species
Biodiversity Risk Weighting	3
Source	BAM-C
Potential Habitat Description	**TBDC:** The single known population occupies north-west-facing slopes derived from sandstone. Present as a mid-canopy species to a height of 6 m within dry sclerophyll woodland which has a canopy comprising *Eucalyptus fibrosa, Callitris endlicheri and*, to a lesser extent, *Corymbia maculata*.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3485
Required Survey Period	All year
Survey Requirements	There are no survey requirements or additional information noted in the TBDC (DCCEEW 2025). The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
General Species Polygon Requirements	NA
Targeted Surveys	Survey method: Targeted threatened flora surveys following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023 1 November 2023. Survey effort: Total of 7 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 5.91 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 February and April 2021 September 2023 February and March 2025. Survey effort: Estimate of 8 person hours of survey within 4 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).

Survey details – Pokolbin mallee *(Eucalyptus pumila)*	
	Estimate of 172 person hours across all 86 BAM integrity plots (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded.
Species Polygon Required?	No

Survey details – *Ozothamnus tesselatus*	
Credit Type	Species
Biodiversity Risk Weighting	1.5
Source	BAM-C, PMST
Potential Habitat Description	**TBDC:** Grows in eucalypt woodland.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431
Required Survey Period	September–October
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Flowers are used to locate. This species can be identified by foliage year-round by a skilled botanist. The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Targeted threatened flora surveys following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023. Survey effort: Total of 508 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 131.94 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**).

Survey details – *Ozothamnus tesselatus*	
	Survey dates: September 2020 February and April 2021 September 2023 February and March 2025. Survey effort: Estimate of 130 person hours of survey within 65 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – scant pomaderris *(Pomaderris queenslandica)*	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Flowers are useful to identify, as easily confused with *P. intermedia*, however species can be distinguished by leaf morphology; *P. intermedia* generally has a much larger leaf compared to *P. queenslandica*. The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Targeted threatened flora surveys following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 11 August 2022

Survey details – scant pomaderris *(Pomaderris queenslandica)*	
	18 September 2023 1 November 2023. Survey effort: Total of 508 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 131.94 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 February and April 2021 September 2023 February and March 2025. Survey effort: Estimate of 130 person hours of survey within 65 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – Tarengo leek orchid (*Prasophyllum petilum*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Grows in open sites within Natural Temperate Grassland at the Boorowa and Delegate sites. Also grows in grassy woodland in association with River Tussock (*Poa labillardieri*), Black Gum (*Eucalyptus aggregata)* and tea-trees (*Leptospermum* spp.) near Queanbeyan and within the grassy ground layer dominated by Kangaroo Grass under Box-Gum Woodland at Ilford (and Hall, ACT).
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431 3485
Required Survey Period	September–December
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Survey months differ based on location. The Hunter populations are to be surveyed in September to October and the timing may vary depending on season. The unit of measure for this species is area.

Survey details – Tarengo leek orchid (*Prasophyllum petilum*)	
	Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Targeted threatened flora surveys following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023 1 November 2023. Survey effort: Total of 515 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 137.85 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 February and April 2021 September 2023 February and March 2025. Survey effort: Estimate of 138 person hours of sampling within and around 69 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – *Prasophyllum* sp. *Wybong*	
Credit Type	Species
Biodiversity Risk Weighting	3
Source	BAM-C
Potential Habitat Description	**TBDC:** Known to occur in open eucalypt woodland and grassland
Habitat Constraints or Geographic Limitations	None

Survey details – *Prasophyllum* sp. *Wybong*	
Associated PCTs	3431 3485
Required Survey Period	September–October
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Flowers are to be used to identify the species. Flowering usually occurs in early October. May require multiple surveys. Surveys should first be conducted in September, and if not found during survey, it should be surveyed again in October. The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Targeted threatened flora surveys following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023. Survey effort: Total of 515 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 137.85 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 February and April 2021 September 2023 February and March 2025 Survey effort: Estimate of 138 person hours of sampling within and around 69 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot).
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – *Pterostylis chaetophora*	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** The preferred habitat is seasonally moist, dry sclerophyll forest with a grass and shrub understorey. The most commonly observed habitat is vegetation characterised by grassy open forests or derived native grasslands of *Eucalyptus amplifolia* and *Eucalyptus moluccana* on gentle flats, or that are dominated by *Corymbia maculata* with any of *Eucalyptus fibrosa, Eucalyptus sideroploia* or *Eucalyptus crebra*.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431 3485
Required Survey Period	September - November
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Flowering material is to be used to identify the species. This species flowers in September to early November. The unit of measure for this species is area. Minimum survey requirements as per the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e).
Targeted Surveys	Survey method: Targeted threatened flora surveys following the two-phase grid-based systematic approach as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Use of 100 m grids with approximate 20 m^2 circle at each intersection point and 5–10 m parallel traverses (refer to Figures in **Annexure C**). Survey dates: 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023. Survey effort: Total of 515 grid centre points surveys across predicted PCTs and a total estimate of survey coverage of approximately 137.85 ha. Refer to **Section 4.1.3.1** for detail.
Opportunistic and other Notable Surveys	Survey method: Sampling and opportunistic observations during floristic and vegetation plot surveys (refer to Figures in **Annexure C**). Survey dates: September 2020 February and April 2021 September 2023 February and March 2025. Survey effort: Estimate of 138 person hours of sampling within and around 69 BAM integrity plots undertaken in predicted PCTs (based on an average of 2 person hours per plot). Estimate of 172 person hours across all 86 BAM integrity plots (based on an average of 2 person hours per plot).

Survey details – *Pterostylis chaetophora*	
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – bush stone-curlew *(Burhinus grallarius)*	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber.
Habitat Constraints or Geographic Limitations	Fallen/standing dead timber including logs.
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): This species may be easier to detect during breeding season, possibly calls all year, but it is unclear how well it responds to playback. The unit of measure for this species is area. There is no minimum survey requirement for this species.
Targeted Surveys	**Acoustic recorder surveys:** A minimum detector spacing of 800 m covering all associated vegetation zones containing living or dead trees with a hollow >20 cm diameter that occurs >4 metres above the ground, reflecting a 400 m recording radius per detector. Detectors will be set to record from 30 minutes before sunset to 30 minutes after sunrise, every night while deployed. <u>Survey dates and effort:</u> June and July 2025. Survey effort TBC. **Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species are visually identified using 10 x 40 magnification binoculars or by call recognition. <u>Survey dates and effort:</u> 23–26 March 2020 – 7 person hours across 16 locations over 4 consecutive nights. 6–9 July 2020 – 6.4 person hours across 15 locations over 4 consecutive nights.

Survey details – bush stone-curlew *(Burhinus grallarius)*	
	23–26 October, 27 November, 5, 11 December 2023 – 16 person hours across 7 nights targeting riparian habitats. **Diurnal bird surveys**. Undertaken during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. 3–6 June 2019 12–15 August 2019 24 person hours across 40 locations in 2019. 14–18 and 29 August 2023 30–31 October 2023. 42 person hours across 42 locations in 2023. We note that 2019 surveys do not meet data currency requirements under the BAM however they are included in this summary for context
Opportunistic and other Notable Surveys	**Walking traverses during flora surveys**. It is likely that this species would be 'flushed' in the course of walking transects undertaken during the targeted threatened flora surveys. This survey methodology is identified in the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments an Activities* (DEC 2004) which notes that flushing of bush stone-curlews can be achieved during diurnal surveys by walking through suitable habitat (DEC 2004). <u>Survey dates:</u> 12–16 October 2020 19–23 October 2020 14 October 2021 18 September 2023 1 November 2023. <u>Survey effort:</u> Estimate of 280 person hours over 13 days across the Development Footprints. **Remote camera surveys** were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. It is acknowledged that this survey method would only detect incidental recordings of this species and is not targeted. <u>Survey dates and effort:</u> 24 March – 8 July 2020 126 trap nights across 9 locations in 2020. 17–30 October 2023 1381 trap nights in rehabilitation habitat.
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – gang-gang cockatoo (*Callocephalon fimbriatum*)	
Credit Type	Dual
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas. May also occur in sub-alpine Snow Gum (*Eucalyptus pauciflora*) woodland and occasionally in temperate rainforests. Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 7 cm in diameter or larger in eucalypts and 3 m or more above the ground.
Habitat Constraints or Geographic Limitations	Eucalypt tree species with hollows at least 3 m above the ground and with hollow diameter of 7 cm or larger
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	October–January
Survey Requirements	As noted in the TBDC (DCCEEW 2025): 1. Assessors should look for signs of breeding on site as follows; (a) lone adult males identified during the breeding season (October to January); or (b) an occupied nest. 2. Where signs of breeding on site are present, potential nest trees should be identified. Potential nest trees are forest and woodland eucalypts containing hollows that are; (i) at least 3 m above the ground and (ii) with hollow diameter of 7 cm or larger. 3. Where potential nest trees are identified on site, monitor for this species during the breeding season (October to January) to confirm the presence of any actual nest trees on site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements). The unit of measure for this species is area.
Targeted Surveys	**Searches for hollow-bearing trees** with hollows greater than 7 cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Searches were initially undertaken in March 2020 for suitable tree hollows. Updated targeted searches for suitable hollows were undertaken across the Development Footprint in April 2025. All observations of hollows included watching for signs of breeding activity around the potential breeding habitat and observations of any individuals in the locality. <u>Survey dates</u> 23–26 March 2020 2–4, 9–11, 14–15, 28–29 April 2025

Survey details – gang-gang cockatoo (*Callocephalon fimbriatum*)	
	Survey effort: Approximately 304 person hours across 19 days of survey within associated PCTs in the Development Footprint. **Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. Survey dates and effort: 14–18 and 29 August 2023 30–31 October 2023 42 person hours across 42 locations in 2023.
Opportunistic and other Notable Surveys	**Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. Survey dates and effort: 3–6 June 2019 12–15 August 2019 24 person hours across 40 locations in 2019. **Searches for hollow-bearing trees** Additional hollow tree searches were undertaken on 23, 25, 30, 31 October 2023 and 1 November 2023 to support the Commonwealth assessment for the Project.
Survey Requirements Met?	Partial Following initial hollow tree searches in April 2025, targeted checks of identified trees will be undertaken in spring 2025 due to data currency of original March 2020 surveys.
Present?	No
Justification	Not recorded – the species has not been recorded on site despite many years of survey, opportunistic observations and no breeding activity has been observed.
Species Polygon Required?	TBD

Survey details – glossy black-cockatoo (*Calyptorhynchus lathami*)	
Credit Type	Dual
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (*Casuarina cristata*).
Habitat Constraints or Geographic Limitations	Living or dead tree with hollows greater than 15 cm diameter and higher than 8 m above ground.

Survey details – glossy black-cockatoo (*Calyptorhynchus lathami*)	
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	April–August
Survey Requirements	As noted in the TBDC (DCCEEW 2025): The identification of breeding habitat will require survey or an expert report. 1. Assessors should look for signs of breeding on site as follows; (a) begging birds of any age or sex; or (b) lone adult males identified during the breeding season (April to August); or (c) an occupied nest. 2. Where signs of breeding on site are present, potential nest trees should be identified. Potential nest trees contain hollows that are; (i) at least 8 m above the ground; and (ii) in stems with a diameter of at least 30 cm; and (iii) hollow diameter is at least 15 cm; and (iv) stem angle is at least 45 degrees, and may be near-vertical or vertical. 3. Where potential nest trees are identified on site, monitor for this species during the breeding season (April to August) to confirm the presence of any actual nest trees on site. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements). The unit of measure for this species is area. No minimum survey effort for this species.
Targeted Surveys	**Searches for hollow-bearing trees** with hollows greater than 15 cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020, August 2023 and April 2025 with opportunistic searches also undertaken concurrently during the targeted threatened flora surveys in October 2020. Surveys included spending 5 minutes watching for any signs of activity around the potential breeding habitat, followed by diurnal bird surveys consisting of 20 minute meandering transects within proximity to the potential breeding habitat. <u>Survey dates</u> 23–26 March 2020 14–18, 29 August 2023 9–11, 14–15 April 2025. <u>Survey effort:</u> Approximately 304 person hours across 19 days of survey within associated PCTs in the Development Footprint. **Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. <u>Survey dates and effort:</u> 16–17 and 28–29 August 2023 42 person hours across 42 locations in 2023.

Survey details – glossy black-cockatoo (*Calyptorhynchus lathami*)	
Opportunistic and other Notable Surveys	**Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. Survey dates and effort: 3–6 June 2019 12–15 August 2019 24 person hours across 40 locations in 2019. 6–10 July 2020 19 person hours across 19 locations in 2020. **Searches for hollow-bearing trees** Additional hollow tree searches were undertaken on 23, 25, 30, 31 October 2023 and 1 November 2023 to support the Commonwealth assessment for the Project.
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – eastern pygmy-possum (*Cercartetus nanus*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. They may occupy small patches of vegetation in fragmented landscapes and although the species prefers habitat with a rich shrub understory, they are known to occur in grassy woodlands and the presence of Eucalypts alone is sufficient to support populations in low densities.
Habitat Constraints or Geographic Limitations	None.
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	October–March
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Species is very difficult to detect, especially via spotlighting. The unit of measure for this species is area. No minimum survey for this species.

Survey details – eastern pygmy-possum (*Cercartetus nanus*)	
Targeted Surveys	**Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 23–26 March 2020 7 person hours across 16 locations over 4 consecutive nights. 23–26 October, 27 November, 5, 11 December 2023 16 person hours across 7 nights targeting riparian habitats.
Opportunistic and other Notable Surveys	**Pitfall traps** were installed in suitable habitat. Each trap array comprised of 10 m of drift-fence with a 20 L bucket with a lid at either end. The lid was elevated 2 cm to 3 cm (using sticks) above the lip of the bucket. Leaf litter and small twigs were placed in the bottom of each bucket to provide shelter for trapped animals. Survey dates and effort: 29 May – 11 August 2023 64 pitfall traps were installed across the Development Footprints including: • 12 in PCT3431 Moderate • 3 in PCT3431 Thinned Woodland • 1 In PCT3431 Plantation • 7 in PCT3431 Scattered Regeneration • 1 in PCT3431 Cooba Woodland • 19 in PCT3431 Poor Condition DNG • 11 in PCT3431 Exotic Grassland • 1 in PCT4089 Exotic Grassland • 9 in mine rehabilitation Totalling 256 trap nights. **Remote camera surveys** were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. Survey dates and effort: 24 March – 8 July 2020 126 trap nights across 9 locations in 2020.
Survey Requirements Met?	Partial
Present?	Assumed present – pending additional survey outcomes.
Justification	The eastern pygmy possum has not been recorded within the Development Footprints, or within proximity of the Development Footprint. The species is not known to have been recorded in the Central Hunter Valley outside of areas associated with intact habitats in National Parks (e.g. Yengo and Mount Royal National Park). While the species is known to prefer habitats containing a distinct shrubby or heathy midstorey, particularly containing banksias. These habitats do not occur in the Development Footprints, however no habitat constraints are listed in the TBDC for the species.

Survey details – eastern pygmy-possum (*Cercartetus nanus*)	
	For the purposes of this report, the species has been assumed present until surveys can be undertaken to determine the presence or absence of the species within the Development Footprint. Dr David Sharpe was consulted on refining the likely suitable habitat on the site and the most appropriate survey methods and effort.
Species Polygon Required?	Yes

Survey details – Hunter Valley delma (*Delma vescolineata*)	
Credit Type	Species
Biodiversity Risk Weighting	Not available at the time of writing
Source	-
Potential Habitat Description	**TBDC:** Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland. Habitat is where grassland is dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda australis*, spear-grasses *Austrostipa* spp. and poa tussocks *Poa* spp., and occasionally wallaby grasses *Austrodanthonia* spp. Sometimes present in modified grasslands with a significant content of exotic grasses. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter. Sometimes utilises dried cowpats for shelter.
Habitat Constraints or Geographic Limitations	None.
Associated PCTs	Not available at the time of writing (PCTs 3431 and 3485 used as per *Delma impar*)
Required Survey Period	Not available at the time of writing (Sept-Dec used as per *Delma impar*)
Survey Requirements	As noted in the TBDC (DCCEEW 2025) and the Threatened reptiles BAM survey guide (2022): Install artificial cover (tile boards) in suitable habitat at least one month prior to the first survey. Place cover boards in areas where grass sward height >10 cm, ideally positioned on a northerly aspect. Cover boards should consist of 50 pale-coloured roof tiles or roof tiles installed pale side up, with 5 m spacing between tiles, arranged in an array of 10 x 5 tiles. For suitable habitat that is: =2 ha, use 2 tile arrays; >2 ha – 30 ha, use 1 tile array per 3 ha of suitable habitat; >30–50 ha, use 10 tile arrays. Check artificial cover boards once per week, for 10 weeks, when ambient temperature is 15–25°C. Commence cover board checks at alternating arrays to ensure each array is surveyed at a range of tile temperatures. Check shelter sites no more than once per week, as this may cause the species to abandon the site.
Targeted Surveys	**Targeted artificial shelter site (i.e. tile grid) surveys** were conducted. Tile grids consisted of 50 tiles, at 5 m spacing between tiles, arranged in a grid of 10 tiles by five. This survey was undertaken in consideration of the methods outlined in the EPBC Act Referral Guidelines for the vulnerable striped legless lizard Delma impar (DSWPC 2011). 2020 Survey

Survey details – Hunter Valley delma (*Delma vescolineata*)	
	Ten sites were checked weekly between 22 September 2020 and 4 November 2020. Following confirmed presence of the species, six sites were moved to new areas within the Development Footprints and four additional sites were installed, totalling 20 locations within the Development Footprints. These were checked for fauna occupation once per week between 12 November 2020 to 2 December 2020. 2021 Survey 4 additional tile grids installed between 27 and 29 July 2021 in areas of exotic grasslands and checked weekly between 7 October and 20 December 2021. In total 24 tile grids were installed across the Development Footprints. <u>Survey dates and effort (2020):</u> Checks undertaken: 22 and 30 September 2020 9, 16, 23 and 28 October 2020 4 November 2020 10 sites of 50 tiles each were installed on 13 August 2020 in: 8 sites PCT3431 DNG 1 site PCT3431 Exotic Grassland 1 site PCT4089 DNG Checked weekly for 7 weeks. Checks undertaken: 12, 13, 18, 19, 24 and 25 November 2020 2 and 8 December 2020 6 sites of 50 tiles each were relocated on 4 November 2020 in: 2 sites PCT3431 Moderate 1 site PCT3431 Plantation 2 sites PCT3431 Scattered Regeneration 1 site PCT4089 Moderate Checked weekly for 4 weeks (including 4 tile grids left in situ). <u>Survey dates and effort (2021):</u> Checks undertaken 7, 12, 18, 28 October, 1, 8, 15, 23 November, 1, 6, 15, 20 December 2021. 4 additional sites of 50 tiles each installed on 29 July 2021 in: 2 sites in PCT3431 Exotic Grassland 2 sites in PCT4089 Exotic Grassland Checked weekly for 12 weeks. Checks undertaken 7, 12, 18, 28 October, 1, 8, 15, 23 November, 1, 6, 15, 20 December 2021. 4 additional sites of 50 tiles each installed on 29 July 2021 in: 2 sites in PCT3431 Exotic Grassland 2 sites in PCT4089 Exotic Grassland Checked weekly for 12 weeks.
Opportunistic and other Notable Surveys	None
Survey Requirements Met?	Yes
Present?	Yes
Justification	Recorded.

Survey details – Hunter Valley delma (*Delma vescolineata*)	
Species Polygon Required?	Yes. The species is not currently predicted by the BAM-C. Striped legless lizard (*Delma impar*) has been used as a surrogate in the BAM-C. The Hunter Valley delma habitat polygon includes all vegetation zones across the Development Footprint where the species was recorded, being: PCT3431 – Central Hunter Ironbark Grassy Woodland (*Derived Native Grassland*, *Thinned Woodland*, *Scattered Regeneration* condition). PCT4089 – Namoi-Upper Hunter River Red Gum Forest (*Derived Native Grassland* condition). • No impact to the Hunter Valley delma was assessed for Management Zone (MZ) 2 (New transmission line Easement) for the purposes of the BAM assessment (refer to **Section 6.1** for management zone descriptions). Areas outside the proposed installation disturbance (restricted to tracks and pole pads) for the proposed new easement (MZ2) will be managed in accordance with ISSC 20 Guideline for the Management of Activities within *Electricity Easements and Close to Electricity Infrastructure (ISSC 2012)* and will remain in grassland condition.

Survey details – white-bellied sea-eagle (*Haliaeetus leucogaster*)	
Credit Type	Dual
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass.
Habitat Constraints or Geographic Limitations	Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines.
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	July–December

Survey details – white-bellied sea-eagle (*Haliaeetus leucogaster*)	
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Breeding habitat is live large old trees within 1 km of a rivers, lakes, large dams or creeks, wetlands and coastlines and the presence of a large stick nest within tree canopy; or an adult with nest material; or adults observed duetting within breeding period. Due to the similarities in nest structure and use of the same nests by white-bellied sea eagles and wedge-tailed eagles, where a nest is observed without a bird present, searches for prey remains/feathers below the structure should be undertaken. The differing diets of both species and distinctive adult feathers, should provide evidence of nest use, however; where prey items/feathers are absent, repeat visits to the nest until a bird is observed should be undertaken. The unit of measure for this species is area.
Targeted Surveys	**Targeted bird of prey nest searches** Suitable nest trees and stags were recorded and inspected for large nests. <u>Survey dates and effort:</u> 12–16 October 2020 19–23 October 2020 14–18 and 29 August 2023. Approximately 128 person hours of survey across the Development Footprint. **Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. <u>Survey dates and effort (2021):</u> 3–6 June 2019 12–15 August 2019 24 person hours across 40 locations in 2019. 6–10 July 2020 19 person hours across 19 locations in 2020. 14–18 and 29 August 2023 42 person hours across 42 locations in 2023.
Opportunistic and other Notable Surveys	**Targeted bird of prey nest searches** Suitable nest trees and stags were recorded and inspected for large nests. <u>Survey dates:</u> 23–26 March 2020 2-4, 9-11, 14-15, 28-29 April 2025
Survey Requirements Met?	Partial. Further updated stick nest surveys to be undertaken in spring 2025 due to data currency of original March 2020 surveys.
Present?	No
Justification	Not recorded – large stick nests containing an active breeding site for this species has not been recorded on site despite many years of survey, opportunistic observations.
Species Polygon Required?	TBD

Survey details – little eagle (*Hieraaetus morphnoides*)	
Credit Type	Dual
Biodiversity Risk Weighting	1.5
Source	BAM-C
Potential Habitat Description	**TBDC:** Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.
Habitat Constraints or Geographic Limitations	Nest trees – live (occasionally dead) large old trees within vegetation.
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	August–October
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Breeding habitat is live (occasionally dead) large old trees within suitable vegetation AND the presence of a male and female; or any adult with nesting material; or an individual on a large stick nest in the top half of the tree canopy; or pairs displaying (soaring, diving, engaging in chases, or a male observed calling in flight with a female begging from tree).
Targeted Surveys	**Targeted bird of prey nest searches** were undertaken. Suitable nest trees and stags were recorded and inspected for large nests. <u>Survey dates and effort :</u> 23–26 March 2020 12–16 October 2020 19–23 October 2020 14–18 and 29 August 2023 2-4, 9-11, 14-15, 28-29 April 2025. Approximately 300 person hours of survey across the Development Footprint. **Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. <u>Survey dates and effort:</u> 3–6 June 2019 12–15 August 2019 24 person hours across 40 locations. 14–18 and 29 August 2023 42 person hours across 42 locations in 2023.
Opportunistic and other Notable Surveys	**Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded.

Survey details – little eagle (*Hieraaetus morphnoides*)	
	Survey dates: 3–6 June 2019 6–10 July 2020.
Survey Requirements Met?	Partial. Further updated stick nest surveys to be undertaken in spring 2025 due to data currency of original March 2020 surveys.
Present?	No
Justification	Not recorded– large stick nests containing an active breeding site for this species has not been recorded on site despite many years of survey, opportunistic observations.
Species Polygon Required?	TBD

Survey details – Green and golden bell frog (*Litoria aurea*)	
Credit Type	Species
Biodiversity Risk Weighting	2.00
Source	PMST, Bionet Atlas, BAM-C
Potential Habitat Description	**TBDC:** Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas.
Habitat Constraints or Geographic Limitations	**Habitat Constraints:** Semi-permanent/ephemeral wet areas: Within 1 km of wet areas Swamps: Within 1 km of swamp Waterbodies: Within 1 km of waterbody
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	November–March
Survey Requirements	As noted in the NSW survey guidelines for frogs (DPIE) 2020c: Aural-visual or acoustic recorder surveys can be completed along the edges of suitable breeding habitat or, if feasible, through shallow wetlands. Tadpole surveys can be used to replace up to two of the aural-visual surveys. Tadpole searches should target areas of shallow and open water where the tadpoles are likely to congregate. If the plague minnow (Gambusia holbrooki) is present this method is not recommended. The presence of the plague minnow should be recorded. Surveys should sample the available range of waterbodies on the subject land. Sweep netting should target areas of open water.

Survey details – Green and golden bell frog (*Litoria aurea*)	
	Minimum survey effort comprises aural-visual surveys for 480 minutes per 500 m of suitable breeding habitat for four nights OR 154 recorder days for 14 days OR 10 minutes of dip netting per 50 m2 of surface areas repeating this up to twice (to replace up to two nights of aural-visual surveys) (NSW Survey Guideline for Threatened Frogs, September 2020).
Targeted Survey Effort Post September 2020 (in accordance with the BAM survey requirements)	Survey methods using the NSW survey guidelines for frogs (DPIE) 2020c: **Aural-visual and dip-netting surveys – February–March 2025** ***Aural-visual Surveys*** 1. Quiet listening for 5 minutes (record any species heard) 2. Start call playback with 2 mins of broadcast and then 2 mins of listening and spotlighting. 3. Start visual survey with walking and spotlighting the perimeter of the pond. 4. Repeat steps 2 and 3 approx. every 50 metres of pond/dam. 5. Ensure the correct pro-rated time is spent at the pond as per guidance in table above. ***Dip-netting Surveys*** 1. Walk perimeter of half the ponds for plague minnow. 2. If no plague minnow, undertake dip netting for tadpoles over 10 m transect. 3. Revisit ponds without minnow and repeat dip netting for tadpoles. Survey Effort: Aural-visual surveys = 55.5 person hours over 20 nights at 29 dams totalling a perimeter of approximately 2.9 km). Dip netting was carried out at 29 dams, repeated twice at each dam that was not found to have plague minnow Survey Dates: 24–28 February 2025 3–7 March 2025 10–14 March 2025 24–27 March 2025 **Dip netting surveys** were undertaken along a 10 m transect in suitable dam habitat. Survey dates: 24–28 February 2025 3–7 March 2025 10–14 March 2025 24–27 March 2025. Survey effort: Nocturnal call playback and spotlighting was conducted over 55.5 person hours over 20 nights at a total of 29 dams containing potentially suitable habitat (totalling a perimeter of approximately 2.9 km) using the correct pro-rated time at each pond as per guidance. Dip netting was carried out at 29 dams, repeated twice at each dam that was not found to have plague minnow.

Survey details – Green and golden bell frog (*Litoria aurea*)	
Other Notable Surveys	Survey methods pre-NSW survey guidelines for frogs (DPIE) 2020c: **Targeted Amphibian Surveys – March 2020** Nocturnal **call playback surveys** were undertaken for this species. These sessions began with a period of quiet listening for approximately 5 minutes. *Litoria aurea* calls were played using a 15 watt directional loud hailer for approximately 4 minutes, followed by a listening period of five minutes. Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Notes were made on the presence or otherwise of plague minnow. Survey Effort: 8 person hours over 4 consecutive nights across 17 dams, drainage line or river edge locations. Survey Dates: 23–26 March 2020 Survey methods using the Commonwealth survey guidelines (Commonwealth DEWHA 2010): **Targeted surveys for the Commonwealth Assessment – October 2023** Surveys included **call playback**, which consisted of a period of quiet listening for five (5) minutes followed by broadcasting green and golden bell frog calls over a 15-watt directional loud hailer for approximately four (4) minutes. Following call playback, **spotlighting and active searches** of banks with emergent vegetation and overhanging trees were completed. Survey dates: 23–26 October 2023 Survey effort: Targeted green and golden bell frog surveys were completed at seven dams within and surrounding the Development Footprints. Aural-visual surveys = 6.83 person hours over 4 consecutive nights at 7 dams. Each dam or area of deemed suitable habitat was surveyed twice over four consecutive nights, within the seasonal survey period, for a total of 6.83 person hours.
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – square-tailed kite (*Lophoictinia isura*)	
Credit Type	Dual
Biodiversity Risk Weighting	1.5
Source	BAM-C
Potential Habitat Description	**TBDC:** Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland.
Habitat Constraints or Geographic Limitations	Nest trees.
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	September–January
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Where a breeding site has been identified in accordance with the BAM the species buffer polygon should be established by providing a circular polygon with a 300 m radius around the nest tree and incorporate all woody and non-woody native vegetation within the radius. DPIE is currently developing survey guidance for threatened bird species. In the interim, assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys (as per the BAM threatened species survey requirements).
Targeted Surveys	Targeted searches for suitable nest trees and stags are proposed to be carried out in spring 2025.
Opportunistic and other Notable Surveys	**Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. <u>Survey dates and effort:</u> 3–6 June 2019 12–15 August 2019 24 person hours across 40 locations . 6–10 July 2020 19 person hours across 19 locations in 2020. 14–18 and 29 August 2023 42 person hours across 42 locations in 2023. **Targeted bird of prey nest searches** were undertaken. Suitable nest trees and stags were recorded and inspected for large nests. <u>Survey dates and effort (2020):</u> 23–26 March 2020 14–18 and 29 August 2023 2–4, 9–11, 14–15, 28–29 April 2025 Approximately 300 person hours of survey across the Development Footprint.

Survey details – square-tailed kite (*Lophoictinia isura*)	
Survey Requirements Met?	Partial. Further updated stick nest surveys to be undertaken in spring 2025 due to data currency of original March 2020 surveys.
Present?	No
Justification	Not recorded - large stick nests containing an active breeding site for this species has not been recorded on site despite many years of survey, opportunistic observations.
Species Polygon Required?	TBD

Survey details – southern myotis (*Myotis macropus*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C, Bionet Atlas
Potential Habitat Description	**TBDC:** Generally, roost in groups of 10–15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, wharves, bridges and in dense foliage.
Habitat Constraints or Geographic Limitations	Waterbodies with permanent pools/stretches 3 m or wider, including rivers, large creeks, billabongs, lagoons, estuaries, dams and other waterbodies, on or within 200 m of the site.
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	October - March
Survey Requirements	As noted in the NSW threatened bat survey guidelines (DPIE 2021): Harp trap or mist net are to be placed in areas of potential habitat. Traps or nets should be set beside or preferably over pools of water along creeks or rivers, particularly in flat or areas of low relief if present. The survey may use only mist nets, or a combination of harp traps and mist nets. Any bridges, tunnels, culverts or other structures identified as potential breeding habitat should be searched for bats or signs of bats (guano etc). Passive acoustic detection can be used, with the microphone directed over pools of water along creeks or rivers or other waterbodies or active detection searching over suitable waterbodies in potential habitat using acoustic detectors and visual aids to confirm the presence of southern myotis. Passive detectors or traps are to be set in areas of potential habitat, such as under bridges, culverts or overhanging branches. For larger waterbodies acoustic detection or mist nets may be necessary. Minimum survey effort requires either 16 harp traps for a minimum of four nights OR 16 passive acoustic recorders for a minimum of four nights OR 8 hours of active detection over a minimum of four nights per 2.5 km of potential riparian habitat.

Survey details – southern myotis (*Myotis macropus*)	
Targeted Surveys	Survey methods: **Echolocation recorder surveys** were undertaken. At each site, the Titley Scientific Anabat Express was positioned at an approximate 30 degree angle one metre above the ground in waterproof housing. Each detector was positioned towards potential micro-bat flyaways along areas of suitable habitat. The Anabat detector was programmed to start recording from one hour before sunset to one hour after sunrise. All recorded calls were analysed by Anna McConville of Echo Ecology using AnalookW (Version 4.2n) software. The identification of calls was undertaken with reference to Pennay et al. (2004) and through the comparison of recorded reference calls from north-eastern NSW and the Sydney Basin. Each call sequence ('pass') was assigned to one of five categories, being definite, probable, possible, species group and unknown. For the purposes of this assessment, definite and probable levels of confidence were treated as positive identifications. Survey dates and effort: 23–27 March 2020 13 recording nights over 4 nights in six locations .
Opportunistic and other Notable Surveys	**Nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 23–26 March 2020 - 7 person hours across 16 locations over 4 consecutive nights 6–9 July 2020 - 6.4 person hours across 15 locations. Nocturnal spotlighting near farm dams and riparian zones: 23-26 October, 27 November, 5, 11 December 2023 - 16 person hours across 7 nights targeting riparian habitats. 24–28 February 2025, 3-7 March 2025, 10–14 March 2025, 24–27 March 2025 - 55.5 person hours over 20 nights at a total of 29 dams.
Survey Requirements Met?	Yes
Present?	Yes Assumed present and recorded.
Justification	The southern myotis (*Myotis macropus*) has been assumed present based on the prevalence of records in the local area and region. In particular, the species was recorded near Ravensworth West Mine in 2008 (DPE 2022a). A likely southern myotis was recorded in March 2025 during the nocturnal green and golden bell frog surveys, swooping and fishing over a dam in the western section of the HVO North Development Footprint. See **Section 4.2.2.1** for further details.
Species Polygon Required?	Yes

Survey details – barking owl (*Ninox connivens*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey found on these fertile riparian soils.i Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.
Habitat Constraints or Geographic Limitations	Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Acoustic recording (songmeters: e.g. BAR-LT, Audio Moth) (can be undertaken year-round) – evidence of the value of acoustic recording units for monitoring owls is emerging. The Department seeks to build data to support developing a standardised survey effort (survey nights, replicates, and unit densities). For projects proposing to use passive acoustic recording for targeted Biodiversity Assessment Method (BAM) owl survey, provide a draft survey approach via BOS.helpdesk@environment.nsw.gov.au for information and review by the Department. This is an interim measure to help contribute to the building of future guidance. The draft survey approach must include: 1. Type of recording unit; 2. A map showing density of recording unit distribution; 3. Justification for proposed recording unit density (including details of previous surveys published or otherwise, where the proposed recorder density has detected owls or birds with similar call volume and pitch)(note: less sensitive recorders like Audio Moths with a smaller recording radius of up to approximately 100 m will need to be more densely distributed than other songmeters where recording radius may be up to 400 m), and the proposed time and recording period each day (e.g. “daily 3 hours before dawn and 3 hours after dusk”); 4. The proposed survey period and minimum total survey duration (e.g. “3 months from March to May 2024” or “90 days over 3 disjunct 30 day periods in April, July and October”) and justification for this proposed approach (including details of previous surveys published or otherwise, when owls were detected using the proposed approach) 5. How the recordings will be analysed (e.g. what call recognisers are proposed to be applied).

Survey details – barking owl (*Ninox connivens*)	
	OR Call playback can be undertaken in all months. Playback during the nesting season should be conducted with caution. The conservation benefit of detecting the presence of owls on a site is considered important enough that potential disturbance of nesting pairs is outweighed. Call playback must be conducted at night (preferably around dawn or dusk) during calm (i.e. less than 5 beaufort scale, 29–38 km/hr; at this speed, small trees sway; whitecaps form on waves) and dry weather (see Reference 1 in General Notes field) because responses may be erratic and quiet. Survey as follows; 1. Allow 10 minutes listening and observation time prior to broadcasting. If the target owl(s) is observed or call is heard during this period, call playback is not required. 2. Evenly distribute call playback stations within areas of up to 1000 ha of suitable habitat (as per the Threatened Biodiversity Database Collection (TBDC)) approximately 1000 m apart (I.e.1000 m x 1000 m grid or every 100 ha). This equates to 10 stations for 1000 ha of suitable habitat. 3. Broadcast pre-recorded calls (e.g. single male, single female, duet and for masked owl, screech and chatter) for no more than 15 seconds followed by at least 30 seconds of listening time. Listen for the response or appearance of the target owl(s) during the listening time. Watch/listen for an owl that may be circling overhead. 4. At each station repeat the broadcast and listening sequence for 15 minutes for each target owl, unless the target owl is detected before 15 minutes expires. As a guide, gradually increase the volume from approximately 60 decibels (as measured 1 m from the broadcast device) to 100 decibels with each repeated broadcast. Phone apps are available to help calibrate volume. By analogy, 60 dB equals normal conversation volume at 1 m and 100 dB is roughly equal to the volume of a chainsaw. The intent is start at a low volume which does not frighten nearby owls into silence, and then escalate to elicit a response from distant owls, which can hear calls four times farther away than humans. 5. Search for owls drawn in by the broadcast within a 1 ha circular plot around each broadcast station (radius approximately 57 m) at the end of the 15 minute repeated broadcast and listening sequence. Look and listen for the target species using a spotlight for 15 minutes, unless the target owl is detected before 15 minutes expires. Watch/listen for an owl that may be circling overhead. 6. Record the direction of fly in and time to respond to playback of detected owls, to reduce multiple counts of the same owl at different sample stations. 7. If simultaneously surveying for multiple owl species (e.g. masked owl, sooty owl, powerful owl and barking owl), the playback sequence may include an escalating sequence of calls of these species punctuated with listening periods between each species' call. The masked owl calls should come at the end of the sequence so that if birds respond with a single shriek the response is not obscured by further playback (DSE 2011). 8. Repeatedly sample at each survey station with up to 15 minutes of broadcast calls and listening sequences (as above), until an owl responds, or for at least 6 nights. Survey nights are best spread across multiple weeks. When the area of suitable habitat is 100 hectares or less locate the call playback station as centrally as possible within suitable habitat (as per the TBDC). For areas of suitable habitat greater than 1000 ha, place sampling stations at a density of approximately one every 1500 m (i.e. 1500 m x 1500 m grid or every 225 ha), distributed evenly to cover at least half of the area of suitable habitat.

Survey details – barking owl (*Ninox connivens*)	
Targeted Surveys	**Searches for hollow-bearing trees** with hollows greater than 20 cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020, August 2023 and April 2025 and opportunistic searches were also undertaken concurrently during the targeted threatened flora surveys in October 2020. All observations of hollows included watching for signs of breeding activity around the potential breeding habitat and observations of any individuals in the locality. Survey dates and effort: 23–26 March 2020 12–16 October 2020 19–23 October 2020 14–18 and 29 August 2023 2–4, 9–11, 14–15, 28–29 April 2025 Approximately 300 person hours of survey across the Development Footprint. **Nocturnal call playback surveys** were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. Ninox connivens calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. Survey dates and effort: 6–9 July 2020 6.4 person hours across 15 locations. Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 6–9 July 2020 - 6.4 person hours across 15 locations.
Opportunistic and other Notable Surveys	**Nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 23-26 October, 27 November, 5, 11 December 2023 - 16 person hours across 7 nights targeting riparian habitats. **Opportunistic observations during nocturnal surveys for green and golden bell frog** Survey dates and effort: 24–28 February 2025, 3–7 March 2025, 10–14 March 2025, 24–27 March 2025 - 55.5 person hours over 20 nights at a total of 29 dams.
Survey Requirements Met?	Partial Deployment of acoustic recorders is being undertaken in June/July 2025 due to data currency of original March 2020 surveys.
Present?	TBD
Justification	TBD
Species Polygon Required?	TBD

Survey details – powerful owl (*Ninox strenua*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C, Bionet Atlas
Potential Habitat Description	**TBDC:** Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as *Turpentine Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species.
Habitat Constraints or Geographic Limitations	Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above the ground.
Associated PCTs	3431 3485 4015 4081 4089
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Acoustic recording (songmeters: e.g. BAR-LT, Audio Moth) (can be undertaken year-round) – evidence of the value of acoustic recording units for monitoring owls is emerging. The Department seeks to build data to support developing a standardised survey effort (survey nights, replicates, and unit densities). For projects proposing to use passive acoustic recording for targeted Biodiversity Assessment Method (BAM) owl survey, provide a draft survey approach via BOS.helpdesk@environment.nsw.gov.au for information and review by the Department. This is an interim measure and to help contribute to the building of future guidance. The draft survey approach must include: 1. Type of recording unit; 2. A map showing density of recording unit distribution; 3. Justification for proposed recording unit density (including details of previous surveys published or otherwise, where the proposed recorder density has detected owls or birds with similar call volume and pitch)(note: less sensitive recorders like Audio Moths with a smaller recording radius of up to approximately 100 m will need to be more densely distributed than other songmeters where recording radius may be up to 400 m), and the proposed time and recording period each day (e.g. “daily 3 hours before dawn and 3 hours after dusk”); 4. The proposed survey period and minimum total survey duration (e.g. “3 months from March to May 2024” or “90 days over 3 disjunct 30 day periods in April, July and October”) and justification for this proposed approach (including details of previous surveys published or otherwise, when owls were detected using the proposed approach); 5. How the recordings will be analysed (e.g. what call recognisers are proposed to be applied). OR

Survey details – powerful owl (*Ninox strenua*)	
	Call playback can be undertaken in all months. Playback during the nesting season should be conducted with caution. The conservation benefit of detecting the presence of owls on a site is considered important enough that potential disturbance of nesting pairs is outweighed. Call playback must be conducted at night (preferably around dawn or dusk) during calm (i.e. less than 5 beaufort scale, 29–38 km/hr; at this speed, small trees sway; whitecaps form on waves) and dry weather (see Reference 1 in General Notes field) because responses may be erratic and quiet. Survey as follows; 1. Allow 10 minutes listening and observation time prior to broadcasting. If the target owl(s) is observed or call is heard during this period, call playback is not required. 2. Evenly distribute call playback stations within areas of up to 1,000 hectares of suitable habitat (as per the Threatened Biodiversity Database Collection (TBDC)) approximately 1000 m apart (I.e.1,000 m x 1,000 m grid or every 100 ha). This equates to 10 stations for 1,000 ha of suitable habitat. 3. Broadcast pre-recorded calls (e.g. single male, single female, duet and for masked owl, screech and chatter) for no more than 15 seconds followed by at least 30 seconds of listening time. Listen for the response or appearance of the target owl(s) during the listening time. Watch/listen for an owl that may be circling overhead. 4. At each station repeat the broadcast and listening sequence for 15 minutes for each target owl, unless the target owl is detected before 15 minutes expires. As a guide, gradually increase the volume from approximately 60 decibels (as measured 1 m from the broadcast device) to 100 decibels with each repeated broadcast. Phone apps are available to help calibrate volume. By analogy, 60 dB equals normal conversation volume at 1 m and 100 dB is roughly equal to the volume of a chainsaw. The intent is start at a low volume which does not frighten nearby owls into silence, and then escalate to elicit a response from distant owls, which can hear calls four times farther away than humans. 5. Search for owls drawn in by the broadcast within a 1 ha circular plot around each broadcast station (radius approximately 57 m) at the end of the 15 minute repeated broadcast and listening sequence. Look and listen for the target species using a spotlight for 15 minutes, unless the target owl is detected before 15 minutes expires. Watch/listen for an owl that may be circling overhead. 6. Record the direction of fly in and time to respond to playback of detected owls, to reduce multiple counts of the same owl at different sample stations. 7. If simultaneously surveying for multiple owl species (e.g. masked owl, sooty owl, powerful owl and barking owl), the playback sequence may include an escalating sequence of calls of these species punctuated with listening periods between each species' call. The masked owl calls should come at the end of the sequence so that if birds respond with a single shriek the response is not obscured by further playback (DSE,2011). 8. Repeatedly sample at each survey station with up to 15 minutes of broadcast calls and listening sequences (as above), until an owl responds, or for at least 6 nights. Survey nights are best spread across multiple weeks. When the area of suitable habitat is 100 hectares or less locate the call playback station as centrally as possible within suitable habitat (as per the TBDC). For areas of suitable habitat greater than 1,000 ha, place sampling stations at a density of approximately one every 1,500 m (i.e. 1,500 m x 1,500 m grid or every 225 ha), distributed evenly to cover at least half of the area of suitable habitat.
Targeted Surveys	**Searches for hollow-bearing trees** with hollows greater than 20 cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020, August 2023 and April 2025 and opportunistic searches were also undertaken concurrently during the targeted threatened flora surveys in October 2020.

Survey details – powerful owl (*Ninox strenua*)	
	All observations of hollows included watching for signs of breeding activity around the potential breeding habitat and observations of any individuals in the locality. Survey dates and effort: 23–26 March 2020 12–16 October 2020 19–23 October 2020 14–18 and 29 August 2023 2–4, 9–11, 14–15, 28–29 April 2025 Approximately 300 person hours of survey across the Development Footprint. **Nocturnal call playback surveys** were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. *Ninox strenua* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. Survey dates and effort: 6–9 July 2020 - 6.4 person hours across 15 locations. Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 6–9 July 2020 - 6.4 person hours across 15 locations.
Opportunistic and other Notable Surveys	**Nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 23–26 October, 27 November, 5, 11 December 2023 - 16 person hours across 7 nights targeting riparian habitats. **Opportunistic observations during nocturnal surveys for green and golden bell frog** Survey dates and effort: 24–28 February 2025, 3–7 March 2025, 10–14 March 2025, 24–27 March 2025 - 55.5 person hours over 20 nights at a total of 29 dams.
Survey Requirements Met?	Partial Deployment of acoustic recorders is being undertaken in June/July 2025 due to data currency of original March 2020 surveys.
Present?	TBD
Justification	TBD
Species Polygon Required?	TBD

Survey details – eastern osprey (*Pandion cristatus*)	
Credit Type	Dual
Biodiversity Risk Weighting	1.5
Source	BAM-C
Potential Habitat Description	**TBDC:** Favour coastal areas, especially the mouths of large rivers, lagoons and lakes.
Habitat Constraints or Geographic Limitations	Presence of stick-nests in living and dead trees (>15 m) or artificial structures within 100 m of a floodplain for nesting.
Associated PCTs	3481 4015 4081 4089
Required Survey Period	April–November
Survey Requirements	As noted in the TBDC (DCCEEW 2025): This species can nest in isolated trees. Nests are distinctive but easiest to identify when birds are in attendance. No further details of survey requirements are provided in the TBDC.
Targeted Surveys	Survey methods: **Targeted bird of prey nest searches** were undertaken. Suitable nest trees and stags were recorded and inspected for large nests. Survey dates and effort: 23–26 March 2020 12–16 October 2020 19–23 October 2020 14–18 and 29 August 2023 2–4, 9–11, 14–15, 28–29 April 2025. Approximately 300 person hours of survey across the Development Footprint. **Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. Survey dates and effort: 14–18 and 29 August 2023 42 person hours across 42 locations in 2023.
Opportunistic and other Notable Surveys	**Diurnal bird surveys** were carried out during morning and afternoon periods (peak times for bird activity). A 15–20 minute survey with two observers using 10 x 40 magnification binoculars was completed at each site. All bird species observed or heard were recorded. Survey dates: 3–6 June 2019 12–15 August 2019 24 person hours across 40 locations in 2019. 6–10 July 2020.

Survey details – eastern osprey (*Pandion cristatus*)	
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – southern greater glider (*Petauroides volans*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Feeds exclusively on eucalypt leaves, buds, flowers and mistletoe. Shelter during the day in tree hollows and will use up to 18 hollows in their home range.
Habitat Constraints or Geographic Limitations	Hollow-bearing trees.
Associated PCTs	3485 4015
Required Survey Period	All year
Survey Requirements	As noted in the survey guidelines for Australia's threatened mammals: Survey requirements for this species includes daytime searches for presence of potentially suitable habitat resources for nests and burrows, and signs of the species' presence. It also includes spotlighting surveys in suitable vegetation types, stag watching, and call detection and/or call playback surveys.
Targeted Surveys	Survey methods: **Thermal Drone Surveys** Thermal drone flight paths were undertaken in areas of suitable habitat for the species. Detection methods included hot spot alert, shape detection, characteristic trait, drone infra-red thermal and colour zoom imagery with spotlight. Survey times were between 21:00–06:00 each night/morning at suitable temperatures. Survey dates and effort: 12–20 July 2023 - Over 900 km of survey transects were undertaken across areas of predicted and other potential habitat for southern greater glider. **Searches for hollow-bearing trees** were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020, August 2023, and April 2025 with opportunistic searches also undertaken concurrently during the targeted threatened flora surveys in October 2020. Survey dates and effort: 23–26 March 2020 12–16 October 2020 19–23 October 2020 14–18 and 29 August 2023 2–4, 9–11, 14–15, 28–29 April 2025.

Survey details – southern greater glider (*Petauroides volans*)	
	Approximately 300 person hours of survey across the Development Footprint. **Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 23–26 March 2020 - 19.8 person hours across 16 locations. 6–9 July 2020 - 6.4 person hours across 15 locations over 4 consecutive nights. 23-26 October, 27 November, 5, 11 December 2023 - 16 person hours across 7 nights targeting riparian habitats. **Remote camera surveys** were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. Survey dates and effort: 24 March – 8 July 2020 126 trap nights across 9 locations.
Opportunistic and other Notable Surveys	None
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – squirrel glider (*Petaurus norfolcensis*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431 4081 4089
Required Survey Period	All year

Survey details – squirrel glider (*Petaurus norfolcensis*)	
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Survey year round for this species, but sites with bipinnate *Acacia*, autumn winter flowering trees and shrubs such as *Eucalyptus robusta* and *Banksia* sp. (*integrifolia* etc.) should be subject to a more retracted survey period of between March-August. Relies on large old trees with hollows for breeding and nesting. These trees are also critical for movement and typically need to be closely-connected (i.e. no more than 50 m apart).
Targeted Surveys	Survey methods: **Nocturnal call playback surveys** were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. *Petaurus norfolcensis* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. Survey dates and effort: 6–9 July 2020 6.4 person hours across 15 locations over 4 consecutive nights. Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 23–26 March 2020 7 person hours across 16 locations over 4 consecutive nights. 6–9 July 2020 6.4 person hours across 15 locations over 4 consecutive nights. **Remote camera surveys** were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. Survey dates and effort: 24 March–8 July 2020 126 trap nights across 9 locations.
Opportunistic and other Notable Surveys	**Thermal Drone Surveys** Thermal drone flight paths were undertaken in areas of suitable habitat for the species. Detection methods included hot spot alert, shape detection, characteristic trait, drone infra-red thermal and colour zoom imagery with spotlight. Survey times were between 21:00–06:00 each night/morning at suitable temperatures. Survey dates and effort: 12–20 July 2023 - Over 900 km of survey transects were undertaken across areas of predicted and other potential habitat for squirrel glider
Survey Requirements Met?	Partial – further surveys proposed in spring 2025.
Present?	Assumed present.
Justification	The squirrel glider has not been recorded within the Development Footprints, but has been previously recorded in habitats west of the Hunter Valley Glider Club (BioNet 2025).

Survey details – squirrel glider (*Petaurus norfolcensis*)	
	For the purposes of this report, the species has been assumed present until surveys can be undertaken to determine the presence or absence of the species within the Development Footprint. Approved species expert, Dr David Sharpe, was consulted on refining the likely suitable habitat on the site and the most appropriate survey methods and effort.
Species Polygon Required?	Yes

Survey details – brush-tailed phascogale (*Phascogale tapoatafa*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431 3485 4015 4089
Required Survey Period	December–June
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Low population densities, large home range size, annual male die-off and fluctuating local abundance make Brush-tailed Phascogales difficult to detect reliably. It may be more appropriate to seek an expert report to determine presence or absence. Survey Dec–Jun, noting that Dec–Feb is the main juvenile dispersal period and May–Jun is the peak mating season, when males are most likely to be detected (particularly towards the end of the season, as deceased individuals). Survey must be undertaken using baited cameras. Cameras should be set at head height, or above, facing the branch or tree trunk where a honey-based bait has been placed. Cameras must be evenly spaced across the site. Cameras must remain in place for a minimum of 4 weeks with cameras checked and baits replaced after 2 weeks. A minimum of 4 cameras, independent of the size of the subject land, must be used for sites up to 1 ha, then an additional 2 cameras for every ha of suitable habitat thereafter. That is, at least 22 working, baited, evenly spaced camera traps are required for the first 10 ha of suitable habitat.
Targeted Surveys	<u>Survey methods:</u> **Nocturnal spotlighting searches** were conducted at each site for between 10–30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. <u>Survey dates and effort:</u> 23–26 March 2020 7 person hours across 16 locations over 4 consecutive nights.

Survey details – brush-tailed phascogale (*Phascogale tapoatafa*)	
	6–9 July 2020 6.4 person hours across 15 locations over 4 consecutive nights. **Remote camera surveys** were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. Survey dates and effort: 24 March – 8 July 2020 126 trap nights across 9 locations.
Opportunistic and other Notable Surveys	**Thermal Drone Surveys** Thermal drone flight paths were undertaken in areas of suitable habitat for the species. Detection methods included hot spot alert, shape detection, characteristic trait, drone infra-red thermal and colour zoom imagery with spotlight. Survey times were between 21:00–06:00 each night/morning at suitable temperatures. Survey dates and effort: 12–20 July 2023 - Over 900 km of survey transects were undertaken across areas of predicted and other potential habitat for species.
Survey Requirements Met?	Yes
Present?	Yes – recorded and assumed present across the site.
Justification	The species has been recorded annually at the Ashton Coal Mine offset site between 2015 and 2024 located approximately 1.8 km from the eastern extent of the HVO North Development Footprint. The species was recorded on four occasions from one location outside the HVO North Development Footprint near the confluence of the Hunter River and Bowmans Creek in moderate condition PCT 3431 - Central Hunter Ironbark Grassy Woodland during the surveys undertaken for this assessment. The species was not captured on any other cameras across the Development Footprint, however noting the species populations are known to fluctuate and the species' ability to occupy a range of PCTs, for the purposes of this assessment all associated PCTs (in accordance with the TBDC) in woody condition have been included in the species polygon (refer to **Figure 4.10**).
Species Polygon Required?	Yes

Survey details – koala (*Phascolarctos cinereus*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C, Bionet Atlas, PMST
Potential Habitat Description	**TBDC:** Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.
Habitat Constraints or Geographic Limitations	Presence of koala use trees.

Survey details – koala (*Phascolarctos cinereus*)	
Associated PCTs	3431 3485 4081 4089
Required Survey Period	All year
Survey Requirements	As noted in the koala BAM survey guide (DPE 2022a): The minimum survey effort to detect koala presence on the subject land requires the total effort for two standard survey methods to be met. A scat detection method, which may indicate past occupancy, must be paired with a non-scat detection method as follows: 1. Spot Assessment Technique (SAT) or detection dogs, and 2. Spotlighting or passive acoustic or drones.
Targeted Surveys	Survey methods: **Thermal Drone Surveys** Thermal drone flight paths were undertaken in areas of suitable koala habitat in accordance with the BAM (2020). Detection methods included hot spot alert, shape detection, characteristic trait, drone infra-red thermal and colour zoom imagery with spotlight. Survey times were between 21:00–06:00 each night/morning at suitable temperatures. Survey dates and effort: 12–20 July 2023 Over 900 km of survey transects were undertaken across areas of suitable habitat for koala. Searches for signs of the presence of koalas were undertaken using the **Spot Assessment Technique (SAT).** The koala SAT was undertaken in eucalypt dominated sites only as per the technique outlined in Phillips and Callaghan (2011) and DPE (2022a). Searches were undertaken on and around the base of 30 trees at each survey site. The searches focused on signs of presence including scats at the base of trees and characteristic scratches on tree trunks. Surveys focused on areas containing koala feed trees according to the Approved Recovery Plan for the Koala (DECC 2008). Survey dates and effort: 6–10 July 2020 29 May – 9 June 2023 February and March 2025. 57 SAT locations targeting koala feed trees in areas of suitable habitat (refer to **Table D.3**). **Nocturnal call playback surveys** were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. koala calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. Survey dates and effort: 6–9 July 2020 6.4 person hours across 15 locations over 4 consecutive nights. Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition.

Survey details – koala (*Phascolarctos cinereus*)	
	Survey dates and effort: 23–26 March 2020 7 person hours across 16 locations over 4 consecutive nights. 6–9 July 2020 6.4 person hours across 15 locations over 4 consecutive nights.
Opportunistic and other Notable Surveys	**Remote camera surveys** were undertaken. At each site, a Bushnell Trophy Cam HD remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey and tuna. Cameras were set to take three photos in quick succession when movement was detected. Survey dates and effort: 24 March – 8 July 2020 126 trap nights across 9 locations.
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – common planigale (*Planigale maculata*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water.
Habitat Constraints or Geographic Limitations	None
Associated PCTs	3431
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2024): Survey any time of the year, noting that males are more active during winter, and juvenile dispersal usually occurs between December and January. Survey must be undertaken using pitfall traps where the substrate allows. Occasionally, the substrate may be too rocky, hard or inundated to allow the use of pitfall traps. In these circumstances, we strongly advise that an expert report should be obtained. Pitfall trap design: Ideally, each pitfall trap array should comprise 10 m of drift-fence with a 20 L or larger bucket with a lid at either end. Survey placement: Target the placement of traps in suitable habitat within about 200 m of the ecotonal boundary of adjoining PCTs, in or adjacent to dense grass cover, deep leaf litter and/or abundant logs. Traps must remain in place for a minimum of four consecutive nights.

Survey details – common planigale (*Planigale maculata*)	
	Survey effort: A minimum of three pitfall trap arrays must be used for an area of suitable habitat up to 1 ha. For suitable habitat >1–10 ha, one additional pitfall trap array must be used for every additional hectare, with a maximum of 10 pitfall trap arrays for any one patch of suitable habitat. Where suitable habitat patches are separated by 200 m or greater, the same survey effort must be applied in each patch. Polygon: the species polygon is drawn to 500 m either side of the PCT ecotonal boundary, or to the other PCT boundary, whichever is smaller.
Targeted Surveys	Survey methods: **Pitfall traps** were installed in suitable habitat. Each trap array comprised of 10 m of drift-fence with a 20 L bucket with a lid at either end. The lid was elevated 2 cm to 3 cm (using sticks) above the lip of the bucket. Leaf litter and small twigs were placed in the bottom of each bucket to provide shelter for trapped animals. Consultation with the BCD was undertaken to determine the survey effort required across the Development Footprints which is considered 'large-scale'. The conclusion was where "total suitable habitat > 50 ha: 22 arrays plus one additional for every 10 ha of suitable habitat above 10 ha. For example, 60 ha of suitable habitat will require 23 arrays." The Development Footprints contain approximately 420 ha of potentially suitable habitat subject to impacts in accordance with the predicted vegetation zones in the TBDC. Based on this advice, it was calculated that a total of 59 pitfall trap arrays should be established to adequately survey for the common planigale. Survey dates and effort: 29 May–11 August 2023 61 pitfall traps were installed across the Development Footprints including: 12 in PCT3431 Moderate 3 in PCT3431 Thinned Woodland 1 In PCT3431 Plantation 7 in PCT3431 Scattered Regeneration 1 in PCT3431 Cooba Woodland 19 in PCT3431 Poor Condition DNG 11 in PCT3431 Exotic Grassland 1 in PCT4089 Exotic Grassland 9 in mine rehabilitation Totalling 256 trap nights. The final location of the pitfalls were often located in proximity to, and straddling, another vegetation zone/PCT as this is in accordance with the survey information for the species in the TBDC. As such, the definite number of traplines per vegetation zone is accurate to the point of what PCT the trapline was established in relative to the vegetation mapping for the site.
Opportunistic and other Notable Surveys	**Collapsible funnel traps** were installed in suitable habitat. Each trap array comprised of a 10 m drift fence with 10 collapsible funnel traps positioned equidistantly along each side of the drift fence. Collapsible funnels were positioned so that they were flush with the ground and checked daily for 4 consecutive days. No evidence of chew marks or holes were detected in the traps following installation. Funnel traps were used in conjunction with pitfall trapping where the substrate was too hard to dig. Subsequent advice from BCD noted that this survey method was not acceptable and further efforts for pitfall trapping was employed (see below), however the effort and results of these surveys should not be discounted from informing the assessment.

Survey details – common planigale (*Planigale maculata*)	
	Survey dates and effort: 29 May – 2 June 2023 17 funnel traps were installed across the Development Footprints including: • 2 in PCT3485 Moderate • 3 in PCT3431 Moderate • 4 in PCT3431 Thinned Woodland • 2 in PCT3431 Scattered Regeneration • 4 in PCT3431 Poor Condition DNG • 2 in PCT4089 Moderate. Totalling 68 trap nights. **Nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species are visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 23–26 March 2020 7 person hours across 16 locations over 4 consecutive nights. 6–9 July 2020 6.4 person hours across 15 locations over 4 consecutive nights.
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – grey-headed flying-fox (*Pteropus poliocephalus*)	
Credit Type	Dual
Biodiversity Risk Weighting	2
Source	BAM-C, Bionet Atlas, PMST
Potential Habitat Description	**TBDC:** Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.
Habitat Constraints or Geographic Limitations	Breeding camps
Associated PCTs	3431 3485 4081 4089
Required Survey Period	October–December

Survey details – grey-headed flying-fox (*Pteropus poliocephalus*)	
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Breeding camps will need to be identified by survey, as per OEH Guidelines. The initial search for camps should encompass any recorded camps and roosting habitat likely to occur on the subject land. If a camp is located the survey only needs to take place in the camp (that is the area occupied by the target species) to identify breeding females. Camps used for breeding must be mapped. Use GPS to map outer perimeter of the camp to create the species polygon. Surveys must be undertaken as per the Threatened Bat Survey Guide to confirm breeding habitat.
Targeted Surveys	Survey methods: **Daytime searches for camps** were conducted concurrently with threatened flora surveys undertaken comprehensively across the Development Footprint, including most recently in March and April 2025. Survey dates and effort: 12–23 October 2020 14 October 2021 14–18 and 29 August 2023 2–4, 9–11, 14–15, 28–29 April 2025 300 person hours over 18 days.
Opportunistic and other Notable Surveys	All other surveys undertaken within and around the Development Footprint provide opportunistic observations as flying-fox breeding camps are highly detectable.
Survey Requirements Met?	Yes
Present?	No
Justification	Not recorded
Species Polygon Required?	No

Survey details – masked owl (*Tyto novaehollandiae*)	
Credit Type	Species
Biodiversity Risk Weighting	2
Source	BAM-C
Potential Habitat Description	**TBDC:** Lives in dry eucalypt forests and woodlands from sea level to 1.100 m. A forest owl, but often hunts along the edges of forests, including roadsides.
Habitat Constraints or Geographic Limitations	Living or dead trees with hollows greater than 20 cm diameter and greater than 4 m above ground.
Associated PCTs	3431 3485 4081 4089

Survey details – masked owl (*Tyto novaehollandiae*)	
Required Survey Period	All year
Survey Requirements	As noted in the TBDC (DCCEEW 2025): Acoustic recording (songmeters: e.g. BAR-LT, Audio Moth) (can be undertaken year-round) – evidence of the value of acoustic recording units for monitoring owls is emerging. The Department seeks to build data to support developing a standardised survey effort (survey nights, replicates, and unit densities). For projects proposing to use passive acoustic recording for targeted Biodiversity Assessment Method (BAM) owl survey, provide a draft survey approach via BOS.helpdesk@environment.nsw.gov.au for information and review by the Department. This is an interim measure and to help contribute to the building of future guidance. The draft survey approach must include: 1. Type of recording unit; 2. A map showing density of recording unit distribution; 3. Justification for proposed recording unit density (including details of previous surveys published or otherwise, where the proposed recorder density has detected owls or birds with similar call volume and pitch)(note: less sensitive recorders like Audio Moths with a smaller recording radius of up to approximately 100 m will need to be more densely distributed than other songmeters where recording radius may be up to 400 m), and the proposed time and recording period each day (e.g. "daily 3 hours before dawn and 3 hours after dusk"); 4. The proposed survey period and minimum total survey duration (e.g. "3 months from March to May 2024" or "90 days over 3 disjunct 30 day periods in April, July and October") and justification for this proposed approach (including details of previous surveys published or otherwise, when owls were detected using the proposed approach); 5. How the recordings will be analysed (e.g. what call recognisers are proposed to be applied). OR Call playback can be undertaken in all months. Playback during the nesting season should be conducted with caution. The conservation benefit of detecting the presence of owls on a site is considered important enough that potential disturbance of nesting pairs is outweighed. Call playback must be conducted at night (preferably around dawn or dusk) during calm (i.e. less than 5 beaufort scale, 29–38 km/hr; at this speed, small trees sway; whitecaps form on waves) and dry weather (see Reference 1 in General Notes field) because responses may be erratic and quiet. Survey as follows; 1. Allow 10 minutes listening and observation time prior to broadcasting. If the target owl(s) is observed or call is heard during this period, call playback is not required. 2. Evenly distribute call playback stations within areas of up to 1000 ha of suitable habitat (as per the Threatened Biodiversity Database Collection (TBDC)) approximately 1,000 m apart (I.e.1,000 m x 1,000 m grid or every 100 ha). This equates to 10 stations for 1,000 ha of suitable habitat. 3. Broadcast pre-recorded calls (e.g. single male, single female, duet and for masked owl, screech and chatter) for no more than 15 seconds followed by at least 30 seconds of listening time. Listen for the response or appearance of the target owl(s) during the listening time. Watch/listen for an owl that may be circling overhead.

Survey details – masked owl (*Tyto novaehollandiae*)	
	4. At each station repeat the broadcast and listening sequence for 15 minutes for each target owl, unless the target owl is detected before 15 minutes expires. As a guide, gradually increase the volume from approximately 60 decibels (as measured 1 m from the broadcast device) to 100 decibels with each repeated broadcast. Phone apps are available to help calibrate volume. By analogy, 60 dB equals normal conversation volume at 1 m and 100 dB is roughly equal to the volume of a chainsaw. The intent is start at a low volume which does not frighten nearby owls into silence, and then escalate to elicit a response from distant owls, which can hear calls four times farther away than humans. 5. Search for owls drawn in by the broadcast within a 1 ha circular plot around each broadcast station (radius approximately 57 m) at the end of the 15 minute repeated broadcast and listening sequence. Look and listen for the target species using a spotlight for 15 minutes, unless the target owl is detected before 15 minutes expires. Watch/listen for an owl that may be circling overhead. 6. Record the direction of fly in and time to respond to playback of detected owls, to reduce multiple counts of the same owl at different sample stations. 7. If simultaneously surveying for multiple owl species (e.g. masked owl, sooty owl, powerful owl and barking owl), the playback sequence may include an escalating sequence of calls of these species punctuated with listening periods between each species' call. The masked owl calls should come at the end of the sequence so that if birds respond with a single shriek the response is not obscured by further playback (DSE,2011). 8. 8. Repeatedly sample at each survey station with up to 15 minutes of broadcast calls and listening sequences (as above), until an owl responds, or for at least 6 nights. Survey nights are best spread across multiple weeks. When the area of suitable habitat is 100 ha or less locate the call playback station as centrally as possible within suitable habitat (as per the TBDC). For areas of suitable habitat greater than 1,000 ha, place sampling stations at a density of approximately one every 1,500 m (i.e. 1,500 m x 1,500 m grid or every 225 ha), distributed evenly to cover at least half of the area of suitable habitat.
Targeted Surveys	Survey methods: **Searches for hollow-bearing trees** with hollows greater than 20 cm in diameter were undertaken across the Development Footprint. Where hollows were found, the tree species, hollow size and location (spout, trunk, branch) were recorded. Targeted searches were undertaken in March 2020, August 2023 and April 2025 and opportunistic searches were undertaken concurrently during the targeted threatened flora surveys in October 2020. All observations of hollows included watching for signs of breeding activity around the potential breeding habitat and observations of any individuals in the locality. Survey dates and effort: 23–26 March 2020 12–16 October 2020 19–23 October 2020 14–18 and 29 August 2023 2–4, 9–11, 14–15, 28–29 April 2025 Approximately 300 person hours of survey across the Development Footprint. **Nocturnal call playback surveys** were undertaken. These sessions began with a period of quiet listening for approximately 5 minutes. *Tyto novaehollandiae* calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes.

Survey details – masked owl (*Tyto novaehollandiae*)	
	Survey dates and effort: 6–9 July 2020 6.4 person hours across 15 locations. Following call playback sessions, **nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 6–9 July 2020 6.4 person hours across 15 locations.
Opportunistic and other Notable Surveys	**Nocturnal spotlighting searches** were conducted at each site for between 15–30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. Survey dates and effort: 23–26 October, 27 November, 5, 11 December 2023 - 16 person hours across 7 nights targeting riparian habitats. **Opportunistic observations during nocturnal surveys for green and golden bell frog** Survey dates and effort: 24-28 February 2025, 3-7 March 2025, 10-14 March 2025, 24-27 March 2025 - 55.5 person hours over 20 nights at a total of 29 dams.
Survey Requirements Met?	No Deployment of acoustic recorders is proposed to be undertaken in June/July 2025 due to data currency of original March 2020 surveys.
Present?	TBD
Justification	TBD
Species Polygon Required?	TBD

D.3 Suitable Habitat Assessment for Koala

Umwelt reviewed the PCTs associated with the koala in the Threatened Biodiversity Database Collection (TBDC) and the data collected through the vegetation integrity assessments (i.e. BAM plots) across the HVO North and South disturbance areas. **Table D.3** below outlines the results of this review and recommendations on whether additional surveys are required in accordance with the new survey guide (DPE 2022).

Table D.3 Suitable Habitat Assessment for Koala

Plant Community Type	Associated PCT for Koala	Vegetation Zone and Condition	Koala Use Trees Present^	Tree Growth Form Present	Surveys Required?
3431 - Central Hunter Ironbark Grassy Woodland	Yes	1. Moderate	*Eucalyptus blakelyi* *Eucalyptus crebra* *Eucalyptus moluccana* *Angophora floribunda*	Yes	Yes
		2. Thinned Woodland	*Eucalyptus blakelyi* *Eucalyptus crebra* *Eucalyptus moluccana* *Angophora floribunda*	Yes	Yes
		3. Woodland with Exotic Understorey	*Eucalyptus crebra*	Yes	Yes
		4. Plantation	*Casuarina glauca* *Corymbia maculata* *Eucalyptus camaldulensis* *Eucalyptus saligna* *Eucalyptus grandis*	Yes	Yes
		5. Scattered Regeneration	No	Yes - *Allocasuarina luehmannii, Geijera salicifolia, Notelaea macrocarpa* and *Acacia salicina* only	**Yes** – surveys targeted on isolated trees only
		6. Cooba Woodland	No	Yes - *Allocasuarina luehmannii, Brachychiton populneus, Geijera salicifolia, Notelaea macrocarpa* only	**Yes** – surveys targeted on isolated trees only
		7. Poor Condition Derived Native Grassland	No	Yes - *Acacia salicina* only	No
		8. Exotic Grassland	*Eucalyptus blakelyi* <--> *tereticornis*	Yes	**Yes** – surveys targeted on isolated trees only

Plant Community Type	Associated PCT for Koala	Vegetation Zone and Condition	Koala Use Trees Present^	Tree Growth Form Present	Surveys Required?
		9. Bulloak Variant	*Angophora floribunda* *Eucalyptus blakelyi* *Eucalyptus crebra*	Yes	**Yes**
3485 - Hunter Valley Footslopes Slaty Gum Forest	Yes	10. Moderate	*Eucalyptus moluccana*	Yes	Yes
4015 - Central Hunter Swamp Oak Riparian Forest	No	11. Moderate	*Casuarina glauca*	Yes	No
4081 - Northwest River Oak-River Red Gum Forest	Yes	12. Moderate	None	Yes - *Acacia salicina* only	No
4089 - Namoi-Upper Hunter River Red Gum Forest	Yes	13. Moderate	*Eucalyptus melliodora* *Eucalyptus moluccana*	Yes	Yes
		14. Low to Moderate	*Eucalyptus camaldulensis*	Yes	Yes
		15. Cooba Woodland	None	Yes - *Acacia salicina* only	No
		16. Derived Native Grassland	None	Yes - *Acacia salicina* only	No
		17. Exotic Grassland	None	No	No

^Central Coast Koala Modelling Region - Koala Use Trees recorded in BAM plots.

D.4 Weather Conditions

Table D.4 below outlines the weather conditions for all survey periods. Data is derived from the Singleton (Defence) weather station (061430) from the Bureau of Meteorology (BOM 2023) or site met data supplied by HVO.

Table D.4 Weather Conditions for Surveys

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (3pm) (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (3pm) (mean) (%)
3 June 2019	11.2–17.1	1.6	42	7.5–18.5	9.4	51
4 June 2019	4.0–14.8	0.2	54			
5 June 2019	7.9–15.3	1.2	55			
6 June 2019	3.7–19.3	0	30			
12 August 2019	4.4–17.9	0	38	7.1–20.7	22.0	32
13 August 2019	1.7–20.3	0	19			
14 August 2019	2.0–20.7	0	14			
15 August 2019	1.4–21.8	0	17			
23 March 2020	18.3–23.9	0	61	16.0–25.5	79.4	61
24 March 2020	15.9–25.9	0	54			
25 March 2020	14.4–24.9	0	93			
26 March 2020	16.4–17.9	21.2	87			
27 March 2020	25.3–22.9	3.4	55			
11 May 2020	5.4–18.9	0	33	9.2–19.9	22.2	55
12 May 2020	3.5–20.8	0	45			
13 May 2020	6.0–21.8	0.2	39			
14 May 2020	6.9–19.2	0	56			
15 May 2020	9.8–17.5	0	65			
10 June 2020	12.9–16.6	8.8	94	7.7–18.0	36.6	59
11 June 2020	12.9–20.2	4.0	54			
6 July 2020	3.5–18.3	0	45	7.1–17.7	98.6	56
7 July 2020	4.8–17.9	0	51			
8 July 2020	7.2–16.5	0	62			
9 July 2020	5.1–19.1	0.2	56			
10 July 2020	8.8–15.5	0.2	89			
10 August 2020	6.9–16.8	25.4	69	7.0–18.5	44.8	45
11 August 2020	9.8–18.8	4.2	55			
12 August 2020	8.4–18.9	0	66			
13 August 2020	9.8–22.8	2.0	41			
14 August 2020	7.9–15.9	0.2	86			
31 August 2020	11.6–24.9	0	31			
1 September 2020	10.3–19.2	0	46	10.7–22.8	37.0	44

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (3pm) (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (3pm) (mean) (%)
2 September 2020	5.9–23.8	0	38			
3 September 2020	12.4–26.9	0	38			
4 September 2020	18.8–26.5	0	40			
22 September 2020	15.7–26.3	3.6	24			
30 September2020	9.2–20.1	0	54			
9 October 2020	12.3–24.9	0	28	13.1–26.2	93.6	44
12 October 2020	11.2–28.8	0	28			
13 October 2020	11.5–30.7	0	24			
14 October 2020	12.6–25.6	0	48			
15 October 2020	12.9–30.8	0	30			
16 October 2020	16.6–27.3	0	55			
19 October 2020	14.9–21.2	7.6	65			
20 October 2020	12.5–24.9	0	52			
21 October 2020	11.3–27.6	0	36			
22 October 2020	14.3–29.4	0	36			
23 October 2020	13.6–31.5	0	33			
28 October 2020	11.7–20.7	1.2	69			
4 November 2020	11.0–28.8	0	28	15.8–27.7	66.2	47
6 November 2020	NR–22.5	26.2	39			
12 November 2020	NR–30.8	0	36			
13 November 2020	17.4–27.4	3.6	83			
18 November 2020	15.7–25.3	0.2	50			
19 November 2020	13.8–29.2	0	46			
24 November 2020	16.2–25.1	0	55			
25 November 2020	15.3–26.7	0	46			
2 December 2020	20.8–23.6	15.4	71	17.2–27.0	158.8	60
4 December 2020	18.3–35.5	0	31			
8 December 2020	15.9–26.4	0	-			
17 December 2020	21.0–31.7	1.2	87			
2 February 2021	17.9–26.5	18.0	56	17.5–27.3	91.8	60
3 February 2021	16.4–25.7	0	57			
8 April 2021	15.7–24.9	6.2	65	10.9–23.4	20.6	49
12 April 2021	6.3–20.6	0	32			
13 April 2021	5.5–22.7	0	37			
14 April 2021	8.9–26.6	0	28			
15 April 2021	12.1–26.6	0	32			
29 July 2021	7.4–18.2	2.0	47	6.1–17.7	23.4	77

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (3pm) (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (3pm) (mean) (%)
7 October 2021	11.1–29.0	0	65	12.0–25.3	75.4	65
12 October 2021	11.3–15.3	8.0	95			
14 October 2022	11.3–28.7	1.4	81			
18 October 2021	8.7–26.4	0	62			
28 October 2021	14.5–30.9	0	64			
1 November 2021	9.7–23.3	0	67	14.7–24.1	231.0	75
8 November 2021	17.0–28.3	11.0	95			
15 November 2021	11.1–22.9	0.8	47			
23 November 2021	15.6–24.2	1.0	78			
1 December 2021	18.1–24.9	4.0	81	16.8–28.1	91.4	72
6 December 2021	15.4–22.5	0	62			
15 December 2021	13.4–31.7	0	74			
20 December 2021	18.1	0	73			
13 July 2022	5.7–14.9	5.0	53	7.3–16.7	11.0	62
11 August 2022	7.9–16.2	0	61	7.8–19.4	55.4	87
15 May 2023	11.3–20.6	0	64	6.9–20.4	13.2	42
16 May 2023	8.4–21.5	0	35			
17 May 2023	10.8–17.2	0	60			
18 May 2023	9.0–18.7	0	49			
19 May 2023	5.5–18.3	2.4	44			
22 May 2023	4.8–20.2	0	31			
23 May 2023	3.9–22.1	0	22			
24 May 2023	4.0–23.1	0	16			
25 May 2023	5.6–23.5	0	19			
26 May 2023	11.2–20.9	0	91			
6 June 2023	11.7–19.7	0.2	57	6.9–18.8	11.8	46
7 June 2023	7.8–19.9	0	60			
8 June 2023	7.2–17.8	0	91			
9 June 2023	8.1–19.2	1.0	43			
11 July 2023	3.5–17-9	0	38	7.0–19.8	9.4	44
12 July 2023	2.8–19.6	0	45			
13 July 2023	3.4–21.5	0	32			
14 July 2023	6.5–22.0	0	34			
17 July 2023	10.2–21.2	0	48			
18 July 2023	6.4–22.5	0	33			
19 July 2023	6.7–17.4	0	26			
20 July 2023	1.2–18.6	0	26			

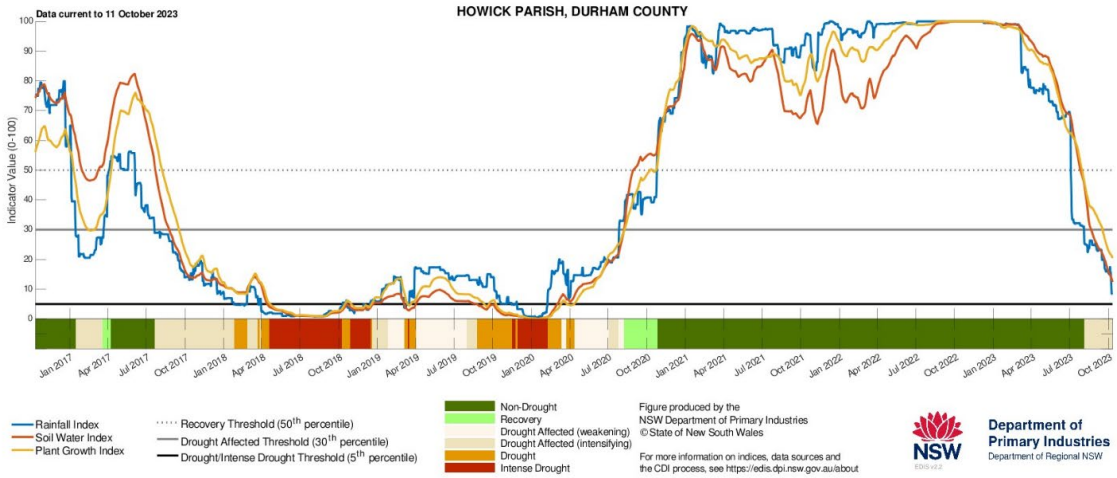
Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (3pm) (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (3pm) (mean) (%)
21 July 2023	6.0–17.5	0	58			
24 July 2023	7.8–18.0	1.4	59			
25 July 2023	4.8–20.2	0	47			
26 July 2023	5.9–21.0	0.2	41			
27 July 2023	5.5–22.0	0	35			
28 July 2023	6.9–23.2	0	34			
29 July 2023	11.8–24.9	0	33			
7 August 2023	10.7–19.4	0.4	58	7.8–21.5	28.0	39
8 August 2023	8.3–18.9	0	50			
9 August 2023	6.2–21.2	0	39			
10 August 2023	6.0–24.7	0.2	24			
11 August 2023	6.8–20.4	0	27			
12 August 2023	5.2–24.7	0	24			
13 August 2023	11.1–20.1	0.4	77			
14 August 2023	9.7–16.2	5.2	100			
15 August 2023	10.1–18.3	10	47			
16 August 2023	8.7–19.4	0	35			
17 August 2023	5.1–22.9	0.2	28			
18 August 2023	8.0–18.6	9.4	34			
29 August 2023	7.6–25.2	0	24.3			
18 September 2023	11.4–34.9	0	9	4.6–34.9	30.2	59
23 October 2023	13.7 - 28.7	0	11	12.5 - 26.1	34.6	28.1
24 October 2023	12.2 - 34.3	0	11			
25 October 2023	18.1 - 32.4	0	12			
26 October 2023	10.2 - 17.5	17	91			
27 October 2023	9.9 - 16.4	3.8	71			
30 October 2023	14.4 - 31.5	0	15			
31 October 2023	15.9 - 30.3	0	11			
1 November 2023	13.7 - 23.5	0	30	15.7 - 26.9	45.2	42.7
11 December 2023	19.7 - 25.2	0	34	18.7 - 31.0	69.6	36.4
19 February 2024		0				
11 April 2024	9.5-31.0	0	37	13.2-24.6	37.6	53
24 February 2025	18.6-37.9	0	26	17.9-24.6	51.0	49
25 February 2025	21.0-26.8	0	67			
26 February 2025	18.9-31.7	0.2	46			
27 February 2025	19.1-34.6	3.2	39			
28 February 2025	19.2-39.2	0.6	25			

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (3pm) (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (3pm) (mean) (%)
3 March 2025	20.8-27.9	0	55	18.7-28.3	110.0	59
4 March 2025	18.4-28.7	0.8	53			
5 March 2025	18.6-28.6	4.4	49			
6 March 2025	19.1-25.9	2.8	69			
7 March 2025	18.4-24.6	0	70			
10 March 2025	20.3-23.1	0	77			
11 March 2025	20.0-25.1	0.2	76			
12 March 2025	19.5-26.4	0	89			
13 March 2025	18.0-31.4	2.0	52			
14 March 2025	17.3-35.9	0	31			
17 March 2025	18.4-37.6	0	34			
20 March 2025	16.8-33.9	0	35			
21 March 2025	17.6-24.4	0	100			
24 March 2025	19.9-27.5	0.4	70			
25 March 2025	19.7-26.1	0	69			
26 March 2025	18.8-26.3	4.6	59			
27 March 2025	18.2-26.5	0	48			
2 April 2025	15.2-20.6	0	67	14.1-25	86.0	50
3 April 2025	13.3-27.2	0	30			
4 April 2025	11.2-n/a	0	n/a			
9 April 2025	13.2-25.2	0	48			
10 April 2025	12.1-26.2	0	50			
11 April 2025	12.8-28.7	0	40			
14 April 2025	12.3-27.8	0	43			
15 April 2025	17.1-22.9	0	51			
16 April 2025	14.3-21.4	2.0	55			
17 April 2025	15.8-24.7	0	45			

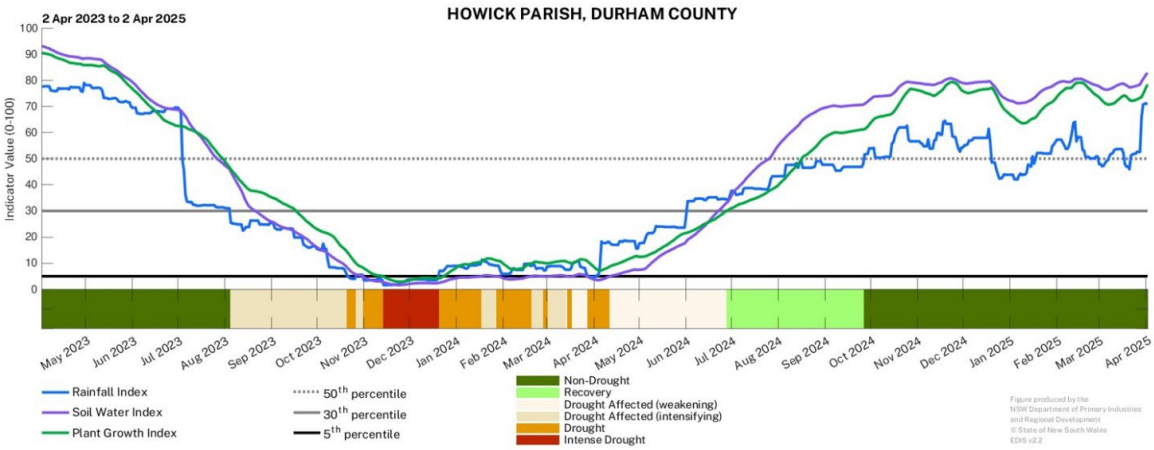
D.5 Survey Limitations

The surveys undertaken in 2019 and 2020 were likely influenced by drought conditions experienced across the Development Footprints and wider Hunter region leading up to and during 2020. The region has been listed as alternating between 'Drought Affected', in 'Drought' and in 'Intense Drought' since July 2017, with a period of 'Recovery' beginning in September 2020 (DPI 2022). The Plant Growth Index did not cross the recovery threshold (50th percentile) until around December 2020 (**Graph D.1**).

From September 2023 to May 2024, the region experienced another brief drought period (refer to **Graph D.2**), before recovering from August 2024. The majority of vegetation integrity plots utilised for this assessment were undertaken in September 2020, February/April 2021 and February/March 2025.



Graph D.1 Combined Drought Indicator Results 2017-2023 (DPI 2023)



Graph D.2 Combined Drought Indicator Results 2013-2025 (DPI 2025)

It is acknowledged that some flora transects appear to show a distance greater than what is recommended in the *Surveying threatened plants and their habitats: NSW survey guide for the BAM* (DPIE 2020). In many instances gaps or deviations can be attributed to GPS accuracy which is, at best, only accurate to 5 m. Furthermore, transects will often necessarily deviate from parallel 10 m spacing due to natural obstacles such as fallen logs, trees, water, waste, steep rocky areas.

Appendix E

Vegetation Integrity Data

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E.1 Vegetation Integrity Data

The following vegetation integrity data presented in **Table E.1** was collected from surveys of the Development Footprints. It includes the composition, structure and function attributes that are recorded in each BAM plot. This data is assessed against benchmark data for PCTs and entered into the BAM Calculator to assess the condition of each vegetation zone in the Development Footprints.

The following abbreviations for growth forms are used in **Table E.1** below:

- Tr – Tree
- Sh – Shrub
- Gr – Grass
- Fb – Forb
- Fn – Fern
- Ot – Other.

Table E.1 Vegetation Integrity Data

Plot ID	COMPOSITION						STRUCTURE						FUNCTION											Area (ha)		Patch Size	Zone	Easting (MGA56) GDA94	Northing (MGA56) GDA94	Bearing
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds	HVO North	HVO South				
													>5	5-9	9-19	20-29	30-49	50-79											
Vegetation Zone 1 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Moderate*																													
P047	3	6	11	14	0	2	45.2	1	5.2	1.6	0	0.2	1	1	1	1	1	0	0	2	81.6	12	6.7	64.1	0.5	101	56	316372	6404468	300
P050	2	3	9	6	1	2	20	0.4	59.9	2.5	2	0.3	1	1	1	1	1	0	0	1	46	15.5	0.9	64.1	0.5	101	56	316492	6399504	320
P059	7	7	13	17	2	3	25.2	1.4	45.2	1.9	0.2	0.4	1	1	1	1	1	0	0	2	81.6	22	0.4	64.1	0.5	101	56	308830	6405707	55
P069	2	0	11	15	1	2	34	0	16.3	3.9	0.2	0.2	1	1	1	1	0	0	1	1	78	3.5	15.7	64.1	0.5	101	56	315782	6402041	310
P070	3	2	13	13	1	2	38	0.6	18.5	3.2	0.1	0.2	1	1	1	1	0	0	0	0	67	49.5	10.6	64.1	0.5	101	56	316000	6401670	82
P071	3	4	15	16	2	1	30	0.5	47.4	3.2	0.3	0.2	1	1	1	1	1	0	0	0	74	8.5	1.4	64.1	0.5	101	56	316254	6401681	131
P072	3	6	15	20	0	1	22	0.9	37.3	4.2	0	0.1	1	1	1	1	1	1	2	0	66	6	8.6	64.1	0.5	101	56	316190	6401745	294
P074	3	0	9	8	1	0	36.5	0	6.4	1	2	0	1	1	1	1	1	0	0	0	59	37	0.7	64.1	0.5	101	56	315760	6401956	248
P075	2	2	11	11	1	0	40.3	0.4	18.5	1.4	0.2	0	1	1	1	1	0	0	1	1	29	27	11.3	64.1	0.5	101	56	315473	6402183	161
P076	3	0	11	11	1	0	33	0	20.4	1.4	0.2	0	1	1	1	0	0	0	0	0	52	8	10.4	64.1	0.5	101	56	315537	6402098	84
P077	2	1	10	9	1	0	30	0.2	34.2	1.4	0.2	0	1	1	1	0	0	0	0	0	35	4	17.4	64.1	0.5	101	56	315431	6401893	53
P078	2	6	12	9	1	2	35	1.5	7.5	2.2	0.2	0.2	1	1	1	1	1	0	0	0	67	40	0.4	64.1	0.5	101	56	315883	6395399	312
P083	2	5	17	20	2	1	25	6.6	34.3	2.9	0.3	0.1	1	1	1	1	1	1	3	4	68	50	0.5	64.1	0.5	101	56	316691	6394836	180
P084	3	7	11	16	2	2	23	2.9	41.7	4	0.3	0.3	1	1	1	1	0	1	1	1	78	0	0.6	64.1	0.5	101	56	317565	6393501	146
P088	2	4	11	5	1	1	15	2.7	7.2	3.7	0.3	0.1	1	1	1	1	0	0	0	0	74	76	0.2	64.1	0.5	101	56	316745	6394591	338
P092	1	5	13	8	0	1	25	0.6	33	1.4	0	0.1	1	1	1	0	0	0	0	0	40	0	0.5	64.1	0.5	101	56	315382	6402138	187
P114	2	8	13	11	0	2	25	2.6	12.7	1.6	0	0.2	1	1	1	1	1	1	3	1	86	84	1.3	64.1	0.5	101	56	316447	6399557	185
P129	5	8	5	13	0	1	38.1	38	27.2	6.5	0	1	1	1	1	1	1	1	1	0	76	45	0.4	64.1	0.5	101	56	309920	6406210	184
P132	6	3	14	15	0	1	52.3	2.2	73.4	6.6	0	0.1	1	1	1	1	1	1	3	0	71	56	2.2	64.1	0.5	101	56	308932	6405289	285
Vegetation Zone 2 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Thinned Woodland*																													
P055	2	3	9	9	0	3	22	0.4	23.6	1.4	0	0.3	0	1	1	0	1	0	0	2	11	12	1.4	9.6	1.9	101	56	307334	6402297	75
P060	5	6	11	12	2	4	32.2	2.7	23.5	6.7	0.2	1.4	1	1	1	1	0	1	2	2	42	7	4.3	9.6	1.9	101	56	309103	6405566	180
P085	5	9	7	5	1	0	12.8	5.9	8.6	0.7	0.1	0	1	1	1	1	0	0	0	0	72	8	0.2	9.6	1.9	101	56	317437	6393618	319
P130	3	1	10	14	0	1	16.3	1	84.4	4.2	0	0.5	1	1	1	1	0	1	1	0	54	65	1.7	9.6	1.9	101	56	309025	6405562	354
P145	4	4	12	9	1	2	30.2	1.2	18.9	2.3	0.2	0.2	1	0	0	1	1	1	1	0	79	6	1.4	9.6	1.9	101	56	309372	6412230	189
Vegetation Zone 3 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Woodland with Exotic Understorey*																													
P116	1	0	4	3	0	0	20	0	11	2.2	0	0	1	1	1	1	0	0	0	1	49	0	72.3	1.9	0.0	101	56	315961	6402785	185
P117	2	0	5	2	0	0	20.2	0	15.9	0.2	0	0	1	1	1	0	0	1	2	1	26	15	81.4	1.9	0.0	101	56	315968	6402553	128
Vegetation Zone 4 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Plantation*																													
P058	6	2	7	12	2	2	30.5	0.6	19.8	2.2	0.2	0.5	1	1	1	1	0	0	0	0	86	10	0.6	3.1	0.0	101	56	307801	6405273	160
P147	2	5	16	11	0	2	25.2	2.9	28.8	8.6	0	0.3	1	0	1	1	1	0	0	0	54	5	0	3.1	0.0	101	56	305530	6408024	13
P148	3	5	11	15	1	2	20.3	1.4	9.8	4.6	0.1	0.2	1	1	0	1	1	0	0	0	76	0	1	3.1	0.0	101	56	305571	6408277	12
P150	1	5	11	8	1	2	35	2.1	30.1	3	0.2	0.3	0	1	1	1	0	0	0	0	44	3	17.2	3.1	0.0	101	56	306649	6410285	47
Vegetation Zone 5 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Scattered Regeneration*																													

Plot ID	COMPOSITION						STRUCTURE						FUNCTION												Area (ha)		Patch Size	Zone	Easting (MGA56) GDA94	Northing (MGA56) GDA94	Bearing
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds		HVO North	HVO South					
													>5	5-9	9-19	20-29	30-49	50-79													
P056	2	1	9	16	1	1	5	0.2	68.7	2.2	0.1	0.3	1	1	1	0	0	0	0	0	7.4	0	0.7		39.3	0.0	101	56	307532	6405009	150
P120	3	5	10	11	2	1	11	16.2	29.8	1.8	0.7	0.2	1	1	1	1	0	0	0	0	55	7	1.3		39.3	0.0	101	56	310680	6406828	67
P133	1	1	17	17	0	3	5	0.4	58.8	3.8	0	0.3	1	1	1	1	0	0	0	0	22.2	2	3.2		39.3	0.0	101	56	307110	6404958	271
P141	4	3	10	9	0	2	28.6	1.7	83	4.8	0	0.2	1	1	1	1	1	0	0	0	13	0	1.1		39.3	0.0	101	56	305126	6406222	284
P153	3	6	17	7	2	0	10.6	3.7	32.9	6.9	0.7	0	1	1	0	1	1	0	0	0	37	10	3.6		39.3	0.0	101	56	305574	6405800	165
Vegetation Zone 6 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Cooba Woodland*																															
P064	5	3	10	18	1	2	13.4	0.4	42.4	3.4	0.2	0.3	1	1	1	1	1	0	0	0	7.4	4	0.9		11.8	0.2	101	56	304980	6406078	110
P065	2	2	15	13	2	2	15.1	0.4	56.7	9.5	8.2	0.3	1	1	1	1	1	0	0	0	49	2	0.8		11.8	0.2	101	56	307483	6404820	280
P066	3	5	14	16	2	2	15	1.1	78.3	2	0.2	0.5	1	1	1	1	1	0	0	0	12.4	19	12.6		11.8	0.2	101	56	309502	6405485	100
P126	2	3	7	6	1	2	16	1.1	6.9	11.5	0.4	0.2	1	1	1	1	1	0	0	0	53	2	4.9		11.8	0.2	101	56	309552	6405891	46
P127	1	2	8	5	1	0	40	0.2	7.6	1.4	0.1	0	1	1	1	0	0	0	0	0	22	9	69.1		11.8	0.2	101	56	310212	6405847	84
Vegetation Zone 7 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Poor Condition Derived Native Grassland*																															
P048	0	3	7	4	1	0	0	0.3	77	5.3	0.1	0	0	0	0	0	0	0	0	0	6.7	2.5	2.7		154.1	7.1	101	56	316571	6404400	75
P063	0	0	7	5	2	0	0	0	83.1	0.7	0.2	0	0	0	0	0	0	0	0	0	4.2	0	1.2		154.1	7.1	101	56	305313	6407169	220
P111	0	1	7	0	0	0	0	0.1	79.8	0	0	0	0	0	0	0	0	0	0	0	50	0	3		154.1	7.1	101	56	315242	6397159	264
P123	0	1	8	4	1	0	0	0.3	75.1	5.2	0.1	0	0	0	0	0	0	0	0	0	5	0	12.7		154.1	7.1	101	56	308177	6404963	211
P128	0	1	8	4	0	0	0	0.2	85.3	0.6	0	0	0	0	0	0	0	0	0	0	27	0	18.3		154.1	7.1	101	56	316631	6404426	185
P142	1	2	8	4	1	1	4	0.4	82	0.6	0.1	0.1	0	0	0	0	0	0	0	0	9	0	10.7		154.1	7.1	101	56	306442	6404226	120
P146	0	4	12	6	1	1	0	1.3	40.3	2	0.3	0.1	0	0	0	0	0	0	0	0	13	0	2.9		154.1	7.1	101	56	308695	6411793	304
P149	0	1	12	11	0	1	0	0.4	29.8	2.2	0	0.1	0	0	0	0	0	0	0	0	18	0	0.2		154.1	7.1	101	56	305834	6408497	20
P154	0	0	9	8	0	3	0	0	50.2	6.9	0	0.3	0	0	0	0	0	0	0	0	30	0	0.9		154.1	7.1	101	56	307042	6403396	322
Vegetation Zone 8 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Exotic Grassland*																															
P049	0	0	4	7	0	1	0	0	21.1	3.7	0	0.1	0	0	0	0	0	0	0	0	5	0	15.3		47.9	7.4	0	56	317099	6400380	155
P051	0	0	2	3	0	0	0	0	0.2	0.4	0	0	0	0	0	0	0	0	0	0	22.6	0	71.2		47.9	7.4	0	56	316523	6398922	180
P062	0	1	5	6	0	0	0	0.1	9.8	4.5	0	0	0	0	0	0	0	0	0	0	32	0	2.4		47.9	7.4	0	56	307257	6403058	185
P112	0	0	3	2	0	0	0	0	5.3	0.3	0	0	0	0	0	0	0	0	0	0	32	0	76.1		47.9	7.4	0	56	316623	6399079	181
P113	0	0	7	1	0	0	0	0	66.3	0.1	0	0	0	0	0	0	0	0	0	0	48	0	2.2		47.9	7.4	0	56	317192	6400368	191
P115	0	0	3	2	0	0	0	0	2.6	0.2	0	0	0	0	0	0	0	0	0	0	39	0	47.5		47.9	7.4	0	56	315689	6402416	340
P144	1	1	8	6	2	1	0.2	0.1	56.1	3.2	0.2	0.1	0	0	0	0	0	0	0	0	30	0	20.6		47.9	7.4	0	56	309840	6412514	203
P155	1	0	9	5	1	1	0.2	0	31.1	2.8	0.5	0.1	1	1	0	0	0	0	0	0	18	0	41.4		47.9	7.4	0	56	313889	6413123	123
Vegetation Zone 9 – PCT 3431 - Central Hunter Ironbark Grassy Woodland - *Bulloak Variant*																															
P057	2	1	8	9	0	2	25.2	0.1	5.8	1.2	0	0.3	1	1	1	0	0	0	0	0	72	0	0.3		0	33	101	56	307807	6405121	105
P073	4	1	9	8	0	0	31	0.2	1.2	2.9	0	0	1	1	1	0	0	0	0	0	53	23	0.7		33.0	0.0	101	56	315967	6401839	127
P082	1	4	13	12	2	2	25	0.4	14.4	1.8	0.4	0.2	1	1	1	1	0	0	0	0	61	35	0.5		33.0	0.0	101	56	316609	6395078	255
P089	1	1	9	3	1	1	25	0.1	1.2	0.8	0.2	0.1	1	1	1	1	1	0	0	0	74	4	2.6		33.0	0.0	101	56	315917	6395531	132
P090	2	1	11	3	1	2	28	0.1	1.6	0.3	0.1	0.2	1	1	1	1	1	0	0	0	47	28	0.1		33.0	0.0	101	56	316445	6394770	137

Plot ID	COMPOSITION						STRUCTURE						FUNCTION											Area (ha)		Patch Size	Zone	Easting (MGA56) GDA94	Northing (MGA56) GDA94	Bearing
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds	HVO North	HVO South				
													>5	5-9	9-19	20-29	30-49	50-79											
P125	1	1	4	7	1	1	75	0.1	3.1	2.5	0.1	0.1	1	1	0	0	0	1	1	1	70	17	0.3	33.0	0.0	101	56	308468	6405051	50
P151	2	4	10	5	2	3	26	1.8	8.6	1.5	1.2	0.3	1	1	1	1	1	0	0	0	68	5	0.6	33.0	0.0	101	56	305507	6407399	132
P152	2	6	10	13	1	2	25.3	1.6	17.8	7.7	0.2	0.2	1	1	1	1	1	0	0	0	76	6	0.6	33.0	0.0	101	56	305677	6406368	183
Vegetation Zone 10 – PCT 3485 - Hunter Valley Footslopes Slaty Gum Forest - *Moderate*																														
P061	8	6	10	11	1	1	24.5	0.9	7.8	1.5	0.1	0.1	1	1	1	1	1	0	0	0	93.6	39	0.5	7.1	0.0	101	56	309365	6405339	15
P122	5	9	9	10	0	2	47.2	3.9	2	1.5	0	0.2	1	1	1	1	1	0	0	1	93	119	0	7.1	0.0	101	56	309470	6405315	295
P124	5	5	10	10	0	3	45.2	1.2	12	2	0	0.5	1	1	1	1	1	1	3	1	91	165	1.2	7.1	0.0	101	56	309385	6405386	222
P131	4	2	12	9	0	0	62	1.2	84.3	2.2	0	0	1	1	1	1	1	1	8	1	85	174	0.7	7.1	0.0	101	56	309206	6405390	158
Vegetation Zone 11 – PCT 4015 - Central Hunter Swamp Oak Riparian Forest - *Moderate*																														
P140	3	7	4	8	1	3	45.4	8.6	86	1.9	0.1	1.3	1	1	1	1	0	0	0	0	38	3	3.2	2.2	0.0	101	56	305285	6407356	282
P156	2	3	2	3	0	3	30.1	0.4	35	1.7	0	0.4	1	1	1	1	1	0	0	0	65	13	61.7	2.2	0.0	101	56	314003.3	6413041	204
Vegetation Zone 12 – PCT 4081 - Northwest River Oak-River Red Gum Forest - *Moderate*																														
P045	2	0	2	1	0	0	40.1	0	1.3	0.1	0	0	0	1	1	1	1	0	0	0	25	14	0.9	1.7	0.0	101	56	310060	6400703	165
P134	3	1	4	2	0	0	45.2	0.2	1.5	0.9	0	0	1	1	1	1	1	0	0	0	27	300	35.1	1.7	0.0	101	56	310062	6400699	352
Vegetation Zone 13 –PCT 4089 - Namoi-Upper Hunter River Red Gum Forest – *Moderate*																														
P121	5	11	19	26	0	3	62.5	6.3	22.5	13.8	0	0.3	1	1	1	1	0	1	1	3	21	26	6.6	1.0	0.0	101	56	308300	6404744	70
Vegetation Zone 14 – PCT 4089 - Namoi-Upper Hunter River Red Gum Forest - *Low to Moderate*																														
P137	2	0	2	1	0	0	22	0	25.1	0.1	0	0	1	1	1	0	1	0	0	0	11.4	61	90.2	0.0	0.1	101	56	310014	6400683	156
Vegetation Zone 15 – PCT 4089 - Namoi-Upper Hunter River Red Gum Forest - *Cooba Woodland*																														
P138	1	1	7	3	0	1	25	0.1	89.9	0.5	0	0.2	1	1	1	1	1	0	1	2	3.6	278	4.6	0.1	0.6	101	56	309815	6400606	157
Vegetation Zone 16 – PCT 4089 - Namoi-Upper Hunter River Red Gum Forest - *Derived Native Grassland*																														
P043	1	0	1	1	0	0	0.2	0	45	0.1	0	0	1	0	0	0	0	0	0	0	2.4	0	0.6	1.0	0.0	101	56	312601	6401544	5
P046	1	1	2	2	0	0	1	0.3	40.2	0.2	0	0	0	1	0	0	0	0	0	0	3.2	0	2.5	1.0	0.0	101	56	310145	6400543	295
P119	0	0	6	3	0	0	0	0	82.2	0.5	0	0	0	0	0	0	0	0	0	0	10	0	2.6	1.0	0.0	101	56	312782	6401567	61
P135	1	0	1	7	0	0	0.2	0	15	3.9	0	0	1	1	0	0	0	0	0	0	16	10	25.4	1.0	0.0	101	56	310153	6400639	142
Vegetation Zone 17 – PCT 4089 - Namoi-Upper Hunter River Red Gum Forest - *Exotic Grassland*																														
P044	0	0	1	2	0	0	0	0	10	0.2	0	0	0	0	0	0	0	0	0	0	38.3	0	29.1	7.7	4.7	0	56	312516	6401573	30
P053	0	2	2	0	0	0	0	0.4	0.6	0	0	0	0	0	0	0	0	0	0	0	69	0	85	7.7	4.7	0	56	309434	6400666	260
P054	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79	5	62.4	7.7	4.7	0	56	308395	6401601	180
P118	0	0	3	4	0	0	0	0	45.8	0.9	0	0	0	0	0	0	0	0	0	0	19	0	0.4	7.7	4.7	0	56	313793	6402303	208
P136	0	0	4	1	0	0	0	0	46.6	0.1	0	0	0	0	1	0	0	0	0	0	11.2	20	72.5	7.7	4.7	0	56	310223	6400646	150
P139	1	0	1	3	0	0	0.1	0	2	0.4	0	0	0	1	0	0	0	0	0	0	14	14	95.6	7.7	4.7	0	56	308231	6401459	21

Appendix F

Credit Summary Reports

umwelt

BAM Credit Summary Report

Proposal Details

Assessment Id
00054717/BAAS17005/25/00054718

Proposal Name
HVO North - Amended Project

BAM data last updated *
28/10/2024

Assessor Name
Kate Connolly

Report Created
31/07/2025

BAM Data version *
Current classification (live - default) (80)

Assessor Number
BAAS17005

BAM Case Status
Finalised

Date Finalised
31/07/2025

Assessment Revision
0

BOS entry trigger

Assessment Type
Major Projects

* 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

Central Hunter Ironbark Grassy Woodland												
1	3431_Moderate_TEC	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	57.9	57.9	64.1	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		1856
2	3431_Thinned_Woodland_TEC	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	53.8	53.0	9.6	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		254
3	3431_Woodland_Exotic_TEC	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	22.1	22.1	1.9	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		21

4	3431_Plantation_TEC	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	47	35.9	0.5	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		9
											Subtotal	**2140**
Central Hunter Ironbark Grassy Woodland												
7	3431_Plantation	Not a TEC	47	43.8	2.6	PCT Cleared - 86%	High Sensitivity to Gain			2.00		57
8	3431_Scattered_Regen	Not a TEC	46.5	45.7	39.2	PCT Cleared - 86%	High Sensitivity to Gain			2.00		896
9	3431_Cooba_Woodland	Not a TEC	47.8	47.4	11.8	PCT Cleared - 86%	High Sensitivity to Gain			2.00		280
10	3431_Poor_Condition_DNG	Not a TEC	16.2	13.9	154.1	PCT Cleared - 86%	High Sensitivity to Gain			2.00		0
11	3431_Exotic_Grassland	Not a TEC	12.9	12.9	47.9	PCT Cleared - 86%	High Sensitivity to Gain			2.00		0

12	3431_Bull oak_Variant	Not a TEC	41.4	41.4	33	PCT Cleared - 86%	High Sensitivity to Gain			2.00		683
											Subtotal	**1916**
Central Hunter Riparian Forest												
13	4015_Moderate	Not a TEC	69.8	69.8	2.2	PCT Cleared - 88%	High Sensitivity to Gain			2.00		77
											Subtotal	**77**
Central Hunter Slaty Gum Grassy Forest												
5	3485_Moderate_TEC	Not a TEC	88.1	88.1	7.1	PCT Cleared - 89%	High Sensitivity to Gain			2.00		313
											Subtotal	**313**
Namoi-Upper Hunter River Red Gum Forest												
6	4089_Moderate_TEC	Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	65	65.0	1	Population size	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	33

18	4089_Low_to_Moderate	Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions	29.4	29.4	0.05	Population size	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00	True	1
											Subtotal	**34**
Namoi-Upper Hunter River Red Gum Forest												
15	4089_Cooba_Woodland	Not a TEC	54.5	40.5	0.1	PCT Cleared - 94%	High Sensitivity to Gain			2.50		3
16	4089_DNG	Not a TEC	21.8	14.8	1	PCT Cleared - 94%	High Sensitivity to Gain			2.50		9
17	4089_Exotic_Grassland	Not a TEC	9.3	9.3	7.7	PCT Cleared - 94%	High Sensitivity to Gain			2.50		0
											Subtotal	**12**

Northwest River Oak-River Red Gum Forest											
14	4081_Moderate	Not a TEC	34.6	34.6	1.7	PCT Cleared - 90%	High Sensitivity to Gain			2.50	37
										Subtotal	**37**
										Total	**4529**

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
Cercartetus nanus / Eastern Pygmy-possum (Fauna)									
3431_Moderate_TEC	57.9	57.9	61.4	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	1777
3431_Thinned_Woodland_TEC	53.0	53.0	7.9	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	209

3485_Moderate_TEC	88.1	88.1	7.1	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	313
3431_Scattered_Regen	45.7	45.7	15.9	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	363
4015_Moderate	69.8	69.8	0.5	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	17
								Subtotal	**2679**
Eucalyptus camaldulensis - endangered population / Eucalyptus camaldulensis population in the Hunter catchment (Flora)									
4081_Moderate	34.6	34.6	0.1	Biodiversity Conservation Act listing status	Seedbank Persistence	Endangered Population	Not Listed	False	2
4089_DNG	14.8	14.8	0.1	Biodiversity Conservation Act listing status	Seedbank Persistence	Endangered Population	Not Listed	False	1
4089_Exotic_Grassland	9.3	9.3	0.2	Biodiversity Conservation Act listing status	Seedbank Persistence	Endangered Population	Not Listed	False	1

4089_Low_to_Moderate	29.4	29.4	0.05	Biodiversity Conservation Act listing status	Seedbank Persistence	Endangered Population	Not Listed	False	1
								Subtotal	**5**
Myotis macropus / Southern Myotis (Fauna)									
3431_Moderate_TEC	57.9	57.9	26.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	758
3431_Thinned_Woodland_TEC	53.0	53.0	4	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	106
3431_Plantation_TEC	35.9	35.9	0.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	2
3485_Moderate_TEC	88.1	88.1	3.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	137
4089_Moderate_TEC	65.0	65.0	0.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	29

3431_Plantation	43.8	43.8	0.6	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	13
3431_Scattered_Regen	45.7	45.7	13.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	315
3431_Cooba_Woodland	47.4	47.4	5.8	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	138
3431_Bulloak_Variant	41.4	41.4	19.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	397
4015_Moderate	69.8	69.8	1.3	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	45
4081_Moderate	34.6	34.6	1.7	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	29
4089_Cooba_Woodland	40.5	40.5	0.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	2

4089_Low_to_Moderate	29.4	29.4	0.05	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	1
								Subtotal	**1972**
Petaurus norfolcensis / Squirrel Glider (Fauna)									
3431_Moderate_TEC	57.9	57.9	61.4	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	1777
3431_Thinned_Woodland_TEC	53.0	53.0	7.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	209
3431_Scattered_Regen	45.7	45.7	15.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	363
								Subtotal	**2349**
Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)									
3431_Plantation	47.0	47.0	2.6	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	61

4015_Moderate	69.8	69.8	2.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	77
3431_Moderate_TEC	57.9	57.9	64.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	1856
3431_Thinned_Woodland_TEC	53.8	53.8	9.6	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	258
3431_Woodland_Exotic_TEC	22.1	22.1	1.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	21
3431_Plantation_TEC	47.0	47.0	0.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	12
3485_Moderate_TEC	88.1	88.1	7.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	313
4089_Moderate_TEC	65.0	65.0	1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	33

3431_Bulloak_Variant	41.4	41.4	33	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	683
4089_Low_to_Moderate	29.4	29.4	0.05	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	1
								Subtotal	**3315**

BAM Credit Summary Report

Proposal Details

Assessment Id
00054725/BAAS17005/25/00054726

Proposal Name
HVO South - Amended Project

BAM data last updated *
28/10/2024

Assessor Name
Kate Connolly

Report Created
31/07/2025

BAM Data version *
Current classification (live - default) (80)

Assessor Number
BAAS17005

BAM Case Status
Finalised

Date Finalised
31/07/2025

Assessment Revision
0

BOS entry trigger

Assessment Type
Major Projects

* 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

Central Hunter Ironbark Grassy Woodland												
1	3431_Moderate_TEC	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	57.9	57.9	0.5	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		14
2	3431_Thinned_Woodland_TEC	Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	53.8	53.8	1.9	Biodiversity Conservation Act listing status	High Sensitivity to Gain	Endangered Ecological Community	Not Listed	2.00		51
											Subtotal	**65**
Central Hunter Ironbark Grassy Woodland												
3	3431_Cooba_Woodland	Not a TEC	47.8	47.8	0.2	PCT Cleared - 86%	High Sensitivity to Gain			2.00		5
4	3431_Poor_Condition_DNG	Not a TEC	16.2	15.6	7	PCT Cleared - 86%	High Sensitivity to Gain			2.00		0

5	3431_Exotic_Grassland	Not a TEC	12.9	12.9	7.4	PCT Cleared - 86%	High Sensitivity to Gain			2.00		0
											Subtotal	**5**
Namoi-Upper Hunter River Red Gum Forest												
6	4089_Cooba_Woodland	Not a TEC	54.5	54.5	0.6	PCT Cleared - 94%	High Sensitivity to Gain			2.50		20
7	4089_Exotic_Grassland	Not a TEC	9.3	9.3	4.7	PCT Cleared - 94%	High Sensitivity to Gain			2.50		0
											Subtotal	**20**
											Total	**90**

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
Cercartetus nanus / Eastern Pygmy-possum (Fauna)									
3431_Moderate_TEC	57.9	57.9	0.5	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	14

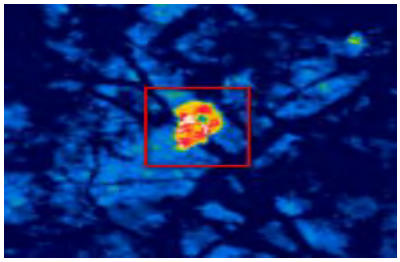
3431_Thinned_Woodland_TEC	53.8	53.8	1.9	Biodiversity Conservation Act listing status	Effectiveness of management in controlling threats	Vulnerable	Not Listed	False	51
								Subtotal	**65**
Eucalyptus camaldulensis - endangered population / Eucalyptus camaldulensis population in the Hunter catchment (Flora)									
3431_Cooba_Woodland	47.8	47.8	0.1	Biodiversity Conservation Act listing status	Seedbank Persistence	Endangered Population	Not Listed	False	2
3431_Exotic_Grassland	12.9	12.9	0.2	Biodiversity Conservation Act listing status	Seedbank Persistence	Endangered Population	Not Listed	False	1
4089_Cooba_Woodland	54.5	54.5	0.1	Biodiversity Conservation Act listing status	Seedbank Persistence	Endangered Population	Not Listed	False	3
4089_Exotic_Grassland	9.3	9.3	0.2	Biodiversity Conservation Act listing status	Seedbank Persistence	Endangered Population	Not Listed	False	1
								Subtotal	**7**

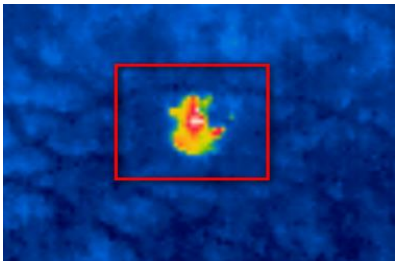
Myotis macropus / Southern Myotis (Fauna)									
3431_Moderate_TEC	57.9	57.9	0.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	14
3431_Thinned_Woodland_TEC	53.8	53.8	1.4	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	38
3431_Cooba_Woodland	47.8	47.8	0.1	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	2
4089_Cooba_Woodland	54.5	54.5	0.2	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	5
								Subtotal	**59**
Petaurus norfolcensis / Squirrel Glider (Fauna)									
3431_Moderate_TEC	57.9	57.9	0.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	14
3431_Thinned_Woodland_TEC	53.8	53.8	1.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	51
								Subtotal	**65**

Phascogale tapoatafa / Brush-tailed Phascogale (Fauna)									
3431_Moderate_TEC	57.9	57.9	0.5	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	14
3431_Thinned_Woodland_TEC	53.8	53.8	1.9	Biodiversity Conservation Act listing status	Species dependent on habitat attributes	Vulnerable	Not Listed	False	51
								Subtotal	**65**

Appendix G

Thermal Drone Report





Umwelt HVO – Thermal Drone Koala Surveys

Prepared for Umwelt, 31 July 2023

Wildlife Drones

Ripper Corp.

Table of Contents

1. Introduction

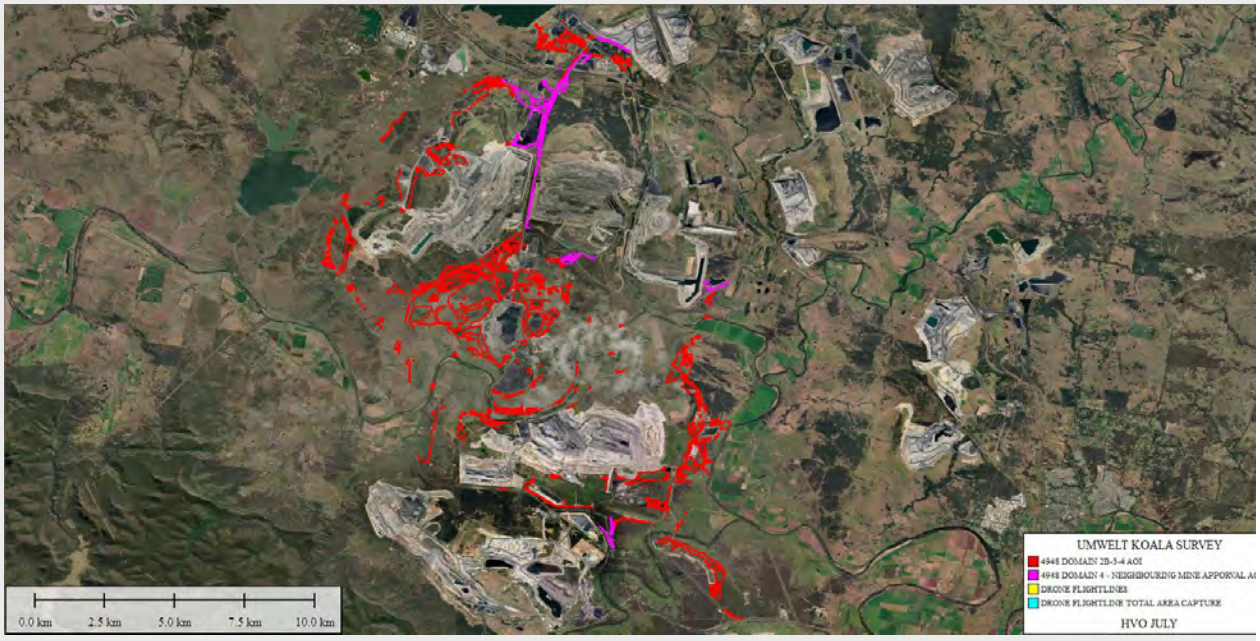
Wildlife Drones were tasked with surveying for Koalas (*Phascolarctos cinereus*), using professional grade drones and sensors including DJI XH20T, H20N or XT2 sensors.

1.1. Study site

Umwelt provided existing site information attained from biodiversity surveys including; vegetation mapping, land use assessment, SAT surveys and nocturnal surveys to inform the priority habitat for koalas.

Map 1: HVO Study Site

4948 DOMAIN 2B-3-4: AOI @ 1,014.9HA (RED BOUNDARY AREAS)
4948 DOMAIN 4 NEIGHBOURING MINE APPROVAL AOI'S: AOI @ 107.31HA (PURPLE BOUNDARY AREAS)



Topography	Active mine areas
Land access by client	Granted
Land access by landholder	Granted
Site manager/contractor	Umwelt
Species to be detected	*Phascolarctos cinereus* (Koala)

2. Methodology

A detailed site assessment was conducted across the project area to identify suitability for *Phascolarctos cinereus* (Koala) thermal sensor surveys. Items considered included airspace, landfall and vegetation mass. Additional elements of influence regarding safe and successful flight also included risk management factors, CASA air law generally and RPA (Remotely Piloted Aircraft) standard operating procedures that may influence outcomes.

Thermal drone surveys were undertaken from 12-20th July 2023 in accordance with Section 4.5 of the Koala Biodiversity Assessment Methodology Survey Guide (DPE 2022) as a minimum standard.

2.1. Desktop Research

A desktop review was conducted based upon evidence from Umwelt regarding land usage and possible rehabilitation of regions within the survey area. Tree taxon considerations such as food, shelter or other resources were identified regarding abundance not only in the survey area but also in the surrounding region.

2.2. Drone survey methodology

Flight line direction	N-NW/S-SE (adjusted to corridor angle & site specific heliotropic angle corrections). Whilst generally these lines were observed, due to terrain differences, safety considerations and site configuration, flight direction was variable. Fence, creek and easement areas were surveyed with specific orientation to best optimise coverage.
Flight line overlap (side)	30-40%
Survey altitude (AGL)	60-70m AGL (adjusted to flight waterline areas, required adjustments due to slope changes and altitude difference between take off and mission areas)
Inspection altitude (AGL)	30m AGL above object
Detection method (a)	Hot spot alert
Detection method (b)	Shape detection
Detection method (c)	Characteristic trait
Detection method (d)	Drone infra-red thermal and colour zoom imagery with spotlight
Total flight area (ha)	2693.5 ha
Total Koalas detected	No koalas detected
Flight speed	<6m/s to enable higher resolution image collection
Survey times	21:00 - 06:00 each night/morning at suitable temperatures
Survey nights	10 standard survey nights undertaken over a 7 night period

Optimised flight line directions

Section 4.5 of the NSW government Biodiversity Assessment Methodology (BAM) (NSW DPE 2022) for surveying koalas using drones includes the use of grid flight patterns, which were used as the base format of these surveys. Although the direction of grid flights is not generally given much consideration industry wide, our extensive experience specialising in this form of targeted detection work highlights the benefits of very specific, directional flight lines for optimising fauna detection in natural variable habitats compared to standard methods. That is, our flight line direction takes into consideration both the heliotropic characteristics of native flora in which allows a much higher confidence spotting outcome, as well as following the terrain rise and fall and the relative look/sensor angle.

Large side overlap (30-40%) to ensure no data gaps

Peer reviewed research (e.g. Hamilton *et al* 2020; Witt *et al* 2020) have accepted a 10% side overlap, and the BAM method includes >30% side overlap based upon a 60-75m above ground flight altitude. However, in order to guarantee the most robust survey results where there are no possible gaps in the data we always fly with 30-40% overlap taking into account frame width, lens length, height and other factors, including vegetation and terrain variability (rise and fall height of trees and other vegetation).

Superior thermal data - flight altitude, ground sampling distance & inspection altitudes

We use 19mm focal length thermal sensors which allow greater separation between the tree canopy and drone, making it not only safer in terms of drone flights, but also in terms of detecting and not disturbing wildlife. BAM and other similar methods discuss predominately using 13mm sensors flown at the same altitude, which would result in only 4-6 pixels per koala compared to 14-16 pixels per mature koala from our 19mm sensor at the same height (survey grid height). Therefore, our methods produce a higher likelihood of precise target animal detection and a larger, clearer resultant hotspots for each animal.

Ethical considerations

Inspections carried out upon hotspot detection are performed at no closer than 30m from the fauna for detection. Our team has found disturbance is observed within 25m of both captive and wild koalas during surveys in Queensland, Victoria and New South Wales and so we conduct our surveys further away than this.

In our operations, any disturbance observed other than expected during operations triggers the pilot to move away immediately from the koala, note information regarding the encounter and report back to our team ecologists for discussion. The fauna reaction to the drone is then considered, evaluated and improvements are integrated into our methods particularly around closer inspection for identification whereby we consider fauna wellbeing as a matter of priority, and our team remains vigilant in this regard throughout all survey efforts.

Temperature for flight operations

BAM methodology discusses a minimum overnight temperature of 18 deg, however, if the drone sensor has isothermal capability, the pilot can isolate temperature ranges. This limitation on surveys has been adjusted with isotherm capable drones to a minimum overnight temperature of 25 deg.

Testing regarding temperature ranges and Koalas is continually occurring based upon new sensors, detection methods etc. Our pilots regularly test temperature isolation and other methodology-based aspects, and have compared to simultaneous ground based surveys, with results indicating that the drone detections outperforms ground-based surveys with 50-100% increased detection rate of koalas (pers. comm., Jamie Holyoak 2023).

2.3. Equipment

Enterprise grade drone equipment and sensors

Drones	DJI Matrice 300
Thermal & RGB sensors	DJI XH20T, DJI H20N, DJI XT2 Thermal sensitivity: ≤50 mK • Spectral range: LWIR or 8–14 µm • Thermal resolution: ≥640 x 512 px • Focal length: 19 mm • Frame capture rate: ≥30 Hz

- The H20T sensor was used for all specific fauna inspection occurrences. Sensor automatic calibrations occurred every minute of operation with additional calibrations manually performed as needed.
- 22 inch, high contrast screens were used to project controller imagery/video to a larger screen allowing higher detail and quicker confirmation of species for detection.

2.4. Detection evidence:

Hotspot detection

Hotspot detection is the primary detection metric whilst at survey altitude, with a hot spot alert in place, this also detects fauna of a temperature higher than the surrounding environment. Isothermic methods are also used within the detection process at survey altitude which allows isolation of specific temperature ranges in which one may reasonably expect to detect koalas. Considerations are made regarding ambient temperature, thermal drop off/radiation loss through the night, previous day temperature, humidity and object reflectance mitigation.
Our thermal sensors allow certain false positives to be mostly removed through heat reflectance masking on specific object types, such as certain eucalypt trunk verities, termite mounds and other miscellaneous objects. Existing peer review academic

methods generally do no utilise isothermic methods, as the smaller drones used do not have this feature available.
Our team use Enterprise grade drones and sensors for all of our fauna detection operations. Where available, a passive spotlight detection is used to rapidly confirm in RGB/colour what species has been detected by the initial thermal sensor. This recent innovation, has allowed much shorter time periods of loiter regarding the drone around fauna for inspection thus reducing any possible impacts that prolonged drone inspection may produce. Our team generally does not loiter on a fauna inspection target for any more than two minutes in any single inspection effort per animal.

Combined hot spot, characteristic traits (shape, ears, arms, legs, movement), allow the pilot to gather suitable evidence in an effort to determine fauna type with the use of a spotlight to confirm.

Detection validations & species confirmation:

Our team utilises spotlighting from the drone to confirm species detected whilst airborne. This has generally removed the requirement for follow-up post-survey validation from on the ground. Where there is any uncertainty ground-validations can be undertaken where access to the site is possible, or repeat surveys of the location may be undertaken. A colour image of the species detected is captured upon detection as documented validation of the animals observed. Generally, the team will only capture the target species for detection (koala in this case), however, a base capture of other fauna is catalogued during operations to demonstrate the diversity of fauna that are present at the site.

Calibration and field testing:

Our team utilise several established test ranges with known koala populations to confirm both the sensor quality, settings and other considerations. These ranges also allow our pilots the capability to be trained in a controlled and known environment which senior pilots may grade and determine their suitability for commercial operations. All pilots generally perform testing at least once a month where not field spotting koalas for our commercial clients and partners to maintain well-honed skills and observation abilities.

3. Survey Results

Our team surveyed all survey areas across the site over 7 nights from 12/07/2023-20/07/2023. Given time was of the essence during the surveys, the Chief Remote Pilot approved extended periods of survey each night, equating to 10 standard thermal survey nights.

Weather conditions were stable throughout the survey period with some site related complexities causing delays and postponements. There no incidents reported during the surveys from an aviation perspective. There was reasonable access to all areas and so all proposed flight areas were surveyed. Mobilisation generally occurred mid to late afternoon to account for site access and escort assignment. Our pilot generally flew from mid evening through to dawn the following day.

3.1. Detection evidence

Koala detections

No koalas were detected during these comprehensive surveys.

Other wildlife detected

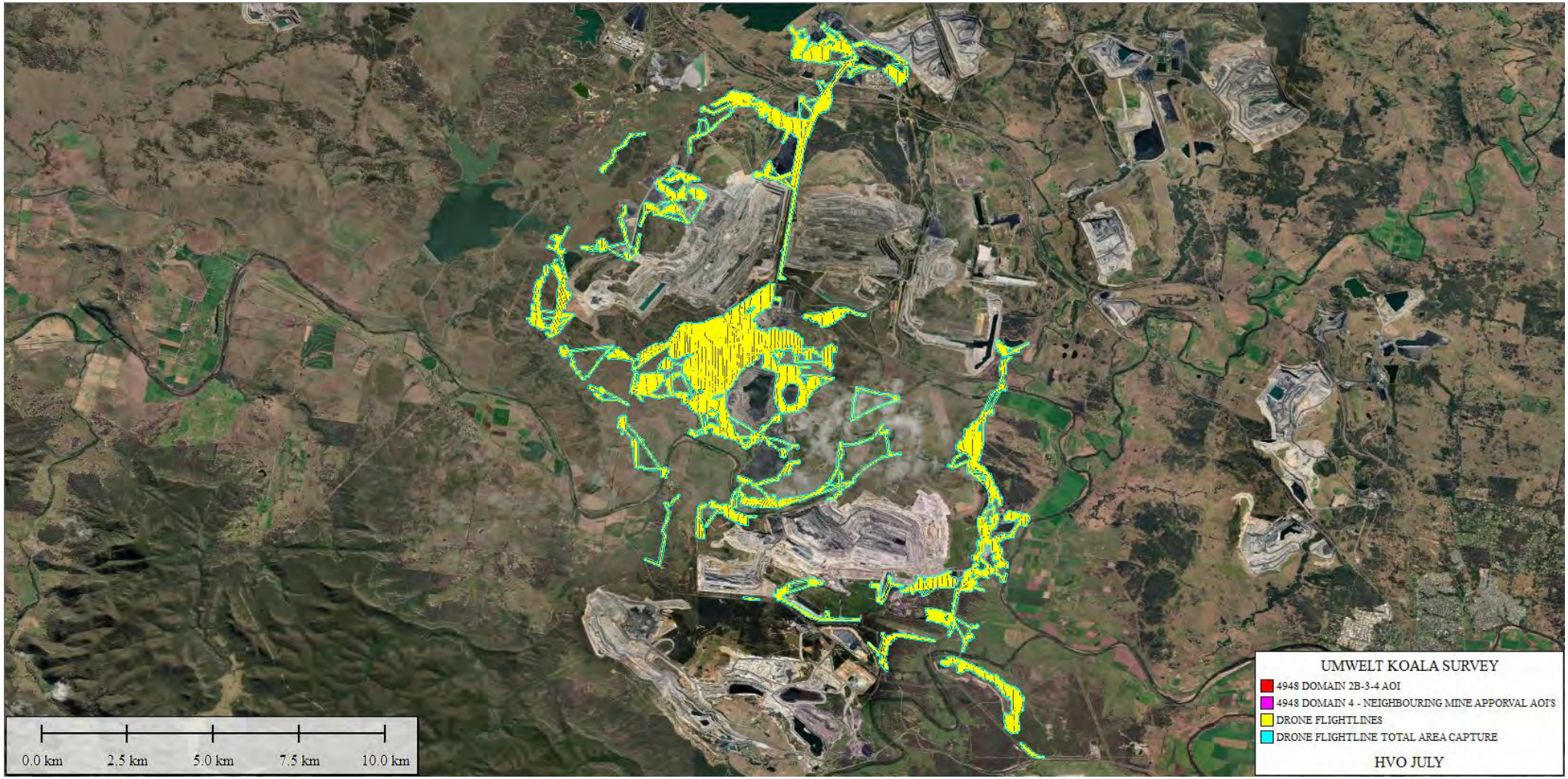
Our pilots use an excel spreadsheet to make wildlife observation notes during all surveys. This document is included with the data collected for these surveys.

The diversity of animals detected and recorded provides evidence of the comprehensive nature of our surveys and illustrates successful detection of an array of wildlife, including a variety of animals with different shapes, sizes and temperature signatures. An example of the data captured on the spreadsheet is provided below:

Species	Time	Date/Notes	Confirmed/uncont	Lat/	Pin	Image	File #	Est.	Abnor
		2023-07-12				FALSE			No
Macropod	1:19:07 AM				1	TRUE			No
Macropod	1:30:46 AM				2	TRUE			No
Possum Brushtail	1:35:00 AM				3	TRUE			No
Possum Brushtail	1:39:08 AM				4	TRUE			No
Bird	2:57:55 AM				5	TRUE			No
Bird	3:14:13 AM				6	TRUE			No
Bird	4:42:53 AM				7	TRUE			No

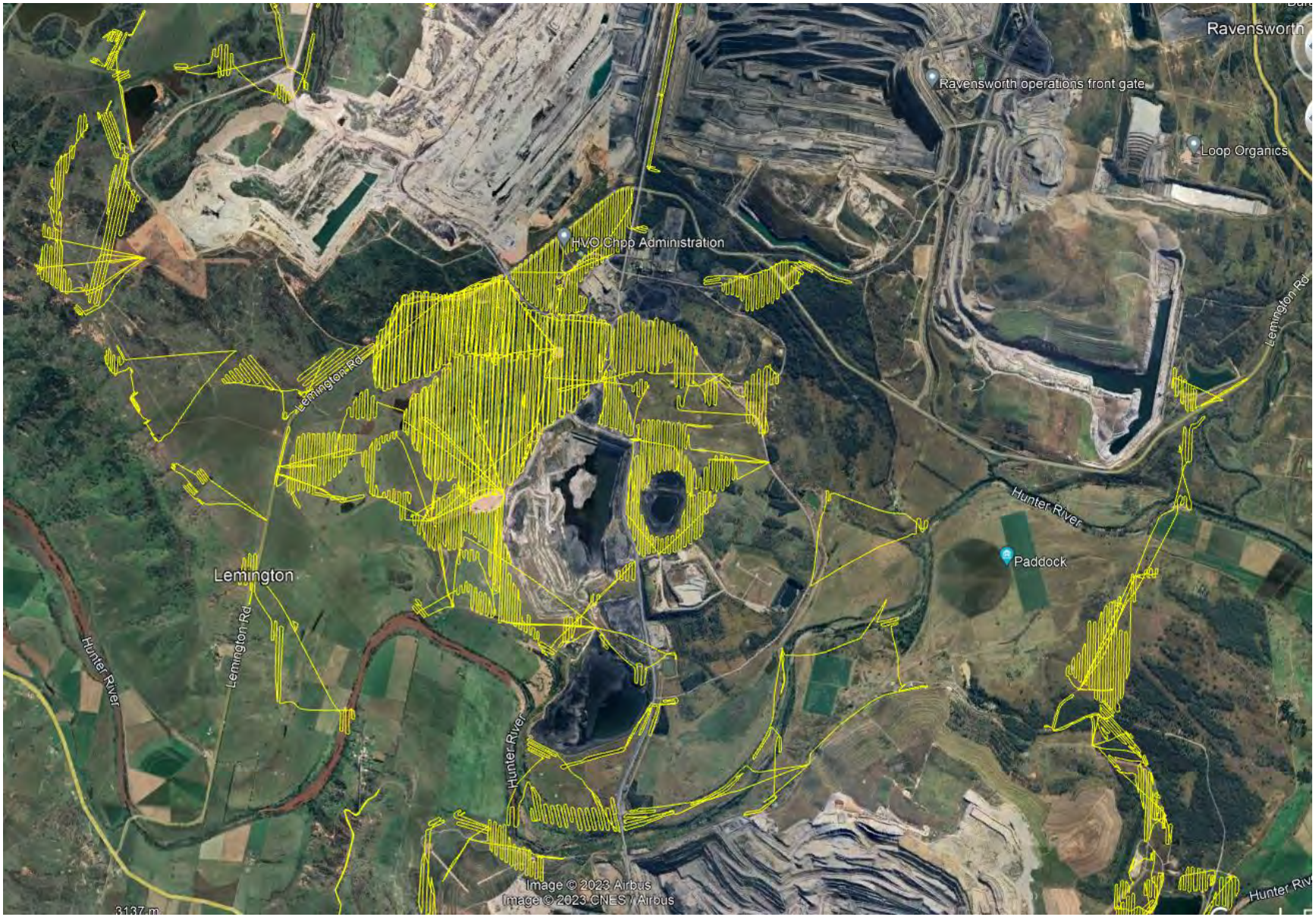
All video and still imagery have been provided via our secure cloud portal. Species images can be found by sorting the file names by time/date and finding the ones that correspond to species on the spreadsheet.

Map 2: Flight line coverage – all sites



Map 3: Flight line coverage – Northern areas detail

Map 4: Flight line coverage – Central areas detail



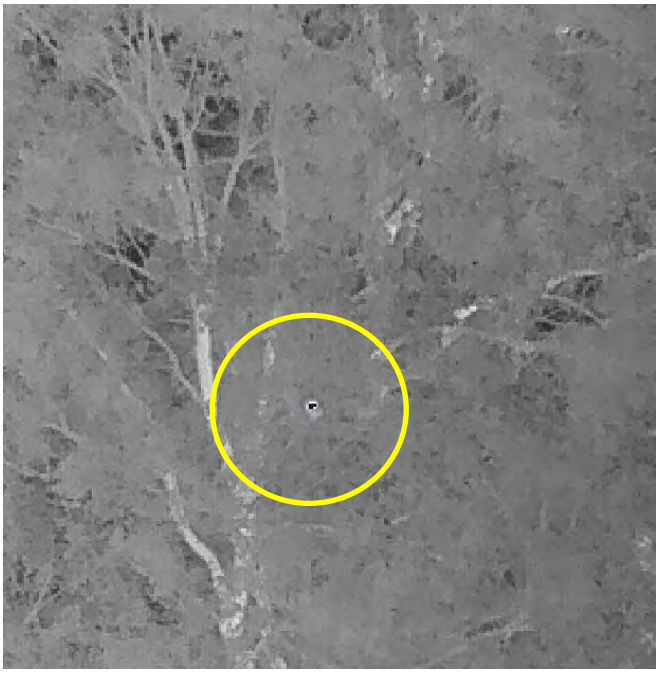
Map 5: Flight line coverage – Southern areas detail

3.2. Koala detections - details

Koala detection details	No koalas were detected

3.3. Examples of non-target species detected

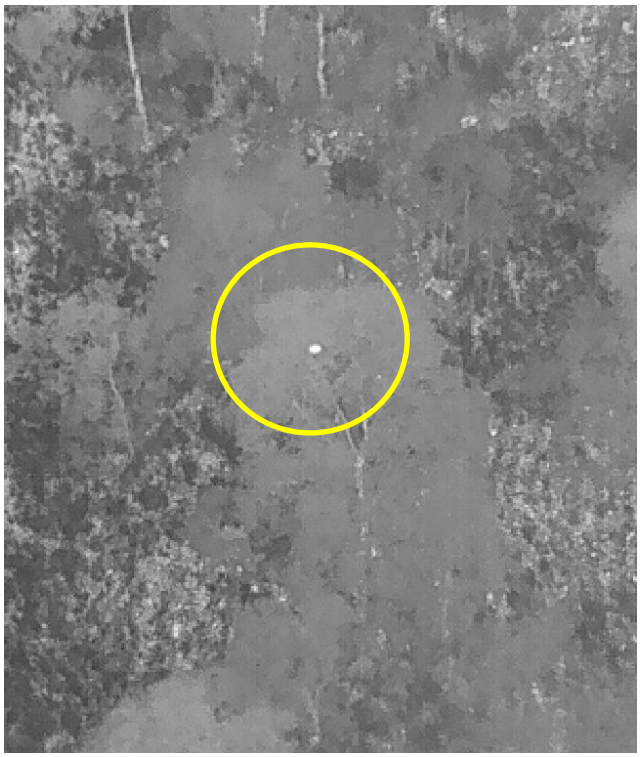
Roosted birds:



Feral pig

Macropod

Possums



Field operations:

4. Conclusion

Although the aerial surveys did not find any Koalas, a range of other native and feral species were detected and identified as a result of the comprehensive survey coverage across the site.

5. References

- Hamilton G, Corcoran E, Denman S, Hennekam ME and Koh LP (2020), When you can't see the koalas for the trees: Using drones and machine learning in complex environments, Biological Conservation, vol.247, p.108598, doi: 10.1016/j.biocon.2020.108598.
- NSW DPE (2022) Biodiversity Assessment Methodology https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/koala-phascolarctos-cinereus-biodiversity-assessment-method-survey-guide-220249.pdf)
- Witt RR, Beranek CT, Howell LG, Ryan SA, Clulow J, Jordan NR, Denholm B and Roff A (2020), Real-time drone derived thermal imagery outperforms traditional survey methods for an arboreal forest mammal, PLoS ONE, vol.15, no.11: e0242204, doi.org/10.1371/journal.pone.0242204.

Please use the below email addresses to obtain any other relevant files used in this assessment, or if you have any questions.

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Appendix H

BCD Submissions and Responses

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Table H.1 BCD Submissions and Response – 13 March 2023

Ref.	BCD Comment	BCD Recommendation	Proponent Response
1.	The BDAR outlines that the project will clear 1.5 hectares of the EEC, which is about 0.35% of its estimated extent of 436 hectares. **Section 5.2.3** of the BDAR describes measures that have been undertaken to avoid impacts to this EEC, including the avoidance of impacts to about 255 of the 269 River Red Gums that are in the vicinity of the transmission line that forms the part of the project that will cause impacts to this EEC. **Table 6.9** states that the project triggers SAII Principle 3 for the Warkworth Sands Woodland EEC. The project would clear 5.2 hectares of the EEC which represents 1.59% of its estimated extent of 333 hectares. BCD notes that both EECs have a very limited geographic distribution by having an extent of occurrence of < 1,000 square kilometres. Weeds have also caused a decline in the environmental quality and biotic interactions within both EECs, hampering the recruitment and establishment of characteristic species, even in areas of active management such as the Carrington Billabong for Hunter Floodplain Red Gum Woodland EEC and the Warkworth Mine's Northern Offset for Warkworth Sands Woodland EEC. As a result of these two factors BCD considers the project represents a risk of SAII to both EECs.	BCD recommends that if the project is approved that it includes specific conditions of consent that will minimise the impact of the project on Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregion EEC and Warkworth Sands Woodland in the Sydney basin Bioregion EEC. BCD further recommends that management and mitigation strategies for these EECs are produced, and this is done in consultation with Planning and Assessment Group and with BCD.	Further avoidance measures have been undertaken to ensure that the Project has no direct impact to Warkworth Sands Woodland CEEC and a further reduction of impacts on Hunter Floodplain Red Gum Woodland EEC (refer to **Section 5.0**) Additional recommendations are provided in **Section 5.6** of the revised BDAR in relation to additional measures for: • Weed management. • Protection and habitat restoration. • Establishment of native vegetation. • Monitoring and adaptive management. A Hunter Floodplain Red Gum Woodland Restoration Site is proposed to provide an 'additional measures' offset for impacts associated with SAII (refer to **Section 9.0**).
2.	Proponent should provide the following information: • Table of candidate threatened plant species surveyed for the project. Table to include: Area of suitable habitat within Project area (h) by VZ and PCT and a total area within the subject land; number of circular survey areas per VZ, per PCT, and in Project area; are surveyed by these circular survey areas by VZ, PCT, and for the subject land. • description of how 2-phase grid method was applied including details of how the 1 km grids sampled were chosen, and a discussion on any assumptions and limitations of the use of this method. As described in Section 4.4 of 'Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method' (EES, 2020) this survey method applies only where suitable habitat for a particular species is larger than 50 hectares, and this has not been demonstrated in the BDAR. BCD notes that only vegetation zones 13, 19 and 20 are larger than 50 hectares.	The proponent should provide the following information to demonstrate the effectiveness of the two-phase grid-based systematic survey technique applied for this assessment: • A table of candidate threatened plant species surveyed for this project with the area of suitable habitat within the Project area given in hectares by Vegetation Zone and by Plant Community Type (PCT), and a total area within the subject land; the number of circular survey areas per Vegetation Zone, per PCT and in the Project area; and the area surveyed by these circular survey areas by Vegetation Zone, by PCT and for the subject land. • A description of how the two-phase grid-based systematic survey approach was applied for this project, including details of how the one-kilometre grids that were sampled were chosen, and a discussion on any assumptions and limitations of the use of this method.	Further detail and justification on grid-based approached provided in **Section 4.1.3.1** and **Table 4.1** of the revised BDAR. Targeted threatened flora surveys following the two-phase grid-based systematic approach was undertaken across all suitable habitat areas within the Development Footprints as outlined in Section 4.4.1. of the NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e). Due to the size of the impact area and varying condition of PCTs (i.e. mosaic of vegetation zones) across the Development Footprints, it was determined that undertaking the two-phase grid method across all suitable habitat for all predicted species was the most effective way to cover the site (rather than assess habitat discretely by vegetation zone). The NSW survey guide for surveying threatened plants and their habitats (DPIE 2020e) does not specify a requirement to undertake the two-phase grid-based approach on a vegetation zone-basis.
3.	Columns should be added to a revised version of Table D2.2 including: 1. 'Minimum survey effort requirements'; 2. 'Survey requirements met (answered yes, no, partially). A 'Notes' column may be added, or the same text otherwise provided to explain why survey effort and survey methods used may not have met survey requirements.	Columns should be added to a revised version of Table D2.2 of the BDAR that cover: • 'Minimum survey effort requirements'. • 'Survey requirements met?' (to be answered by 'Yes', 'No' or 'Partially'). A 'Notes' column may be added, or the same text otherwise provided to explain why survey effort and survey methods used may not have met survey requirements.	Updated in **Table D.2** of **Annexure D** to include information requested.
4.	For under-surveyed areas of potentially suitable koala habitat that additional surveys are undertaken, or the species is assumed to be present, or an expert report is prepared. Survey requirements for the koala changed during the period that the BDAR was being prepared, and after most targeted surveys for the koala has been undertaken. Nevertheless, the survey effort outlined in the BDAR for the koala does not meet the survey requirements applicable at the time of submission.	Further assessment should be undertaken for the potential presence of the koala where survey effort does not meet BCD's survey requirements. The additional assessment may be in the form of additional targeted threatened species survey, done in accordance with current survey guidelines, or from the provision of an expert report, or by assuming the presence of the koala in areas of suitable habitat.	Thermal drone surveys and additional SAT surveys for the koala have been undertaken. The BDAR has been updated in **Table 4.2** and **Table D.2** to reflect these surveys. **Figure 4.2** has been updated to identify the extent of survey coverage**. Table D.3** in **Annexure D** outlines the assessment of suitable koala habitat as described in the Koala (*Phascolarctos cinereus*) Biodiversity Assessment Method Survey Guide. **Annexure G** includes the drone report. No koalas or signs of koala were recorded during the targeted surveys.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
5.	**Annexure D** 'Threatened Species Assessment and Survey Methodology' and the BAM Calculator file shows that the targeted surveys for some threatened species were either partially (e.g., Gang-gang Cockatoo, Eastern Pygmy Possum, and *Thesium australe*), or fully (e.g., *Cryptostylis hunteriana*) done outside of the specified survey months. Further details are required to demonstrate that BCD's minimum survey requirements have been followed and that the minimum survey effort has been done; if not those species will require further surveys (in the appropriate months), or an assessment by an Expert Report or to be assumed to be present and offset accordingly.	Further information should be provided about the survey effort undertaken within the specified months for targeted surveys for all candidate species-credit species, and that surveys within the specified months are compared against the required survey effort. If some species have been inadequately surveyed then further surveys (done in the appropriate months), an expert report, or the species is assumed to be present and offset accordingly.	**Table D.2** updated in **Annexure D**, where relevant. Each of the threatened species identified by BCD in their submission were adequately surveyed, with surveys undertaken during the survey windows specified in the TBDC. Additionally, surveys undertaken during sub-optimal seasons are also included in **Table D.2** of **Annexure D** as supplementary surveys which contribute to the overall survey effort, noting that the majority of threatened species can be identified outside of the nominated survey period and these surveys provide important contextual surveys for all species. Additional survey effort undertaken following the exhibition of the EIS included: • Additional koala SAT surveys and thermal drone surveys targeting koala. • Pitfall trapping targeting the common planigale. • Further surveys were undertaken in October 2023 and November 2023 and March, April and June 2025 that included: • Spotlighting surveys for Stephens banded snake. • Hollow tree searches for breeding activity for gang-gang cockatoo. • Threatened flora transects targeting species detectable in November (Thesium australe and Cryptostylis hunteriana). • Additional remote camera surveys and green and golden bell frog surveys . • Hollow bearing tree surveys and nesting/roosting habitat constraints • Acoustic recorded surveys • Dip netting for green and golden bell frog tadpoles and Gambusia sp.
6.	The survey requirements for the common Planigale (*Planigale maculata*) have not been met. The appropriate survey technique for this species is pitfall trapping however, **Table 4.1** 'Species-credit Species Surveys' of the BDAR states that the following survey has been conducted for common Planigale: • Nocturnal spotlighting; and • Remote camera survey. The Threatened Biodiversity Data Collection in BioNet states that 'surveys must be undertaken using pitfall traps.' Where that is not possible, due to rocky ground, for example, then the alternative is an expert report.	Areas of suitable habitat for the common planigale in the subject land should be surveyed using pitfall trapping, or the species is assessed by an expert report, or that the species is assumed to be present and then offset in accordance with the Biodiversity Offset Scheme.	Pitfall traps were installed across the Development Footprint as outlined in **Table 4.1** and **Annexure D**. Consultation with the BCD was undertaken to determine the survey effort required across the Development Footprints which is considered 'large-scale'. The conclusion was where "total suitable habitat > 50 ha: 22 arrays plus one additional for every 10 ha of suitable habitat above 10 ha. For example, 60 ha of suitable habitat will require 23 arrays." The Development Footprints contain approximately 420 ha of potentially suitable habitat subject to impacts in accordance with the predicted vegetation zones in the TBDC. Based on this advice, it was calculated that a total of 59 pitfall trap arrays should be established to adequately survey for the common planigale. A total of 64 pitfall trap surveys were installed. No common planigales were recorded. Consultation with BCD was undertaken to determine the extent of surveys required.
7.	**Section 4.2.2.1** 'Southern Myotis (*Myotis macropus*)' of the BDAR outlines that habitat polygon mapping for the southern Myotis was calculated on the direct impacts to the population by buffering all recorded individuals by 30 metres. This approach does not cover all waterbodies within the project site. Under the BAM 2020, for fauna species assessed by area (as per the threatened biodiversity data collection (TBDC)), the species polygon is meant to be used to measure the area of suitable habitat on the subject land. The 'Species credit' threatened bats and their habitats - NSW survey guide for the Biodiversity Assessment Method, outlines that 'All habitat on the subject land where the subject land is within 200 m of a waterbody with pools/ stretches 3 m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies on the subject land' should be included in the species polygon for the southern Myotis.	The species and habitat polygons for the southern Myotis should be updated to include waterbodies as outlined in the BAM 2020 and associated guidance documents.	**Section 4.2.2.1** of the BDAR does not state this. The southern myotis habitat polygon mapping was undertaken by clipping associated PCTs within the Development Footprint and within 200 m of a waterbody what was 3 m or wider. This included rivers (such as the Hunter River), creeks and dams within the locality of the Project. This is consistent with the requirements outlined in Table 1 of 'Species credit' threatened bats and their habitats NSW survey guide for the Biodiversity Assessment Method (OEH 2018). No changes to the assessment in the revised BDAR have been undertaken.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
8.	The assessor should not exclude the Stephens banded snake from assessment and should provide further details of potential habitat for cave-dwelling bats within the project area that could be provided by built structures and mine shafts.	Stephens banded snake (*Hoplocephalus stephensii*) – the TBDC notes that this species uses very old primary forest with many large old hollow bearing trees and therefore discounts this species. However, this description is provided as a general guidance and the TBDC also states that fallen timber, hollow bearing trees and areas within 500 metres of arboreal vine tangles can also provide habitat. As the Project area contains these features, the species habitat constraints, the species should not be ruled out due to lack of habitat.	Surveys were undertaken for this species in accordance with relevant survey guidelines however the species is no longer a candidate species, as per the TBDC, following an update to the BAM-C and TBDC in October 2024.
		Cave-dwelling microbats (*Chalinolobus dwyeri* and Bentwings) – the BDAR does not contain enough information to quantify prescribed impacts to threatened microbats from the loss of mine shafts, and other old mine workings, and buildings in the Project area.	Additional text added to the justification in **Table D.1** in **Annexure D** noting that there are no mine shafts, workings, or old buildings within the Development Footprints.
		Foraging *Miniopterus australis* bats were recorded on site. This species roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges, and buildings. BAM assessments that require surveys for roosting sites for this species and also require an assessment of the importance of the habitat to the migration of this species. This species is very selective for roosting habitat and will move between roosts sites depending on temporal variance. The removal of any roosting habitat should be compensated with supplementary habitat so as to not disrupt migration to the maternity roost: a significant impact to a maternity roost for this species would be considered to be a Serious and Irreversible Impact.	Additional text added to the justification in **Table D.1** in **Annexure D** noting that there are no mine shafts, workings, or old buildings within the Development Footprints. Furthermore, targeted searches of culverts in October 2023 (undertaken as part of the Commonwealth assessment for the Project) did not result in the identification of roosting microbats. As there was no roosting habitat identified in the Development Footprint, or nearby further assessment of the disruption to migratory patterns. As there is no impact to roosting or maternity habitat of *Miniopterus australis*, the species is not at risk of a SAII.
9.	Vegetation at and around BAM Plot 18, within Warkworth Sands Woodlands appears to be in a discharge zone of the local aquifer, this suggests that consideration of groundwater impacts will be required for the proposed relocation of Lemington Road in this area. During the site visit of 22 February 2023, it was noted that the vegetation in and around BAM Plot 18 included *Myriophyllum* sp., *Xyris* sp., and *Drosera burmanni*. The soil at the site was wet too, with standing water, but the presence of these wetland species suggests this is due to a local, relatively persistent source of water rather than from the heavy rain that fell before the site visit. Given that this site is downslope of part of the biodiversity offset for the Warkworth Mine, with Warkworth Sands Woodland, BCD recommends that an assessment of the local aquifer, within the sandsheet is undertaken to ensure that any development of the site will not adversely affect the aquifer and affect other areas of Warkworth Sands Woodland, by either draining the upslope section of sandsheet or blocking the flow of water.	An assessment of potential impacts to Warkworth Sand Woodland in areas adjacent to BAM Plot 18 should be undertaken if development activities in that area are likely to change local groundwater conditions (e.g. by either draining the upslope section of sandsheet or blocking the flow of water)	Further discussion on this provided in **Table 6.4** of the BDAR including a graphic (**Figure 6.2**) from the groundwater assessment demonstrating that the community relies on the perched aquifer and will not be altered by groundwater impacts.
10.	**Figure 6.1** 'Location of Prescribed Impacts' shows the general location of corridors within the project area. However, the BDAR does not show how the corridors in the project area fit within the wider landscape and important corridors have not been identified. This does not meet the requirements of Section 7.2.1 (c) of the BAM 2020, which requires the proponent to 'locate the proposal to avoid severing or interfering with corridors connecting different areas of habitat and migratory flight paths, to important habitat or local movement pathways.'	The BDAR should be amended to discuss how the project fits within the wider landscape and presents a new, or revised version of **Figure 6.1**, or both that has clear lines that indicate probable corridors.	**Table 6.4** (formerly **Figure 6.1**) updated to show regional corridors based on native vegetation mapped on SVTM. Further justification is provided in **Table 6.6** of the BDAR, demonstrating that HVO is not located within an important regional corridor and that the project will not result in the severing of regional corridors.
11.	**Figure 6.4** 'Assessment of Indirect Impacts' of the BDAR provides a brief discussion of indirect impacts, including from weed invasion. BCD recommends that further information is provided in relation to measures to be implemented to prevent new weeds from becoming established in Warkworth Sands Woodland from the re-routed Lemington Road. BCD notes that several exotic species are already present in the patch of Warkworth Sands Woodland at Archerfield (such as Eragrostis curvula, Melinis repens and Heterotheca grandiflora) but the patch is vulnerable to the establishment of other weeds from sandy soils nearby (such as Bryophyllum delagoense and Coreopsis lanceolata).	Further details should be provided around measures to be implemented to prevent new weeds from becoming established in Warkworth Sands Woodland from the re-routed Lemington Road.	Additional recommendations are provided in Section 5.6 of the revised BDAR in relation to additional measures for: • Weed management. • Protection and habitat restoration. • Establishment of native vegetation. • Monitoring and adaptive management.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
12.	**Table 5.4** 'Impacts and Avoided Impacts in Easement Realignment Design' of the BDAR does not document the limitations and risk of failure of the proposed measures to mitigate or manage impacts as required by Chapter 8 'Assessing the impacts of the proposal on biodiversity values' of the BAM 2020.	The BDAR should be revised include the limitations and risk of failure of the proposed measures to mitigate or manage impacts, as required under the BAM 2020.	Additional text is provided at **Table 5.8** and **Section 5.5** of the BDAR to confirm that the impact minimisation and mitigation strategies are well known and represent a low risk of failure. These strategies are implemented widely across mining projects in the Hunter Valley and elsewhere and will be documented in a BMP.
13.	The BDAR does not adequately discuss prescribed impacts in relation to southern Myotis from direct impacts to waterbodies, including dams, within the subject land. **Table 6.5** 'Prescribed Impacts identified at HVO North and HVO South' discusses potential impacts to the habitat of threatened species or ecological communities, including impacts to human-made structures, impacts to connectivity, and impacts to '…water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities.' The first two potential impacts were identified as likely to occur for this project, but not the last one. **Table 6.6** 'Prescribed Impacts Assessment' discusses '…impacts on the habitat of threatened species or ecological communities associated with the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range' in relation to all threatened fauna species and native vegetation but does not discuss the likely impact on the loss of water bodies on the subject land in relation to the movement of the southern Myotis.	The BDAR should include an assessment of potential prescribed impacts of the project on the southern Myotis by the removal of water bodies in accordance with section 8.3 'Assess prescribed biodiversity impacts' in the BAM 2020.	Additional prescribed impact assessment included in **Table 6.7** and shown on **Figure 6.4.**
14.	**Section 1.1.1** 'HVO North' of the BDAR does not provide enough information on the likely location of ancillary or temporary construction facilities and infrastructure and the likely amount of clearing associated with them. The BDAR does not identify these areas on any maps, such as **Figure 1.3** 'Hunter Valley Operations Continuation Project' or **Figure 1.4**. 'The Development Footprints HVO North and HVO South' This information is required under Section 2 'Stage 1: Biodiversity assessment' (page 5) and also Table 24 'Minimum information requirements for the Biodiversity Development Assessment Report and the Biodiversity Certification Assessment Report – Stage 1: Biodiversity assessment' (page 116) of the BAM 2020.	The BDAR should be amended to provide more information on the location of temporary or ancillary construction facilities that will require additional clearing, and to show these locations on one or more maps.	The proposed location of ancillary or temporary construction facilities is now shown on **Figure 1.4** of the BDAR. While these locations are indicative only, the proponent confirms that these will be cited in existing approved disturbance areas or within the proposed Development Footprints. Ancillary or temporary construction facilities will not be constructed outside these boundaries and therefore no additional impacts are proposed.
15.	A map showing the location of indirect impacts from the project is required. **Table A.1** 'Assessment of compliance with BDAR minimum information requirements' of the BDAR states, on page A-15, that maps of indirect impact zones for the project are not applicable for this project. However, indirect impacts for the project have been identified in: **Section 6.2** 'Indirect impacts' and described in **Table 6.4** 'Assessment of indirect impacts'. A map showing the location of areas of indirect impacts; specifically: • where drawdown impacts to groundwater-dependent ecosystems are located • where rubbish dumping on the aligned Lemington Road is a threat to any threatened species of communities • edge effects that may impact threatened species or communities outside of the development footprint • fugitive light, noise and dust impacts to native plant communities and threatened species. A map, or maps, would meet the requirements of Table 25 'Minimum information requirements for the BDAR or BCAR – Stage 2: Impact assessment (biodiversity values)' (page 124) of the BAM 2020.	The BDAR should be amended to include a map, or maps of likely indirect impacts from the project in order to meet requirements of the BAM 2020.	**Figure 6.1A** and **Figure 6.1B** shows Wollombi Brook and Hunter River (respectively) alluvium- maximum cumulative drawdown during operations. **Figure 6.2** shows the maximum predicted incremental drawdown during operations in the Hunter River alluvium. **Figure 6.3** now shows edge effects around Lemington Road realignment and indicative habitat connectivity in the locality and region based on the SVTM native vegetation extent.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
16.	**Section 6.2** 'Indirect impacts' of the BDAR does not identify or describe the limitations and assumptions of the assessment of indirect impacts for the project. This is required to meet Section 8.2.1 (c) of 'Assess indirect impacts on native vegetation, threatened ecological communities, threatened species and their habitat' for the BAM 2020.	The BDAR should include a discussion on the limitations and assumptions in the assessment of indirect impacts of the project to meet the requirements of the BAM 2020.	**Section 6.2** updated with a statement relating to the confidence of the indirect impacts assessed in the BDAR, based on a long history of assessment and monitoring of impacts to biodiversity due to mining in the Hunter Valley over the last 20 years.
17.	BCD recommends that additional information is provided to meet the requirements of the BAM 2020 as outlined in this letter of advice.	The BDAR does not include all of the information required by BAM 2020, including: • The BAM 2020 assesses the biodiversity values of the 'subject land', however the BDAR does not define the 'subject land' for this project.	Definition of 'Subject Land' now included in **Section 1.2** of revised BDAR.
		• **Figure 2.1** 'Site Map', **Figure 2.2A** 'Location Map – HVO North' and **Figure 2.2B** 'Location map - HVO South' do not show dams and mine sites on a Map.	**Figure 2.2A** and **Figure 2.2B** have been updated to show dams and surrounding mining sites.
		• Maps of Native Vegetation Extent are not presented at < 1:10,000 scale, as required by **Section 4.1** 'Map of native vegetation extent on the subject land' of the BAM 2020 (The maps of native vegetation extent in APPENDIX C are presented at a scale of 1:28,000).	**Annexure C** figures have been updated to be 1:10,000 scale.
		• Threatened Ecological Communities that are dependent on or use habitat features associated with prescribed impacts are not listed.	Features added to **Table 6.6** of the revised BDAR.

Table H.2 BCD Submissions and Response – 19 June 2024

Ref.	BCD Comment	BCD Recommendation	Proponent Response
1.	**Table D.1** of the BDAR states "Habitat searches undertaken in…2020 did not record the habitat constraints required…Furthermore, targeted searches of culverts…did not result in identification of roosting microbats." However, the BDAR identifies that suitable habitat such as old buildings, mine shafts and workings exist at the site. Microbats will roost in buildings that are in frequent use and therefore all buildings should be treated as potential roosting and breeding habitat for the target species. The BDAR should also detail the methodology used for potential roost assessment (i.e. specific methodology used for culvert searches). The BDAR does not include an assessment of SAII microbat species. This is required under Section 9.1 of the Biodiversity Assessment Method 2020 (BAM).	The BDAR should be amended to include the detailed methodology used for potential roost assessment (i.e. specific methodology used for culvert searches). The BDAR should be amended to include a SAII impact assessment for microbats in accordance with section 9.1 of the BAM.	The BDAR does not require further assessment of SAII entity microbats if the Accredited Assessor determines that there is not going to be an impact on breeding habitat of the candidate SAII bat species, (DPIE 2019). For the reasons set in **Section 6.4** of the BDAR, as the Accredited Assessor has determined that there will not be an impact on the breeding habitat of the candidate SAII bat species, the BDAR is not considered to require amendment.
2.	Section 4.4 of Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method outlines that a two-phase grid-based systematic survey approach may be used within areas of suitable habitat greater than 50 ha. The proponent should demonstrate that more than 50 ha of habitat exists within the site for this method to be applied. BCS's previous advice of 13 March 2024 recommended that suitable habitat be displayed in hectares by vegetation zone and plant community type (PCT). **Section 4.1.3.1** of the BDAR outlines that the proponent did not use vegetation zones and condition of PCTs to determine suitable habitat. However, the BDAR does describe that suitable habitat was considered by stating that some survey was undertaken in 'exotic condition zones' and areas with 'VI scores below the minimum offsetting threshold' however, these areas were 'determined to be substantially degraded and highly unlikely to contain threatened flora species'. The BDAR does not state which species are being referred to or provide reasoning for this approach. As outlined in section 5.2.3 of the BAM, the assessor must include a description in the BDAR of the microhabitats assessed as required by the species (this must be based on evidence such as published literature) and the assessor must provide their reasons for determining a candidate species credit species is unlikely to have suitable habitat on the subject land (or specific vegetation zones). **Table 4.1** of the BDAR demonstrates that the only PCT within the development footprint more than 50 ha is PCT 1691: Narrow-leaved ironbark – Grey Box grassy woodland of the central and upper Hunter. However, the BDAR uses the grid search method in PCT 1692: Bull Oak grassy woodland of the central Hunter Valley and discontiguous areas of PCT 1691. PCT 1692 only equates to 35.6 ha of the development footprint and so this PCT does not offer greater than 50 ha of potential habitat (see figure 1 below). The discontiguous areas of PCT 1691 do not consists of areas greater than 50 ha. This means BCS does not consider that the proponent has surveyed targeted threatened flora in accordance with relevant guidelines and the Threatened Biodiversity Data Collection (TBDC).	The proponent should undertake flora surveys that meet the requirements of relevant guidelines and the TBDC. Otherwise, the proponent may choose to engage an expert to prepare a report on why alternative approaches are appropriate or assume presence.	Umwelt has undertaken substantial targeted threatened species surveys over multiple seasons across the Development Footprints, with no threatened flora species recorded. Umwelt implemented the large area survey method for most candidate species as prescribed in the Surveying threatened plants and their habitats: NSW survey guide for the BAM (DPIE 2020). Potentially suitable habitat for threatened flora species was determined at the commencement of the Project when a threatened flora sampling methodology was prepared. This included identifying the potentially suitable habitat within the Development Footprints for candidate threatened species, which was based on the extent of associated PCTs as outlined in the TBDC occurring in the Development Footprints. Large sites are defined in the guideline as areas of suitable habitat greater than 50 hectares (ha). We note that the area of native vegetation within the Development Footprints subject to targeted surveys for species predicted to occur in all PCTs is [609 ha] which is 12-fold larger than this definition of a large site. In cases where threatened flora species were predicted to occur in suitable habitat that totalled less than 50 ha, parallel transects were undertaken (e.g. *Chryptostylis hunteriana* and *Thesium australe* are only predicted to occur in PCTs 4081 and 3485). If there is uncertainty, Umwelt will always take a conservative approach and sample accordingly. BCS has identified a small area alongside Comleroi Road (Figure 3 of the BCS submission) that does not contain flora survey transects or grids. This area was included within the Development Footprint in error. The area is in fact already contained within the existing and approved disturbance area at HVO South under the current project approval and does not require any further approval under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) to disturb. This area does not require survey as it does not occur in the Development Footprint. The substantial targeted threatened flora surveys undertaken in the Development Footprint are considered to be appropriate for the scale of the Project and the condition and quality of potentially suitable habitat identified during the assessment. Umwelt does not therefore consider that further surveys are required.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
3	The 'Species credit' threatened bats and their habitats - NSW survey guide for the Biodiversity Assessment Method, outlines that 'All habitat on the subject land where the subject land is within 200 m of a waterbody with pools/ stretches 3 m or wider including rivers, creeks, billabongs, lagoons, dams and other waterbodies on the subject land' should be included in the species polygon for the southern myotis. However, the polygons provided in the BDAR only partially include the habitat to be impacted. This example shows a waterbody (light blue polygon), a 200 m buffer of the waterbody (lime green polygon line), the project footprint (red polygon) and myotis species polygon (blue hatching).	The southern myotis species polygon should be amended to include all areas of proposed impact within a 200 m buffer of any medium to large permanent creeks, rivers or other waterbodies.	Umwelt has reviewed and amended the species polygon for the southern myotis as per BCS's recommendations. The layer was not previously updated to reflect the change in Development Footprint boundary following the avoidance of the Warkworth Sands Woodland EEC associated with the amended realignment of Lemington Road, as presented in the Amendment Report (EMM 2023). Please note that the example area provided in Figure 4 of BCS's response is not within the Development Footprint but was erroneously shown as being included. This area does not require approval under the EP&A Act to disturb. This area does not require the generation of myotis credits as it does not occur in the Development Footprint.
4	Austral toadflax (*Thesium australe*) and leafless tongue orchid (*Cryptostylis hunteriana*)*:* **Section 4.2** of the Surveying threatened plants and their habitats: NSW survey guide for the Biodiversity Assessment Method sets out the maximum distance between parallel field traverses. Table 1 of this guide states that the maximum traversal distance for orchids and herbs within open vegetation is 10 m, and 5 m within dense vegetation. The data package provided to BCS on 13 March 2024 shows distances of up to 17.5 m between field transects within dense vegetation (see figure 5 of Response to Submission) This does not meet the requirements of the guideline. The proponent should complete additional surveys to address this.	Additional surveys should be done for Austral toadflax (*Thesium australe*) and leafless tongue orchid *(Cryptostylis hunteriana).*	It is acknowledged that some transects appear to show a distance greater than what is recommended in the Surveying threatened plants and their habitats: NSW survey guide for the BAM (DPIE 2020). In many instances gaps or deviations can be attributed to GPS accuracy which is, at best, only accurate to 5 m. Furthermore, transects will often necessarily deviate from parallel 10 m spacing due to natural obstacles such as fallen logs, trees, water, waste, steep rocky areas. It should be noted that the vegetation structure within the Development Footprint would be considered open vegetation. Dense vegetation is characterised by foliage cover of >70%. Examples of this in Walker and Hopkins (1990) include rainforests and closed Casuarina forests. In the case of surveying for orchids and herbs in the Development Footprint, there are no areas of dense vegetation that would reasonably prevent detection of these species using 10 m transects. Following the updates to the new East Coast PCT Classification and species associations, the BAM-C longer predicts these species for the Project. No further assessments or surveys are required.
	Gang-gang cockatoo (*Calyptorhynchus lathami*) and glossy black-cockatoo (*Callocephalon fimbriatum*): The TBDC listings for the gang-gang cockatoo and glossy-black cockatoo require the potential nest trees within the site to be identified and monitored during breeding season. In lieu of NSW guidelines, the TBDC states 'assessors must undertake a species survey using best practice methods that can be replicated for repeat surveys.' The shapefile provided in the Response to Submission lists regent honeyeater and swift parrot as the target bird species for surveys conducted in August 2023. **Table D.2** of the BDAR states targeted surveys were completed for gang-gang cockatoo in October 2023, however, the shapefile does not include track data from October 2023.	The proponent should provide sufficient evidence to demonstrate that it has done targeted surveys for glossy-black cockatoos and gang-gang cockatoos, and that the method can be replicated.	Umwelt confirms that targeted bird surveys, that included observations for glossy-black cockatoo (and any potential nests), were undertaken over 23 days during the following dates (it is noted that the survey timing for glossy-black cockatoo has changed since the assessment for the Project and surveys are now suitable between January-September): 3–6 June 2019 12–15 August 2019 6–10 July 2020 16-17 and 28-29 August 2023 18 September 2023 9-11, 14-15 April 2025 Surveys for gang-gang cockatoo hollow trees were undertaken over 16 days over the following dates: 12–16 and 19–23 October 2020 14 October 2021 23, 25, 30, 31 October 2023 1 November 2023 Neither the gang-gang cockatoo nor the glossy black-cockatoo, or evidence of these species, were recorded as part of any surveys undertaken for this assessment. All of the survey methods undertaken are able to be readily replicated by returning to the locations (points and transects) as provided in the GIS files submitted to BCS as part of this response.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
	Pale-headed snake (*Hoplocephalus bitorquatus*): Section 4.2 of the Biodiversity Assessment Method Operational Manual – Stage 1 states that the TBDC is updated regularly to include the best available information and to add new listings under the BC Act. Therefore the BDAR should be consistent with the TBDC on the date it is finalised. As such, pale-headed snake surveys should comply with the Threatened reptiles: Biodiversity Assessment Method survey guide which requires a minimum spotlight survey effort of 120 person minutes for 4 nights and 72 funnel trap nights. This means the proponent needs to do additional survey for this species.	Additional surveys should be done for the proposed road upgrade to meet BAM requirements for the pale-headed snake (*Hoplocephalus bitorquatus*). Species surveys should be conducted in accordance with relevant guidelines and the TBDC. Any proposed deviations from species survey must be first approved by BCS.	Following the updates to the new East Coast PCT Classification and species associations, the BAM-C longer predicts pale-headed snake for the Project. No further assessments or surveys are required.
	Stephen's banded snake (*Hoplocephalus stephensii*): The Threatened reptiles: Biodiversity Assessment Method survey guide states that a minimum 120 person-minute survey is required to be replicated 4 times. It also states that suitable habitat for this species is 'hollow bearing trees, arboreal vine tangles, fallen/standing dead timber including logs (or within 500 m of these habitats)". Table 2.2 of the Addendum report states that the proponent spent a total of 7 nights surveying over a total of 16 person hours. It also states that "Nocturnal road surveys were also undertaken for opportunistic sightings, however these were not in accordance with the survey guidelines as they were not undertaken within suitable habitat and exceeded the required travelling speed of 5 kilometres per hour at times." Section 2.3 of the Addendum Report also notes that the "small size of the patches of suitable habitat within associated PCTs precluded the necessity to survey within 500 metres of suitable habitat". Shapefile ECO_4948_Umwelt_SBS_SpotlightingTransects_231219_GDA20z56 does not include legible dates and timing of surveys, it also includes the road surveys within the transects despite the Addendum Report acknowledging that the road surveys were not conducted in accordance with guidelines. The proponent should provide a shapefile that clearly defines spotlight surveys and the date and time of surveys. Given the information available, BCS cannot determine if surveys met relevant guideline requirements.	The proponent should provide a shapefile for Stephen's banded-snake (*Hoplocephalus stephensii*) with the spotlight surveys only and include the specific date and time of surveys so that it can be established that surveys were conducted in accordance with the guideline.	Following the updates to the new East Coast PCT Classification, the BAM-C longer predicts Stephens banded snake for the Project. Despite this, surveys targeting the species was undertaken in 2023 prior to the PCT change taking place.
	Eastern pygmy possum (*Cercartetus nanus*): Section 5.3.2(c) of the BAM states that assessors should 'use best practice methods that can be replicated for repeat surveys, if the Department has not published guidelines.' BCS considers that Commonwealth guidelines provide best-practice methods in lieu of the Department releasing survey guidelines for eastern pygmy possum. The Commonwealth's Survey guidelines for Australia's threatened mammals recommends: • cameras be deployed for at least 14 nights, and • approximately 10 cameras be deployed per hectare. **Table D.2** of the BDAR notes 9 camera traps were commissioned over the 609.5 ha development footprint. Considering the above, additional camera traps should be deployed to comply with the Commonwealth guidelines.	Additional surveys should be done for the proposed road upgrade to meet BAM requirements for the eastern pygmy possum (*Cercartetus nanus*). Species surveys should be conducted in accordance with relevant guidelines and the TBDC. Any proposed deviations from species survey must be first approved by BCS.	The Commonwealth Guidelines referenced by BCS being the Survey guidelines for Australia's threatened mammals (DSEWPC 2011), do not provide species-specific recommendations for the eastern pygmy possum (*Cercartetus nanus*) as this species is not listed under the EPBC Act. Umwelt does not consider the Commonwealth Guidelines (DSEWPC 2011) the most suitable species-specific guideline for the eastern pygmy possum, and deploying 10 cameras per hectare of potential habitat (resulting in 1844 cameras across 184.3 ha), as suggested is required by BCS, is not practicable. Additional surveys for eastern pygmy possum are proposed to be undertaken in 2025. In the meantime, the BDAR has assumed presence for the species.
	Green and golden bell frog (*Litoria aurea*) and green-thighed frog (*Litoria brevipalmata*): **Table D.2** of the BDAR states that green and golden bell frog and green-thighed frog surveys included a total of 8 person hours over 4 consecutive nights across 17 dams, drainage lines or rover locations. The NSW Survey Guide for Threatened Frogs requires the surveyor to survey for a minimum 480 mins per 500 m transect with each site repeated 4 times. Additionally, the green-thighed frog requires surveys to be done after flooding rain. Given this, the proponent should do additional amphibian surveys to comply with relevant survey guidelines.	Additional surveys should be done for the proposed road upgrade to meet BAM requirements for the green and golden bell from (*Litoria aurea*) and green-thighed frog (*Litoria brevipalmata*). Species surveys should be conducted in accordance with relevant guidelines and the TBDC. Any proposed deviations from species survey must be first approved by BCS.	As the original surveys for the green and golden bell frog were undertaken in March 2020, new surveys in accordance with the BAM Frog Survey Guideline was undertaken between February-March 2025 in suitable waterbody habitat within the Development Footprints. Further information is provided in **Section 4.1.3** of the BDAR. Following the updates to the new East Coast PCT Classification, the PCTs within the Development Footprint no longer predict green-thighed frog.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
	Raptors: **Table D.2** of the BDAR states that targeted bird of prey searches were conducted throughout the site. The data package did not include a GIS file including raptor transects. The proponent should provide this to allow BCS to determine if surveys were conducted in accordance with relevant guidelines.	The GIS data for raptor transects should be provided to BCS.	Additional raptor nest surveys were undertaken in April 2025 to supplement the surveys undertaken prior to September 2020. Umwelt to provide the transects for survey dates outlined in the BDAR.
	Forest Owls: The shapefile FAUNA_Umwelt_HollowBearing Trees_231220 includes a visual record of a barn owl (*Tyto alba*). Barn owls calls are very difficult to differentiate from masked owls (Tyto novaehollandiae). There are several masked owl BioNet records within and surrounding the footprint which indicates that the recording could have been a masked owl. BCS discussed this with the consultant during a site inspection on 19 February 2024. The proponent should provide further evidence (i.e. photographs) to determine presence of barn owl and absence of masked owl. If the proponent cannot provide further evidence, the precautionary approach should be applied and masked owl assumed present. BCS also notes best-practice survey methodology for forest owls is night monitoring of each potential nest location for a minimum of two nights, with surveys commencing 30 minutes prior to dusk and continuing for 60 minutes after sunset.	Further evidence should be provided (i.e. photographs) to determine presence of barn owl (Tyto alba) and absence of masked owl (Tyto novaehollandiae). If further evidence cannot be provided, the precautionary approach should be applied and masked owl assumed present.	Umwelt does not consider that barn owls and masked owls are difficult to differentiate. While both species have similar features belonging to the Tyto genus, Umwelt's ecologists are well-trained and experienced to understand the features that distinguish common and threatened species in the field. The specimen in question was carefully observed by two ecologists who agreed the individual was an eastern barn owl. The ecologists made specific efforts to observe the size of the owl's legs and talons, which matched those typically exhibited by eastern barn owls. A photograph was not taken at the time of survey and therefore cannot be provided, however it is noted that this is not required as part of the BAM (2020) or the BAM Operational Manual Stage 1 (DPIE 2020). Regardless of the above, Umwelt will be undertaking targeted owl surveys using acoustic recorders in June and July 2025. The survey method and plan has been deemed adequate by both the BOS Helpdesk and the Newcastle CPHR office. Reporting of the outcomes will be provided either in the RTS phase or other addendum reporting.
	Microbats: **Section 4.2.2** of the BDAR states 'large-eared pied-bat (*Chalinolobus dwyeri*) and little bent-winged bat (*Miniopterus australis*) were positively recorded, however no areas containing breeding habitat occur'. Appendix H of the BDAR also states there are 'no mine shaftings, workings, or old buildings within the Development Footprints'. BCS has analysed aerial imagery and made observations during the site inspection on 19 February 2024. This shows that the proposed footprint contains buildings, which is noted as roosting habitat within the TBDC for the large-eared pied-bat. The proponent should do additional surveys, in accordance with the 'Species credit' threatened bats and their habitats, within all building/structure proposed for removal. **Table D.1** of the BDAR notes targeted microbat searches of culverts were completed as part of the Commonwealth assessment. All survey information in relation to BC Act listed species should be included in the BDAR. The above species are also both considered SAII entities. This means the proponent needs to do an assessment for SAII in line with the requirements set out in section 9.1 of the BAM.	Additional surveys should be done for the proposed road upgrade to meet BAM requirements for microbats. Species surveys should be conducted in accordance with relevant guidelines and the TBDC. Any proposed deviations from species survey must be first approved by BCS. Additional surveys for microbat species should be completed in accordance with the 'Species credit' threatened bats and their habitats within all building/structure proposed for removal.	As outlined in the response in Ref 1 above, it is unlikely that either large-eared pied-bat or little bent-winged bats would use buildings for breeding. It is therefore highly unlikely that there is active breeding habitat for these species within either the natural habitat on site, or in the disused or used buildings in the Development Footprints. This is further discussed in **Section 6.4** of the BDAR.
5	Prescribed impacts have not been adequately assessed: Section 4.3.4 of the Biodiversity Assessment Method 2020 Operational Manual – Stage 2 outlines that the location of prescribed impacts, including polygons identifying the extent of the impact, must be mapped on the Site and Location maps included in the BDAR. Section 6.1.2 of the BAM requires that for non-native vegetation, a BDAR must: • provide a description of the type of human-made structure or non-native vegetation habitat • prepare a list of threatened species that use these features as habitat	• provide a description of the type of human-made structure or non-native vegetation habitat • prepare a list of threatened species that use these features as habitat	Prescribed impacts are assessed in **Section 6.3** of BDAR and shown on a specific figure (**Figure 6.4**). The BAM (2020) outlines the reporting requirements for a BDAR. The BAM (2020) does not require prescribed impacts to be displayed on the Site Map or Location Map, despite what is noted in the BAM Operation Manual Stage 2 (DPE 2023). It is understood that where there is ambiguity, the BAM (2020) takes precedence. The Site Map and Location Map contains a range of features and is unlikely to be legible with the potential prescribed impacts relevant to the Project. It is considered that the display of prescribed impacts on **Figure 6.4** is appropriate. Impacts relating to non-native vegetation habitat is outlined in **Table 6.7** of the BDAR which describes the threatened species likely to occupy this habitat and a description of the habitat.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
	<u>Mine rehabilitation:</u> Approximately 356 ha of Category 1 - Exempt land and 1,153 ha of mine rehabilitation would be impacted by the proposal. **Table 6.6** of the BDAR lists hunter valley delma (*Delma vescolineata*) as the only threatened entity likely to inhabit Category 1 – Exempt lands. It is likely additional threatened species would use the 1,153 ha of mine rehabilitation.	The proponent should provide additional information so that BCS can fully understand the prescribed impacts related to the mine rehabilitation areas. This should include: • the vegetation types and formations within the mine rehabilitation areas • all habitat features within the mine rehabilitation areas and Category 1 – Exempt lands • details of targeted threatened species surveys completed within the mine rehabilitation area to determine presence of threatened species.	Areas of mine rehabilitation in the wider HVO Complex were not included in the Development Footprint for the assessment as: • All mine rehabilitation areas are already approved for disturbance. • None of these areas have been relinquished or meet the completion criteria as outlined in the Rehabilitation Management Plan (RMP) and the existing consent documents acknowledge that further disturbance to rehabilitated areas may still be required. • None of the rehabilitation established at HVO that will be disturbed by the Project is required to conform to a PCT or TEC. • The location of the rehabilitation is only shown conceptually by the consent documents and does not represent areas that have been formally 'set aside' for nature conservation, re-vegetation of native vegetation or as a native vegetation offset. • The obligation to rehabilitate the areas that are currently approved for disturbance under the HVO North Development Consent (DA 450-10-2003) and HVO South Project Approval (PA 06_0261) will be incorporated into the proposed new consents. • The mine rehabilitation areas that will be disturbed by the Project can be classified as Category 1 – Exempt Land as they were cleared prior to 1990 or lawfully cleared after 1 January 1990 and: • have not been "notified to the Environment Agency Head"; and • are not required to have been "set aside" by any condition of any of the Consents "for nature conservation, for re-vegetation of native vegetation or as a native vegetation offset" which forms part of the definition of Category 2 -sensitive regulated land (DCCEEW 2024). This is further discussed in **Section 2.4** of the BDAR.
	<u>Drawdown Impacts</u>: The BDAR currently does not include information on the PCT/Threatened Ecological Communities (TECs) or threatened entities which exist or may use the areas of predicted drawdown outside of the development footprint. Section 2.1 of the Groundwater and SAII Report states that the "groundwater drawdown spatial information provided to BCD represents the predicted maximum cumulative alluvial drawdown. This predicted drawdown is due to mining effects from a number of approved mining operations within the groundwater model domain" and that the "10 m drawdown contours evidenced within are not a result of the Project". Section 4.3.5 of the Biodiversity Assessment Method 2020 Operational Manual – Stage 2 (BAM Ops – Stage 2) states that cumulative impacts from the proposed development and other largescale or similar developments within the region should be considered and discussed in the BDAR. Neither the BDAR or the Groundwater and SAII Report consider the impact to water quality in groundwater discharges given that the aquifers would no longer be confined systems. The BDAR should consider the short term and long term impact of altered baseflow and stream flows to the PCTs and threatened species within the area.	The proponent should: • amend the BDAR to consider cumulative impacts, with section 6.1.4 and 8.3.4 of the BAM completed and assessed • provide GIS shapefiles of the PCT/TECs within the areas of predicted drawdown • amend **Section 5.5** of the BDAR to include proposed mitigation measures for impacts to man-made structures, non-native vegetation and hydrological processes • provide an adaptive management plan be provided for areas of predicted drawdown in line with Section 8.5 of the BAM outlines that an adaptive management plan should be used to address impacts that are infrequent or difficult to measure	The BDAR addresses cumulative impacts in **Table 6.5** in relation to potential drawdown impacts and cumulative impacts on biodiversity in the wider locality. It should be noted that all drawdown impact predictions are cumulative – that is they take into account drawdown predictions from surrounding developments in the locality. It is considered that the measures outlined in **Section 5.4, Section 5.5** and **Section 5.6** of the BDAR will mitigate the impacts on indirect and prescribed impacts including those on man-made structures and non-native vegetation.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
6	<u>Identify the limitations and risk of failure for measures to mitigate or management impacts:</u> The proponent has amended **Section 5.4** of the BDAR to include a statement suggesting mitigation strategies are well known and represent a low risk of failure. Section 8.4.2 (b) (c) of the BAM specifically requires the proponent to: • identify any measures for which there is risk of failure • evaluate the risk and consequence of any impacts likely to remain after mitigation measures are applied	The BDAR should be amended to include the following: • identify any measures for which there is risk of failure; and • evaluate the risk and consequence of any impacts likely to remain after mitigation measures are applied	As outlined in the BDAR, the mitigation measures are considered to represent a suitable suite of management strategies that are well known and routinely implemented in biodiversity management plans for mining projects in the Hunter Valley and elsewhere and therefore are considered to represent a low risk of failure. HVO's existing Integrated Biodiversity Management Plan (EMM 2018) includes a risk framework and adaptive management measures to ensure successful implementation of management measures and actions. This includes specific monitoring, annual review processes and updating of plans on a regular basis to ensure best practice mitigation and improvements once new information is available or changed circumstances arise. Refer to **Table 5.8** *Risks to Achieving Key Mitigation Measure Objectives and Responses* of BDAR for an outline for risk assessment for mitigation measure efficacy and the consequences and adaptive actions proposed if there is a failure.
7	<u>Further information is required to demonstrate the future vegetation integrity (VI) score in the BAM-C:</u> As set out in section 8.1.1 of the BAM, the value of the attributes in the future can be amended to reflect the impacts from partially clearing a vegetation zone, including areas such as asset protection zones and easements. The BAM also states that the assessor must map these areas of the vegetation zone as a separate management zone, refer to these areas in the BDAR, and in the BDAR specify how the remaining attributes will be maintained. If it is likely these attributes will continue to degrade, the BDAR should assume full loss. And the BAM specifies that the future value of an attribute must not be higher than the current observed value for that attribute. The future value for each attribute must be 0 when a proposal will clear that attribute or all the vegetation in the development footprint, or equivalent area for other types of proposals on the subject land. The proposal's BAM-C file shows that multiple management zones have a total VI loss that does not equate to zero. The reasons for this should be explained in the BDAR.	• The BDAR should be amended to specify why the future VI loss does not equate to zero, and how remaining attributes will be maintained. • The BDAR should include a figure demonstrating each management zone.	This detail is provided in **Section 6.1** of the BDAR and figures of the management zones are shown in the detailed vegetation figures in **Annexure C** of the BDAR. Umwelt confirms this information was included in both the original BDAR (Umwelt 2022) and the revised BDAR following RTS (Umwelt 2023).
8	<u>information is required for BAM-C ecosystem credit species:</u> The BDAR does not include microbats and birds as confirmed predicted species from grassland vegetation zones even though this was in the BDAR submitted with the EIS. The BAM allows ecosystem species to be removed if they do not meet any one of the criteria outlined in section 5.2.1.2 (a-f) of the BAM. However, the BAM requires that if any past surveys of the subject land have recorded the presence of a threatened species or it has been incidentally observed on site, the species must be assessed regardless of whether the relevant criteria have been met. The BDAR does not justify excluding microbats or birds in grassland vegetation zones. BCS requests the BDAR be amended to include justification for excluding ecosystem credit species, in line with the requirements of the BAM.	The BDAR should be amended to include justification for exclusion for ecosystem credit species per the BAM.	This has been resolved in the latest version of the BAM-C.

Ref.	BCD Comment	BCD Recommendation	Proponent Response
9	Further information is required for BAM-C species credit species: The proponent has removed the pink-tailed legless lizard (*Aprasia parapulchella*) from the assessment citing an absence of rocky areas. However, BCS observed rocky areas within the footprint during our site inspection on 19 February 2024. As the habitat constraint exists within the development footprint, the proponent should not exclude this from its assessment. The proponent needs to do targeted surveys for pink-tailed legless lizard. The proponent also excluded the Stephens' banded snake, large-eared pied bat and both Miniopterus species as confirmed candidate species. However, each species were targeted for surveys. The BAM-C should accurately reflect site values and surveys.	Recommended action: • Targeted surveys are required for pink-tailed legless lizard. • The BAM-C should be amended to accurately reflect site values and targeted species surveys undertaken.	Following the updates to the new East Coast PCT Classification, the BAM-C no longer predicts pink-tailed legless lizard. No further assessment or surveys are required.

Appendix I

Memorandum: HVO Warkworth Sands Field Investigation 2023 (Minesoils 2023)

27th October 2023

EMM Consulting
6/146 Hunter St,
Newcastle NSW 2300

Attention: Nicole Armit

Dear Nicole,

Re: Memorandum: HVO Warkworth Sands Field Investigation 2023.

Background and context

Minesoils understands Hunter Valley Operations (HVO) seeks to amend the location of the proposed Lemington Road realignment to avoid areas containing Warkworth Sands Woodland Endangered Ecological Community (EEC) within the HVO continued operations project. Minesoils' Clayton Richards (CPSS) accompanied representatives from HVO and Umwelt on Tuesday 5th September for a site inspection of the proposed new route and disturbance area. The inspection team walked the entire length of the proposed new section of the realigned road corridor observing the vegetation and soils, aiming to confirm the presence/absence of the Warkworth Sands Woodland EEC. This memorandum follows on from an initial assessment of the area undertaken in 2020 by Minesoils and Umwelt, which inspected 22 sites along eight transects within the area.

The findings of the initial assessment found two general soil types; 1. Deep Sands (Tenosol) which are uniform profiles of sand textured soils; and 2. Duplex soils (Chromosol, Sodosol and/or Kurosol), which are texture contrast soils with a Sand/Loamy Sand/Sandy Loam horizon/s overlying a clear boundary to Clay subsoil.

1. The Deep Sand profiles are considered likely to be either fully or partly aeolian derived based on the shape and smoothness of the sand grains. The depth of these profiles is also consistent with the presence of dunes formed by wind blown material to depths >1.5m as observed on site (limit of excavation).
2. The Duplex soil profiles are less clearly aeolian derived and may consist of sand, loamy sand or sandy loan in the upper A horizons. These soils also typically displayed a bleached A2 horizon lying over a clear boundary to the clay B horizon subsoils. Whilst these profiles would not generally be considered to be linked to aeolian sand deposits, and are considered the dominant soil types throughout the Hunter Valley, the definition of soil types for the Warkworth Sands EEC Woodland states a 'thin veneer' of aeolian derived sands is also considered a suitable substrate for this EEC (Benson 1981). Without a more detailed or prescriptive definition of what constitutes a 'thin veneer', there is a possibility (albeit with less confidence) that there is a 'thin veneer' of possible aeolian derived sands within the upper horizon material of these Duplex Soil profiles. Therefore, the conservative approach for the assessment was to assume that the presence of any sand layer in the upper horizon was adequate to consider the soil profile as potentially meeting the requirements for Warkworth Sands Woodland EEC deep sands through to a 'thin veneer' of aeolian derived sand.

The 2020 assessment found the depth of an upper sandy horizon ranged from 0.30m through to >1.50m, as shown in **Table 1** and **Figure 1**. Of the 22 sites inspected 8 sites were considered moderate or deep sands (Tenosols) and 13 sites were considered duplex soils. One site (WS13-1 Clay Soil) was considered

likely disturbed due to proximity to a dam and being located within a drainage line. The 16 sites within close proximity of the proposed realigned road corridor are shown in Figure 1.

Table 1: Sand Depths and Soil Types 2020 Assessment

Site	Sand depth (m)	Soil Type Description
WS8-36	1.50	Deep Sand - Tenosol
WS8-37	1.00	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS8-38	0.65	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS9-33	0.60	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS9-34	0.80	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS9-35	1.50	Deep Sand - Tenosol
WS10-30	0.30	Duplex Soil (Shallow)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS10-31	1.50	Deep Sand - Tenosol
WS10-32	0.60	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS11-14	0.40	Duplex Soil (Shallow)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS11-27	0.40	Duplex Soil (Shallow)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS11-28	1.00	Moderately Deep Sand - Tenosol
WS11-29	1.50	Deep Sand - Tenosol
WS12-4	1.00	Moderately Deep Sand - Tenosol
WS12-13	1.00	Moderately Deep Sand - Tenosol
WS12-23	0.40	Duplex Soil (Moderate) - (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS12-24	0.90	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS12-25	0.80	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS12-26	0.80	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)
WS13-1	0.00	Clay Soil in drainage line (may be influenced by Dam construction)
WS13-2	1.00	Deep Sand - Tenosol
WS13-3	0.60	Duplex Soil (Deep)- (Sand / Loamy Sand / Sandy Loam overlying Clay Subsoil)

Presence of aeolian sands in the proposed disturbance footprint

A review of the original proposed route for Lemington Road indicated the soils located within the disturbance corridor were deep sands (Tenosols) or deep duplex soils with sandy upper horizons. These soils would likely be more consistent with the typical profiles derived from aeolian sand dunes which form the substrate for Warkworth Sands Woodland EEC.

The 2023 inspection of the proposed revised route for Lemington Road consisted of reviewing some sites from the 2020 Assessment and digging shallow holes along the route to confirm soil type and possible sand layers conservatively considered a 'thin veneer' of possible aeolian derived sand.

The northern section of the proposed new disturbance corridor (Refer to Figure 1), which was located across most of the pasture/grassed areas, contained upper layers of sand to 0.5m deep and would likely be considered Tenosols. These sands could be considered aeolian or partly aeolian derived based on fine sand texture, rounded smooth shape of sand grains, unconsolidated nature and poor profile development throughout the solum.

The middle section to the immediate north of Archerfield Road (Refer to Figure 1) appeared to have very minimal to no sand present in the upper layers. The area appeared to have been subject to extensive sheet erosion, as the majority of the area appears to have the Clay subsoil at the surface or within 0.05m to 0.10m

of the surface. The drainage lines were infilled with coarse sand, presumed to be washed off the surrounding land. This sand in the drainage depositional areas was coarse and gritty in texture and did not appear to be of aeolian origin. This middle section of the proposed revised route contained areas of mature trees and more dense regrowth.

South of Archerfield Road the proposed disturbance is located on soils considered as Spoilic Anthroposols, which are man-made soils built of overburden (spoil) with a surface layer of fine to medium textured topsoil ranging from 0.1 to 0.3m deep. These Spoilic Anthroposols are not considered to be a likely substrate for the development of Warkworth Sands Woodland EEC and are certainly not remnant forms of soil profiles.

Summary

In summary, the main areas of the proposed amended section of the Lemington Road realignment containing deep sands (potentially aeolian) are located within the northern section of the area on improved and native pastures. The vegetated (Woodland) areas through the middle sections of the area appeared to be heavily affected by sheet erosion and had very little (<0.10m), if any sand layer at the surface.

A review of the original road alignment found the soils within the disturbance area to be more typical (deep sands and deep duplex soils with sandy A horizons) of aeolian derived soil profiles from sand dunes and interdunes where a 'thin veneer' of sand may be present.

Amended Lemington Road section – Impacts to land and soil capability and agriculture

The proposed amended section of the Lemington Road re-aligned corridor is also considered as like for like with the original corridor, with regard to general soil types (albeit shallower A horizons) and land and soil capability classification, based on close proximity to the original alignment, landform position and landform element. Therefore, the soil, land and agriculture impact assessment and soil management strategies for the proposed new corridor, remains consistent with that presented in the EIS (refer to Appendix P), and no changes are proposed.

Yours sincerely,

Clayton Richards.
Principal Consultant & Director
Minesoils Pty Ltd

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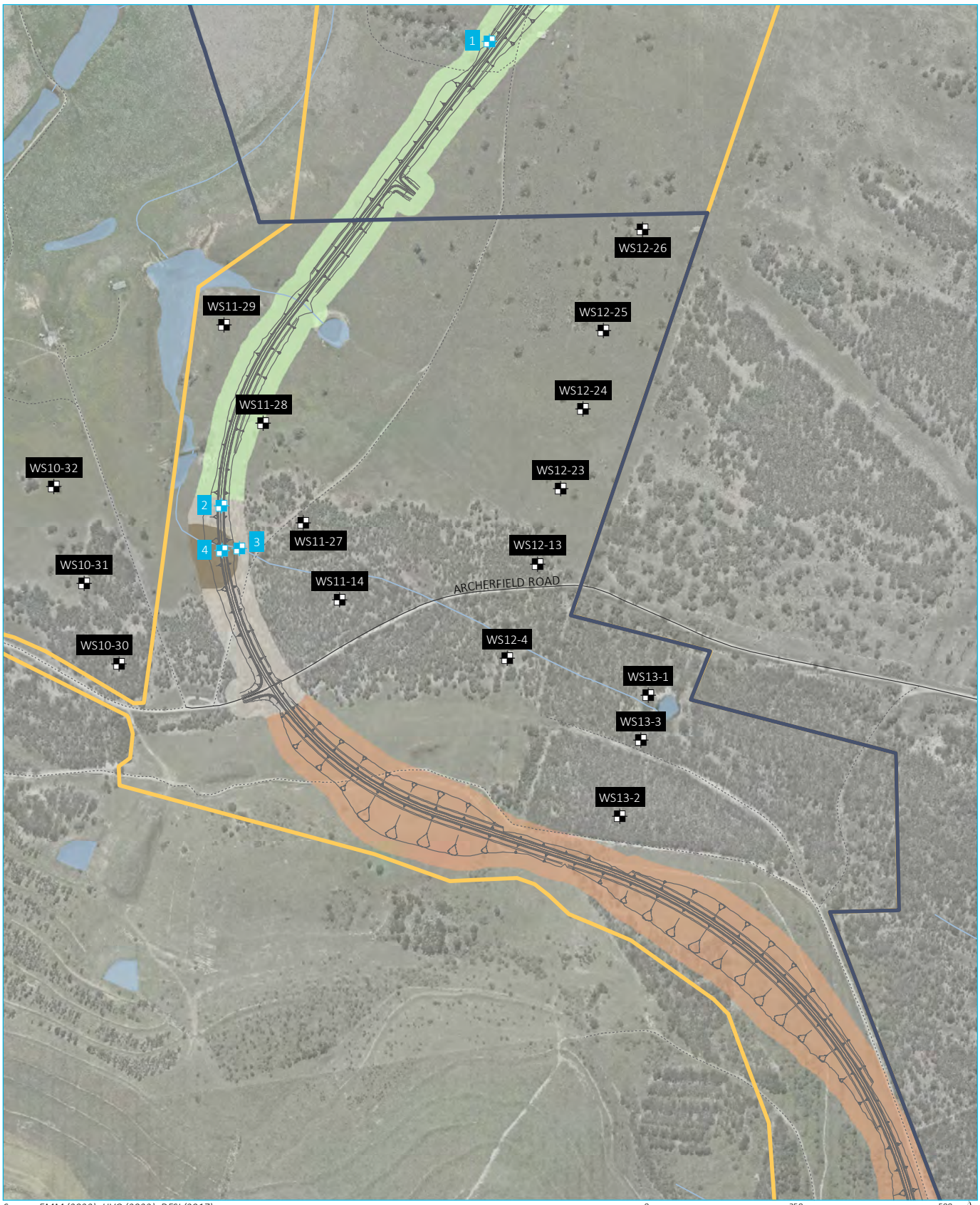
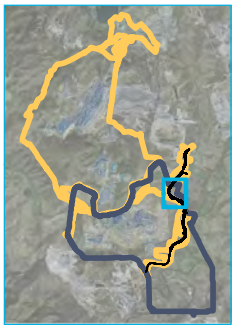


Source: EMM (2023); HVO (2023); DFSI (2017)

0 250 500 m

GDA2020 MGA Zone 56

N



KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Revised Lemington Road realignment
- Soil test site – 2022 (EIS)
- Soil test site – 2023 (Amendment report)

Soil type

- Coarse alluvial sands
- Deep sands and deep duplex soils
- Degraded shallow duplex soils
- Spoilic anthroposols

Existing environment

- Minor road
- Vehicular track
- Named watercourse
- Named waterbody

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Soil test sites and soil types

HVO Continuation Project
HVO Warkworth Sands Field Investigation
Figure 1

EMM creating opportunities

Transect 8

Point WS8-36

Point WS8-37

Point WS8-38

Transect 9

Point WS9-33

Point WS9-34

Point WS9-35

Transect 10

Point WS10-30

Point WS10-31

Point WS10-32

Transect 11

Point WS11-14

Point WS11-27

Point WS11-28

Point WS11-29

Transect 12

Point WS12-4

Point WS12-13

Point WS12-23

Point WS12-24

Point WS12-25

Point WS12-26

Transect 13

Point WS13-1

Point WS13-2

Point WS13-3

2023 Soil Field Observations (1-4)

Site 1 - North Section Represented (Excludes gully area). Deep sand to 0.5m, layer continues.

Site 2 – Very thin veneer of sand (<5cm). Appears sheet erosion has stripped most of the A horizon. B Horizon clay layer continues.

Site 3 – No sand layer present. Appears sheet erosion has stripped all of the A horizon. B Horizon clay layer continues.

Site 4 – Drainage line comprised of deep sand (<0.5m deep). Appears alluvial from the sheet erosion of the surrounding land.

Appendix J

Royal Botanic Gardens Sydney Correspondence

BOTANIC GARDENS OF SYDNEY

National Herbarium of New South Wales

Adam CAVALLARO
Umwelt
75 York St
Teralba, NSW 2284
AUSTRALIA

BIS Enquiry No: 23076
Botanical.Is@botanicgardens.nsw.gov.au
Ph. No: (02) 4631 5135
Date: 20 May 2025

Dear Adam,

Thank you for your enquiry regarding collections from **Lemington Rd, Ravensworth, 2 Apr 2025**. We are happy to provide the following information:

Acacia pendula conf. P. Jobson 20 May 2025 – **retained.**

There will be no fee to cover the cost of identification.

Yours sincerely,

Catherine Wardrop
Techinical Officer
Botanical Identification Service

umwelt

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NSW | ACT | WA | QLD | VIC | SA ABN 18 059 519 041