Maroota Sands
Biodiversity Development Assessment Report

Deerubbin Local Aboriginal Land Council

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Template 2.8.1

Executive Summary

Eco Logical Australia Pty Ltd was engaged by Deerubbin Local Aboriginal Land Council (DLALC) to prepare a Biodiversity Development Assessment Report for a proposed development at Maroota in The Hills Shire Council local government area. The subject land is the assessable area which includes the area of land defined by land title boundaries of Lot 213 DP752025, Lot 7005 DP1055724, and Lot 202 DP752025 located on DLALC land in bushland off Wisemans Ferry Road, Maroota.

The proposed development is for the use of part of the subject land as an extractive industry (i.e. the development site and development footprint); being the extraction and processing of Hawkesbury Sandstone into a fine-medium graded sand, among other products. The development is classified as a State Significant Development under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

This report has followed the Biodiversity Assessment Method 2020 (BAM) established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016* (BC Act).

This report describes the biodiversity values within the subject land and development site, describes the impacts and outlines the measures to be taken to avoid, minimise and mitigate impacts to the Plant Community Types and threatened species habitat present within the subject land, development footprint and development site.

The report provides the number of biodiversity credits that would be required to be retired to offset the residual loss of biodiversity from the impacts of the development as described.

The proposed development involves direct impacts to the biodiversity values within the development footprint, and indirect impacts within the development site. Following avoidance and mitigation, the residual direct impacts were calculated in accordance with the BAM by utilising the BAM Credit Calculator.

Requirements of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), applicable State Environmental Planning Policies and *The Hills Shire Local Environment Plan 2019* and *The Hills Development Control Plan 2016* have also been addressed in this report.

The proposed development site is approximately 61.92 ha in size and currently comprises very good condition remnant bushland. The proposed development will directly remove 50.95 ha of native vegetation within the development footprint and indirectly impact 9.97 ha of vegetation within the development site.

Four Plant Community Types (PCTs), comprising seven vegetation zones, are present within the development site and development footprint. A summary of the areas of each zone within the development footprint is provided below.

Veg Zone	PCT ID	PCT Name	Condition	Area with the development footprint (ha)
1	1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Open understorey	22.69
2	1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Dense midstorey	3.02
3	1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Heathy understorey	1.95
4	1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Open understorey	1.32
5	1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Open understorey	10.22
6	1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Heathy understorey	3.58
7	1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Good	8.17
Total				**50.95**

The occurrence of PCT 1081 *Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion* in the subject land corresponds with the Commonwealth listed threatened ecological community *Shale Sandstone Transition Forest of the Sydney Basin Bioregion* listed as a critically endangered ecological community under the EPBC Act. However, it does not correspond with the NSW BC Act listing for *Shale Sandstone Transition Forest in the Sydney Basin Bioregion* due to differences in species composition between the State and Commonwealth listings.

Maroota Sands Swamp Forest, a Groundwater Dependent Ecosystem (GDE) is listed as an endangered ecological community under the NSW BC Act, and occurs within the subject land to the north of the development site. According to the Groundwater Constraints Analysis prepared by EMM in April 2020, and the Maroota Sand Quarry Water Assessment prepared by EMM in November 2020 (EMM 2020), direct and indirect impacts to the GDE can been avoided by the provision of a 50 m buffer from the edge of the extraction area to the edge of the GDE, and by not permitting extraction to occur below two metres of the wet weather high regional water table. Also, according to the Water Assessment, the *Maroota Sands Swamp Forest* GDE is maintained by shallow groundwater, which is interpreted to be the shallow aquifer. Groundwater abstraction from the deep aquifer is not expected to impact the shallow aquifer. Hence, no impacts to the GDE are expected (EMM 2020).

A total of 1,070 ecosystem credits will be required for the removal of vegetation within the development footprint. A summary of the ecosystem credits required is provided below.

PCT ID	PCT Name	Direct impact (ha)	Credits required
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	25.71	536
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	3.27	66
1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	13.8	286
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	8.17	182
		Total	**1,070**

A total of 8,004 species credits will be required for the removal of threatened species habitat within the development footprint. A summary of the species credits requirements is provided below.

Species	Common Name	Species presence	Habitat (ha)	Credits required
Acacia bynoeana	Bynoe's Wattle	yes-detected during surveys	1.64	43
Calyptorhynchus lathami	Glossy Black Cockatoo	yes-detected during surveys	49.04	1380
Cercartetus nanus	Eastern Pygmy-possum	Presence assumed	50.95	1427
Heleioporus australiacus	Giant Burrowing Frog	Presence assumed	50.95	1070
Hoplocephalus bungaroides	Broad-headed Snake	Presence assumed	25.24	1068
Kunzea rupestris		yes – detected during surveys	0.81	20
Myotis macropus	Southern Myotis	yes – detected during anabat surveys	7.08	195
Petaurus norfolcensis	Squirrel Glider	yes – detected during surveys	50.95	1427
Pimelea curviflora var. *curviflora*		yes – detected during surveys	0.91	25
Pommerhelix duralensis	Dural Land Snail	yes-detected during surveys	25.71	714
Pseudophryne australis	Red-crowned Toadlet	yes – detected during surveys	24.50	519
Tetratheca glandulosa		yes – detected during surveys	4.13	116
			Total	**8,004**

Serious and Irreversible Impact (SAII) values have also been considered in this assessment. *Hoplocephalus bungaroides* (Broad-headed Snake) is listed as a SAII in the BioNet Threatened Biodiversity Data Collection (TBDC). According to the TBDC, the SAII threshold type for this species is area, and the threshold is zero. The development will result in removal of 25.24 ha of habitat for Broad-headed Snake.

Fourteen Matters of National Environmental Significance (MNES) under the EPBC Act were identified as having potential to be adversely affected by the proposed works. These MNES are as follows:

- *Shale Sandstone Transition Forest of the Sydney Basin Bioregion*
- *Acacia bynoeana* (Bynoe's Wattle)
- *Kunzea rupestris*
- *Pimelea curviflora* var. *curviflora*
- *Heleioporus australiacus* (Giant Burrowing Frog)
- *Anthochaera phrygia* (Regent Honeyeater)
- *Lathamus discolor* (Swift Parrot)
- *Pommerhelix duralensis* (Dural Land Snail)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Dasyurus maculatus* (Spotted-tailed Quoll)
- *Phascolarctos cinereus* (Koala)
- *Pseudomys novaehollandiae* (New Holland Mouse)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Hoplocephalus bungaroides* (Broad-headed Snake).

Assessments of the Commonwealth Significant Impact Criteria were undertaken and concluded that the proposed development would result in a significant impact to *Shale Sandstone Transition Forest of the Sydney Basin Bioregion* and Dural Land Snail. Referral to the Commonwealth is therefore required.

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Abbreviations

Abbreviation	Description
AHD	Australian Height Datum
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Credit Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
CEEC	Critically Endangered Ecological Community
DCP	Development Control Plan
DAWE	Commonwealth Department of Agriculture Water and Environment (formerly Department of Environment and Energy (DoEE))
DLALC	Deerubbin Local Aboriginal Land Council
DPIE	NSW Department of Planning Industry and Environment (formerly OEH)
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	Local Environment Plan
LGA	Local Government Area
LLS	Local Land Service
NSW	New South Wales
OEH	NSW Office of Environment and Heritage (Now DPIE)
PCT	Plant Community Type
PMST	Protected Matters Search Tool
SAII	Serious and Irreversible impact
SAT	Spot Assessment Technique (SAT)
SEARS	Secretary Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development

Abbreviation	Description
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened Ecological Community
VMP	Vegetation Management Plan
WM Act	NSW *Water Management Act 2000*

1. Stage 1: Biodiversity assessment

1.1 Introduction

This Biodiversity Development Assessment Report (BDAR) has been prepared by Nicole McVicar (BAAS 18077) who is an Accredited Person under the NSW *Biodiversity Conservation Act 2016* (BC Act). The report has been peer reviewed by Accredited Assessor Meredith Henderson (BAAS17001). The contents of this BDAR comply with the minimum requirements outlined in Table 24 of the Biodiversity Assessment Method (BAM) (Office of Environment and Heritage (OEH) 2020).

Definitions relevant to the report are provided in Appendix A.

1.1.1 General description of the project and the development site

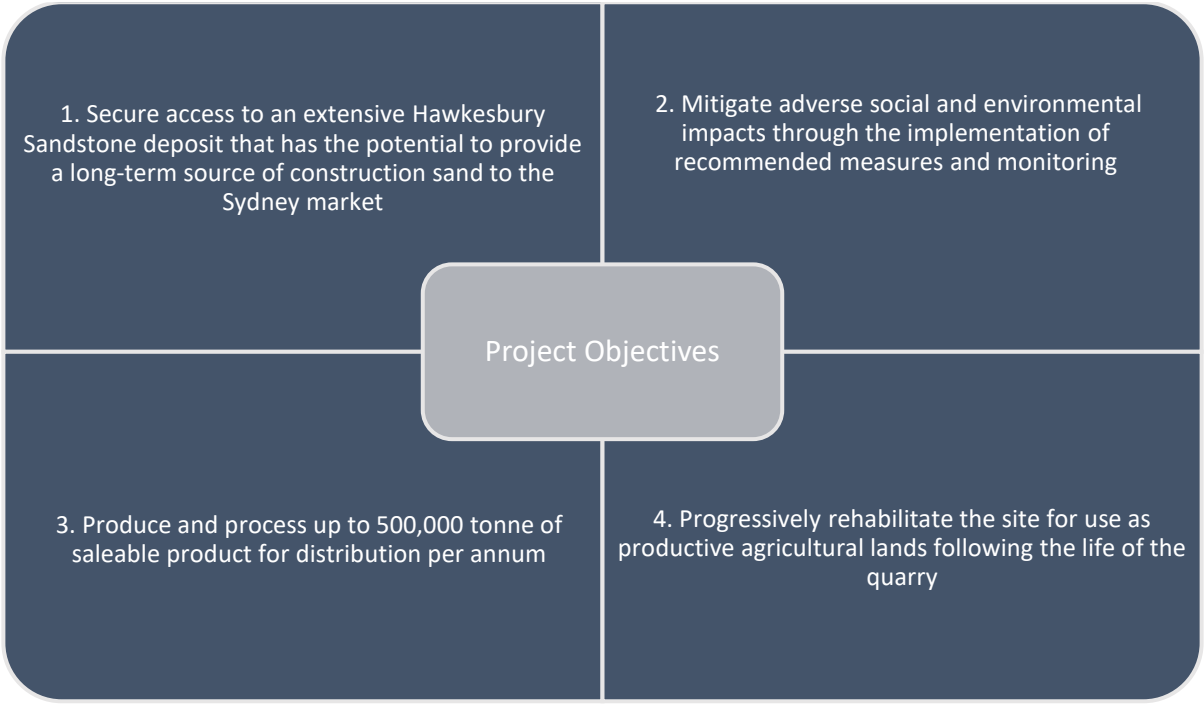
This BDAR assesses the impacts on biodiversity of a proposed development within the following lots (i.e. the subject land):

- Lot 213 DP752025
- Lot 7005 DP1055724
- Lot 7304 DP1144116

Development consent is sought under 'Division 4.7 - Stage Significant Development' of the *Environmental Planning and Assessment Act 1979* for the use of the site as an extractive industry.[1] The extractive material is comprised primarily of Hawkesbury Sandstone, shale and clays. Extractive material will be processed on site, stockpiled and distributed by external contractors. The extracted material can be processed into fine-medium graded sand with crushed sandstone, fine graded sand and a fine aggregate being produced as by-products.

[1] An ***extractive industry*** is defined under the Standard Instrument as *"the winning or removal of extractive materials (otherwise than from a mine) by methods such as excavating, dredging, tunnelling or quarrying, including the storing, stockpiling or processing extractive materials by methods such as recycling, washing, crushing, sawing or separating, but does not include turf farming"*. Extractive material means *"sand, soil, gravel, rock or similar substances that are not minerals within the meaning of the Mining Act 1992"*.

The objectives of the project are as follows:



The subject land is 177.69 ha and is located within remnant bushland close to the corner of Old Northern Road and Wisemans Ferry Road, Maroota within The Hills Shire local government area. The subject land is surrounded by sand quarries and rural properties to the north, north east, east, south and south west. Beyond this cluster of the development, the land transitions to vast areas of undeveloped bushland. To the west and north, the subject land is directly connected to a large expanse of remnant native vegetation which continues relatively uninterrupted to the Hawkesbury River and then beyond (Figure 1).

The development site is subject to the proposed State Significant Development application SSD-10410. The BAM defines the development site as *an area of land that is subject to a proposed development application, application for approval, or activity within the meaning of Part 5 of the Environmental Planning and Assessment Act*. In relation to this project, the development site comprises all land directly (i.e. development footprint) and indirectly affected.

The BAM defines the development footprint as *the area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials. The term development footprint is also taken to include clearing footprint*. In relation to this project, the development footprint is all the land that will be directly affected.

Direct impacts are defined in the BAM and are described in the BAM Operational Manual Stage 2 (Department of Planning, Industry and Environment (DPIE) 2019a) as those impacts *that result from clearing vegetation for a development. These impacts are predictable, usually occur at or near to the subject land, and can be readily identified during the planning and design phases of a development. Direct impacts may be permanent (e.g. construction of a railway or building) or temporary (e.g. only occurring over weeks or months) and may result in partial (e.g. ground cover, litter and functional*

attributes such as logs removed but all other structural components of the vegetation remain) or complete clearing.

Direct impacts areas within the development footprint therefore includes the extraction area, plant and administration area, water storage dam, haul roads and selected areas of vegetation outside these areas which will be heavily affected by the development. It also includes direct impact buffers of particular distances. These direct impact areas are as follows:

- extraction area plus a 10m buffer around the edge of the extraction area
- plant area and dam plus a 5m buffer
- haul road where it exits at Patricia Fay Drive plus 2m added either side of the road.
- strip of retained vegetation north of the plant area and south and the extraction area.

The development footprint is 50.95 ha in size. Biodiversity credits have been calculated for all areas directly affected by the proposed development (i.e. the entire development footprint).

The development site comprises the development footprint and additional areas subject to indirect impacts. Indirect impacts are described in the BAM Operational Manual Stage 2 (DPIE 2019a) as *development related activities not associated with clearing for the development footprint. Examples include increased noise, dust, light spill, weeds and pathogens and edge effects that can be reasonably attributed to the development. Indirect impacts often occur beyond the development footprint or even the development site, have a lower or variable intensity of impact compared to direct impacts, may be harder to predict spatially and temporally, may have unclear boundaries of responsibility.*

The indirect impact buffer areas in the development site are as follows:

- extraction area - 30m additional around the edge of the 10m direct impact area
- plant area - 10m additional from the edge of the 5m direct impact area.
- haul road – 5m additional on the outside edges of the 2m direct impact areas.

The development site is 61.92 ha in size. Biodiversity credits have not been calculated for these indirect impact buffer areas. These areas will be subject to mitigation measures.

The development site is located wholly within good condition remnant native vegetation and consists primarily of dry sclerophyll forest on shale sandstone transition soils and sandy soils derived from Hawkesbury Sandstone, with a mosaic of Plant Community Types (PCTs). Figure 1- Figure 5 displays the general bushland environment within the subject land. Of note, and shown in Figure 3, the development site is dominated by PCT 1081 *Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion* which corresponds with the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) listed Threatened Ecological Community (TEC) *Shale Sandstone Transition Forest of the Sydney Basin Bioregion*. This PCT does not correspond with the listing under the NSW BC Act or the best fit PCT (PCT 1395) which corresponds to *Shale Sandstone Transition Forest in the Sydney Basin Bioregion* BC Act listing. The PCT (PCT 1081) is equivalent to Hinterland Transition Woodland DSFp146 as defined in the BioNet Vegetation Classification, and it is stated clearly that that this PCT does not correspond to Shale Sandstone Transition Forest: *There are currently no TECs associated with this PCT. It is similar to Shale Sandstone Transition Forest but occurs on a quartz-rich soil and has more Proteaceae shrubs* (accessed on 23 July 2020).

Also of note and shown in Figure 4, is a remnant patch of the *Maroota Sands Swamp Forest* within the subject land directly north of the development site. This community is listed as an endangered ecological community under the NSW BC Act and is a Groundwater Dependent Ecosystem (GDE). This community is located outside the direct and indirect impact areas of the development site and development footprint.

Several first order creeklines are located within and adjacent to the development site, which eventually drain into the Hawkesbury River to the north.

The development site has been subject to past clearing and disturbance in places, however degraded areas are limited to the subject land boundaries to the south and east on the fringes of urban development. These degraded areas are outside the development site, aside from along Patricia Fay Drive where the haul road exit location is proposed.

This report includes two base maps, the Site Map (Figure 5) and the Location Map (Figure 6).

1.1.2 Development site footprint and detailed project description

The development site footprint is described in Table 1 and in the text below (1.1.2.1– 1.1.2.5) and displayed in Figure 7.

Table 1: Development details

Key Element	Detail
Proposed Land Use	*Extractive Industry*
Extraction Method	Overburden Stripping & Raw Feed Extraction
Resource	Hawkesbury and Maroota Sandstone, shale and clay
Processing Method	Processed into washed sand of various diameters including for use in concrete and road base, and other resource-based products as appropriate.
Quarry Life	Approximately 28 years. Approval sought for 30 years.
Groundwater Buffer	2m above the wet-weather groundwater levels
Disturbance Area	• 43.89 extraction area • 2.4ha site Infrastructure Area • 0.31 ha access haul road (outside the extraction area) • 0.2ha Surface water Dam Total: 47.2ha
Annual Production	500,000 tonnes
Total Resource Recovered	• 15,200 million tonnes of raw sandstone processed into 13,600 million tonnes of saleable product • 160 tonnes of shale • 370 tonnes of overburden
Management of Waste	Tailings will be press dried and incorporated with the overburden to from the final landforms. Other waste will be segregated and removed by a licensed contractor.
	• Relocatable sand processing plant • Weighbridge • Administration office and carpark • Water tank integrated within the production plant • Storage bins for dried tailings • Internal haul roads • Sales haul road • Electrical power supply • Potable water supply • Enviro-cycle sewage system • Machinery workshop and diesel storage tanks • Site fencing • Surface water dam • Groundwater bore
Truck movements	120 truck movements Monday to Friday 60 truck movements Saturday
Employment	• 1 full-time quarry manager • 2 full-time sales loaders • 1 part-time water cart driver

Key Element	Detail
	• 1 full-time and 1 part-time weighbridge & sales • 1 full-time and 1 part-time excavator operator • 2 full-time articulated truck drivers • 1 full-time and 1 part-time sand plant operator • 8 full-time privately contracted truck drivers.
Hours of Operation	• Sales – 6am to 6pm, Monday to Saturday • Quarry operations – 7am to 6pm, Monday to Saturday
Statutory Approvals Required (expanded upon in Section 5)	• Development Consent under the *Environmental Planning & Assessment Act 1979* • Controlled action approval under the *Environmental Protection and Biodiversity Conservation Act 1999* • Environmental Protection Licence under the *Protection of the Environment Operations Act 1997* • Water access licence under the *Water Management Act 2000* • Section 138 Approval under the *Roads Acts 1993*

1.1.2.1 Pre-operation construction activities and site preparation

The following works are required to enable quarry operations.

- Marking out the locations of the site which are to be cleared for site establishment and construction.
- Progressive pre-clearing of fauna before the clearing of vegetation to expose working surfaces for construction of the access haul road and intersection, site infrastructure, surface water dam and the initial cut of the extraction pit. The Proponent will work with the ecologist to remove fauna per their recommendations before clearing and grubbing taking place.
- Initial removal of overburden to allow the construction of the access haul road and to provide exposure to raw material for the initial cut into the extraction area. Overburden will be used as fill to level the site infrastructure area to a height of 155 Australian Height Datum (AHD). (13,000m^3 of excess overburden will temporarily be stored within the extraction footprint during year 1 of the operation before being rehandled in year 2 to construct rehabilitated landforms in the extracted pit).
- Establishment of the processing plant and associated infrastructure including weighbridge, administration area, a water tank and storage bins for dry tailings in the site infrastructure area.
- Establishment of a surface water dam and groundwater bore to provide clean water supplies to the processing plant.

A six to 12-month timeframe is anticipated for the site preparation.

1.1.2.2 Site access

Access to the site is proposed via the construction of a haul road from Patricia Fay Drive to the site infrastructure area.. The route of the proposed haul road has been designed to achieve three objectives:

1. To complement the existing topography of the site.
2. To locate the access road away from southern neighbouring properties to mitigate noise, dust and visual impacts.
3. To contain the majority of the access road within the extraction footprint to minimise the project's area of disturbance.

1.1.2.3 Internal haul roads

Internal haul roads will be constructed from the site infrastructure area to the extraction pit as the extraction area progresses. These roads will be regularly graded and watered to maintain their profile and running surface and to minimise dust generation.

1.1.2.4 Proposed extraction area

The proposed extraction area occupies approximately 43.98 ha of the development site. The extraction area will be excavated to a floor elevation ranging between 148 AHD and 165 AHD. No extraction will occur within two metres of the wet-weather high groundwater levels or outside the proposed extraction area. The key constraints and objectives listed below have informed the design of the extraction area.

- Maximise access to the sandstone located under the site's two major ridgelines
- A 50m buffer to the endangered Groundwater Dependent Ecosystem known as the 'Maroota Sands Swamp Forest' situated to the north of the development site.
- A 100m buffer to the neighbouring properties located to the south of the development site.
- 35 m buffer to nearby Aboriginal artefacts.

1.1.2.5 Extraction method

The sand operation will utilise conventional extraction methods. Generally, an excavator will be used to remove friable sandstone and load the raw material into an articulated truck. Where necessary, a bulldozer equipped with ripper bars will be used to rip stronger material before an excavator picks it up and transfers the material. A rock breaker will likely be required for pockets of competent sandstone. Once loaded, articulated trucks will cart the raw material to the sand plant for processing.

No blasting is proposed as part of the application.

1.1.3 Sources of information used

The following data sources were reviewed as part of this report:

- BioNet Vegetation Classification (accessed between 14 January and 23 July 2020)
- Threatened Biodiversity Data Collection (accessed between 14 January and 23 July 2020)
- BioNet / Atlas of NSW Wildlife 5 km database search (DPIE, accessed 7 January 2020) (Figure 8 and Figure 9)
- Atlas as of Living Australia – Broad-headed Snake search (accessed 19 November 2021)
- Groundwater Dependent Ecosystems Atlas (accessed 23 July 2020)
- Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool 5 km database search (DAWE, accessed 21 October 2019 and 9 July 2020). Likelihood of occurrence table has been provided in Appendix F.
- NSW Government Biodiversity Values Map and Threshold Tool (BV Map). The subject land is not mapped on the BV Map (accessed 7 January 2020 and 20 July 2020)
- Aerial mapping (SIXMaps and NearMaps) (accessed between 7 January and 23 July 2020)
- Additional geographic information system (GIS) datasets including soil, topography, geology and drainage

- *Wisemans Ferry Road, Maroota Due Diligence Ecology Report for Deerubbin Local Aboriginal Land Council* May 2011 Draft Report prepared by Cumberland Ecology.
- Groundwater Constraints Assessment Maroota Friable Sandstone Extraction Project prepared by EMM April 2020
- Maroota Sand Quarry Water Assessment v1 Draft Report prepared by EMM November 2020

Figure 1: General environment within the subject land looking west to undisturbed, remnant bushland

Figure 2: Predominant sandstone environment within the development site

Figure 3: PCT 1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion within the development site.

Figure 4: Maroota Sand Swamp Woodland within the study area outside the development site

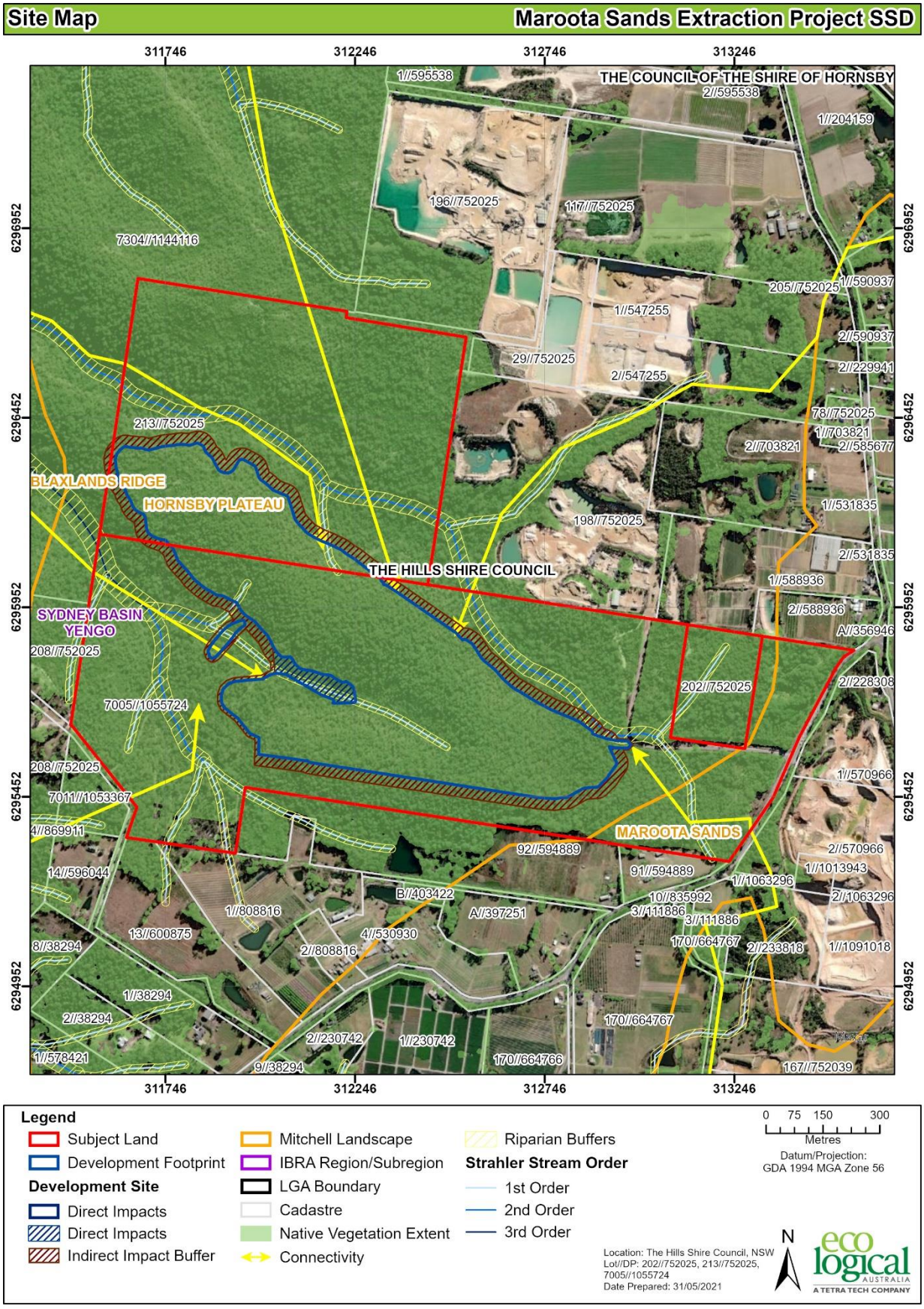


Figure 5: Site Map

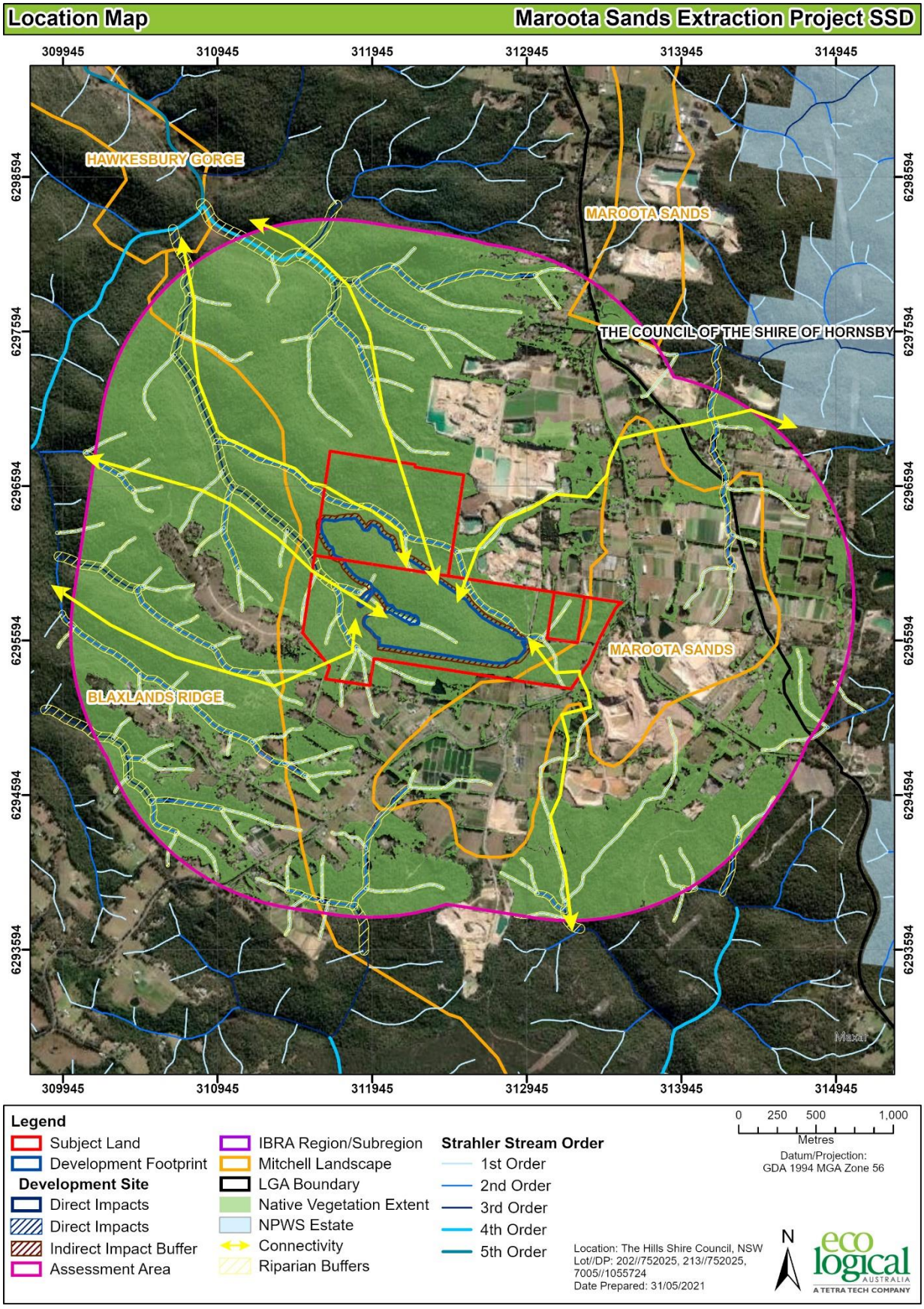


Figure 6: Location Map

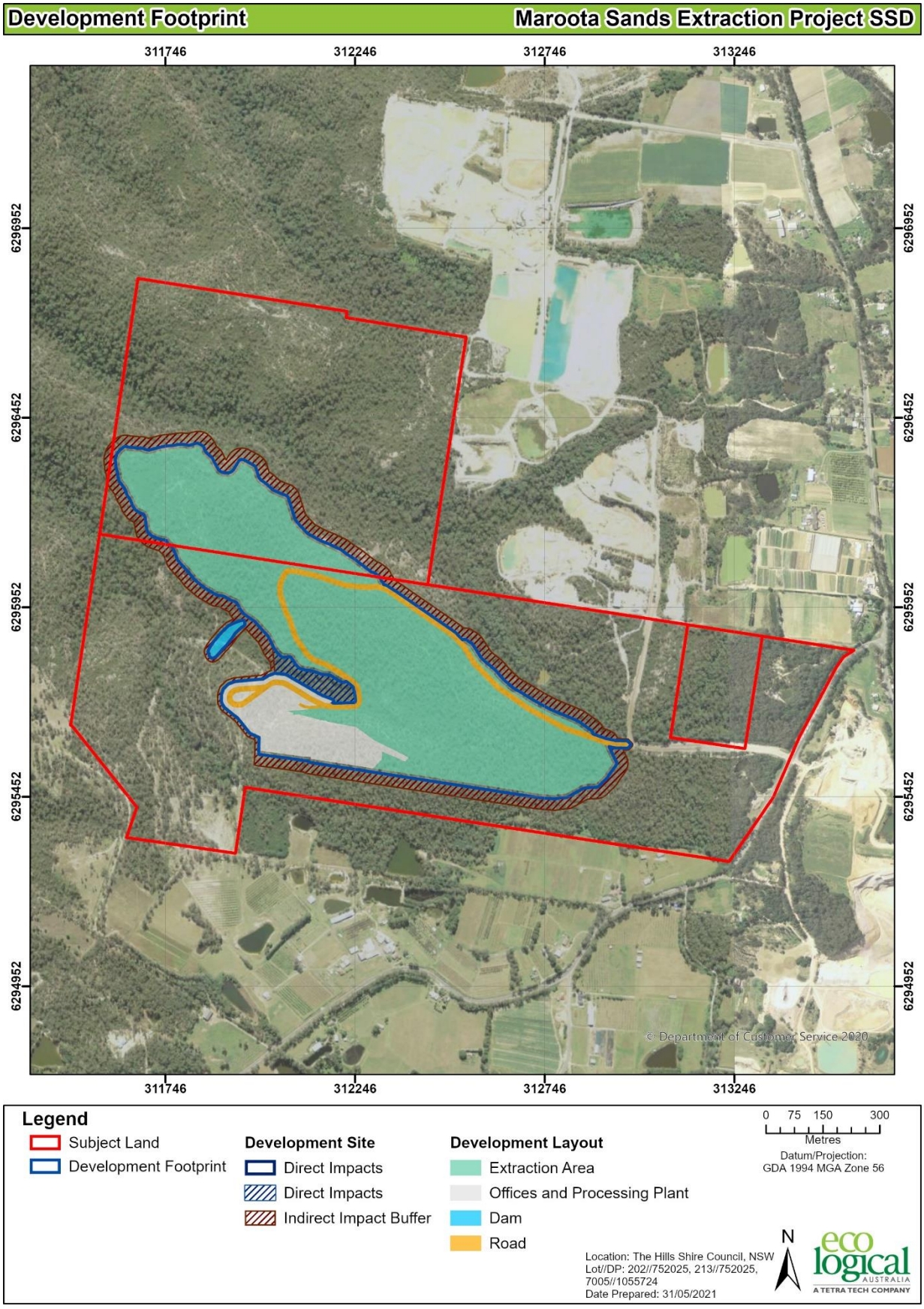


Figure 7: Development site and development footprint

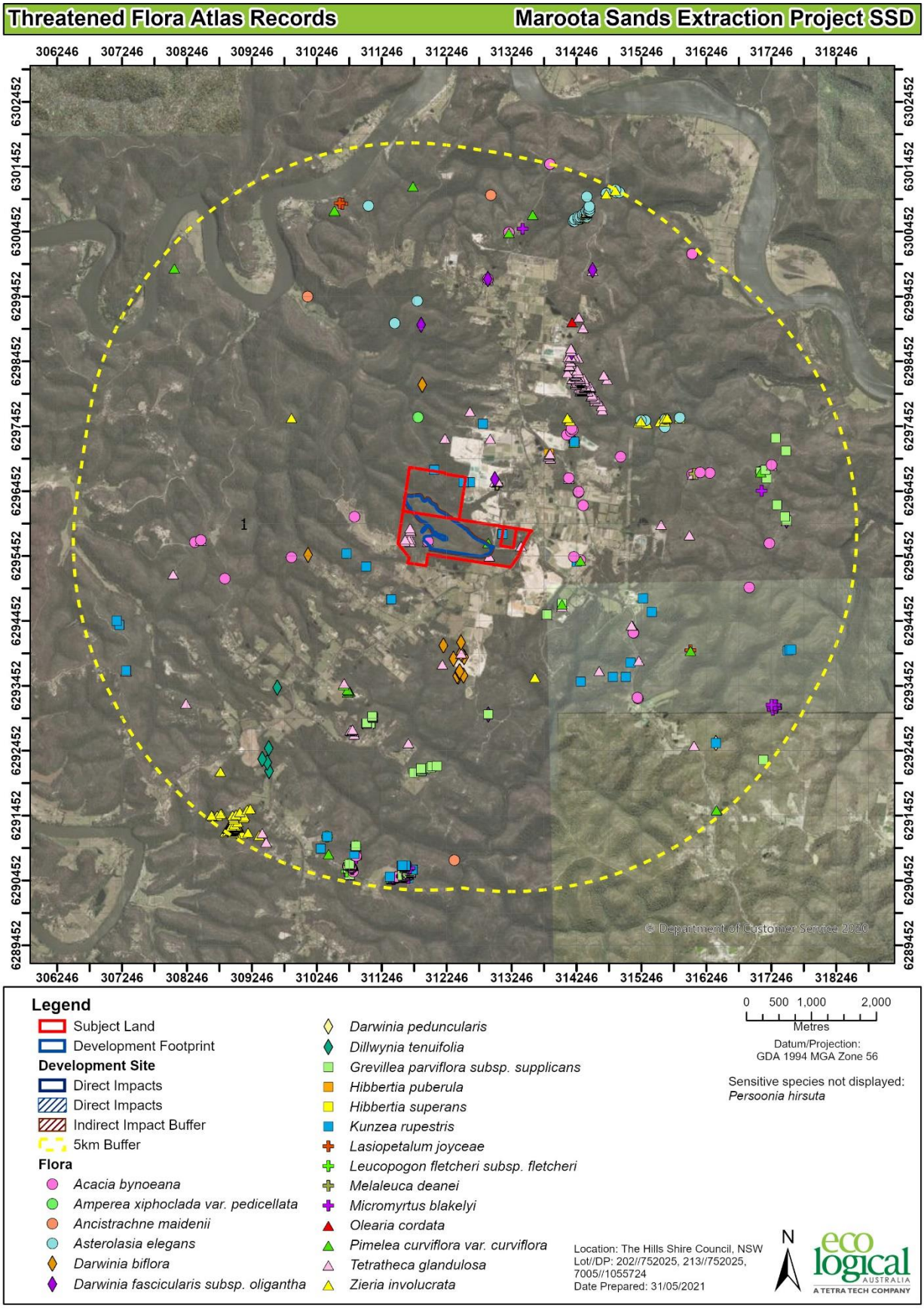


Figure 8: BioNet (Wildlife Atlas) threatened flora records

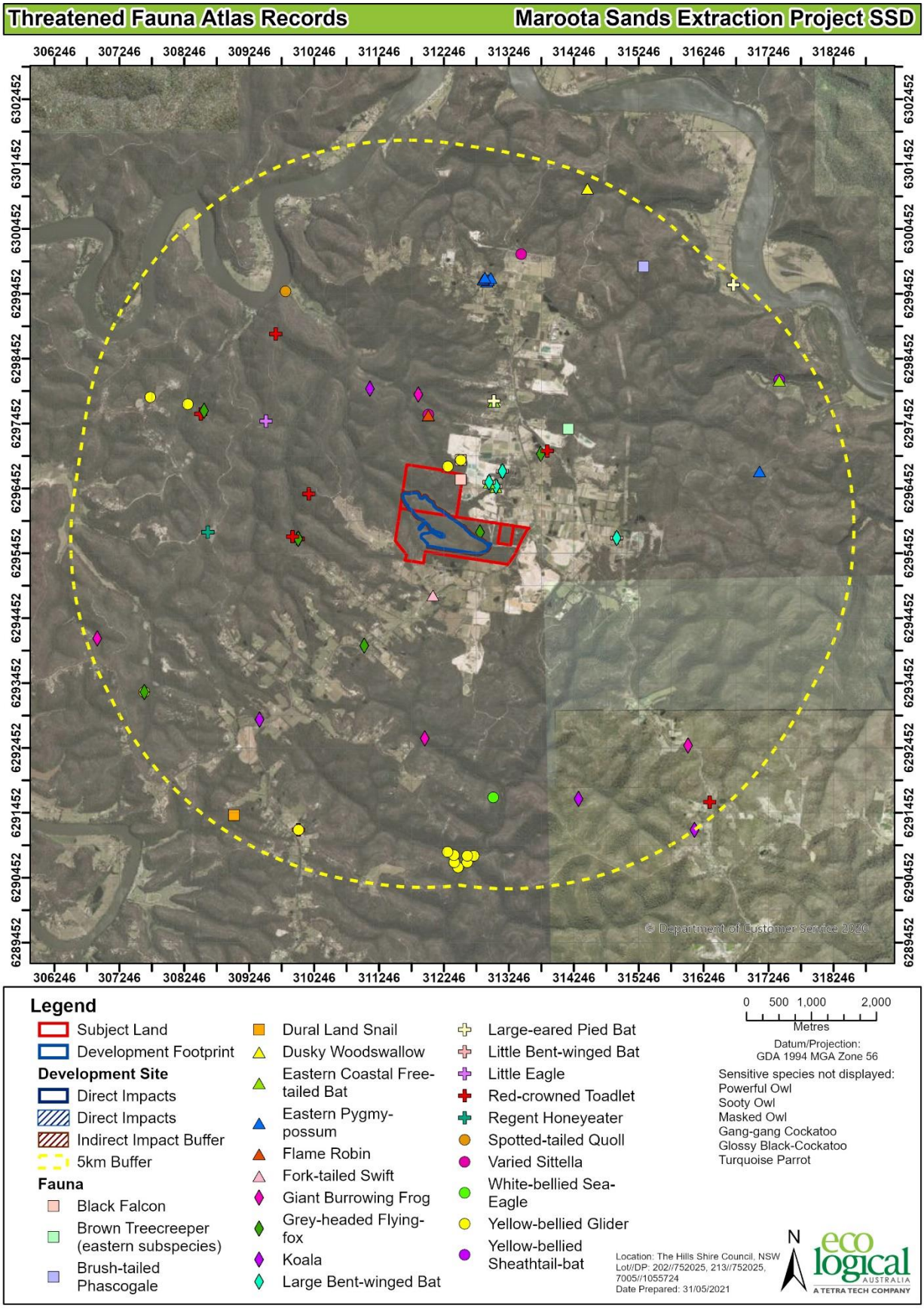


Figure 9: BioNet (Wildlife Atlas) threatened fauna records

1.2 Legislative context

Table 2: Legislative context

Name	Relevance to the project
Commonwealth	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Matters of National Environmental Significance (MNES) have been identified on or near the development site. This report assesses impacts to MNES and concludes that the proposed action is likely to have a significant impact on MNES. Further information Is provided in section 2.6.1. On 18 May 2021 the Department of Agriculture, Water and the Environment determined that the project is a controlled action under section 75 of the EPBC Act. It was also confirmed that the proposed action will be assessed in accordance with the bilateral assessment agreement *Amending Agreement No.1.* Details have been contained in the supplementary SEARs for SSD-10410 provided by the Commonwealth Department in May 2021.
State	
Environmental Planning and Assessment Act 1979 (EP&A Act)	The proposed development is State Significant Development (SSD-10410) and is to be assessed under Part 4.1 of the EP&A Act. Secretary's Environmental Assessment Requirements (SEARS) have been issued (SSD-10410 issues on 18 February 2020) and the relevant SEARs are as follows: *The EIS must address the following key issues* *Biodiversity – including:* • *accurate predictions of any vegetation to be cleared on site;* • *a detailed 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* • *a strategy to offset any residual impacts of the development in accordance with the offset rules under the Biodiversity Conservation Act 2016.* As discussed above under the Commonwealth requirements, supplementary SEARs for SSD-10410 to address the requirements under the Amended Bilateral Agreement were provided by the Commonwealth Department in May 2021. The supplementary SEARS state that the proposed action is required to be assessed in the manner specified in Schedule 1 of Amending Agreement No. 1, including addressing the matters outlined in Schedule 4 of the *Environment Protection and Biodiversity Conservation Regulations 2000.* Further detail area provided in the body of the supplementary SEARs.
Biodiversity Conservation Act 2016 (BC Act)	The proposed development is SSD and thus requires the submission of a Biodiversity Development Assessment Report in accordance with Part 7 Division 2 Section 7.9 (2) of the BC Act: *Any such application is to be accompanied by a biodiversity development assessment report unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values.*
Fisheries Management Act 1994 (FM Act)	The development does not involve impacts to Key Fish Habitat, does not involve harm to marine vegetation, dredging, reclamation or obstruction of fish passage. A permit or consultation under the FM Act is not required. Further to this, under S.4.41 of the EP&A Act, the following approvals/permits are not required for SSD : *(b) a permit under section 201, 205 or 219 of the Fisheries Management Act 1994.*
Local Land Services Amendment Act 2016 (LLS Act)	The LLS Act does not apply to areas of the state to which the Vegetation in Non Rural Area State Environmental Planning Policy 2017 (Vegetation SEPP) applies. The Vegetation SEPP applies to The Hills Shire local government area.
Water Management Act 2000 (WM Act)	The *Water Management Act 2000* aims to provide sustainable and integrated management of water sources within NSW, chiefly to:

Name	Relevance to the project
	• Apply principles of ecologically sustainable development • Protect, enhance and restore water sources, their ecosystems, ecological processes, water quality and biodiversity • Recognise significant social and economic benefits, including the role of the community • Encourage best practice management and use of water. Under S.4.41 of the EP&A Act, the following approvals/permits are not required for SSD: *(g) a water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the Water Management Act 2000*. Therefore approval under the WM Act is not required.
Environmental Planning Instruments	
Vegetation in Non Rural Area State Environmental Planning Policy 2017 (Vegetation SEPP)	The Vegetation SEPP applies to development in urban areas and environmental conservation zones that does not require consent. As this project requires consent under the EP&A Act, the Vegetation SEPP does not apply.
SEPP (Koala Habitat Protection) 2021 (Koala SEPP 2021)	The Koala SEPP 2021 replaces SEPP 44 – Koala Habitat Protection and SEPP Koala Habitat Protection 2019. According to Schedule 1 of the SEPP, the SEPP does not apply to the Hills Shire Council. Therefore, no further provisions of this policy apply to this development.
SEPP Coastal Management 2018	SEPP Coastal Management 2018 consolidated SEPP 14 Coastal Wetlands, SEPP 26 Littoral Rainforests and SEPP 71 Coastal Protection. The proposed development is not located on or adjacent to land subject to this SEPP therefore this SEPP is not applicable.
The Hills Local Environment Plan 2019 (The Hills LEP)	The subject land and development site is zoned RU2 Rural Landscape under The Hills LEP. The development site is subject to the Terrestrial Biodiversity overlay in the LEP which requires consideration of *Part 7 Clause 7.4 Terrestrial Biodiversity:* *1) The objective of this clause is to maintain terrestrial biodiversity, including by—* *(a) protecting native fauna and flora, and* *(b) protecting the ecological processes necessary for their continued existence, and* *(c) encouraging the conservation and recovery of native fauna and flora and their habitats.* *(2) This clause applies to land identified as "Biodiversity" on the Terrestrial Biodiversity Map.* *(3) In deciding whether to grant development consent for development on land to which this clause applies, the consent authority must consider—* *(a) whether the development is likely to have—* *(i) any adverse impact on the condition, ecological value and significance of the fauna and flora on the land, and* *(ii) any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna, and* *(iii) any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and* *(iv) any adverse impact on the habitat elements providing connectivity on the land, and* *(b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.* *(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that—* *(a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or*

Name	Relevance to the project
	(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or *(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.* This has been further discussed in Section 2.6.2 of this report.
The Hills Development Control Plan 2012 (The Hills DCP)	As the project is SSD, Development Control Plans are not applicable to the project under Section 11 of State Environmental Planning Policy (State and Regional Development) 2011. However, at the request of the Hills Shire Council, the project has been assessed against the relevant sections of the DCP. The Hills DCP Part B Section 1 Rural contains provisions relating to native vegetation in Rural Landscape under the LEP. Relevant to the proposed development is *Part 2 Extractive Industries*: Section 1 Site Planning: E*xtractive industries and related activities maintain an effective buffer to protect landscape quality, the habitats of threatened species, populations and ecological communities of the shire.* Section 5 Flora and Fauna Buffer Zones: *Sufficient separation is provided to threatened species and critical ecological communities, and the scenic and environmental quality of the Shire is retained.* *The development controls* states for Extractive Industry Buffer Zones • *To be a minimum of 50m from important habitats of threatened species, populations, ecological communities and/or;* • *No less than the site specific requirements of the National Parks & Wildlife Services.* *The buffer zone should not be disturbed except for ongoing management or rehabilitation purposes* *Part C Section C Landscaping* also provides the following controls relevant to the proposed development: Section 2.3 Weed Species; *The Biosecurity Act 2015*, specifies the control of Priority weeds in New South Wales. The responsibility for eradication of weeds on private land is that of the owner. Private landholders are responsible for ensuring that as far as reasonably practicable, the biosecurity risk posed by priority weeds is prevented, eliminated or minimised. This has been further discussed in Section 2.6.3 of this report.

1.3 Landscape features

1.3.1 IBRA regions and subregions

The development site falls entirely within the Sydney Basin IBRA region and Yengo subregion.

1.3.2 Mitchell Landscapes

The development site falls entirely within the Hornsby Plateau Mitchell Landscape. Maroota Sands Mitchell Landscape is located to the east of the development site. The Mitchell Landscapes are described in Table 3.

Table 3: Mitchell Landscapes

Mitchell Landscapes Name	Description (DECC 2002)
Hornsby Plateau	Benched hill slopes and steep hills with narrow flat-topped ridges and broader plateau tops on horizontal Triassic quartz sandstone with occasional conglomerate and thin discontinuous shales. Isolated thicker shales and areas of 'laterite' development on plateaus. General elevation 0 to 220m, local relief 30 to 120m. Shallow uniform sands amongst rock outcrops. Deep gradational yellow earths on some plateau areas,

Mitchell Landscapes Name	Description (DECC 2002)
	yellow texture-contrast soils on benches, deep uniform sands, organic sands and limited podsols in depositional areas. Very diverse vegetation related to site and soil conditions. Crests and ridges, *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus capitellata* (Brown Stringybark), *Eucalyptus sieberi* (Silvertop Ash) and Banksia serrata (Old Man Banksia) with a high proportion of Proteaceae and Acacia in the understorey. Slopes; *Angophora costata* (Smooth-Barked Apple), *Eucalyptus piperita* (Sydney Peppermint), *Corymbia eximia* (Yellow Bloodwood), *Leptospermum* sp., and *Allocasuarina torulosa* (Forest Oak); protected valley floors with rainforest elements including *Syncarpia glomulifera* (Turpentine), *Eucalyptus saligna* (Sydney Blue Gum), *Eucalyptus pilularis* (Blackbutt), *Tristaniopsis laurina* (Water Gum), *Ceratopetalum apetalum* (Coachwood), *Livistona australis* (Cabbage-tree Palm). Extensive wet and dry heaths on plateau, Sydney blue gum, blackbutt, turpentine tall forest on thicker shale ridge tops with deep gradational red clay loam to clay soil.
Maroota Sands	A single unit of fluvial quartz sands with minor gravel and white clay on the crest of a ridge above the Hawkesbury, general elevation 240m, local relief <10m. The sediments are of uncertain age but appear to be capped by a small remnant of Tertiary basalt. Deep yellow earth and well developed podsol profiles with limited yellow to grey texture-contrast profiles. Woodland of *Eucalyptus squamosa* (Scaly Bark), *Eucalyptus sclerophylla* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), common *Calytrix tetragona* (Fringe Myrtle), and *Darwinia fascicularis* with diverse shrubs and wetland species on marginal springs.

1.3.3 Native vegetation extent

The current percent native vegetation cover in the landscape was assessed using GIS and aerial imagery sourced from NearMaps using increments of 5%. The extent of native vegetation within the development site and 1500 m buffer is outlined below in Table 4.

Table 4: Native vegetation extent

Total area within the 1,500m buffer	Area of native vegetation within the 1,500 m buffer area	Area within the development site	Cover of native vegetation within the 1500m buffer area (%)
1816.43 ha	1146.43 ha	61.92 ha	63 %

There are no differences between the mapped vegetation extent and the aerial imagery.

1.3.4 Rivers and streams

The development site contains rivers and streams as outlined in Table 5.

Table 5: Rivers and streams

River/stream	Order	Riparian buffer
Unnamed	1st order	10
Unnamed	1st order	10
Unnamed	1st order	10

1.3.5 Wetlands

The development site does not contain any wetlands.

1.3.6 Groundwater Dependent Ecosystems

Groundwater Dependant Ecosystems (GDEs) are defined as ecosystems whose current species composition, structure and function are reliant on a supply of groundwater as opposed to surface water supplies from overland flow paths. The frequency of groundwater influence may range from daily to inter-annually, however it becomes clearly apparent when either the supply of groundwater or its quality (or both) is altered for a sufficient length of time to cause changes in plant function. Groundwater use by an ecological community or individual species does not necessarily imply groundwater dependence.

In Australia, many ecosystems have a dependence on groundwater, although the full understanding of the role of groundwater in maintaining ecosystems is generally poor. Most wetland communities and many river systems have some degree of dependence on groundwater resources.

GDEs are generally classified into six categories:

- Terrestrial vegetation – forests and woodland which develop a permanent or seasonal dependence on groundwater, often by extending roots into the water table.
- Base flow in streams – aquatic and riparian ecosystems that exist in or adjacent to streams that are fed by groundwater base flow.
- Aquifer and cave systems – aquatic ecosystems that occupy caves or aquifers.
- Wetlands – aquatic communities and fringing vegetation that depend on groundwater fed lakes and wetlands.
- Estuarine and near shore marine ecosystems – various ecosystems including mangroves, saltmarsh and seagrass, whose ecological function has some dependence on groundwater discharge.
- Terrestrial fauna – fauna species assemblages reliant on groundwater for drinking water.

A final category is also recognised ‘not apparently dependent’. This category acknowledges that some ecosystems, particularly wetland and riparian vegetation, might superficially appear to be groundwater dependent while in fact they are dependent entirely on surface flows and or rainfall.

The most likely GDE types in the Sydney region are terrestrial vegetation communities with deep roots that use groundwater, wetlands, and river baseflow systems.

A search of the GDE Atlas (Bureau of Meteorology, accessed 23 July 2020) did not indicate presence of a GDE with in the subject land, however a known GDE *Maroota Sands Swamp Forest* is present within the subject land to the north of the development site.

1.3.7 Connectivity features

The development site contains the connectivity features outlined in Table 6.

Table 6: Connectivity features

Connectivity feature name	Feature type
Remnant bushland to the north west, and north west	Intact bushland
Remnant bushland to the east and south	Intact bushland

1.3.8 Areas of geological significance and soil hazard features

The development site contains the areas of geological significance and soil hazard features as outlined in Table 7.

Table 7: Areas of geological significance and soil hazard features

Area of geological significance or soil hazard feature	Feature type
Sandstone rockshelves and outcrops	Sandstone rockshelves and outcrops in PCTs 1083,1328 and 1181

1.3.9 Site context

1.3.9.1 Method applied

The site based method has been applied to this development.

1.3.9.2 Patch size

Patch size was calculated using available vegetation mapping for all patches of intact native vegetation on and adjoining the development site. The development site contains only one patch of native vegetation. The patch size area was determined to be >101 ha.

1.4 Field survey and methodology

1.4.1 Native vegetation

1.4.1.1 Vegetation mapping and BAM plots

Vegetation survey and BAM plots were undertaken within and adjacent to the development site on the following dates shown in Table 8.

Table 8: Details of vegetation survey within the development site

Date	Personnel
14 January 2020	Nicole McVicar and Stacey Wilson
21 January 2020	Nicole McVicar and Carolina Mora
24 February 2020	Nicole McVicar and Liz Norris
28 February 2020	Nicole McVicar
29 May 2020	Nicole McVicar and Stacey Wilson
1 June 2020	Nicole McVicar and Stacey Wilson
9 June 2020	Nicole McVicar and Alex Gorey
7 July 2020	Nicole McVicar and Mike Lawrie

1.4.1.2 Plant Community Types present

A total of four PCTs were identified on the development site and six PCTS within part of the subject land (Table 9, Figure 10). Of these, one is a listed Threatened Ecological Community (TEC) under the Commonwealth EPBC Act: *Shale Sandstone Transition Forest of the Sydney Basin Bioregion (*PCT 1081), and one is a listed TEC under the NSW BC Act: *Maroota Sands Swamp Forest* (PCT 923). Justification for the selection of PCTs occurring on the development site is based on a quantitative analysis of full-floristic

plot data and is provided in section 1.4.1.3. Further detail on the TEC justification for EPBC Act listed PCT 1081 and a description of the BC Act listed *Maroota Sands Swamp Forest* (PCT 923) is provided below in section 1.4.2.2 below. A map of the TECs is provided in Figure 11.

A total of 20 full-floristic and vegetation integrity plots were surveyed to identify PCTs and TECs within the development site and part of the subject land. Seven vegetation zones were identified in the development site and development footprint. The area of each vegetation zone within the development footprint is displayed below in Table 10. All field data collected at full-floristic and vegetation integrity plots is included in Appendix B. A map of PCTs within the development footprint, development site, and part of the subject land, is provided in Figure 12.

Table 9: Plant Community Types within the development footprint

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Area within development footprint (ha)	Percent cleared
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Sydney Hinterland Dry Sclerophyll Forests	Dry Sclerophyll Forest (shrubby sub-formation)	25.71	40
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Sydney Hinterland Dry Sclerophyll Forests	Dry Sclerophyll Forest (shrubby sub-formation)	3.27	17
1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Sydney Hinterland Dry Sclerophyll Forests	Dry Sclerophyll Forest (shrubby sub-formation)	13.8	5
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Sydney Hinterland Dry Sclerophyll Forests	Dry Sclerophyll Forest (shrubby sub-formation)	8.17	20
Total				**50.95**	

Table 10: Vegetation integrity plots

Veg Zone	PCT ID	PCT Name	Condition	Area with the development footprint (ha)	Plots required	Plots surveyed
1	1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Open understorey	22.69	4	5
2	1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Dense midstorey	3.02	2	3

Veg Zone	PCT ID	PCT Name	Condition	Area with the development footprint (ha)	Plots required	Plots surveyed
3	1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Heathy understorey	1.95	1	1
4	1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Open understorey	1.32	1	1
5	1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Open understorey	10.22	3	4
6	1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Heathy understorey	3.58	2	2
7	1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Good	8.17	3	4
Total				**50.95**	**16**	**20**

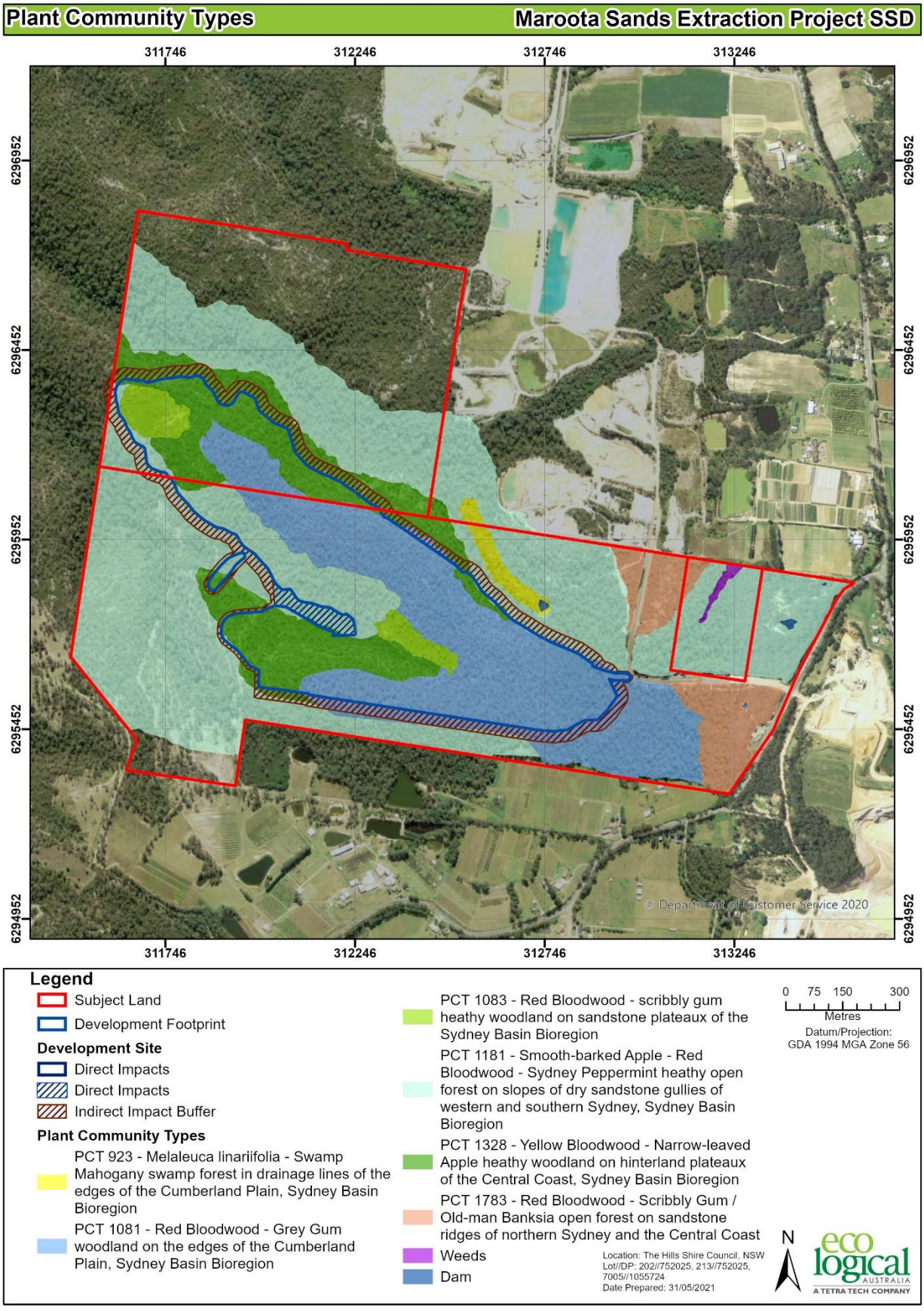


Figure 10: Plant Community Types within the development site and subject land

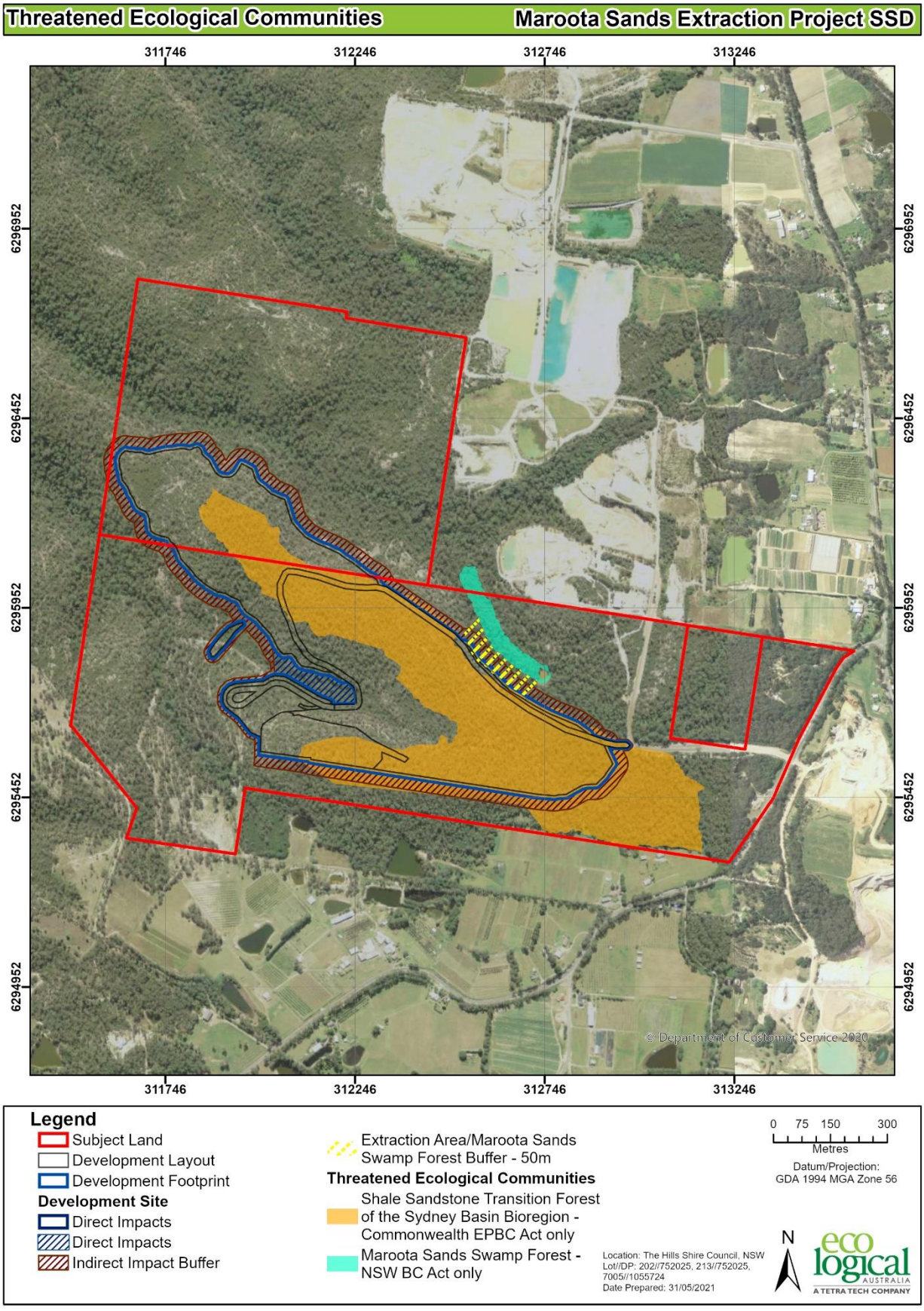


Figure 11: Threatened Ecological Communities

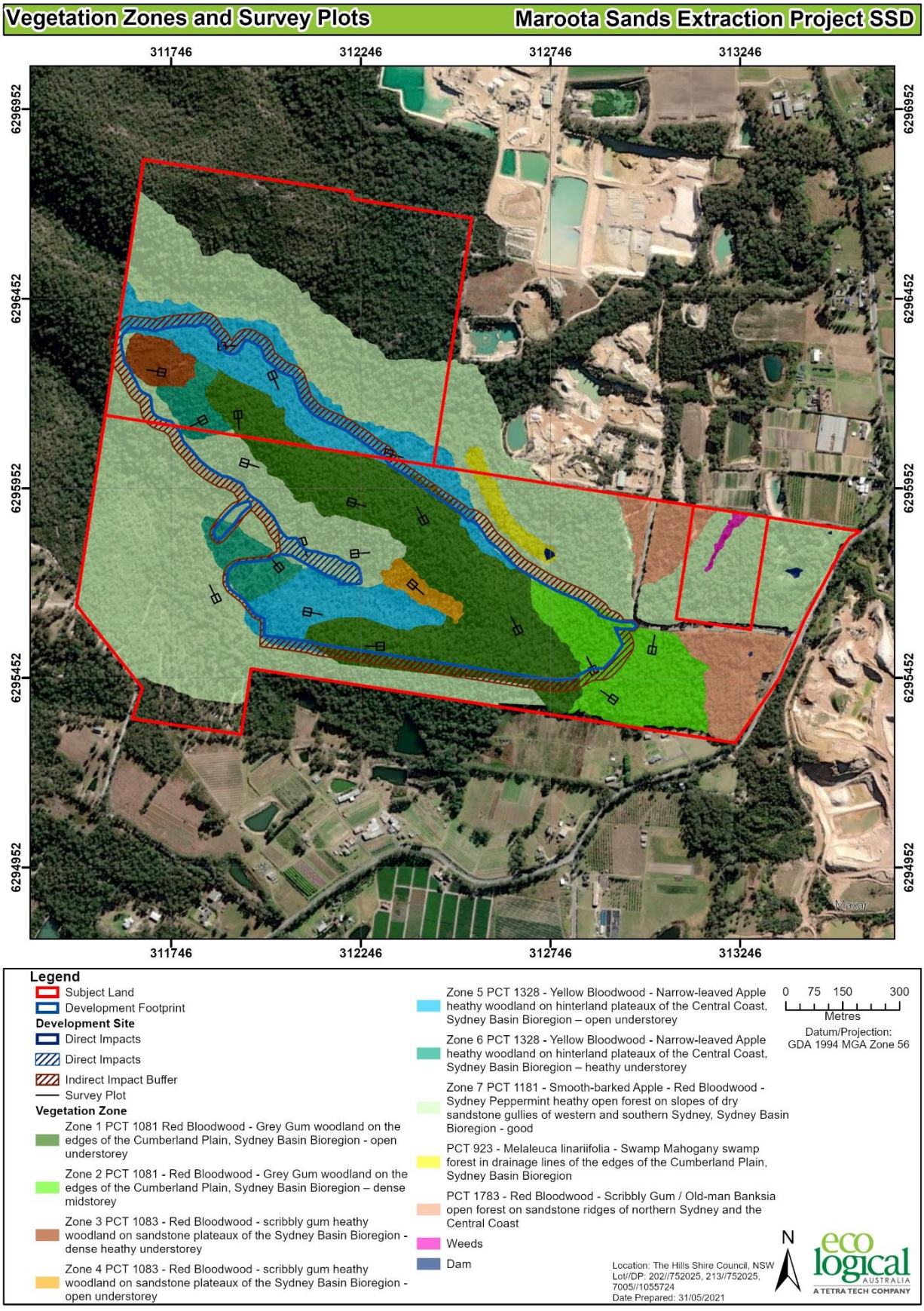


Figure 12: Vegetation zones and plot locations within the development site

1.4.1.3 PCT Selection Justification and Vegetation Zone Description

Table 11 to Table 17 provide a detailed description and justification of the PCT assignment for each of the vegetation zones within the development site. Figure 13 below displays another example of PCT 1081 within the development site.

Figure 13: General environment within the development site. This photo is taken along the internal access track within PCT 1081 Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion

Table 11: PCT 1081 Vegetation Zone 1

VEGETATION ZONE 1	
PCT	1081
PCT name	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion
PCT name other (if applicable)	Hinterland Transition Woodland (DSF p146) (Tozer 2010), Sydney Hinterland Greg Gum Ridgetop Forest - DSF18 (OEH 2016)
Condition	Open understorey
TEC	EPBC Act only – Shale Sandstone Transition Forest of the Sydney Basin Bioregion
Impact area	22.69 ha
Plots	5
Vegetation Integrity Score	55.5
PCT selection criteria	Soil type, dominant canopy, midstorey and groundcover species, vegetation formation and class, IBRA subregion, landscape position
Diagnostic tools	Hager/Steenebeeke 2010 vegetation analysis tool, The Native Vegetation of Sydney Metropolitan Area 2016 V 3.1 diagnostic species list, BioNet Vegetation Classification, EPBC Act Approved Conservation Advice (including listing advice) for Shale Sandstone Transition Forest of the Sydney Basin Bioregion EPBC diagnostic species list -Appendix A.
Description/ justification	Open woodland structure comprising primarily regrowth canopy species (in order of dominance): *Corymbia gummifera* (Red Bloodwood), *Eucalyptus punctata* (Grey Gum), *Eucalyptus sparsifolia* (Narrow-leaved Stringybark), *Corymbia eximia* (Yellow Bloodwood), *Angophora bakeri* (Narrow-leaved Apple), *Angophora costata* (Sydney Red Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus resinifera* (Red Mahogany), *Eucalyptus haemastoma (*Scribbly Gum*)* and *Eucalyptus squamosa* (Scaly Bark). Older hollow bearing trees of a range of diameter were scattered throughout the zone. Midstorey species were relatively sparse allowing an open structure and comprised primarily *Allocasuarina littoralis* (Black She-oak), regrowth *Angophora bakeri* (Narrow-leaved Apple), *Corymbia eximia* (Yellow Bloodwood) and *Corymbia gummifera* (Red Bloodwood), *Hakea sericea* (Needlebush), *Leucopogon muticus* (Blunt Beard-health) *Persoonia linearis* (Narrow-leaved Geebung), and *Leptospermum trinervium* (Flaky-barked Tea-tree). The native groundcover was dense and comprised *Austrostipa pubescens, Anisopogon avenaceus* (Oat Speargrass), *Cyathochaeta diandra, Entolasia stricta* (Wiry Panic), *Entolasia marginata (*Bordered Panic), *Hovea linearis, Mirbelia rubifolia* (Heathy Mirbelia), *Themeda triandra* (Kangaroo Grass), *Bossiaea obcordata* (Spiny Bossiaea), *Lomandra obliqua, Lomandra multiflora,* (Many-flowered Mat-rush), *Lomandra glauca* (Pale Mat-rush), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush), *Phyllanthus hirtellus* (Thyme Spurge) and *Xanthorrhoea media* (Grass Tree). Soil had a distinctive clay texture with no sandstone outcropping in the core areas. Sandstone outcropping was confined to the edges of the community where it transitioned to PCTs 1328, 1083 and 1181. A Hager/Steenebeeke 2010 analysis of the plot data was undertaken with the best fit PCT corresponding to Hinterland Transition Woodland (standardised ration comparison (+ve x (req/total): total native) score of 13.24, compared to 9.93 for Hinterland Sandstone Gully Forest and 10.49 for Coastal Sandstone Ridgetop Woodland. As stated in the BioNet Vegetation Classification "*Sydney Hinterland Transition Woodland (DSF p146) .....is a eucalypt woodland with an open understorey of sclerophyll shrubs, sedges, forbs and grasses. This transition woodland encircles the Cumberland Plain rainshadow, on loamy soils typically derived from sediments belonging to the Hawkesbury or Mittagong formations.* *About one-third of Sydney Hinterland Transition Woodland's original distribution has been cleared, and clearing continues in localised areas of suburban expansion including Dural-Maroota, the lower Blue Mountains and east of Campbelltown".*

VEGETATION ZONE 1	
	Other diagnostic features provided in the BioNet Vegetation Classification states the community is found *"typically on soils derived from sediments of the Hawkesbury and Mittagong formations. Woodland with open understorey of sclerophyll shrubs and ground layer of sedges, forbs and grass".* An EPBC Act diagnostic species assessment was undertaken and it was confirmed that the community comprises an adequate number of diagnostic species to classify the community as the EPBC Act listed community (25-50% over the five plots).
Photo	

Table 12: PCT 1081 Vegetation Zone 2

VEGETATION ZONE 2	
PCT	1081
PCT name	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion
PCT name other (if applicable)	Hinterland Transition Woodland (DSF p146) (Tozer 2010), Sydney Hinterland Greg Gum Ridgetop Forest - DSF18 (OEH 2016)
Condition	Dense midstorey
TEC	EPBC Act only – Shale Sandstone Transition Forest of the Sydney Basin Bioregion
Impact area	3.02 ha
Plots	3
Vegetation Integrity Score	55.9
PCT selection criteria	Soil type, dominant canopy, midstorey and groundcover species, vegetation formation and class, IBRA subregion, landscape position
Diagnostic tools	Hager/Steenebeeke 2010 vegetation analysis tool, The Native Vegetation of Sydney Metropolitan Area 2016 V 3.1 diagnostic species list, BioNet Vegetation Classification, EPBC Act Approved Conservation Advice (including listing advice) for Shale Sandstone Transition Forest of the Sydney Basin Bioregion EPBC Act diagnostic species list - Appendix A.
Description/ justification	Open woodland structure with a dense midstorey and lower abundance of groundcover species than in zone 1. Canopy species comprised primarily regrowth canopy species (in order of dominance): *Corymbia gummifera* (Red Bloodwood) *Eucalyptus punctata* (Grey Gum), *Eucalyptus sparsifolia* (Narrow-leaved Stringybark), *Corymbia eximia* (Yellow Bloodwood), *Angophora bakeri* (Narrow-leaved Apple), *Angophora costata* (Sydney Red Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus resinifera* (Red Mahogany), *Eucalyptus haemastoma (*Scribbly Gum*)* and *Eucalyptus squamosa* (Scaly Bark). Older hollow bearing trees of a range of diameters were scattered throughout the zone. Midstorey species were dense creating a closed structure and comprised primarily *Allocasuarina littoralis* (Black She-oak), regrowth *Angophora bakeri* (Narrow-leaved Apple), *Corymbia eximia* (Yellow Bloodwood) and *Corymbia gummifera* (Red Bloodwood), *Hakea sericea* (Needlebush), *Leucopogon muticus* (Blunt Beard-health) *Persoonia linearis* (Narrow-leaved Geebung), and *Leptospermum trinervium* (Flaky-barked Tea-tree). The native groundcover was relatively sparse compared to zone 1 and comprised *Austrostipa pubescens, Anisopogon avenaceus* (Oat Speargrass), *Cyathochaeta diandra, Entolasia stricta* (Wiry Panic), *Entolasia marginata (*Bordered Panic), *Hovea linearis, Mirbelia rubifolia* (Heathy Mirbelia), *Themeda triandra* (Kangaroo Grass), *Bossiaea obcordata* (Spiny Bossiaea), *Lomandra obliqua, Lomandra multiflora,* (Many-flowered Mat-rush), *Lomandra glauca* (Pale Mat-rush), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush), *Phyllanthus hirtellus* (Thyme Spurge) and *Xanthorrhoea media* (Grass Tree). Soil had a distinctive clay texture with no sandstone outcropping in the core areas. Sandstone outcropping was confined to the edges of the community where it transitioned to PCTs 1328 and 1181. As per zone 1 a quantitative analysis of the plot data was undertaken with the best fit PCT corresponding to Hinterland Transition Woodland.

VEGETATION ZONE 2	
Photo	

Table 13: PCT 1083 Vegetation Zone 3

VEGETATION ZONE 3	
PCT	1083
PCT Name	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion
PCT name other (if applicable)	Sydney North Exposed Sandstone Woodland - DSF11 (OEH 2016)
Condition	Dense heathy understorey
TEC	N/A
Impact area	1.95 ha
Plots	1
Vegetation Integrity Score	46
PCT selection criteria	Soil type, dominant canopy, midstorey and groundcover species, vegetation formation and class, IBRA subregion, landscape position
Diagnostic tools	Hager/Steenebeeke 2010 vegetation analysis tool, The Native Vegetation of Sydney Metropolitan Area 2016 V 3.1 diagnostic species lists, BioNet Vegetation Classification.
Description/ justification	This PCT was positioned on the exposed sandstone plateau in the very west of the development site. The soil in this zone had a distinctive sandy texture, and sandstone outcropping was very common throughout the zone. A quantitative analysis of plot data was undertaken using the Hager/Steenebeeke 2010 vegetation analysis tool, with the best fit PCT corresponding quite clearly to PCT 1083. Due to the dense sclerophyll midstorey and position in the landscape (i.e. located on a sandstone plateau), whether the PCT corresponded to the TEC Coastal Upland Swamp in the Sydney Basin Bioregion was also considered (i.e. PCT 1134 Scribbly Gum - Hairpin Banksia - Dwarf Apple heathy woodland on hinterland sandstone plateaux of the Central Coast, Sydney Basin Bioregion). It was determined that due to the structure of the community (dense midstorey with consistent eucalypt canopy comprising a variety of species although relatively more spaced than neighbouring PCTs), sedges present although not dominating the midstorey and groundcover, and the lack of evidence of impeded drainage within the zone that the PCT most appropriately aligned to a Dry Sclerophyll Forest (shrubby sub-formation) vegetation formation than a Heathland Vegetation Formation. Also, the quantitative analysis did not return a strong match to the heath and wet heath PCTs . The canopy species (in order of dominance) were *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia gummifera* (Red Bloodwood), *Corymbia eximia* (Yellow Bloodwood), *Eucalyptus sparsifolia* (Narrow-leaved Stringybark), *Angophora bakeri* (Narrow-leaved Apple), and *Eucalyptus punctata* (Grey Gum). Hollow bearing trees with hollows of a small to medium diameter were scattered throughout the zone and were uncommon. The midstorey/shrub layer was consistently dense creating a closed structure. Dominant species included *Banksia ericifolia* (Heath-leaved Banksia), *Angophora hispida* (Dwarf Apple), *Angophora bakeri* (Narrow-leaved Apple), *Banksia serrata* (Old Man Banksia), *Monotoca scorparia, Calytrix tetragona* (Common Fringe Myrtle), *Grevillea buxifolia* (Grey Spider Flower), *Grevillea sericea* (Red Spider Flower), *Isopogon anethifolius* (Narrow-leaved Drumstick), *Petrophile pulchella* (Conesticks), *Leucopogon muticus* (Blunt Beard-health), and *Leptospermum trinervium* (Flaky-barked Tea-tree). The native groundcover/lower shrub layer was relatively sparse due to the dense shrub layer, however very diverse. Dominant species included *Austrostipa pubescens, Caustis flexuosa* (Curly Wig), *Cyathochaeta diandra, Entolasia stricta* (Wiry Panic), *Entolasia marginata (*Bordered Panic), *Leyprodia scariosa, Lepidosperma laterale, Lomandra obliqua, Leucopogon microphyllus* var. *microphyllus, Lomandra multiflora,* (Many-flowered Mat-rush), *Lomandra glauca* (Pale Mat-rush), *Lomandra filiformis* subsp.

VEGETATION ZONE 3	
	filiformis (Wattle Mat-rush), *Lomatia silaifolia* (Crinkle Bush), *Phyllanthus hirtellus* (Thyme Spurge) and *Xanthorrhoea media* (Grass Tree).
Photo	

Table 14: PCT 1083 Vegetation Zone 4

VEGETATION ZONE 4	
PCT	1083
PCT name	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion
PCT name other (if applicable)	Sydney North Exposed Sandstone Woodland - DSF11 (OEH 2016)
Condition	Open understorey
TEC	N/A
Impact rea	1.32 ha
Plots	1
Vegetation Integrity Score	65.2
PCT selection criteria	Soil type, dominant canopy, midstorey and groundcover species, vegetation formation and class, IBRA subregion, landscape position
Diagnostic tools	Hager/Steenebeeke 2010 vegetation analysis tool, The Native Vegetation of Sydney Metropolitan Area 2016 V 3.1 diagnostic species list, BioNet Vegetation Classification species tool.
Description/ justification	This PCT was positioned on the upper slope of an exposed gently sloping sandstone gully. The soil in this zone had a sandy texture, and sandstone outcropping was dominant throughout the zone. A quantitative analysis of plot data was undertaken using the Hager/Steenebeeke 2010 vegetation analysis tool, with the best fit PCT corresponding quite strongly to PCT 1083. A quantitative analysis of the plot data using the BioNet Vegetation Classification species tool was also undertaken, with a clear match to PCT 1083 based on species composition and IBRA subregion. Due to position in the landscape (i.e. located on a sandstone plateau), and observations of the woodland structure (i.e. a relatively sparse Eucalypt cover and fairly shrubby understorey), that the PCT corresponded to the TEC Coastal Upland Swamp in the Sydney Basin Bioregion was also considered (i.e. PCT 1134 Scribbly Gum - Hairpin Banksia - Dwarf Apple heathy woodland on hinterland sandstone plateaux of the Central Coast, Sydney Basin Bioregion). It was determined that the structure of the community aligned more with a woodland than a heath (i.e. the Eucalypt canopy, although more open than surrounding PCTs comprised a variety of species and was consistent throughout the zone), sedges were present although not dominating the midstorey and groundcover, also the species of sedges are commonly occurring sedges in woodland communities. There was also no strong evidence of impeded drainage within the zone. The PCT more appropriately aligned to a Dry Sclerophyll Forest (shrubby sub-formation) vegetation formation than a Heathland Vegetation Formation. Finally, the quantitative analysis using both PCT analysis tools (i.e. Sydney Metro tool and BioNet Vegetation Classification) did not return a strong match to the heath and wet heath PCTs. The canopy species (in order of dominance) were *Eucalyptus haemastoma* (Scribbly Gum), *Corymbia eximia* (Yellow Bloodwood), *Corymbia gummifera (Red Bloodwood), Eucalyptus sparsifolia* (Narrow-leaved Stringybark), *Angophora bakeri* (Narrow-leaved Apple), and *Eucalyptus punctata* (Grey Gum). Hollow bearing trees with hollows of a small to medium diameter were scattered throughout the zone and were uncommon. The midstorey/shrub layer was consistently an open structure. Dominant species included *Banksia ericifolia* (Heath-leaved Banksia), *Angophora hispida* (Dwarf Apple), *Banksia serrata* (Old Man Banksia), *Banksia oblongifolia, Calytrix tetragona* (Common Fringe Myrtle), *Grevillea buxifolia* (Grey Spider Flower), *Grevillea sericea* (Red Spider Flower), *Petrophile pulchella* (Conesticks), and *Leptospermum trinervium* (Flaky-barked Tea-tree). The native groundcover/lower shrub layer was relatively sparse due to the dense shrub layer, however very diverse. Dominant species included *Austrostipa pubescens, Cyathochaeta diandra, Entolasia stricta*

VEGETATION ZONE 4	
	(Wiry Panic), *Entolasia marginata (*Bordered Panic), *Leyprodia scariosa, Lepidosperma laterale, Lomandra obliqua, Leucopogon microphyllus* var. *microphyllus, Lomandra glauca* (Pale Mat-rush), *Lomatia silaifolia* (Crinkle Bush), *Phyllanthus hirtellus* (Thyme Spurge) and *Xanthorrhoea media* (Grass Tree).
Photo	

Table 15: PCT 1328 Vegetation Zone 5

VEGETATION ZONE 5	
PCT	1328
PCT name	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion
PCT name other (if applicable)	Sydney North Exposed Sandstone Woodland - DSF11 (OEH 2016)
Condition	open understorey
TEC	N/A
Impact area	10.22 ha
Plots	4
Vegetation Integrity Score	52.5
PCT selection criteria	Soil type, dominant canopy, midstorey and groundcover species, vegetation formation and class, IBRA subregion, landscape position
Diagnostic tools	Hager/Steenebeeke vegetation analysis tool, The Native Vegetation of Sydney Metropolitan Area 2016 V 3.1 diagnostic species list, BioNet Vegetation Classification.
Description/ justification	Very sandy soils with sandstone outcropping very prominent throughout the zone (dominant in places), except on the upslope edges of the community where it transitioned into the clay soils of PCT 1081. A quantitative analysis of all plot data was undertaken using the Hager/Steenebeeke vegetation analysis tool, with the best fit PCT corresponding to PCT 1083, however based on dominant canopy species (*Corymbia eximia, Eucalyptus sparsifolia, Eucalyptus haemastoma, Angophora bakeri and Corymbia gummifera*) and the IBRA subregion, it was assigned to 1328. The community comprised a very open woodland, dominated by sandstone outcropping, with a moderately dense midstorey in soil deposits between rock outcrops. The canopy species (in order of dominance) were *Corymbia eximia* (Yellow Bloodwood), *Eucalyptus punctata* (Grey Gum), *Angophora bakeri* (Narrow-leaved Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus sparsifolia* (Narrow-leaved Stringybark), and *Eucalyptus haemastoma (*Scribbly Gum*)*). Hollow bearing trees with hollows of a small to medium diameter were scattered throughout the zone and were not common. Dominant midstorey species included *Angophora hispida* (Dwarf Apple), *Angophora bakeri* (Narrow-leaved Apple), *Banksia serrata* (Old Man Banksia), *Banksia marginata* (Silver Banksia), *Monotoca scorparia, Lambertia formosa* (Mountain Devil), *Calytrix tetragona* (Common Fringe Myrtle), *Grevillea buxifolia* (Grey Spider Flower), *Grevillea sericea* (Red Spider Flower), *Hakea dactyloides* (Finger Hakea), *Isopogon anethifolius* (Narrow-leaved Drumstick), *Petrophile pulchella* (Conesticks), *Leucopogon muticus* (Blunt Beard-health), and *Leptospermum trinervium* (Flaky-barked Tea-tree). The native groundcover/lower shrub layer was relatively sparse (however very diverse) due to the dominance of the rock outcrops. Dominant species included *Austrostipa pubescens, Caustis flexuosa* (Curly Wig), *Cyathochaeta diandra, Entolasia stricta* (Wiry Panic), *Entolasia marginata (*Bordered Panic), *Leyprodia scariosa, Lepidosperma laterale, Lomandra obliqua, Leucopogon microphyllus* var. *microphyllus, Lomandra multiflora,* (Many-flowered Mat-rush), *Lomandra glauca* (Pale Mat-rush), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush), *Ptilothrix deusta*, *Phyllanthus hirtellus* (Thyme Spurge) and *Xanthorrhoea media* (Grass Tree).

VEGETATION ZONE 5	
Photo	

Table 16: PCT 1328 Vegetation Zone 6

VEGETATION ZONE 6	
PCT	1328
PCT name	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion
PCT name other (if applicable)	Sydney North Exposed Sandstone Woodland - DSF11 (OEH 2016)
Condition	heathy understorey
TEC	N/A
Area	3.58 ha
Plots	4
Vegetation Integrity Score	64
PCT selection criteria	Soil type, dominant canopy, midstorey and groundcover species, vegetation formation and class, IBRA subregion, landscape position
Diagnostic tools	Hager/Steenebeeke 2010 vegetation analysis tool, The Native Vegetation of Sydney Metropolitan Area 2016 V 3.1 diagnostic species list, BioNet Vegetation Classification.
Description/ justification	Very sandy soils with sandstone outcropping common throughout the zone A quantitative analysis of all plot data was undertaken using the Hager/Steenebeeke vegetation analysis tool, with the best fit PCT corresponding to PCT 1083, however based on dominant canopy species (*Corymbia eximia, Eucalyptus sparsifolia, Eucalyptus haemastoma, Angophora bakeri and Corymbia gummifera*) and the IBRA subregion, it was assigned to 1328. The community comprised a very open woodland, dominated by sandstone outcropping, with a denser midstorey than zone 4. The canopy species (in order of dominance) were *Corymbia eximia* (Yellow Bloodwood), *Eucalyptus punctata* (Grey Gum), *Angophora bakeri* (Narrow-leaved Apple), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus sparsifolia* (Narrow-leaved Stringybark), and *Eucalyptus haemastoma (*Scribbly Gum*)*). Hollow bearing trees with hollows of a small to medium diameter were scattered throughout the zone and were not common. The midstorey was considerably denser than zone 4, although contained similar species. Dominant midstorey species included *Angophora hispida* (Dwarf Apple), *Angophora bakeri* (Narrow-leaved Apple), *Banksia serrata* (Old Man Banksia), *Banksia marginata* (Silver Banksia) *Monotoca scorparia, Lambertia formosa* (Mountain Devil), *Calytrix tetragona* (Common Fringe Myrtle), *Grevillea buxifolia* (Grey Spider Flower), *Grevillea sericea* (Red Spider Flower), *Hakea dactyloides* (Finger Hakea), *Isopogon anethifolius* (Narrow-leaved Drumstick), *Petrophile pulchella* (Conesticks), *Leucopogon muticus* (Blunt Beard-health), and *Leptospermum trinervium* (Flaky-barked Tea-tree). The native groundcover/lower shrub layer was relatively sparse (however very diverse) due to the presence of rock outcrops. Dominant species included *Austrostipa pubescens, Caustis flexuosa* (Curly Wig), *Cyathochaeta diandra, Entolasia stricta* (Wiry Panic), *Entolasia marginata (*Bordered Panic), *Leyprodia scariosa, Lepidosperma laterale, Lomandra obliqua, Leucopogon microphyllus* var. *microphyllus, Lomandra multiflora,* (Many-flowered Mat-rush), *Lomandra glauca* (Pale Mat-rush), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush), *Ptilothrix deusta*, *Phyllanthus hirtellus* (Thyme Spurge) and *Xanthorrhoea media* (Grass Tree).

VEGETATION ZONE 6	
Photo	

Table 17: PCT 1181 Vegetation Zone 7

VEGETATION ZONE 7	
PCT	1181
PCT name	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion
PCT name other (if applicable)	Hinterland Sandstone Gully Forest – DSFp142 (Tindall et al.))
Condition	Good
TEC	N/A
Impact area	8.17 ha
Plots	4
Vegetation Integrity Score	59.4
PCT selection criteria	Soil type, dominant canopy, midstorey and groundcover species, vegetation formation and class, IBRA subregion, aspect, landscape position
Diagnostic tools	Hager/Steenebeeke 2010 vegetation analysis tool, The Native Vegetation of Sydney Metropolitan Area 2016 V 3.1 diagnostic species list, BioNet Vegetation Classification.
Description/ justification	Occurs along the south facing gully slopes, and along the riparian areas in the west of the development site and outside the development site to the north, north-west south and south-west. Soils are typically sandy with sandstone outcropping common throughout the zone except on the upslope edges of the community where it transitions into the clay soils of PCT 1081. A quantitative analysis of all plot data was undertaken using the Hager/Steenebeeke 2010 vegetation analysis tool. Whilst the analysis did not return 1181 as the 'best fit' in terms of species diversity, the sheltered position in the landscape, aspect, community structure, dominant canopy species and IBRA subregion provides the justification to assign the vegetation to PCT 1181. The community comprised an open woodland to open forest with a moderately dense midstorey and groundcover layer. The canopy species (in order of dominance) were *Angophora costata* (Sydney Red Cum), *Eucalyptus piperita* (Sydney Peppermint), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus punctata* (Grey Gum), *Corymbia eximia* (Yellow Bloodwood), *Angophora bakeri* (Narrow-leaved Apple), *Eucalyptus sparsifolia* (Narrow-leaved Stringybark), and *Eucalyptus haemastoma (*Scribbly Gum*)*). Hollow bearing trees with hollows of a small to large diameter were scattered throughout the zone and were relatively common in parts. Dominant midstorey species included *Ceratopetalum gummiferum* (Christmas Bush), *Angophora bakeri* (Narrow-leaved Apple), *Banksia serrata* (Old Man Banksia), *Banksia spinulosa* (Hairpin Banksia), *Monotoca scorparia, Hakea sericea* (Needlebush) *Grevillea buxifolia* (Grey Spider Flower), *Grevillea sericea* (Red Spider Flower), *Hakea dactyloides* (Finger Hakea), *Boronia ledifolia* (Showy Boronia), *Boronia pinnata*, *Isopogon anemonifolius* (Broad-leaved Drumstick), *Petrophile pulchella* (Conesticks), *Leucopogon muticus* (Blunt Beard-health), and *Leptospermum trinervium* (Flaky-barked Tea-tree). The native groundcover/lower shrub layer was relatively abundant and diverse. Dominant species included *Austrostipa pubescens, Brunoniella pumilio* (Dwarf Brunoniella), *Caustis flexuosa* (Curly Wig), *Cyathochaeta diandra, Entolasia stricta* (Wiry Panic), *Entolasia marginata (*Bordered Panic), *Lindsaea linearis* (Screw Fern), *Lepidosperma laterale, Lomandra obliqua, Leucopogon microphyllus* var. *microphyllus, Lomandra multiflora,* (Many-flowered Mat-rush), *Lomandra glauca* (Pale Mat-rush), *Lomandra filiformis* subsp. *filiformis* (Wattle Mat-rush), *Ptilothrix deusta*, *Phyllanthus hirtellus* (Thyme Spurge), *Scaevola ramosissima* (Purple Fan-flower) and *Xanthosia pilosa* (Woolly Xanthosia).

VEGETATION ZONE 7	
Photo	

1.4.2 Threatened Ecological Communities

TECs present within the subject land and development site are summarised in Table 18 and displayed above in Figure 11. Section 1.4.2.1 and 1.4.2.2 below provides further detail of the EPBC Act listed *Shale Sandstone Transition Forest of the Sydney Basin* Bioregion and BC Act listed *Maroota Sands Swamp Forest.*

Table 18: Threatened Ecological Communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Area (ha)	Listing status	Name	Area (ha)
1081	Not listed	N/A	N/A	Critically Endangered	Shale Sandstone Transition Forest of the Sydney Basin Bioregion	25.71 ha within development footprint. 28.8 ha within the development site. 35.7 ha with subject land.
923	Endangered	Maroota Sands Swamp Forest	1.6 ha within the subject land	Not Listed	N/A	N/A.

1.4.2.1 Shale Sandstone Transition Forest of the Sydney Basin Bioregion

Through detailed analysis, it was determined that PCT 1081 (i.e. Hinterland Transition Woodland) does correspond with the Commonwealth EPBC Act definition of *Shale Sandstone Transition Forest of the Sydney Basin Bioregion.* The PCT is not aligned with the NSW BC Act definition of *Shale Sandstone Transition Forest in the Sydney Basin Bioregion*: "*There are currently no TECs associated with this PCT. It is similar to Shale Sandstone Transition Forest but occurs on a quartz-rich soil and has more Proteaceae shrubs*"- as stated in the BioNet Vegetation Classification (accessed 20 July 2020). A full discussion and justification with regards to this is provided below.

NSW Biodiversity Conservation Act 2016

As discussed, the predominant vegetation community in the development site can be categorised as Sydney Hinterland Transition Woodland - PCT 1081 *Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion*. PCT 1081 occurs around the edges of the Cumberland Plain and it is known to occur in the Maroota-Dural area. This best-fit PCT was determined using a quantitative analysis of floristic plot data from five sample plots undertaken in the vegetation community, and a qualitative analysis of the site's characteristics (such as soil type, position in the landscape, and elevation). The quantitative analysis resulted in a very strong match to PCT 1081 based purely on the species in the plots. This sites' characteristics (soil type, landscape position etc.) also provided a good justification for assigning this vegetation to PCT 1081.

From this analysis it was confidently determined that the vegetation community does not conform to the NSW definition of Shale Sandstone Transition Forest in the Sydney Basin Bioregion, listed as a critically endangered ecological community under the BC Act.

Commonwealth Environment Protection Biodiversity Conservation Act 1999

The approved conservation and listing advice for the Commonwealth definition of *Shale Sandstone Transition Forest of the* Sydney *Basin Bioregion* was consulted to determine if PCT 1081 within the development site still corresponds with the Commonwealth definition of Shale Sandstone Transition Forest. Appendix C page 29 of the approved conservation advice states *'if a patch mapped as DSF p146 Sydney Hinterland Transition Woodland (Tozer 2010) meets the description of Shale Sandstone Transition Forest, it is considered the ecological community'*.

The Commonwealth defines the community more broadly than does the NSW BC Act. The conservation advice states that the transitional nature of the community means that its character is not simple to describe, and that particular plant species are considered to be strongly indicative of the community. The presence of a considerable number of these species, combined with the abiotic factors of landscape, soil substrate and adjacent vegetation communities can assist in the identification of the community.

From a qualitative analysis based on the presence of abiotic and biotic factors, and a quantitative analysis of the species present with the vegetation community, it has been determined that PCT 1081 does correspond with the Commonwealth definition of Shale Sandstone Transition Forest.

Summary of analysis

Below is a summary of the analysis undertaken to determine if PCT 1081 within the development site does conform to the Commonwealth definition of *Shale Sandstone Transition Forest*.

Abiotic Factors

In relation to the site, the following abiotic factors are consistent with the Commonwealth definition:

- The ecological community is found on the sandstone dominated Hornsby plateau that adjoins the Cumberland Plain
- The soil at the site is derived from a shale substrate and has a clay texture
- In this instance the ridges of the Hornsby plateau have uplifted from exposing remnant shales caps
- Average annual rainfall for Maroota is 911.4 mm (BOM 2020 http://www.bom.gov.au/jsp/ncc/cdio/wData/wdata?p_nccObsCode=139&p_display_type=dataFile&p_stn_num=067014) – the conservation advice states that Shale Sandstone Transition Forest generally occurs in areas receiving between 800mm and 1100mm mean average rainfall (Tozer 2010)
- Maroota is approximately 200 above sea level (ASL) – the conservation advice states that Shale Sandstone Transition Forest typically occurs at elevations less than 200m ASL, however it may occur up to 250 m ASL in parts of the lower Blue Mountains and western Woronora Plateau and may also occur at approximately 300m ASL at its southern limit in the Southern Highlands.

Biotic Factors - Vegetation

Canopy
The conservation advice states: 'The canopy is a mix of native tree species typically including two or more of the following: *Eucalyptus punctata* (Grey Gum), *E. crebra* (Narrow-leaved Ironbark), *E. fibrosa* subsp. *fibrosa*(Broad-leaved Ironbark), *E. tereticornis* subsp*. tereticornis* (Forest Red Gum), *E. resinifera* subsp*. resinifera* (Red Mahogany), *E. eugenioides* (or *E. globoidea* depending on local species present and degree of sandstone influence) and *Angophora bakeri* (Narrow-leaved Apple).

On the site, the canopy comprises three of these diagnostic canopy species including:

- *Eucalyptus punctata* (Grey Gum)
- *Eucalyptus resinifera* (Red Mahogany)
- *Angophora bakeri* (Narrow – leaved Apple).

The canopy also comprised the following species which are also listed as characteristic plant species in Appendix A of the conservation/listing advice:

- *Angophora costata* (Sydney Red Gum)
- *Syncarpia glomulifera* (Turpentine)
- *Corymbia gummifera* (Red Bloodwood)
- *Corymbia eximia* (Yellow Bloodwood).

Mid Storey

Small Tree and Shrub Layer

The conservation/listing advice states that Eucalypts and *Allocasuarina littoralis* (Black She-oak) and *Syncarpia glomulifera* (Turpentine) dominate the midstorey – small tree stratum layer. This was the case within the development site with *Allocasuarina littoralis* at times very dominant in the small tree layer. *Syncarpia glomulifera* (Turpentine) was observed in patches within the community. There were also many small and regenerating eucalypts occurring such as *Eucalyptus squamosa* (Scaly Bark), *Eucalyptus sparsifolia* (Narrow-leaved Stringy Bark) and *Angophora bakeri* (Narrow -leaved Apple). *Persoonia linearis* (Narrow-leaved Geebung) occurs commonly in the community and this is listed as a common species in the conservation advice.

Ground Layer

The conservation/listing advice states: 'The ground layer is often diverse and dominated by grasses and herbs including *Aristida vagans* (Three-awned Spear Grass), *Austrostipa pubescens* (Spear Grass), *Cheilanthes sieberi subsp. sieberi* (Poison Rock Fern), *Dichondra repens* (Kidney Weed), *Echinopogon ovatus* (Forest Hedgehog Grass), *Entolasia marginata* (Bordered Panic), *Entolasia stricta* (Wiry Panic), *Lepidosperma laterale* (Saw Sedge), *Lomandra multiflora, Microlaena stipoides var. stipoides* (Weeping Grass), *Oxalis perennans* (Wood-sorrel), *Pimelea linifolia subsp. linifolia, Phyllanthus hirtellus, Pomax umbellata, Pratia purpurascens* (White Root), *Solanum prinophyllum* (Forest Nightshade) and *Themeda triandra syn T. australis* (Kangaroo Grass)'.

On the site the following ground cover species from the above list were found:

- *Austrostipa pubescens* (very common)
- *Entolasia stricta* (very common)
- *Entolasia marginata*
- *Aristida vagans*
- *Lepidosperma laterale (very common)*
- *Lomandra multiflora* (very common)
- *Themeda triandra* (very common).

Quantitative Analysis of species occurring in the plot

A quantitative analysis was undertaken for each plot based on the species list provided in Appendix A of the conservation/listing advice. It was found that on average 40% of the species occurring in the plots were diagnostic species for the Commonwealth definition of Shale Sandstone Transition Forest.

1.4.2.2 Maroota Sands Swamp Forest

The field assessment identified *Maroota Sands Swamp Forest,* listed as endangered ecological community under the BC Act. This community is a groundwater dependent ecosystem and located outside the development site is described below in Table 19.

Table 19: PCT 923 Vegetation Zone 8

VEGETATION ZONE 8	
PCT	923
PCT Name	Melaleuca linariifolia - Swamp Mahogany swamp forest in drainage lines of the edges of the Cumberland Plain, Sydney Basin Bioregion
Condition	Good
TEC	Maroota Sands Swamp Forest
Area	1.6 ha
Plots	NA (outside the development site therefore plots not undertaken)
Vegetation Integrity Score	NA
PCT Selection criteria	Soil type, dominant canopy, midstorey and groundcover species, vegetation formation and class, IBRA subregion, aspect, landscape position
Description/ justification	A forested wetland community occurring on sandy clay alluvium along drainage lines. It occurs below 50m along the margins of the Cumberland Plain. This community occurs outside the development site, within the subject land directly to the north of the development footprint. Dominated by *Eucalyptus robusta* (Swamp Mahogany) in the canopy. Dominant midstorey species included *Melaleuca linariifolia* (Flax-leaved Paperbark), *Glochidion ferdinandi* (Cheese Tree), *Cyathea australis* (Black Tree-fern), *Trema tomentosa* var. *aspera* (Peach-leaf Poison-bush) *Callicoma serrulata* (Black Wattle) and *Acacia parramattensis* (Parramatta Wattle). The native groundcover/lower shrub layer comprised ferns *Hypolepsis muelleri* (Harsh Ground Fern), *Gleichenia microphylla* (Scrambling Coral Fern), *Schoenus melanostachys* (Black Bog-rush), *Gahnia sieberiana* (Red-fruit Saw-sedge), *Pteridium esculentum* (Bracken), *Calochlaena dubia* (Rainbow Fern, *Entolasia marginata* (Bordered Panic) and *Glycine tabacina* (Variable Glycine) .
Photo	

1.4.3 Vegetation integrity assessment

A vegetation integrity assessment using the Credit Calculator (BAMC) was undertaken and the results are outlined in Table 20.

Table 20: Vegetation integrity

Veg Zone	PCT ID	Condition	Area in development footprint (ha)	Composition Condition Score	Structure Condition Score	Function Condition Score	Current vegetation integrity score
1	1081	Open understorey	22.69	70.1	40.7	60.1	55.5
2	1081	Dense midstorey	3.02	81.4	26.7	80.3	55.9
3	1083	Heathy understorey	1.95	85.1	51.4	22.2	46
4	1083	Open understorey	1.32	91.3	67.5	45	65.2
5	1328	Open understorey	10.22	79.5	35.5	50.4	52.2
6	1328	Heathy understorey	3.58	94.9	62.1	44.5	64
7	1181	Good	8.17	98	28.6	74.9	59.4

1.4.4 Use of local data

The use of local data is not proposed as part of this assessment.

1.5 Fauna Habitat Assessment

During vegetation survey and site assessments, habitat features for threatened fauna were identified and mapped within the development site. This informed the methodology for targeted surveys. Habitat features of interest included:

- Hollow-bearing trees
- Nests
- Feed trees for birds and mammals
- Riparian areas and waterbodies
- Suitable roost trees for owls.

Hollow-bearing trees identified within the development site are displayed in Table 21 and Figure 14. Raw hollow-bearing tree data is provided in Appendix C.

1.6 Targeted flora and fauna survey methodology

The targeted flora and fauna survey methodology was undertaken in accordance with the following documents:

- *'Species credit' threatened bats and their habitats* (OEH 2018)
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft* (DEC 2004)
- *Surveying Threatened Plant and their Habitats - NSW Survey Guide for the Biodiversity Assessment Method* (DPIE 2020)
- *A review of koala tree use across New South Wales* (DPIE 2018).

The development site is a total of 61.92 ha and development footprint is 50.95 ha. Under the 2004 draft survey guidelines, minimum fauna survey effort is required per 50 ha unit, and an additional survey effort for each additional 100 ha. Therefore, the study area essentially contained one - two 'survey units'.

A combination of fauna survey methods was used and these included Anabat survey, spotlighting, call playback, stag watching, transect searches for snails and scats, and Koala Spot Assessment Technique. Flora transects and random meander surveys were considered to be suitable to assess a selected number of candidate species credit species. For species credit flora or fauna species considered likely to occur in the development site, where suitable techniques could not be implemented due to time constraints and BAM survey period constraints, these species were assumed to be present. These surveys also included incidental surveys for fauna species *Calyptorhynchus lathami* (Glossy Black Cockatoo) and *Callocephalon fimbriatum* (Gang Gang Cockatoo).

1.6.1 Microbat Survey

Microbat surveys were undertaken from 24 – 28 February 2020 within the development site and subject land. Microbat surveys were undertaken using four Anabat Swift ultrasonic detectors set over four nights (i.e. 16 survey nights).

The microbat survey targeted *Myotis macropus* (Southern Myotis), *Chalinolobus dwyeri* (Large-eared Pied Bat), and *Vespadelus troughtoni* (Eastern Cave Bat), all candidate species credit species. It is noted

that that the survey was undertaken outside of the BAM defined survey period for Large-eared Pied Bat and Eastern Cave Bat. One detector was set adjacent to dams and water bodies and in bushland near potential flyways. Due to one Anabat failing, a total of only 12 survey nights of survey were undertaken within the development site. The locations of the Anabat units are displayed in Figure 10. Detailed methodology and results of the microbat survey are provided in Appendix E.

1.6.2 Koala survey

Diurnal *Phascolarctos cinereus* (Koala) surveys were undertaken throughout the development site on 22 and 29 July 2020. Suitable habitat, as determined in accordance with *A review of koala tree use across New South Wales* (DPIE 2018), was searched for scats and scratch marks using techniques taken from the Spot Assessment Technique (SAT) (Phillips and Callaghan 2011) and parallel field traverses, with a separation width of approximately 10 m within areas of open vegetation and 5m in areas of dense vegetation. Scats collected during survey were analysed by Scats About. Survey effort is displayed in Figure 16.

Nocturnal Koala survey methods are detailed in Section 1.6.4.

1.6.3 Dural Land Snail diurnal survey

Surveys were undertaken in areas of vegetation identified as PCT 1081 within the development site on 22 and 29 July 2020. Searches for *Pommerhelix duralensis* (Dural Land Snail) shells or live individuals involved overturning leaf litter and logs across parallel field traverses with a separation width of approximately 10 m within areas of open vegetation and 5m in areas of dense vegetation. Photographs of shells collected during survey were analysed by Peter Ridgeway for confirmation of their identification. Survey effort is displayed in Figure 17.

1.6.4 Forest owl and arboreal mammal nocturnal surveys-spotlighting and call playback

Spotlighting and call playback were undertaken for the following fauna species:

- *Petaurus norfolcensis* (Squirrel Glider)
- *Phascogale tapoatafa* (Brush-tailed Phascogale)
- *Phascolarctos cinereus* (Koala)
- *Ninox strenua* (Powerful Owl)
- *Ninox connivens* (Barking Owl)
- *Tyto novaehollandiae* (Masked Owl).

Targeted surveys for these species were undertaken over eight nights over June and July 2020. On each night, survey involved an initial listening period of 10 to 15 minutes, followed by a spotlight search for 10 minutes, call playback for 5 minutes, followed by another 10 minute listening period for each of the above candidate species. Survey effort is displayed in Figure 18 and Figure 19.

Fauna species identified within the subject land and development site are provided in Appendix D.

1.6.5 Targeted flora survey

Where suitable habitat was identified for candidate threatened flora species, targeted flora surveys were undertaken in accordance with *NSW Guide to Surveying Threatened Plants* (DPIE 2020) and within the seasonal requirements outlined in the BAM Calculator and Threatened Biodiversity Data Collection. Targeted flora surveys involved parallel field traverses with a separation width of approximately 10 m

within areas of open vegetation and 5m in areas of dense vegetation. Survey effort is displayed in Figure 20.

Table 21: Hollow bearing tree data

Habitat tree	Quantity
Hollow-bearing trees - small	58
Hollow-bearing trees - medium	29
Hollow-bearing trees - large	28
Stag - small	29
Stag - medium	1
Stag - large	5
Total	**150**

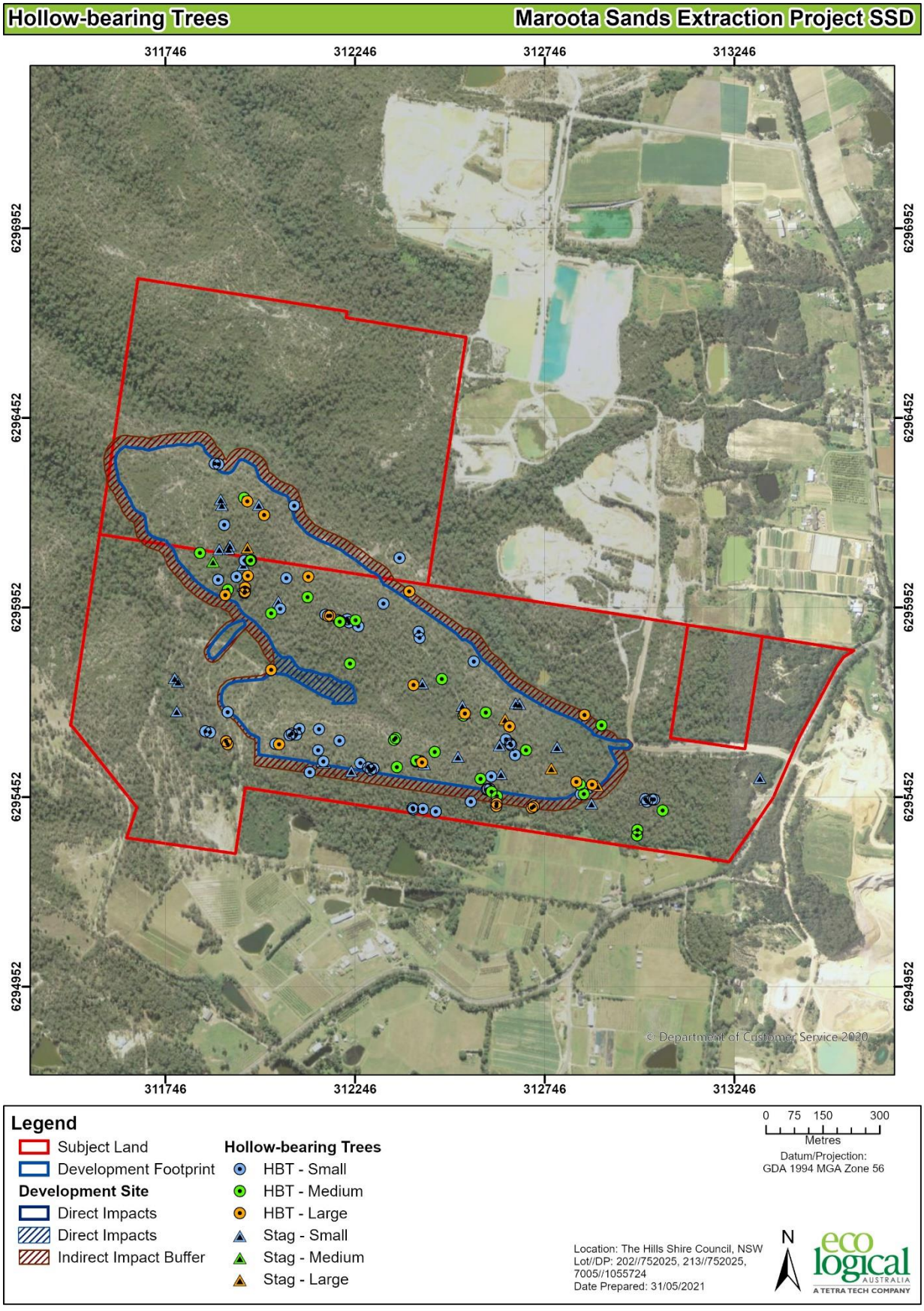


Figure 14: Hollow-bearing trees – survey results

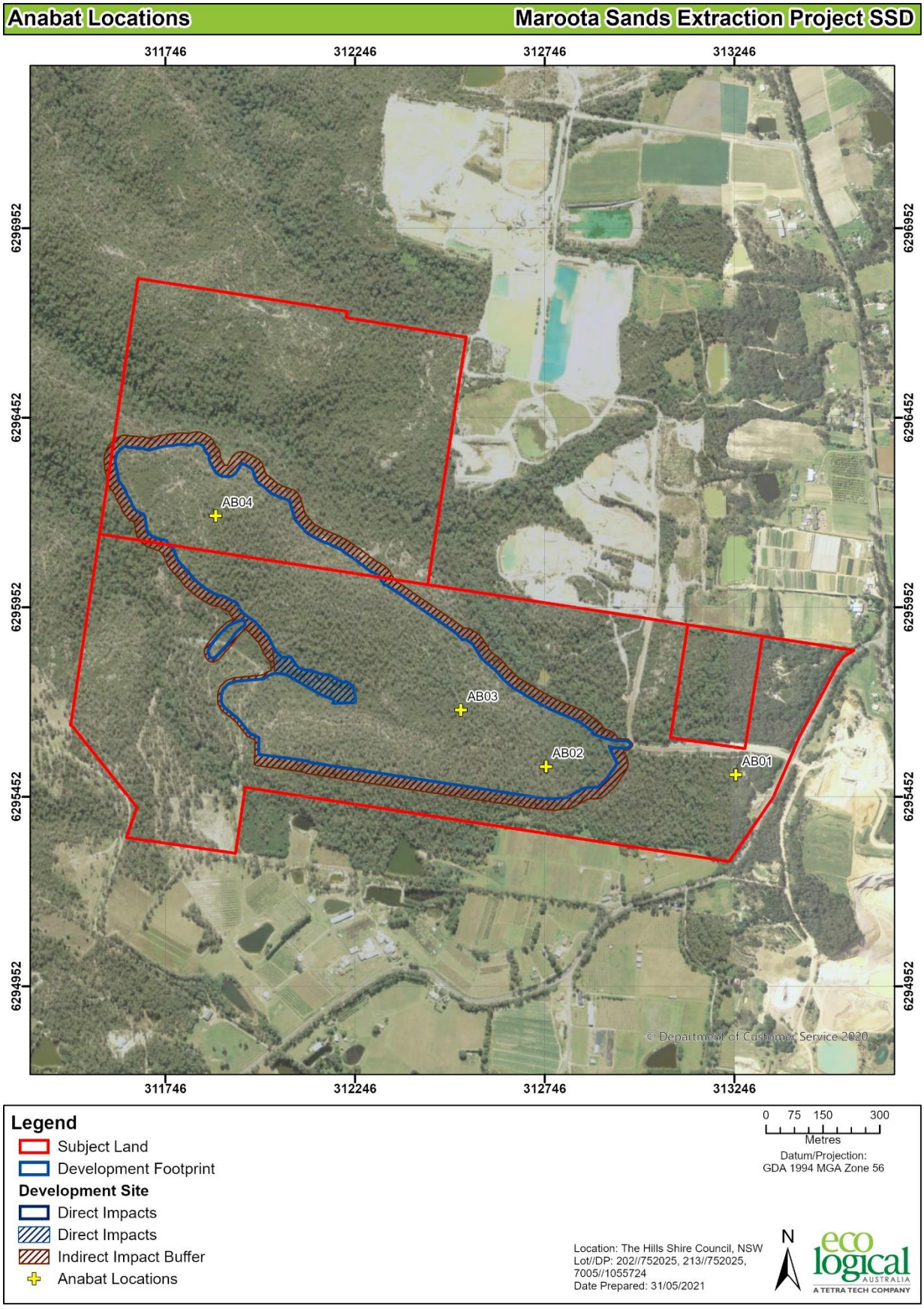


Figure 15: Anabat locations

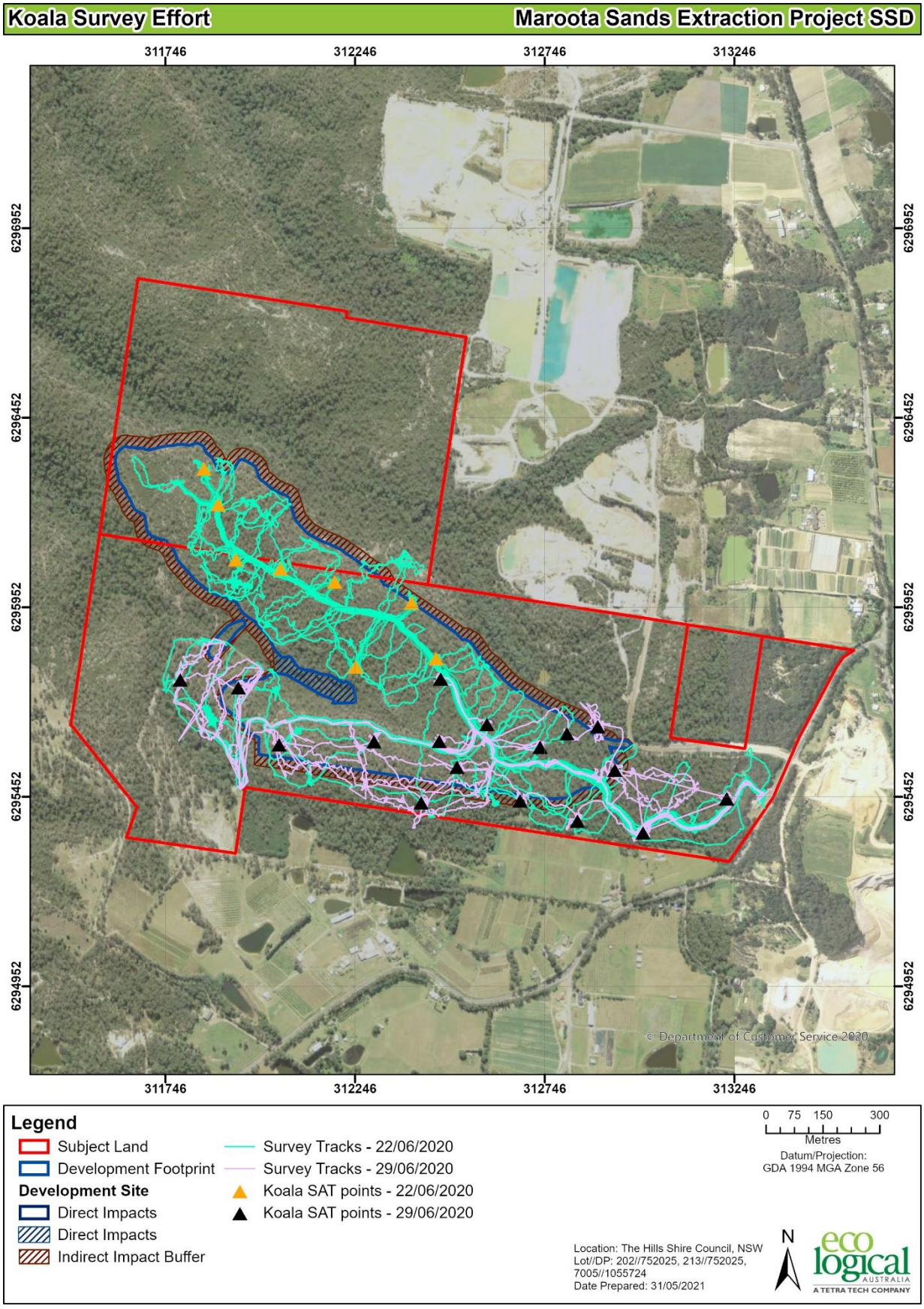


Figure 16: Koala – survey effort

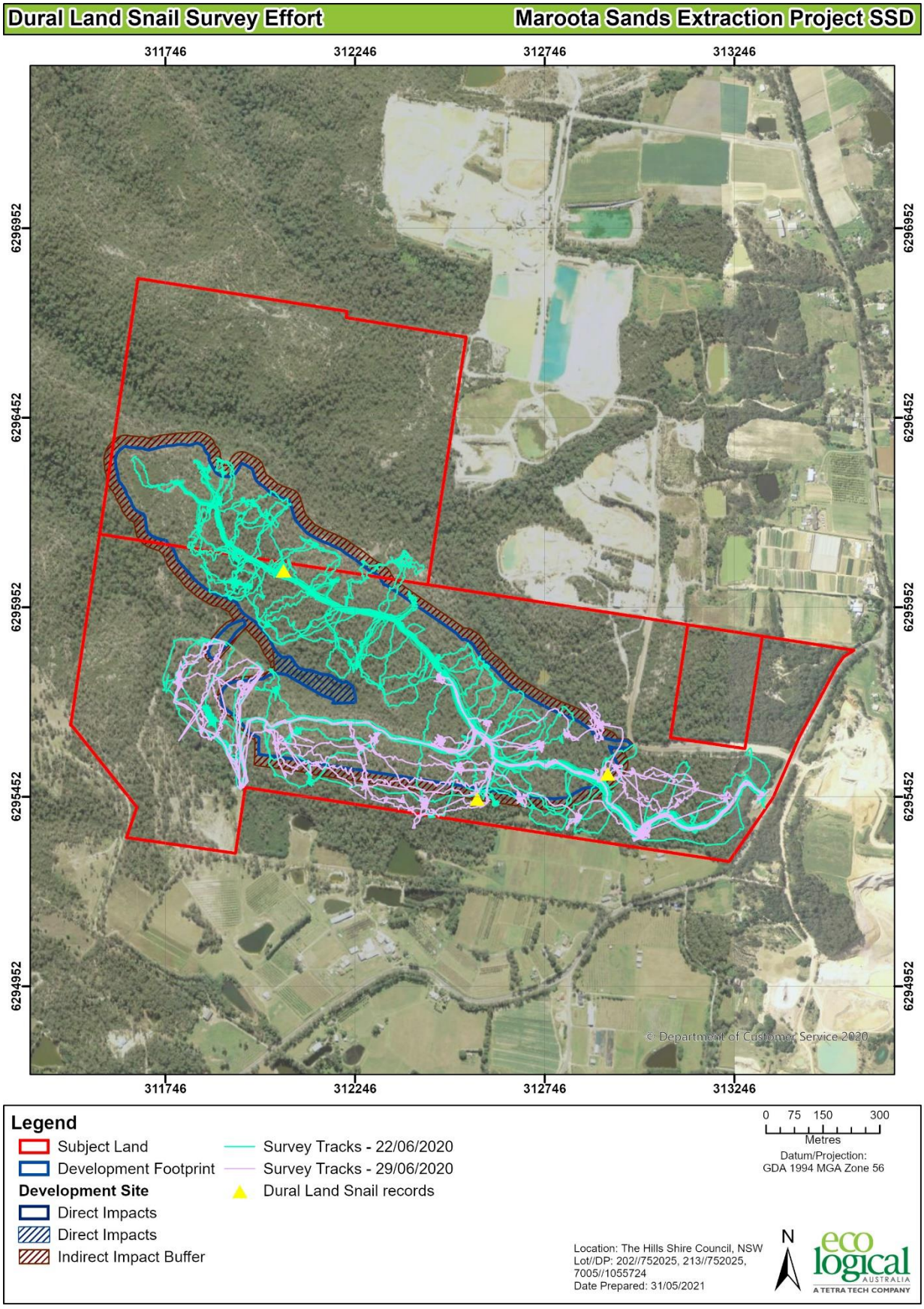


Figure 17: Dural Land Snail – survey effort

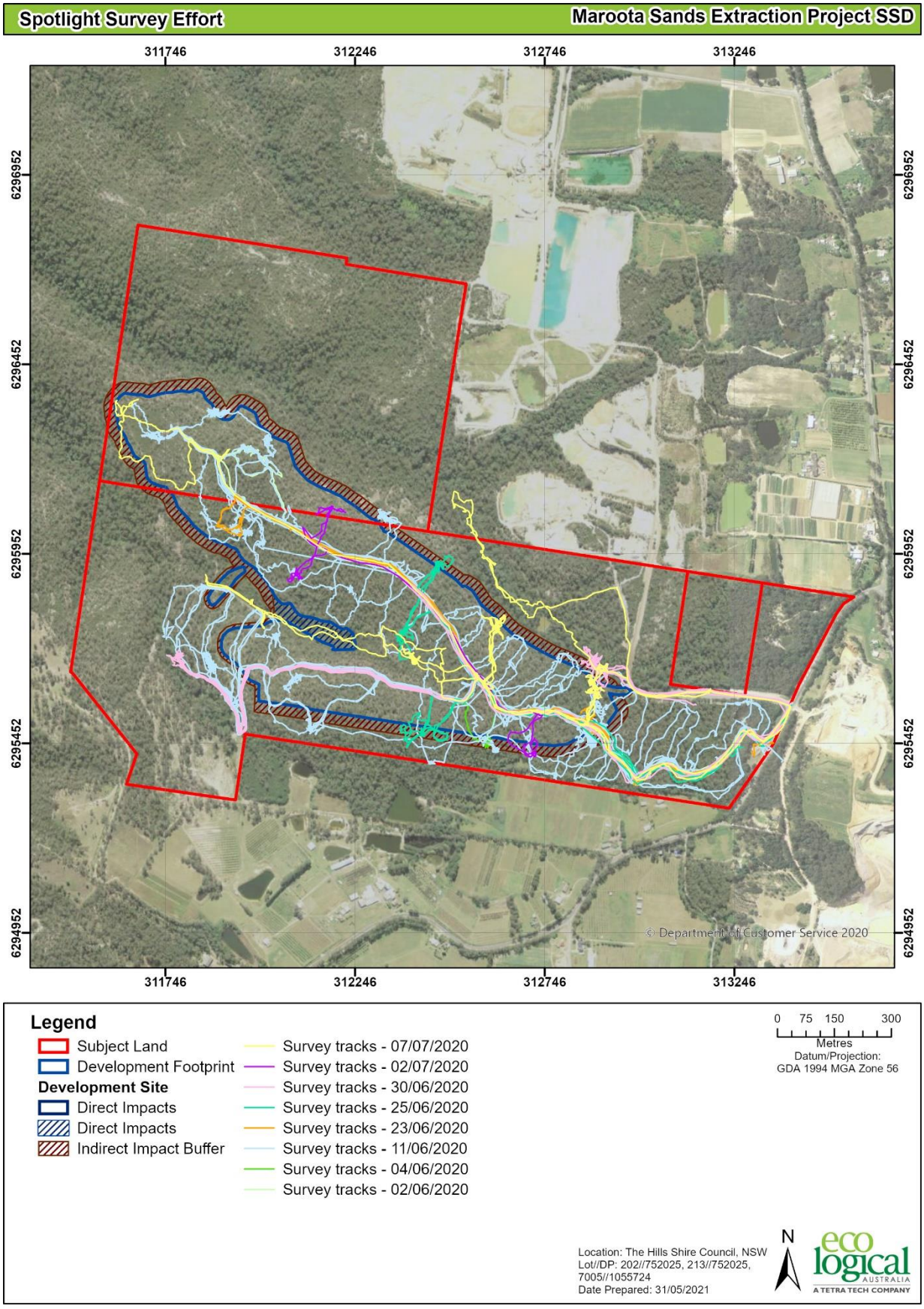


Figure 18: Spotlighting and call playback – survey effort - tracks

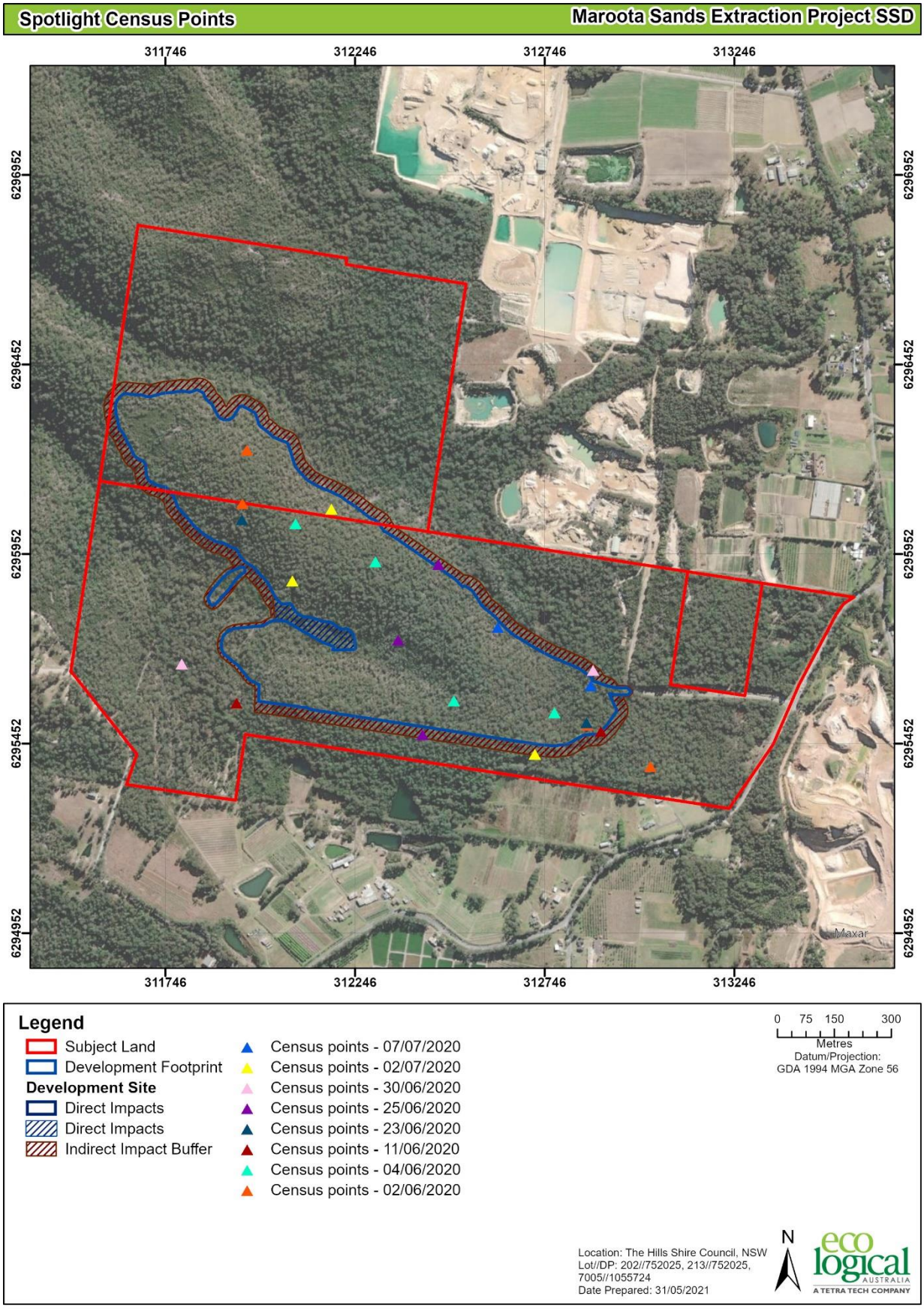


Figure 19: Spotlighting and call playback – census point

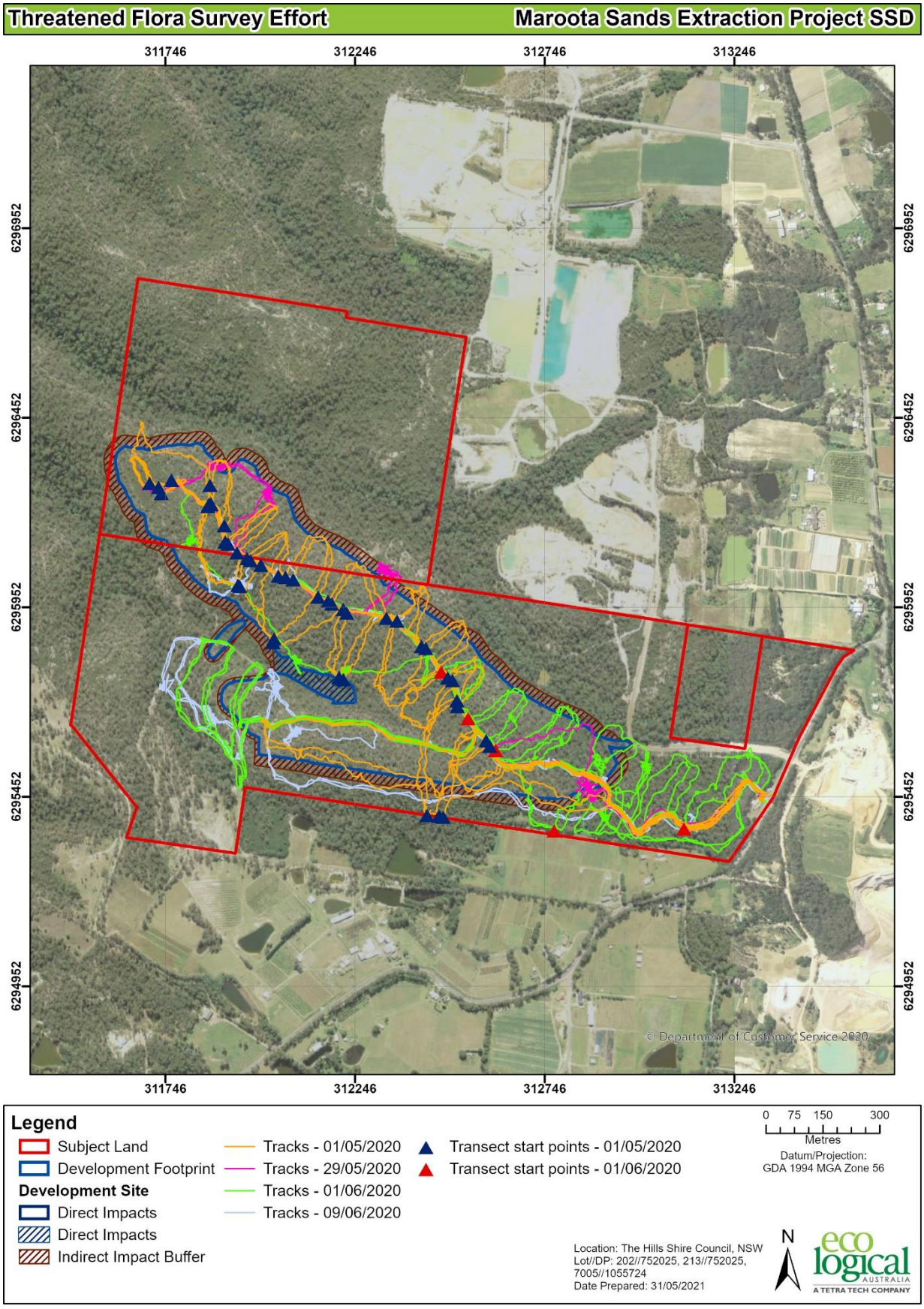


Figure 20: Threatened Flora – survey effort

1.7 Threatened species

1.7.1 Ecosystem credit species

Ecosystem credit species predicted to occur at the development site, their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 22. Ecosystem credit species which have been excluded from the assessment and relevant justification are also included.

Table 22: Predicted ecosystem credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Anthochaera phrygia	Regent Honeyeater (Foraging)	-	-	High	CE	CE	**Included** Suitable foraging habitat detected within the development site. BioNet returned 2 records for the species within 5 km of the development site.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	-	-	Moderate	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 1 record for the species within 5 km of the development site.
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)	-	-	Moderate	V	Not Listed	**Included (excluded after survey)** BioNet returned 3 records for the species within 5 km of the development site. However, not detected during targeted surveys. No evidence of breeding or foraging was detected during surveys. Therefore not included as a species credit or ecosystem credit species in final assessment.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Calyptorhynchus lathami	Glossy Black Cockatoo (Foraging)	Other/ Presence of *Allocasuarina* and *Casuarina* species	-	High	V	Not Listed	**Included** Suitable foraging habitat detected within the development site. BioNet returned 36 records for the species within 5 km of the development site.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 1 record for the species within 5 km of the development site.
Daphoenositta chrysoptera	Varied Sittella	-	-	Moderate	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 7 records for the species within 5 km of the development site.
Dasyurus maculatus	Spotted-tailed Quoll	-	-	High	V	E	**Included** Suitable habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site. Detected during anabat surveys.
Glossopsitta pusilla	Little Lorikeet	-	-	High	V	Not Listed	**Included**

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
							Suitable habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Grantiella picta	Painted Honeyeater	Other/ Mistletoes present at a density of greater than five mistletoes per hectare	-	Moderate	V	V	**Excluded** Suitable habitat not detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Haliaeetus leucogaster	White-bellied Sea-Eagle (Foraging)	N/A/Waterbodies Within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	-	High	V	Not Listed	**Included** Suitable foraging habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Hieraaetus morphnoides	Little Eagle (Foraging)	-	-	Moderate	V	Not Listed	**Included** Suitable foraging habitat detected within the development site. BioNet returned 1 record for the species within 5 km of the development site.
Hoplocephalus bungaroides	Broad-headed Snake (Foraging)	-		High	E	V	**Included** Suitable foraging habitat detected within the development site.
Lathamus discolor	Swift Parrot (Foraging)	-	-	Moderate	E	CE	**Included** Suitable foraging habitat detected within the development site. No BioNet records for this species within

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
							the development site or within 5 km radius of the development site.
Lophoictinia isura	Square-tailed Kite (Foraging)	-	-	Moderate	V	Not Listed	**Included** Suitable foraging habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	-	-	Moderate	V	Not Listed	**Included** Suitable habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	-	-	Moderate	V	Not Listed	**Included** Suitable habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 4 records for the species within 5 km of the development site. Detected during anabat surveys.
Miniopterus australis	Little Bent-winged Bat (Foraging)	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 4

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
							records for the species within 5 km of the development site. Detected during anabat surveys.
Miniopterus orianae oceanensis	Large Bent-winged Bat (Foraging)	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 4 records for the species within 5 km of the development site.
Neophema pulchella	Turquoise Parrot	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 3 records for the species within 5 km of the development site.
Ninox connivens	Barking Owl (Foraging)	-	-	High	V	Not Listed	**Included (excluded after survey)** No BioNet records for this species within the development site or within 5 km radius of the development site. Not detected during targeted surveys. No evidence of breeding or foraging was detected during surveys. Therefore not included as a species credit or ecosystem credit species in final assessment.
Ninox strenua	Powerful Owl (Foraging)	-	-	High	V	Not Listed	**Included** Suitable foraging habitat detected within the development site. Detected during targeted surveys. BioNet returned 14 records for the species within 5 km of the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Pachycephala olivacea	Olive Whistler	-	-	Moderate	V	Not Listed	**Included** Suitable habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Pandion cristatus	Eastern Osprey (Foraging)	-	-	Moderate	V	Not Listed	**Excluded** Suitable foraging habitat not detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Petaurus australis	Yellow-bellied Glider	Hollow bearing trees/Hollows > 25cm diameter	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 26 records for the species within 5 km of the development site.
Petroica boodang	Scarlet Robin	-	-	Moderate	V	Not Listed	**Included** Suitable habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Phascolarctos cinereus	Koala (Foraging)	-	-	High	V	V	**Included** Suitable foraging habitat detected within the development site. BioNet returned 3 records for the species within 5 km of the development site.
Phoniscus papuensis	Golden-tipped Bat	-	-	High	V	Not Listed	**Included**

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
							Suitable foraging habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	-	-	Moderate	V	Not Listed	**Included** Suitable habitat detected within the development site. No BioNet records for this species within the development site or within 5 km radius of the development site.
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	-	-	High	V	V	**Included** Suitable foraging habitat detected within the development site. BioNet returned 8 records for the species within 5 km of the development site.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. BioNet returned 1 record for the species within 5 km of the development site. Detected during anabat surveys.
Scoteanax rueppellii	Greater Broad-nosed Bat	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site. Detected during anabat surveys.
Stagonopleura guttata	Diamond Firetail	-	-	Moderate	V	Not Listed	**Included** Suitable habitat detected within the development site.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Tyto novaehollandiae	Masked Owl (Foraging)	-	-	High	V	Not Listed	**Included (excluded after survey)** BioNet returned 8 records for the species within 5 km of the development site. However, not detected during targeted surveys. No evidence of breeding or foraging was detected during surveys. Therefore not included as a species credit or ecosystem credit species in final assessment.
Varanus rosenbergi	Rosenberg's Goanna	-	-	High	V	Not Listed	**Included** Suitable habitat detected within the development site.

1.7.2 Species credit species

Species credit species predicted to occur at the development site (i.e. candidate species), their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 23. Species credit species which have been excluded from further assessment and relevant justification are also included.

Table 23: Candidate species credit species

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Acacia bynoeana	Bynoe's Wattle		High	E	V	**Included** Habitat available in PCT 1328 and PCT 1083. Suitable habitat not present in PCT 1081, or PCT 1181. Therefore, targeted surveys undertaken in PCT 1328 and PCT 1083. Two specimens were detected during targeted survey in the development site. BioNet records within the development site, and within 5km (388 records) of development site.
Acacia gordonii		Rocky areas sandstone outcrops, ridgetops, spurs or within 200 m	High	E	E	**Included** Habitat available in PCT 1328 and PCT 1083. Suitable habitat not present in PCT 1081, or PCT 1181. Therefore targeted surveys undertaken in PCT 1328 and PCT 1083. No BioNet records within the development site, or within 5km of development site.
Acacia pubescens	Downy Wattle	-	-	V	V	**Excluded** Only very marginal habitat present within PCT 1081. Considered very unlikely to occur within the development site. No BioNet records within the development site, or within 5km of development site.
Ancistrachne maidenii		-	High	V	Not Listed	**Included** Distribution of this species includes the Maroota area. Potential habitat (sandstone derived soils) present within PCT 1328, 1181 and 1083. BioNet records within 5km of development site (23 records).

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Anthochaera phrygia	Regent Honeyeater	DPIE mapped areas	High	CE	CE	**Excluded** Development site not within DPIE mapped areas (as accessed on BOAMS on 6 July 2020). BioNet records within 5km of development site (2 records).
Asterolasia elegans		-	Moderate-	E	E	**Excluded** Habitat (moist hillsides/sheltered forest on mid to lower slopes and valleys on Hawkesbury sandstone) not present within the development site. Although BioNet records have been recorded in a 5km radius (15,620), no records within the development site. Considered very unlikely to occur within the development site.
Burhinus grallarius	Bush Stone-curlew	Fallen/standing dead timber including logs	-High	E	Not Listed	**Excluded** Suitable habitat (open forests and woodlands with a sparse groundcover and fallen timber) not detected in the development site. No BioNet records within 5km of development site. Considered very unlikely to occur within the development site.
Callistemon linearifolius	Netted Bottle Brush	-	Moderate	V	Not Listed	**Excluded** Suitable habitat not detected in the development site. No BioNet records within 5km of development site. Considered very unlikely to occur within the development site.
Callocephalon fimbriatum	Gang-gang Cockatoo (Breeding)	-	High	V	Not Listed	**Included** Suitable habitat (suitable sized hollow-bearing trees) available within the development site. BioNet records within 5km of development site (3 records).
Callocephalon fimbriatum - endangered population	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai local	Hornsby and Ku-ring-gai LGAs	High	EP	Not Listed	**Included** Although outside the defined range of this endangered population, the development site may move beyond to forage outside this defined range, therefore further assessment has been undertaken. Suitable foraging and breeding habitat (suitable sized hollow-

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
	government areas					bearing trees) available within the development site. BioNet records within 5km of development site (3 records).
Calyptorhynchus lathami	Glossy Black-Cockatoo (Breeding)	Hollow bearing trees/Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground	High	V	Not Listed	**Included** Suitable foraging and breeding habitat (suitable sized hollow-bearing trees) available within the development site. BioNet records within the development site, and within 5 km of the development site (36 records).
Cercartetus nanus	Eastern Pygmy-possum	-	High	V	Not Listed	**Included** Suitable foraging (Banksias and Eucalypts) and breeding habitat (woodland and heaths with tree hollows and vegetation thickets) available within the development site. No BioNet records within the development site however 13 records were returned within 5km of the development site.
Chalinolobus dwyeri	Large-eared Pied Bat	Cliffs/Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels	Very High	V	V	**Included** Likely to be suitable foraging habitat within the development site due to presence of Hawkesbury sandstone terrain to the north and west of the subject land. Suitable breeding habitat not detected in the development site. No BioNet records returned within the development site however 6 records were returned within 5km of the development site.
Darwinia biflora		-	High	V	V	**Included** Potential habitat available in PCT 1081 and transition areas to PCT 1181, 1083 and 1328. No BioNet records within the development site, however 13 records were returned within 5km radius of the development site.
Darwinia fascicularis subsp. oligantha - endangered population	Darwinia fascicularis subsp. oligantha	Other/Sandstone areas or within 100m.	High	EP	Not Listed	**Included** Potential habitat available in sandstone outcrops and rocky heath associated with PCT 1083 and 1328. No BioNet records within the

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
	population in the Baulkham Hills and Hornsby local government areas	Hills and Hornsby LGAs (as amended from the Determination))				development site, however 57 records were returned within 5km radius of the development site.
Darwinia peduncularis		Rocky areas or within 50 m of rocky areas	High	V	Not Listed	**Included** Potential habitat available in sandstone outcrops and rocky heath associated with PCT 1083 and 1328. No BioNet records within the development site, however 1 record was returned within 5km radius of the development site.
Dillwynia tenuifolia		-	Moderate	V	Not Listed	**Excluded** Potential habitat available in shale and shale sandstone transitional area between PCT 1081 and PCTS 1328,1083 and 1181, however this is considered very marginal. No BioNet records within the development site, however 606 records were returned within 5 km radius of the development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Dillwynia tenuifolia - endangered population	Dillwynia tenuifolia Sieber ex D.C. in the Baulkham Hills local government area	The Hills LGA (as amended from the Determination)	High	EP	Not Listed	**Excluded** Potential habitat available in shale and shale sandstone transitional area between PCT 1081 and PCTS 1328,1083 and 1181, however this is considered very marginal. No BioNet records within the development site, however 606 records were returned within 5 km radius of the development site. No specimen were detected during fieldwork. Considered very unlikely to occur within the development site.
Epacris purpurascens var. purpurascens		-	Moderate	V	Not Listed	**Excluded** Potential habitat available in shale and shale sandstone transitional area between PCT 1081 and PCTS 1328,1083 and 1181, however

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
						this is considered very marginal. No BioNet records within the development site or within 5km radius of the development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Eucalyptus fracta	Broken Back Ironbark	-	High	V	Not Listed	**Excluded** Out of geographic range (Central Coast and Cessnock regions) for this species.
Eucalyptus sp. Cattai	Eucalyptus sp. Cattai	-	High	CE	CE	**Included** Potential habitat available in shale area (PCT 1081). No BioNet records within the development site or within 5km radius of the development site.
Grammitis stenophylla	Narrow-leaf Finger Fern	-	Moderate	E	Not Listed	**Excluded** Suitable habitat (moist areas, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest) not present. No BioNet records within the development site or within 5km radius of the development site. Considered very unlikely to occur within the development site.
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	-	High	V	V	**Excluded** Potential habitat available in shale and shale sandstone transitional area between PCT 1081 and PCTS 1328,1083 and 1181, however this is considered very marginal. No BioNet records within the development site or greater study area, however there are 768 records within a 5km radius of the development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Grevillea parviflora subsp. supplicans			High	E	Not Listed	**Excluded** Potential habitat available in shale and shale sandstone transitional area between PCT 1081 and PCTS 1328,1083 and 1181, however this is considered very marginal. No BioNet records within the

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
						development site or within a 5km radius of the development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Gyrostemon thesioides		Other/Sandy, alluvial or colluvial soil within 50 m of a water course	High	E	Not Listed	**Excluded** Suitable habitat (hillsides and riverbanks – restricted to fine sandy soils) not present. No BioNet records within the development site or within 5km radius of the development site. Considered very unlikely to occur within the development site.
Haliaeetus leucogaster	White-bellied Sea-Eagle (Breeding)	Other/Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines	High	V	Not Listed	**Excluded** Likely to be suitable foraging habitat within the development site. Suitable breeding habitat (living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines) not recorded within the development site. No BioNet records returned within the development site or within 5km of the development site. No nests recorded in the site during field survey works.
Heleioporus australiacus	Giant Burrowing Frog		Moderate	V	V	**Included** Suitable habitat recorded in riparian areas**.** No BioNet records within the development site, however 108 records were returned within 5 km radius of the development site.
Hibbertia procumbens	Spreading Guinea Flower	Within Yengo National Park	High	E	Not Listed	**Excluded** Habitat conditions may be present in areas within the development site (scrub/heath on skeletal sandy soils), however it is considered out of the range for this species. No BioNet records within the development site or within 5km radius of the development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Hibbertia puberula		-	High	E	Not Listed	**Excluded** Habitat conditions may be present in areas within the development site (sandy soil associated with sandstone, or on clay) however this is considered to be marginal. No BioNet records within the development site, however 1 record was returned within 5 km radius of the development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Hibbertia superans			High	E	Not Listed	**Excluded** Habitat conditions may be present in areas within the development site (sandstone ridgetops often near the shale sandstone boundary). No BioNet records within the development site, however 8 records were returned within 5 km radius of the development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Hieraaetus morphnoides	Little Eagle (Breeding)	Other/Nest trees - live (occasionally dead) large old trees within vegetation)	Moderate	V	Not Listed	**Excluded** Likely to be suitable foraging habitat within the development site. Suitable breeding habitat (living or dead large old trees) were uncommon in the development site. Not recorded within the development site. No BioNet records returned within the development site however 1 record was returned within 5km of the development site. No nests recorded in the site during field survey works.
Hoplocephalus bitorquatus	Pale - headed Snake	-	High	V	Not Listed	**Excluded** Out of range for this species where only a small number of historical records are known from the New England Tablelands. No BioNet records within the development site or within 5km radius of the development site. No specimens were detected during fieldwork.

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Hoplocephalus bungaroides	Broad-headed Snake (Breeding)	Rocky areas Including escarpments, outcrops and pogodas within the Sydney Sandstone geologies	Very High	E	V	**Included** Potential habitat available in sandstone PCT 1328. No BioNet records within the development site or within 5km radius of the development site. No specimens were detected during fieldwork.
Kunzea rupestris		Rocky areas/Hawkesbury sandstone rock platforms or within 50m	High	V	V	**Included** Habitat available in PCT 1328 and PCT 1083. Suitable habitat not present in PCT 1081, or PCT 1181. Therefore, targeted surveys undertaken in PCT 1328 and PCT 1083. Two large populations were detected in the development site. No BioNet records within the development site, however 2184 records were returned within 5 km radius of the development site.
Lasiopetalum joyceae			Moderate	V	V	**Included** Habitat available in PCT 1081, PCT 1328 and PCT 1083. Therefore targeted surveys undertaken although outside the BAM survey period. No BioNet records within the development site, however 34 records were returned within 5km of development site.
Lathamus discolor	Swift Parrot (Breeding)	Other/As per mapped areas	Moderate	E	CE	**Excluded** Development site not within DPIE mapped areas (as confirmed by the DPIE BAM support on 23 July 2020). No BioNet records within the development site, or within 5km of development site.
Leionema lamprophyllum subsp. fractum		Cliffs/Sandstone cliffs or ledges or within 100 m/Other/Sandstone footslopes or within 100 m	High	CE	Not Listed	**Excluded** Out of range for this species where only a small number of historical records are known from Broken Back Range near Cessnock. No BioNet records within the development site, or within 5km of development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Leptospermum deanei		Waterbodies or within 100m of freshwater or estuarine streams	High	V	V	**Excluded** Habitat (riparian scrub) was not detected in the development site. No BioNet records within the development site, or within 5km of development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Leucopogon fletcheri subsp. fletcheri *Leucopogon*		Other/Slopes nearby rocky areas or within 50 m/Rocky areas	High	E	Not Listed	**Excluded** Although habitat conditions may be present in areas within the development site (dry eucalypt woodland on clayey soils) it is considered marginal habitat and therefore unlikely that the species will be present within the development site. No BioNet records within the development site, however 160 records were returned within 5 km radius of the development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Litoria aurea	Green and Golden Bell Frog	Semi-permanent/ephemeral wet areas Within 1km of wet areas/Swamps Within 1km of swamp/Waterbodies Within 1km of waterbody	High	E	V	**Excluded** The development site is located within 1km of several artificial waterbodies on private land, however the development site does not contain any suitable habitat for Green and Golden Bell Frog. No BioNet records within the development site or within 5km radius of the development site. Considered very unlikely to occur within the development site.
Litoria booroolongensis	Booroolong Frog		High	E	E	**Excluded** The development site does not contain suitable habitat (permanent streams) and is not within the known range for the species (western flowing streams of the Great Dividing Range). No BioNet records within the development site or within 5km radius of the development site.

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Litoria littlejohni	Littlejohn's Tree Frog		High	V	V	**Excluded** The development site does not contain suitable habitat (upper reaches of permanent streams) and is not within the known range for the species (plateaus and slopes of the Great Dividing Range). No BioNet records within the development site or within 5km radius of the development site.
Lophoictinia isura	Square-tailed Kite (Breeding)	Other /Nest trees	Moderate	V	Not Listed	**Excluded** Likely to be suitable foraging habitat within the development site. Suitable breeding habitat (living or dead large old trees) was uncommon in the development site. Not recorded within the development site. No BioNet records returned within the development site however one record was returned within 5km of the development site. No nests recorded in the site during field survey works.
Melaleuca deanei	Deane's Paperbark		High	V	V	**Excluded** Habitat (wet heath on sandstone) was not detected in the development site. No BioNet records within the development site, however 23 records within 5km of development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Melaleuca groveana	Grove's Paperbark		High	V	Not Listed	**Excluded** Habitat (exposed heath and shrubland) was detected in the development site. However, it is considered to be considerably south of its known range. No BioNet records within the development site, and no records returned within 5km of development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Micromyrtus blakelyi		Other/Skeletal soil/Rocky areas	Moderate	V	V	**Included**

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
		Hawkesbury sandstone rock platforms and outcrops or				Potential habitat available in PCT 1328 and PCT 1083. Therefore, targeted surveys undertaken. No BioNet records within the development site, however 1,538 records were returned within 5km of development site.
Miniopterus australis	Little Bent-winged Bat (Breeding)	Caves tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records in BioNet with microhabitat code 'IC – in cave' observation type code 'E nest-roost' with numbers of individuals >500 or from the scientific literature	Very High	V	Not Listed	**Excluded** Breeding habitat (caves, tunnels, mines etc.) not detected within the development site. No BioNet records within the development site, however 4 records were returned within 5km of development site.
Miniopterus orianae oceanensis	Large Bent-winged Bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave" observation type code "E nest-roost" with	Very High	V	Not Listed	**Excluded** Breeding habitat (caves, tunnels, mines etc.) not detected within the development site. No BioNet records within the development site, however 4 records were returned within 5km of development site.

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
		numbers of individuals >500				
Mixophyes balbus	Stuttering Frog		Very High	E	V	**Excluded** The development site does not contain suitable habitat (rainforest and wet tall open forest) and is not within the known range for the species (foothills and escarpments on the eastern side of the Great Dividing Range). No BioNet records within the development site or within 5km radius of the development site.
Myotis macropus	Southern Myotis	Hollow bearing trees Within 200 m of riparian zone/Other Bridges, caves or artificial structures within 200 m of riparian zone/Waterbodies This include rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site	High	V	Not Listed	**Included** Potential habitat available due to presence of hollow bearing trees and water bodies within close proximity to the development site. Therefore, targeted surveys undertaken. No BioNet records within the development site, and no records within 5km of development site.
Ninox connivens	Barking Owl (Breeding)	Hollow bearing trees Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground	High	V	Not Listed	**Included** Potential habitat due to presence of a number of large hollow-bearing trees within the development site. Therefore, targeted surveys undertaken. No BioNet records within the development site, and no records within 5km of development site.
Ninox strenua	Powerful Owl (Breeding)	Hollow bearing trees	High	V	Not Listed	**Included**

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
		Living or dead trees with hollow greater than 20cm diameter				Potential habitat due to presence of a number of large hollow-bearing trees within the development site. Therefore, targeted surveys undertaken. No BioNet records within the development site, however there are 14 records within 5km of development site, with one record just outside the development site. Species detected during targeted surveys.
Olearia cordata		-	Moderate	V	V	**Excluded** Described habitat (dry open forest on sandstone ridges) was detected in the development site. However, it is considered to be substantially south of its known range. No BioNet records within the development site, and no records returned within 5km of development site. No specimens were detected during fieldwork. Considered very unlikely to occur within the development site.
Pandion cristatus	Eastern Osprey (Breeding)	Other/Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting)	Moderate	V	Not Listed	**Excluded** Breeding habitat was not present in the development site (i.e. development site is not within 100m of a floodplain. No BioNet records within the development site, and no records within 5km of development site
Persoonia hirsuta	Hairy Geebung	-	High	E	E	**Included** Potential habitat available in PCT 1081. Therefore, targeted surveys undertaken. No BioNet records within the development site, however 4 records were returned within 5km of development site.
Petauroides volans	Greater Glider	Hollow bearing trees	High	Not listed	V	**Included** Although preferred habitat not (*taller, montane, moist eucalypt forests with relatively old trees and abundant hollows* (Commonwealth Conservation Advice *Petauroides volans* 2016). Potential habitat detected in all PCTS due to presence of hollow-bearing trees. Targeted survey undertaken. No BioNet records

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
						within the development site, and no records within 5km of development site.
Petaurus norfolcensis	Squirrel Glider		High	V	Not Listed	**Included** Potential habitat detected in all PCTS due to presence of hollow-bearing trees and feeds trees such as *Corymbia gummifera* (Red Bloodwood). Targeted survey undertaken. No BioNet records within the development site, and no records within 5km of development site.
Petrogale penicillata	Brush-tailed Rock-wallaby	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	Very High	E	V	**Excluded** Potential habitat (rocky escarpments, outcrops and cliffs) not present within the development site. No BioNet records within the development site, and no records within 5km of development site.
Phascogale tapoatafa	Brush-tailed Phascogale	-	High	V	Not Listed	**Included** Potential habitat (hollow-bearing trees) was recorded in the development site. Therefore, targeted survey was undertaken. No BioNet records within the development site, and 2 records within 5km of development site.
Phascolarctos cinereus	Koala (Breeding)	Areas identified via survey as important habitat.	High	V	V	**Included** Potential foraging habitat detected in all PCTs due to presence of feeds trees such as *Eucalyptus punctata* (Grey Gum) *Corymbia eximia* (Yellow Bloodwood), *Corymbia gummifera* (Red Bloodwood). Therefore, targeted survey was undertaken. No BioNet records within the development site, and 3 records within 5km of development site.
Pimelea curviflora var. *curviflora*		-	High	V	V	**Included** Potential habitat available in PCT 1081 and on the transitional areas to PCT 1328, 1083 and 1181. Therefore, targeted surveys

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
						undertaken. BioNet records are present within the development site, and 347 records were returned within 5km of development site.
Pomaderris brunnea	Brown Pomaderris	-	High	E	V	**Excluded** Suitable habitat (moist woodland or forest on clay and alluvial soils of floodplains and creeklines) not present within the development site. No BioNet records within the development site or within 5km of development site. Considered very unlikely to occur within the development site.
Pommerhelix duralensis	Dural Land Snail	Leaf litter and shed bark or within 50m of litter or bark/Rocky areas Rocks or within 50m of rocks/fallen/standing dead timber including logs Including logs and bark or within 50m of logs or bark	High	E	E	**Included** Suitable habitat present within PCT1081. Targeted survey therefore undertaken. No BioNet records within the development site, however 2 records were returned within 5 km radius of the development site.
Prostanthera cineolifera	Singleton Mint Bush	-		V	V	**Excluded** Not within range of this species (restricted to near Scone, Cessnock and St Albans). No BioNet records within the development site or within 5km of development site. Species not detected during fieldwork.
Pseudophryne australis	Red-crowned Toadlet	-	Moderate	V	Not Listed	**Included** Species detected during field survey work. Suitable habitat also detected in riparian areas within and adjacent to the development site. No BioNet records within the development site however 26 records were returned within 5km of development site.

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	Breeding camps	High	V	V	**Excluded** No breeding camps present within the development site.
Pultenaea parviflora		-	Moderate	E	V	**Excluded** Not within range of this species (Endemic to the Cumberland Plain). No BioNet records within the development site or within 5km of development site. Species not detected during fieldwork. Considered very unlikely to occur within the development site.
Rutidosis heterogama	Heath Wrinklewort	-	High	V	V	**Excluded** Not within range of this species (Found from Wyong to Newcastle and Cessnock to Kurri Kurri). No BioNet records within the development site or within 5km of development site. Species not detected during fieldwork
Seringia denticulata - endangered population	Seringia denticulata in the Hawkesbury local government area	Colo River area between Lower Portland and Morans Rock and near Gees Lagoon	High	EP	Not Listed	**Excluded** Suitable habitat (Sydney Coastal River-flat Forest) not present within the development site. Not within the known range for this population (Colo River area between Lower Portland and Morans Rock). No BioNet records within the development site or within 5km of development site. Species not detected during fieldwork**.**
Tetratheca glandulosa		-	High	V	Not Listed	**Included** Species detected during field survey work. Suitable habitat also detected in PCT 1081, 1328, 1083, and 1181. BioNet records within the development site and 31,310 records were returned within 5km of development site.
Tyto novaehollandiae	Masked Owl (Breeding)	Hollow bearing trees Living or dead trees with hollows greater than 20cm diameter	Hight	V	Not Listed	**Included** Potential habitat due to presence of a number of large hollow-bearing trees within the development site. Therefore, targeted surveys undertaken. No BioNet records within the development

Species	Common Name	Habitat constraints/Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded from further assessment
						site, however 8 records were returned within 5 km radius of the development site.
Velleia perfoliata		-	High	V	V	**Excluded** Not within the known range for this population (Hawkesbury district to upper Hunter Valley). No BioNet records within the development site or within 5km of development site. Species not detected during fieldwork.
Vespadelus troughtoni	Eastern Cave Bat	Caves Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops	Very High	V	Not Listed	**Included** Likely to be suitable foraging habitat within the development site due to presence of Hawkesbury sandstone terrain directly adjacent to the development site. Suitable breeding habitat not detected in the development site. No BioNet records returned within the development site or within 5km of the development site.
Zieria involucrata		-	High	E	V	**Excluded** Suitable habitat (sheltered forests on mid to lower slopes) not present within the development site. No BioNet records within the development site however 1,047 within 5km of development site. Not detected during field surveys. Considered very unlikely to occur within the development site.

1.7.3 Targeted surveys - results

Targeted surveys for species credit flora and fauna species were therefore undertaken on the development site for the following species at the development site on the dates outlined in Table 24 and Table 25. Weather conditions during the targeted surveys are outlined in Table 26.

Details of survey effort undertaken at the development site and results are outlined in Table 27, and some images of the species detected on site are displayed in Figure 21 to Figure 26. The results of the surveys shown on Figure 27 and Figure 28.

Table 24: Targeted flora surveys

Date	Surveyors	Target species
1 May 2020 1 June 2020	Nicole McVicar Stacey Wilson Carolina Mora Alex Gorey	*Acacia bynoeana* *Acacia gordonii* *Aristrachne maidenii* *Darwinia biflora* *Darwinia fascicularis* subsp. *oligantha* *Darwinia peduncularis* *Eucalyptus sp. Cattai* *Kunzea rupestris* *Lasiopetalum joyceae* *Micromyrtus blakelyi* *Persoonia hirsuta* *Pimelea curviflora* var. *curviflora* *Tetratheca glandulosa* Also included fauna species Glossy Black Cockatoo and Gang Gang Cockatoo

Table 25: Targeted fauna surveys

Date	Surveyors	Target species
2 June 2020 4 June 2020 11 June 2020 23 June 2020 25 June 2020 30 June 2020 2 July 2020 7 July 2020	Nicole McVicar Stacey Wilson Carolina Mora Mike Lawrie Kirsten Velthuis	Powerful Owl Masked Owl Barking Owl Squirrel Glider Koala Brush-tailed Phascogale
22 June 2020 29 June 2020	Nicole McVicar Stacey Wilson Carolina Mora Mike Lawrie Alex Gorey	Dural Land Snail Koala Glossy Black Cockatoo Gang Gang Cockatoo
24 February 2020- 27 February 2020	Nicole McVicar	*Myotis macropus* (Southern Myotis)

Table 26: Weather conditions (Bureau of Meteorology 2020)

Date	Rainfall (mm)	Minimum temperature (°C)	Maximum temperature (°C)
14 January 2020	0.4	17.2	32.2
21 January 2020	0	16.1	34.5
24 January 2020	0.2	17.7	29.9
28 February 2020	0	17.2	28.3
1 May 2020	0	8.9	17.2
1 June 2020	0	7.2	22.9
2 June 2020	0	4.5	17.6
4 June 2020	0	3.7	17.1
11 June 2020	0.4	11.3	20.8
22 June 2020	0	4.7	17.7
23 June 2020	1	0.7	16.9
25 June 2020	0	2.7	18.6
29 June	0	5.2	18.2
30 June 2020	0.2	5.5	17.8
2 July 2020	0	3.5	23.3
7 July 2020	0	4.4	16.9

Figure 21: *Tetratheca glandulosa* found within the development site

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Table 27: Survey effort and results

Target species	Common Name	Survey Method	Survey effort	Survey Dates	BAM survey period	Species recorded during survey	Species credits required / species polygon justification. Methodology for species polygon.
Acacia bynoeana	Bynoe's Wattle	Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	Yes. Two specimens recorded close to original BioNet record and Cumberland Ecology records.	Yes. 30m buffer around each record and each Cumberland Ecology record.
Acacia gordonii		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	No	No Not recorded in the development site.
Aristrachne maidenii		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	December - April	No	No. Not recorded in the development site
Callocephalon fimbriatum	Gang-gang Cockatoo	Opportunistic Stagwatching – potential nesting hollows or areas of activity stag-watched opportunistically	24 person hours	16/1/20 – 07/07/20	October – January and all year for endangered population	No	No – species not recorded, and no evidence of breeding was detected. Not included as a species credit or ecosystem credit species.
Calyptorhynchus lathami	Glossy Black Cockatoo	Opportunistic Stagwatching – potential nesting hollows or areas of activity stag-watched opportunistically	24 person hours	16/1/20 – 07/07/20	Mar – Aug	Yes – pair recorded foraging within development site and subject land on numerous occasions.	Yes – although specific nest tree not recorded. 200m buffer applied to all HBTs medium sized or above.
Darwinia biflora		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	No	No

Target species	Common Name	Survey Method	Survey effort	Survey Dates	BAM survey period	Species recorded during survey	Species credits required / species polygon justification. Methodology for species polygon.
Darwinia fascicularis subsp. *oligantha*		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	No	No
Darwinia peduncularis		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	No	No
Eucalyptus sp. Cattai		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	No	No
Kunzea rupestris		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	Yes - two rock platforms with large populations approximately 50 individuals and 200 individuals	Yes, 30m buffer around each mapped Kunzea polygon. .
Lasiopetalum joyceae		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	September - November	No – note this was undertaken outside the survey period however *Lasiopetalum joyceae* was not detected in the development site during the surveys and after survey it was determined that the species was unlikely to occur within the development site.	No
Micromyrtus blakelyi		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	No	No

Target species	Common Name	Survey Method	Survey effort	Survey Dates	BAM survey period	Species recorded during survey	Species credits required / species polygon justification. Methodology for species polygon.
Myotis macropus	Southern Myotis	Anabat survey	4 nights within development site with 3 anabats – 12 survey nights.	24/2/20 – 28/2/20	October - March	yes	Yes – 200 m buffer applied to waterbodies. Species polygon applies to all PCTs associated with the species within 200 m of waterbodies
Ninox connivens	Barking Owl	Stagwatch/listening survey	8 listening/call playback nights 8 Spotlighting nights	02/06/20 4/06/20 11/06/20 23/06/20 25/06/20 30 /06/20 02/07/20 07/07/20	May – Dec	No	No – species not recorded, and no evidence of breeding was detected. Not included as a species credit or ecosystem credit species.
Ninox strenua	Powerful Owl	Stagwatch/listening survey	8 listening/call playback nights 8 Spotlighting nights	02/06/20 4/06/20 11/06/20 23/06/20 25/06/20 30 /06/20 02/07/20 07/07/20	May – Aug	Yes – one individual responded to the call play back on the second night of survey 4 June 2020.	No – during the spotlighting and call playback surveys, and during daytime survey work no nest trees were identified within the development site. Large HBTs and stags were inspected for evidence of use and no pellets observed under any of these habitat trees. During call playback, only one bird responded to call

Target species	Common Name	Survey Method	Survey effort	Survey Dates	BAM survey period	Species recorded during survey	Species credits required / species polygon justification. Methodology for species polygon.
							playback. Two birds have not been heard duetting. A male and female bird were not identified in the development site. Therefore, this is an ecosystem credit species only.
Persoonia hirsuta		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	All year	No	No
Petauroides volans	Greater Glider	Spotlighting	8 listening/call playback nights 8 Spotlighting nights	02/06/20 4/06/20 11/06/20 22/06/20 23/06/20 25/06/20 29/06/20 30 /06/20	All year	No	No
Petaurus norfolcensis	Squirrel Glider	Spotlighting	8 listening/call playback nights 8 Spotlighting nights	02/06/20 4/06/20 11/06/20 22/06/20 23/06/20 25/06/20 29/06/20	All year	Yes. This species was observed and positively identified on spotlighting night 1 – 2 June 2020.	Yes. All PCTs within the development site mapped in species polygon.

Target species	Common Name	Survey Method	Survey effort	Survey Dates	BAM survey period	Species recorded during survey	Species credits required / species polygon justification. Methodology for species polygon.
				30 /06/20			
Phascogale tapoatafa	Brush-tailed Phascogale	Spotlighting	8 listening/call-playback nights 8 Spotlighting nights	02/06/20 4/06/20 11/06/20 22/06/20 23/06/20 25/06/20 29/06/20 30 /06/20	Dec – Jun	No	No
Phascolarctos cinereus	Koala	Stagwatching/listening surveys Scat and observational transects Spot Assessment Technique (SAT) surveys	8 listening/call playback nights 8 Spotlighting nights 40 person hours for scat and SAT surveys	02/06/20 4/06/20 11/06/20 22/06/20 23/06/20 25/06/20 29/06/20 30 /06/20 02/07/20 07/07/20	All year	No Koalas recorded in the development site. One suspected scat was recorded and sent for identification at Scats about. It was determined that the scat was 'probably' from a Koala. No other scats were determined to be from Koala.	No. No evidence of Koalas breeding in the development site. Ecosystem credit species only.
Pimelea curviflora var. *curviflora*		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	October to March	Yes, detected even though outside BAM survey period. Present as scattered individuals	Yes. 30m buffer around each mapped specimen.

Target species	Common Name	Survey Method	Survey effort	Survey Dates	BAM survey period	Species recorded during survey	Species credits required / species polygon justification. Methodology for species polygon.
						detected throughout the entire development site.	
Pommerhelix duralensis	Dural Land Snail	Transects	40 person hours	22/06/20, 29/06/20	All year	Yes. Three specimens recorded.	Yes – PCT 1081 mapped as species polygon
Pseudophryne australis	Red-crowned Toadlet	Opportunistic aural detection	Opportunistic	24/02/20	All year	Yes, detected opportunistically by aural call twice in the same location	Yes – location of record and potential habitat with a 100 m buffer around.
Tetratheca glandulosa		Flora transects and random meander	60 person hours	01/05/20 01/06/20, 29/06/20	August - November	Yes, detected even though outside BAM survey period. Present as scattered individuals detected throughout the entire development site.	Yes. 30m buffer around each mapped specimen within development footprint.
Tyto novaehollandiae	Masked Owl	Stagwatch/listening survey	8 listening/call-playback 8 Spotlighting nights	02/06/20 4/06/20 11/06/20 22/06/20 23/06/20 25/06/20 29/06/20 30 /06/20	May - Aug	No	No – species not recorded, and no evidence of breeding was detected. Not included as a species credit or ecosystem credit species.

Figure 22: *Acacia bynoeana* found within the development site

Figure 23: *Pimelea curviflora* var. *curviflora* found within the development site

Figure 24: Powerful Owl responding to call playback in the development site on spotlighting night 2

Figure 25: Dural Land Snail found in PCT 1081 during snail surveys

Figure 26: Squirrel Glider identified within the development site on spotlighting night 1

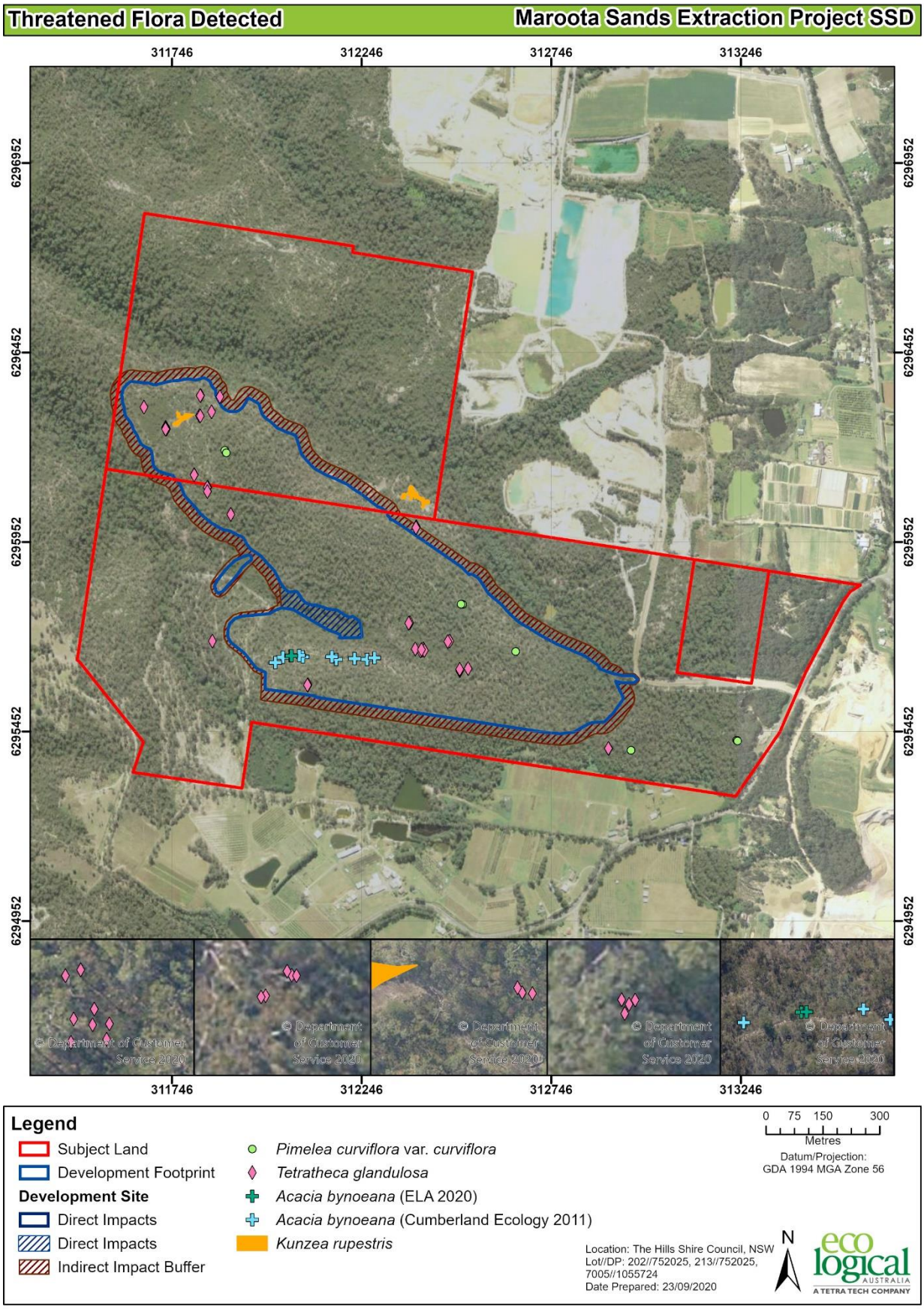

Figure 27: Targeted flora surveys – survey result

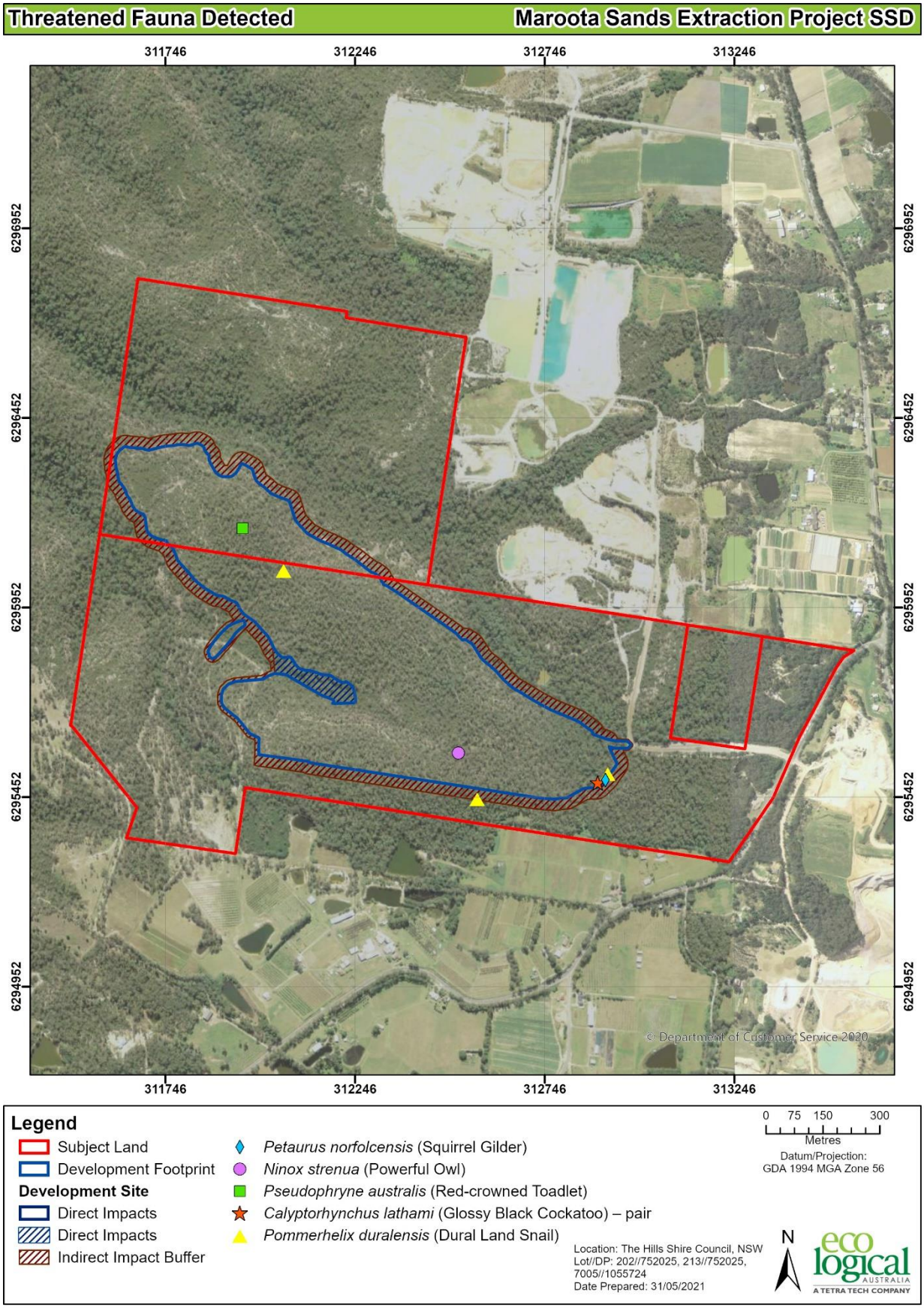

Figure 28: Targeted fauna survey – survey result

1.7.4 Species credit species – Assumed presence

Species credit species where presence has been assumed due to habitat assessed as likely to be present and BAM survey timeframes constraints are provided below in Table 28.

Table 28: Species credit species where presence has been assumed

Target species	Common Name	BAM survey period	Species credits required / species polygon justification. Methodology for species polygon.
Cercartetus nanus	Eastern Pygmy-possum	October-March	Not surveyed. Potential habitat exists within all PCTs within the development site. Species polygon is therefore all of PCT 1081, PCT 1083, PCT 1181 and PCT 1328 within the development footprint.
Chalinolobus dwyeri	Large eared Pied - bat	November-January	Detected during Anabat survey however outside of BAM survey period. Species polygon is defined as associated PCTs in development footprint within 2km buffer from caves, scarps cliffs where potential roost features may be present. A detailed analysis using high resolution aerial imagery and topographic mapping was undertaken to identify potential roost habitat features within the subject land and outside of the subject land within a 2 km buffer. No suitable roost features were identified within the subject land and the 2km buffer during this exercise. Therefore a species polygon is not required for Large-eared Pied Bat.
Heleioporus australiacus	Giant Burrowing Frog	October to May	Not surveyed. Potential habitat exists within first order creeklines and riparian buffers within the development site. Species polygon mapped as a 300m buffer around potential habitat (300m around creek buffers) within development footprint.
Hoplocephalus bungaroides	Broad-headed Snake	August - September	Outside of BAM survey period. Potential habitat exists within rocky areas within sandstone dominated PCTs. Species polygon is all of PCT 1328 and 1083 within development footprint.
Vespadelus troughtoni	Eastern Cave Bat	November-December	Potentially detected during the Anabat survey however outside of BAM survey period. Species polygon is defined as associated PCTs in development footprint within 2km buffer from caves, scarps cliffs where potential roost features may be present. A detailed analysis using high resolution aerial imagery and topographic mapping was undertaken to identify potential roost habitat features within the subject land and outside of the subject land within a 2 km buffer. No suitable roost features were identified within the subject land and the 2km buffer during this exercise. Therefore a species polygon is not required for Eastern Cave Bat.

1.7.5 Species credit species included in this assessment

Following completion of the habitat assessment, targeted surveys, an analysis of the species where presence has been assumed, analysis of species polygons requirements and mapping of species polygons, the final list of species credit species included in the assessment is outlined in Table 29. Species polygons are shown on Figure 29 – Figure 39

Table 29: Species credit species included in the assessment

Species	Common Name	Species presence	Geographic limitations	Habitat (ha)	Biodiversity Risk Weighting
Acacia bynoeana	Bynoe's Wattle	yes - detected during surveys	-	1.64	High
Calyptorhynchus lathami	Glossy Black Cockatoo	yes - detected during surveys	-	49.04	High
Cercartetus nanus	Eastern Pygmy-possum	presence assumed	-	50.95	High
Heleioporus australiacus	Giant Burrowing Frog	presence assumed	-	50.95	Moderate
Hoplocephalus bungaroides	Broad-headed Snake	Presence assumed	-	25.24	Very High
Kunzea rupestris		yes – detected during surveys	-	0.81	High
Myotis macropus	Southern Myotis	yes – detected during anabat surveys	-	7.08	High
Petaurus norfolcensis	Squirrel Glider	yes – detected during surveys	-	50.95	High
Pimelea curviflora var. *curviflora*		yes – detected during surveys	-	0.91	High
Pommerhelix duralensis	Dural Land Snail	yes - detected during surveys	-	25.71	High
Pseudophryne australis	Red-crowned Toadlet	yes – detected during surveys	-	24.50	Moderate
Tetratheca glandulosa		yes – detected during surveys	-	4.13	High

1.7.6 Use of local data

The use local data is not proposed for this assessment.

1.7.7 Expert reports

Expert reports were not used as part of this assessment.

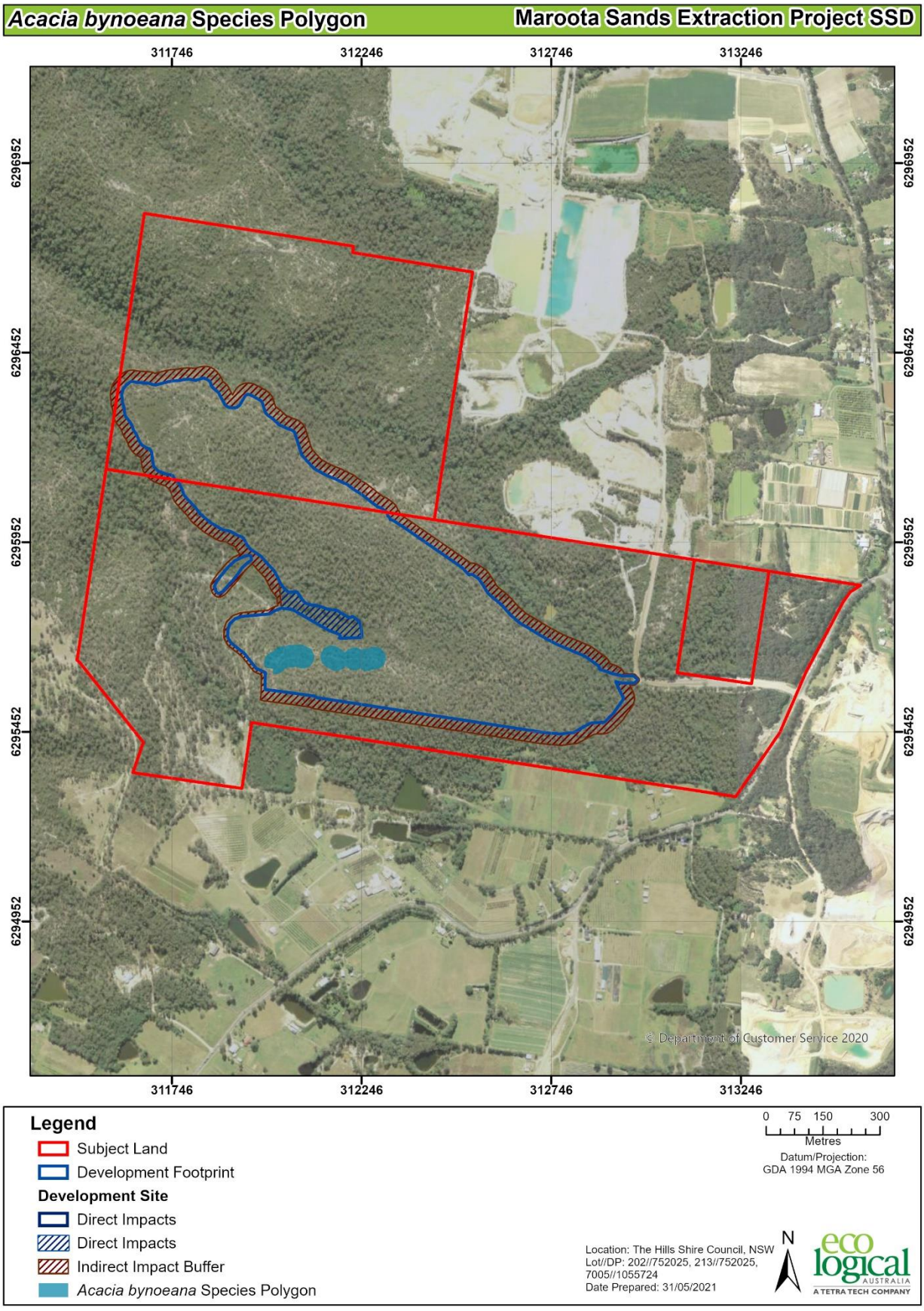

Figure 29: Species polygon – *Acacia bynoeana*

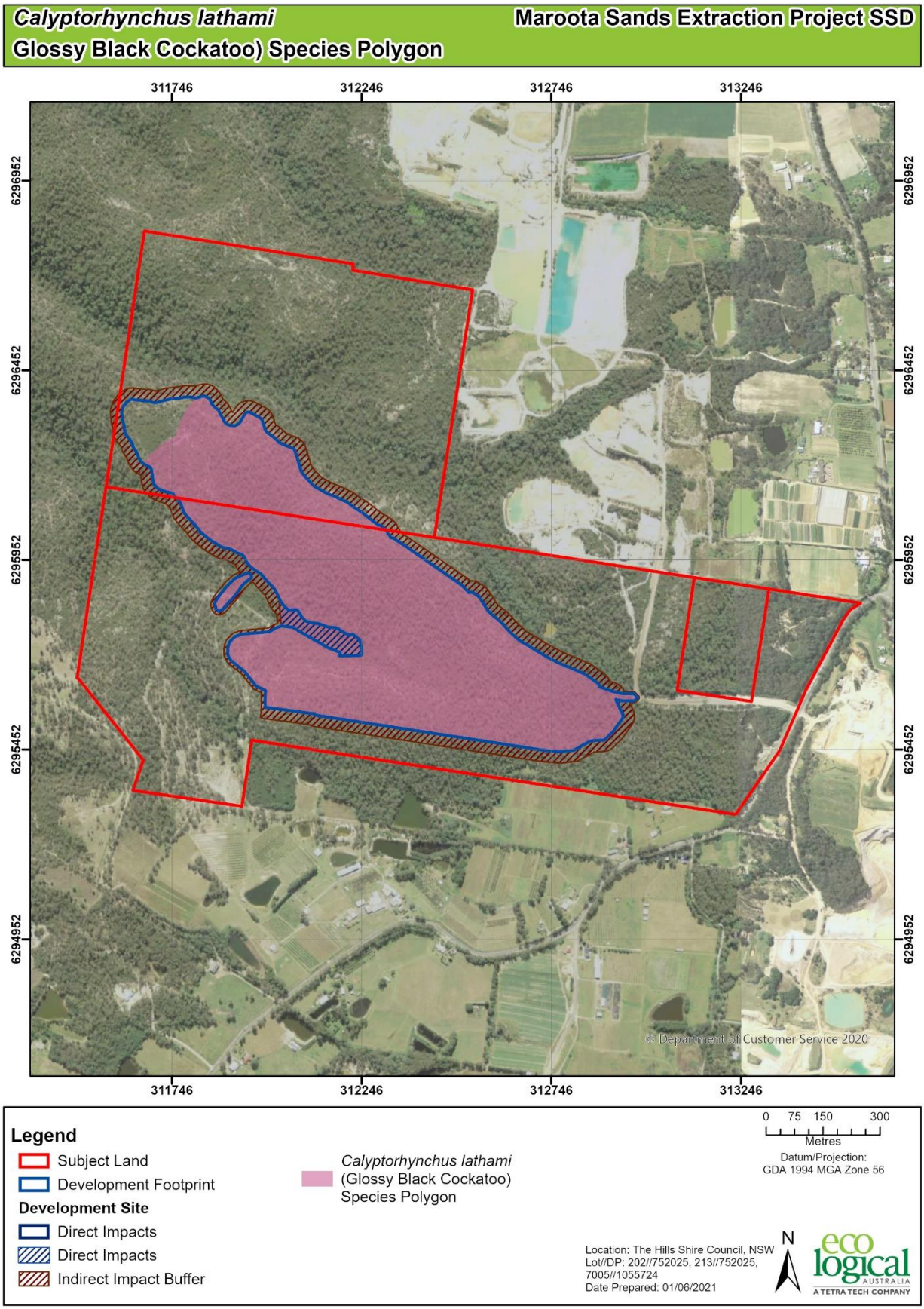

Figure 30: Species polygon Glossy Black Cockatoo

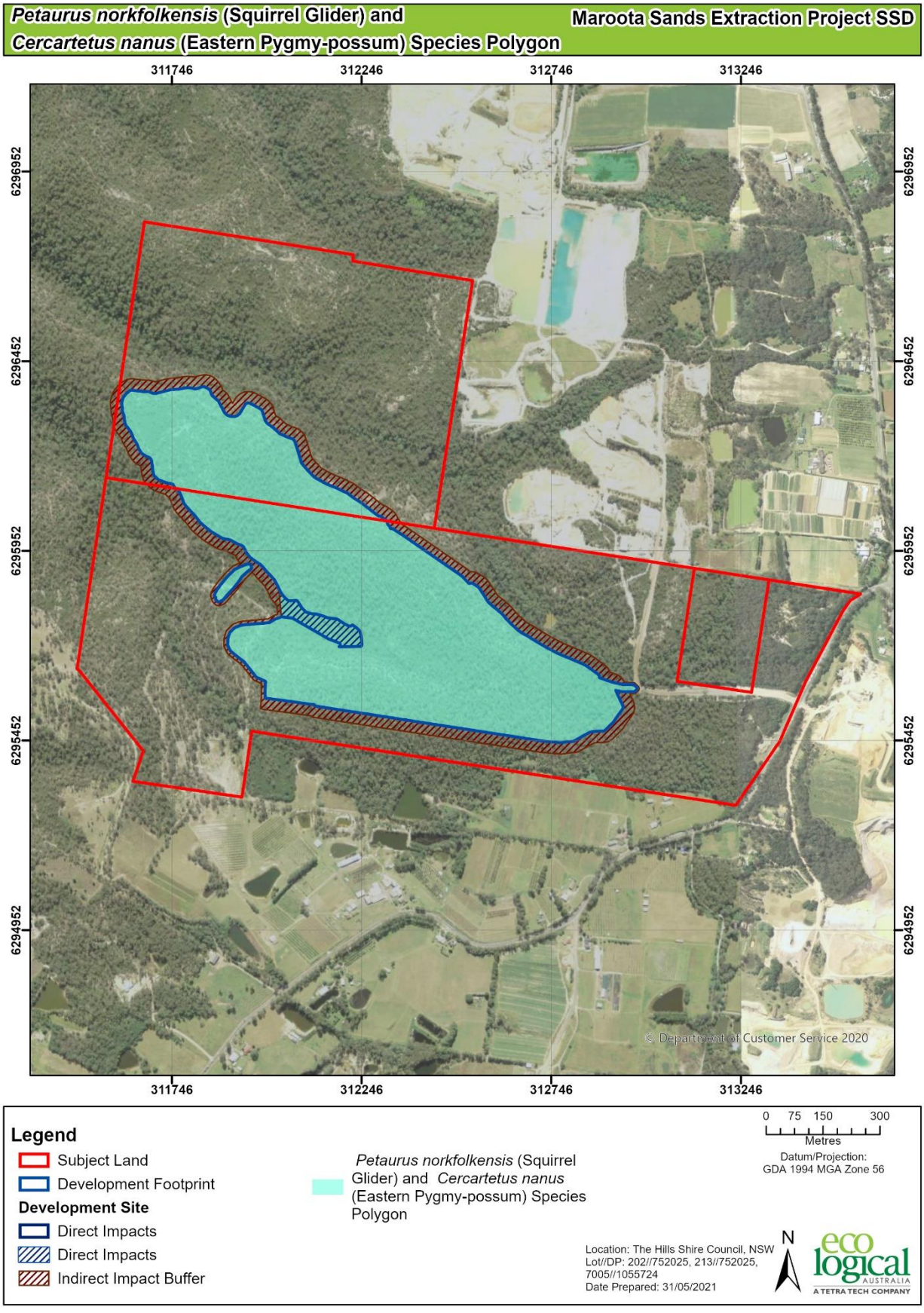

Figure 31: Species polygon Squirrel Glider and Eastern Pygmy-possum

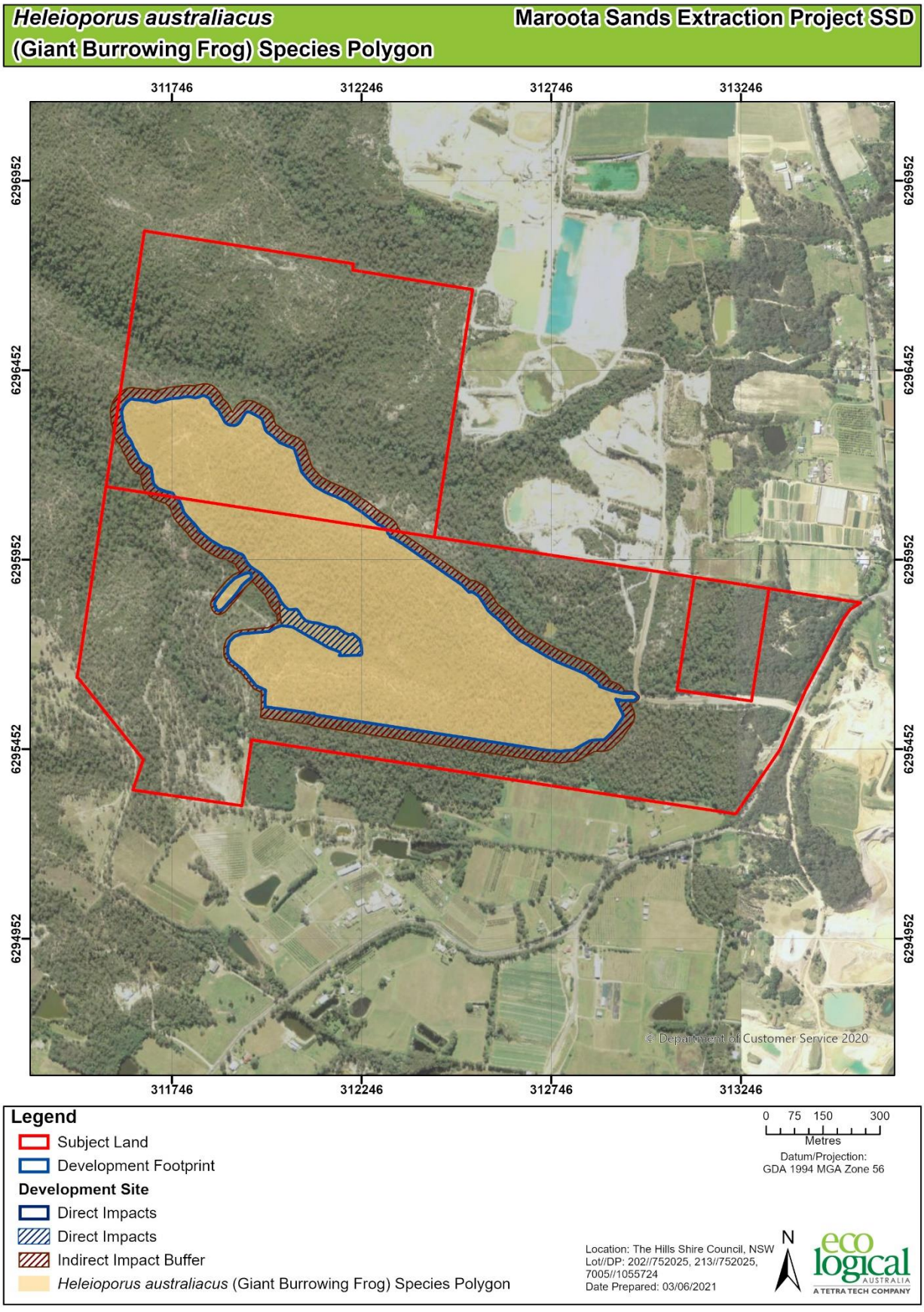

Figure 32: Species polygon Giant Burrowing Frog

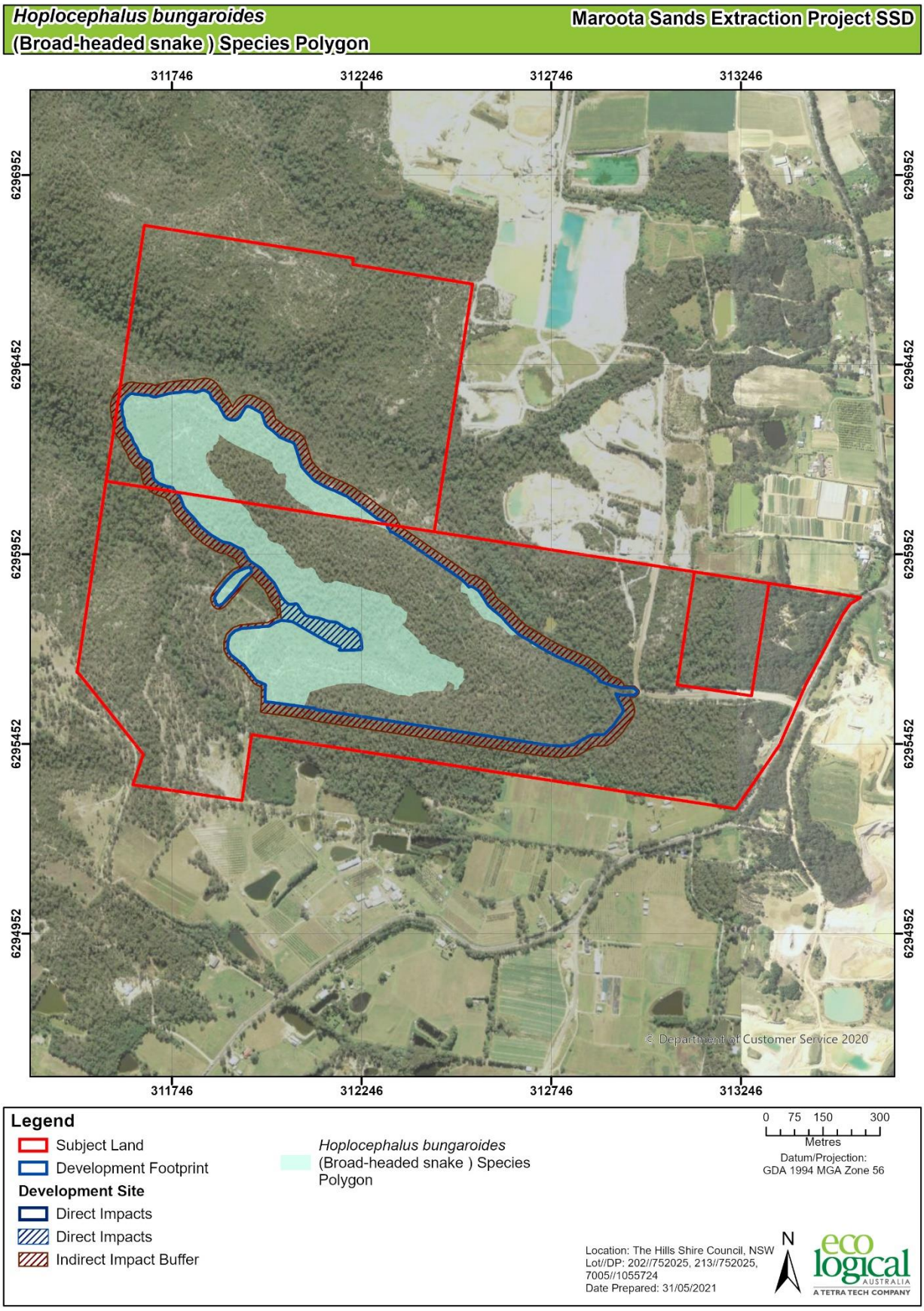

Figure 33: Species polygon Broad-headed Snake

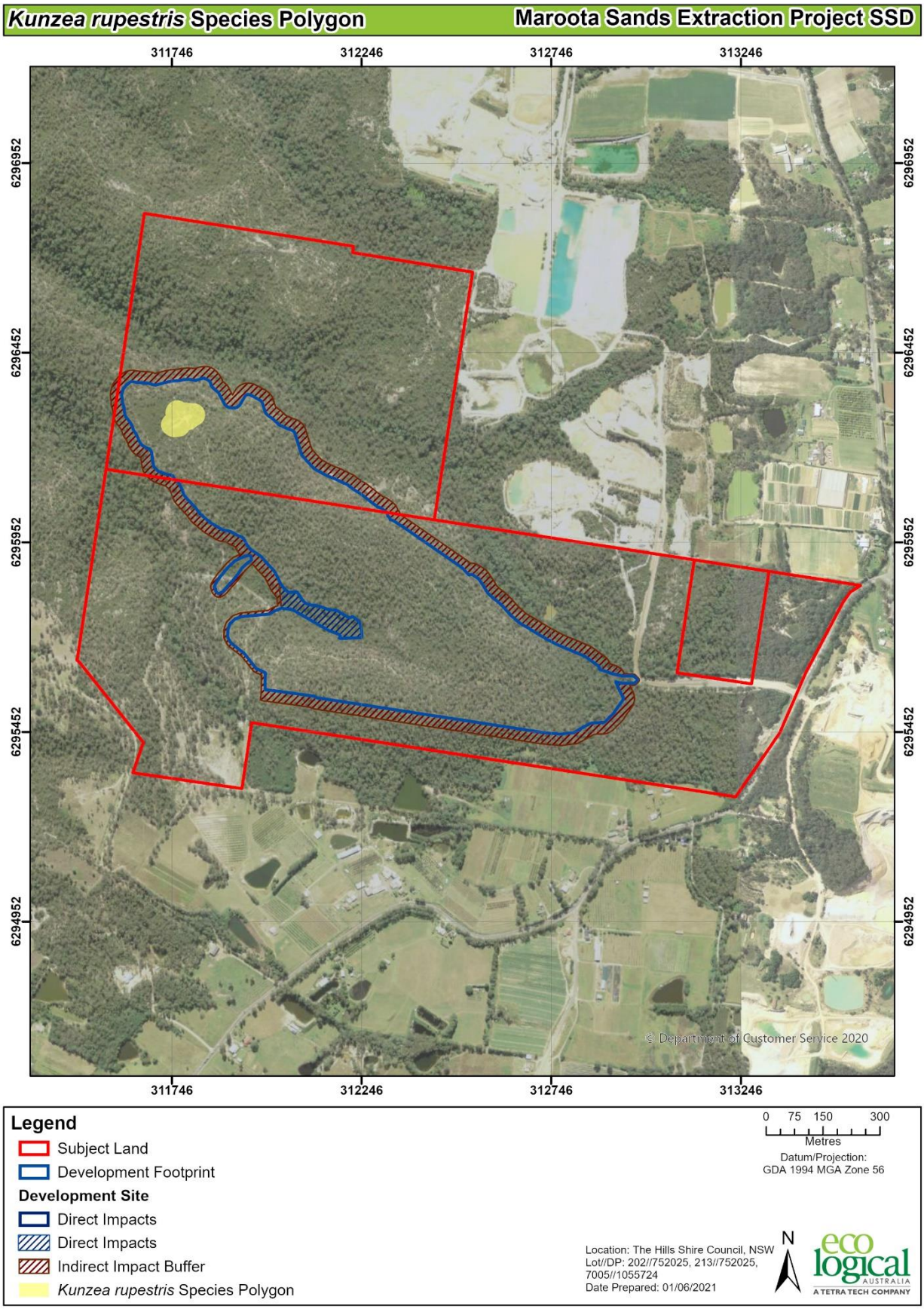

Figure 34: Species polygon *Kunzea rupestris*

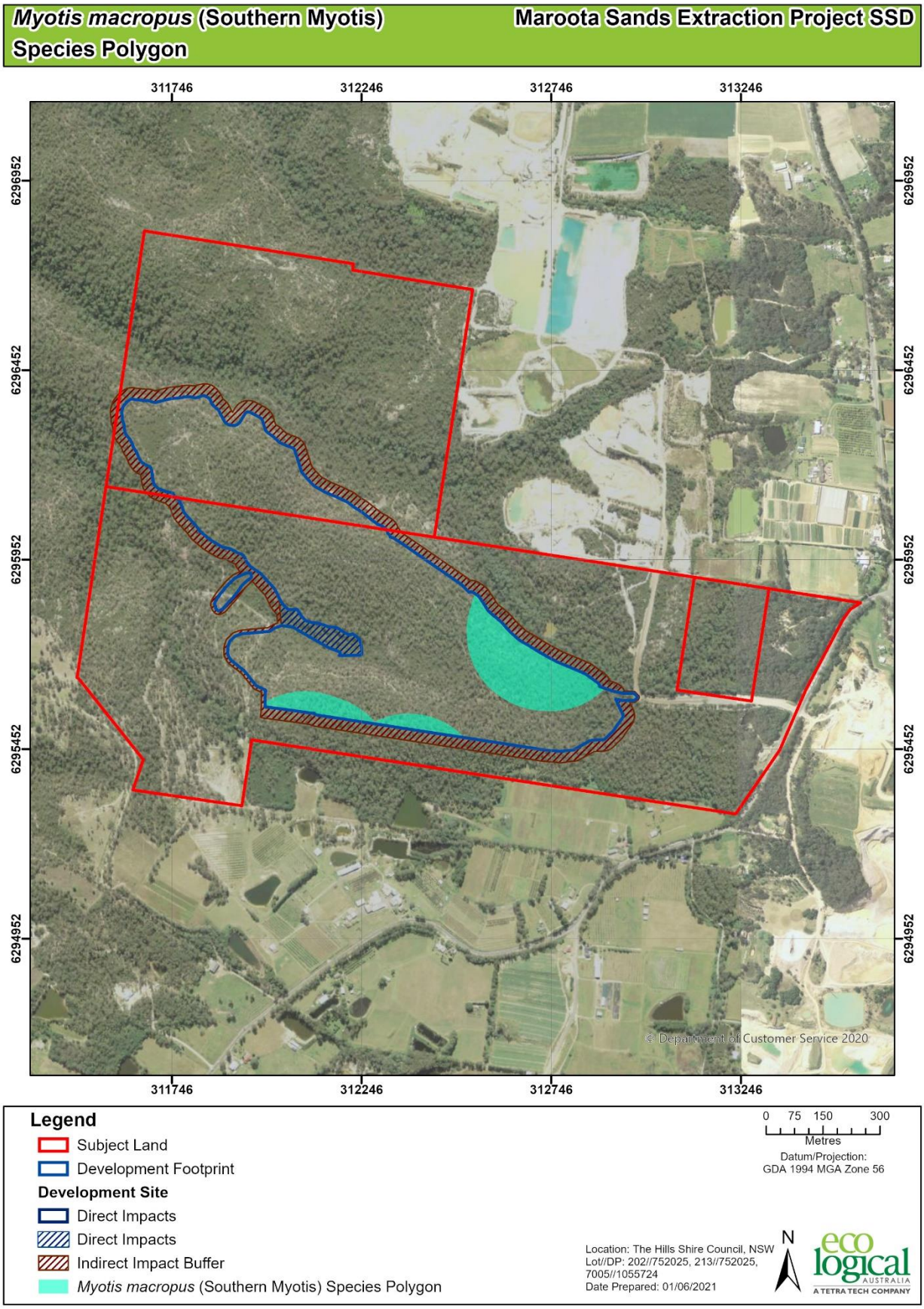

Figure 35: Species polygon Southern Myotis

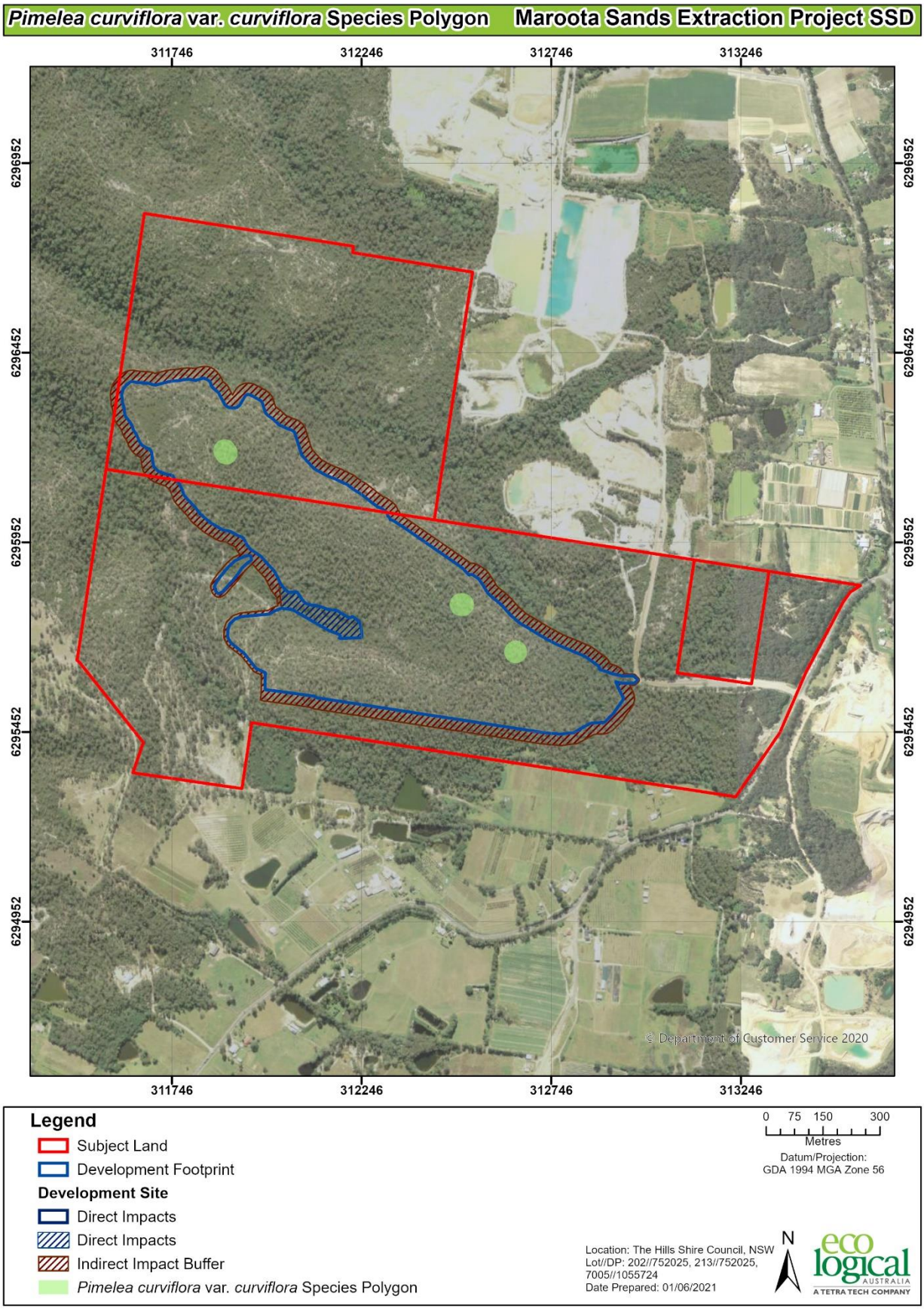

Figure 36: Species polygon *Pimelea curviflora* var. *curviflora*

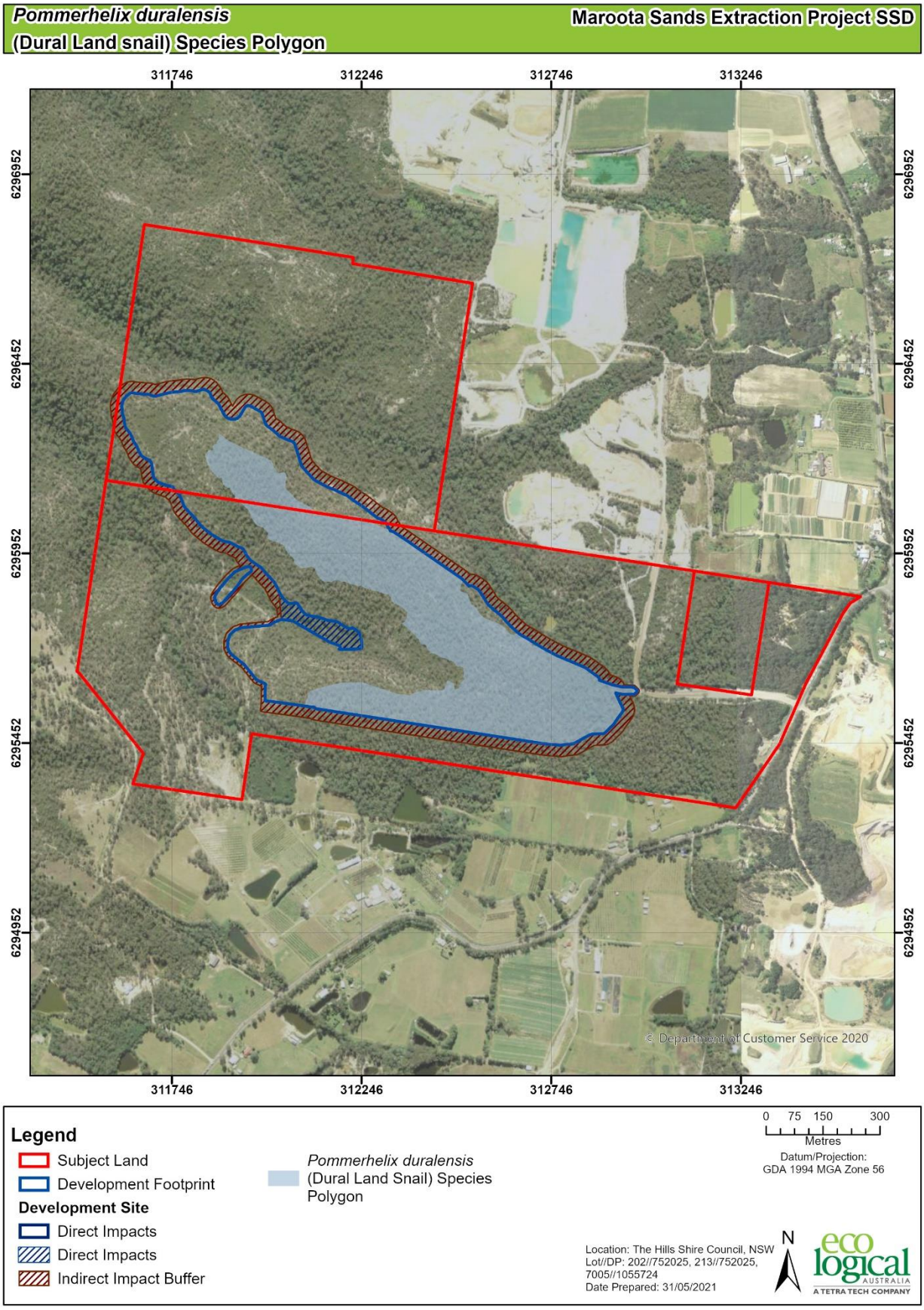

Figure 37: Species polygon Dural Land Snail

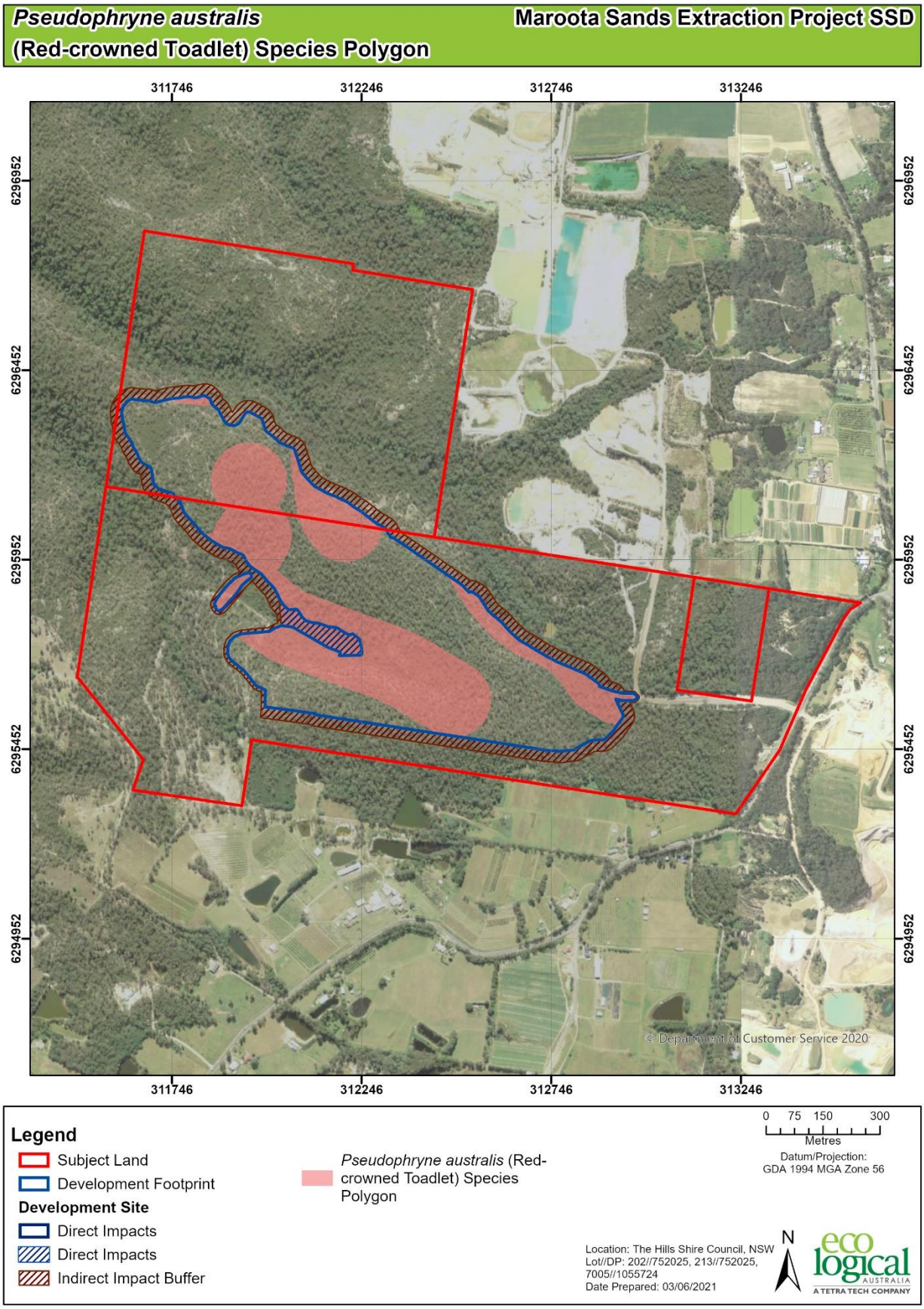

Figure 38: Species polygon Red-crowned Toadlet

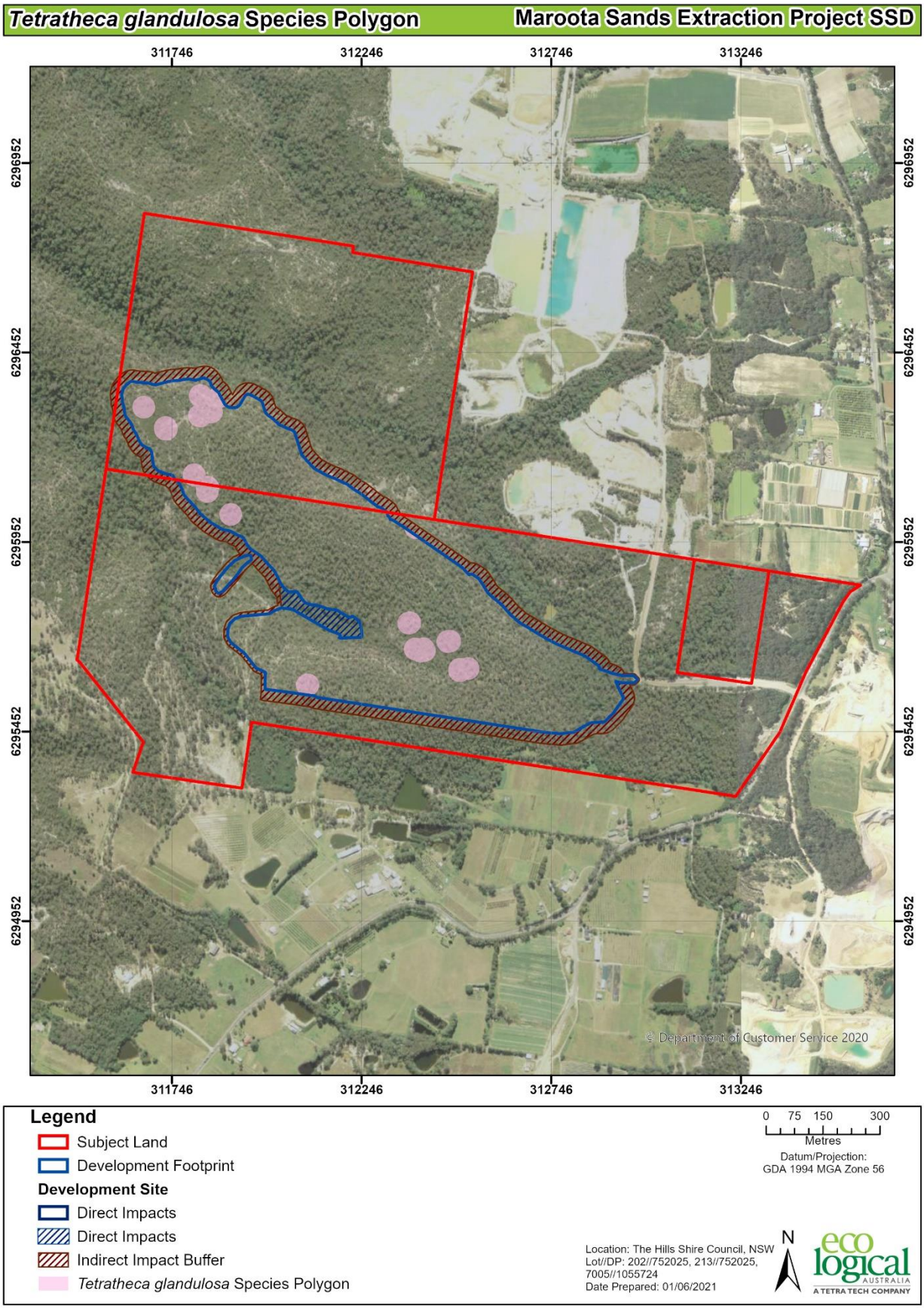

Figure 39: Species polygon *Tetratheca glandulosa*

1.8 Identification of prescribed impact entities

The prescribed impacts at the development are detailed below and displayed on Figure 40.

1.8.1 Karst, caves, crevices, cliffs, rocks and other geological features of significance

The development site contains crevices and rock features within the sandstone PCTs: PCT 1328, PCT1083 and to a lesser degree PCT 1181. These features include rocky outcrops, rock platforms, and shallow crevices.. The Broad -headed Snake utilises this habitat by sheltering in rock crevices and under flat sandstone rocks during autumn, winter and spring (DPIE 2021).. The Rosenberg's Goanna uses rock crevices and outcrops habitat for sheltering, and platforms for basking. The locations of the rock features identifiable by aerial imagery are displayed on Figure 40.

1.8.2 Human-made structures and non-native vegetation

The development site does not contact human-made structures and non-native vegetation which would comprise habitat for threatened entities.

1.8.3 Habitat connectivity

The development site contains remnant bushland which provides connectivity and linkages to habitat for a wide range for all the threatened flora and fauna species known, and considered likely to occur within the development site. These species have been previously identified and described in Section 1.7 however the species include species include *Tetratheca glandulosa, Kunzea rupestris, Pimelea curviflora* var. *curviflora, Acacia bynoeana*, Eastern Pygmy Possum, Koala, Dural Land Snail, Red-crowned Toadlet, Giant Burrowing Frog, Squirrel Glider, Glossy Black-Cockatoo, Southern Myotis, Large-eared Pied-bat, Eastern Cave Bat, Broad-headed Snake, Rosenberg's Goanna, Powerful Owl, Spotted-tailed Quoll.

Removing this vegetation will result in direct impacts to these species by reducing their ability to move across their range and maintain their life cycle. The habitat connectively is displayed as the mapped PCTS on the development site, and adjacent aerial imagery.

1.8.4 Water bodies, water quality and hydrological processes

The development site presently contains a number of first order creeklines and riparian buffers. The development site is also located to the south of a Groundwater Dependent Ecosystem *Maroota Sands Swamp Forest*. The development will result in an impact to water bodies, water quality and hydrological process due to direct removal of these first order watercourses and riparian buffers. It will result in a reduction in water quality due to additional runoff and there will be clearing of native vegetation within riparian buffers. It may also result in the accidental extraction of the groundwater during mining operations.

The threatened species directly impacted include the Red-crowned Toadlet and Giant Burrowing Frog. It is considered that there will be direct impacts on all species previously described in Section 1.7 as these watercourses form part of the habitat connectivity within the development site. The location of the riparian buffers is shown on Figure 40.

1.8.5 Wind farm developments

N/A this development is not a wind-farm development.

1.8.6 Vehicle strikes

Once the development site is cleared and operational, it is possible that ground and arboreal dwelling threatened fauna species may be subject to inadvertent vehicle strike. There is potential for native fauna to be struck by working machinery and moving vehicles during the site preparation and also during mining operations. The species likely to be impacted include Eastern Pygmy Possum, Broad -headed Snake, Rosenberg's Goanna, Spotted-tailed Quoll, Koala.

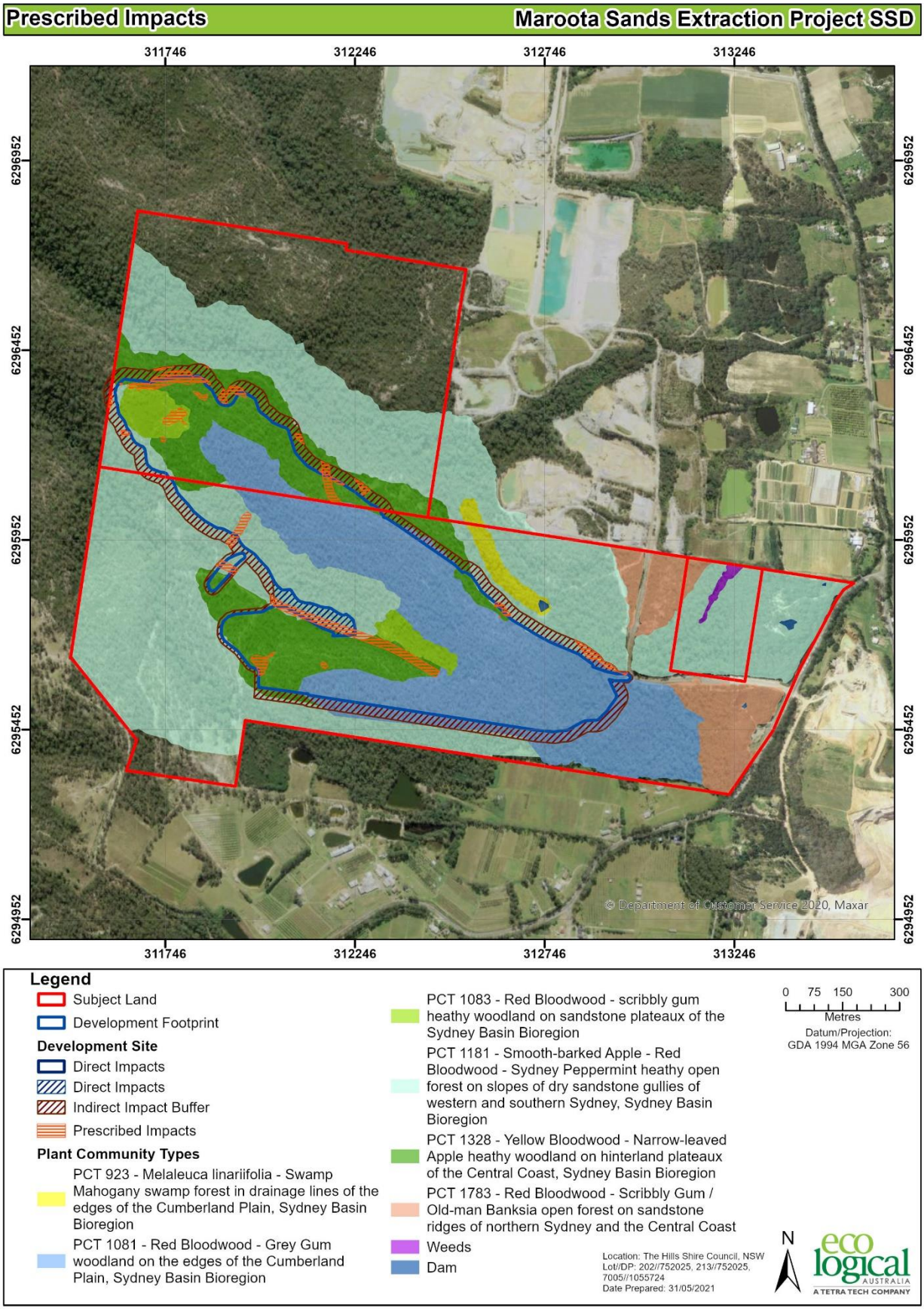

Figure 40: Prescribed impacts

2. Stage 2: Impact assessment (biodiversity values)

2.1 Avoiding impacts

2.1.1 Locating a project to avoid and minimise impacts on vegetation and habitat

The project involves the extraction of a Hawkesbury Sandstone deposit to produces a fine-medium and fine graded sand, crushed sandstone, and a fine aggregate development. Due to the location of the Hawkesbury Sandstone deposit it has not been feasible to locate the project in an area which wholly avoids impacts to vegetation and habitat. It is therefore acknowledged that this project has considerable impact on biodiversity values.

However, during the project design and scoping stages there have been a number of footprint iterations which can demonstrate a process of avoid and minimise was implemented, in particular for some of the biodiversity values within the subject land. This process has been outlined in Table 30.

Table 30: Locating and designing project to avoid and minimise impacts on vegetation and habitat

BAM project location and design principles	How addressed and justification
Locating the project in areas where there are no biodiversity values or where the native vegetation or threatened species habitat is in the poorest condition.	The entire project area is located in remnant bushland, therefore the project has not been located in an area where there are no biodiversity values. All the vegetation within the subject land is of a good quality condition, therefore it is not feasible to locate the project in an area where native vegetation and threatened species habitat is in the poorest condition. However, over the course of initial scoping and feasibility studies, the project location and design has been modified in order to minimise impacts to identified environmental constraints. Throughout the Environmental Impact Assessment process, the project location and design were refined through consultation with environmental specialists and with consideration to the concerns raised by community members and stakeholders. Four revisions of the footprint have thus been prepared. **Original concept layout** The original concept layout is provided in Figure 41. This original location already took into account the location of the Groundwater Dependent Ecosystem (GDE) *Maroota Sands Swamp Forest* endangered ecological community to the north. At this early stage the design had not yet incorporated appropriate buffers to avoid impacts to the vegetation community as these were still to be determined. Ancillary features (i.e. overburden, tailings, administration, water storage etc.) were proposed to be located within an area of PCT1081 *Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion* (listed and a critically endangered ecological community under the Commonwealth EPBC Act). **Revision A: relocation of plant equipment.** This layout is displayed in Figure 42. Following the issuing the of SEARS, the first design revision was to relocate the proposed plant, weighbridge and office area to the rear of the site (west) to mitigate noise and visual impacts for those neighbours located immediately south of the project site. Tailings and overburden storage, as well as a surface water dam, were to be located at the south-west corner of the development site. The site access road was intended to run along the southern boundary of the extraction area to the plant, weighbridge and administration area. The relocation of the plant resulted in the retention of PCT 1081 in the east of the subject land and the removal of impacts to the first order creekline which flows south to north where it eventually flows to the creekline feeding the *Maroota Sands Swamp Forest*. It did however result in a larger, expanded footprint to the west, with the water storage dam now located within a 3rd order creekline, additional removal of non-listed vegetation PCT 1328 *Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion* and PCT 1181 *Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion*, and removal of additional habitat for threatened species such as *Tetratheca glandulosa*.
Designing the project to reduce the clearing footprint of the project	
Designing the project to locate ancillary facilities in areas where there are no biodiversity values.	
Designing the project to locate ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	

BAM project location and design principles	How addressed and justification

Revision B: Relocation of Overburden and Tailings.

To minimise the project's area of disturbance and the resulting environmental impacts, the location for the temporary storage of overburden and tailings was relocated to sit within the proposed extraction area that is also to be quarried late in the quarries project life. This redesign is shown in Figure 43. Further, a sand plant was selected that allows the generation of dry cake tailings. These tailings have the ability to be moved by a front-end loader. This equipment removed the need for large tailings ponds, which in turn has reduced the area of disturbance.

Additionally, this relocation ensures that the watercourses that flow through the south-west corner of the project site are adequately protected.

The water storage dam was initially to be located at the intersection of a 3rd order watercourse. This location is shown in Figure 42 and Figure 43.

Revision C: Relocation of the surface water dam

To avoid impacts to the 3rd order watercourse, that is defined as a major stream under the WM Act, the surface water dam was relocated further to the east onto a 2nd order watercourse, thus reducing impacts to riparian corridors. This location is shown in Figure 44.

Revision D: Relocation of site access roads

As shown in Figure 44, the project design was amended to incorporate a temporary access road that runs through the centre of the extraction area. The access road was proposed to be used until the southern section of the quarry is excavated. At this point, the access road was relocated to run within the southern boundary of the extraction area. This design allows the access road to sit in the extracted area, below the original landform, allowing both a visual and acoustic buffer to those neighbours located immediately south of the project site. Additionally, this redesign reduced the project's area of disturbance and increases the buffer between the access road and the neighbouring properties. This revision also incorporated a 50 m buffer between the edge of the extraction area and the *Maroota Sands Swamp Forest* as per recommendations of the hydrogeologist provided in the Groundwater Constraints Assessment prepared by EMM April 2020. This location also retained the surface water dam within the 2nd order creekline as far east as feasible, in order to reduce impacts to riparian buffers.

Revision E Final design - amended plant area and site access road plus increased buffer to Aboriginal archaeological items in north-west corner

The finalised design relies upon a single access road that is designed to complement the topography of the project site. Like revision D, the majority of the access road is contained within the proposed extraction area to reduce the project's area of disturbance and mitigate visual and noise impacts. The construction of a single access road, as opposed to the two proposed access roads per revision D, moderately reduces the project's area of disturbance near the intersection with Patricia Fay Drive. Furthermore, the finalised designed confirmed the layout of the site infrastructure area and reduced its footprint. The finalised design retains the surface water dam within the 2nd order creek line as far east as feasible to reduce impacts to riparian buffers. This design also reduces the original extraction area by providing a 35 m buffer to the Aboriginal archaeological items located in the north west corner of the development site. The final design is shown in Figure 45.

BAM project location and design principles	How addressed and justification
Locating and designing the project in areas that avoid habitat for species and vegetation in high threat categories (e.g. an EEC or CEEC), indicated by the biodiversity risk weighting for a species	As discussed above, the project has been located and designed to avoid impacts to *Maroota Sands Swamp Forest* endangered ecological community to the north of the development site. Over several revisions, the project has been located and designed to reduce the area of PCT 1081 removed to facilitate ancillary features.
Locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained	The project location will result in the considerable fragmentation of bushland. The parcel of PCT 1081 to the east will the most heavily affected by the project. However, a 100 m vegetated buffer to the south will be retained, thus enabling some movement between PCT 1081 to the east and bushland to the south and south west of the development site. Corridors to the north will be maintained, thus movement to the large core areas of bushland west and north-west of the development site will be maintained.
Providing structures to enable species and genetic material to move across barriers or hostile gaps	Structures to enable species and genetic materials to move across barriers or hostile gaps are not considered appropriate to this development as nature corridors for movement to the north and south of the development site will be retained.
Making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site	A Vegetation Management Plan for all vegetation within the 10 m direct impact areas, 30 m indirect impact area, and affected riparian corridors is recommended for this project. An Adaptive Management Strategy Ecological Monitoring Plan to monitor for impacts on the *Maroota Sands Swamp Forest* and adjoining riparian areas is also required as part of this project.

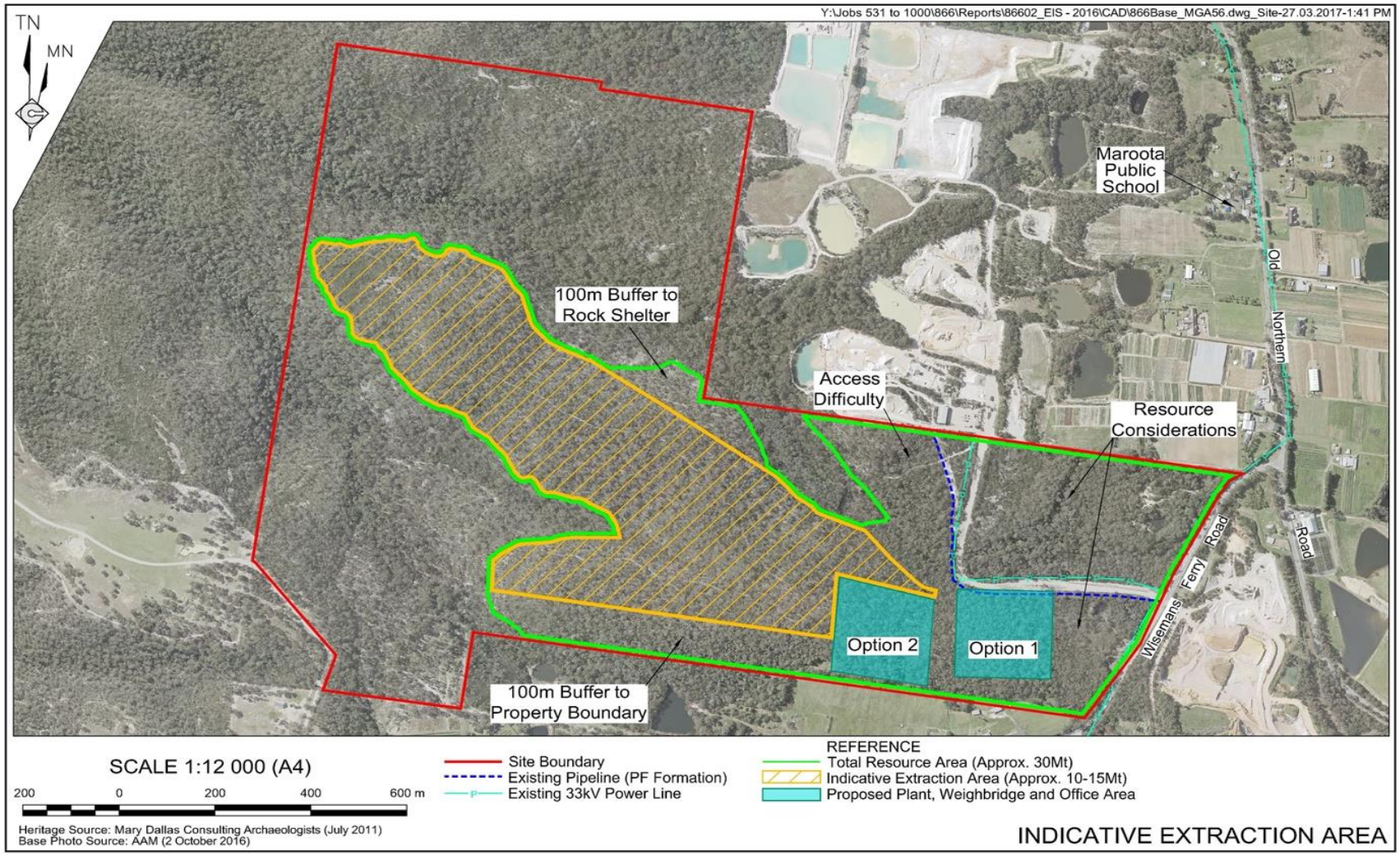

Figure 41: Original footprint location and design concept

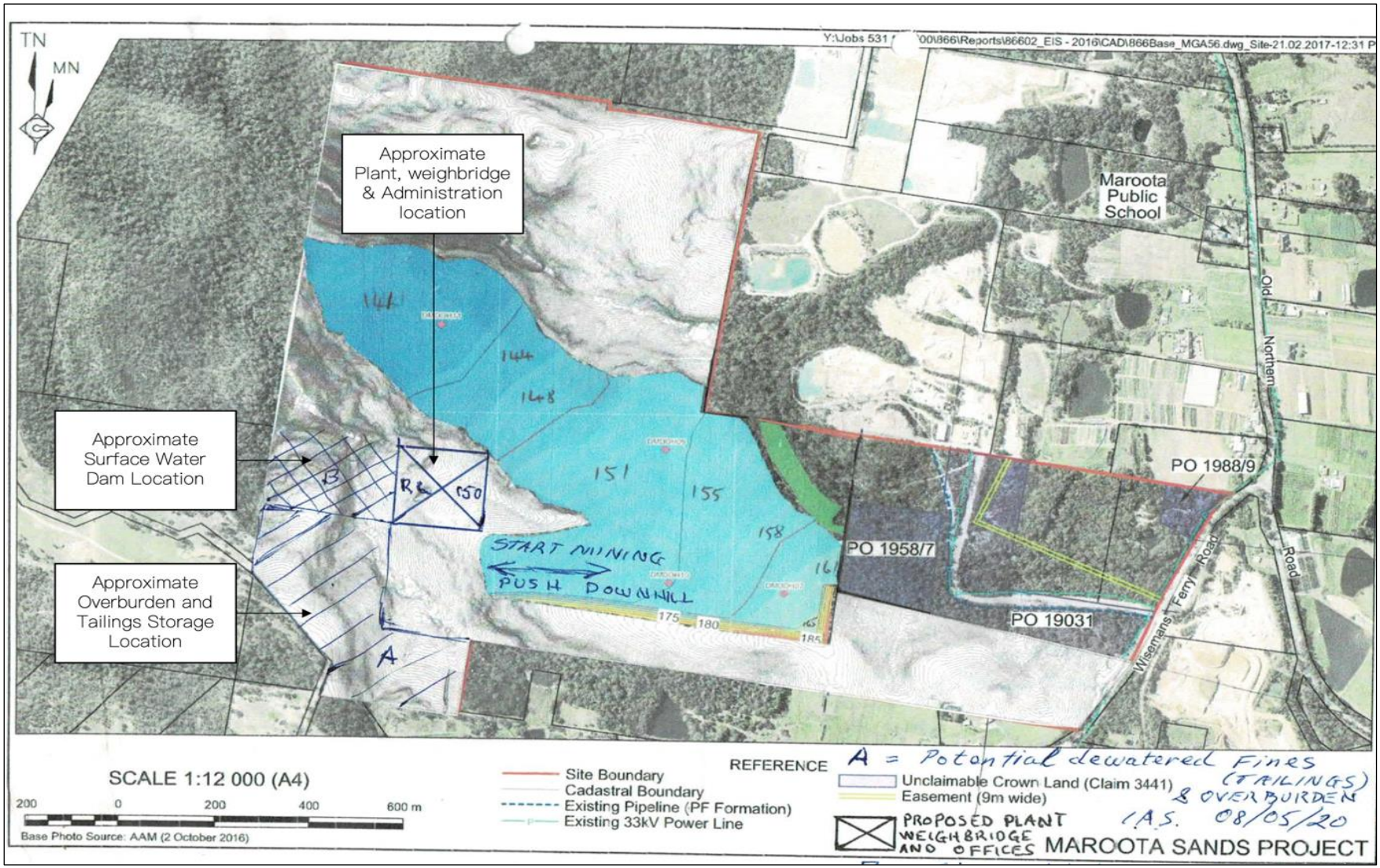

Figure 42: Revision A footprint location and design

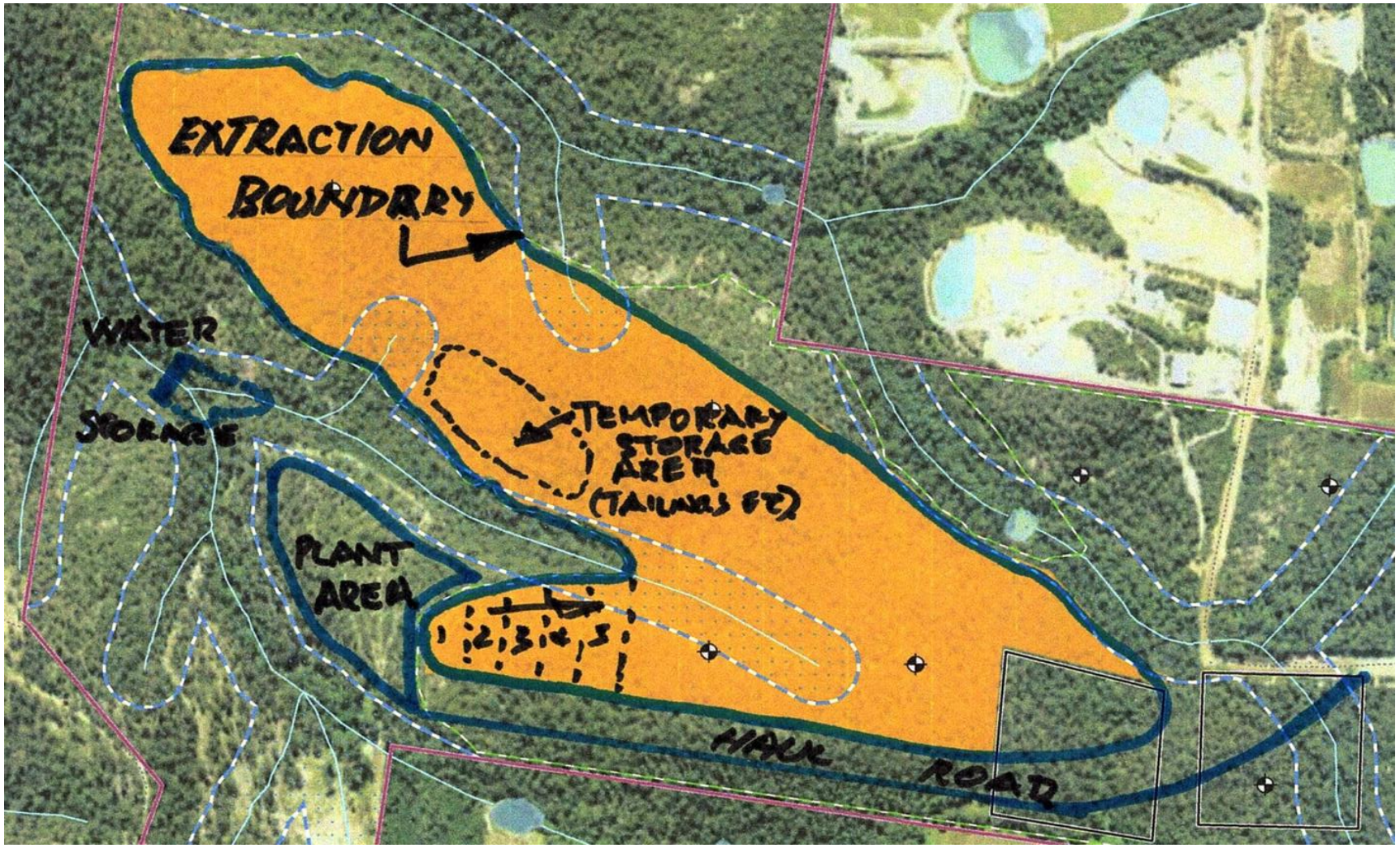

Figure 43: Revision B footprint location and design

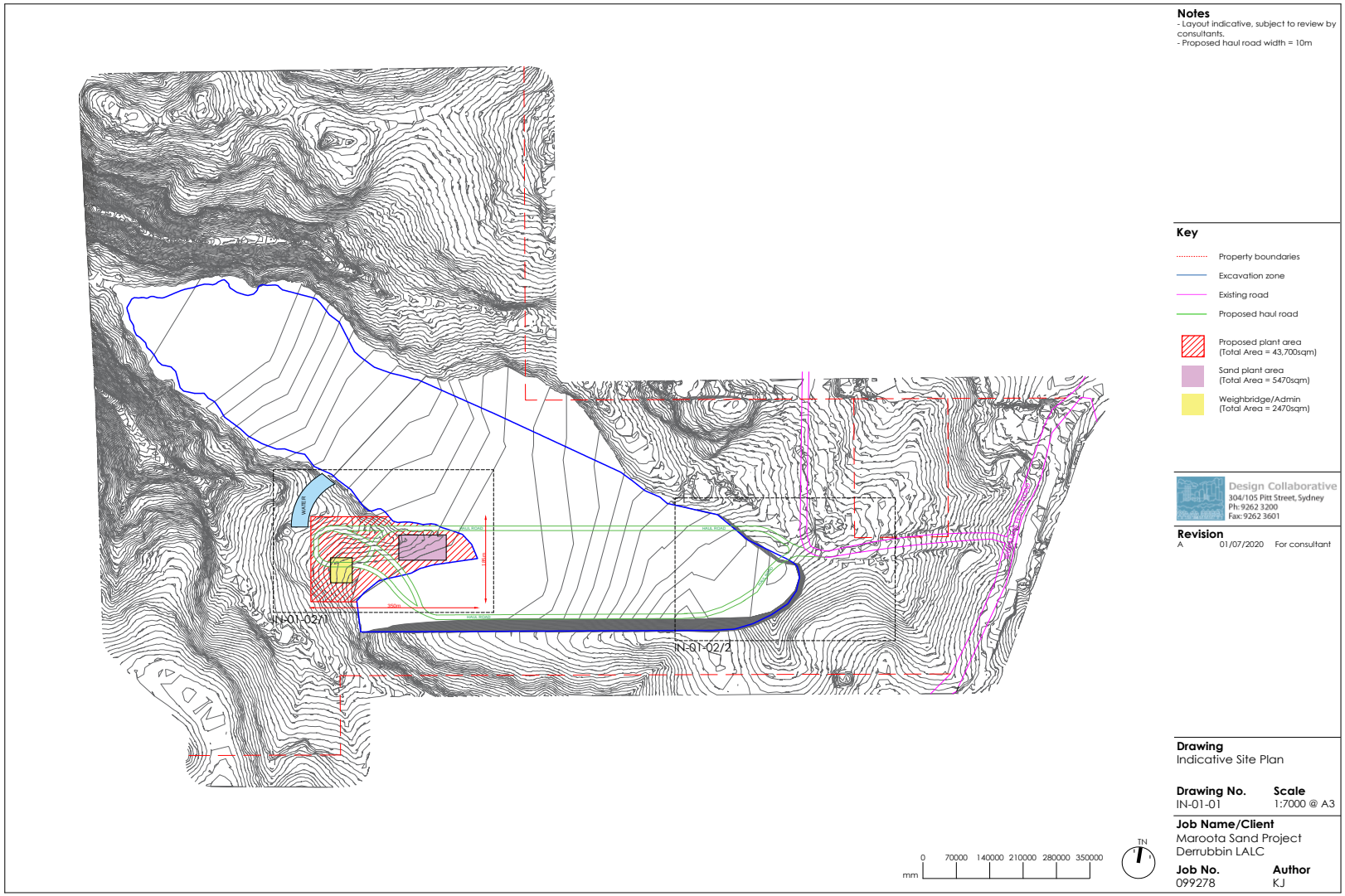

Figure 44: Revision C and D - footprint location and design

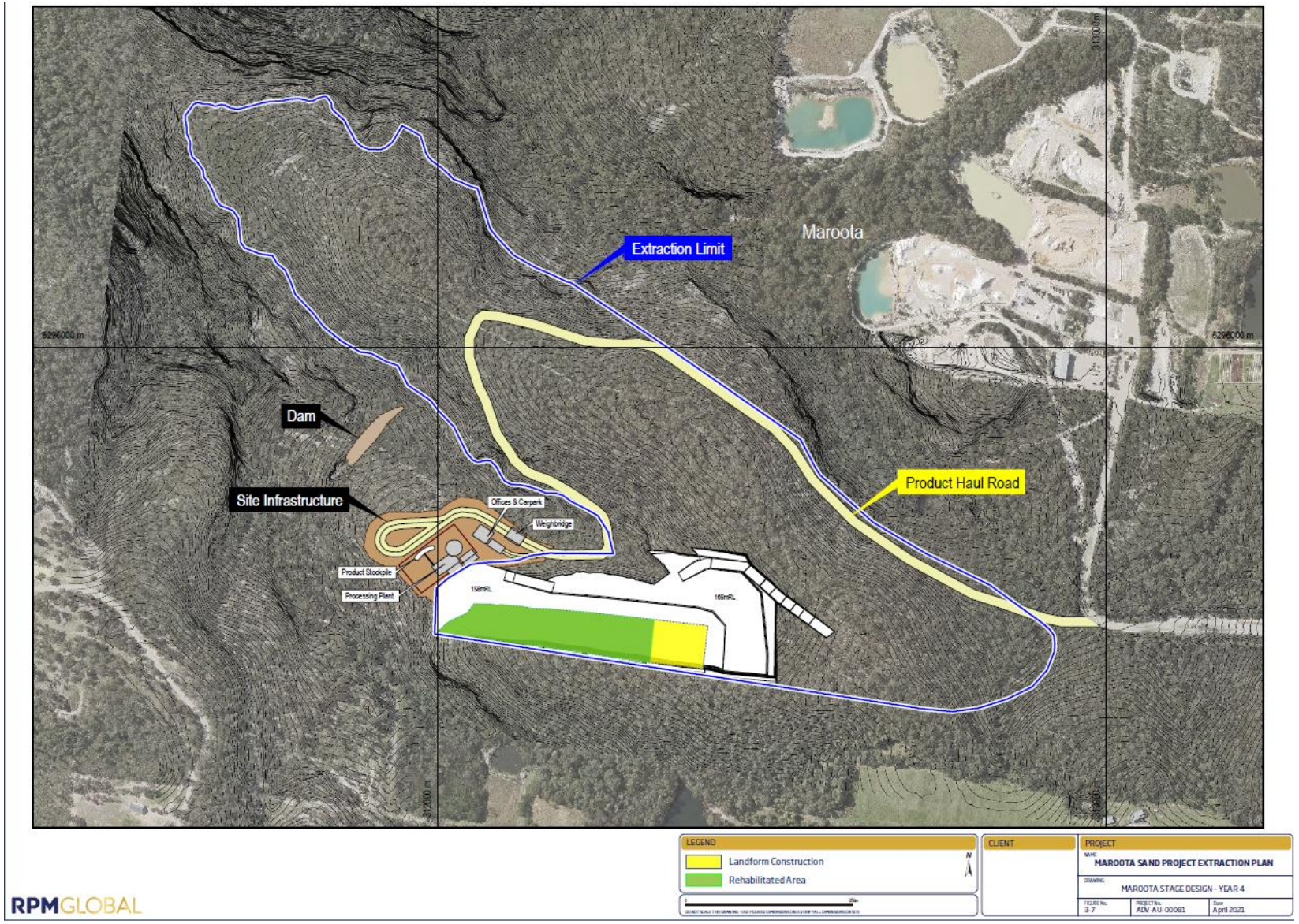

Figure 45: Revision E - final footprint location and design

2.1.2 Prescribed biodiversity impacts

The development site has the prescribed biodiversity impacts as outlined in Table 31.

Table 31: Prescribed biodiversity impacts

Prescribed biodiversity impact	Description in relation to the development site	Threatened species or ecological communities affected
Impacts of development on the habitat of threatened species or ecological communities associated with: • Crevices, and other geological features of significance, or • rocks	The development site contains crevices and rock features within the sandstone PCTs: PCT 1328, PCT1083 and to a lesser degree PCT 1181. These features include rocky outcrops, rock platforms, and shallow crevices.	Broad-headed Snake, Rosenberg's Goanna.
Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	The development site presently contains bushland which provides uninterrupted connectivity features for TECs and threatened species habitat.	*Shale Sandstone Transition Forest of the Sydney Basin Bioregion* (EPBC Act only), *Tetratheca glandulosa, Kunzea rupestris, Pimelea curviflora* var. *curviflora, Acacia bynoeana*, Eastern Pygmy Possum, Koala, Dural Land Snail, Red-crowned Toadlet, Giant Burrowing Frog, Squirrel Glider, Glossy Black-Cockatoo, Southern Myotis, Large-eared Pied-bat, Eastern Cave Bat, Broad-headed Snake, Rosenberg's Goanna, Powerful Owl, Spotted-tailed Quoll. .
Impacts of development on movement of threatened species that maintains their lifecycle	The development site presently contains bushland which provides uninterrupted connectively features allowing for the movement of threatened species that maintain their lifecycle.	Shale Sandstone Transition Forest of the Sydney Basin Bioregion (EPBC Act only), *Tetratheca glandulosa, Kunzea rupestris, Pimelea curviflora* var. *curviflora, Acacia bynoeana*, Eastern Pygmy Possum, Koala, Dural Land Snail, Red-crowned Toadlet, Giant Burrowing Frog, Squirrel Glider, Glossy Black-Cockatoo, Southern Myotis, Large-eared Pied-bat, Eastern Cave Bat, Broad-headed Snake, Rosenberg's Goanna, Yellow-bellied Gilder, Powerful Owl, Spotted-tailed Quoll.
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)	The development site presently contains a number of first order creeklines and riparian buffers. The development site is located to the south of a Groundwater Dependent Ecosystem *Maroota Sands Swamp Forest*.	*Maroota Sands Swamp Forest* endangered ecological community to within the subject land the north of the development site, Red-crowned Toadlet, Giant Burrowing Frog.
Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	Once the development site is cleared and operational, it is possible that ground and arboreal dwelling threatened fauna species may be subject to inadvertent vehicle strike.	Eastern Pygmy Possum, Broad -headed Snake, Rosenberg's Goanna, Spotted-tailed Quoll, Koala.

2.1.2.1 Locating and designing a project to avoid and minimise prescribed biodiversity impacts

A full description of the project design to avoid and minimise impacts has been provided above in Table 30. A justification for how the project avoids and minimises impacts to prescribed biodiversity impacts is outlined below in Table 32.

Table 32: Locating and designing a project to avoid and minimise prescribed biodiversity impacts

BAM project location and design principles for prescribed biodiversity impacts	How addressed and justification
Locating the envelope of surface works to avoid direct impacts on the habitat features	Not addressed. Due to the inherent nature of the project (a friable sandstone extractive industry), direct impacts on habitat features such as shallow crevices, sandstone outcrops, platforms and rocks cannot be avoided.
Locating the envelope of sub-surface works, both in the horizontal and vertical plane, to avoid and minimise operations beneath the habitat features, e.g. locating long wall panels away from geological features of significance or water dependent plant communities and their supporting aquifers	This final design incorporates a 50 m buffer between the edge of the extraction area and the *Maroota Sands Swamp Forest* as per recommendations of the Groundwater Constraints Assessment prepared by EMM (April 2020). This final location also locates the surface water dam within the 2nd order creekline as far east as feasible, in order to reduce impacts to downstream riparian buffers.
Locating the project to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or preferred local movement pathways	The project location will result in the considerable fragmentation of bushland. The parcel of PCT 1081 to the east will the most heavily affected by the project. However, a 100 m vegetated buffer to the south will be retained, thus enabling some movement between PCT 1081 to the east and bushland to the south and south west of the development site. Corridors to the north will be maintained, thus movement to the large core areas of bushland west and north-west of the development site will be maintained.
Optimising project layout to minimise interactions with threatened and protected species and ecological communities, e.g. designing turbine layout to allow buffers around features that attract and support aerial species, such as forest edges, riparian corridors and wetlands, ridgetops and gullies	Interaction with the *Maroota Sands Swamp Forest* has been minimised with the provision of a 50 m buffer from the extraction boundary. The location for the temporary storage of overburden and tailings was relocated to sit within the proposed extraction area that is also to be quarried late in the quarries project life. Further, a sand plant was selected that allows the generation of dry cake tailings. These tailings have the ability to be moved by a front-end loader. This equipment removed the need for large tailings ponds (although some smaller tailing ponds are required), which in turn has reduced the area of disturbance.
Locating the project to avoid direct impacts on water bodies. Design of the project to maintain hydrological processes that sustain threatened species and TECs.	The final design incorporates a 50 m buffer between the edge of the extraction area and the *Maroota Sands Swamp Forest* as per recommendations of the hydrogeologist. This final location also retains the surface water dam within the 2nd order creekline as far east as feasible, in order to reduce impacts to riparian buffers. Movement of plant and the water storage dam to east has reduced impacts to the first order creekline which runs south-north to the east of the development site.

BAM project location and design principles for prescribed biodiversity impacts	How addressed and justification
Design of the project to avoid and minimise downstream impacts on rivers, wetlands and estuaries by control of the quality of water released from the site.	Permanent sediment and water quality control measures are to be implemented during and after construction to prevent offsite impacts to downstream waterways and water dependent communities. It is recommended that stormwater quality improvement devices will be installed to prevent long-term impacts to downstream waterbodies including the *Maroota Sands Swamp Forest*. .
Engineering solutions, e.g. proven techniques to minimise fracturing of bedrock underlying features of geological significance, water dependent communities and their supporting aquifers; proven engineering solutions to restore connectivity and favoured movement pathways	It is understood that the project will be an above water table quarry operation and will not intercept the water table. If interception of the groundwater table is to be avoided, the quarry extraction depth will be set to 2 m above the observed high groundwater elevation, i.e. the highest observed groundwater level elevation. It is understood that as part of the mine design, extraction will not occur below two metres of the wet weather high groundwater levels for the subject land.

2.2 Assessment of Impacts

2.2.1 Direct impacts

The direct impacts of the development on:

- native vegetation is outlined in Table 33
- threatened ecological communities are outlined in Table 34
- threatened species and threatened species habitat is outlined in Table 35
- Groundwater Dependent Ecosystem *Maroota Sands Swamp Forest* is outlined Section 2.2.3
- prescribed biodiversity impacts are outlined in Section 2.2.5.

Direct impacts including the final project footprint (construction and operation) are shown on Figure 7.

The BAM defines the development footprint as *the area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials. The term development footprint is also taken to include clearing footprint*. In relation to this project, the development footprint is all the land that will be directly impacted by the proposed development.

Direct impacts are defined in the BAM and are described in the BAM Operational Manual Stage 2 (DPIE 2020) as those impacts *that result from clearing vegetation for a development. These impacts are predictable, usually occur at or near to the subject land, and can be readily identified during the planning and design phases of a development. Direct impacts may be permanent (e.g. construction of a railway or building) or temporary (e.g. only occurring over weeks or months) and may result in partial (e.g. ground cover, litter and functional attributes such as logs removed but all other structural components of the vegetation remain) or complete clearing.*

Direct impacts areas within the development footprint therefore includes the extraction area, plant and administration area, water storage dam, haul roads and selected areas of vegetation outside these areas which will be heavily impacted by the development. It also includes direct impact buffers of the following distances:

- extraction area plus a 10 m buffer around the edge of the extraction area
- plant area and dam plus a 5 m buffer
- haul road where it exits at Patricia Fay Drive plus 2m added either side of the road.
- strip of retained vegetation north of the plant area and south and the extraction area.

The development footprint is 50.95 ha in size. Biodiversity credits have been calculated for all areas directly affected by the proposed development (i.e. the entire development footprint).

Table 33: Direct impacts to native vegetation

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Sydney Hinterland Dry Sclerophyll Forest	Dry Sclerophyll Forests (Shrubby sub-formation)	25.71

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Sydney Coastal Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	3.27
1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Sydney Hinterland Dry Sclerophyll Forest	Dry Sclerophyll Forests (Shrubby sub-formation)	13.8
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Sydney Coastal Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	8.17
			Total	**50.95**

Table 34: Direct impacts on threatened ecological communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Direct impact (ha)	Listing status	Name	Direct impact (ha)
1081	Not Listed	N/A	N/A	CEEC	Shale Sandstone Transition Forest of the Sydney Basin Bioregion	25.71

Table 35: Direct impacts on threatened species and threatened species habitat

Species	Common Name	Habitat (ha)	NSW listing status	EPBC Listing status
Acacia bynoeana	Bynoe's Wattle	1.64	Endangered	Vulnerable
Calyptorhynchus lathami	Glossy Black Cockatoo	49.04	Vulnerable	Not Listed
Cercartetus nanus	Eastern Pygmy-possum	50.95	Vulnerable	Not Listed
Heleioporus australiacus	Giant Burrowing Frog	50.95	Vulnerable	Vulnerable
Hoplocephalus bungaroides	Broad-headed Snake	25.24	Endangered	Vulnerable
Kunzea rupestris		0.81	Vulnerable	Vulnerable
Myotis macropus	Southern Myotis	7.08	Vulnerable	Not Listed
Petaurus norfolcensis	Squirrel Glider	50.95	Vulnerable	Not Listed
Pimelea curviflora var. curviflora		0.91	Vulnerable	Vulnerable

Species	Common Name	Habitat (ha)	NSW listing status	EPBC Listing status
Pommerhelix duralensis	Dural Land Snail	25.71	Endangered	Endangered
Pseudophryne australis	Red-crowned Toadlet	24.50	Vulnerable	Not Listed
Tetratheca glandulosa		4.13	Vulnerable	Not Listed

2.2.2 Change in vegetation integrity

The change in vegetation integrity as a result of the development is outlined in Table 36.

Table 36: Change in vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity
1	1081	Open understorey	22.69	55.5	0	-55.5
2	1081	Dense midstorey	3.02	55.9	0	-55.9
3	1083	Heathy understorey	1.95	46	0	-46
4	1083	Open understorey	1.32	65.2	0	-65.2
5	1328	Open understorey	10.22	52.2	0	-52.2
6	1328	Heathy understorey	3.58	64	0	-64
7	1181	Good	8.17	59.4	0	-59.4

2.2.3 Impacts to Groundwater Dependent Ecosystems (GDE)

Maroota Sands Swamp Forest GDE is dependent on both groundwater inflow (i.e. the shallow aquifer (EMM2020)) and external sources from two 1st order creeklines that flow in from the east. Therefore, the GDE is able to draw on surface water as well as groundwater to sustain its ecosystem.

There is the potential for impacts to the GDE if groundwater drawdown extends beneath it and if upstream surface water flow are impacted. The forest contains species, such as *Eucalyptus robusta* and *Melaleuca linariifolia* which may show signs of stress if the water level drops below their rooting depths. Therefore, any lowering of the groundwater table or changes to the surface water regime may stress the community.

According to the EMM 2020, abstraction of groundwater for quarry water supply would see a maximum drawdown impact of less than 2 metres. According to the Water Assessment drawdown in the shallow aquifer has not been modelled, however it is stated that drawdown is unlikely to occur in the shallow aquifer as the shallow aquifer is interpreted to be perched above the deep aquifer, meaning that the two aquifers are vertically separated by an unsaturated zone. Groundwater abstraction from the deep

aquifer is not expected to impact the shallow aquifer. Hence, no impacts to the GDE are expected (EMM 2020).

It is proposed to allow a 50m vegetated buffer from the edge of the extraction area to the southern edge of the GDE. It is understood that the project will be an above water table quarry operation and will not intercept the water table. The quarry extraction depth will be set to 2 m above the observed high groundwater elevation, i.e. the highest observed groundwater level elevation. It is understood that as part of the extractive industry design, extraction will not occur below two metres of the wet weather high groundwater levels for the subject land.

There is potential for groundwater drawdown to impact trees near the GDE and watercourses, however trees in these areas are not completely dependent on the water table (and are likely supported by the shallow aquifer), also drawing water from the soils and rocks in the unsaturated zone.

2.2.4 Indirect impacts

The development site comprises the development footprint and additional areas subject to indirect impacts. Indirect impacts are described in BAM Operational Manual Stage 2 (DPIE 2020) as *development related activities not associated with clearing for the development footprint. Examples include increased noise, dust, light spill, weeds and pathogens and edge effects that can be reasonably attributed to the development. Indirect impacts often occur beyond the development footprint or even the development site, have a lower or variable intensity of impact compared to direct impacts, may be harder to predict spatially and temporally, may have unclear boundaries of responsibility.*

The indirect impact buffer areas in the development site are as follows:

- extraction area – 30 m additional around the edge of the 10 m direct impact area
- plant area – 10 m additional from the edge of the 5 m direct impact area
- haul road – 5 m additional on the edge of the 2 m direct impact area.

The development site is 61.92 ha in size. Biodiversity credits have not been calculated for these indirect impact buffer areas. These areas will be subject to management and mitigation measures.

The indirect impact areas are shown below in Table 37.

Table 37: Vegetation zone areas of Indirect impact area.

Veg Zone	PCT ID	Condition	Area (ha)
1	1081	Open understorey	2.21
2	1081	Dense midstorey	0.84
3	1083	Heathy understorey	0
4	1083	Open understorey	0.01
5	1328	Open understorey	3.66
6	1328	Heathy understorey	0.3
7	1181	Good	3.97
		Total	**10.97**

The indirect impacts of the development are outlined in Table 38. Indirect impact zones are shown on Figure 7.

Table 38: Indirect impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Sedimentation and contaminated and/or nutrient rich run-off	Construction and operation	Runoff during construction and operation resulting in pollution and degradation of adjacent creeklines	Potential sedimentation and contaminated runoff into adjacent creeks	During rainfall events	During construction and operational phase of project	Potentially long-term impacts
Noise, dust or light spill	Construction and operation	Noise and dust from machinery, light spill during operational phase disturbing fauna activity in adjacent vegetation.	Adjacent vegetation	Daily, during construction works and operational phase	During construction and operational phase of project	Potentially long-term impacts
Inadvertent impacts on adjacent habitat or vegetation	Construction and operation	Damage to adjacent habitat and vegetation including riparian areas TECs as a result of construction or operation of development.	Adjacent vegetation	Daily, during construction works and operational phase	During construction and operational phase of project	Potentially long-term impacts
Transport of weeds and pathogens from the site to adjacent vegetation	Construction and operation	Spread of weed seed and pathogens from incoming machinery and equipment	Potential spread into nearby habitat	Daily, during construction and operational phases	During construction and operational phase of project	Potentially long-term impacts
Vehicle strike	Construction and operation	Potential for native fauna to be struck by working machinery and moving vehicles	Within construction and operational area	Daily, during construction and operational phases	During construction and operational phase of project	Potentially long-term impacts
Trampling of threatened flora species	Construction / operation	Potential for trampling of *Tetratheca glandulosa, Acacia bynoeana, Pimelea curviflora* var. *curviflora* and *Kunzea rupestris* outside of development site within the indirect impact areas.	Adjacent to and within the development site .	Daily, during construction and operational phases	During construction and operational phase of project	Potentially long-term impact

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
Rubbish dumping	Construction and operation	Unauthorised rubbish dumping by workers and public leading to degradation of adjacent vegetation	Potential for rubbish to spread into adjacent vegetation in the indirect impact areas and outside development site	Daily, during construction and operational phases	During construction and operational phase of project	Potentially long-term impacts
Wood collection	Construction and operation	Removal of wood in indirect impact areas and vegetation adjacent to development site resulting in loss of habitat resources for fauna	Throughout adjacent vegetation	Potential to occur at any time during construction or operational phases	During construction and operational phase of project	Medium-term impacts
Bush rock removal and disturbance	Construction and operation	Removal and disturbance of bush rock in indirect impact areas and vegetation adjacent to development site resulting in loss of habitat resources for fauna	Throughout adjacent vegetation	Potential to occur at any time during construction or operational phases	During construction and operational phase of project	Long-term impacts
Increase in predatory species populations	Construction and operation	Potential to increase if food scraps/rubbish is left on or adjacent to site. Potential to increase -/+ decrease due to disturbance to existing vegetation resulting in increased predation on native fauna	Within the development and throughout indirect impact areas and adjacent vegetation	Potential to occur gradually after disturbance to habitat and vegetation takes place	During construction and operational phase of project	Potentially long-term impacts
Increase in pest animal populations	Construction and operation	Potential to increase if food scraps/rubbish is left on or adjacent to site. Potential to increase -/+ decrease due to disturbance to existing vegetation.	Within the development and throughout indirect impact areas and adjacent vegetation	Potential to occur gradually after disturbance to habitat and vegetation takes place	During construction and operational phase of project	Potentially long-term impacts
Increased risk of fire	Construction and operation	Potential for fire to spark during construction and operation from any	Throughout adjacent vegetation	Potential to occur at any time throughout the operational	During operating/ construction hours	Potentially long-term impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
		machinery or electrical works		or construction phases		

2.2.5 Prescribed biodiversity impacts

The development site has the prescribed biodiversity impacts as outlined in Table 39.

Table 39: Direct impacts on prescribed biodiversity impacts

Prescribed biodiversity impact	Nature	Extent	Frequency	Duration	Timing
Impacts of development on the habitat of threatened species or ecological communities associated with: • Crevices, other geological features of significance, or • rocks	Removal of Hawkesbury Sandstone rock features which provides habitat for threatened fauna Broad-headed Snake and Rosenberg's Goanna	Removal of 25.24 ha of sandstone PCTS	Single event.	Permanent removal	Long term impacts
Impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	Reduced connectivity of vegetation and habitat for threatened species this reducing their ability to move across their range.	Removal of 50.95 ha of native vegetation.	Single event	Permanent removal of remnant, naturally occurring bushland which provides connectivity to facilitate movement of threatened species across their ranges. Connectivity will be partially restored when the extractive industry is rehabilitated at end of extractive industry's life.	Long term impacts
Impacts of development on movement of threatened species that maintains their lifecycle	Reduced connectivity of vegetation and habitat for threatened species thus reducing their ability to maintain their lifecycle.	Removal of 50.95 ha of native vegetation	Single event	Permanent removal of remnant, naturally occurring bushland which provides habitat to maintain lifecycle of threatened species. Habitat will be partially restored when the extractive industry is rehabilitated at end of extractive industry's life.	Long Term Impacts
Impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from	Reduction in water quality due to runoff. Clearing of native vegetation within riparian buffers.	Clearing of 1.43 ha of native vegetation within the riparian buffers.	Daily, during construction and operational phases. During heavy rainfall events	Single event during construction. During rainfall events. Multiple events during operations	Long-term impacts

Prescribed biodiversity impact	Nature	Extent	Frequency	Duration	Timing
subsidence or upsidence resulting from underground mining)	Accidental extraction of the groundwater during mining operations.	Mining to within 2m of groundwater levels.			
Impacts of vehicle strikes on threatened species or on animals that are part of a TEC.	Potential for native fauna to be struck by working machinery and moving vehicles.	Within construction and operational area	Daily, during construction and operational phases	During construction and operational phase of project	Long-term impacts

2.2.6 Mitigating and managing impacts

Measures proposed to mitigate and manage impacts at the development site before, during and after construction are outlined in Table 40.

Table 40: Measures proposed to mitigate and manage impacts

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Timing works to avoid critical life cycle events such as breeding or nursing	High	Low	Tree felling of hollow bearing trees should be undertaken outside of spring and summer (main breeding season for native birds and microbats). If this is not possible, strict pre-clearing protocols must be observed when removing tree hollows.	Prevent disturbance to fauna during breeding.	During felling	Contractor, Project Ecologist
Instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or licensed wildlife handler during clearing events	High	Medium	All hollow-bearing trees within the footprint will be removed. Pre-clearance and clearance survey to be undertaken by suitably qualified ecologists to relocate potential fauna inhabitants. Areas for clearing are to be surveyed in detail for presence of Dural Land Snail. Any live snails are to be relocated to the retained vegetation (PCT 1081) in the east of the subject land. Pre-clearance and clearance survey to be undertaken by suitably qualified ecologists to relocate potential fauna inhabitants. It is recommended that at a minimum, two ecologists are present at the clearing site at all times.	Prevent injury or death to native fauna.	Prior to and during felling.	Project Ecologists, Project Manager
Installing artificial habitats for fauna in adjacent retained vegetation and habitat to replace the habitat resources lost and encourage animals to move from the impacted site, e.g. retaining hollows and adding nest boxes if appropriate	High	Medium	Hollows to be removed should be retained and reused within the remaining vegetation within the subject land, Following the pre-clearance survey, a nest box and retained hollow plan should be prepared. Nest boxes and retained hollows should be installed by a qualified arborist in the adjacent vegetation to replace hollows removed at a minimum ratio of 1:1 (i.e. 1 nest box/retained hollow for each hollow removed). Boxes should be chosen to match the likely target species of each hollow. Boxes should be installed prior to construction to allow fauna to move/be relocated to nest boxes prior to removal of hollow-bearing trees and be maintained and monitored for 5 years.	Provide fauna with compensatory roosting/nesting habitat to replace removed hollow-bearing trees	Prior to construction	Project Manager Ecologist, Arborist,

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Artificial lighting can have a negative impact upon nocturnal and diurnal fauna species. Lighting needs to be designed to minimise impacts to nocturnal and diurnal fauna.	Moderate	Minor	Light pollution can be reduced by limiting the duration of spotlight illumination, reducing the brightness of lights where possible, installing shield fixtures to reduce light scattering, and using narrow-spectrum light sources to reduce the wavelengths likely to interfere with animal behaviour (Gaston et al 2012). High priority areas where the implementation of measures to reduce light pollution should be considered would be located adjacent to important habitat. Wildlife friendly lighting (i.e. filtered yellow-green and amber LEDs wavelength of 590 nm with light shield protection controlling light spill) should be considered adjacent to retained bushland areas.	Lighting impacts on nocturnal and diurnal fauna is minimised	During clearing works and post construction (i.e. design).	Project Manager/Landscape Designer/Ecologist
Clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	High	Low	Boundaries of the impact area to be clearly delineated with heavy duty fencing, retained areas marked with "No Go" signage, in particular in the areas adjacent to the *Maroota Sand Swamp Forest*.	Protection of retained vegetation with heavy duty fencing.	Throughout the life of the project	Project Manager in consultation with the ecologist
Area of Kunzea rupestris in the indirect area to be protected by fencing	High	Moderate	Area which contains retained *Kunzea rupestris* plus a 30m buffer in the indirect impact area in the north of the development site to be protected by permanent fencing	Protection of Kunzea rupestris population and buffer area		
Sediment barriers or sedimentation ponds to control the quality of water released from the	High	Moderate	Install permanent sediment barriers and erosion control during and post construction to prevent runoff into adjacent creeklines and downstream into the Maroota Sand Swamp Forest,	Control of erosion, sedimentation and runoff of contaminated	Throughout life of project	Project Manager

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
site into the receiving environment			maintain controls throughout construction and undertake regular inspections (weekly – or daily if raining).	substances into adjacent waterways		
Noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	Low	Very Low	Daily timing of construction activities is recommended in accordance with Table 1 of Interim Noise Guidelines (2009).	Noise impacts associated with the development will be managed in accordance with guidelines.	Throughout life of project	Project Manager
Light shields or daily/seasonal timing of construction and operational activities to reduce impacts of light spill	Low	Very Low	Conduct works during daylight hours.	Avoid light disturbance to native fauna during construction	Throughout life of project	Project Manager
Adaptive dust monitoring programs to control air quality	High	Moderate	Dust management controls to be implemented during construction and operations. If water is being used to manage dust, ensure contaminated water in managed appropriately on and off site in accordance with a water management plan or similar.	Control dust and maintain air quality during construction.	During construction and operations.	Project Manager, Contractor.
On site water management	High	Moderate	All water being used onsite (e.g. dust management, cleaning, processes) is to be managed appropriately on site in accordance with a water management plan or similar.	Control contaminated water on site and prevent from leaving the site.	Throughout like of the project	Project Manager, Contractor
Programming construction activities to avoid impacts; for example, timing construction activities for when migratory species are absent from the site, or when particular	Medium	Low	Impacts to vegetation during the Spring Summer breeding period should be minimised to avoid disrupting the breeding cycles of threatened species.	Avoid disruption of breeding cycle of threatened species.	During construction	Project Manager

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
species known to or likely to use the habitat on the site are not breeding or nesting						
Temporary fencing to protect significant environmental features such as riparian zones	High	Low	Temporary fencing and signage to be installed at the edge of the development site to prevent entry into the adjacent retained vegetation.	No unintended clearing or trampling of adjacent vegetation to be retained.	During construction.	Project Manager
Hygiene protocols to prevent the spread of weeds or pathogens between infected areas and uninfected areas	Medium	Low	Phytophthora control measures must be undertaken from the commencement of the project to minimise the risk of spread and to the site. The following guidelines should be followed: https://www.rbgsyd.nsw.gov.au/science/plants/pests-diseases/phytophthora-dieback/disinfection-procedures http://www.environment.gov.au/biodiversity/invasive-species/publications/management-phytophthora-cinnamomi-biodiversity-conservation Vehicles, machinery and building refuse should remain only within the development site and disposed of at an appropriate waste management facility. Weed management to be undertaken where required. Vehicles should be washed down before entering and exiting the site to prevent the spread of weeds to or from the development site and adjacent vegetation. In particular, machinery work on or nearby dams are required to be washed down in order to prevent the spread of chytrid fungus into or from the development site. If water trucks are being used for dust control, implement procedures to manage Phytophthora such as daily cleaning of the water truck and equipment.	Spread of weeds between unaffected areas prevented.	During construction.	Project Manager / Contractors

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Medium	Low	All staff working on the project will undertake an environmental induction as part of their site familiarisation. Site briefings should be updated based on phase of the work. This induction will include items such as: • Site environmental procedures (vegetation management, sediment and erosion control, exclusion fencing) • Threatened species habitat and TECs • What to do in case of environmental emergency (chemical spills, fire, injured fauna) • Key contacts in case of environmental emergency • What to do in the case of finding a threatened species • What to do in the case of finding fauna on the site	All staff entering the site are fully aware of all environmental aspects relating to the development and know what to do in case of any environmental emergencies	To occur for all staff entering / working at the site and when environmental issues become apparent	Project Manager, all staff
Making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site	High	Medium	A Vegetation Management Plan should be prepared which covers the retained bushland in the direct and indirect impact areas, all the retained bushland within PCT 1081 to the east of the extraction area, and within the adjacent riparian buffers and Maroota Sand Swamp Forest. An ecological rehabilitation and restoration strategy should be prepared as part of the extractive industry closure planning. An adaptive monitoring program should be established to monitor short and long term impacts of the extractive industry on the adjacent Maroota Sand Swamp Forest and downstream riparian areas.	Protection of flora and fauna outside of the development footprint	Prior to the commencement of construction	Client
Groundwater monitoring adjacent to *Maroota Sands Swamp Forest* Groundwater Dependent Ecosystem and riparian area.	Very High	High	An ongoing groundwater monitoring program implemented to monitor groundwater levels to avoid any direct and indirect impacts to the *Maroota Sands Swamp Forest* Groundwater Dependent Ecosystem and riparian areas.	Protection of the groundwater quality and levels to sustain *Maroota Sands Swamp Forest* Groundwater Dependent Ecosystem and riparian areas.	Throughout life of the project	Project Manager, Hydrogeologist

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Making provision for monitoring of terrestrial impacts to the *Maroota Sands Swamp Forest* Groundwater Dependent Ecosystem and riparian areas.	Very High	High	An ongoing terrestrial vegetation monitoring program implemented to monitor impacts to vegetation to avoid any direct and indirect impacts to the *Maroota Sands Swamp Forest* Groundwater Dependent Ecosystem and riparian areas.	Protection of terrestrial components of the *Maroota Sands Swamp Forest* Groundwater Dependent Ecosystem and riparian areas.	Throughout life of the project	Project Manager, Ecologist

2.2.7 Serious and Irreversible Impacts (SAII)

The development has candidate Serious and Irreversible Impacts (SAII) values as outlined in Table 41 and **Error! Reference source not found.**. Detailed consideration of whether impacts on candidate species are serious and irreversible is included in Table 42. SAII values are displayed in Figure 46.

Table 41: Candidate Serious and Irreversible Impacts

Species / Community	Common Name	Principle	Direct impact area (ha)	Threshold
Hoplocephalus bungaroides	Broad-headed Snake	4 - the affected species or ecological community is unlikely to respond to measures to improve its habitat and vegetation integrity and therefore its members are not replaceable.	25.24	Zero

Table 42: Evaluation of an impact on a candidate species consistent with Section 9.1.2 of the BAM

Impact Assessment Provision	Assessment
1. The action and measures taken to avoid the direct and indirect impact on the species at risk of an SAII. Where these have been addressed elsewhere the assessor can refer to the relevant sections of the BDAR or BCAR	Due to the inherent nature of this proposal, i.e. sand extraction from friable sandstone, direct and indirect impacts to Broad -headed Snake cannot be avoided.
2a. evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the: **i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or** **ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites**	Evidence of rapid decline of Broad-headed Snake in the past 10 years is provided by J.K Webb et al 2021 in the study *Effects of the Australian 2019–2020 megafires on a population of endangered broad-headed snakes Hoplocephalus bungaroides.* It is stated that the wildfires in Morton National Park may have caused high mortality of adult Broad-headed Snakes which shelter in tree hollows over summer. However there was strong evidence that adult mortality was also high due to human disturbance. The paper stated that over the 29 year study, the population of Broad – headed Snake in the study area had declined by 60%. It concluded that the removal of snakes and associated habitat disturbance poses a more serious threat to population viability than infrequent wildfires (J.K Webb et al 2021)
2b. evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by: **i. an estimate of the species' current population size in NSW, and** **ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and** **iii. where such data is available, an estimate of the number of mature individuals in each subpopulation, or the**	No specific data on the current population size was found to be available for Broad – headed Snake. The Atlas of Living Australia has recorded 150 human observations of Broad-headed Snake between 2010-2019 (date accessed 19 November 2021). The BioNet search returned 269 records for the period 1 January 2010 to the present. Whilst records aren't an accurate estimation of actual population size, they can provide some evidence that the current population size of Broad-headed Snake is a relatively small.

Impact Assessment Provision	Assessment
percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations	According to DAWE 2020c, the current distribution of Broad-headed Snake extends from Wollemi National Park, the Clyde River catchment in the south-west of Nowra, as far east as the Royal National Park and as far west as Newnes in the Blue Mountains (DAWE 2020c). According to DAWE, there are four general areas of occurrence: *Blue Mountains, southern Sydney, an area north-west of the Cumberland Plain and the Nowra hinterland.* Thus the species is therefore highly restricted in its range and also its habitat requirements. The Broad -headed Snake occupies a discrete home range of approximately 3.43 ha and exhibits strong site fidelity (DAWE 2020c). They are unlikely to move into unoccupied habitat due to short dispersal distances of both adult and juvenile snakes (approximately 375 m for juveniles) and strong site fidelity of adult snakes (Webb & Shine 1997b in DAWE 2020c). According to DAWE 2020c, male snake's home ranges do not overlap, and all snakes avoid sharing space with other Broad-headed snakes over time. Female and males will overlap to some degree for breeding purposes. It is also stated that snakes are unlikely to move into unoccupied habitat due to short dispersal distances and strong site fidelity. The local population remaining within the subject land would continue to have a direct connection to other populations of this species due to the direct connectivity available to the north of the development site within the subject land, and to the north and west of the subject land in rugged bushland which is expected to comprise similar. habitat features (due to the Hawkesbury Sandstone environment).
2c. evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by: **i. extent of occurrence** **ii. area of occupancy** **iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and** **iv. whether the species' population is likely to undergo extreme fluctuations**	As discussed, according to DAWE 2020c, the current distribution of this species extends from Wollemi National Park, the Clyde River catchment in the south-west of Nowra, as far east as the Royal National Park and as far west as Newnes in the Blue Mountains (DAWE 2020c). According to DAWE, there are four general areas of occurrence: *Blue Mountains, southern Sydney, an area north-west of the Cumberland Plain and the Nowra hinterland.* The Broad -headed Snake occupies a discrete home range of approximately 3.43 ha and exhibits strong site fidelity (DAWE 2020c). They are unlikely to move into unoccupied habitat due to short dispersal distances of both adult and juvenile snakes (approximately 375 m for juveniles) and strong site fidelity of adult snakes (Webb & Shine 1997b in DAWE 2020c). Broad-headed Snake habitat locations include sandstone rocky habitat, and areas of adjacent hollow-bearing trees, in sandstone PCTS and cliffline areas. Threats in these locations includes habitat removal and disturbance through

Impact Assessment Provision	Assessment
	removal of hollow bearing trees and rocky areas. This is due to the ongoing development of residential and infrastructure areas on sandstone escarpments. It is considered unlikely that the species population would undergo extreme fluctuations in numbers due to these constants threats to habitat
2d. evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because: **i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site** **ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or** **iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).**	Management actions according to the TBDC include • Habitat management: Retain sandstone rock in bushland on escarpment areas; implement LEPs, DCPs with suitable restrictions on the removal of bushrock. • Habitat management: Site Protection (eg Fencing/Signage) Limit vehicle and pedestrian access to and recreational use of sandstone escarpments where this species occurs. • Habitat management: Retain woodland adjacent to sandstone escarpments, particularly large hollow-bearing trees. • Habitat Rehabilitation/Restoration and/or Regeneration: Restore rocky habitat to escarpments that have been disturbed. • Report suspected illegal reptile collection or sale. • Survey and/or Mapping Targeted survey of areas of secure potential habitat. • Advocate the use of quarried sandstone or alternatives in preference to sandstone sourced from bushland on escarpments; implement a community and industry bushrock education strategy. • Captive Husbandry or ex-situ collection/propagation: Maintain colonies in captivity for future re-introduction to depleted sites or sites undergoing restoration. • Habitat management: Undertake feral goat control programs in sandstone escarpment areas. The proposed development is contradictory to these management actions and will increase threats identified in the Approved Conservation Advice as “disturbance of habitat, in particular the removal of large hollow-bearing trees adjacent to sandstone escarpments and bush rock removal” Clearance of habitat is another key threat that will result in fragmentation and isolation of habitat (DAWE 2020c). The proponent is proposing to establish an offset site in the IBRA regions and subregion if possible, in similar habitat to the development site.
3. Where the TBDC indicated that data is ‘unknown’ or ‘data deficient’ for a species for a criterion listed in	The TBDC has not identified any criterion as data deficient.

Impact Assessment Provision	Assessment
subsection 9.1.1(2), the assessor must record this in the BDAR or BCAR.	
4a. the impact on the species' population (Principles 1 and 2) presented by: **i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and** **ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or** **iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal**	No Broad-headed Snakes were observed within the development site during surveys. No BioNet records exist for the species within the development site or within 5 km of the development site. However, despite this, a local population may still be present within the subject land based on the habitat features present. The development will indirectly affect 7.94 ha and directly affect 25.24 ha of habitat for the Broad-headed Snake, therefore affecting the ecology of the local population by removing or modifying an area of habitat previously available for dispersal, breeding and foraging. Based on the location of the habitat to be removed within the development footprint (i.e. 25.24 ha in the southern portion of the subject land), it is considered that fragmentation and isolation will occur due to the Broad-headed Snake's high site fidelity and short dispersal distances. As discussed above, it is expected that the remainder of land within the subject land (109.74 ha), and lands to the west and north contain suitable habitat for the local population of Broad-headed Snake to persist. It is estimated that approximately 10 home ranges will be affected by the proposals direct and indirect impacts. It is estimated that approximately 30 separate home ranges will remain in the remaining portions of the subject land. For those individuals remaining in the subject land, breeding, foraging, dispersal and movement can still occur due to suitable rocky habitat being retained in the subject land and the connectivity to large areas of habitat to the west and north of the subject land.
4b. impact on geographic range (Principles 1 and 3) presented by: **i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW** **ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted** **iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species**	According to DAWE 2020c, the current distribution of this species extends from Wollemi National Park, the Clyde River catchment in the south-west of Nowra, as far east as the Royal National Park and as far west as Newnes in the Blue Mountains (DAWE 2020c). The proposed development will change the habitat available to the local population for foraging and breeding by direct removal of vegetation and rocky habitat, and indirect impacts that will lead to the potential disturbance of habitat. The total area of direct and indirect impacts is 33.18 ha - indirect impact of 7.94 ha and direct impact of 25.24 ha. In terms of isolation of the population, the area of habitat adjacent to the direct and indirect impact areas will remain connected to the core bushland to the north, north west and west of the development site. Therefore, movement to these core areas will not be impeded or cut off despite the direct removal of 25.24 ha of vegetation. Areas which will become fragmented (to the east and south) are not

Impact Assessment Provision	Assessment
iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target species, the assessor may refer to the relevant sections of the BDAR or BCAR.	considered to be favourable habitat for Broad-headed Snake. The local population at Maroota is not at the limit of the species range: the range of Broad-headed Snake extend s to suitable sandstone habitat within an approximate 200 km radius of Sydney (Cogger et al. 1993; NSW NPWS 2001 in DAWE 2020c). Therefore, the impact of clearing within the development site on an individual's home range, (i.e. part of the local population) is likely to be high due to these characteristics, if the individuals were located within the development site. On the contrary, due to these characteristics of having a discrete home range and short dispersal distances, the remaining habitat within the subject land is considered suitable for occupation of the local population, even once the development has taken place. It is estimated that approximately 10 home ranges will be affected by the proposals direct and indirect impacts. For those individuals remaining in the subject land, breeding, foraging, dispersal and movement can still occur due to suitable rocky habitat being retained in the subject land (109.74 ha) and the connectivity to large areas of habitat to the west and north of the subject land. It is estimated that approximately 30 home ranges will remain in the remaining portions of the subject land

2.3 Adaptive management strategy

As discussed in the BAM Stage 2 Operations Manual, some impacts are difficult to predict or assess prior to the commencement of the development. An adaptive management strategy is therefore required in these instances.

Adaptive management is an adjustment of action based on the results of monitoring to achieve a certain outcome. As per the BAM Stage 2 Operations Manual: *it requires a trigger for necessary remedial action to be taken, such as adjusting the activity causing the impact or adjusting the mitigation measure. Monitoring should enable the proponent to determine if measures are being implemented as planned and provide an early warning of measures that are ineffective and/or the uncertain impact is being realised.*

Documentation of any adaptive management plan must, where relevant, include:

- *baseline data to be used to monitor change; this must be collected pre-impact*
- *seasonal changes or relevant impacts to be measured*
- *monitoring techniques and effort based on best practice (e.g. published peer-reviewed guidelines)*
- *frequency and type of reporting*
- *completion and performance criteria that adhere to the SMART principles, and are ecologically-based; these can then act as triggers for management intervention actions*

- *information that will be necessary to measure the impact over time and consideration given to how these results could be used to inform ongoing (or future) operations*

For this development, it is proposed that an adaptive management strategy is prepared to monitor potential impact to the *Maroota Sand Swamp Forest* to the north of the development site, the associated creekline, and the creekline in the southern part of the development site which feeds the water storage area and exits to the west of the water storage area. This strategy could use the Addendum to NSW Biodiversity Offsets Policy for Major Projects to provide the framework for the strategy, as recommended in the BAM Stage 2 Operations Manual, and could include the following:

- Baseline data against which monitoring will occur
- Monitoring methods, including frequency, timing and reporting: monitoring program with timeframes (e.g. minimum two-year pre-impact monitoring), and design requirements (e.g. control sites to ensure that changes in indicators are a result of the development activity as opposed to natural variability)
- Seasonal changes to the resource or relevant to the impacts being monitored
- Information that will be necessary to measure the impact over time.
- Measurable thresholds at which impacts are likely to affect the target entities (e.g. quantifiable changes in hydrology within 12 months of the commencement of mining operations)
- Indicators to detect impacts on the target entities (e.g. hydrological monitoring, species condition monitoring)
- Trigger values for the commencement of adaptive management actions
- Adaptive management actions proposed to reduce or eliminate the impact
- Consideration of how the results of the monitoring program could be used to inform ongoing operations in order to reduce the extent of indirect impacts
- Steps to be undertaken once impact thresholds have been triggered (e.g. reporting, results to the consent authority, review of results by an independent panel, changes to future layout to avoid further impacts)
- The process to calculate, and retire, an offset requirement if thresholds are exceeded and impacts occur.

2.4 Impact summary

Following implementation of the BAM and the BAMC, the following impacts have been determined.

2.4.1 Serious and Irreversible Impacts (SAII)

The development has candidate Serious and Irreversible Impacts (SAII) values as outlined in Table 41 and shown on Figure 46. Detailed consideration of whether impacts on candidate species are serious and irreversible is included in Table 42.

Table 43: Serious and Irreversible Impacts Summary

Species / Community	Common Name	Principle	Direct impact area (ha)
Hoplocephalus bungaroides	Broad-headed Snake	4	25.24

2.4.2 Impacts requiring offsets

The impacts of the development requiring offset for native vegetation are outlined in Table 44 and shown on Figure 47. The impacts of the development requiring offset for threatened species and threatened species habitat are outlined in Table 45 and on Figure 47.

Table 44: Impacts to native vegetation that require offsets

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Sydney Hinterland Dry Sclerophyll Forest	Dry Sclerophyll Forests (Shrubby sub-formation)	25.71
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Sydney Coastal Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	3.27
1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Sydney Hinterland Dry Sclerophyll Forest	Dry Sclerophyll Forests (Shrubby sub-formation)	13.8
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Sydney Coastal Dry Sclerophyll Forests	Dry Sclerophyll Forests (Shrubby sub-formation)	8.17
			Total	**50.95**

Table 45: Impacts on threatened species and threatened species habitat that require offsets

Species	Common Name	Direct impact number of individuals / habitat (ha)	NSW listing status	EPBC Listing status
Acacia bynoeana	Bynoe's Wattle	1.64	Endangered	Vulnerable
Calyptorhynchus lathami	Glossy Black Cockatoo	49.04	Vulnerable	Not Listed
Cercartetus nanus	Eastern Pygmy-possum	50.95	Vulnerable	Not Listed
Heleioporus australiacus	Giant Burrowing Frog	50.95	Vulnerable	Vulnerable
Hoplocephalus bungaroides	Broad-headed Snake	25.24	Endangered	Vulnerable
Kunzea rupestris		0.81	Vulnerable	Vulnerable
Myotis macropus	Southern Myotis	7.08	Vulnerable	Not Listed
Petaurus norfolcensis	Squirrel Glider	50.95	Vulnerable	Not Listed
Pimelea curviflora var. curviflora		0.91	Vulnerable	Vulnerable
Pommerhelix duralensis	Dural Land Snail	25.71	Endangered	Endangered
Pseudophryne australis	Red-crowned Toadlet	24.50	Vulnerable	Not Listed
Tetratheca glandulosa		4.13	Vulnerable	Not Listed

2.4.3 Impacts not requiring offsets

There are no areas within the direct impact area that do not require offset.

2.4.4 Areas not requiring assessment

There are no areas that do not require assessment.

2.4.5 Credit summary

The number of ecosystem credits required for the development are outlined in Table 46. The number of species credits required for the development are outlined in Table 47. The biodiversity credit report is included in Appendix F.

Table 46: Ecosystem credits required

PCT ID	PCT Name	Vegetation Formation	Direct impact (ha)	Credits required
1081	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	25.71	536
1083	Red Bloodwood - scribbly gum heathy woodland on sandstone	Dry Sclerophyll Forests (Shrubby sub-formation)	3.27	66

PCT ID	PCT Name	Vegetation Formation	Direct impact (ha)	Credits required
	plateaux of the Sydney Basin Bioregion			
1328	Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	13.8	286
1181	Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Dry Sclerophyll Forests (Shrubby sub-formation)	8.17	182
			Total	**1,070**

Table 47: Species credit summary

Species	Common Name	Direct impact number of individuals / habitat (ha)	Credits required
Acacia bynoeana	Bynoe's Wattle	1.64	43
Calyptorhynchus lathami	Glossy Black Cockatoo	49.04	1380
Cercartetus nanus	Eastern Pygmy-possum	50.95	1427
Heleioporus australiacus	Giant Burrowing Frog	50.95	1070
Hoplocephalus bungaroides	Broad-headed Snake	25.24	1068
Kunzea rupestris		0.81	20
Myotis macropus	Southern Myotis	7.08	195
Petaurus norfolcensis	Squirrel Glider	50.95	1427
Pimelea curviflora var. curviflora		0.91	25
Pommerhelix duralensis	Dural Land Snail	25.71	714
Pseudophryne australis	Red-crowned Toadlet	24.50	519
Tetratheca glandulosa		4.13	116
		Total	**8,004**

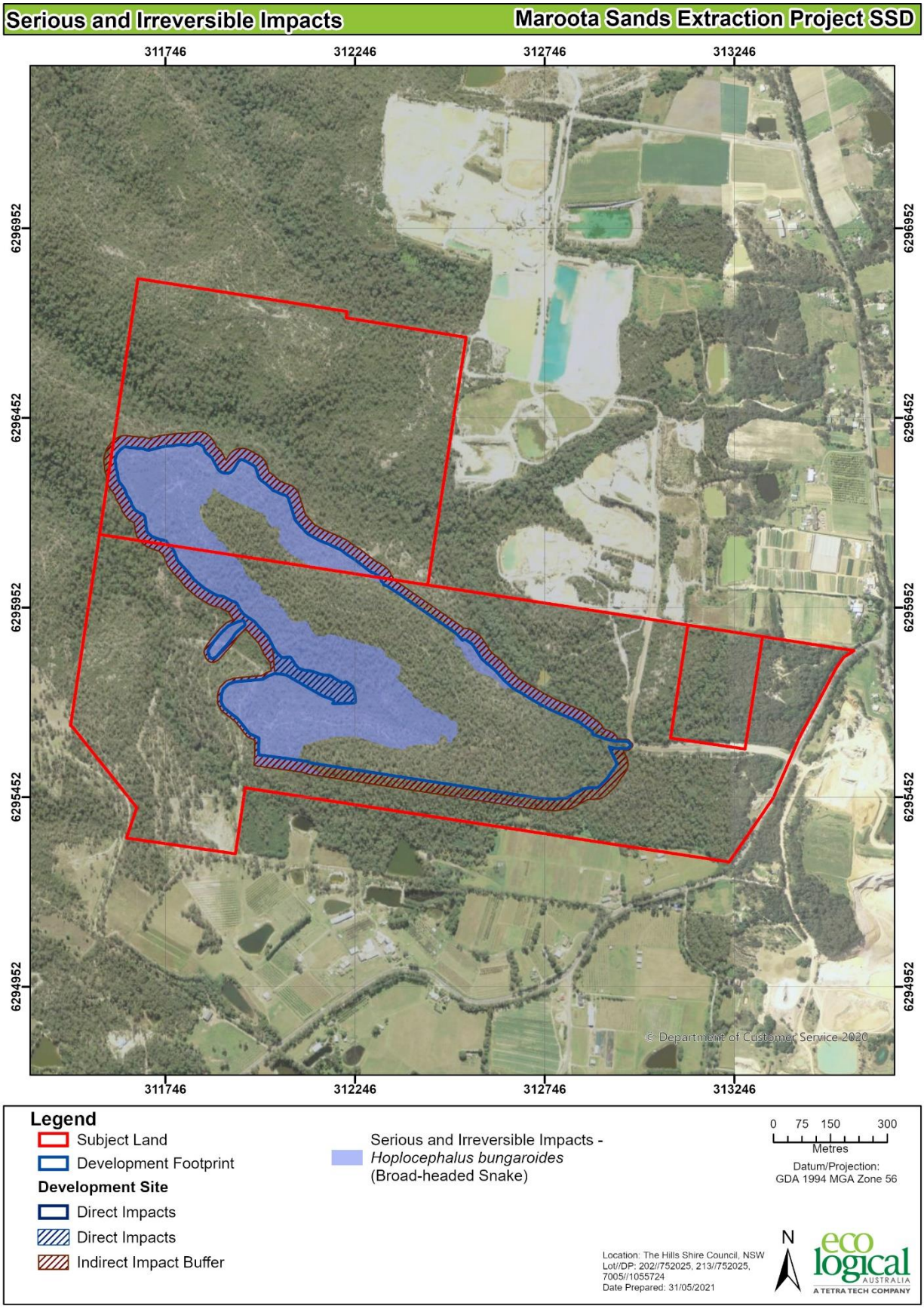

Figure 46: Serious and Irreversible Impacts – Broad-headed Snake

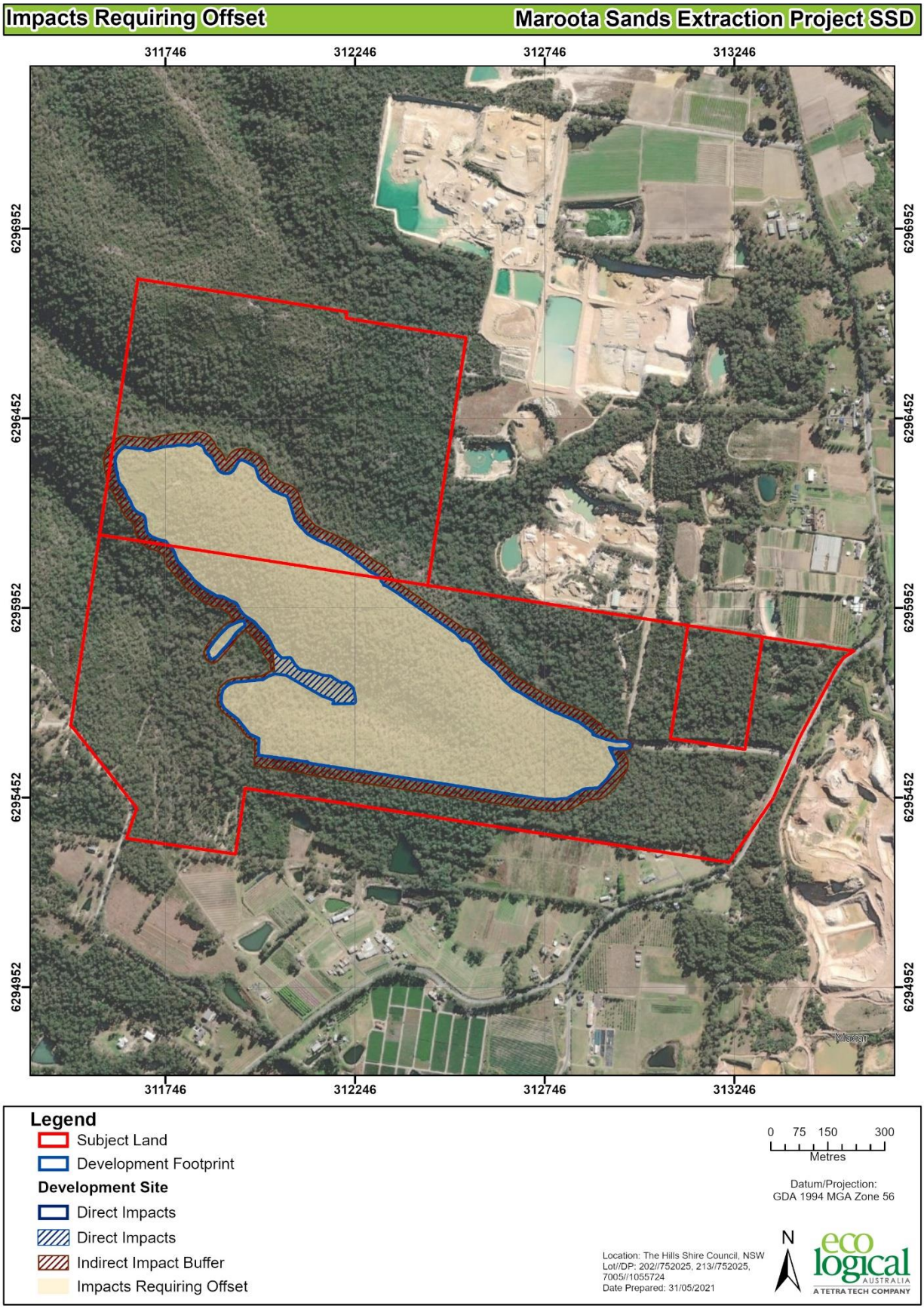

Figure 47: Impacts requiring offset

2.5 Offset Strategy

To fulfil their biodiversity offset obligation, Deerubbin Local Aboriginal Land Council (DLALC) plans to deliver a viable and ecologically functioning offset by establishing a Biodiversity Stewardship Site.

DLALC has a number of land holdings where appropriate biodiversity credits (both ecosystem and species credits) can be generated. Key requirements for the use of generated ecosystem credits include:

- credits must be like for like
- credits must be generated within the same or adjacent IBRA sub region as the impact site
- land must meet eligibility requirements under the BC Act.

The impacted land proposed to be offset is 50.95 ha in area. It is estimated that approximately 306 ha of land is required to generate the number of credits required to fulfil their ecosystem credit obligation. This has been determined by using an average of 3.5 credits per hectare generated at the Biodiversity Stewardship Site. The breakdown per PCT is provided below in Table 48.

Figure 48 identifies the subject land and development site, as well DLALC land holdings in the context of relevant IBRA Regions.

Figure 49 shows potential opportunities for larger land parcels to operate as a Stewardship Site utilising currently available information on vegetation class. It is assumed that relevant species credit species may also be able to be generated from these sites. More detailed assessment, including site survey, will be required to confirm the suitability of the sites and the number of potential credits available for use.

The required species credits can be offset with like for like species credits from any IBRA region in NSW. If some or all of the species credits are not able to be generated on these sites, DLALC has the option to source all or some of the credits from the market, or make a payment into the Biodiversity Conservation Fund.

Table 48: Estimated areas of land required to offset ecosystem biodiversity credits

PCT Number	Area of Impact (ha	No. of credits to be retired	Trading group and PCTs used for offsetting (Like for Like credit retirement options)	IBRA Region	Estimated approximate area of land (ha) required to offset (based on an estimation of generation of 3.5 ha credits per ha)
PCT 1081 -	25.71	536	Sydney Coastal Dry Sclerophyll Forests <50% PCTS 612,621,624,1080,1081,1086,1159,1246,1255,1327, 1328,1614,1622,1628,1631,1634,1640,1664,1666,1667, 1789,1790,1912	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site.	153
PCT 1083	3.27	66	Sydney Coastal Dry Sclerophyll Forests <50% PCTs1083,1138,1156,1181,1183,1250,1253,1619,1620, 1621,1623,1624,1625,1627,1632,1636,1638,1642,1643,1681 1776,1777,1778,1780,1782,1783,1785, 1786,1787	As above	19
PCT 1328	13.88	286	Sydney Hinterland Dry Sclerophyll Forests <50% PCTs612,621,624,1080,1081,1086,1159,1246,1255,1327, 1328,1614,1622,1628,1631,1634,1640,1664,1666,1667,1789 1790,1912	As above	82
PCT 1181	8.17	182	Sydney Coastal Dry Sclerophyll Forests <50% PCTs1083,1138,1156,1181,1183,1250,1253,1619,1620,1621, 1623,1624,1625,1627,1632,1636,1638,1642,1643,1681,1776 1777,1778,1780,1782,1783,1785 1786,1787	As above	52
Total	**50.95**	**1081**			**306**

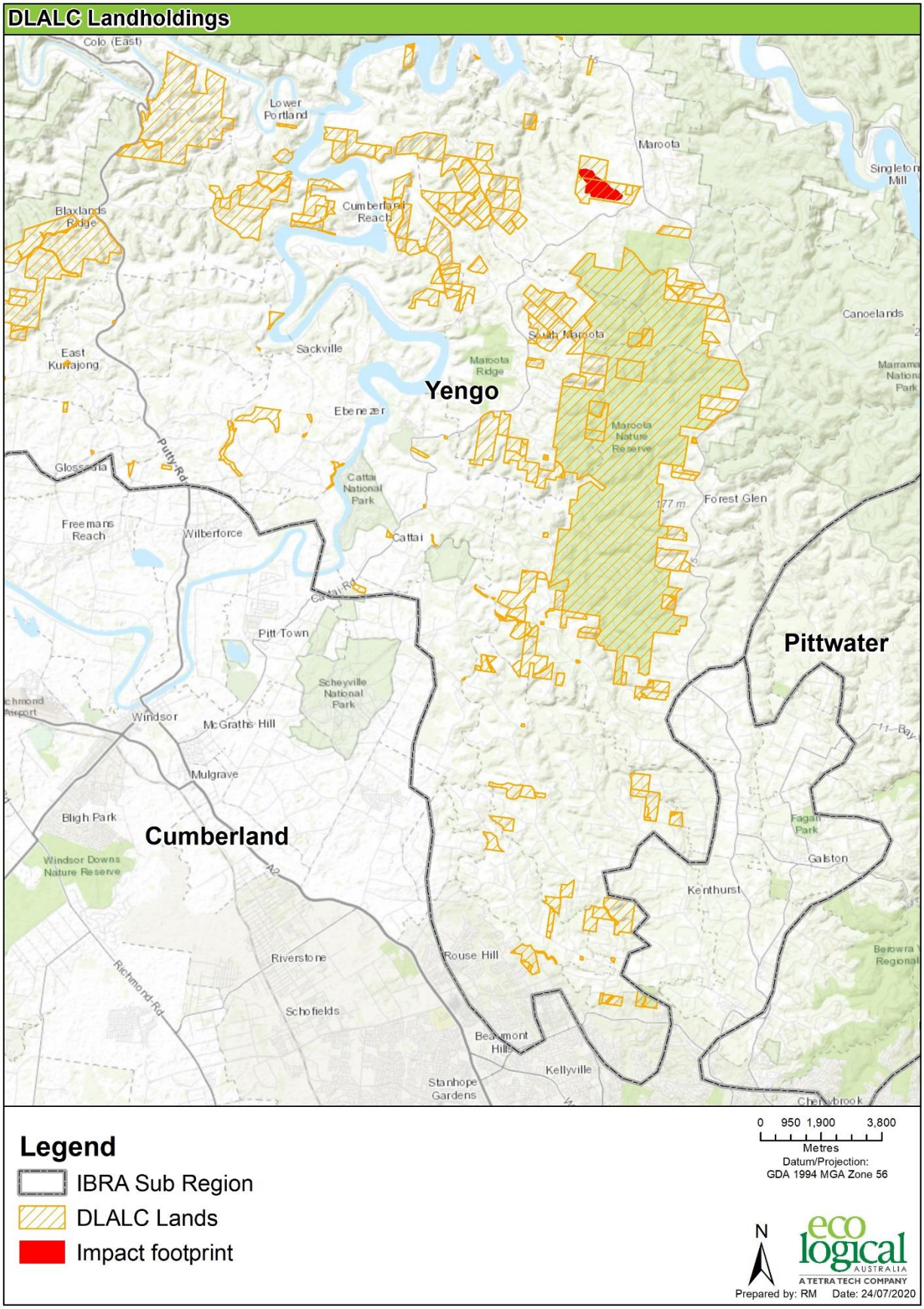

Figure 48: DLALC lands and IBRA Sub Regions

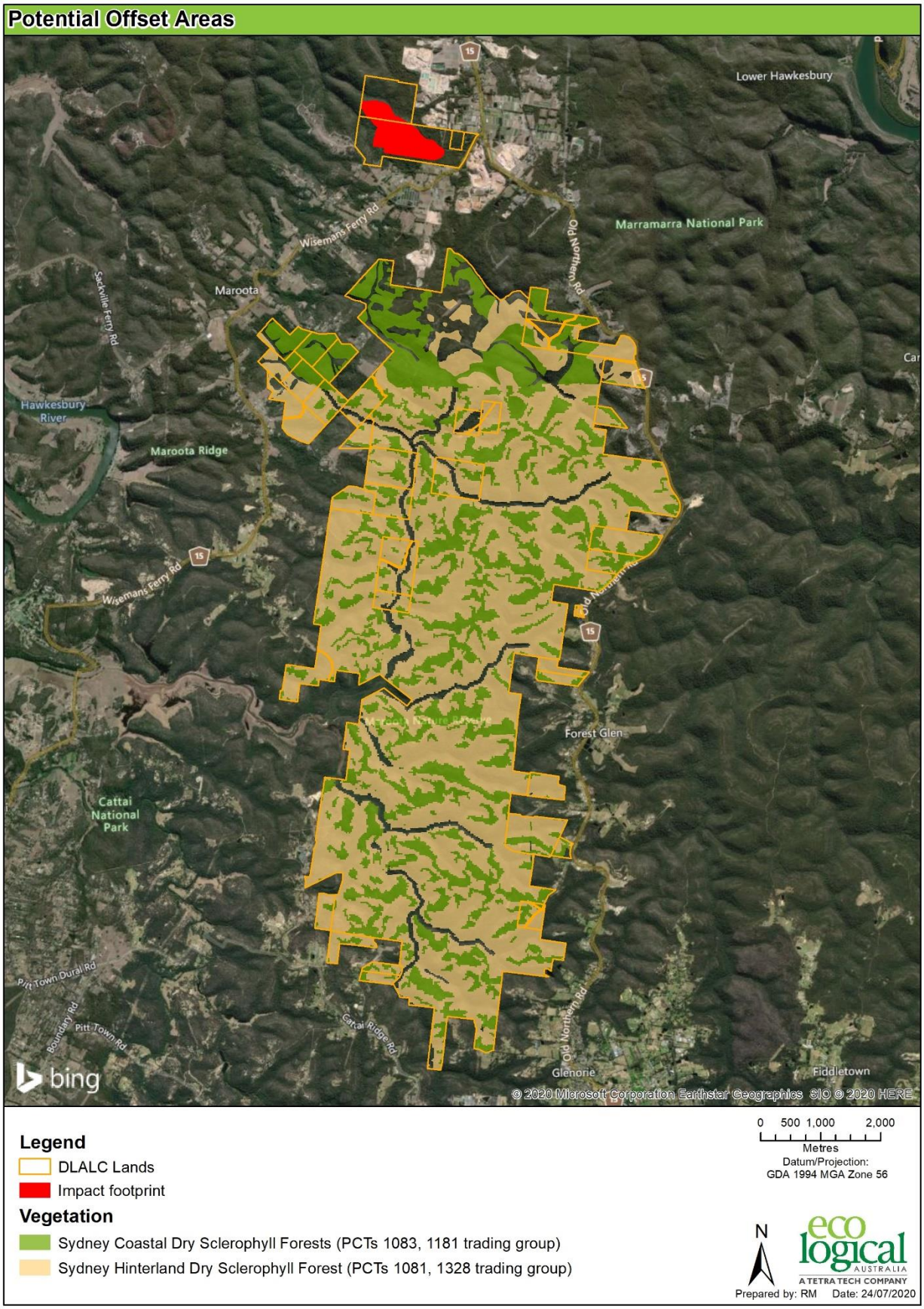

Figure 49: DALC Lands - potential areas for use as offset

2.6 Consistency with legislation and policy

Additional matters relating to impacts on flora and fauna which are not covered by the BC Act must also be addressed for the proposed development. Potential MNES in accordance with the Commonwealth EPBC Act have been addressed in Section 2.6.1. Matters relating to The Hills Shire planning instruments have been addressed in Section 2.6.2 and 2.6.3.

2.6.1 Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act)

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where MNES may be affected. Under the Act, any action which "has, will have, or is likely to have a significant impact on MNES" is defined as a "controlled action", and requires approval from the Commonwealth Department of Agriculture, Water and the Environment (DAWE), which is responsible for administering the EPBC Act.

A habitat assessment and Likelihood of Occurrence was completed for listed threatened species that represent MNES (Appendix F). The following MNES were assessed as either having the potential to occur within the development site, likely to occur or known from the development site:

- *Shale Sandstone Transition Forest of the Sydney Basin Bioregion*
- *Acacia bynoeana* (Bynoe's Wattle)
- *Kunzea rupestris*
- *Pimelea curviflora* var. *curviflora*
- *Heleioporus australiacus* (Giant Burrowing Frog)
- *Anthochaera phrygia* (Regent Honeyeater)
- *Lathamus discolor* (Swift Parrot)
- *Pommerhelix duralensis* (Dural Land Snail)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Dasyurus maculatus* (Spotted-tailed Quoll)
- *Phascolarctos cinereus* (Koala)
- *Pseudomys novaehollandiae* (New Holland Mouse)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Hoplocephalus bungaroides* (Broad-headed Snake).

The assessments in this section were prepared in accordance with the EPBC Act Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (Department of Environment 2009). These guidelines were established to assist proponents to determine whether a proposed action is likely to result in a significant impact on a matter of national environmental significance.

It was determined that the action will have or is likely to have a significant impact on *Shale Sandstone Transition Forest of the Sydney Basin Bioregion* and *Pommerhelix duralensis* (Dural Land Snail). Therefore, a referral to the Commonwealth is required.

2.6.1.1 Shale Sandstone Transition Forest of the Sydney Basin Bioregion

Shale Sandstone Transition Forest is listed as critically endangered under the EPBC Act. This ecological community is comprised of forest or woodland with an overstorey dominated by various Eucalypt species and an understorey comprising of sclerophyll shrubs, grasses and herbs. The structure and composition of vegetation are primarily determined by the transitional geology between Wianamatta shale and Hawkesbury sandstone and vary considerably depending on the degree and the source of shale influence (Wianamatta or Hawkesbury Group, or Mittagong Formation). The vegetation is also influenced by other environmental variables such as rainfall, topographic shelter, slope, proximity to the coast and elevation (DAWE 2020c).

The subject land contains 35.7 ha of PCT 1081: *Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion*, which conforms to the Commonwealth listed threatened ecological community *Shale Sandstone Transition Forest*. The proposed action will impact 28.8 ha of this threatened ecological community. Approximately 61.43 ha is mapped within 1,500 m radius of the subject land.

Criterion	Question	Response
An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:		
1)	reduce the extent of an ecological community	The proposed action will affect 28.8 ha of vegetation comprising Shale Sandstone Transition Forest. This represents 80.67% of the extent of the critically endangered community within the patch and 46.88 % of its mapped extent within an area of 1,500 m.
2)	fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	The proposed action will fragment the extent of Shale Sandstone Transition Forest within the patch by removing 80.67% of its extent, leaving 6.9 ha remaining in the eastern corner.
3)	adversely affect habitat critical to the survival of an ecological community	The Approved Conservation Advice for Shale Sandstone Transition Forest 2014 identifies areas that meet the minimum (moderate class) condition thresholds as areas critical to the survival of the ecological community. The proposed action will adversely affect habitat critical to the survival of this ecological community by removing 28.8 ha of vegetation comprising Shale Sandstone Transition Forest in high condition class.
4)	modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The proposed action will affect 28.8 ha of vegetation comprising Shale Sandstone Transition Forest. The proposed used of the referral area for the extraction of Hawkesbury Sandstone will modify or destroy abiotic factors such as water, nutrients and soil necessary for the ecological community's survival, especially soil.
5)	cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	The proposed action will affect 28.8 ha of vegetation comprising Shale Sandstone Transition Forest, causing a substantial and permanent change in the species composition of 80.67% of the occurrence of the ecological community within the patch. About 6.9 ha of the community will remain within the patch.

Criterion	Question	Response
6) i and ii	cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: assisting invasive species, that are harmful to the listed ecological community, to become established, or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	It is considered that the impact to 28.8 ha of Shale Sandstone Transition Forest will cause a substantial reduction in the quality or integrity of the ecological community remaining in the patch (19.33 %). It is considered that the action will also cause a substantial reduction in the quality or integrity of the ecological community within a 1,500 m radius because the action proposes to clear 46.88 % of its mapped occurrence. It is considered that proposed action will result in the regular mobilisation of pollutants into the ecological community which will affect the remaining community in the patch.
7)	interfere with the recovery of an ecological community.	There is no adopted or made Recovery Plan for this ecological community. The Approved Conservation Advice for Shale Sandstone Transition Forest identifies several high priority recovery and threat abatement actions related to habitat loss, disturbance and modification. The proposed action is likely to interfere with the recovery of an ecological community through the impact to 80.67% of its occurrence within the patch and 46.88 % of its mapped occurrence within a 1,500 m radius of the referral area.
Conclusion	Is there likely to be a significant impact?	Yes. The proposed impact to 28.8 ha of Shale Sandstone Transition Forest will have a significant impact on Shale Sandstone Transition Forest for the following reasons: The proposed action will fragment the ecological community. The proposed action will remove habitat critical to the ecological community's survival. The proposed action will modify or destroy abiotic factors necessary for the ecological community's survival. The proposed action will interfere with the ecological community's recovery.

2.6.1.2 *Acacia bynoeana* (Bynoe's Wattle)

Acacia bynoeana is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. Two known individuals of this species identified during surveys are proposed to be removed. The proposed action will impact 1.64 ha of habitat suitable for this species (PCTs 1328 and 1083).

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:* *key source populations either for breeding or dispersal •* *populations that are necessary for maintaining genetic diversity, and/or* *populations that are near the limit of the species range.*	The proposed action will remove two known *Acacia bynoeana* individuals, which are not considered to be part of an important population, and affect 1.64 ha of suitable habitat for the species. The two specimens are not considered an important population as there are 388 BioNet records for the species within 5 km of the referral area, and there is a population in a reserve located approximately 6 km southeast of the referral area at Maroota Ridge State Conservation Area. The action is therefore unlikely to lead to a long-term decrease in the size of an important population of this species.
2)	reduce the area of occupancy of an important population	The proposed action will affect two *Acacia bynoeana* specimens present within the referral area and will reduce the potential area of occupancy of the species by 1.64 ha. However, this suitable habitat is not occupied by an important population due to reasons above. Other areas of similar habitat exist within and outside the referral area to the west and north. These areas are not being affected.
3)	fragment an existing important population into two or more populations	The proposed action will remove all the *Acacia bynoeana* present within the referral area and will not fragment an existing important population. The proposed action will however remove suitable habitat for this species by removing 1.64 ha of habitat suitable for this species.

Criterion	Question	Response
4)	adversely affect habitat critical to the survival of a species *Note: 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:* for activities such as foraging, breeding, roosting, or dispersal for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species or ecological community.	The proposed action will affect 1.64 ha of suitable habitat for this species. However, this impact is considered unlikely to adversely affect the survival of the species given that similar habitat is available adjacent to the referral area and other populations of the species are known from the within 5 km of the referral area.
5)	disrupt the breeding cycle of an important population	The proposed action is unlikely to result in the loss of a large number of individuals that would disrupt the life cycle of this species. The Acacia bynoeana in the referral area are also not an important population.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will remove or decrease the quality of habitat for the species by 1.64 ha. However, it is unlikely that the extent of this vegetation removal will cause the species to decline. Only two plants are to be removed and they are unlikely to be an important genetic source for an important population. Also, suitable habitat is available adjacent to the referral area and other populations are known from the region.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action is unlikely to result in the establishment of an invasive species that is harmful to *Acacia bynoeana*, such as weeds, rabbits or the European Hare. This is because the referral area is not directly adjacent to any known populations where invasive species could be introduced.
8)	introduce disease that may cause the species to decline, or	The proposed action is unlikely to introduce disease such as *Phytophthora cinnamomi* that would cause the species to decline. This is because the referral area is not directly adjacent to any known populations where disease could be introduced.
9)	interfere substantially with the recovery of the species.	The proposed action will affect suitable habitat for this species; however this will not interfere substantially with recovery actions listed in the Approved Conservation Advice *Acacia bynoeana* 2013.

Criterion	Question	Response
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on *Acacia bynoeana* for the following reasons: The two individuals identified within the referral area are not considered to be part of an important population. More habitat for this species is available adjacent to the referral area. Other populations of *Acacia bynoeana* are known from the region.

2.6.1.3 Kunzea rupestris

Kunzea rupestris is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. One population (approximately 100 individuals) of this species was identified on a rock platform which are proposed to be affected. The proposed action will impact 0.81 ha of habitat suitable for this species (PCTs 1328 and 1083). The other population of approximately 50 individuals is outside the direct impact area and will not be affected by the proposed development.

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:* *key source populations either for breeding or dispersal •* *populations that are necessary for maintaining genetic diversity, and/or* *populations that are near the limit of the species range.*	The proposed action will affect one population of *Kunzea rupestris*, which is not considered to be part of an important population: there are 2,184 BioNet records for the species within 5 km of the referral area, therefore this population is not considered necessary for the species long-term survival and recovery. The action is therefore unlikely to lead to a long-term decrease in the size of an important population of this species.
2)	reduce the area of occupancy of an important population	The proposed action will affect one population of *Kunzea rupestris* present within the referral area and will reduce the potential area of occupancy of the species by 0.81 ha. However, this suitable habitat is not occupied by an important population. Other areas of similar habitat exist outside the referral area to the west and north of the footprint. If occupied. these would be considered important habitat for this species. These areas are not being affected.

Criterion	Question	Response
3)	fragment an existing important population into two or more populations	The proposed action will affect all the *Kunzea rupestris* present within the referral area however it will not fragment an existing important population. The proposed action will fragment suitable habitat for this species by affecting 0.81 ha of habitat suitable for this species.
4)	adversely affect habitat critical to the survival of a species *Note: 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:* for activities such as foraging, breeding, roosting, or dispersal *for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)* *to maintain genetic diversity and long term evolutionary development, or* *for the reintroduction of populations or recovery of the species or ecological community.*	The proposed action will affect 0.81 ha of suitable habitat for this species. However, this impact is considered unlikely to affect habitat critical to the survival of the species given that similar habitat is available adjacent to the referral area and other populations of the species are known from within 5km of the referral area.
5)	disrupt the breeding cycle of an important population	The proposed action is unlikely to result in the loss of a large enough number of individuals over a large enough area that would disrupt the breeding cycle of an important population, as this is not considered an important population. .
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will decrease the availability of habitat for the species within the locality by 0.81 ha. However, it is unlikely that the extent of this vegetation removal will cause the species to decline because suitable habitat is available adjacent to the referral area and other populations are known from the region.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action may result in the establishment of an invasive species in the indirect areas that is harmful to *Kunzea rupestris*, such as weeds.
8)	introduce disease that may cause the species to decline, or	The proposed action is unlikely to introduce disease that would cause the species to decline.
9)	interfere substantially with the recovery of the species.	The proposed action will remove individual species and suitable habitat for this species. It will interfere with recovery actions listed in the Approved Conservation Advice for *Kunzea rupestris* 2008 as soil and sand extraction activities are listed as a main threat to the species. However this is not considered to be substantial as there are other known populations within the region .

Criterion	Question	Response
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on *Kunzea rupestris* for the following reasons: The population identified within the referral area are not considered to be part of an important population. The other population identified during the surveys will remain in the indirect impact area. More habitat for this species is available adjacent to the referral area. Other populations of *Kunzea rupestris* are known from the region.

2.6.1.4 Pimelea curviflora var. *curviflora*

Pimelea curviflora var. *curviflora* is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. A total of 11 individuals of this species were identified throughout the development site during surveys and are proposed to be removed. The proposed action will affect 0.91 ha of habitat suitable for this species (PCT 1081 and on the transitional areas to PCTs 1328, 1083 and 1181 (i.e. 50% of the area of PCTs 1328,1083 and 1181).

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:* *key source populations either for breeding or dispersal •* *populations that are necessary for maintaining genetic diversity, and/or* *populations that are near the limit of the species range.*	The proposed action will remove 11 known individual and 0.91 ha of *Pimelea curviflora* var. *curviflora* habitat identified within the referral area however these individuals are not considered to be part of an important population, as they are not considered necessary for the species long term survival (there are 347 BioNet records for the species within 5 km of the referral area). The action is unlikely to lead to a long-term decrease in the size of an important population of this species.
2)	reduce the area of occupancy of an important population	The proposed action will remove 11 *Pimelea curviflora* var. *curviflora* identified within the referral area and will reduce the potential area of occupancy of the species by affecting 0.91 ha of habitat. However, this suitable habitat is not occupied by an important population. Other areas of similar habitat exist outside the referral area to the west and north. If occupied. these would be considered important habitat for this species. These areas are not being affected.

Criterion	Question	Response
3)	fragment an existing important population into two or more populations	The proposed action will remove all the *Pimelea curviflora* var. *curviflora* present within the referral area and will not fragment an existing important population. The proposed action will fragment suitable habitat for this species by impacting 0.91 ha of habitat suitable for this species. Suitable habitat will remain in extensive areas of bushland to the west and north of the referral area.
4)	adversely affect habitat critical to the survival of a species *Note: 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:* for activities such as foraging, breeding, roosting, or dispersal *for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)* *to maintain genetic diversity and long term evolutionary development, or* *for the reintroduction of populations or recovery of the species or ecological community.*	The proposed action will affect 0.91 ha of suitable habitat for this species. However, this impact is considered unlikely to adversely affect the survival of the species critical to the survival of this species as this is not part of an important population. Suitable habitat will remain within bushland to the west and north of the referral area.
5)	disrupt the breeding cycle of an important population	The proposed action is unlikely to result in the loss of a large number of individuals that would disrupt the life cycle of this species. Suitable habitat will remain in bushland to the west and north of the referral area.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will decrease the availability of habitat for the species within the subject land by 0.91 ha. However, it is unlikely that the extent of this vegetation removal will cause the species to decline because suitable habitat is available adjacent to the referral area in bushland north and west. Also, many other individuals of the species are known from within 5 km of the referral area.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action is unlikely to result in the establishment of an invasive species that is harmful to *Pimelea curviflora* var. *curviflora*, such as weeds, rabbits, pigs or goats.
8)	introduce disease that may cause the species to decline, or	The proposed action is unlikely to introduce disease that would cause the species to decline.
9)	interfere substantially with the recovery of the species.	The proposed action will remove suitable habitat for this species; however this will not interfere substantially with recovery actions listed in the Approved Conservation Advice for *Pimelea curviflora* var. *curviflora* 2008.

Criterion	Question	Response
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on *Pimelea curviflora* var. *curviflora* for the following reasons: The individuals identified within the referral area are not considered to be part of an important population. More habitat for this species is available adjacent to the referral area in bushland to the west and north of the referral area. Other individuals of *Pimelea curviflora* var. *curviflora* are known from the region.

2.6.1.5 *Heleioporus australiacus* (Giant Burrowing Frog)

The Giant Burrowing Frog is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. Targeted survey was not undertaken for this species nor was the species identified opportunistically. However, 50.95 ha of potential habitat for this species exists within the development site in the form of first order creeklines and the 300 m buffers associated with them.

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery.*	The Giant Burrowing Frog occurs in two disjunct populations, one confined to sandstone within the Sydney Basin and another extending from Narooma to Walhalla, Victoria (DAWE 2020c). The proposed action will affect 50.95 ha of suitable habitat for this species. Although this will result in the removal of potential habitat for Giant Burrowing Frog, it is not considered that this habitat is necessary for the species long term survival and recovery. This is given that similar habitat is available immediately surrounding the referral area and numerous records (108) are known from within 5 km of the referral area.
2)	reduce the area of occupancy of an important population	The proposed action would reduce the amount of potential habitat for this species by 50.95 ha. This will result in the removal of potential habitat for Giant Burrowing Frog, thus reduce its area of occupancy. However, it is not considered that this habitat is necessary for the species long term survival and recovery. This is given that similar habitat is available immediately surrounding the referral area and numerous records (108) are known from within 5 km of the referral area..
3)	fragment an existing important population into two or more populations	The proposed action is unlikely to fragment an important population into two or more populations. This is because similar habitat is available immediately surrounding the referral area, downstream from the referral area.

Criterion	Question	Response
4)	adversely affect habitat critical to the survival of a species *Note: 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:* *for activities such as foraging, breeding, roosting, or dispersal* *for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)* *to maintain genetic diversity and long term evolutionary development, or* *for the reintroduction of populations or recovery of the species or ecological community.*	No habitat critical to the survival has been identified for this species. The proposed action will affect 50.95 ha of potential habitat for this species, however similar habitat is available within 1,500 m of the referral area.
5)	disrupt the breeding cycle of an important population	The proposed action is unlikely to result in the loss of a large number of individuals that would disrupt the life cycle of this species.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will affect 50.95 ha of suitable habitat for this species. However, it is unlikely that the extent of this habitat removal will cause the species to decline. Furthermore, suitable habitat is available within 1,500 m of the subject land and no populations of the species are known from within a 5km radius.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action is unlikely to result in the establishment of an invasive species, such as feral cats or European Red Fox, in the habitat of Giant Burrowing Frog.
8)	introduce disease that may cause the species to decline, or	The proposed action is may introduce disease, such as Chytrid Fungus, that would cause this species to decline.
9)	interfere substantially with the recovery of the species.	The Conservation Advice for this species identifies the following threats: habitat loss, hydrological changes, forest disturbance associated with forestry operations and Chytridiomycosis caused by infection with chytrid fungus. The proposed action will result in some habitat loss (up to 50.95 ha) and hydrological changes, however the action is considered unlikely to exacerbate these threats to the extent that it would interfere substantially with the recovery of the species.

Criterion	Question	Response
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on Giant Burrowing Frog for the following reasons: The proposed action is unlikely to result in the loss of a large number of individuals that would interfere with the recovery of the northern population of the species. Suitable habitat for this species is available within 1,500 m of the referral area.

2.6.1.6 Forest birds *(Anthochaera phrygia* (Regent Honeyeater) *and Lathamus discolor* (Swift Parrot)*)*

The Regent Honeyeater and Swift Parrot are both listed as critically endangered under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. Due to similar habitat requirements of these species, a single test was undertaken for both. These species were not recorded within the development site during surveys. The proposed action will impact 61.92 ha of potential foraging habitat for both the Regent Honeyeater and Swift Parrot (PCTs 1081,1083, 1328 and 1181). The development site is not included within the DPIE mapped breeding areas for either threatened species.

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery.*	The proposed action will affect 61.92 ha of native vegetation which represents potential foraging habitat for the Large-eared Pied Bat. It is not considered that the foraging habitat comprises habitat for an important population, due to the presence of more extensive habitat adjacent to the referral area and the fact that no breeding habitat (caves, cliffs, disused mine shafts or abandoned Fairy Martin nests) is within the referral area and will be removed by the proposed action. Therefore, this impact would not lead to a long-term decrease in the size of an important population of the species, given the proximity of similar, more extensive habitat adjacent to the referral area and the fact that no breeding habitat would be removed.
2)	reduce the area of occupancy of an important population	The proposed action would reduce the amount of potential foraging habitat for this species by up to 61.92 ha. The Large-eared Pied Bat is not known to breed within the referral area but does forage within the referral area. It is not considered that the referral area comprises foraging habitat for an important population therefore the proposed action will not reduce the area of occupancy of an important population.
3)	fragment an existing important population into two or more populations	The proposed action will not fragment an existing important population into two or more populations.
4)	adversely affect habitat critical to the survival of a species	The 2011 National Recovery Plan for this species identifies the following as habitat critical to the survival of the species: disused mine shafts, caves (particularly arch caves with dome roofs, overhangs abandoned Fairy Martin nests and sandstone cliffs and fertile wooded valley habitat within close proximity of each other. No critical habitat for this species was identified within the referral area. Considering that only suitable foraging habitat will be affected, and more similar, and extensive habitat is available adjacent to the referral area, the proposed action is considered unlikely to adversely affect critical habitat for this species.

Criterion	Question	Response
5)	disrupt the breeding cycle of an important population	The proposed action will not disrupt the breeding cycle of the Large-eared Pied Bat given that no breeding habitat or known roost sites will be affected by the proposed action and suitable foraging habitat is available adjacent to the referral area.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will affect 61.92 ha of vegetation, including foraging habitat for the Large-eared Pied Bat. It is unlikely that the extent of this vegetation removal will cause the species to decline because suitable, and extensive habitat is available adjacent to the referral area. The removal of vegetation from within the referral area will not fragment or isolate any breeding habitat such as cliffs and caves.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action are unlikely to result in the establishment of an invasive species in the habitat of the Large-eared Pied Bat.
8)	introduce disease that may cause the species to decline, or	The action is unlikely to introduce disease that would cause this species to decline.
9)	interfere substantially with the recovery of the species.	The 2011 National Recovery Plan for this species identifies the following potential threats: destruction of and interference with roosts, mining of roosts, mine induced subsidence of cliff lines, disturbance from human recreational activities, habitat disturbance, predation by introduced predators, vegetation clearance in proximity of roosts and loss of genetic diversity. The proposed action will impact foraging habitat; however, the action is unlikely to exacerbate these threats to the extent that it would interfere substantially with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on the Large-eared Pied bat for the following reasons: No breeding habitat will be impacted by the action. The species is highly mobile and will continue to access different areas of habitat.

2.6.1.7 *Pommerhelix duralensis* (Dural Land Snail)

The Dural Land Snail is listed as endangered under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. Three specimens of this threatened species were recorded during surveys. The proposed action will impact 28.8 ha of habitat suitable for this species (PCT 1081).

Criterion	Question	Response
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility of the following:		
1)	will the action lead to a long-term decrease in the size of a population	The Conservation Advice for this species states that "given the species occurs in a limited location and has a fragmented distribution the Committee considers all populations to be important." The Conservation Advice also identifies that the Dural Land Snail "occurs in low abundance" with a maximum recorded density of three live snails per hectare. Given that the proposed action will affect 28.8 ha of habitat, including areas where three specimens were recorded during survey, this action has the potential to lead to a long-term decrease in the size of the population.
2)	will the action reduce the area of occupancy of the species	The proposed action will the reduce the potential area of occupancy for three individuals and an additional 28.8 ha of potential habitat for the species within the referral area.
3)	will the action fragment an existing population into two or more populations	The proposed action will affect a large tract (28.8 ha) of habitat suitable for this species. This may fragment an existing population into two or more populations.
4)	will the action adversely affect habitat critical to the survival of a species	Habitat important to the survival of the species, as listed in the Conservation Advice for the Dural Land Snail, includes "shale-influenced vegetation types". The proposed action will adversely affect habitat critical to the survival of the species through the impact of 28.8 ha of Shale Sandstone Transition Forest.
5)	will the action disrupt the breeding cycle of a population	According to the Conservation Advice for the species, "the genetic viability of Dural Land Snail populations is of concern." The proposed action will affect 28.8 ha of habitat, which is likely to contribute to genetic isolation and inbreeding depression. This will reduce overall population genetic fitness and limit the population's ability to recover from stochastic environmental events.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will affect 28.8 ha of habitat available for the species within the referral area. Dispersal of the Dural Land Snail is extremely slow (the Conservation Advice states the maximum nightly straight-line-dispersal recorded as 0.96 m in a survey conducted over 16 survey-animal-nights). The proposed action is likely to result in the death of all individuals present within the development footprint. Therefore the proposed action will destroy, isolate and decrease the availability or quality of habitat to the extent that the species is likely to decline.

Criterion	Question	Response
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposed action may result in the establishment of *Bradybaena similaris* (Asian Tramp Snail), and / or *Cornu aspersum* (Common Garden Snail) (imported via mining machinery or cars), invasive species that are harmful to the Dural Land Snail. The proposed action may also result in increased risk of predation by *Turdus merula* (Common Blackbird).
7)	will the action introduce disease that may cause the species to decline	The action is unlikely to introduce disease that would cause this species to decline.
8)	will the action interfere with the recovery of the species	One of the primary conservation objectives listed in the Conservation Advice for the Dural Land Snail is "maintain and enhance the species' habitat and connectivity." The proposed action will interfere substantially with this objective through the proposed clearing of 28.8 ha of habitat for this species.
Conclusion	Is there likely to be a significant impact?	Yes. The proposed clearing of 28.8 ha of habitat will have a significant impact on the Dural Land Snail for the following reasons: The proposed action will remove habitat critical to the survival of the species. The proposed action will interfere with the recovery of the species.

2.6.1.8 *Chalinolobus dwyeri* (Large-eared Pied Bat)

The Large-eared Pied Bat is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. This species was recorded from ultrasonic surveys undertaken in late February 2020. The proposed action will remove/modify 61.92 ha of foraging habitat suitable for this species (PCTs 1081,1083, 1328 and 1181).

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery.*	The proposed action will affect 61.92 ha of native vegetation which represents potential foraging habitat for the Large-eared Pied Bat. It is not considered that the foraging habitat comprises habitat for an important population, due to the presence of more extensive habitat adjacent to the referral area and the fact that no breeding habitat (caves, cliffs, disused mine shafts or abandoned Fairy Martin nests) is within the referral area and will be removed by the proposed action. Therefore, this impact would not lead to a long-term decrease in the size of an important population of the species, given the proximity of similar, more extensive habitat adjacent to the referral area and the fact that no breeding habitat would be removed.
2)	reduce the area of occupancy of an important population	The proposed action would reduce the amount of potential foraging habitat for this species by up to 61.92 ha. The Large-eared Pied Bat is not known to breed within the referral area but does forage within the referral area. It is not considered that the referral area comprises foraging habitat for an important population therefore the proposed action will not reduce the area of occupancy of an important population.
3)	fragment an existing important population into two or more populations	The proposed action will not fragment an existing important population into two or more populations.
4)	adversely affect habitat critical to the survival of a species	The 2011 National Recovery Plan for this species identifies the following as habitat critical to the survival of the species: disused mine shafts, caves (particularly arch caves with dome roofs, overhangs abandoned Fairy Martin nests and sandstone cliffs and fertile wooded valley habitat within close proximity of each other. No critical habitat for this species was identified within the referral area. Considering that only suitable foraging habitat will be affected, and more similar, and extensive habitat is available adjacent to the referral area, the proposed action is considered unlikely to adversely affect critical habitat for this species.
5)	disrupt the breeding cycle of an important population	The proposed action will not disrupt the breeding cycle of the Large-eared Pied Bat given that no breeding habitat or known roost sites will be affected

Criterion	Question	Response
		by the proposed action and suitable foraging habitat is available adjacent to the referral area.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will affect 61.92 ha of vegetation, including foraging habitat for the Large-eared Pied Bat. It is unlikely that the extent of this vegetation removal will cause the species to decline because suitable, and extensive habitat is available adjacent to the referral area. The removal of vegetation from within the referral area will not fragment or isolate any breeding habitat such as cliffs and caves.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action are unlikely to result in the establishment of an invasive species in the habitat of the Large-eared Pied Bat.
8)	introduce disease that may cause the species to decline, or	The action is unlikely to introduce disease that would cause this species to decline.
9)	interfere substantially with the recovery of the species.	The 2011 National Recovery Plan for this species identifies the following potential threats: destruction of and interference with roosts, mining of roosts, mine induced subsidence of cliff lines, disturbance from human recreational activities, habitat disturbance, predation by introduced predators, vegetation clearance in proximity of roosts and loss of genetic diversity. The proposed action will impact foraging habitat; however, the action is unlikely to exacerbate these threats to the extent that it would interfere substantially with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on the Large-eared Pied bat for the following reasons: No breeding habitat will be impacted by the action. The species is highly mobile and will continue to access different areas of habitat.

2.6.1.9 *Dasyurus maculatus* (Spotted-tailed Quoll)

The Spotted-tailed Quoll is listed as endangered under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. This species was not recorded within the development site during surveys and has not been recorded within five kilometres of the development site. The proposed action will affect 61.92 ha of suitable habitat for this species (PCTs 1328, 1083 1081 and 1181).

Criterion	Question	Response
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility of the following:		
1)	will the action lead to a long-term decrease in the size of a population *Note: A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area.*	No populations of the Spotted-tailed Quoll are known from the referral area or from a 5 km radius around the referral area however the proposed action will affect 61.92 ha of vegetation which comprises potential habitat for the species. The removal/modification of 61.92 ha of potential habitat would not lead to a long-term decrease in the size of a population of the species, given the proximity of similar, and more extensive habitat in connective vegetation adjacent to the referral area.
2)	will the action reduce the area of occupancy of the species	The proposed action would reduce the amount of potential habitat for this species by 61.92 ha, however there is similar habitat available adjacent to the referral area and species is not known to occupy the site.
3)	will the action fragment an existing population into two or more populations	The proposed action will not fragment an existing population into two or more populations.
4)	will the action adversely affect habitat critical to the survival of a species	The National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus* 2016 identifies habitat critical to the survival of the species as including "large patches of forest with adequate denning resources and relatively high densities of medium-sized mammalian prey." The proposed action will remove 61.92 ha of potential habitat for this species. However, the Plan also states that all habitats "known to be occupied are considered important." The proposed action is unlikely to adversely affect habitat critical to the survival of the species because no populations are known from within a 5 km radius of the referral area and similar, more extensive habitat is available adjacent to the referral area.
5)	will the action disrupt the breeding cycle of a population	The proposed action is unlikely to result in the loss of a large number of individuals that would disrupt the life cycle of this species.
6) i	will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will decrease the availability of habitat for the species within the subject land by 61.92 ha. However, it is unlikely that the extent of this habitat removal will cause the species to decline because suitable habitat is available adjacent to the referral area and no populations are known from the region.

Criterion	Question	Response
6) ii	will the action result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposed action is unlikely to result in the establishment of an invasive species, such as introduced carnivores, in the habitat of the Spotted-tailed Quoll.
7)	will the action introduce disease that may cause the species to decline	The action is unlikely to introduce disease that would cause this species to decline.
8)	will the action interfere with the recovery of the species	The proposed action will remove potential habitat for this species; however this will not interfere substantially with recovery objectives listed in the National Recovery Plan for the Spotted-tailed Quoll *Dasyurus maculatus* 2016.
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on the Spotted-tailed Quoll for the following reasons: The proposed action will not impact a known population of the species. More suitable foraging habitat for this highly mobile species is available adjacent to the referral area.

2.6.1.10 *Phascolarctos cinereus* (Koala)

The Koala is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. One probable Koala scat was detected during targeted survey. The proposed action will affect 61.92 ha of native vegetation, some of which contains suitable foraging habitat for this species. No evidence of breeding was detected.

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery.*	The proposed action will affect 61.92 ha of native vegetation, some of which contains potential foraging habitat for the Koala. No Koalas were detected in the referral area during survey, nor has there been any Koalas recorded on BioNet within 10 km of the referral area within the last 20 years. No evidence of breeding habitat was detected within the referral area during surveys. The referral area is not located in an area which is at the limit of the Koala's range. Therefore it is not considered that referral area comprises habitat for an important population of the Koala. The proposed action would therefore not lead to a long-term decrease in the size of an important population of the species.
2)	reduce the area of occupancy of an important population	The proposed action would affect up to 61.92 ha of potential foraging habitat for this species. The Koala is not known to occupy the referral area but may occasionally forage within the referral area. As the referral area is not considered to be habitat for an important population of Koala, the proposed action would not reduce the area of occupancy of an important population of Koala.
3)	fragment an existing important population into two or more populations	The proposed action will not fragment an existing important population into two or more populations.

Criterion	Question	Response
4)	adversely affect habitat critical to the survival of a species *Note: 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:* for activities such as foraging, breeding, roosting, or dispersal for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species or ecological community.	According to the listing advice, in the national context the koala is widely distributed throughout the coastal and inland areas of eastern Australia. Their range extends from north-eastern Queensland to Eyre Peninsula in South Australia. In NSW the koala mostly occurs within the north coast and central coasts, with other significant populations on the western slopes (such as the Pilliga and Gunnedah region) and the western plains. There are also known sites in the central and southern tablelands, records from the northern tablelands and some disjunct populations on the south coast. Through application of the Koala Habitat Assessment Tool it was determined that the referral area may comprise habitat critical to the survival of the koala. The Koala is not known to occupy the referral area but may occasionally forage within the referral area (i.e. no koalas were detected in the referral area during survey, nor has there been any koalas recorded on BioNet within 10 km of the referral area within the last 20 years). The proposed action may affect up to 61.92 ha of potential habitat for the koala, which is considered habitat critical to the survival of the species according to the Koala Habitat Assessment Tool.
5)	disrupt the breeding cycle of an important population	No important population of koala has been identified in the referral area (i.e. no Koalas were detected in the referral area, nor has there been any Koalas recorded on BioNet within 10km of the referral area within the last 20 years). The proposed action will therefore not disruption the breeding cycle of an important population of koala.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will affect up to 61.92 ha of potential habitat for the koala. It is unlikely that the extent of this vegetation removal will cause the species to decline because suitable, more extensive habitat is available adjacent to the referral area.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action is unlikely to result in the establishment of an invasive species in the potential habitat of the koala.
8)	introduce disease that may cause the species to decline, or	The proposed action is unlikely to introduce disease that would cause this species to decline.
9)	interfere substantially with the recovery of the species.	The Approved Conservation Advice for this species identifies the following main threats: loss and fragmentation of habitat, vehicle strike, disease and predation by dogs. The proposed action will impact foraging habitat; however the action is unlikely to exacerbate these threats to the extent that it would interfere substantially with the recovery of the species.

Criterion	Question	Response
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on the Koala for the following reasons: No breeding habitat will be impacted by the action. More suitable habitat for this species is available adjacent to the referral area.

2.6.1.11 *Pseudomys novaehollandiae* (New Holland Mouse)

The New Holland Mouse is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. This species was not recorded within the development site during surveys and has not been recorded within five kilometres of the development site. The proposed action will impact 61.92 ha of potential habitat for this species (PCTs 1181, 1328, 1083 and 1081).

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery.	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. It is not considered that the referral area comprises habitat for an important population of New Holland Mouse. No populations of the New Holland Mouse are known from the referral area or from a 5 km radius around the referral area, and the referral area is not located at the limit of the species range. However the proposed action will affect 61.92 ha of vegetation which comprises potential habitat for the species. Therefore the proposed action would affect 61.92 ha of potential habitat, however, would not lead to a long-term decrease in the size of an important population of the species. Further to this the referral area is directly connected to a large tract of bushland which would provide similar, or potentially superior habitat.
2)	reduce the area of occupancy of an important population	The proposed action would affect 61.92 ha of potential habitat for this species, however it would not reduce the area of occupancy of an important population.
3)	fragment an existing important population into two or more populations	The proposed action will not fragment an existing important population into two or more populations.
4)	adversely affect habitat critical to the survival of a species Note: 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary: for activities such as foraging, breeding, roosting, or dispersal for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)	No habitat critical to survival has been identified for this species. The proposed action will affect 61.92 ha of potential habitat for this species, however similar habitat is available adjacent to the referral area.

Criterion	Question	Response
	to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species or ecological community.	
5)	disrupt the breeding cycle of an important population	The proposed action is unlikely to result in the loss of a large number of individuals that would disrupt the breeding cycle of an important population of this species.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will remove or decrease the quality of habitat for the species within the subject land by 61.92 ha. However, it is unlikely that the extent of this habitat removal will cause the species to decline because suitable habitat is available adjacent to the referral area and no populations of the species are known from within 5 km of the referral area.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action is unlikely to result in the establishment of an invasive species, such as feral cats, red foxes or wild dogs, in the habitat of the New Holland Mouse.
8)	introduce disease that may cause the species to decline, or	The action is unlikely to introduce disease, such as *Phytophthora cinnamomi,* that would cause this species to decline through vegetation dieback.
9)	interfere substantially with the recovery of the species.	The Conservation Advice for this species identifies the following threats: loss of habitat due to development, weed invasion, Phytophthora dieback, inappropriate fire management, predation by introduced predators and climate change. The proposed action is unlikely to exacerbate these threats such that it would interfere substantially with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on the New Holland Mouse for the following reasons: The proposed action will not impact a known important population of the species. More suitable habitat for this species is available adjacent to the referral area.

2.6.1.12 *Pteropus poliocephalus* (Grey-headed Flying-fox)

The Grey-headed Flying-fox is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. This species was identified within the development site during surveys. The proposed action will remove/modify 61.92 ha of native vegetation, some of which comprises suitable foraging habitat for this species. No camps were identified within the development site, the nearest Flying-fox Camp is located approximately 10 km east of the subject land at Singleton Mills. No camps will be affected by the proposed action.

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery.*	No roosting habitat (camps) will be affected by the proposed action. The proposed action will affect 61.92 of native vegetation, some of which comprises suitable foraging habitat for the Grey-headed Flying-fox. The Grey-headed Flying-fox is recorded as travelling long distances (up to 50 km) on feeding forays. Given the proximity of more suitable habitat in connective vegetation within 1,500 m of the referral area, the removal of this potential foraging habitat would not lead to the long-term decrease in the size of an important population of Grey-headed Flying-fox.
2)	reduce the area of occupancy of an important population	The proposed action would affect 61.92 ha of potential foraging habitat for this species. The Grey-headed Flying-fox is not known to occupy the referral area in the form of a camp but may occasionally forage within the referral area. The Grey-headed Flying-fox is recorded as travelling long distances on feeding forays and would likely utilise the potential foraging habitat outside of the referral area.
3)	fragment an existing important population into two or more populations	According to the Draft Recovery Plan for the Grey-headed Flying-fox 2017, "the Grey-headed Flying-fox is considered to be a single, mobile population with individuals distributed across Queensland, New South Wales, Victoria, South Australia, Tasmania and the ACT." The proposed action will not fragment an existing important population into two or more populations. No camps will be affected by the proposed action and other areas of foraging habitat are available for this highly mobile species within the region.
4)	adversely affect habitat critical to the survival of a species *Note: 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:* for activities such as foraging, breeding, roosting, or dispersal for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) to maintain genetic diversity and long term evolutionary development, or	The Draft Recovery Plan for the Grey-headed Flying-fox 2017 identifies 'a continuous temporal sequence of productive foraging habitats, linked by migration corridors or stopover habitats, and suitable roosting habitat within nightly commuting distance of foraging areas' as habitat critical to the survival of the species. The proposed action will affect 67.95 ha of native vegetation, some of which may represent habitat critical survival to this species. However, this impact is considered unlikely to have an adverse effect given that the species is recorded as travelling long distances (50 km) on feeding forays and similar habitat is available adjacent to the referral area.

Criterion	Question	Response
	for the reintroduction of populations or recovery of the species or ecological community.	
5)	disrupt the breeding cycle of an important population	The proposed action will not disrupt the breeding cycle of the Grey-headed Flying-fox given that no camps will be affected by the proposed action and suitable foraging habitat is available adjacent to the referral area.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will remove/modify 61.92 ha of vegetation, including foraging habitat for the Grey-headed Flying-fox. It is unlikely that the extent of this vegetation removal will cause the species to decline because suitable habitat is available adjacent to the referral area.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action is unlikely to result in the establishment of an invasive species that is harmful to the Grey-headed Flying-fox.
8)	introduce disease that may cause the species to decline, or	Grey-headed Flying-fox are reservoirs for the Australian bat lyssavirus, Hendra Virus and Menangle virus, and can cause clinical disease and mortality in Grey-headed Flying-fox. The proposed action would not increase the incidence of this disease.
9)	interfere substantially with the recovery of the species.	The proposed action will remove suitable foraging habitat for this species; however this will not interfere substantially with recovery objectives listed in the Draft National Recovery Plan for the Grey-headed Flying-fox 2017. The proposed action will not affect any camps and suitable foraging habitat is available adjacent to the referral area.
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on the Grey-headed Flying-fox for the following reasons: No camps will be removed by the proposed action. More suitable foraging habitat for this highly mobile species is available adjacent to the referral area.

2.6.1.13 *Hoplocephalus bungaroides* (Broad-headed Snake)

The Broad-headed Snake is listed as vulnerable under the EPBC Act. The distribution and habitat associations of this threatened species are presented in Appendix F. This species was not recorded within the development site during surveys and has not been recorded within five kilometres of the development site. The proposed action will remove/modify 25.24 ha of native vegetation (PCT 1181, 1238 and 1083) which comprises suitable habitat for this species.

Criterion	Question	Response
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:		
1)	lead to a long-term decrease in the size of an important population of a species *Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery.*	No populations of the Broad-headed Snake are known from the referral area or from a 5 km radius around the referral area, however the proposed action will impact 25.24 ha of vegetation, which comprises potential habitat for the species. It is not considered that the referral area comprises habitat for an important population as the referral area is not located at the limit of the species range, nor is it located in the general areas of occurrence detailed in the Conservation Advice. There is extensive, similar habitat in connective vegetation adjacent to the referral area. Therefore, impacts to potential habitat would not lead to a long-term decrease in the size of an important population of the species.
2)	reduce the area of occupancy of an important population	The proposed action would affect 25.24 ha of potential habitat for this species. There is similar, extensive habitat available adjacent to the referral area and the species is not known to occupy the site. As discussed, it is considered that the referral area does not comprise habitat for an important population, therefore the proposed action will not reduce the area of occupancy of an important population.
3)	fragment an existing important population into two or more populations	The proposed action will not fragment an existing important population into two or more populations.
4)	adversely affect habitat critical to the survival of a species *Note: 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:* for activities such as foraging, breeding, roosting, or dispersal for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species or ecological community.	No habitat critical to survival has been identified for this species. The proposed action will remove 25.24 ha of potential habitat for this species, however similar, extensive habitat is available adjacent to the referral area. It is also not considered that the referral area comprises habitat for an important population of this species.

Criterion	Question	Response
5)	disrupt the breeding cycle of an important population	The proposed action is unlikely to result in the loss of a large number of individuals that would disrupt the life cycle of this species.
6)	modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposed action will remove or decrease the quality of habitat for the species by 25.24 ha. However, it is unlikely that the extent of this habitat removal will cause the species to decline because suitable habitat is available adjacent to the referral area and no populations of the species are known from the region.
7)	result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposed action are unlikely to result in the establishment of an invasive species in the habitat of the Broad-headed Snake.
8)	introduce disease that may cause the species to decline, or	The action is unlikely to introduce disease that would cause this species to decline.
9)	interfere substantially with the recovery of the species.	The Conservation Advice for this species identifies the following threats: disturbance of habitat, development of ridgetops, pine plantation development and inappropriate fire regimes. The proposed action will disturb habitat, but the action is unlikely to exacerbate these threats such that it would interfere substantially with the recovery of the species.
Conclusion	Is there likely to be a significant impact?	No. The proposed action is unlikely to have a significant impact on the Broad-headed Snake for the following reasons: The proposed action will not impact a known population of the species. More suitable habitat for this species is available adjacent to the referral area.

2.6.2 The Hills Local Environment Plan 2019

The subject land and development site is zoned RU2 Rural Landscape under The Hills LEP.

The development site is subject to the Terrestrial Biodiversity overlay in the LEP which requires consideration of *Part 7 Clause 7.4 Terrestrial Biodiversity:*

1) The objective of this clause is to maintain terrestrial biodiversity, including by

(a) protecting native fauna and flora, and

(b) protecting the ecological processes necessary for their continued existence, and

(c) encouraging the conservation and recovery of native fauna and flora and their habitats.

(2) This clause applies to land identified as "Biodiversity" on the Terrestrial Biodiversity Map.

As the project is SSD, the council planning provisions do not apply in a statutory context, However, the development has addressed the LEP is provided in Table 50.

Table 49: The Hills Local Environment Plan 2019

Relevant LEP Section	How addressed
Part 7 Clause 7.4 (3) In deciding whether to grant development consent for development on land to which this clause applies, the consent authority must consider: (a) whether the development is likely to have (i) any adverse impact on the condition, ecological value and significance of the fauna and flora on the land, and (ii) any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna, and (iii) any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and (iv) any adverse impact on the habitat elements providing connectivity on the land, and (b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development.	(a) (i) Due to the nature of the project, the development will result in an adverse impact on the condition, ecological value and significance of the flora and fauna on the land. This will be through the direct removal of 50.95 ha of native vegetation which provides habitat for threatened flora and fauna and non-threatened flora and fauna, and which also includes 25.71 ha of the EPBC Act listed TEC Shale Sandstone Transition Forest of the Sydney Basin Bioregion. (a) (ii) The project will have an adverse impact on the importance of the vegetation on the land to habitat the survival of native fauna, due to the direct removal of 51.49 ha of native vegetation and partial fragmentation of vegetation the north, south and east of the development site. (a) (iii) The project has the potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land due to the direct removal of 50.95 ha of native vegetation and partial fragmentation of vegetation the north, south and east of the development site. (b) The project avoidance and minimisation measures have been provided above in Section 2.1.1 Locating a project to avoid and minimise impacts on vegetation and habitat, and Section 2.2.2.1 Locating and designing a project to avoid and minimise prescribed biodiversity impacts The final design has incorporated a 50 m buffer to minimise impacts on the Maroota Sands Swamp Forest to the north of the development site. This buffer zone will be subject to ongoing monitoring and weed management to manage impacts of the operations on the Maroota Sands Swamp Forest and surrounding bushland and riparian areas.

Relevant LEP Section	How addressed
	A Vegetation Management Plan shall be prepared which covers the retained bushland in the direct and indirect impact areas, all the retained bushland within PCT 1081 to the east of the extraction area, and within the adjacent riparian buffers and *Maroota Sand Swamp Forest*. Additional mitigation measures to mitigate impacts are provided above in Section 2.2.5 Mitigating and managing impacts.
Part 7 Clause 7.4 (4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that— (a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or (b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or (c) if that impact cannot be minimised—the development will be managed to mitigate that impact.	(4)(a) Impacts to threatened ecological communities and threatened species are expected as part of this development. As discussed above, the project avoidance and minimisation measures have been documented in Section 2.1.1 Locating a project to avoid and minimise impacts on vegetation and habitat and Section 2.1.2.1 Locating and designing a project to avoid and minimise prescribed biodiversity impacts. (b) The design has incorporated a 50 m buffer to minimise impacts on the *Maroota Sands Swamp Forest to* the north of the site. The development has also incorporated a 100 m buffer along the southern boundary of the subject land which minimises visual impacts. As part of the extractive industry design, extraction will not occur below two metres of the wet weather high groundwater levels for the subject land. (c) A Vegetation Management Plan shall be prepared which covers the retained bushland in the direct and indirect impact areas, all the retained bushland within PCT 1081 to the east of the extraction area, and within the adjacent riparian buffers and *Maroota Sand Swamp Forest.* Additional mitigation measures to mitigate impacts are provided above in Section 2.2.5 Mitigating and managing impacts.

2.6.3 The Hills Development Control Plan 2012

The Hills DCP Part B Section 1 Rural contains provisions relating to native vegetation in Rural Landscape under the LEP. As the project is SSD, the council planning provisions do not apply in a statutory context, However, the development has addressed the DCP is provided in Table 50.

Table 50: The Hills Development Control Plan 2012

Relevant DCP Section	How addressed
Part 2 Extractive Industries Section 1 Site Planning: Extractive industries and related activities maintain an effective buffer to protect landscape quality, the habitats of threatened species, populations and ecological communities of the shire. The development controls states for Extractive Industry Buffer Zones • To be a minimum of 50m from important habitats of threatened species, populations, ecological communities and/or; • No less than the site specific requirements of the National Parks & Wildlife Services. The buffer zone should not be disturbed except for ongoing management or rehabilitation purposes	Due to the nature of the project, the development will result in the removal of a threatened ecological community, threatened species and threatened species habitat, The development design has incorporated a 50 m buffer to minimise impacts to the Maroota Sands Swamp Forest to the north of the site. This buffer zone will be subject on ongoing monitoring and weed management to manage any impacts of the operations on the *Maroota Sands Swamp Forest* and surrounding bushland and riparian areas.
Part 2 Extractive Industries Section 5 Flora and Fauna Buffer Zones: Sufficient separation is provided to threatened species and critical ecological communities, and the scenic and environmental quality of the Shire is retained.	As discussed, impact to threatened ecological communities and threatened species are expected as part of this development. The design has incorporated a 50 m buffer to minimise impacts on the Maroota Sands Swamp Forest to the north of the site. The development has also incorporated a 100 m buffer along the southern boundary of the subject land which minimises visual impacts thus somewhat retaining the scenic quality of the Hills Shire.
Part C Section C Landscaping Section 2.3 Weed Species; *The Biosecurity Act 2015*, specifies the control of Priority weeds in New South Wales. The responsibility for eradication of weeds on private land is that of the owner. Private landholders are responsible for ensuring that as far as reasonably practicable, the biosecurity risk posed by priority weeds is prevented, eliminated or minimised.	Mitigation measures have been provided in Section 2.2.5 Mitigating and managing impacts. Those which address the DCP Control are as follows: Weed management is to be to be undertaken where required. Vehicles should be washed down before entering and exiting the site to prevent the spread of weeds to or from the development site and adjacent vegetation. In particular, machinery work on or nearby dams are required to be washed down in order to prevent the spread of chytrid fungus into or from the development site.

Relevant DCP Section	How addressed
	Vehicles, machinery and building refuse should remain only within the development site and disposed of at an appropriate waste management facility. A Vegetation Management Plan should be prepared which covers the retained bushland in the direct and indirect impact areas, all the retained bushland within PCT 1081 to the east of the extraction area, and within the adjacent riparian buffers and Maroota Sand Swamp Forest. An ecological rehabilitation and restoration strategy should be prepared as part in the extractive industry closure planning. An adaptive monitoring program should be established to monitor short and long term impacts of the extractive industry on the adjacent *Maroota Sand Swamp Forest*.

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Appendix A Definitions

Terminology	Definition
Biodiversity credit report	The report produced by the Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
BioNet Atlas	The BioNet Atlas (formerly known as the NSW Wildlife Atlas) is the OEH database of flora and fauna records. The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails) and some fish
Broad condition state:	Areas of the same PCT that are in relatively homogenous condition. Broad condition is used for stratifying areas of the same PCT into a vegetation zone for the purpose of determining the vegetation integrity score.
Connectivity	The measure of the degree to which an area(s) of native vegetation is linked with other areas of vegetation.
Credit Calculator	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.
Development	Has the same meaning as development at section 4 of the EP&A Act, or an activity in Part 5 of the EP&A Act. It also includes development as defined in section 115T of the EP&A Act.
Development footprint	The area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials.
Development site	An area of land that is subject to a proposed development that is under the EP&A Act.
Ecosystem credits	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
High threat exotic plant cover	Plant cover composed of vascular plants not native to Australia that if not controlled will invade and outcompete native plant species.
Hollow bearing tree	A living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1 m above the ground. Trees must be examined from all angles.
Important wetland	A wetland that is listed in the Directory of Important Wetlands of Australia (DIWA) and SEPP 14 Coastal Wetlands
Linear shaped development	Development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length
Local population	The population that occurs in the study area. In cases where multiple populations occur in the study area or a population occupies part of the study area, impacts on each subpopulation must be assessed separately.
Local wetland	Any wetland that is not identified as an important wetland (refer to definition of Important wetland).
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000.

Terminology	Definition
Multiple fragmentation impact development	Developments such as wind farms and coal seam gas extraction that require multiple extraction points (wells) or turbines and a network of associated development including roads, tracks, gathering systems/flow lines, transmission lines
Operational Manual	The Operational Manual published from time to time by OEH, which is a guide to assist assessors when using the BAM
Patch size	An area of intact native vegetation that: a) occurs on the development site or biodiversity stewardship site, and b) includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the development site or stewardship site.
Proponent	A person who intends to apply for consent to carry out development or for approval for an activity.
Reference sites	The relatively unmodified sites that are assessed to obtain local benchmark information when benchmarks in the Vegetation Benchmarks Database are too broad or otherwise incorrect for the PCT and/or local situation. Benchmarks can also be obtained from published sources.
Regeneration	The proportion of over-storey species characteristic of the PCT that are naturally regenerating and have a diameter at breast height <5 cm within a vegetation zone.
Remaining impact	An impact on biodiversity values after all reasonable measures have been taken to avoid and minimise the impacts of development. Under the BAM, an offset requirement is calculated for the remaining impacts on biodiversity values.
Retirement of credits	The purchase and retirement of biodiversity credits from an already-established biobank site or a biodiversity stewardship site secured by a biodiversity stewardship agreement.
Riparian buffer	Riparian buffers applied to water bodies in accordance with the BAM
Sensitive biodiversity values land map	Development within an area identified on the map requires assessment using the BAM.
Site attributes	The matters assessed to determine vegetation integrity. They include: native plant species richness, native over-storey cover, native mid-storey cover, native ground cover (grasses), native ground cover (shrubs), native ground cover (other), exotic plant cover (as a percentage of total ground and mid-storey cover), number of trees with hollows, proportion of over-storey species occurring as regeneration, and total length of fallen logs.
Site-based development	a development other than a linear shaped development, or a multiple fragmentation impact development
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Subject land	Is land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by OEH and accessible from the BioNet website.
Threatened species	Critically Endangered, Endangered or Vulnerable threatened species as defined by Schedule 1 of the BC Act, or any additional threatened species listed under Part 13 of the EPBC Act as Critically Endangered, Endangered or Vulnerable.

Terminology	Definition
Vegetation Benchmarks Database	A database of benchmarks for vegetation classes and some PCTs. The Vegetation Benchmarks Database is published by OEH and is part of the BioNet Vegetation Classification.
Vegetation zone	A relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same PCT and broad condition state.
Wetland	An area of land that is wet by surface water or ground water, or both, for long enough periods that the plants and animals in it are adapted to, and depend on, moist conditions for at least part of their life cycle. Wetlands may exhibit wet and dry phases and may be wet permanently, cyclically or intermittently with fresh, brackish or saline water
Woody native vegetation	Native vegetation that contains an over-storey and/or mid-storey that predominantly consists of trees and/or shrubs

Appendix B Vegetation plot data

Table 51: Species matrix (species recorded by plot)

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	SG	*Acacia hispidula*			0	0	0	0	0	0	0	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0	0
M	SG	*Acacia hispidula*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
M	SG	*Acacia linifolia*			0	0	0	0.2	0.5	0	0	0	0.1	0	0	0	0.1	0	0.1	0	0	0.1	0	0
M	SG	*Acacia myrtifolia*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0
G	SG	*Acacia spp.*			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	SG	*Acacia suaveolens*			0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	SG	*Acacia suaveolens*			0	0	0	0	0	0	0.1	0	0	0	0	0.1	0	0	0	0	0	0	0.5	0.1
G	SG	*Acacia suaveolens*			0	0	0	0	0	0	0	0.1	0.1	0	0.1	0	0.1	0	0	0.1	0	0	0	0
M	SG	*Acacia ulicifolia*			0	0	0	0	0	0	0	0	0.2	0	0	0.2	0	0	0	0.1	0.1	0.1	0	0
G	SG	*Acacia ulicifolia*			0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0.1	0	0	0	0.1	0.1
G	FG	*Actinotus helianthi*			0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0	0	0	0	0
G	FG	*Actinotus minor*			0	0	0	0	0	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0	0.1	0.1	0	0.1	0.1	0.1
U	TG	*Allocasuarina littoralis*			0.1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	TG	*Allocasuarina littoralis*			0	0	0	0	0	3	0	0	0	0.5	0	0	0	7	0	0	0.1	0.1	0	0
G	TG	*Allocasuarina littoralis*			0	0	0	0	0	0	0	0	2	0	0	0	0	0	7	0	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
U	TG	*Angophora bakeri*			5	0.1	7	0	0	0	3	1	2	3	0	2	0	0	5	0	0	0	0	0
M	TG	*Angophora bakeri*			0	0	0	10	0.1	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0
G	TG	*Angophora bakeri*			0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	TG	*Angophora costata*			0	1	0	0	0	0	0	0	0	0	0	0	1	7	0	1	0	0	0	0
U	TG	*Angophora hispida*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0
M	TG	*Angophora hispida*			0	0	0	0	0	0	1	1	0	0	5	0	0	0	0	0	0	2	0	30
G	GG	*Anisopogon avenaceus*			0	1	5	0.1	0	0	1	0.1	0.4	1	0	0	0	0	0.5	0	2	0	0	0
G	GG	*Aristida spp.*			0	0	0	0	0	0.1	0	0.1	0	0	0	0	0.1	0	0	0	0	0	0	0
G	GG	*Aristida vagans*			0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	GG	*Aristida warburgii*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
G	SG	*Astroloma humifusum*			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0
G	GG	*Austrostipa pubescens*			0	20	20	15	10	2	0	0.1	0.6	1	0.5	3	4	2	1	3	0	2	3	40
M	SG	*Banksia ericifolia* subsp. *ericifolia*			0	0	0	0	0	0	25	0	0	0	5	0	0	0	0	0	0	0	0	0.1
G	SG	*Banksia marginata*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
M	SG	*Banksia oblongifolia*			0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	4	0	1	5
M	TG	*Banksia serrata*			0	0	0	0	0	0	0.1	0.5	0	0	5	1	1	0	0	1	0	2	0.1	2

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
M	SG	*Banksia spinulosa*			0	0	1	0	0	1	0	1	1	1	0.2	2	0.5	1	0.1	1	1	0	0	0.2
G	SG	*Banksia spinulosa*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
G	OG	*Billardiera scandens*			0.1	0	0	0	0	0.1	0	0	0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0	0.1	0	0
M	SG	*Boronia ledifolia*			0	0	0	0	0	0	2	0.2	0.2	0.5	0.3	0	0	0	0	0	0	0	0	0.2
G	SG	*Boronia ledifolia*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0
M	SG	*Boronia pinnata*			0	0	0	0	0	0	0.1	0	0	0	0.1	0	0.5	0	0	0	0	0	0.5	0
G	SG	*Boronia pinnata*			0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.5	0	0	0	0.1
G	SG	*Bossiaea heterophylla*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
M	SG	*Bossiaea lenticularis*			0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
G	SG	*Bossiaea lenticularis*			0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.5	0	0.5	0	0
M	SG	*Bossiaea obcordata*			0	0.1	0.1	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1	0	0	0	0
G	SG	*Bossiaea obcordata*			0	0	0	0.2	0.2	0.5	0	0	0	0.1	0.1	1	0	0.1	0	0	0	0.5	0	0
G	FG	*Brunoniella australis*			0.1	0.1	0.1	0.1	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0
G	FG	*Brunoniella pumilio*			0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0.1	0.1	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	OG	*Calochlaena dubia*			0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0.2	0	0	0	0
M	SG	*Calytrix tetragona*			0	0	0	0	0	0	10	5	5	1	2	0	0	0	0	0	0	0	0	0.2
G	FG	*Calytrix tetragona*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0
M	OG	*Cassytha glabella* f. *glabella*			0.1	0	0	0	0	0	0.1	0	0	0.1	0	0.1	0	0	0	0	0	0	0	0
G	OG	*Cassytha glabella* f. *glabella*			0	0.1	0.1	0.1	0	0	0	0.1	0.1	0	0.1	0	0	0	0	0.1	0.1	0.1	0.1	0.2
M	OG	*Cassytha pubescens*			0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0
G	OG	*Cassytha pubescens*			0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	GG	*Caustis flexuosa*			0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
M	GG	*Caustis flexuosa*			0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
G	GG	*Caustis flexuosa*			0	0	0	0	0	0	0	0.1	0.1	0	0.3	2	0	0	0	0	0	0	0	0
M	GG	*Caustis pentandra*			0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
M	TG	*Ceratopetalum gummiferum*			0	0	0	0	0	0	0	0	0	0	0.1	1	0	0	0	0.1	0	0	0	0
G	EG	*Cheilanthes sieberi* subsp. *sieberi*			0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Conospermum longifolium* subsp. *longifolium*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	FG	*Corybas* spp.			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0
U	TG	*Corymbia eximia*			15	3	1	3	1	0	7	10	0	7	7	0.5	0	0	0	0	7	2	1	0.1
M	TG	*Corymbia eximia*			0	0	0	0	0	2	0	0	1	0	0	0	5	0	0	0	0	0	0	0
U	TG	*Corymbia gummifera*			0	10	10	1	7	7	0	0	5	0	5	0	0	7	7	0	3	4	3	0
M	TG	*Corymbia gummifera*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0
G	FG	*Cryptostylis erecta*			0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0.1
G	FG	*Cryptostylis subulata*			0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0.1	0	0.1
G	GG	*Cyathochaeta diandra*			1	5	10	0.5	0	0.2	2	0.1	0.1	1	2	0.5	0.2	1	0.5	0.5	2	1	4	20
G	GG	*Cyperus* spp.			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	FG	*Dampiera stricta*			0	0	0.1	0	0.1	0.1	0.1	0	0.1	0	0.1	0	0	0	0	0.1	0.1	0	0.1	0.1
G	SG	*Daviesia genistifolia*			0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	FG	*Dianella longifolia* var. *longifolia*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0
G	FG	*Dianella prunina*			0	0	0.1	0	0	0.1	0	0	0	0.1	0.1	0.1	0.1	0	0.1	0	0	0	0.1	0
G	FG	*Dianella revoluta* var. *revoluta*			0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	SG	*Dillwynia retorta*			0	0	0	0	0	0	5	0	0.5	0	0.6	0	0	0	0	0	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	SG	*Dillwynia retorta*			0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0.1	0	0	0	0.1
G	SG	*Dodonaea pinnata*			0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0	0	0	0	0	0
M	SG	*Dodonaea triquetra*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
G	FG	*Dodonaea triquetra*			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0	0
G	GG	*Drosera peltata*			0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0.1	0	0	0	0.1
G	GG	*Entolasia marginata*			0	0	0	0	5	0.3	0	0.2	2	5	2	1	1	7	4	2	2	2	3	1
G	SG	*Entolasia stricta*			10	10	20	20	10	1	1	0	1	0	0.5	1	1	3	2	1	0.5	1	2	1
M	SG	*Epacris pulchella*			0	0	0	0	0	0	0.5	0.1	0	0	0	0.5	0	0	0	0	0	0.1	0	0.2
G	SG	*Epacris pulchella*			0	0.1	0.1	0	0	0	0.5	0	0.1	0	1	0.5	0.5	0	0	0.5	0	0	1	0
G	GG	*Eragrostis brownii*			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	TG	*Eucalyptus haemastoma*			0	0	0	0	0	5	0	0	0	0	2	0	3	0	2	2	0	1	2	3
U	TG	*Eucalyptus piperita*			0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	5	0	4	0	0
U	TG	*Eucalyptus punctata*			0	0	0	5	1	0.3	0	3	5	2	0	1	3	2	0	0	2	3	0	0
M	TG	*Eucalyptus punctata*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																		
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
U	TG	*Eucalyptus resinifera* subsp. *resinifera*			5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	TG	*Eucalyptus sparsifolia*			5	10	10	10	10	0	0	0	0	2	0	2	0	1	0	0	0	2	7	0
U	TG	*Eucalyptus squamosa*			0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	SG	*Exocarpos* spp.			0	0	0	0	0	0	0	0	0	0	0	0.2	0.1	0	0	0	0	0.1	0	0
G	SG	*Exocarpos* spp.			0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0
M	SG	*Exocarpos strictus*			0	0	0	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	FG	*Forb*			0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
G	FG	*Forb*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
G	FG	*Forb*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
M	SG	*Gompholobium glabratum*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0
G	SG	*Gompholobium glabratum*			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Gompholobium grandiflorum*			0	0	0	0	0	0	0	0	0	0.1	0.2	0	0.1	0	0	0.1	0	0.1	0	0
G	SG	*Gompholobium minus*			0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
G	FG	*Gonocarpus tetragynus*			0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																		
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	FG	*Gonocarpus teucrioides*			0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
G	FG	*Goodenia bellidifolia* subsp. *bellidifolia*			0	0	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1
M	FG	*Grevillea buxifolia* subsp. *buxifolia*			0	0	0.2	0.1	0	0	2	0	2	5	2	0.5	2	0	0	0.2	1	0	3	0.3
G	SG	*Grevillea buxifolia* subsp. *buxifolia*			0	0	0	0	0	0.1	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0
M	SG	*Grevillea speciosa*			0	0	0	0	0	0	1	0.5	2	0	0.1	0	1	0	0	1	1	0	1	2
G	SG	*Grevillea speciosa*			0	0	0	0	0	0.1	0	0	0	0.5	0	0.2	0	0	0	0	0	0.2	0	0
M	SG	*Hakea dactyloides*			0	0	0	0	0	0	0	0.3	0.4	0	0.1	0.1	1	0	0	0	0.1	0.1	2	5
G	SG	*Hakea dactyloides*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0
M	SG	*Hakea sericea*			2	2	1	0.1	0.1	0.5	0	0	0	0	0	0	0.1	5	0	0	0.1	0.1	0.1	0.1
G	SG	*Hakea sericea*			0	0	0	0	0	0	0	0	0	0.1	0	2	0	0	3	0	0	0	0	0
G	SG	*Hibbertia aspera* subsp. *aspera*			0	0	0	0	0	0	0.5	0.1	0	0	0.1	0.5	0.1	0	0	0	0	0	1	0.2
M	SG	*Hibbertia bracteata*			0	0.1	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.1	0.1	0	0	0.3	0	0
G	SG	*Hibbertia bracteata*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0
G	SG	*Hibbertia obtusifolia*			0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	SG	*Hibbertia spp.*			0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	FG	*Hovea linearis*			0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	FG	*Hovea linearis*			0	0	0	0.1	0.1	0	0	0.1	0	0	0.1	0.1	0.1	0.1	0.1	0	0	0.1	0.1	0.1
G	FG	*Hybanthus monopetalus*			0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	SG	*Isopogon anemonifolius*			0	0	0.1	0	1	0	1	0	0.1	1	0	0.5	0	0	0	0	0	0	0	0
G	SG	*Isopogon anemonifolius*			0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0.2	0
M	SG	*Isopogon anethifolius*			0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Isopogon anethifolius*			0	0	0	0	0	0	0	0.1	0	0	0	0	0.1	0	0	0	0	0	0	0
M	SG	*Lambertia formosa*			0	0	0	0	0	0	1	0.1	0.1	0.2	2	0.5	0.5	0	0	1	0.5	0	10	0
G	SG	*Lambertia formosa*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
G	SG	*Lasiopetalum parviflorum*			0	0	0	0	0	0	0	0	0	0.1	0	0.1	0.1	0	0	0	0.1	0	0	0
G	FG	*Laxmannia gracilis*			0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
G	GG	*Lepidosperma laterale*			0.1	2	0.5	0.2	0.2	0	1	5	0	4	0.1	0.1	0	0.1	0.1	0	0.1	0	0	0.1
G	GG	*Lepidosperma neesii*			0.1	0.1	0	0	0.1	0.1	0	0.1	0	0.1	0	0.1	0.1	0	0.1	0	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																		
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
M	SG	*Leptospermum parvifolium*			0	0	0	0.4	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
M	SG	*Leptospermum trinervium*			0	0	0	0.2	2	10	25	10	7	20	7	20	15	0	0	15	15	15	25	10
G	GG	*Leptospermum trinervium*			0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Lepyrodia scariosa*			0	0	0	0	0	0	1	0	0	0	0.1	0	1	0	0	1	1	1	2	5
M	SG	*Leucopogon microphyllus* var. *microphyllus*			0	0	0	0	0	0	1	0	0	0	0	0.5	0	0	0	0	0	0	0	0
G	SG	*Leucopogon microphyllus* var. *microphyllus*			0	0	0	0	0	0	0	0.4	0.5	0	1	0	1	0	0	1	0	0	1	1
M	SG	*Leucopogon muticus*			0	0.1	0	0.2	1	0	0.5	0.2	2	5	2	0.2	1	0	0	0.5	0	0	0	0
G	SG	*Leucopogon muticus*			0	0	0.1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	EG	*Lindsaea linearis*			0	0	0	0	0	0.1	0	0	0	0	0.1	0.1	0	0	0	0.1	0	0.2	0.1	0.1
G	EG	*Lindsaea microphylla*			0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0.1
G	SG	*Lissanthe strigosa* subsp. *strigosa*			0.2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Lissanthe strigosa* subsp. *strigosa*			0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	FG	*Lobelia purpurascens*			0	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0
G	GG	*Lomandra cylindrica*			0	0	0	0.1	0	0	0.1	0	0	0	0	0.1	0	0	0	0.1	0	0	0	0
G	GG	*Lomandra filiformis* subsp. *filiformis*			0	3	1	0.3	0.4	0.5	0.1	0.5	0	1	0.1	0.2	0.1	0.1	0.2	0.1	0	0.1	0.5	0
G	GG	*Lomandra glauca*			0	0	0	0.1	0.4	0.1	1	0.5	0.8	1	0.5	0.5	0	0	0.1	0	0.3	0.1	1	0.5
G	GG	*Lomandra longifolia*			0	0	0	0	0	0.1	0	0	0	0	0.1	0.1	0.1	0.1	0	0.1	0	0.1	0	0
G	GG	*Lomandra multiflora* subsp. *multiflora*			0.1	0.2	0	0.1	0	0.1	0	1	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0
G	GG	*Lomandra obliqua*			5	3	0.5	0.2	0.1	0.1	0	0	0.1	0	0.1	0.1	0.1	2	1	0.1	0.1	0.1	0.1	0.2
G	SG	*Lomatia silaifolia*			0	0	0	0	0	0.1	0	0	0	0	0.2	0.1	0	0	1	0.1	0	0.1	0	0.1
G	SG	*Micrantheum ericoides*			0	0	0	0	0	0	0	0.1	0	0.1	0	0	0	0	0	0	0	0	0	0.1
M	SG	*Micromyrtus ciliata*			0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Micromyrtus ciliata*			0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.1	0	1	0
M	SG	*Mirbelia rubiifolia*			0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Mirbelia rubiifolia*			0	0	0.1	0.1	0	0	0	0	0	0	0	0.1	0	0.1	0	0	0	0	0.1	0.1

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																		
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
M	SG	*Monotoca scoparia*			0	0	0	0.2	0	0	0	0.2	0	0	0	0.2	0	0	0	0	0.1	0	0	0
G	SG	*Monotoca scoparia*			0	0	0.1	0	1	0.1	0.2	0	1	0.5	0.3	0	0.1	0	0.1	0.2	0	0.2	0	0
G	FG	*Opercularia diphylla*			0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	GG	*Panicum simile*			0	0	0	0.1	0	0.1	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0
G	FG	*Patersonia fragilis*			0	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	FG	*Patersonia glabrata*			0	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0.1	0	0	0	0
G	FG	*Patersonia longifolia*			0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
G	FG	*Patersonia sericea*			0	0	0	0	0	0	0	0	0.1	0	0.1	0.1	0	0	0	0	0	0	0	0
M	SG	*Persoonia lanceolata*			0	0	0	0	0	0	0	0	0	0	0.6	0	0	0	0	0	0.5	0	0	0
M	SG	*Persoonia levis*			0	1	0	0.2	0	0.5	2	0.1	0	0	0	0	0.1	0	1	0.3	0	0.2	0.5	0
G	SG	*Persoonia levis*			0	0	1	0	0.2	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0
M	SG	*Persoonia linearis*			0.2	3	2	1	4	0.5	0	0	0.2	0	0	0	0	0.5	0	0.1	0	0	0	0
G	SG	*Persoonia linearis*			0	0	0	0	0	0	0	0	0	0.1	0.1	0	0	0	0.1	0	0	0	0	0
M	SG	*Persoonia pinifolia*			0	0	0	0	0	0	0	0	0	0	0	0.2	0	0	0	0	0	0	0	0
G	SG	*Persoonia pinifolia*			0	0	0	0	0	0.1	0	0	0	0	0	0	0.1	0	0	0	0	0.1	0	0
M	SG	*Petrophile pulchella*			0	0.1	1	0.6	0	0	0.1	0	3	0	0	0.5	0	0	0	2	2	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																		
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	SG	*Petrophile pulchella*			0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
M	SG	*Philotheca hispidula*			0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Philotheca* spp.			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0
G	SG	*Phyllanthus hirtellus*			0.1	0.5	0.1	0.1	0.3	1	0.1	1	0.1	0	0.1	0.5	0.2	1	0.3	0.2	0.1	0.1	0.5	0.1
M	SG	*Phyllota phylicoides*			0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Pimelea curviflora* var. *curviflora*			0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Pimelea linifolia* subsp. *linifolia*			0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Platysace linearifolia*			0	0	0	0	0	0	0.1	0	0	0	0.1	0.2	0.1	0	0	0.1	0.1	0	0.1	0.3
G	GG	*Poaceae*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0
G	FG	*Pomax umbellata*			0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0
G	FG	*Pseuderanthemum variabile*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0
G	EG	*Pteridium esculentum*			0	0	0	0	0	0.1	0	0	0	0	0	0.1	0	0	0.1	0.2	0	0.5	0	0
G	GG	*Ptilothrix deusta*			5	5	10	0.1	0.1	0.5	2	0.2	1	1	3	1	0	0.5	1	1	1	0.2	2	10
G	SG	*Pultenaea scabra*			0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																			
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
M	SG	*Pultenaea tuberculata*			0	0	0.1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0.1	0
G	SG	*Pultenaea tuberculata*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
G	SG	*Rhytidosporum procumbens*			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Rhytidosporum procumbens*			0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	GG	*Rytidosperma longifolium*			20	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	GG	*Rytidosperma* spp.			0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	FG	*Scaevola ramosissima*			0.1	0	0	0	0	0.1	0.1	0	0.1	0	0.1	0.1	0.1	0	0	0.1	0	0.1	0	0
G	EG	*Schizaea bifida*			0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0.1	0	0
G	GG	*Schoenus imberbis*			0	0	0	0	0	0	1	0	1	1	0	0	0.1	0	0	0	0.5	0.1	0.1	0
G	SG	Shrub			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0
G	OG	*Smilax glyciphylla*			0	0	0	0	0	0.1	0	0	0	0	0.1	0.1	0.1	0	0	0.1	0	0	0	0
G	FG	*Stylidium productum*			0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0.1	0	0	0	0
G	SG	*Tetratheca glandulosa*			0	0	0	0	0	0	0.1	0.1	0	0	0.1	0	0	0	0.1	0	0	0	0	0.1
G	SG	*Tetratheca thymifolia*			0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0

Stratum	Form	Species name	Exotic (*)	High Threat Weed (*)	Cover (%) by plot																		
					1: Z1P1_1081	2: Z1P2_1081	3: Z1P3_1081	4: Z1P4_1081	5: Z1P5_1081	6: Z2P1_1081	7: Z3P1_1083	8: Z5P1_1328	9: Z5P2_1328	10: Z5P3_1328	11: Z6P1_1328	12: Z7P1_1181	13: Z7P2_1181	14: Z2P2_1081	15: Z2P3_1081	16: Z7P3_1181	17: Z5P4_1328	18: Z7P4_1181	19: Z6P2_1328	20: Z4P1_1083
G	GG	*Themeda triandra*			10	5	5	0.5	3	1	0	0	0.1	0.1	0	0.1	0.1	1	1	0.1	0	0.1	0	0
G	FG	*Wahlenbergia communis*			0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0	0
G	OG	*Xanthorrhoea media*			0.2	2	2	0.3	0.5	0	0.1	0.1	0.1	0.2	0.1	0	0	0.1	1	0.1	0.1	0.1	1	0.1
G	FG	*Xanthosia pilosa*			0	0	0	0	0	0	0.1	0	0.1	0	0	0.1	0	0	0	0	0	0.1	0	0
G	FG	*Xanthosia tridentata*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0
M	SG	*Xylomelum pyriforme*			0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0	0	0
G	SG	*Xylomelum pyriforme*			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0

Key: U = Upper, M= Middle, G = Ground. EG = Fern, FG = Forb, GG = Grass & grasslike, OG = Other, SG = Shrub, TG = Tree.

Table 52: Vegetation integrity data (Composition, Structure and function)

Plot location data							
Plot no.	PCT	Vegetation Zone	Condition	Zone	Easting	Northing	Bearing (°)
1: Z1P1_1081	1081	1	Open understorey	56	312663	629569	315
2: Z1P2_1081	1081	1	Open understorey	56	312304	6295536	263
3: Z1P3_1081	1081	1	Open understorey	56	312212	6295917	95
4: Z1P4_1081	1081	1	Open understorey	56	312392	6295900	137
5: Z1P5_1081	1081	1	Open understorey	56	311922	6296157	106
6: Z2P1_1081	1081	2	Dense midstorey	56	312873	6295453	308
7: Z3P1_1083	1083	3	Dense heathy understorey	56	311731	6296255	261
8: Z5P1_1328	1328	5	Open understorey	56	311873	6296329	64
9: Z5P2_1328	1328	5	Open understorey	56	312010	6292660	130
10: Z5P3_1328	1328	5	Open understorey	56	312011	6296046	93
11: Z6P1_1328	1328	6	Heathy understorey	56	311816	6296129	219
12: Z7P1_1181	1181	7	Good	56	312089	6295819	160
13: Z7P2_1181	1181	7	Good	56	312218	6295778	65
14: Z2P2_1081	1081	2	Dense midstorey	56	313014	6295530	343
15: Z2P3_1081	1081	2	Dense midstorey	56	312901	6295299	317
16: Z7P3_1181	1181	7	Good	56	311929	6296021	89
17: Z5P4_1328	1328	5	Open understorey	56	312095	6295630	226
18: Z7P4_1181	1181	7	Good	56	311867	6295655	329
19: Z6P2_1328	1328	6	Heathy understorey	56	312046	6295742	313
20: Z4P1_1083	1083	4	Open understorey	56	312409	6295669	298

Composition (number of species)						
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other
1: Z1P1_1081	5	5	7	9	2	0
2: Z1P2_1081	6	**6**	13	13	3	0
3: Z1P3_1081	5	5	16	9	4	0
4: Z1P4_1081	5	5	18	14	5	0
5: Z1P5_1081	5	5	11	11	3	0
6: Z2P1_1081	6	6	19	16	6	2

Composition (number of species)						
7: Z3P1_1083	4	4	27	12	5	0
8: Z5P1_1328	5	5	21	12	3	1
9: Z5P2_1328	5	5	24	11	5	1
10: Z5P3_1328	5	5	20	12	3	0
11: Z6P1_1328	7	7	29	13	7	2
12: Z7P1_1181	7	7	28	15	13	2
13: Z7P2_1181	5	5	28	13	9	0
14: Z2P2_1081	5	5	9	12	3	0
15: Z2P3_1081	4	4	14	13	8	1
16: Z7P3_1181	7	7	26	13	10	2
17: Z5P4_1328	4	4	17	11	1	0
18: Z7P4_1181	9	9	22	13	5	3
19: Z6P2_1328	6	6	26	10	5	1
20: Z4P1_1083	4	4	27	10	8	2

Structure (Total cover %)						
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other
1: Z1P1_1081	30.1	2.8	51.3	0.2	0.0	0.4
2: Z1P2_1081	24.2	10.3	60.3	0.6	0.0	2.1
3: Z1P3_1081	31.0	8.5	72.0	0.4	0.0	2.1
4: Z1P4_1081	29.0	5.2	37.4	0.5	0.0	0.6
5: Z1P5_1081	19.1	10.5	39.3	0.3	0.0	0.6
6: Z2P1_1081	17.8	16.1	6.4	0.7	0.2	0.2
7: Z3P1_1083	11.1	79.1	10.4	0.5	0.0	0.2
8: Z5P1_1328	15.5	20.3	8.0	0.3	0.1	0.2
9: Z5P2_1328	15.0	26.0	7.2	0.5	0.1	0.3
10: Z5P3_1328	14.5	35.7	16.3	0.3	0.0	0.4
11: Z6P1_1328	24.2	25.8	9.4	0.7	0.2	0.5

Structure (Total cover %)						
12: Z7P1_1181	17.5	33.1	9.9	1.3	0.2	0.2
13: Z7P2_1181	13.0	31.6	8.0	0.9	0.0	0.2
14: Z2P2_1081	24.0	8.0	17.4	0.3	0.0	0.2
15: Z2P3_1081	21.0	6.3	11.6	0.8	0.1	1.1
16: Z7P3_1181	9.7	25.3	10.1	1.0	0.3	0.6
17: Z5P4_1328	12.1	25.9	9.6	0.1	0.0	0.2
18: Z7P4_1181	20.1	18.4	7.9	0.5	0.8	0.4
19: Z6P2_1328	20.1	51.3	17.7	0.5	0.1	1.1
20: Z4P1_1083	35.1	28.0	77.9	0.8	0.2	0.3

Function												
Plot no.	Large Trees (DBH > 50 cm)	Hollow trees	Litter Cover (%)	Length Fallen Logs (m)	Tree Stem 5-9 cm	Tree Stem 10-19 cm	Tree Stem 20-29 cm	Tree Stem 30-49 cm	Tree Stem 50-79 cm	Tree Stem 80+ cm	Tree Regen	High Threat Weed Cover (%)
1: Z1P1_1081	1	4	70.4	16.3	1	1	1	1	1	0	1	0
2: Z1P2_1081	0	3	51	13.5	1	1	1	1	0	0	1	0
3: Z1P3_1081	2	5	40	17.5	1	1	1	1	1	0	1	0
4: Z1P4_1081	1	3	78	31	1	1	1	1	1	0	1	0
5: Z1P5_1081	0	0	85	25	1	1	1	1	1	0	1	0
6: Z2P1_1081	2	3	79	11	1	1	1	1	1	0	1	0
7: Z3P1_1083	0	0	30	0	1	1	1	0	0	0	0	0
8: Z5P1_1328	1	6	52.4	10	1	1	1	1	1	0	1	0
9: Z5P2_1328	2	1	93	3	1	1	1	1	1	0	1	0
10: Z5P3_1328	0	4	41.4	7.6	1	1	1	1	0	0	1	0
11: Z6P1_1328	1	5	55	4	1	1	1	1	1	0	1	0
12: Z7P1_1181	1	4	95	2	1	1	1	1	1	0	1	0

Function												
13: Z7P2_1181	0	0	80	3.5	1	1	1	1	0	0	1	0
14: Z2P2_1081	1	3	93.6	21	1	1	1	1	1	0	1	0
15: Z2P3_1081	4	3	96.2	12.5	1	1	1	1	1	0	0	0
16: Z7P3_1181	6	6	95.4	21	0	1	1	1	1	1	1	0
17: Z5P4_1328	0	4	49	12	1	1	1	1	0	0	1	0
18: Z7P4_1181	0	2	78	30	1	1	1	1	0	0	1	0
19: Z6P2_1328	0	2	35	12	1	1	1	1	0	0	1	0
20: Z4P1_1083	0	2	63	1	1	1	1	1	0	0	1	0

For stem size classes: 0 = Absence, 1 = Presence.

Figure 50: Start (left) and end (right) of Plot 1: Z1P1_1081

Figure 51: Start (left) and end (right) of Plot 2: Z1P2_1081

Figure 52: Start (left) and end (right) of Plot 3: Z1P3_1081

Figure 53: Start (left) and end (right) of Plot 4: Z1P4_1081

Figure 54: Start (left) of Plot 5: Z1P5_1081

Figure 55: Start (left) and end (right) of Plot 6: Z2P1_1081

Figure 56: Start (left) and end (right) of Plot 7: Z3P1_1083

Figure 57: Start (left) and end (right) of Plot 8: Z5P1_1328

Figure 58: Start (left) and end (right) of Plot 9: Z5P2_1328

Figure 59: Start (left) and end (right) of Plot 10: Z5P3_1328

Figure 60: Start (left) and end (right) of Plot 11: Z6P1_1328

Figure 61: Start (left) and end (right) of Plot 12: Z7P1_1181

Figure 62: Start (left) and end (right) of Plot 13: Z7P2_1181

Figure 63: Start (left) and end (right) of Plot 14: Z2P2_1081

Figure 64: Start (left) and end (right) of Plot 15: Z2P3_1081

Figure 65: Start (left) and end (right) of Plot 16: Z7P3_1181

Figure 66: Start (left) and end (right) of Plot 17: Z5P4_1328

Figure 67: Start (left) and end (right) of Plot 18: Z7P4_1181

Figure 68: Start (left) and end (right) of Plot 19: Z6P2_1328

Figure 69: Start (left) and end (right) of Plot 20: Z4P1_1083

Appendix C Hollow bearing tree raw data

ID	Hollow size	Notes
1	HBT - Large	L ; STRINGY
2	HBT - Large	S,L; STAG; CORY EXIM
3	HBT - Large	LRG
4	HBT - Large	LRG
5	HBT - Large	LRG ACOSTA
6	HBT - Large	ACOST LRG
7	HBT - Large	LARGE SIZE
8	HBT - Large	2 LRGE
9	HBT - Large	LARGE TREE >80DBH W LARGE HOLLOWS
10	HBT - Large	LRGE
11	HBT - Large	LRGE
12	HBT - Large	LRG
13	HBT - Large	LRG
14	HBT - Large	LRG
15	HBT - Large	2 LRG
16	HBT - Large	LARGE SIZE HOLLOW
17	HBT - Large	LARGE
18	HBT - Large	A COST L! SP
19	HBT - Large	NO TOP L!
20	HBT - Large	L SP
21	HBT - Large	C GUMM
22	HBT - Large	LRG
23	HBT - Large	LRG
24	HBT - Large	LRG
25	HBT - Large	LRG
26	HBT - Large	LRG
27	HBT - Medium	MED
28	HBT - Medium	MED
29	HBT - Medium	MED
30	HBT - Medium	MED
31	HBT - Medium	MED
32	HBT - Medium	MED
33	HBT - Medium	MED
34	HBT - Medium	M; ANGO COST
35	HBT - Medium	M SP;ANGCOS
36	HBT - Medium	MED
37	HBT - Medium	MED SIZE
38	HBT - Medium	2 MED SIZE
39	HBT - Medium	MED
40	HBT - Medium	MED

ID	Hollow size	Notes
41	HBT - Medium	MED SIZE
42	HBT - Medium	MED SIZE
43	HBT - Medium	M SP
44	HBT - Medium	M-L SP& T
45	HBT - Medium	S-M SPOU
46	HBT - Medium	S-M SP
47	HBT - Medium	S M L SP
48	HBT - Medium	S M SP
49	HBT - Medium	S M L DLS
50	HBT - Medium	DL S M P3
51	HBT - Medium	S M L SPS STAG
52	HBT - Medium	ACOST MED
53	HBT - Medium	MED
54	HBT - Medium	MED
55	HBT - Small	
56	HBT - Small	
57	HBT - Small	SMALL
58	HBT - Small	SMALL
59	HBT - Small	SMALL
60	HBT - Small	SMALL
61	HBT - Small	SMALL
62	HBT - Small	
63	HBT - Small	
64	HBT - Small	SMALL
65	HBT - Small	SMALL
66	HBT - Small	
67	HBT - Small	
68	HBT - Small	
69	HBT - Small	
70	HBT - Small	SMALL HOLLOW
71	HBT - Small	3 HOLLOWS
72	HBT - Small	
73	HBT - Small	
74	HBT - Small	
75	HBT - Small	
76	HBT - Small	
77	HBT - Small	
78	HBT - Small	P1 STAG
79	HBT - Small	

ID	Hollow size	Notes
80	HBT - Small	P1 POT SP
81	HBT - Small	P1 E PUNC DEAD LIMB
82	HBT - Small	S SP & T
83	HBT - Small	SP
84	HBT - Small	S DL
85	HBT - Small	P2 DL S
86	HBT - Small	P2 STAG
87	HBT - Small	P2 DL
88	HBT - Small	S SP
89	HBT - Small	DLS
90	HBT - Small	S SP E PUNC SOME SCRAT
91	HBT - Small	A COST M-L SP
92	HBT - Small	P3 S T SP
93	HBT - Small	P3 S DL
94	HBT - Small	P3 M STAG
95	HBT - Small	C GUMM
96	HBT - Small	E OBLONGA 10CM&10-20
97	HBT - Small	10-20 EOBLONGA
98	HBT - Small	ESQUAM 20CM
99	HBT - Small	SML
100	HBT - Small	
101	HBT - Small	
102	HBT - Small	
103	HBT - Small	
104	HBT - Small	
105	HBT - Small	
106	HBT - Small	
107	HBT - Small	
108	HBT - Small	
109	HBT - Small	
110	HBT - Small	
111	HBT - Small	
112	HBT - Small	
113	Stag - Large	LAGE HOLLOWS

ID	Hollow size	Notes
114	Stag - Large	
115	Stag - Large	
116	Stag - Large	
117	Stag - Large	
118	Stag - Medium	M-L CHIM STAG
119	Stag - Small	
120	Stag - Small	
121	Stag - Small	MICROBAT HABITAT
122	Stag - Small	
123	Stag - Small	S; CORY EXIM
124	Stag - Small	SX3 STRINGY
125	Stag - Small	
126	Stag - Small	
127	Stag - Small	
128	Stag - Small	
129	Stag - Small	
130	Stag - Small	MULTI SMALL
131	Stag - Small	
132	Stag - Small	
133	Stag - Small	
134	Stag - Small	DEAD LIMB SPOUT
135	Stag - Small	DEAD LIMB
136	Stag - Small	STAG
137	Stag - Small	STAG M&S
138	Stag - Small	STAG
139	Stag - Small	STAG
140	Stag - Small	STAG AERI TM W S HOLE
141	Stag - Small	STAG
142	Stag - Small	STAG
143	Stag - Small	20CM
144	Stag - Small	10-15
145	Stag - Small	

Appendix D Fauna species list

Class	Family	Scientific name	Common name	Observation Type	Exotic (*)	BC Act status	EPBC Act status
Amphibia	**Myobatrachidae**	***Pseudophryne australis***	**Red-crowned Toadlet**	**W**		**V**	
Aves	Acanthizidae	*Acanthiza lineata*	Striated Thornbill	W			
Aves	Acanthizidae	*Acanthiza nana*	Yellow Thornbill	W			
Aves	Anatidae	*Chenonetta jubata*	Australian Wood Duck	O			
Aves	Artamidae	*Strepera graculina*	Pied Currawong	W			
Aves	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo Shrike	W			
Aves	Climacteridae	*Cormobates leucophaea*	White-throated Treecreeper	W			
Aves	Corvidae	*Corvus coronoides*	Australian Raven	OW			
Aves	Estrilidae	*Neochmia temporalis*	Red-browed Finch	W			
Aves	Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	W			
Aves	Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	W			
Aves	Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	OW			
Aves	Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	OW			
Aves	Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	OW			
Aves	Meliphagidae	*Caligavis chrysops*	Yellow-faced Honeyeater	W			
Aves	Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	W			
Aves	Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	W			
Aves	Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	OW			
Aves	Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	W			
Aves	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	W			
Aves	Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	OW			

Class	Family	Scientific name	Common name	Observation Type	Exotic (*)	BC Act status	EPBC Act status
Aves	Ptilonorhynchidae	*Ptilonorhychus violaceus*	Satin Bowerbird	W			
Aves	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	OW			
Aves	**Strigidae**	***Ninox strenua***	**Powerful Owl**	**OW**		**V**	
Aves	Timaliidae	*Zosterops lateralis*	Silvereye	OW			
Aves	**Cacatuidae**	***Calyptorhynchus lathami***	**Glossy Black Cockatoo**	**OW**		**V**	
Aves	Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	OW			
Aves	Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	OW			
Aves	Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	O			
Gastropoda	**Camaenidae**	***Pommerhelix duralensis***	**Dural Land Snail**	**Y**		**E**	**E**
Mammalia	Peramelidae	*Perameles nasuta*	Long-nosed Bandicoot	O			
Mammalia	Petauridae	*Petaurus breviceps*	Sugar Glider	O			
Mammalia	**Petauridae**	***Petaurus norfolcensis***	**Squirrel Glider**	**O**		**V**	
Mammalia	Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	O			
Mammalia	Pseudocheirinae	*Pseudocheirus peregrinus*	Common Ringtail Possum	O			
Mammalia	**Pteropodidae**	***Pteropus poliocephalus***	**Grey-headed Flying-fox**	**O**		**V**	**V**
Reptilia	Elapidae	*Notechis scutatus*	Tiger Snake	O			
Reptilia	Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	O			

Key: Observation Type: O = Observed, W = Heard call, Y = Shell. Status: V = Vulnerable, E = Endangered.

Appendix E Microbat report

Ultrasonic Analysis Report

Deerubbin Local Aboriginal Land Council, Maroota, NSW.

1. Project background and site description

Eco Logical Australia (ELA) were engaged by Deerubbin Local Aboriginal Land Council to undertake an ultrasonic microbat call survey at Maroota to accompany a Biodiversity Assessment Report (BDAR).

2. Methods

Three Anabat Swift detectors were deployed over five consecutive nights at the Maroota study area. The ultrasonic call data was recorded actively and passively across the entire night using Anabat Swift detectors (Titley Scientific). Anabat Swift detectors record microbat calls in a WAV sound file format.

3. Data Analysis

The data collected during this survey was analysed by Rodney Armistead using Anabat Insight (Version 1.9.2-0g2fd2328). Call identifications used by Rodney Armistead are done so using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al 2004); and south-east Queensland and north-east New South Wales (Reinhold et al 2001) and the accompanying reference library of over 200 calls from Sydney Basin, NSW (which is available at http://www.forest.nsw.gov.au/research/bats/default.asp). Species identification was guided by considering probability of occurrence based upon the general distribution information that is provided in Churchill (2008); Pennay et al. (2011), Van Dyck and Strahan (2008) and Van Dyck et al. (2013). A technical review of this report and a sample of the calls was performed by Alicia Scanlon also from ELA. Alicia has over 13 years of experience in the identification of ultrasonic call recordings.

To ensure reliable and accurate results the following protocols (adapted from Lloyd et al 2006) were applied:

- Search phase calls are used preferentially when analysing the data, rather than cruise phase calls or feeding buzzes (McKenzie et al 2002).
- Recorded calls containing less than three pulses are not analysed as they are often too short to confidently determine the identity of the species making the call (Law et al 1999). These short sequences (as stated previously) were either removed manually or were labelled as being unidentifiable.
- For those calls that are able to be used to identify the species making the call, two categories of confidence are used (Mills et al1996):
  - Definitely present – the quality and structure of the call profile is such that the identity of the bat species making the calls is not in doubt.
  - Potentially present – the quality and structure of the call profile is such that there is some / low probability of confusion with species that produce similar calls profiles.

- Calls made by bats that cannot be used for identification purposes such as social calls, short and low-quality calls, cruise and approach phase calls were removed from the data.
- *Nyctophilus* spp. (Long-eared bats) are difficult to identify or separate confidently to species level based upon their recorded calls. Therefore, we have made no attempt to identify any recorded *Nyctophilus* spp. calls to species level (Pennay et al 2004). There are two potential *Nyctophilus* species that could occur in the study area. Both species, *N. geoffroyi* (Lesser Long-eared Bat) and *N. gouldii* (Gould's Long-eared Bat) are non-threatened species, relatively common and widely distributed across NSW.
- The Free-tailed Bats (previously referred to as the genus *Mormopterus*) have recently undergone taxonomic revision (Reardon et al 2014) and published reference calls for this group of species (Pennay et al 2004) are believed to contain errors (Greg Ford pers comm.). This report uses nomenclature for Free-tailed Bat species as referred to in Jackson and Groves (2015). The correlation between nomenclature used in this report and that used in NSW State legislation is presented in **Table 1** below. All Free-tailed Bats in the new genus *Ozimops* potentially occurring within the survey area will therefore be referred to as *Ozimops* species complex.
- Jackson & Groves (2015) list the Eastern Bent-winged Bat (*Miniopterus schreibersii oceanensis*) under the new name of *M. orianae* (Large Bent-winged Bat). However, we follow the NSW Department of Planning, Industry and Environment (DPIE) nomenclature as it applies to the eastern form of the species which occurs in NSW as a distinct sub-species; *M. o. oceanensis* (Large Bentwing Bat) (see https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10534) (NSW Department of Planning, Industry and Environment (formerly the Office Environment and Heritage) 2019).
- Sequences not attributed to microbat echolocation calls (e.g. insect buzzes, wind, train and vehicle movement) were dismissed from the analysis.

Table 1: Correlations between current and previous nomenclature for the Free-tailed bats of NSW

Jackson and Groves 2015	Previously known as	Common Name	BC Act
Austronomus australis	Tadarida australis	White-striped Free-tailed Bat	
Micronomus norfolkensis	Mormopterus norfolkensis	Eastern Coastal Free-tailed Bat	Vulnerable
Ozimops petersi	*Mormopterus* species 3 (small penis)	Inland Free-tailed Bat	
Ozimops planiceps	*Mormopterus* species 4 (long penis eastern form)	Southern Free-tailed Bat	
Ozimops ridei	Mormopterus species 2	Ride's Free-tailed Bat	
Setirostris eleryi	Mormopterus species 6	Bristle-faced Free-tailed Bat	Endangered

4. Results

There were 1,907 call sequences recorded during this survey. Of these, 753 (39.49%) were deemed useful, because the call profile was of sufficient quality and/or length (number of pulses) to enable positive identification of bat species. The remaining 1,154 (60.51%) call sequences were either too short (less than three pulses) or of low quality, thus preventing positive identification of a bat species. The bulk of the 1,154 un-identifiable calls appeared to have been made by bats that were actively foraging or moving through a 'cluttered' environment. We understand that the study area is heavily vegetated with several forest or woodland dominated Plant Community Types.

There were at least 12 and up to 18 species recorded during this survey (Table 2). This includes up to eight species that are listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act). Based on the call profiles, five vulnerable species listed under the BC Act were deemed to have been definitely present within the study area;

- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Micronomus norfolkensis* (East-coast Free-tailed Bat)
- *Miniopterus australis* (Little Bent-winged Bat)
- *Myotis macropus* (Southern Myotis)
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat)

Three other species including *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Scoteanax rueppellii* (Greater Broad-nosed Bat), and *Vespadelus troughtoni* (Eastern Cave Bat), which are listed as vulnerable under the BC Act could potentially be present within the study area. The defining features of the recorded call profiles of Eastern False Pipistrelle, Greater Broad-nosed Bat and the Eastern Cave Bat could either:

- have overlapped with one or more of the common and non-threatened species also recorded during this survey or are known to occur in this region, or
- the call profile was of poor quality and it was not possible to assign to a single microbat species.

Definite or potential calls from Chocolate Wattled Bat were the most commonly recorded during the survey. Calls attributed to this species accounted for 569 (75.56%) of the 753 identifiable calls recorded during this survey (**Table 3**, **Table 4** and Table 5). In contrast, two definite calls that were attributed to the threatened Large-eared Pied Bat were recorded on B2-0062 (**Table 3**).

4.1 Interpretation of survey results

The presence (or potential presence) of the eight species listed as vulnerable within the study area could require further consideration. A brief description of the threatened microbat species that were recorded or potentially recorded within the study area, and their habitat requirements are provided below.

4.1.1 Hollow dependant microbat species

Four of the microbat species recorded during this survey are hollow dependant species. Those threatened species that were recorded during this survey and that are dependent on hollows include East Coast Free-tailed Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat and Yellow-bellied Sheath-tailed Bat.

4.1.2 Subterranean roosting species

Four threatened microbat species known to roost in subterranean or cave like environments, including caves, mines, tunnels, bridges, culverts, and buildings, were recorded during this survey. This includes the Eastern Cave Bat, Large-eared Pied Bat and Little Bent-winged Bat and Southern Myotis. Of these four, three species, the Large-eared Pied Bat, Little Bent-winged Bat and Southern Myotis were identified with a high degree of confidence as being definitely present within the study area. In contrast, the calls of the Eastern Cave Bat that were recorded during this survey overlapped with the calls of several other more common species.

Eastern Cave Bats will roost in sandstone caves, overhangs, boulder piles, mines and occasionally in buildings which would generally be within foraging range of sandstone escarpments (Churchill 2008). ELA ecologists have found this species roosting in buildings near suitable natural habitat features that would normally provide suitable habitat at other sites in NSW and QLD during surveys conducted in 2017 and more recently in 2020. Potential Eastern Cave Bat calls were recorded during this survey. The calls of this species overlap with the calls of two other more common *Vespadelus* species that could also occur in this region.

Large-eared Pied Bats will roost in the crevices, cracks and indentations in the ceilings of sandstone caves, break-away sections in cliff faces and abandoned mines (Churchill 2008). This species was identified as being present within the study area based upon two definite calls (Figure 2).

The Little Bent-winged Bat will roost in cement culverts, stormwater drains, bridges, disused mine shafts, caves and tree hollows (Churchill 2008). This species was identified as being present within the Study area based upon one definite call, and several potential calls (Figure 7).

Southern Myotis will also utilise both subterranean habitats and tree hollows as roost habitat (Churchill 2008; Campbell 2009). This species was identified as being present within the study area based upon definite calls recorded at all three detector sites. This species is unique in that it forages for insects, small crustaceans and fish over the surface of water bodies and generally roosts within 200 m of permanent water (Churchill 2008).

Table 2: Microbat species diversity recorded ultrasonically within the study area

Species name	Common name	Presence
Austronomus australis	White-striped Free-tailed Bat	D
Chalinolobus dwyeri[*1]	Large-eared Pied Bat	D
Chalinolobus gouldii	Gould's Wattled Bat	D
Chalinolobus morio	Chocolate Wattled Bat	D
*Falsistrellus tasmaniensis**	Eastern False Pipistrelle	P

Species name	Common name	Presence
*Micronomus norfolkensis**	East-coast Free-tailed Bat	D
*Miniopterus australis**	Little Bent-winged Bat	D
*Myotis macropus**	Southern Myotis	D
Nyctophilus geoffroyi	Lesser Long-eared Bat.	P
Nyctophilus gouldi	Gould's Long-eared Bat	P
Ozimops ridei	Ride's Free-tailed Bat	D
Rhinolophus megaphyllus	Eastern Horseshoe Bat	D
*Saccolaimus flaviventris**	Yellow-bellied Sheath-tailed Bat	D
*Scoteanax rueppellii**	Eastern Broad-nosed Bat	P
Scotorepens orion	Greater Broad-nosed Bat	P
Vespadelus pumilus	Eastern Forest Bat	P
*Vespadelus troughtoni**	Eastern Cave Bat	P
Vespadelus vulturnus	Little Forest Bat	P

D = Definitely recorded, P = Potentially recorded. *listed as threatened under the BC Act. [1] Listed as threatened under the EBPC Act

Table 3: Microbat species diversity and number of calls recorded ultrasonically on B2-0061 between 24 – 28 February 2020

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
Austronomus australis	White-striped Free-tailed Bat	1	0	1
*Chalinolobus dwyeri**[1]	Large-eared Pied Bat	2	0	2
Chalinolobus gouldii	Gould's Wattled Bat	5	8	13
Chalinolobus gouldii / *Ozimops ridei*	Gould's Wattled Bat / Ride's Free-tailed Bat	0	9	9
Chalinolobus morio	Chocolate Wattled Bat	113	133	246
Chalinolobus morio / *Miniopterus australis**	Chocolate Wattled Bat / Little Bent-winged Bat	0	8	8
Chalinolobus morio / *Vespadelus pumilus* / *Vespadelus troughtoni** / *Vespadelus vulturnus*	Chocolate Wattled Bat / Southern Forest Bat / Eastern Cave Bat / Little Forest Bat	0	6	6

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Scientific Name	Common Name	Definitely present	Potentially present	Total calls
*Falsistrellus tasmaniensis** / *Scoteanax rueppellii** / *Scotorepens orion*	Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat	0	1	1
*Miniopterus australis**	Little Bent-winged Bat	1	4	5
*Myotis macropus**	Southern Myotis	17	0	17
*Myotis macropus** / *Nyctophilus spp.* In this region *N. geoffroyi* and *N. gouldii* could be present.	Southern Myotis / Long-eared Bat species. In this region, Lesser Long-eared Bat and Gould's Long-eared Bat could be present.	0	7	7
Ozimops ridei	Ride's Free-tailed Bat	2	0	2
Rhinolophus megaphyllus	Eastern Horseshoe Bat	2	0	2
*Saccolaimus flaviventris**	Yellow-bellied Sheath-tailed Bat	1	1	2
Vespadelus pumilus / *Vespadelus troughtoni** / *Vespadelus vulturnus*	Eastern Forest Bat / Eastern Cave Bat / Little Forest Bat	0	3	3
Unidentifiable calls				636
Identifiable calls				324
Total Calls				960
Percentage usable calls				33.75

* Threatened species listed under BC Act, [1]Listed as threatened under the EBPC Act

Table 4: Microbat species diversity and number of calls recorded ultrasonically on B2-0062 between 24-28 February 2020

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
Austronomus australis	White-striped Free-tailed Bat	9	1	10
Chalinolobus gouldii	Gould's Wattled Bat	6	12	18
Chalinolobus gouldii / *Ozimops ridei*	Gould's Wattled Bat / Ride's Free-tailed Bat	0	8	8
Chalinolobus morio	Chocolate Wattled Bat	1	33	34
Chalinolobus morio / *Vespadelus pumilus* / *Vespadelus troughtoni** / *Vespadelus vulturnus*	Chocolate Wattled Bat / Southern Forest Bat / Eastern Cave Bat / Little Forest Bat	0	56	56
*Falsistrellus tasmaniensis** / *Scoteanax rueppellii** / *Scotorepens orion*	Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat	0	1	1
*Micronomus norfolkensis**	East-coast Free-tailed Bat	4	0	4
*Micronomus norfolkensis** / *Ozimops ridei*	East-coast Free-tailed Bat / Ride's Free-tailed Bat	0	3	3
*Myotis macropus**	Southern Myotis	36	0	36
*Myotis macropus** / *Nyctophilus spp.* In this region *N. geoffroyi* and *N. gouldii* could be present.	Southern Myotis / Long-eared Bat species. In this region, Lesser Long-eared Bat and Gould's Long-eared Bat could be present.	0	13	13
Ozimops ridei	Ride's Free-tailed Bat	13	2	15
Rhinolophus megaphyllus	Eastern Horseshoe Bat	13	0	13
*Saccolaimus flaviventris**	Yellow-bellied Sheath-tailed Bat	1	3	4
Unidentifiable calls				263
Identifiable calls				157
Total Calls				478
Percentage usable calls				32.84

* Threatened species listed under BC Act.

Table 5: Microbat species diversity and number of calls recorded ultrasonically on B2-0064 between 24-28 February 2020

Scientific Name	Common Name	Definitely present	Potentially present	Total calls
Austronomus australis	White-striped Free-tailed Bat	1	0	1
Chalinolobus gouldii	Gould's Wattled Bat	1	0	1
Chalinolobus morio	Chocolate Wattled Bat	163	64	227
Chalinolobus morio / *Miniopterus australis**	Chocolate Wattled Bat / Little Bent-winged Bat	0	3	3
*Falsistrellus tasmaniensis** / *Scoteanax rueppellii** / *Scotorepens orion*	Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat /	0	1	1
*Myotis macropus**	Southern Myotis	3	0	3
*Myotis macropus** / *Nyctophilus spp.* In this region *N. geoffroyi* and *N. gouldii* could be present.	Southern Myotis / Long-eared Bat species. In this region, Lesser Long-eared Bat and Gould's Long-eared Bat could be present.	0	26	26
Nyctophilus spp. In this region *N. geoffroyi* and *N. gouldii* could be present.	Long-eared Bat species. In this region, Lesser Long-eared Bat and Gould's Long-eared Bat could be present.	3	0	3
Ozimops ridei	Ride's Free-tailed Bat	1	0	1
Rhinolophus megaphyllus	Eastern Horseshoe Bat	6	0	6
*Saccolaimus flaviventris**	Yellow-bellied Sheath-tailed Bat	0	1	1
Unidentifiable calls				196
Identifiable calls				273
Total Calls				469
Percentage usable calls				58.21

* Threatened species listed under BC Act.

5. Survey Limitations

Calls were only positively identified when the defining characteristics were present and there was no chance of confusion between species with overlapping and/or similar calls. In this survey, there were some call sequences that could not be positively identified to species level. Further, some species recorded in this survey can have call profiles that overlap with other species.

When overlap occurs, species with similar call profiles are assigned to multi species groups of two or three potential species depending on the characteristics displayed in the recorded call sequences. Calls with intermediate characteristics were assigned mixed species labels.

The species recorded in this survey with overlapping call profiles are described below.

Chalinolobus gouldii (Gould's Wattled Bat), *Ozimops ridei* (Ride's Free-tailed Bat) and the East-coast Free-tailed Bat have calls that overlap in the range 28.5 kHz and 32 kHz. Calls were identified as Ride's Free-tailed Bat if the call shape was flat (initial slope S1 of less than 100 octaves per second) and the frequency was between 28 – 32 kHz. Gould's Wattled Bat was distinguished by a curved call with a frequency of 27.5 – 32.5 kHz and alternation in call frequency between pulses. The threatened East-coast Free-tailed Bat calls are identified by flat pulses (initial slope S1 of less than 100 OPS), alternation in call frequency between pulses and a frequency range of 31 kHz to 36 kHz. Calls with intermediate characteristics were assigned mixed species labels.

The calls of Eastern False Pipistrelle, Greater Broad-nosed Bat, and Eastern Broad-nosed Bat can be difficult to separate as their call frequencies and some other call characteristics overlap.

- Greater Broad-nosed Bats can be distinguished by a frequency of 32 – 36 kHz, lack of a tail or short down-sweeping tail, frequency of the knee greater than 37 kHz, and drop of more than 3 kHz from the knee to the characteristic section.
- Eastern False Pipistrelle bat calls have a characteristic frequency between 35 and 39 kHz, display curved, often steep pulses without up-sweeping tails and sometimes with down-sweeping tails. The pre-characteristic section is often long (greater than 3 kHz). This species can only be separated from Eastern Broad-nosed Bat when the characteristic frequency is above 37 kHz.
- Eastern Broad-nosed Bat calls fall between 34 and 37 kHz, are curved and generally do not have tails, but can have down-sweeping tails. The calls of this species can only be separated from Eastern False Pipistrelle when they fall between 34 and 35 kHz, and the frequency of the knee is above 38 kHz.

There were only a few calls that fell in the range of overlap between these species with characteristics intermediate between all species. In all cases the calls could not be assigned to any of the three possible species individually, and consequently were labelled as Eastern False Pipistrelle / Greater Broad-nosed Bat / Eastern Broad-nosed Bat.

The calls of Chocolate Wattled Bat, *Vespadelus pumilus* (Eastern Forest Bat) (50 – 58 kHz), Eastern Cave Bat (49 – 52 kHz) and *Vespadelus vulturnus* (Little Forest Bat) (48.5 – 53 kHz) overlap in the range 49 kHz to 52 kHz. Chocolate Wattled Bats display a curved call with a down-sweeping tail whereas Eastern Forest Bats, Eastern Cave Bats and Little Forest Bats display a curved call with an up-sweeping tail. Call profiles above 54 kHz with upward facing tails can be attributed to the Eastern Forest Bat. Calls below

49 kHz with upward sweeping tails can be attributed to Little Forest Bat. All calls with up sweeping tails falling between 49 kHz and 54 kHz are assigned mixed species labels. When there are no tails present, they are assigned mixed species labels of Chocolate Wattled Bat / Eastern Cave Bat / Eastern Forest Bat / Little Forest Bat.

The calls of Chocolate Wattled Bat and Little Bent-winged Bat are generally not thought to overlap (Penny et al. 2002). However, numerous difficult to interpret calls were recorded during this survey with a characteristic frequency ranging from 54 to 56 kHz. Both species have slightly curved pulses with a down-sweeping tail. Any call that was recorded within the 54 and 56 kHz characteristic frequency with downward facing tails was assigned a multiple species label.

The calls of Southern Myotis are very similar to all *Nyctophilus* (Long-eared Bat) species and it is often difficult to separate these species on call characteristics alone. Calls can be identified as *Nyctophilus spp*. when the time between calls (TBC) is higher than 95ms and the initial slope S1 is lower than 300 octaves per second (OPS). Calls can be identified as Myotis when the time between calls (TBC) is lower than 75ms and the initial slope S1 is greater than 400 (OPS). Where the TBC is between 75 and 95ms and the OPS is between 300 and 400 calls are assigned a mixed species label of Myotis / Long-eared Bats (Pennay, Law and Reinhold 2004).

Furthermore, calls produced by different bat species differ in fundamental ways related to the foraging mode / activity of each species. Calls of different species and the different types of calls produced by each species (cruise, search, social, approach, attack) are not equally recorded by ultrasonic detectors. Weather and climatic conditions affect the quality and quantity of recorded data as well as the availability of insect prey and therefore the suitability of each site at a given time as foraging habitat. The survey was conducted in February during a period of warm temperatures and minimal rainfall.

6. Example Call Profiles

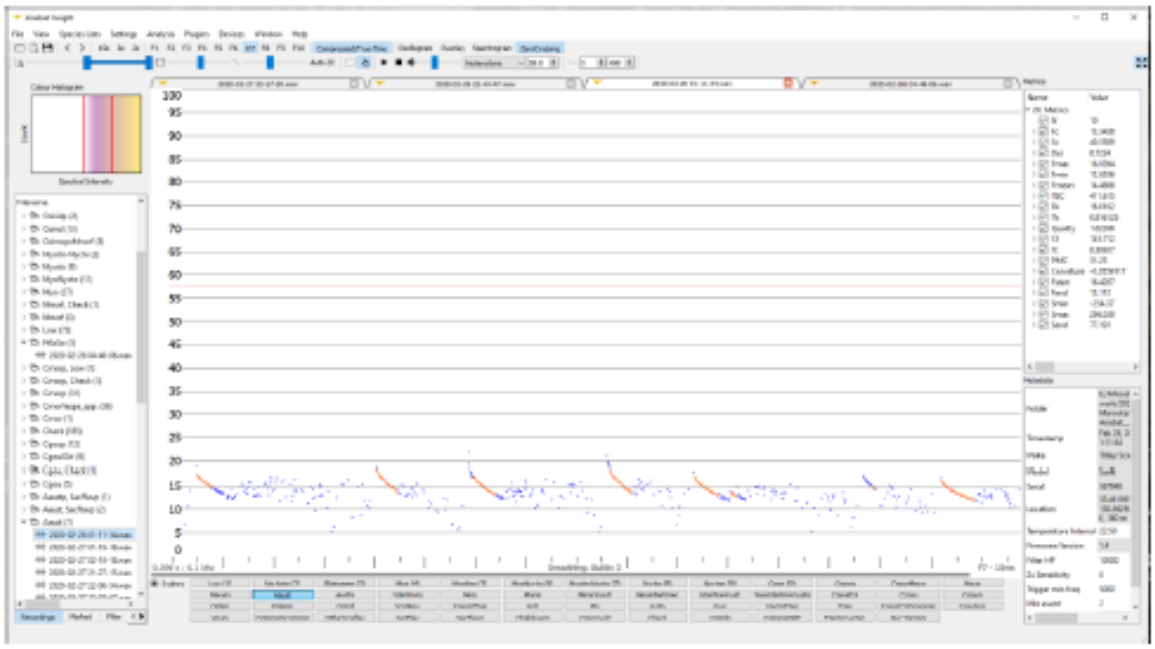

Figure 1. Call profile for *Austronomus australis* (White-striped Free-tailed Bat) recorded on B2-0062 at 0111 (1:11 a.m.) on 25 February 2020.

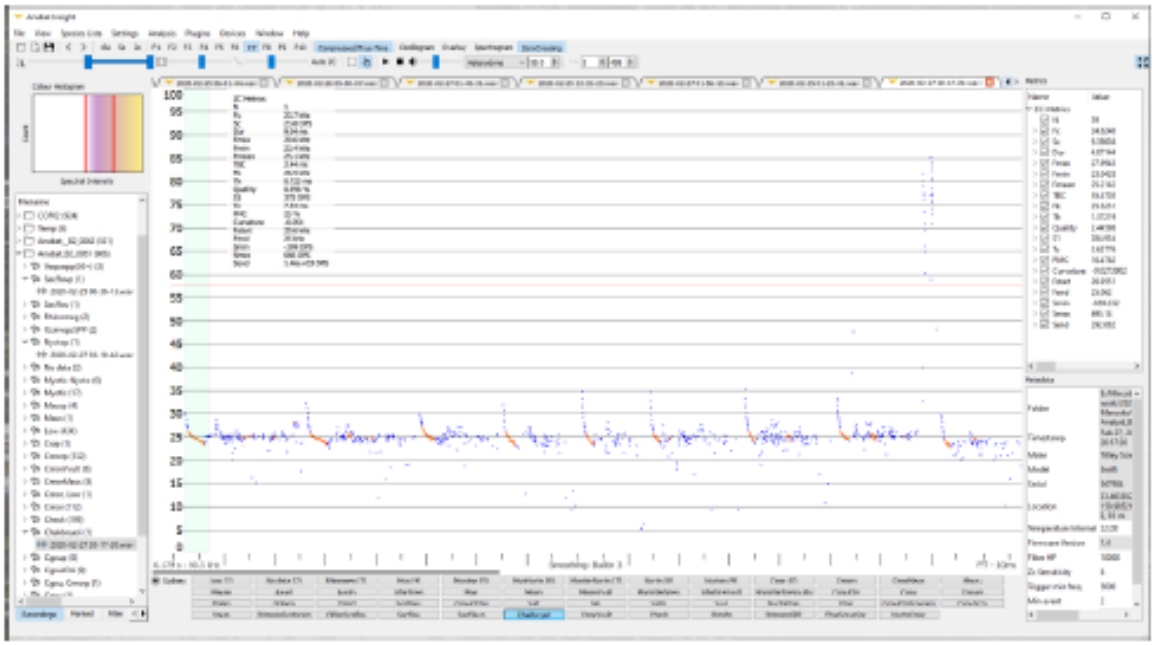

Figure 2. Call profile for *Chalinolobus dwyeri* (Large-eared Pied Bat) recorded on B2-0061 at 0123 (1:32 a.m.) on 25 February 2020.

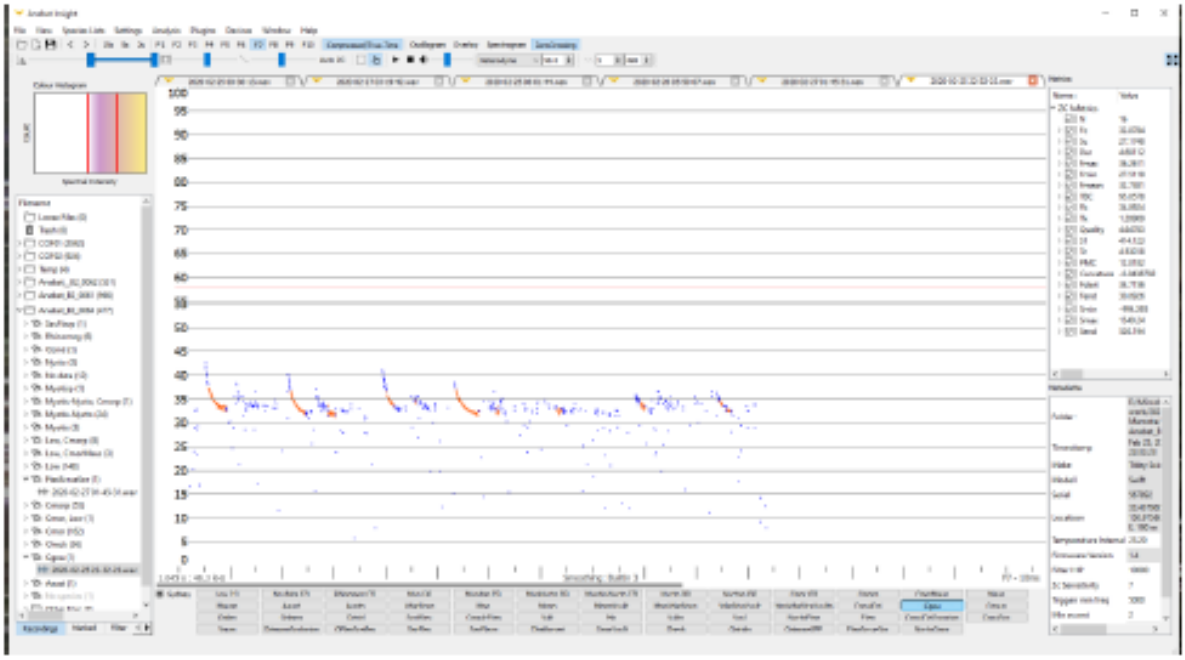

Figure 3. Call profile for *Chalinolobus gouldii* (Gould's Wattled Bat) recorded on B2-0064 at 2232 (10:32 p.m.) on 25 Februay 2020.

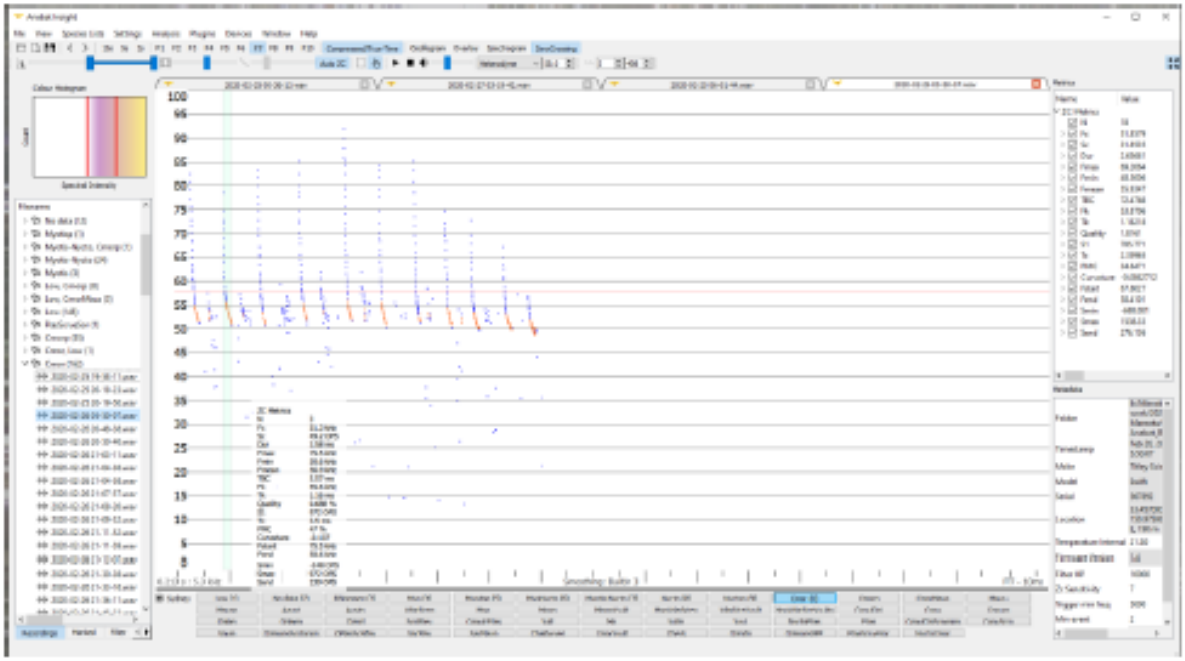

Figure 4. Call profile for *Chalinolobus morio* (Chocolate Wattled Bat) on B2-0064 at 0550 (5:50 am) on 26 February 2020.

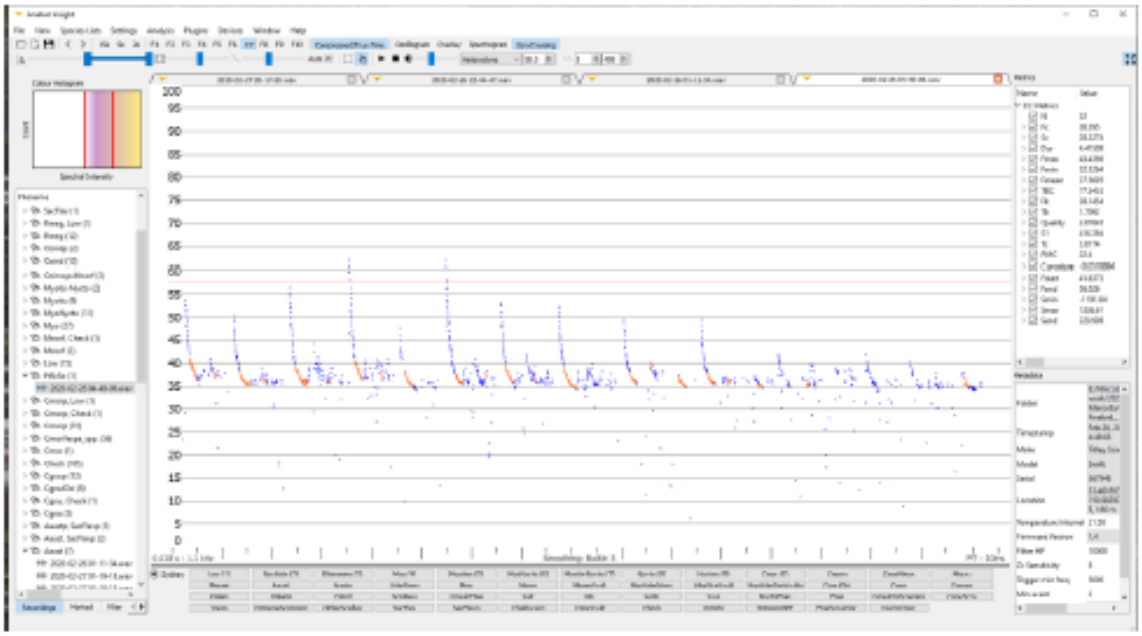

Figure 5. Potential call profile for *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Scoteanax rueppellii* (Greater Broad-nosed Bat) or *Scotorepens orion* (Eastern Broad-nosed Bat) recorded on B2-0062 at 0448 (4:48 a.m.) on 26 February 2020.

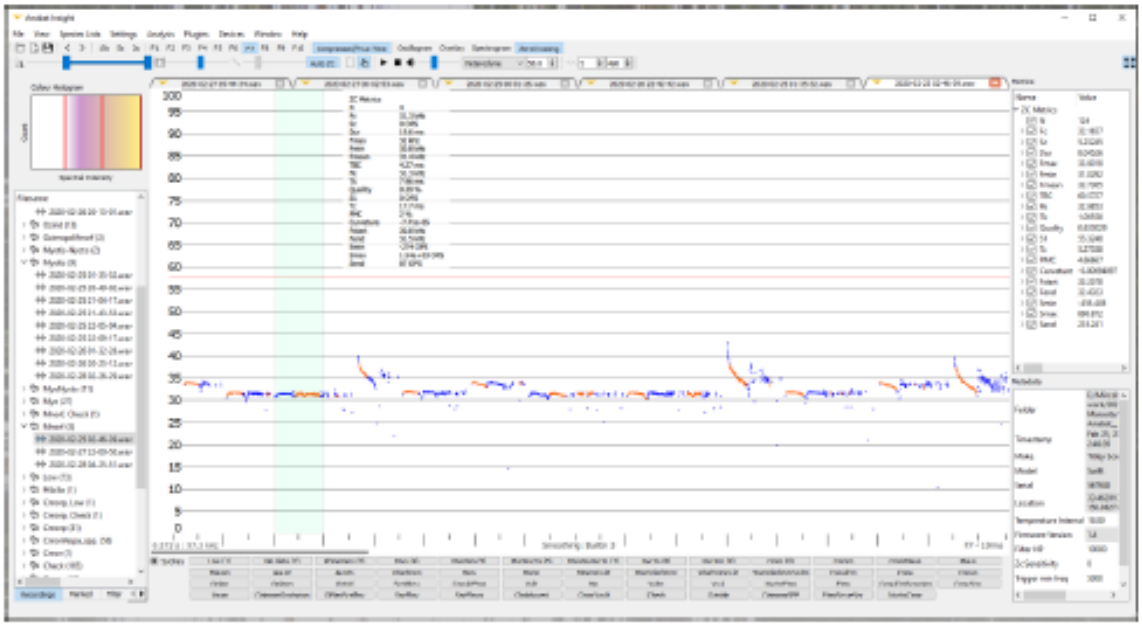

Figure 6. Call profile for *Micronomus norfolkensis* (East-coast Free-tailed Bat) recorded on B2-0062 at 0246 (2:46 a.m.) on 25 February 2020.

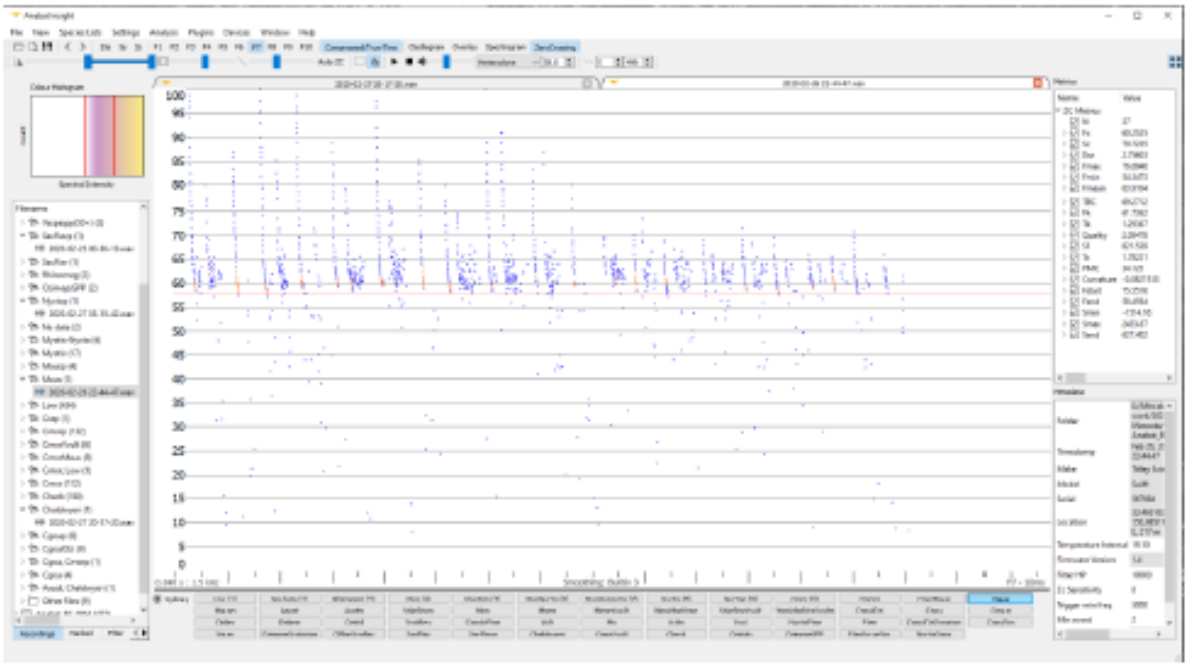

Figure 7. Call profile for *Miniopterus australis* (Little Bent-winged Bat) recorded on B2-0061 at 05:43 (5:43 a.m.) on 26 February 2020.

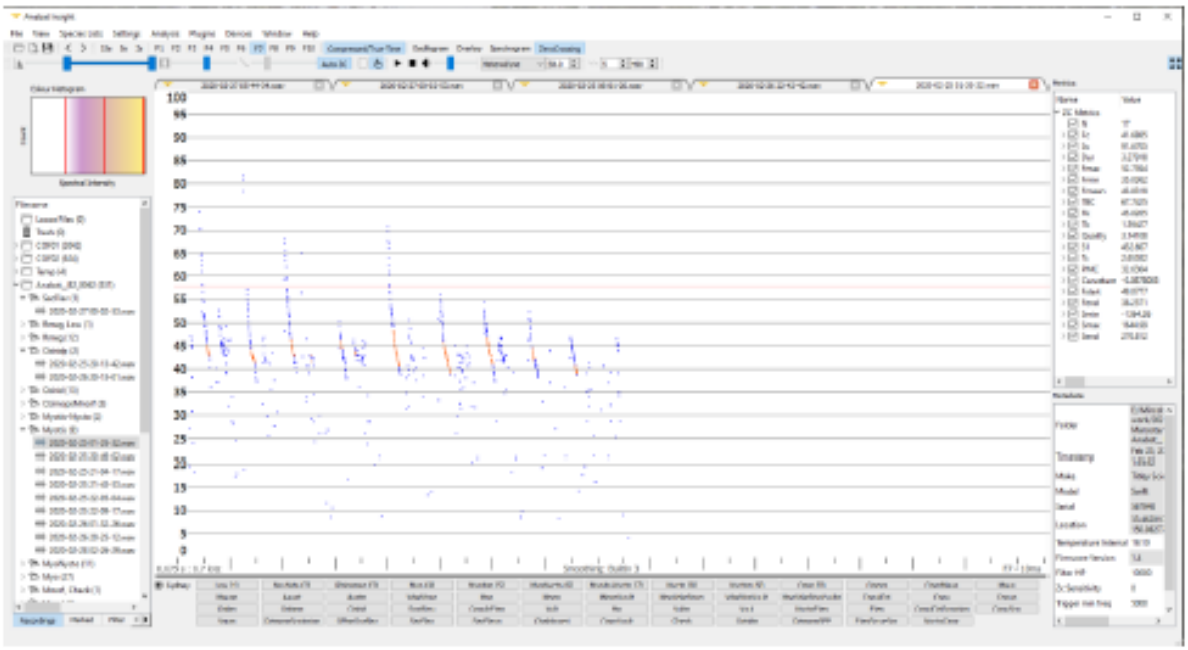

Figure 8. Call profile for *Myotis macropus* (Southern Myotis) recorded on B2-0062 at 0135 (1:35 a.m.) on 25 February 2020.

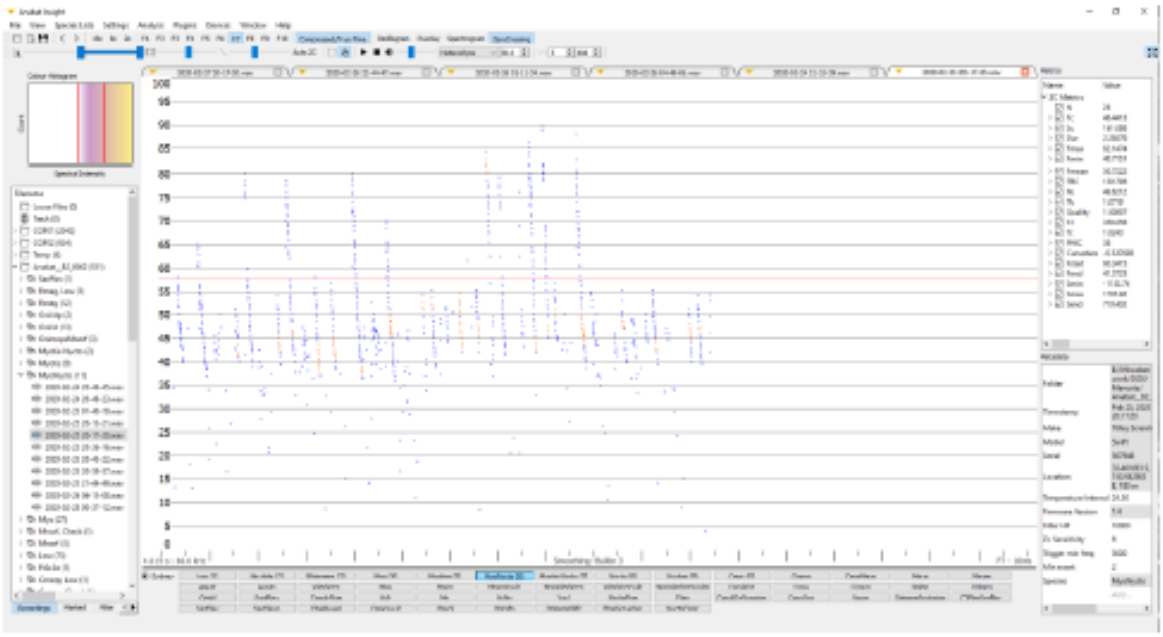

Figure 9. Potential call profile for *Myotis macropus* (Southern Myotis), *Nyctophilus geoffroyi* (Lesser Long-eared Bat) or *Nyctophilus gouldii* (Gould's Long-eared Bat) on B2-0062 at 2017 (20.17 p.m.) on 25 February 2020.

Figure 10. Call profile for *Ozimops ridei* (Rides Free-tailed Bat) recorded on B2-0062 at 0601 (6:01 a.m.) on 25 February 2020.

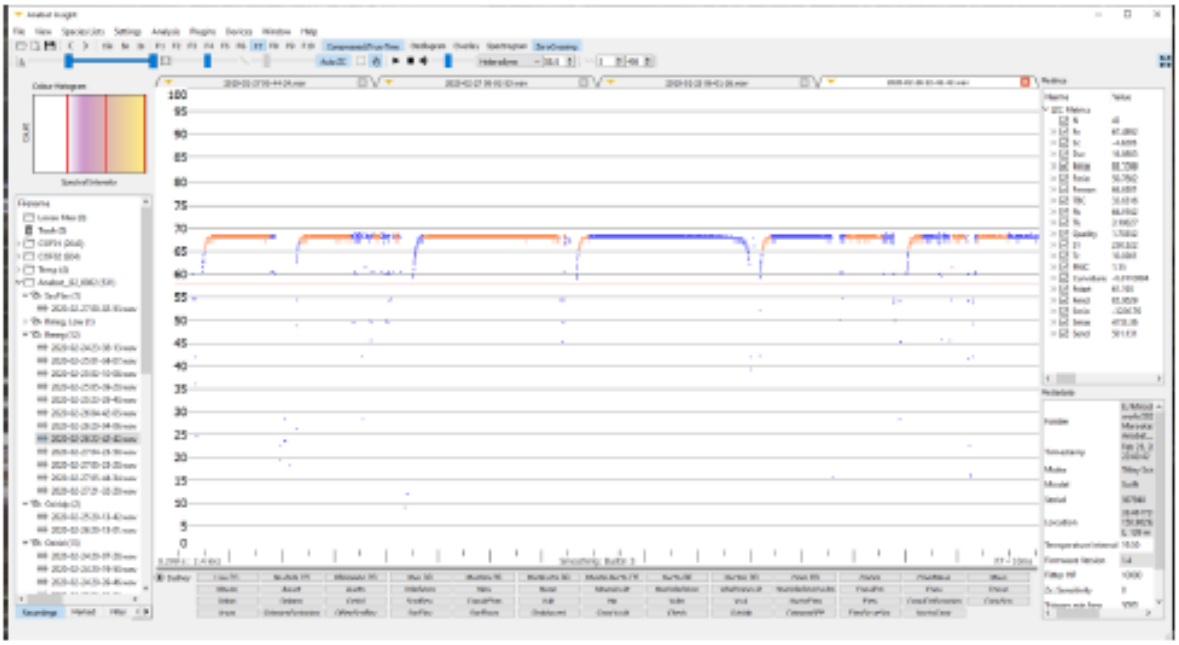

Figure 11. Call profile for *Rhinolophus megaphyllus* (Eastern Horseshoe Bat) recorded on B2-0062 at 0544 (5:44 a.m.) on 27 February 2020.

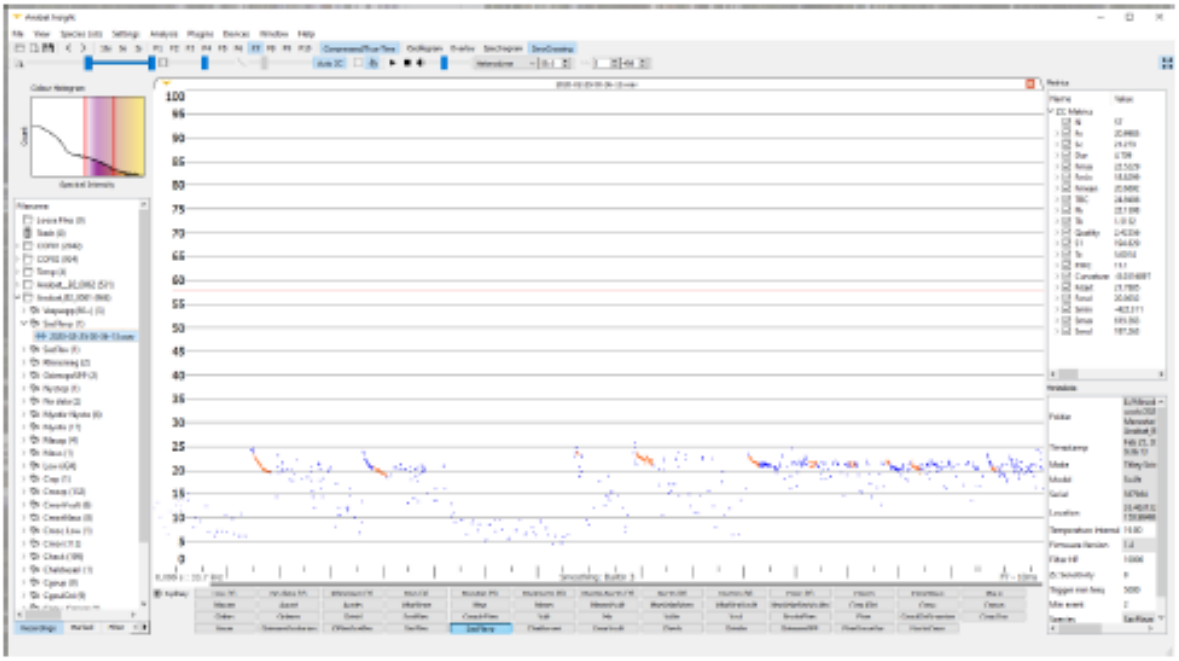

Figure 12. Call profile for *Saccolaimus flaviventris* (Yellow-bellied Sheath-tailed Bat) recorded on B2-0062 at 0544 (5:44 a.m.) on 25 February 2020.

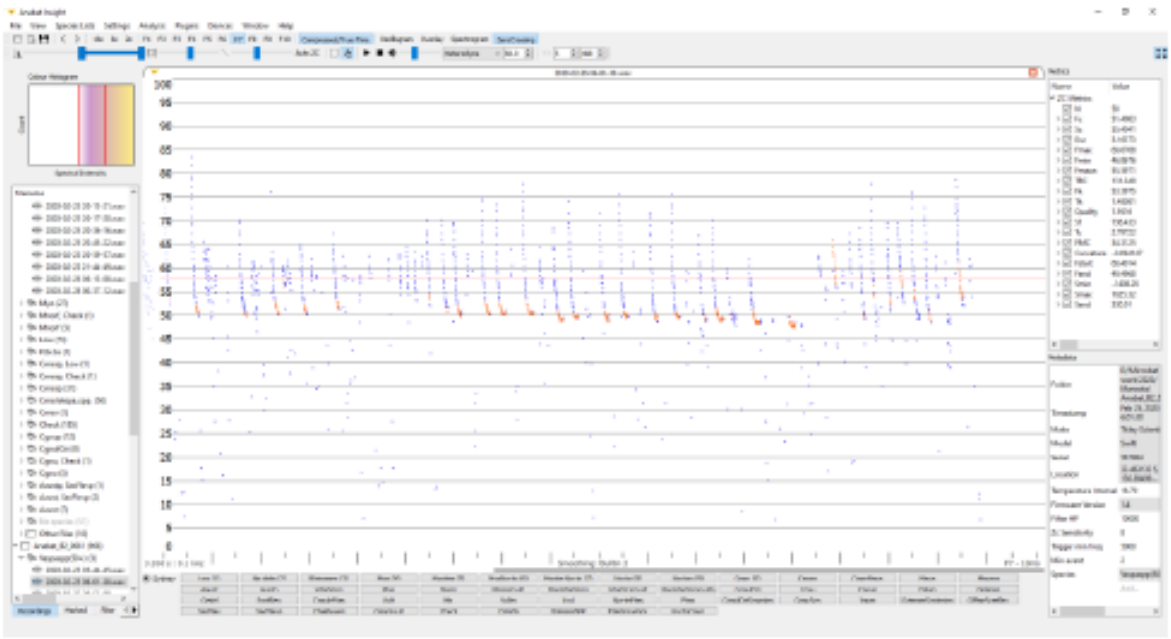

Figure 13. Potential call profile for *Vespadelus pumilus* (Eastern Forest Bat), *Vespadelus troughtoni* (Eastern Cave Bat) or *Vespadelus vulturnus* (Little Forest Bat) recorded on B2-0061 at 0601 (6:01 a.m.) on 25 February 2020.

7. References

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Appendix F EPBC Act Likelihood of Occurrence

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Only species listed under the EPBC Act were included in the assessment. Species listed only under the BC Act were assessed as part of determining credit species included in the BAMC. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the site inspection and professional judgement. Some Migratory or Marine species identified from the Commonwealth database search have been excluded from the assessment, due to lack of habitat. The terms for likelihood of occurrence are defined below:

- "known" = the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site
- "no" = habitat on site and in the vicinity is unsuitable for the species.

A test of significance was conducted for threatened species that were recorded within the study area or had a higher likelihood of occurring and were not recorded during the site visit. It is noted that some threatened fauna species that are highly mobile, wide ranging and vagrant may use portions of the study area intermittently for foraging. For these fauna species, the habitat present and likely to be impacted is not considered to be important to the threatened species, particularly in relation to the amount of similar habitat remaining in the surrounding landscape. As such, a test of significance in reference to Commonwealth legislation was not considered necessary.

The records column refers to the number of records occurring within 5 km of the study area, as provided by the Atlas of NSW Wildlife (BioNet) and Protected Matters Search Tool database search.

Information provided in the habitat associations' column has primarily been extracted (and modified) from the Commonwealth Species Profile and Threats Database and the NSW Threatened Species Profiles.

Table 53: Likelihood of occurrence assessment for threatened flora and fauna species.

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
FLORA							
Acacia bynoeana	**Bynoe's Wattle**	**V**	**Found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. Found in heath or dry sclerophyll forest on sandy soils.**	**388**	**Known – this species was observed within the development site.**	**Yes**	**Yes**
Acacia gordonii	-	E	Restricted to the north-west of Sydney, occurring in the lower Blue Mountains in the west, and in the Maroota/Glenorie area in the east. Sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops.	0	Unlikely – this species was not observed from targeted surveys undertaken in suitable habitat (PCTs 1328 and 1083), no local records.	Yes	No
Allocasuarina glareicola	-	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool.	0	No – lack of suitable habitat recorded within the development site, species not observed during surveys, no local records.	N/A	No
Asterolasia elegans	-	E	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby local government areas. Also likely to occur in the western part of Gosford local government area. Hawkesbury	15620	No – suitable habitat (moist hillsides/shelter	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
			sandstone. Found in sheltered forests on mid- to lower slopes and valleys.		ed forest on mid to lower slopes and valleys on Hawkesbury sandstone) not present within the development site, species not observed during surveys.		
Cryptostylis hunteriana	Leafless Tongue Orchid	V	In NSW, recorded mainly on coastal and near coastal ranges north from Victoria to near Forster, with two isolated occurrences inland north-west of Grafton. Coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest.	0	No - marginal habitat recorded within the development site, however species not observed during surveys and there are no local records.	N/A	No
Cynanchum elegans	White-flowered Wax Plant	E	Restricted to eastern NSW, from Brunswick Heads on the north coast to Gerroa in the Illawarra region, and as far west as Merriwa in the upper Hunter River valley. Dry rainforest; littoral rainforest; *Leptospermum laevigatum-Banksia integrifolia* subsp. *integrifolia* (Coastal Tea-tree– Coastal Banksia) coastal scrub; *Eucalyptus tereticornis* (Forest Red Gum) or *Corymbia maculata* (Spotted Gum) open forest and woodland; and *Melaleuca armillaris* (Bracelet Honeymyrtle) scrub.	0	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
Darwinia biflora	-	V	Recorded in Ku-ring-gai, Hornsby, Baulkham Hills and Ryde local government areas, in an area bounded by Maroota, North Ryde, Cowan and Kellyville. Woodland, open forest or scrub-heath on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone.	13	Unlikely - potential habitat available in PCT 1081 and transition areas to PCT 1181, 1083 and 1328, however species not observed during surveys.	Yes	No
Genoplesium baueri	Bauer's Midge Orchid	E	Has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. Dry sclerophyll forest and moss gardens over sandstone.	0	No – potential habitat available within development site, however species not observed during survey and no local records present.	Yes	No
Haloragis exalata subsp. *exalata*	Square Raspwort	V	Disjunct distribution in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Protected and shaded damp situations in riparian habitats.	0	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
Kunzea rupestris	**-**	**V**	**Mostly in the Maroota - Sackville - Glenorie area and one outlier in Ku-ring-gai Chase National Park.**	**2184**	**Known – this species was observed within the development site.**	**Yes**	**Yes**
Lasiopetalum joyceae	-	V	Restricted to the Hornsby Plateau south of the Hawkesbury River, between Berrilee and Duffys Forest. Heath on lateritic to shaley ridgetops over sandstone.	34	Unlikely – this species was not observed from targeted surveys undertaken in suitable habitat (PCTs 1081, 1328 and 1083), no local records.	Yes	No
Leptospermum deanei	-	V	Hornsby, Warringah, Ku-ring-gai and Ryde LGAs in the Sydney region. Woodland, riparian scrub and open forest on lower hill slopes or near creeks, on sand or sandy alluvial soil.	0	No - suitable habitat (riparian scrub) not recorded within the development site, species not observed during surveys, no local records.	N/A	No
Melaleuca deanei	Deane's Paperbark	V	Ku-ring-gai/Berowra area, Holsworthy/Wedderburn area, Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. Heath on sandstone.	23	No - suitable habitat (wet heath on sandstone) not recorded within	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
					the development site, species not observed during surveys, no local records.		
Micromyrtus blakelyi	-	V	Restricted to areas near the Hawkesbury River, north of Sydney. Distribution extends from north of Maroota in the north, to Cowan in the south. Heathlands in shallow sandy soil, on sandstone rock platforms.	1538	Unlikely – this species was not identified from targeted surveys undertaken in suitable habitat (PCTs 1328 and 1083).	Yes	No
Olearia cordata	-	V	A NSW endemic generally restricted to the south-western Hunter Plateau, eastern Colo Plateau, and the far north-west of the Hornsby Plateau near Wisemans Ferry east of Maroota. Open sclerophyll forest and open shrubland, on sandstone ridges.	0	No – potential habitat (dry open forest on sandstone ridges) was detected in the development site, however it is considered to be considerably south of its known range. Species not observed during surveys and no local records.	Yes	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
Persicaria elatior	Tall Knotweed	V	In south-eastern NSW recorded from Mt Dromedary, Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). Beside streams and lakes, swamp forest or disturbed areas.	0	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	N/A	No
Persoonia hirsuta	Hairy Geebung	E	Scattered distribution around Sydney, from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the west. Sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	4	Unlikely – this species was not identified from targeted surveys undertaken in suitable habitat (PCT 1081).	Yes	No
Pimelea curviflora* var. *curviflora	**-**	**V**	**Confined to the coastal area of the Sydney and Illawarra regions between northern Sydney and Maroota in the north-west and Croom Reserve near Albion Park in the south. Woodland, mostly on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes.**	**347**	**Known – this species was observed within the development site.**	**Yes**	**Yes**
Pterostylis gibbosa	Illawarra Greenhood	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). Open forest or woodland, on flat or gently sloping land with poor drainage.	0	No - suitable habitat not recorded within the development site, species not observed during	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
					surveys, no local records.		
Pterostylis saxicola	Sydney Plains Greenhood	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. Small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines, adjacent to sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	0	No – potential habitat recorded within the development site, however species not observed during surveys and no local records.	N/A	No
Syzygium paniculatum	Magenta Lilly Pilly	V	Only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. Subtropical and littoral rainforest on gravels, sands, silts and clays.	0	No - suitable habitat (rainforest) not recorded within the development site, species not observed during surveys, no local records.	N/A	No
Thesium australe	Austral Toadflax	V	In eastern NSW it is found in very small populations scattered along the coast, and from the Northern to Southern Tablelands. Grassland on coastal headlands or grassland and grassy woodland away from the coast.	0	No - suitable habitat not recorded within the development site, species not observed during surveys, no local records.	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
Zieria involucrata	-	V	North and west of Sydney; recent records come from 22 populations in the catchments of the Macdonald, Colo and Hawkesbury Rivers between Melon Creek and Mogo Creek in the north to Little Cattai Creek (Hillside) and Wheeny Creek (Colo) in the south and from a single population in the upper Blue Mountains north of Katoomba. Wet sclerophyll forest on mid- to lower slopes and valleys; some populations extend upslope into drier vegetation.	1047	No - suitable habitat (sheltered forests on mid to lower slopes) not present within the development site, species not observed during surveys.	N/A	No
FAUNA							
Amphibians							
Heleioporus australiacus	**Giant Burrowing Frog**	**V**	**South eastern NSW and Victoria, in two distinct populations: a northern population in the sandstone geology of the Sydney Basin as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.**	**108**	**Likely – suitable habitat for this species was recorded within the development site.**	**Yes**	**Yes**
Litoria aurea	Green and Golden Bell Frog	V	Since 1990, recorded from about 50 scattered sites within its former range in NSW, from the north coast near Brunswick Heads, south along the coast to Victoria. Records exist west to Bathurst, Tumut and the ACT region. Marshes, dams and stream-sides, particularly those containing *Typha* sp. (bullrushes) or *Eleocharis* sp. (spikerushes). Some populations occur in highly disturbed areas.	0	No – suitable habitat not present within the development site, no local records.	N/A	No
Litoria littlejohni	Littlejohn's Tree Frog	V	Plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest south to Buchan in Victoria. The species has	0	No – suitable habitat not	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
			not been recorded in southern NSW within the last decade. Breeding habitat is the upper reaches of permanent streams and perched swamps. Non-breeding habitat is heath-based forests and woodlands.		present within the development site, development site beyond the known range for the species, no local records.		
Mixophyes balbus	Stuttering Frog	V	Along the east coast of Australia from southern Qld to north-eastern Victoria. Rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	0	No – suitable habitat not present within the development site, development site beyond the known range for the species, no local records.	N/A	No
Aves							
Actitis hypoleucos	Common Sandpiper	M	Summer migrant. In NSW, widespread along coastline and also occurs in many areas inland. Coastal wetlands and some inland wetlands, especially muddy margins or rocky shores. Also estuaries and deltas, lakes, pools, billabongs, reservoirs, dams and claypans, mangroves.	0	No – suitable habitat not present within the development site, no local records.	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
Anthochaera phrygia	**Regent Honeyeater**	**CE**	**Inland slopes of south-east Australia, and less frequently in coastal areas. In NSW, most records are from the North-West Plains, North-West and South-West Slopes, Northern Tablelands, Central Tablelands and Southern Tablelands regions; also recorded in the Central Coast and Hunter Valley regions. Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of *Casuarina cunninghamiana* (River Oak).**	**2**	**Likely – suitable foraging habitat detected within the development site. Development site not within DPIE mapped areas (as accessed on BOAMS on 6 July 2020).**	**Yes (foraging only)**	**Yes**
Apus pacificus	Fork-tailed Swift	M	Recorded in all regions of NSW. Riparian woodland, swamps, low scrub, heathland, saltmarsh, grassland, Spinifex sandplains, open farmland and inland and coastal sand-dunes.	1	Unlikely – suitable habitat not present within the development site.	N/A	No
Botaurus poiciloptilus	Australasian Bittern	E	Found over most of NSW except for the far north-west. Permanent freshwater wetlands with tall, dense vegetation, particularly *Typha* sp. (bullrushes) and *Eleocharis* sp. (spikerushes).	0	Unlikely – suitable habitat not present within the development site, no local records.	N/A	No
Calidris acuminata	Sharp-tailed Sandpiper	M	Summer migrant. Widespread in most regions of NSW, especially in coastal areas, but sparse in the south-central Western Plain and east Lower Western Regions. Shallow fresh	0	Unlikely – suitable habitat not present within the	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
			or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.		development site, no local records.		
Calidris ferruginea	Curlew Sandpiper	CE, M	Occurs along the entire coast of NSW, and sometimes in freshwater wetlands in the Murray-Darling Basin. Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland. Littoral and estuarine habitats, including intertidal mudflats, non-tidal swamps, lakes and lagoons on the coast and sometimes inland.	0	Unlikely – suitable habitat not present within the development site, no local records.	N/A	No
Calidris melanotos	Pectoral Sandpiper	M	Summer migrant to Australia. Widespread but scattered in NSW. East of the Great Divide, recorded from Casino and Ballina, south to Ulladulla. West of the Great Divide, widespread in the Riverina and Lower Western regions. Shallow fresh to saline wetlands, including coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	0	Unlikely – suitable habitat not present within the development site, no local records.	N/A	No
Grantiella picta	Painted Honeyeater	V	Widely distributed in NSW, predominantly on the inland side of the Great Dividing Range but avoiding arid areas. Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	0	No – suitable habitat not present within the development site, no local records.	N/A	No
Hirundapus caudacutus	White-throated Needletail	M	All coastal regions of NSW, inland to the western slopes and inland plains of the Great Divide. Occur most often over open forest and rainforest, as well as heathland, and remnant vegetation in farmland.	0	Unlikely – potential habitat present within the development	Yes	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
					site, no local records		
Lathamus discolor	**Swift Parrot**	**CE**	**Migrates from Tasmania to mainland in Autumn-Winter. In NSW, the species mostly occurs on the coast and south west slopes. Box-ironbark forests and woodlands.**	**0**	**Likely – suitable foraging habitat detected within the development site. Development site not within DPIE mapped breeding areas (as confirmed by the DPIE BAM support 23 July 2020).**	**Yes (foraging only)**	**Yes**
Merops ornatus	Rainbow Bee-eater	M	Distributed across much of mainland Australia, including NSW. Open forests and woodlands, shrublands, farmland, areas of human habitation, inland and coastal sand dune systems, heathland, sedgeland, vine forest and vine thicket.	0	Unlikely – potential habitat present within the development site, no local records	Yes	No
Monarcha melanopsis	Black-faced Monarch	M	In NSW, occurs around the eastern slopes and tablelands of the Great Divide, inland to Coutts Crossing, Armidale, Widden Valley, Wollemi National Park and Wombeyan Caves. It is rarely recorded farther inland. Rainforest, open eucalypt forests, dry sclerophyll forests and woodlands, gullies in mountain areas or coastal foothills, Brigalow scrub, coastal scrub, mangroves, parks and gardens.	0	Unlikely – potential habitat present within the development site, no local records	Yes	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
Motacilla flava	Yellow Wagtail	M	Regular summer migrant to mostly coastal Australia. In NSW recorded Sydney to Newcastle, the Hawkesbury and inland in the Bogan LGA. Swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land, lawns.	0	Unlikely – suitable habitat not present within the development site, no local records.	N/A	No
Myiagra cyanoleuca	Satin Flycatcher	M	In NSW, widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. Eucalypt-dominated forests, especially near wetlands, watercourses, and heavily-vegetated gullies.	0	Unlikely – suitable habitat not present within the development site, no local records.	N/A	No
Numenius madagascariensis	Eastern Curlew	CE, M	Summer migrant to Australia. Primarily coastal distribution in NSW, with some scattered inland records. Estuaries, bays, harbours, inlets and coastal lagoons, intertidal mudflats or sandflats, ocean beaches, coral reefs, rock platforms, saltmarsh, mangroves, freshwater/brackish lakes, saltworks and sewage farms.	0	Unlikely – preferred habitat not present within the development site, no local records.	N/A	No
Rhipidura rufifrons	Rufous Fantail	M	Coastal and near coastal districts of northern and eastern Australia, including on and east of the Great Divide in NSW. Wet sclerophyll forests, subtropical and temperate rainforests. Sometimes drier sclerophyll forests and woodlands.	0	Unlikely – preferred habitat not present within the development site, no local records.	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
Rostratula australis	Australian Painted Snipe	E	In NSW most records are from the Murray-Darling Basin. Other recent records include wetlands on the Hawkesbury River and the Clarence and lower Hunter Valleys. Swamps, dams and nearby marshy areas.	0	Unlikely – suitable habitat not present within the development site, no local records.	N/A	No
Tringa nebularia	Common Greenshank	M	Summer migrant to Australia. Recorded in most coastal regions of NSW; also widespread west of the Great Dividing Range. Found in terrestrial wetlands and sheltered coastal habitats.	0	Unlikely – suitable habitat not present within the development site, no local records.	N/A	No
Gastropods							
Pommerhelix duralensis	**Dural Land Snail**	**E**	**Endemic to NSW. Occurs along the northwest fringes of the Cumberland Plain, within the Hills Shire, Blue Mountains City, Penrith City, Hornsby Shire and Parramatta City LGAs. Shale-sandstone transitional landscapes. Found in Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest; Turpentine-Ironbark Forest; Shale/Sandstone Transition Forest; Turpentine Ironbark Margin Forest; Hinterland Sandstone Gully Forest; and Sydney Hinterland Transition Woodland.**	**2**	**Known – this species was observed within the development site.**	**Yes**	**Yes**
Mammals							
Chalinolobus dwyeri	**Large-eared Pied Bat**	**V**	**Recorded from Rockhampton in Qld south to Ulladulla in NSW. Largest concentrations of populations occur in the sandstone escarpments of the Sydney basin and the NSW north-west slopes. Wet and dry sclerophyll forests, Cyprus Pine dominated**	**6**	**Likely - suitable foraging habitat within the development site due to**	**Yes (foraging only)**	**Yes**

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
			forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.		**presence of rugged Hawkesbury sandstone terrain directly adjacent to the development site which may provide suitable breeding habitat (caves/overhang/escarpments etc.). Suitable breeding habitat not detected in the development site.**		
Dasyurus maculatus	**Spotted-tailed Quoll**	**E**	**Found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Qld. Rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.**	**0**	**Potential – suitable habitat detected within the development site.**	**Yes**	**Yes**
Petauroides volans	Greater Glider	V	Eastern Australia, from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest). Eucalypt forests and woodlands. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows.	0	No – preferred habitat not present within the development site, no local	N/A	No

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
					records. Not detected during targeted surveys		
Petrogale penicillata	Brush-tailed Rock-wallaby	V	In NSW they occur from the Qld border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges.	0	No – preferred habitat not present within the development site, no local records.	N/A	No
Phascolarctos cinereus	**Koala**	**V**	**In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. There are sparse and possibly disjunct populations in the Bega District, and at several sites on the southern tablelands. Eucalypt woodlands and forests.**	**3**	**Likely – suitable habitat identified within the development site. One probable Koala scat was detected during targeted survey. No evidence of breeding detected.**	**Yes (foraging only)**	**Yes**
Pseudomys novaehollandiae	**New Holland Mouse**	**V**	**Fragmented distribution across eastern NSW. Open heathlands, woodlands and forests with a heathland understorey, vegetated sand dunes.**	**0**	**Potential – suitable habitat was observed within the development site.**	**Yes**	**Yes**

Scientific Name	Common Name	EPBC Act Status	Distribution and Habitat	BioNet Records within 5 km	Likelihood of occurrence on site	Habitat on site directly or indirectly impacted	Impact assessment required
Pteropus poliocephalus	Grey-headed Flying-fox	V	Along the eastern coast of Australia, from Bundaberg in Qld to Melbourne in Victoria. Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	8	Known – this species was observed within the development site. Seasonal foraging habitat available within the site. No camps observed within study area.	Yes (foraging only)	Yes
Reptiles							
Hoplocephalus bungaroides	Broad-headed Snake	V	Largely confined to Triassic and Permian sandstones within the coast and ranges in an area within approximately 250 km of Sydney. Dry and wet sclerophyll forests, riverine forests, coastal heath swamps, rocky outcrops, heaths, grassy woodlands.	0	Potential – suitable habitat was observed within the development site.	Yes	Yes

Key: M = Migratory, CD = Conservation Dependent, CE = Critically Endangered, E = Endangered, V = Vulnerable, X = Extinct.

Appendix G Biodiversity credit report

NSW GOVERNMENT

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00018928/BAAS18077/20/00018929	16255 Maroota Sands BDAR	31/05/2021
Assessor Name	Assessor Number	BAM Data version *
		40
Proponent Name(s)	Report Created	BAM Case Status
	04/06/2021	Open
Assessment Revision	Assessment Type	Date Finalised
0	Major Projects	To be finalised

* 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.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		
Species		
Hoplocephalus bungaroides / Broad-headed Snake		

Additional Information for Approval

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

BAM Biodiversity Credit Report (Variations)

Name
Grantiella picta / Painted Honeyeater
Ninox connivens / Barking Owl
Tyto novaehollandiae / Masked Owl
Callocephalon fimbriatum / Gang-gang Cockatoo
Pandion cristatus / Eastern Osprey

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1081-Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	Not a TEC	25.7	536	0	536.00
1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	Not a TEC	3.3	32	34	66.00
1328-Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	Not a TEC	13.8	286	0	286.00
1181-Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion	Not a TEC	8.2	182	0	182.00

1081-Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin Bioregion	**Like-for-like credit retirement options**				
	Class	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Variations)

Sydney Hinterland Dry Sclerophyll Forests This includes PCT's: 612, 621, 624, 1080, 1081, 1086, 1159, 1246, 1255, 1327, 1328, 1614, 1622, 1628, 1631, 1634, 1640, 1664, 1666, 1667, 1789, 1790, 1912	Sydney Hinterland Dry Sclerophyll Forests <50%	1081_Open_understorey	Yes	473	Yengo,Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Sydney Hinterland Dry Sclerophyll Forests This includes PCT's: 612, 621, 624, 1080, 1081, 1086, 1159, 1246, 1255, 1327, 1328, 1614, 1622, 1628, 1631, 1634, 1640, 1664, 1666, 1667, 1789, 1790, 1912	Sydney Hinterland Dry Sclerophyll Forests <50%	1081_Dense_midstorey	Yes	63	Yengo,Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1081_Open_understorey	Yes (including artificial)	473	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1081_Dense_midstorey	Yes (including artificial)	63	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1083_Heathy_understorey	No	34	Yengo,Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1083_Open_understorey	Yes	32	Yengo,Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Variations)

1083-Red Bloodwood - scribbly gum heathy woodland on sandstone plateaux of the Sydney Basin Bioregion

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1083_Heathy_understorey	No	34	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1083_Open_understorey	Yes (including artificial)	32	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

1181-Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1181_Good	Yes	182	Yengo,Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Variation options

Formation	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Variations)

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1181_Good	Yes (including artificial)	182	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1328-Yellow Bloodwood - Narrow-leaved Apple heathy woodland on hinterland plateaux of the Central Coast, Sydney Basin Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Hinterland Dry Sclerophyll Forests This includes PCT's: 612, 621, 624, 1080, 1081, 1086, 1159, 1246, 1255, 1327, 1328, 1614, 1622, 1628, 1631, 1634, 1640, 1664, 1666, 1667, 1789, 1790, 1912	Sydney Hinterland Dry Sclerophyll Forests <50%	1328_Open_understorey	Yes	200	Yengo,Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Sydney Hinterland Dry Sclerophyll Forests This includes PCT's: 612, 621, 624, 1080, 1081, 1086, 1159, 1246, 1255, 1327, 1328, 1614, 1622, 1628, 1631, 1634, 1640, 1664, 1666, 1667, 1789, 1790, 1912	Sydney Hinterland Dry Sclerophyll Forests <50%	1328_Heathy_understorey	Yes	86	Yengo,Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region

BAM Biodiversity Credit Report (Variations)

	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1328_Open_understorey	Yes (including artificial)	200	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 4 or higher threat status	1328_Heathy_understorey	Yes (including artificial)	86	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Acacia bynoeana / Bynoe's Wattle	**1328_Open_understorey**	1.6	43.00
Calyptorhynchus lathami / Glossy Black-Cockatoo	**1081_Open_understorey, 1081_Dense_midstorey, 1083_Heathy_understorey, 1083_Open_understorey, 1328_Open_understorey, 1328_Heathy_understorey, 1181_Good**	49.1	1380.00
Cercartetus nanus / Eastern Pygmy-possum	**1081_Open_understorey, 1081_Dense_midstorey, 1083_Heathy_understorey, 1083_Open_understorey, 1328_Open_understorey, 1328_Heathy_understorey, 1181_Good**	51.0	1427.00

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BAM Biodiversity Credit Report (Variations)

Heleioporus australiacus / Giant Burrowing Frog	**1081_Open_understorey, 1081_Dense_midstorey, 1083_Heathy_understorey, 1083_Open_understorey, 1328_Open_understorey, 1328_Heathy_understorey, 1181_Good**	51.0	1070.00
Hoplocephalus bungaroides / Broad-headed Snake	**1083_Heathy_understorey, 1083_Open_understorey, 1328_Open_understorey, 1328_Heathy_understorey, 1181_Good**	25.2	1068.00
Kunzea rupestris / Kunzea rupestris	**1083_Heathy_understorey, 1328_Open_understorey, 1328_Heathy_understorey**	0.8	20.00
Myotis macropus / Southern Myotis	**1081_Open_understorey, 1081_Dense_midstorey, 1328_Open_understorey, 1181_Good**	7.1	195.00
Petaurus norfolcensis / Squirrel Glider	**1081_Open_understorey, 1081_Dense_midstorey, 1083_Heathy_understorey, 1083_Open_understorey, 1328_Open_understorey, 1328_Heathy_understorey, 1181_Good**	51.0	1427.00
Pimelea curviflora var. curviflora / Pimelea curviflora var. curviflora	**1081_Open_understorey**	0.9	25.00
Pommerhelix duralensis / Dural Land Snail	**1081_Open_understorey, 1081_Dense_midstorey**	25.7	714.00

BAM Biodiversity Credit Report (Variations)

Pseudophryne australis / Red-crowned Toadlet	**1081_Open_understorey, 1081_Dense_midstorey, 1083_Open_understorey, 1328_Open_understorey, 1328_Heathy_understorey, 1181_Good**	24.5	519.00
Tetratheca glandulosa / Tetratheca glandulosa	**1081_Open_understorey, 1081_Dense_midstorey, 1083_Heathy_understorey, 1083_Open_understorey, 1328_Open_understorey, 1328_Heathy_understorey, 1181_Good**	4.1	116.00

Credit Retirement Options

Like-for-like options

Acacia bynoeana/ Bynoe's Wattle	Spp	IBRA region	
	Acacia bynoeana/Bynoe's Wattle	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

BAM Biodiversity Credit Report (Variations)

	Flora	Endangered	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Calyptorhynchus lathami/ Glossy Black-Cockatoo	Spp	IBRA region	
	Calyptorhynchus lathami/Glossy Black-Cockatoo	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Cercartetus nanus/ Eastern Pygmy-possum	Spp	IBRA region	
	Cercartetus nanus/Eastern Pygmy-possum	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

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BAM Biodiversity Credit Report (Variations)

	Fauna	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Heleioporus australiacus/ Giant Burrowing Frog	Spp	IBRA region	
	Heleioporus australiacus/Giant Burrowing Frog	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Hoplocephalus bungaroides/ Broad-headed Snake	Spp	IBRA region	
	Hoplocephalus bungaroides/Broad-headed Snake	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

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BAM Biodiversity Credit Report (Variations)

	Fauna	Endangered	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Kunzea rupestris/ Kunzea rupestris	Spp	IBRA region	
	Kunzea rupestris/Kunzea rupestris	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Flora	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp	IBRA region	
	Myotis macropus/Southern Myotis	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region

BAM Biodiversity Credit Report (Variations)

	Fauna	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Petaurus norfolcensis/ Squirrel Glider	Spp	IBRA region	
	Petaurus norfolcensis/Squirrel Glider	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Pimelea curviflora var. curviflora/ Pimelea curviflora var. curviflora	Spp	IBRA region	
	Pimelea curviflora var. curviflora/Pimelea curviflora var. curviflora	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act	IBRA region

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BAM Biodiversity Credit Report (Variations)

		shown below	
	Flora	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Pommerhelix duralensis/ Dural Land Snail	Spp	IBRA region	
	Pommerhelix duralensis/Dural Land Snail	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Endangered	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Pseudophryne australis/ Red-crowned Toadlet	Spp	IBRA region	
	Pseudophryne australis/Red-crowned Toadlet	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act	IBRA region

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BAM Biodiversity Credit Report (Variations)

		shown below	
	Fauna	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Tetratheca glandulosa/ Tetratheca glandulosa	Spp	IBRA region	
	Tetratheca glandulosa/Tetratheca glandulosa	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Flora	Vulnerable	Yengo, Cumberland, Hunter, Kerrabee, Pittwater, Wollemi and Wyong. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

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