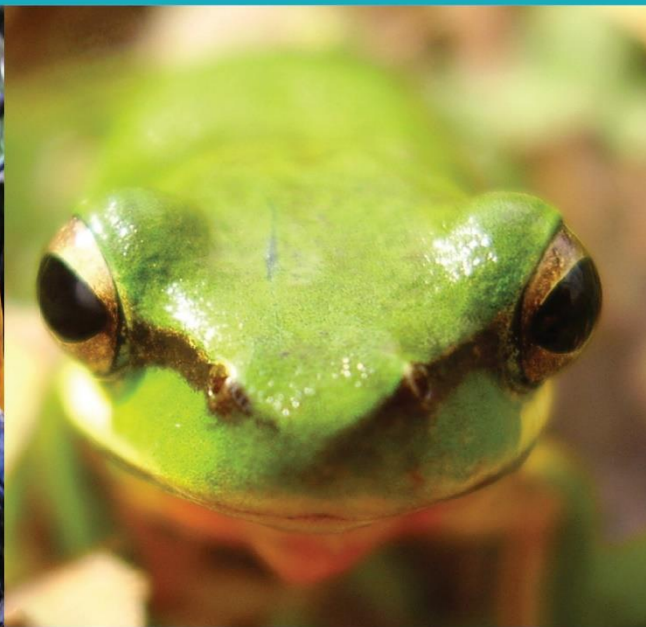




TRAVERS BUSHFIRE & ECOLOGY

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BIODIVERSITY ASSESSMENT REPORT

Proposed Development

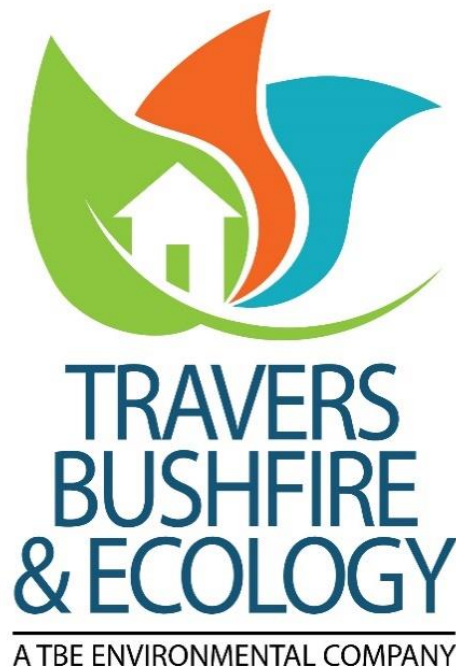
Lot 157, 158, 181 and 202 DP 751276

1551 Joadja Road

Joadja

2 May 2024

(REF: 21BREA02)



BIODIVERSITY ASSESSMENT REPORT

Proposed Eco-tourism Development

Lot 157, 158, 181 & 202 DP 751276,
1551 Joadja Road, Joadja

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File:	21BREA02



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The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features is to be confirmed by a registered surveyor.

LIST OF ABBREVIATIONS

APZ	Asset Protection Zone
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
<i>BC Act</i>	<i>Biodiversity Conservation Act (2016)</i>
<i>BC Reg</i>	<i>Biodiversity Conservation Regulation (2017)</i>
BCAR	Biodiversity Certification Assessment Report
BDAR	Biodiversity Development Assessment Report
BOS	Biodiversity Offset Scheme
BPA	Bushfire Protection Assessment
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically endangered ecological community
<i>CM Act</i>	<i>Coastal Management Act 2016 repealed by Resilience and Hazards SEPP</i>
DAFF	Department of Agriculture, Fisheries and Forestry
DAWE	Department of Agriculture, Water, and the Environment (superseded by DAFF)
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from April 2007)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from October 2009)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEHL from April 2011)
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DEWHA	Commonwealth Department of Environment, Water, Heritage & the Arts (superseded by SEWPAC)
DOEE	Commonwealth Department of Environment & Energy (superseded by DAWE)
DPE	NSW Department of Planning and Environment
DPIE	NSW Department of Planning, Industry and Environment (superseded by DPE 2019)
EEC	Endangered Ecological Community
EPA	Environment Protection Authority
<i>EP&A Act</i>	<i>Environmental Planning and Assessment Act (1979)</i>
<i>EPBC Act</i>	<i>Environment Protection and Biodiversity Conservation Act (1999)</i>
<i>FM Act</i>	<i>Fisheries Management Act</i>
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	Local Environmental Plan
LGA	Local Government Area
<i>LLS Act</i>	<i>Local Land Services Act (2013)</i>
NES	National Environmental Significance
<i>NPW Act</i>	<i>National Parks and Wildlife Act (1974)</i>
NRAR	Natural Resources Access Regulator (NSW)
NSW DPI	NSW Department of Industry and Investment
OEHL	Office of Environment and Heritage (superseded by DPIE from August 2019)
PCT	Plant Community Type
PFC	Projected Foliage Cover
RFS	NSW Rural Fire Service
SAIL	Serious And Irreversible Impacts
SEPP	State Environmental Planning Policy
SEWPAC	Commonwealth Dept. of Sustainability, Environment, Water, Population & Communities (superseded by DOEE)
TEC	Threatened Ecological Community
TPZ	Tree Preservation Zone
VMP	Vegetation Management Plan

EXECUTIVE SUMMARY

Travers bushfire & ecology was engaged to undertake a Biodiversity Assessment Report (BAR) of the proposed eco-tourism DA at Lot 157, 158, 181 & 202 DP 751276, 1551 Joadja Road, Joadja, within Wingecarribee Shire Council local government area (LGA).

This lots subject to a proposed concept plan, entitled Greenstead Valley, and will hereafter be referred to as the 'entire study area.'

Proposed masterplan

The development proposed is an eco-tourist facility, located at 1551 Joadja Road, Joadja, NSW in accordance with a concept masterplan and stage 1 DA.

The proposed masterplan of the site includes an arrival village, community 1, 2 and 3, and 4 community areas for a larger ecotourism project. Each community is intended to have an appropriate community building as a bushfire refuge and associated communal areas (Figure 1-2).

The concept masterplan layout was prepared to inform the placement of stage 1 DA including the arrivals village, community 1 and Community 2.

The proposed development application has been assessed in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979*, the *Biodiversity Conservation Act 2016*, the commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1994*.

Recorded biodiversity

In respect of matters required to be considered under the *EP&A Act* and relating to the provisions of the *BC Act*, two (2) threatened fauna species Southern Myotis (*Myotis Macropus*) and Large Bent-winged Bat (*Miniopterus orianae oceanensis*), no threatened flora species, and no threatened ecological communities (TECs) were recorded.

In respect of matters required to be considered under the *EPBC Act*, no threatened fauna species), no threatened flora species and no threatened ecological communities listed under this Act were recorded within the Stage 1 study area.

Following on-ground flora surveys for the Biodiversity Constraints Report (TBE 2022) and updated following field survey for this BAR, four vegetation types were identified across the entire study area, as follows:

- PCT3483 – Central Gorges Box-Red Gum Grassy Forest.
- PCT3498 – Wingecarribee Gorges Stringybark – Grey Gum Forest.
- PCT4063 – Central and Southern Tableland River Oak Forest.
- Cleared Paddocks, and
- Exotic planted vegetation.

The following plant community types are associated with the following listed TEC's under the *BC Act* and the *EPBC Act*.

- PCT3493 - Southern Highlands Red Gum Forest is associated with the EPBC Listed TEC - *Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion* and is not affected by the proposed Masterplan.
- PCT3328 Wollondilly-Shoalhaven Siltstones Sheltered Forest is associated with the BC Act listed TEC - *Hunter Lowland Redgum Forest in the Sydney Basin and New*

South Wales North Coast Bioregions, and River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and Southeast Corner Bioregions and EPBC Act Listed TEC - River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.

PCT3493 and PCT3328 are mapped elsewhere within the broader land holdings. None of the impacted vegetation PCT3746 - Southern Tableland Snow Gum-Candlebark Shrub Forest is not associated with any of the listed *BC Act* or *EPBC Act* Listed TEC's.

It is considered that this study area does not comprise Core Koala Habitat as there has been significant clearing within the site in which the works are proposed. Native vegetation within the study area is likely utilised by Koalas moving through the landscape between core habitats.

No threatened flora species were recorded within the site or proposed impact areas.

No threatened fauna species were recorded within the site or proposed impact areas. TBE notes that Glossy Black Cockatoo is listed as a record in the central portion of the site in 2019 based on Bionet records.

No endangered populations were observed within the site or proposed impact areas.

Impact Summary

TBE notes that the lack of clarity over the design of future stages which is used to determine the impacts on native vegetation for the entire masterplan. DA 1 only includes the arrival village and community 1 and 2. Community 4 has been relocated in the overall layout to avoid impacting on riparian mapped vegetation. Tiny homes were also proposed and there is a lack of clarity on whether they will be included in future DA's.

Direct impacts are associated with clearing for development and Bushfire APZs for each community. The impact area is summarised below:

Summary of impact area on native vegetation PCTs

	Impact area (ha)	PCT 3483 (ha)	PCT 3498 (ha)	PCT 4063 (ha)	Exotic (ha)
Arrival & Community 2	3.69	0.52	0.00	0.00	0.00
Community 1 & Homestead	1.21	0.13	0.00	0.00	0.26
Community 3	0.79	0.00	0.00	0.00	0.00
Community 4	3.14	0.59	0.00	0.00	0.00
Wastewater	1.14	0.14	0.00	0.00	0.00
TOTAL	9.97	0.79	0.00	0.00	0.26

Of most importance is the totality of impact that triggers entry into the biodiversity offset scheme. The proposed stage 1 DA will impact on an estimated 0.71 ha of PCT3483 and another 4.16 ha of pasture that also may constitute native pasture that also triggers entry into the biodiversity offset scheme. Exact numbers will need to be confirmed at the appropriate DA stage.

The likely direct impacts on native vegetation and associated habitat as a result of the proposed Masterplan is as follows:

Direct impact	BC Act status	SAIL entity	Project phase/timing of impact	Extent (ha)
PCT3483 – Central Gorges Box-Red Gum Grassy Forest	Not associated with a TEC	Not an SAIL	Asset protection zones and effluent treatment areas	1.30
PCT3498 – Wingecarribee Gorges Stringybark-Grey Gum Forest	Not associated with a TEC	Not an SAIL	No impact	Nil
PCT4063 – Central and Southern Tableland River Oak Forest.	Not associated with a TEC	Not an SAIL	No impact	Nil
Exotic Planted Vegetation	Not associated with a TEC	Not an SAIL	No impact	0.26
Pasture/Grassland	Not associated with a TEC	Not an SAIL	Asset protection zones and proposed works	7.49
Removal of potential foraging habitat for threatened species including Dusky Woodswallow, Large Bent-winged Bat, Southern Myotis, Large-eared Pied Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Glossy Black-Cockatoo, Powerful Owl, Speckled Warbler, Varied Sittella, New Holland Mouse, Hooded Robin, Diamond Firetail, Grey-headed Flying-fox, Scarlet Robin, Flame Robin, Yellow-bellied Glider, Greater Glider, Gang-gang Cockatoo and Grey-crowned Babbler.	Various	Yes	Demolition / clearing	1.30

Travers bushfire & ecology concludes that in regard to the concept masterplan:

- The study area is located on lands mapped as Biodiversity Values Land but does not impact on biodiversity values mapped land (after relocation of community 4).
- An estimated 1.3 ha of PCT3483 – Central Gorges Box-Red Gum Grassy Forest will be impacted by asset protection zones.
- An estimated 7.49 ha of Pasture/Grassland by the proposed facilities, landscape management and proposed access tracks.
- Native vegetation loss greater than the area clearing threshold of 0.5 ha and triggers entry into the Biodiversity Offset Scheme (BOS).
- The test of significance has concluded a not-significant impact on the relative entities being tested.

The state assessment of significance (Appendix 3) has concluded that the proposed development will not likely have a significant impact on any threatened species, populations or TECs. Therefore, (a) a Species Impact Statement is not required for the proposal.

However, as the proposal is exceeding the 0.5 ha native vegetation clearance threshold, a Biodiversity Development assessment Report will be required for the proposed DA.

Recommendations

The following recommendations pertain to important design and assessment:

- The development is likely to trigger the BOS and cause biodiversity offsetting subject to degree of impact on native vegetation (including native pasture) and avoidance of impacts demonstrated by the design.

- Consolidate facilities to minimise impacts on native pasture and remnant trees.
- A BDAR is required for impacts on native vegetation.
- Native pasture mapping and biometric plots will be required to determine the quality of native pasture and determine whether its calculated vegetation integrity score (VIS) will cause biodiversity offsets.
- Seasonal survey for flora and fauna will need to be undertaken to assess presence or absence of candidate threatened species associated with the PCT's on site.

The following strategies are recommended landscape improvements to support local flora and fauna species:

- Planting of koala foraging trees to enhance the local landscape and to bring Koalas into the landscape such as *Eucalyptus punctata* (Grey Gum), *Eucalyptus tereticornis* (Forest Red Gum) as primary foraging species within and supplementary foraging species *Eucalyptus bosistoana* (Coast Grey Box), *Eucalyptus eugenioides* (Thin-leaved Stringybark).
- Protecting habitat for the rare Mintbush (*Prostanthera rugosa*) and use within landscaping (a propagatable species).
- Planting of *Casuarina cunninghamiana* subsp. *cunninghamiana* (River Oak for Glossy Black-Cockatoo) along drainage lines and in open areas.
- Enrichment of nesting habitat by the augmentation of hollows in existing trees.
- Planting of a diverse range of high value foraging shrub species in landscape beds.

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1. BACKGROUND

Travers bushfire & ecology was engaged to undertake a Biodiversity Assessment Report (BAR) of the proposed eco-tourism DA at Lot 157, 158, 181 & 202 DP 751276, 1551 Joadja Road, Joadja, within Wingecarribee Shire Council local government area (LGA).

The extent of this entire lot is shown in Figure 1-1 below. This lot is subject to a proposed concept plan, entitled Greenstead Valley, and will hereafter be referred to as the 'entire study area.'

The area containing the proposed development, APZs and all associated impact on habitat features is hereafter referred to as the 'development footprint' (Figure 1-1

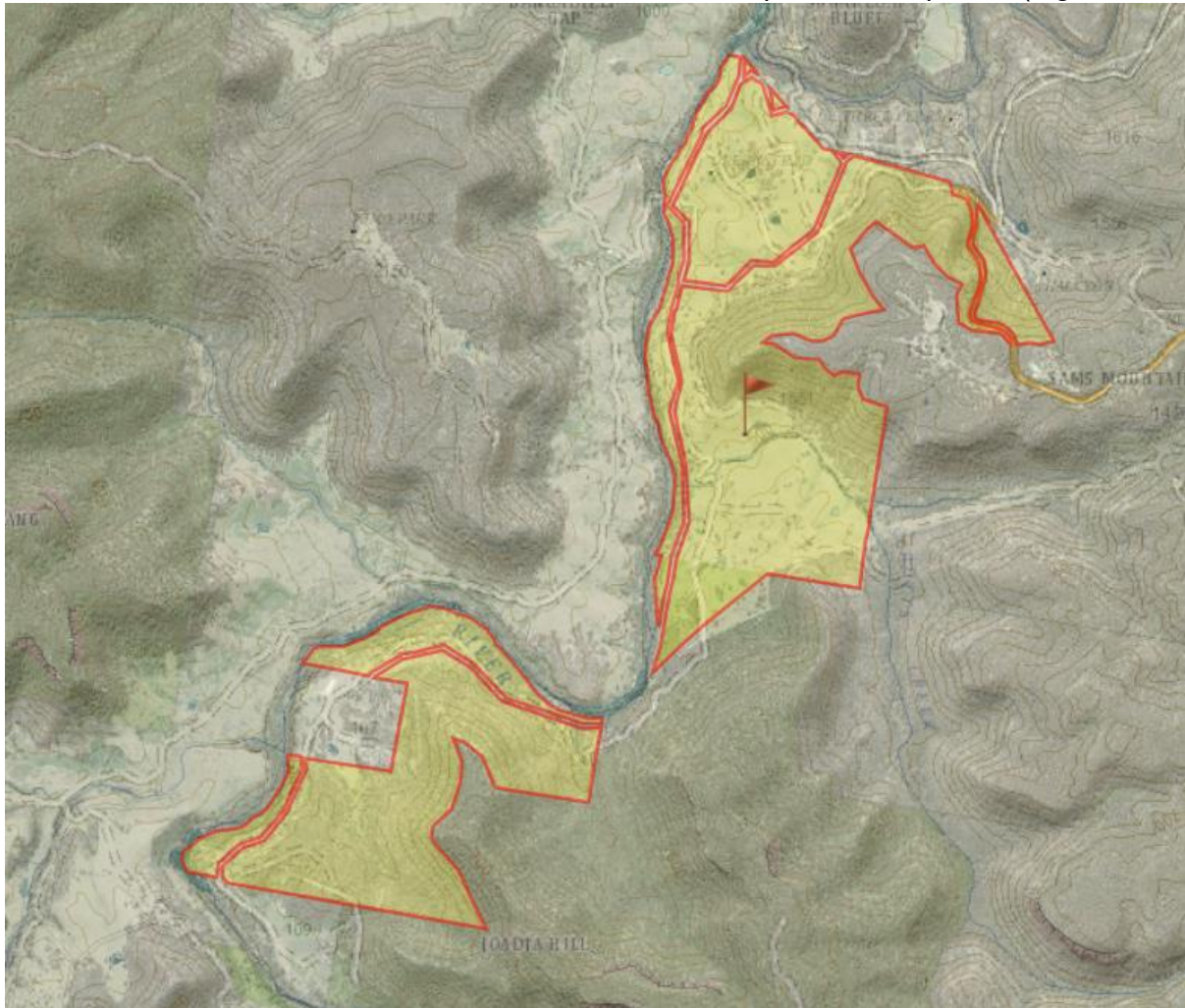


Figure 1-1).

The Concept Masterplan and the stage 1 ecotourism DA potentially trigger the BOS and therefore, *Travers bushfire & ecology* clarifies that this report assesses the likely hood of entering the Biodiversity Offset Scheme. This Biodiversity Assessment is not a Biodiversity Development Assessment Report (BDAR) which is required when a proposal triggers entry into the NSW Biodiversity Offset Scheme (BOS).

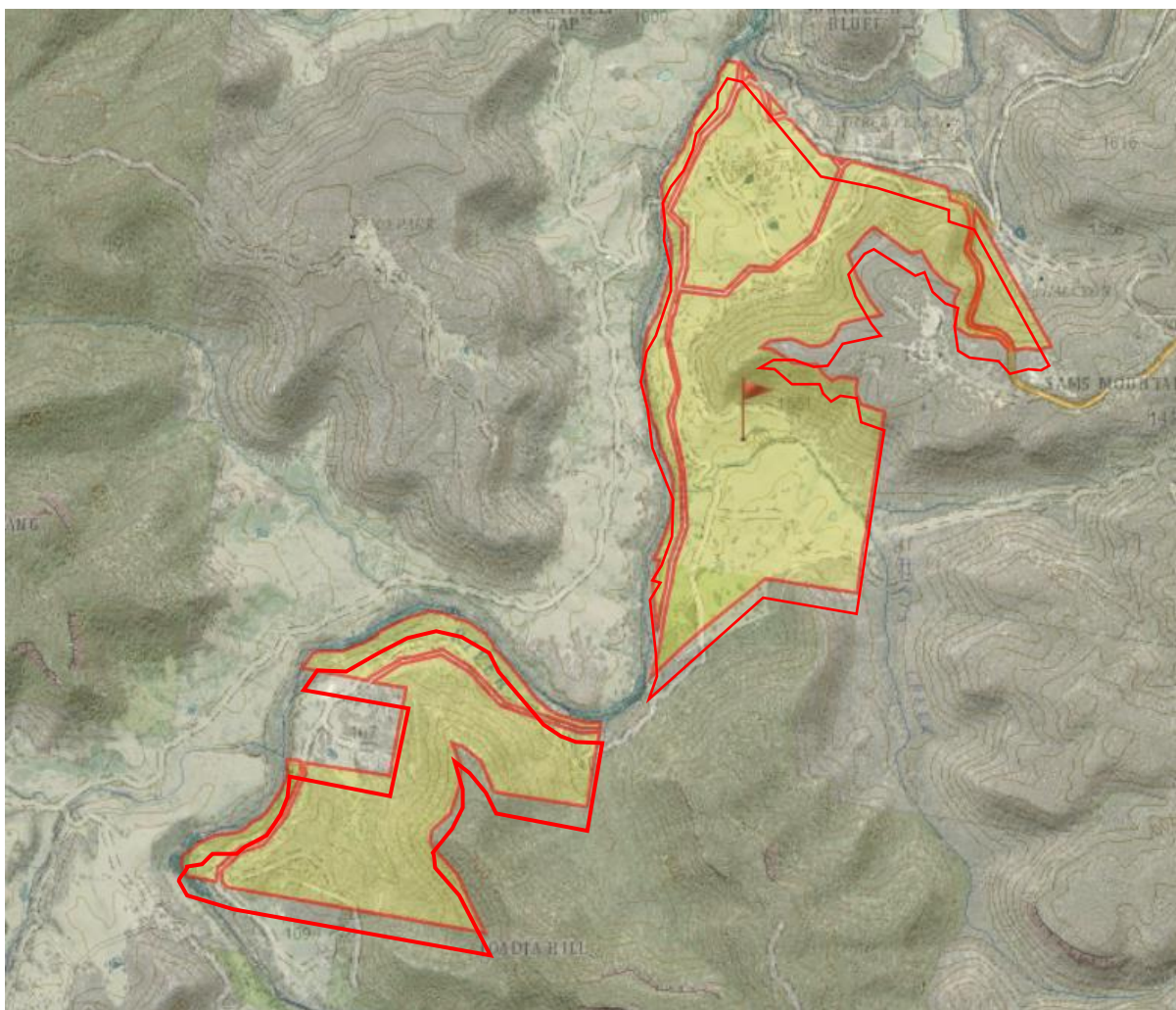


Figure 1-1 – Site location
(Source – SIX Maps 29/12/2023)

1.1 Concept Masterplan and Stage 1 DA

The development proposed is an eco-tourist facility, located at 1551 Joadja Road, Joadja, NSW.

The proposed masterplan of the site includes an arrival village, community 1, 2, 3 and 4 community areas for a larger ecotourism project. Each community is intended to have an appropriate community building as a bushfire refuge and associated communal areas (Figure 1-2).

The concept masterplan layout was prepared to inform the placement of stage 1.

Travers bushfire & ecology notes that the current bushfire protection assessment (*Travers Bushfire & Ecology* 2023) pertains to Stage 1 only. However indicative APZ's have been provided for all stages beyond Stage 1 DA in this Biodiversity Assessment to identify the likelihood of triggering the Biodiversity Offset Scheme (BOS).

We also note that the APZ is the minimum required for the proposed arrival village and refuge buildings in each community. In the context of the landscape management for the proposed ecotourism facilities we expect disturbance and slashing to occur outside the asset protection zones.

The full extent of impacts also includes the outer extent for proposed facilities and any new tracks within the site. The stage 3 and 4 communities have not been designed in detail and consequently the impacts are approximate.

The concept masterplan was prepared on the following basis:

- To demonstrate a connection with the ecological, environmental, and cultural values of the site or area.
- minimise any impact on, and aims to conserve, the natural environment.
- foster an appreciation of the environmental and cultural values of the site or area.
- promote positive environmental outcomes. In particular, the impact on watercourses, soil quality, heritage and native flora and fauna will be minimal.
- maintain (or regenerate where necessary) natural resources and enhancement of the natural environment to ensure its continued protection, and
- promotes measures to remove any threat of serious or irreversible environmental damage.
- provide mechanisms for monitoring and reviewing the effect of the development on the natural environment.

On the whole the concept Masterplan has achieved these outcomes. Stage 1 DA includes further detail including the required asset protection zones and proposed facilities (Figures 1-3 to 1-5).

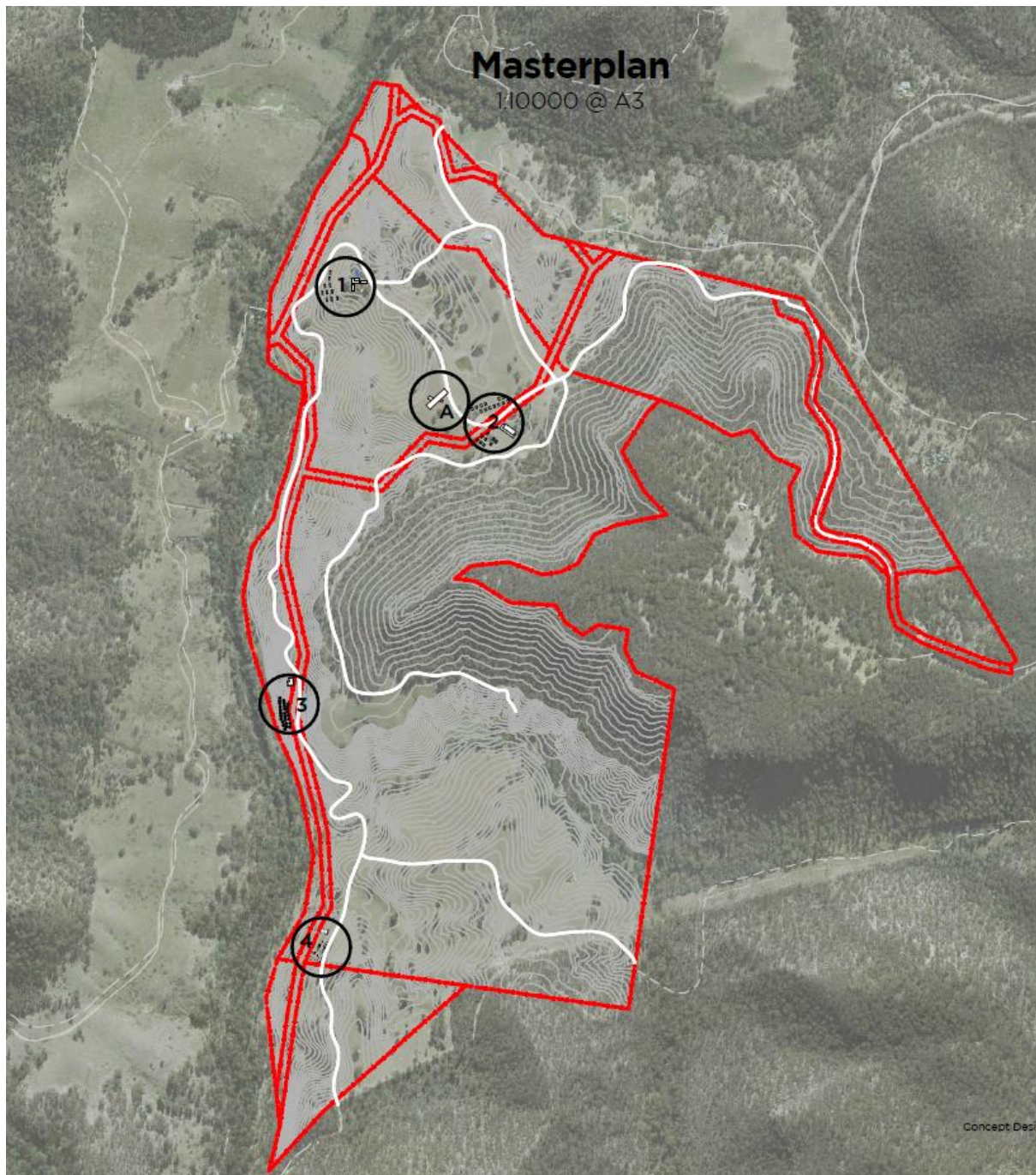


Figure 1-2 – Concept masterplan showing locations of proposed facilities
(Source: Greenstead Valley Concept Design. Revision 1B 08/08/2023)

1.2 Stage 1 DA

A Stage 1 DA is proposed for the facility which includes a variety of community villages, for both short-term stay and day trips.

Stage 1 DA includes:

- The Arrival Village
- Community 1, and
- Community 2.

The proposed inclusions for each area are as follows:

Arrival Village

The provision of an arrival village offering:

- Main entrance building and reception facility,
- 30 car parking bays,
- Three (3) bus bays,
- Turning circle (for emergency vehicles),
- Ten (10) x elevated decking platforms for glamping facilities, and
- Staff accommodation and laundry facilities.

Community 1

- Refurbishment and extension of existing homestead,
- 11 x cabins,
- Turning circle (for emergency vehicles), and
- Outdoor facilities and landscaping.

Community 2

- Building,
- 11 x elevated decking platforms for glamping facilities, and
- Turning circle (for emergency vehicles).

Each community proposes to offer communal areas including dining area, fire pits, toilets, and ablutions. Access to the site will be provided via a single private access road from Joadja Road in the north.

Future stages are expected to offer similar facilities, camp sites and potential use of portable tiny homes in selected locations.

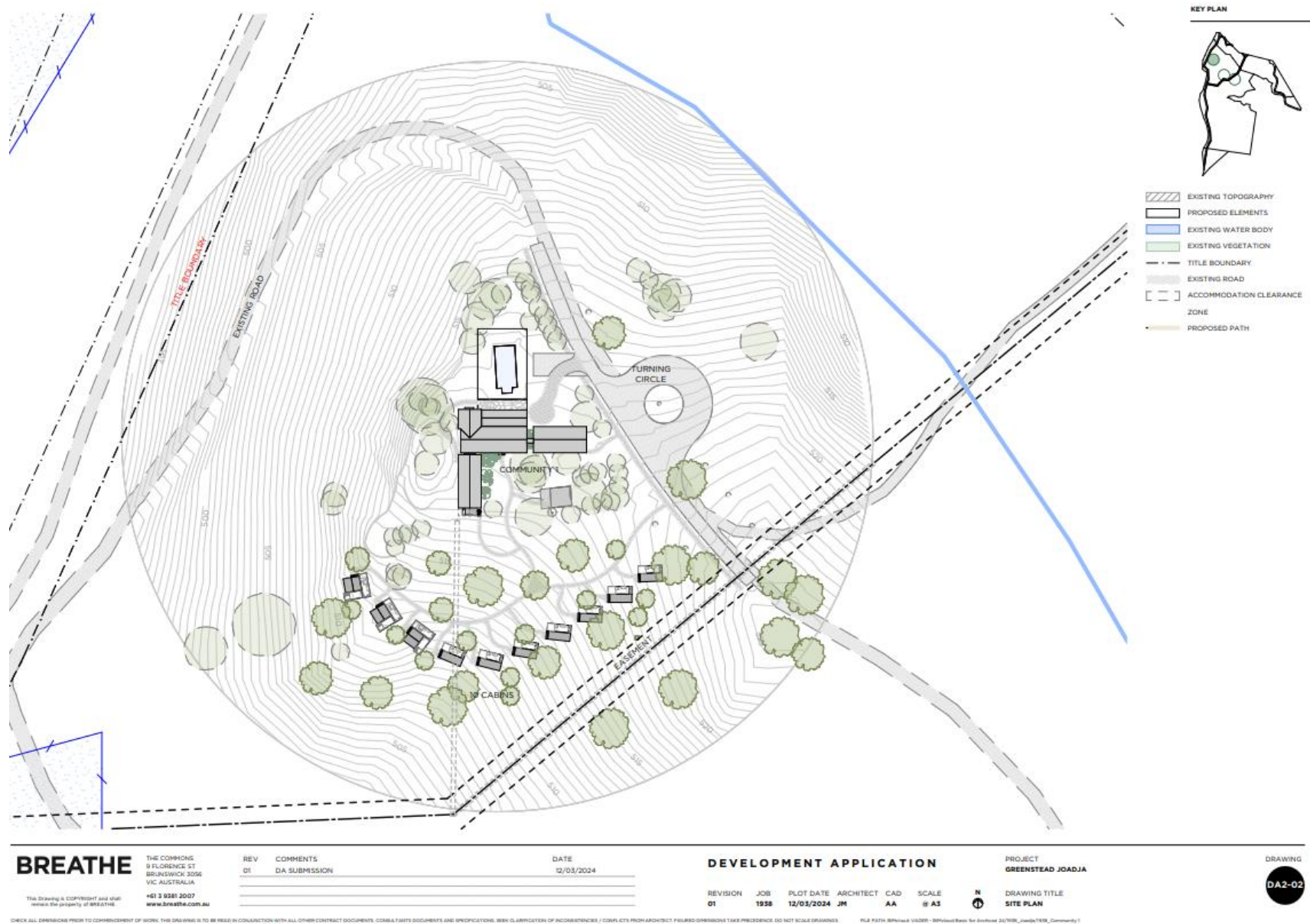
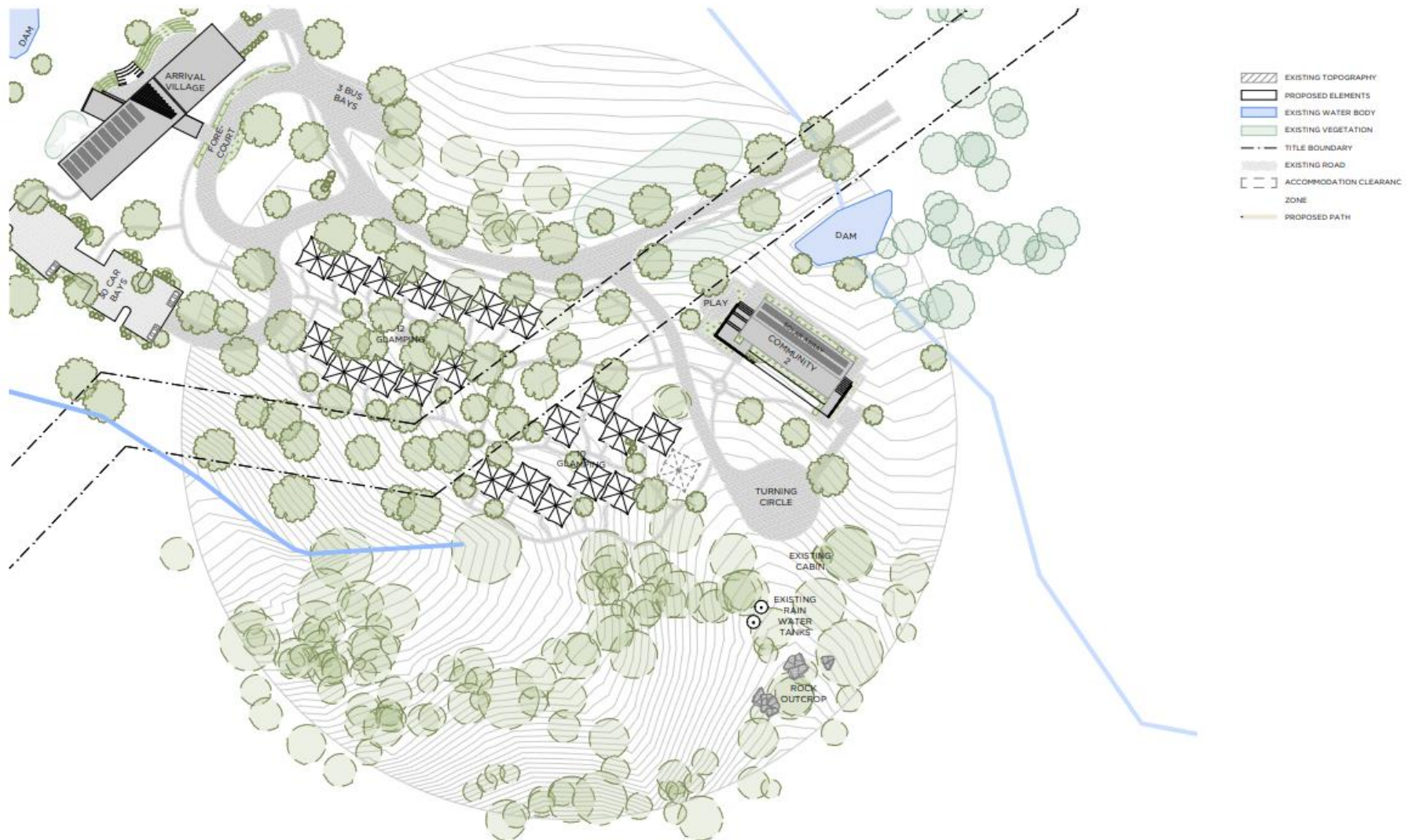


Figure 1-4 – Community 1
(Source: Breathe)



BREATHE

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www.breathe.com.au

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Figure 1-5 – Community 2
(Source: Breathe)

1.3 Site description

Table 1-1 provides a summary of the planning, cadastral, topographical, and disturbance details of the development footprint.

Table 1-1 – Site features

Location	1551 Joadja Road, Joadja, (Lot 157, 158, 181 and 202 DP 751276)
Area	Approximately 324 ha.
Development footprint	As this is a concept plan, the development footprint is not yet finalised.
Local government area	Wingecarribee Shire Council
Zoning	C3 Environmental Management
Grid reference	242654E; 618309N. MGA-56 GDA94.
Elevation	The river flats lie at approximately 490 m AHD, with foot slopes ascending to the eastern boundary up to 650 m AHD.
Topography	The study area comprises a broad (Wingecarribee River) valley with river flats ascending to foothills and lower slopes rising to rocky outcrops and screes with multiple tributaries descending from the slopes including Schott's Creek.
Geology and soils	Geology: The upper slopes are comprised of Hawkesbury Sandstone underlain by Illawarra Coal Measures. Berry Siltstone is exposed on the slopes. The lower slopes and valley floors are comprised of Silurian and Ordovician slate, phyllite and quartzite (GeoScience Australia 2022). Soils: The soils within the study area include the Marulan variant A (myla) associated with the Wingecarribee River and its floodplain. The foothills comprise the Burrawang (bwy) landscape and the Schott's Creek floodplain is identified as Martin's Flat variant B. (eSpade 2022).
Catchment, drainage, and stream order	The planning area lies within the catchment of the Wingecarribee River, which is part of the catchment for Lake Burragorang. The study area hosts a series of arterial creeks and stream orders including Schott's Creek and Joadja Creek which drain into the Wingecarribee River.
Existing land use	The current land use is rural/residential with an existing homestead, shed, riverside cottage and cattle yards.
Connectivity features	There is extensive connectivity along the Wingecarribee River to adjoining National Parks. The riparian zones along streams provide connectivity to the river. The valley floor and lower slopes have stands of remnant trees scattered among the grassy paddocks. These stands provide 'steppingstones' to the riparian corridors and adjacent bushland.

The site is currently zoned C3 Environmental Management (Wingecarribee LEP 2010) (Figure 1-6). Objectives of this zone include protection, management, and restoration of areas with special ecological, scientific, cultural, or aesthetic values and to provide for a limited range of development that does not adversely effect on those values.

2. FLORA

2.1 Flora survey

A botanical survey was undertaken for constraints mapping on 13 and 14 January 2022, over a time frame of approximately 10 hours to confirm the vegetation communities for constraints planning. The plots undertaken for constraints planning were rapid assessment plots.

A targeted second search was conducted on 5 October 2023, specifically within the estimated footprints of the Arrival Centre, Community 1, and Community 2.

The botanical survey included a random meander in accordance with Cropper (1993) to gain a species list of the plants within selected parts of the site, and then 17 rapid data points were undertaken to understand the dominant species, focusing mainly in the areas where the concept design has proposed community hubs and the arrival village. A review of the BioNet Atlas of NSW Wildlife (DPIE 2022) was undertaken prior to the site visit to determine threatened species previously recorded within 10 km of the site, and relevant target searches were undertaken as suited.

All naturally occurring species were identified to species level where possible and are listed in Appendix 1.

2.2 Vegetation communities

The entire study area is situated on the low hills, rises and gullies of the Wingecarribee River catchment. The NSW State Vegetation Type Mapping (SVTM 2023) recently updated mapping across the state.

The following Plant Community Types (PCTs) were mapped, at a regional scale, across the site as follows (Figure 2-1):

- PCT 3110 - Greater Sydney Enriched Grey Myrtle Dry Rainforest
- PCT 3228 - Wollondilly-Shoalhaven Siltstones Sheltered Forest
- PCT 3304 - Southern Tableland Swamp Flats Shrub Woodland
- PCT 3347 - Southern Tableland Creekflat Ribbon Gum Forest
- PCT 3483 - Central Gorges Box-Red Gum Grassy Forest
- PCT 3493 - Southern Highlands Red Gum Forest
- PCT 3498 - Wingecarribee Gorges Stringybark-Grey Gum Forest
- PCT 3643 - Bungonia Tableland Silvertop Ash-Stringybark Forest
- PCT 3738 - Goulburn-Lithgow Tableland Hills Grassy Forest
- PCT 3746 - Southern Tableland Snow Gum-Candlebark Shrub Forest
- PCT 4063 – Central and Southern Tableland River Oak Forest

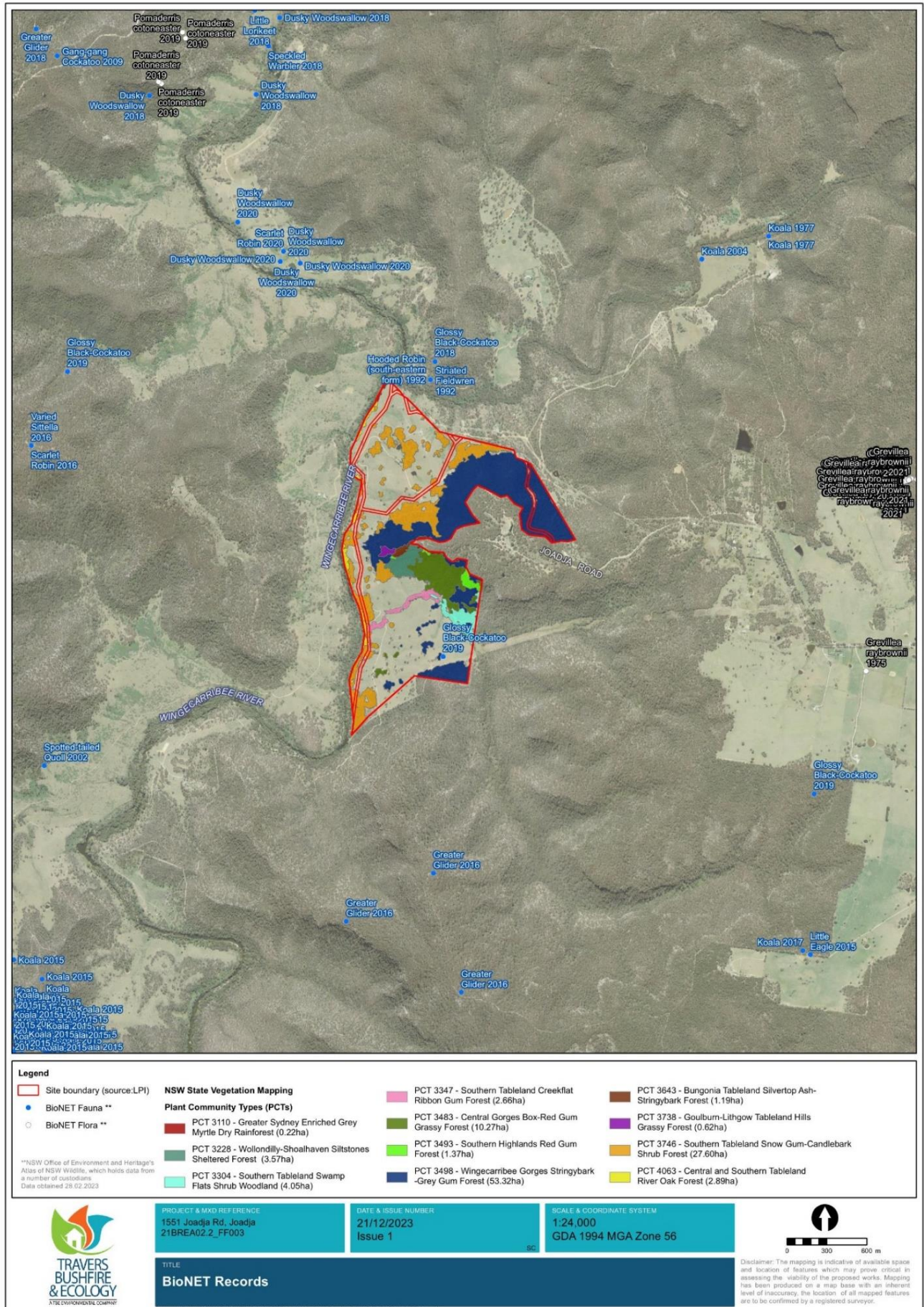


Figure 2-1 - DPE mapping and Bionet records

Following on-ground flora surveys for the Biodiversity Constraints Report (TBE 2022) and updated following field survey for this BAR, four vegetation types were identified across the entire study area (Figure 2-2), as follows:

- PCT3483 – Central Gorges Box-Red Gum Grassy Forest.
- PCT3498 – Wingecarribee Gorges Stringybark – Grey Gum Forest.
- PCT4063 – Central and Southern Tableland River Oak Forest.
- Cleared Paddocks, and
- Exotic planted vegetation.

Table 2-1 summarises the observed vegetation communities confirmed during field survey and does not represent the full extent of native vegetation within the site. The majority of the cleared lands contain native/exotic pastures and subject to the preparation of a BDAR will potentially contribute to any required biodiversity offset requirements. The representative PCT of the native grassland has not been determined but will be required for a Biodiversity Development Assessment Report.

Table 2-1 – Mapped Plant Community types (PCT's) within the site from NSW State Vegetation Mapping

Community	Location within site and condition	Area (ha)
PCT 3110 - Greater Sydney Enriched Grey Myrtle Dry Rainforest	Central sheltered gully	0.22ha
PCT 3228 - Wollondilly-Shoalhaven Siltstones Sheltered Forest	Eastern portion of site southern aspect of ridgelines	3.57ha
PCT 3304 - Southern Tableland Swamp Flats Shrub Woodland	Eastern portion of site on western flats and slopes	4.05ha
PCT 3347 - Southern Tableland Creekflat Ribbon Gum Forest	Centrally in site along a drainage line	2.66ha
PCT 3483 - Central Gorges Box-Red Gum Grassy Forest	Centrally south western slopes	10.27ha
PCT 3493 - Southern Highlands Red Gum Forest	Central East below escarpment edge south western aspect	1.37ha
PCT 3498 - Wingecarribee Gorges Stringybark-Grey Gum Forest	Low hills of the eastern slopes	53.32ha
PCT 3643 - Bungonia Tableland Silvertop Ash-Stringybark Forest	Central and western north facing slopes	1.19ha
PCT 3738 - Goulburn-Lithgow Tableland Hills Grassy Forest	Central lower slopes	0.62ha
PCT 3746 - Southern Tableland Snow Gum-Candlebark Shrub Forest	Low lying lands through the cleared paddocks and lower slopes	(27.60ha)
PCT 4063 – Central and Southern Tableland River Oak Forest	Riparian corridor of the Wingecarribee River	2.89ha
Total area of mapped native vegetation		107.76 ha
Cleared and grazed paddocks		216 ha
Total area of the site		324 ha

The site includes approximately 108 ha of fully vegetated remnant bushland within the site and has not been fully surveyed as part of this Biodiversity Assessment Report. We note that the confirmed vegetation extent on site has not verified the total area of cleared lands which is likely to be larger than what the NSW State Vegetation Mapping indicates.

We note that as part of our ground truthing PCT 4063 – Central and Southern Tableland River Oak Forest has been mapped extensively along the riparian corridor (21.22ha). In addition, PCT 3483 Central Gorges Box-Red Gum Grassy Forest is more widely found on site (19.22ha). Whilst these differences exist, we have not attempted to verify the full extent of native vegetation on the sites propose works and limited impacts.

2.3 Description of vegetation communities observed in the study area

2.3.1 PCT3483 – Central Gorges Box-Red Gum Grassy Forest

PCT3483 – Central Gorges Box-Red Gum Grassy Forest describes the majority of the native vegetation in the study area.



Photo 1 – PCT3483 – Central Gorges Box-Red Gum Grassy Forest (Photo: D. Warman)

This vegetation community describes most of the study area observed on 5 October 2023. The dominance of *Eucalyptus tereticornis* (flowering during the survey period and therefore, able to be identified) was indicative of a different PCT than that mapped (SVTM 2023).

In its natural state, PCT3483 is described as a tall sclerophyll woodland to open forest with a mid-stratum of soft-leaved shrubs, small trees, and a ground cover of grasses and graminoids. Dominant species typically include a canopy of *E. tereticornis* and one Box species such as *E. melliodora*. A sparse mid-stratum of shrubs may include *Acacia implexa*, *Olearia viscidula* and *Bursaria spinosa*. Groundcovers typically include *Lomandra longifolia*, *Gahnia aspera* and *Microlaena stipoides* among many other graminoids and grasses (BioNet Vegetation 2023).

The vegetation across the area, designated as Arrival Village, Community 1, and Community 2 (Photo 1), is disturbed variations of this community. Most of the terrain is rocky outcrops or former gullies that have been historically cleared and grazed, although scattered trees remain,

and in some areas where grazing has been omitted, pioneer shrub species dominate the mid-stratum. On 5 October 2023, the following species were identified across the study area:

Canopy: *Eucalyptus tereticornis*, *E. beyeriana*, *E. cinerea* and *E. macrorhyncha*.

Mid-storey: *Acacia deanei* subsp. *paucijuga*, *Bursaria spinosa*, *Cassinia longifolia*, *Lissanthe strigosa*, *Olearia viscidula* and *Solanum linearifolium*.

Ground layer: *Dichondra repens*, *Microlaena stipoides* var. *stipoides* and *Xerochrysum bracteatum*

Of note, was one rare endemic Mintbush (*Prostanthera rugosa* - Photo 2) located among dense shrubs. While not listed as a threatened species, is thought to be restricted to the Moss Vale district and warrants protection. (RDP1, 2, 3, 4, 5, 15, 16 and 17 fit the following description).



Photo 2 - Mintbush (*Prostanthera rugosa*)

PCT3498 – Wingecarribee Gorges Stringybark-Grey Gum Forest



Photo 3 - PCT3498 - Wingecarribee Gorges Stringybark-Grey Gum Forest

This vegetation is described as a tall dry shrubby sclerophyll open forest restricted to the western margins of the Southern Highlands. This PCT is associated with colluvial gorge slopes on exposed aspects, with loose mixed soils derived from Illawarra Coal Measures sediments and talus from overlying Hawkesbury Sandstone. The tree canopy very frequently includes *Eucalyptus punctata* and commonly *Eucalyptus globoidea*. A sparse to mid-dense shrub layer very frequently includes *Olearia viscidula* and *Persoonia linearis*, commonly also with *Hibbertia obtusifolia*, *Lissanthe strigosa* and *Exocarpos strictus*, and occasionally *Leucopogon lanceolatus* or *Brachyloma daphnoides*. The sparse ground layer very frequently includes *Goodenia hederacea*, *Pomax umbellata*, *Microlaena stipoides* and *Billardiera scandens*, commonly with *Entolasia stricta*, *Lomandra longifolia*, *Lomandra multiflora* subsp. *multiflora*, *Dianella revoluta*, *Lomandra glauca*, *Hardenbergia violacea* and *Oxalis perennans*, and occasionally *Cheilanthes sieberi* subsp. *sieberi* or *Phyllanthus hirtellus*. (BioNet Vegetation).

The vegetation mapped as this unit was on the footslopes of the eastern boundary.

Canopy: Dominated by Grey Gum (*Eucalyptus punctata*) Forest Red Gum (*E. tereticornis*) and Narrow-leaved Stringybark (*E. eugenioides*).

Mid-storey: Native shrubs include *Bursaria spinosa*, *Cassinia longifolia*, *Olearia viscidula* and native *Solanum* sp.

Ground layer: Native Grasses including *Austrostipa* sp., *Microlaena stipoides* var. *stipoides*, *Rytidosperma* sp. and native daisy species including Golden Everlasting (*Xerochrysum bracteatum*).

2.3.2 PCT 4063 – Central and Southern Tableland River Oak Forest



Photo 4 – Central and Southern Tableland River Oak Forest

This vegetation community is associated with the Wingecarribee River and its low-lying tributaries. The density and diversity of shrubs and groundcover was dependent on impact of streamflows and water level.

This vegetation community is described as a tall, dense to open grassy riparian open forest on alluvium on swift-flowing streams of gorges and hilly country of the Central Tablelands. This community occurs at elevations of 400-800 meters asl with mean annual rainfall of 650-850 mm. It is characterised by a canopy of *Casuarina cunninghamiana* subsp. *cunninghamiana*, and a patchy shrub layer that may include occasional *Bursaria spinosa*, *Melicytus dentatus* or *Acacia dealbata*. The predominantly grassy ground layer is almost always dominated by *Microlaena stipoides* and *Lomandra longifolia*, frequently with grasses *Poa labillardierei* var. *labillardierei*, *Echinopogon ovatus* and *Rytidosperma racemosum*, and *Carex appressa*. Other ground layer species include ferns *Asplenium flabellifolium*, *Adiantum aethiopicum*, *Pellaea falcata* and *Pteridium esculentum*, and soft-leaved forbs *Dichondra repens*, *Urtica incisa*, *Acaena novae-zelandiae*, *Hydrocotyle laxiflora*, *Rumex brownii*, *Geranium solanderi* and *Senecio quadridentatus*. It is not associated with a threatened ecological community (TEC) (BioNet Vegetation).

Canopy: *Casuarina cunninghamia* subsp. *cunninghamiana*, with occasional scattered River Peppermint (*Eucalyptus elata*), for example, near the river's convergence with Schott's Creek. Red Stringybark (*Eucalyptus macrorhyncha*) was also found to occur occasionally on the edge of the floodplain.

Mid-storey: *Bursaria spinosa*, *Callistemon subulatus*, *Lomatia myricoides* and *Melicytus dentatus*.

Ground cover: *Einadia hastata*, *Geranium* sp., *Lomandra longifolia*, *Microlaena stipoides* var. *stipoides*, *Oplismenus aemulus* and *Persicaria hydropiper*.

2.3.3 Cleared paddocks



Photo 5 - Cleared land/pasture

This vegetation community describes most of the study area coinciding with the cleared valley floor and undulations to the foothills of the adjacent escarpment. This vegetation was mostly cleared with a remnant canopy that was mainly open, with remnant stands of native trees and scattered isolated trees. Prior to clearing it may have been aligned with PCT3483, however, given the historical use of the cleared land for pasture it is now defined as Cleared Paddocks, for the purpose of this BAR. The ground layer consisted of both native and exotic pasture grasses and native and exotic herbs and forbs.

Canopy: *Eucalyptus cinerea* and *Eucalyptus tereticornis*.

Mid-storey: mostly absent.

Ground cover: *Microlaena stipoides*, *Themeda triandra* and paddock weeds including Yellow Burr-Daisy (*Calotis lappulacea*), the Mulleins (*Verbascum thapsus* and *V. virgatum*) and Purple-top (*Verbena bonariensis*).

2.3.4 Exotic planted vegetation

This vegetation surrounds the house site as exotic gardens. There is a patch of remnant native trees at the rear of the house.



Photo 6 – Managed area/exotic landscape



Photo 7 - Benched gardens

The following lists native species within the house site. However, the majority of plantings are exotic, e.g., Japanese Maple, *Pinus* sp., *Agapanthus praecox*, Liquid Amber, Poplar and *Wisteria* sp.

Canopy: *Eucalyptus beyeriana*, *E. cinerea*, *E. macrorhyncha*.

Mid-storey: *Acacia deanei* subsp. *paucijuga*, *Notelaea neglecta*.

Groundcover: *Themeda triandra*.



2.4 Threatened flora species

BC Act – A search of the *BioNet Atlas of NSW Wildlife* (DPIE, 2022) indicated a list of threatened flora recorded within a 10 km radius of the development footprint. These species are listed in Table (Appendix 2) and are assessed for potential habitat within the development footprint.

EPBC Act – A review of the schedules of the *EPBC Act* indicated the potential for a list of threatened flora species to occur within a 10 km radius of the site. These species are also listed in Table (Appendix 2) and are assessed for potential habitat within the development footprint.

In determining the likelihood of threatened flora with suitable habitat present, *BioNet Atlas of NSW Wildlife records* (BioNet 2023) were searched for, along with the Commonwealth Protected Matters Search Tool (PMST 2023) and BioNet Vegetation (2023) data on each PCT, once mapped. While considering whether threatened flora species may occur, the decision was made to include species that would likely occur within the proposed Stage 1 area (Arrival Village, Community 1, and Community 2). Therefore, based on the habitat assessment within Table (Appendix 2) it is considered that the development footprint of Arrival Area, Community 1 and Community 2 provides potential habitat for the following threatened flora species.

Table 2-2 – Threatened flora species with suitable habitat present

Scientific name	BC Act	EPBC Act	Potential to occur
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	-	E	Possible
<i>Solanum armourense</i>	E	-	Possible

2.5 Endangered flora populations

One (1) endangered flora population occurs within the Wingecarribee Shire Council LGA:

- *Eucalyptus aggregata* in the Wingecarribee local government area.

The threatened species profile database (*BioNet*) indicates that three sub populations, comprising less than 100 plants in total, are located in Berrima, Medway, and Sutton Forest. It also provides a list of surrogate PCTs that the endangered population is typically associated with. These include PCTs within waterbodies, rivers, lakes, and streams. *Eucalyptus aggregata* is not included in the species complex of PCT3483, where the Arrival Centre, Community Area 1 and 2 overlap.

2.6 Threatened ecological communities

The following plant community types recorded in the broader study area are associated with the following listed TEC's under the BC Act and the EPBC Act.

- PCT3493 - Southern Highlands Red Gum Forest is associated with the EPBC Listed TEC - *Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion*.
- PCT3328 Wollondilly-Shoalhaven Siltstones Sheltered Forest is associated with the BC Act listed TEC - *Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions*, and *River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* and EPBC Act Listed TEC - *River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria*.

There were three (3) threatened ecological communities listed under the EPBC Act 1999 (DCCEEW 2023) in a radius of 10 km of the study area. These are as follows:

- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland*,
- *Natural Temperate Grassland of the Southeastern Highlands*, and
- *Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion*.

None of the above TEC's are affected by the proposed Masterplan. The most impacted community PCT 3746 - Southern Tableland Snow Gum-Candlebark Shrub Forest is not associated with any of the listed BC Act or EPBC Act Listed TEC's.

2.7 SEPP (Vegetation in Non-Rural Areas) 2017

The State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017 (Vegetation SEPP) was one of a suite of Land Management and Biodiversity Conservation (LMBC) reforms that commenced in New South Wales on 25 August 2017. The Vegetation SEPP (the SEPP) works together with the *BC Act* and the *Local Land Services Amendment Act 2016* to create a framework for the regulation of clearing of native vegetation in NSW.

As 'development consent' is required for the proposed works the Vegetation SEPP does not apply.

3. FAUNA

3.1 Survey / Habitat assessment

Fauna survey including afternoon/morning diurnal survey, nocturnal survey and threatened species habitat assessment was undertaken within the subject site and nearby surrounds on 13th & 14th January 2022.

Diurnal fauna survey included:

- Frog and reptile habitat searches,
- 5x bird census points (out to a radius of 30-50m for 15 minutes),
- Opportunistic bird call and activity survey between census points,
- Mammal activity searches (scats, scratches, diggings, burrows, etc.),
- Surveillance camera survey (2x baited stations), and
- Opportunistic habitat tree survey.

Significant habitat trees are defined as trees containing large hollows suitable for owls/cockatoos and/or two or more good quality medium hollows and/or several small hollows and/or a tree showing notable use by a threatened species (e.g., sap feed tree, raptor nest tree, microbat roost, etc.).

Weather conditions at the time of diurnal survey were 8/8 cloud, 22km/h NNE wind, 0.4mm rain, 17-27°C between 8:30 – 14:30.

Nocturnal fauna survey included:

- Spotlighting,
- Frog call identification, and
- Ultrasonic microbat recording (x2 passive recording stations).

Weather conditions at the time of nocturnal survey were 8/8 cloud, 15km/h NE wind, 2.6ml rain, 2/4 moon, 16.9°C between 18:45 – 21:45.

Specific survey effort locations and results are shown on Figure 2-2. All fauna species recorded during survey within the development footprint and nearby surrounds are listed in Appendix 2.

A review of the *BioNet Atlas of NSW Wildlife* (DPIE 2022) was undertaken prior to the site visit to determine threatened species previously recorded within 10 km of the development footprint.

3.2 Habitat features

The following notable habitat features were observed present:

- Year-round nectar producing tree species, principally *Eucalyptus* sp.
- Seed producing *Allocasuarina* sp. and *Casuarina* sp. trees.
- Fruit producing trees.
- Dead wood.
- Ephemeral drainage line with sandstone terracing in upper reaches.
- Dense mid and upper-storey foliage areas.

- Aquatic freshwater habitats.
- Habitat trees provide small hollows.
- Grassland, and
- Sandstone caves.

Hollow-bearing trees were not surveyed during the fauna survey. Hollow-bearing trees observed during opportunistic survey were found to contain good quality small to medium hollows. None of these hollows are considered suitable for threatened large forest owls or cockatoos however, without further in-depth survey over the entire site it cannot be determined that large hollows suitable for the abovementioned species are absent.

The hollows noted through survey may however be suitable for hollow-dependent threatened species with considered potential to occur including Southern Myotis, Eastern False Pipistrelle, Greater Broad-nosed Bat, Yellow-bellied Sheath-tailed Bat and Squirrel Glider. Of these species one the Southern Myotis was recorded during survey however, without further survey during warmer temperatures and variable locations across the study site additional species may be detected. With this in consideration, such hollows may be utilised for roosting and breeding. Therefore, we recommend retention of hollows where possible within the development landscape.

3.3 Threatened fauna species

BC Act – A search of the *BioNet Atlas of NSW Wildlife* (DPE, 2023) provided a list of threatened fauna species previously recorded within a 10km radius of the development footprint. These species are listed in Appendix 2 and are considered for potential habitat within the study area.

EPBC Act – A review of the schedules of the *EPBC Act* identified a list of threatened fauna species or species habitat likely to occur within a 10 km radius of the development footprint. These species have also been listed in Appendix 2.

In accordance with Appendix 2 the following state and nationally listed threatened fauna species are considered to have suitable habitat with varying potential to occur within the study area.

Table 3-1 – Threatened fauna species with suitable habitat present

Common name	BC Act	EPBC Act	Potential to occur
Dusky Woodswallow	V	-	recorded
Large Bent-winged Bat	V	-	recorded
Southern Myotis	V	-	recorded
Greater Broad-nosed Bat	V	-	high
Large-eared Pied Bat	V	V	high
Eastern False Pipistrelle	V	-	high
Glossy Black-Cockatoo	V	-	high
Powerful Owl	V	-	high
Speckled Warbler	V	-	high
Varied Sittella	V	-	high
New Holland Mouse	-	V	high

Common name	BC Act	EPBC Act	Potential to occur
Hooded Robin	V	-	high
Diamond Firetail	V	-	high
Grey-headed Flying-fox	V	V	high
Scarlet Robin	V	-	moderate
Flame Robin	V	-	moderate
Yellow-bellied Glider	V	-	moderate
Greater Glider	-	V	moderate
Gang-gang Cockatoo	V	-	moderate
Grey-crowned Babbler	V	-	moderate

3.4 Fisheries Management Act (FM Act)

Habitat suitable for threatened aquatic species was observed within the entire study area and as such the provisions of this Act may require further consideration in further stages. However, Stage 1 of the development footprint (Arrival Area, Community 1, and Community 2) will not impact on the Wingecaribee River or its floodplain.

3.5 Protected migratory species (National)

The *EPBC Act* Protected Matters Report provides additionally listed terrestrial, wetland, and marine migratory species of national significance likely to occur, or with habitat for these species likely to occur, within a 10 km radius of the development footprint. The habitat potential of migratory species is considered in Appendix 2. The habitat potential of threatened migratory species is considered with other threatened species in Table Appendix 2.

3.6 Endangered fauna populations

There are no endangered fauna populations within Wingecaribee Shire Council.

3.7 State Environmental Planning Policy (Biodiversity and Conservation) 2021 – Koala Habitat Protection

Chapter 4 of State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Koala Habitat Protection) applies to land within LGAs listed under Schedule 2 of the Policy. As the study area falls under the Wingecaribee LGA, it is considered that Koala SEPP 2021 applies to this development proposal.

Land to which this policy applies in accordance with Section 4.4 of the SEPP 2021 is as follows:

(1) *This Chapter applies to each local government area listed in Schedule 2.*

- (2) *The whole of each local government area is—*
- (a) *in the koala management area specified in Schedule 2 opposite the local government area, or*
 - (b) *if more than 1 koala management area is specified, in each of those koala management areas.*
- (1) *Despite subsection (1), this Chapter does not apply to—*
- (a) *land dedicated or reserved under the [National Parks and Wildlife Act 1974](#), or acquired under Part 11 of that Act, or*
 - (b) *land dedicated under the [Forestry Act 2012](#) as a State forest or a flora reserve, or*
 - (c) *land on which biodiversity certification has been conferred, and is in force, under Part 8 of the [Biodiversity Conservation Act 2016](#), or*
 - (d) *land in the following land use zones, or an equivalent land use zone, unless the zone is in a local government area marked with an * in Schedule 2—*
 - (i) *Zone RU1 Primary Production,*
 - (ii) *Zone RU2 Rural Landscape,*
 - (iii) *Zone RU3 Forestry.*

The land is listed in Schedule 1 Wingecarribee LGA and is zoned E3 therefore SEPP 2021 applies. Please Note that SEPP 2020 applies in lands zoned as RU1, RU2 and RU3 in accordance with SEPP 2020.

There is currently no approved Koala Plan of Management (KPoM) for the LGA that this site is located in. Therefore, before council may grant consent to a development application for consent to carry out development on the land, the council must assess whether the development is likely to have any impact on Koalas or Koala habitat.

If the council is satisfied that the development is likely to have low or no impact on koalas or Koala habitat, the council may grant consent to the development application. If the council is satisfied that the development is likely to have a higher level of impact on Koalas or Koala habitat, the council must, in deciding whether to grant consent to the development application, take into account a koala assessment report for the development.

As of December 2023, the nearest Koala record to the study area was a rehabilitation record in 2017, approximately 2.5 km southeast of site. Within a 10 km radius, Koala populations are significant with 1,393 observations of Koala, with the highest concentration of records within the Bangadilly National Park to the southeast. These Koala observations can be viewed below in Figure 3-1. To the west of the study area, the Guula Ngurra NP was recently established to protect vital koala habitat. Guula Ngarra means 'koala country' in the Gundungurra language. (NPWS 2022).

Under Schedule 2 of SEPP 2021, Wingecarribee falls within the Central and Southern Tablelands Koala Management Area. At a minimum, five (5) tree species were recorded in the study area which are considered to be Koala use tree species within this Management Area under Schedule 2 of SEPP 2021. These species are *Eucalyptus bosistoana*, *E. eugenioides*, *E. macrorhyncha*, *E. punctata* and *E. tereticornis*.

It is considered that this study area does not comprise Core Koala Habitat as there has been significant clearing within the site in which the works are proposed. Native vegetation within the study area is likely utilised by Koalas moving through the landscape between core habitats.

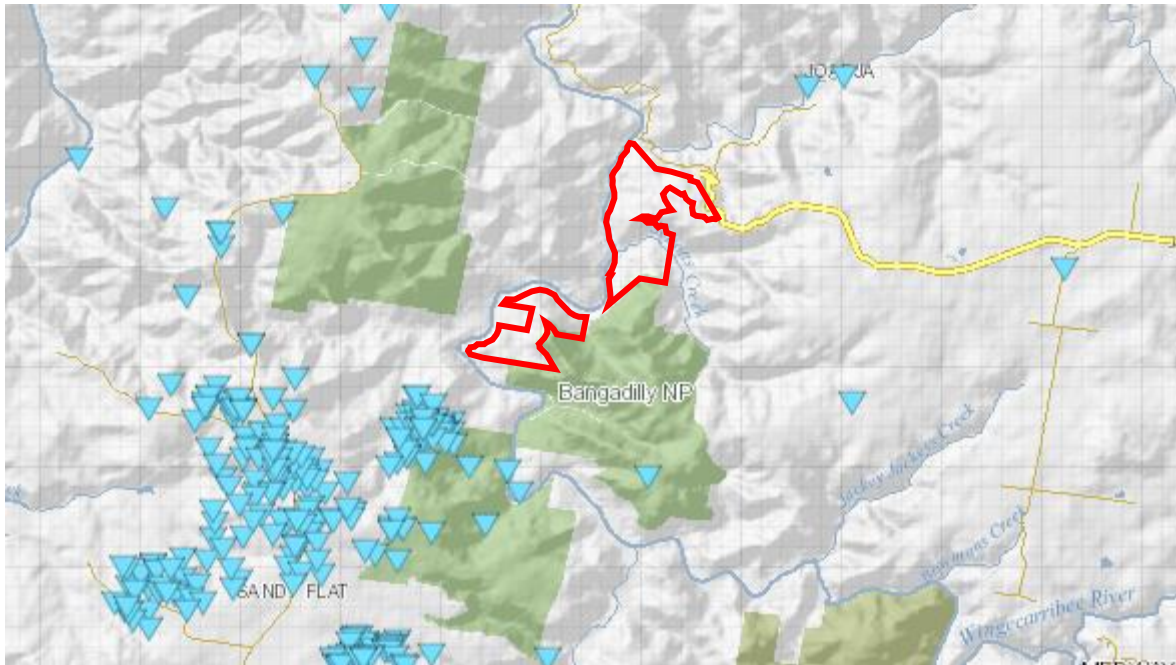


Figure 3-1 – Observations of Koala within a 10km radius
(Source: BioNet 2023)

3.8 Connectivity

Connectivity is considered in the context of linkages in the landscape to aid in the dispersal of biodiversity. Ecological connectivity is defined by IUCN (2020), as:

“Movement of populations, individuals, genes, gametes and propagules between populations, communities and ecosystems, as well as that of non-living material from one location to another”.

The western boundary of the study area encapsulates the riparian corridor of Wingecarribee River. The riparian zone is the area directly influenced by a river, creek, watercourse, or drainage line. The Wingecarribee River riparian corridor links core habitat between Joadja Nature Reserve (NR), Guula Ngurra National Park (NP) and Bangadilly NP (Figure 3-2) and is surrounded by contiguous bushland in all directions outside of the development footprint. These nature reserves and national parks are identified as important habitat for a number of threatened flora and fauna, including the endangered Glossy Black Cockatoo (*Calyptorhynchus lathami*) and Koala (*Phascolarctos cinereus*).

The proposed concept plan (Figure 1-2) includes primary and secondary order streams where riparian linkages are also enabled between the upper gorge habitat, wetland habitat associated with small dams, and the river flats. The Schott’s Creek primary and secondary order riparian corridors link important gorge habitat along its riparian corridor to the Wingecarribee River (Figure 4-2). however, this area is not included in Stage 1.

Beyond the riparian corridors, connectivity is limited across the cleared pastured landscapes with clumps of trees providing stepping stones for aerial fauna.

The proposed concept plan (Figure 1-2) is not part of any registered significant or regional important habitat corridor.

The connective vegetation primarily provides passage for arboreal mammals, bird species and foraging habitat for microbat species. The proposal will minimally reduce within-site connectivity

but will not significantly impact on existing connectivity N–S along the riparian area as the vegetation within Stage 1 is not included in the riparian corridor. The conceptual development footprint does not impact on riparian corridors and maintains its function as a connective passage between primary corridors, nor does it impede the functionality of the primary corridors' connective value.

The study areas' contribution to local connectivity is shown in Figure 3-2.

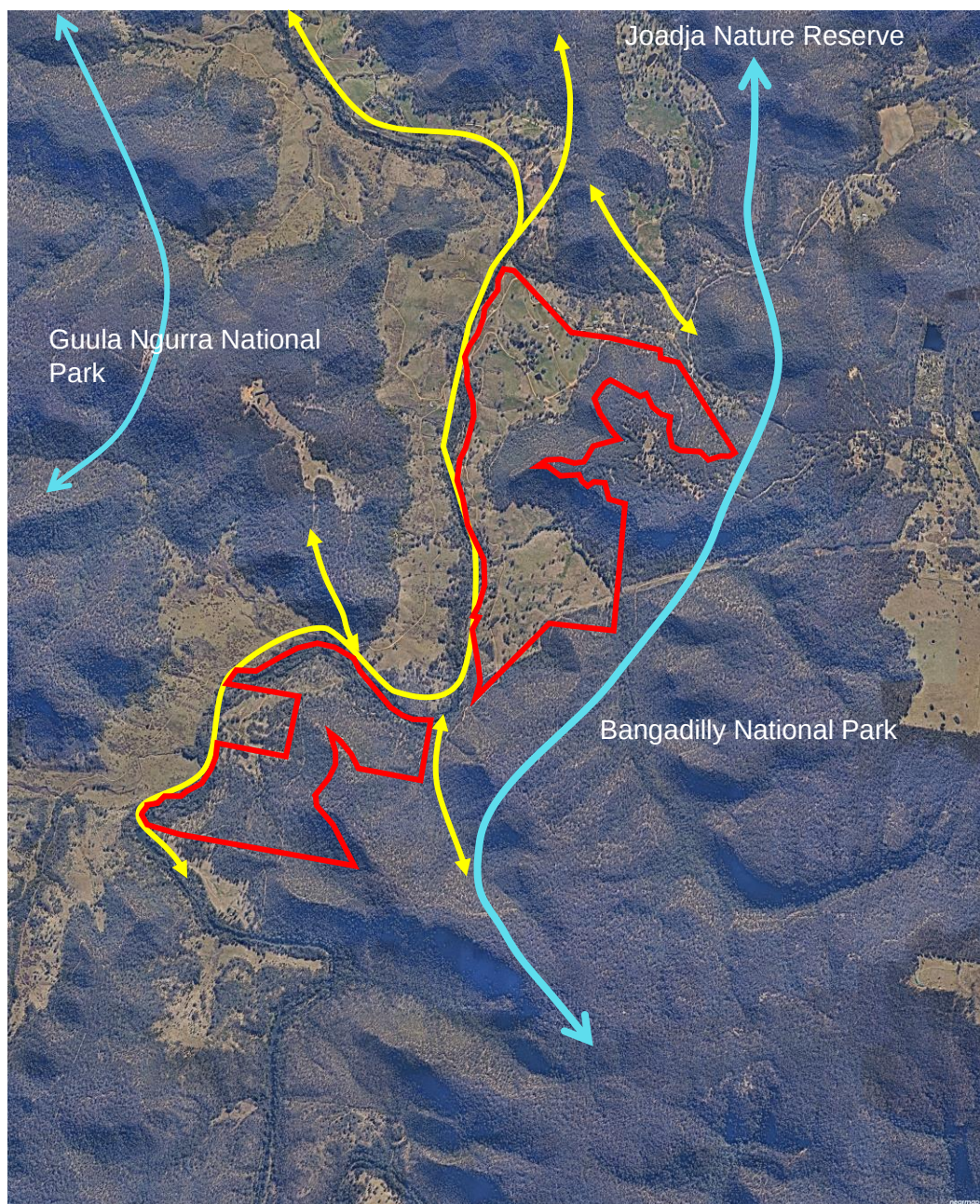


Figure 3-2 – Local connectivity (study area in red, primary corridor in blue, secondary riparian corridor in yellow)

4. WATERCOURSES & WETLANDS

4.1 Endangered wetland communities

Several wetland communities have been listed as an 'endangered ecological community' under the NSW *BC Act*. We note that 'wetlands' are included in the definition of 'waterfront lands' in accordance with the *Water Management Act (WM Act)* 2000, due to their inclusion in the definition of a 'lake' under the same act.

Impacts on wetland communities must be assessed under the *BC Act* and if present the management of wetland communities must be given due consideration in accordance with the objectives and principles of management as contained within the NSW Wetlands Policy (2010), and appropriate management as determined by NSW DPIE - Office of Water in their general terms of approval. This may include but not limited to the provision of buffers, management of stormwater runoff and maintenance of natural inflows or runoff into those wetland communities.

- Artesian Springs Ecological Community.
- Castlereagh Swamp Woodland Community.
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin, and Southeast Corner Bioregions.
- Coastal Upland Swamp in the Sydney Basin Bioregion.
- Coolibah–Black Box woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Penepplain and Mulga Lands Bioregions.
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and Southeast Corner Bioregions.
- Kurri sand swamp woodland in the Sydney Basin Bioregion.
- Lagunaria swamp forest on Lord Howe Island.
- Maroota Sands Swamp Forest.
- Newnes Plateau Shrub Swamp in the Sydney Basin Bioregion.
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin, and Southeast Corner Bioregions.
- Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin, and Southeast Corner Bioregions.
- The shorebird community occurring on the relict tidal delta sands at Taren Point.
- Upland wetlands of the drainage divide of the New England Tableland Bioregion, and
- Wingecarribee Swamp.

No endangered wetland communities were present within the study area and, therefore, a referral to NRAR is not required for impacts on wetlands.

4.2 Groundwater dependent ecosystems (GDEs)

Groundwater dependent ecosystems are communities of plants, animals, and other organisms whose extent and life processes are dependent on groundwater. Some examples of ecosystems which depend on groundwater are:

- Wetlands.
- red gum forests, vegetation on coastal sand dunes and other terrestrial vegetation.
- ecosystems in streams fed by groundwater.
- limestone cave systems.
- Springs, and
- hanging valleys and swamps.

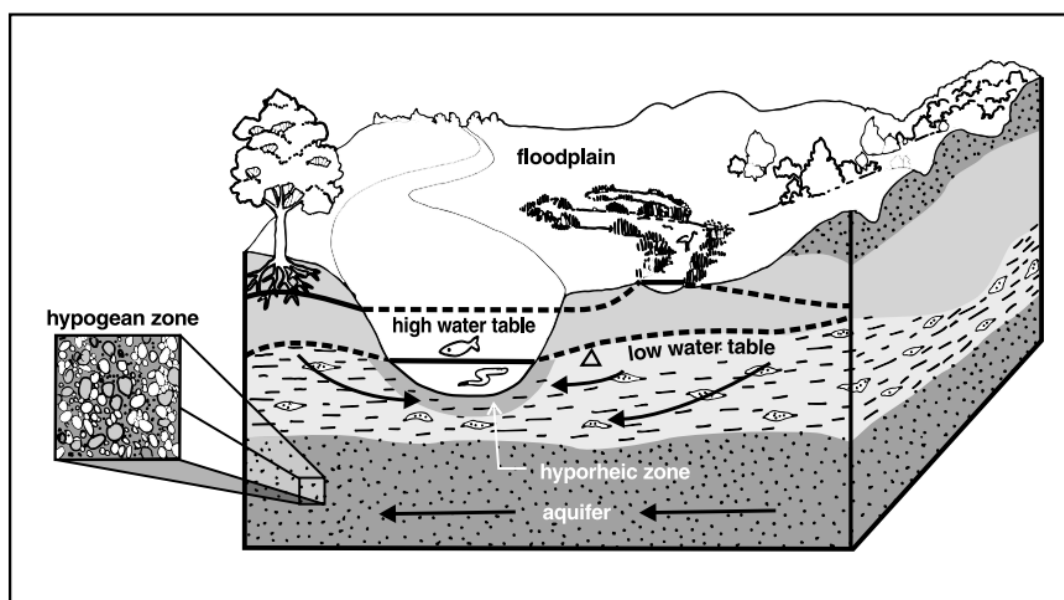


Figure 4-1 – Alluvial groundwater system discharging into a river

Groundwater dependent ecosystems are therefore ecosystems which have their species composition and their natural ecological processes determined by groundwater (NSW State Groundwater Dependent Ecosystems Policy April 2002).

Groundwater Dependent Ecosystems (GDEs) are generally located on the river flats and associated lowland grassy woodland. Any riparian ecosystems are unlikely to be impacted or can be avoided.

4.3 Watercourse assessment

Waterfront land is regulated by the *Water Management Act 2000* (WM Act). Any controlled activities that occur on waterfront land are subject to a controlled activity application. Waterfront land is defined as significant watercourses and drainage lines that occur across the study areas providing a constraint to development. Wingecarribee River is a sixth order stream or greater, and all streams shown in Figure 4-2 are regulated by the NSW Water Regulation Body (2018). Stream order mapping (DPE 2022) indicates that waterfront land, including the bed and bank of any river, is protected within 40 m of the highest bank. Therefore, a controlled activity approval must be obtained from DPE before commencing any controlled activity within 40 m of the highest bank.

A detailed examination of pending development plans will need to be assessed to determine if a referral to NRAR is required for impacts on waterfront land.

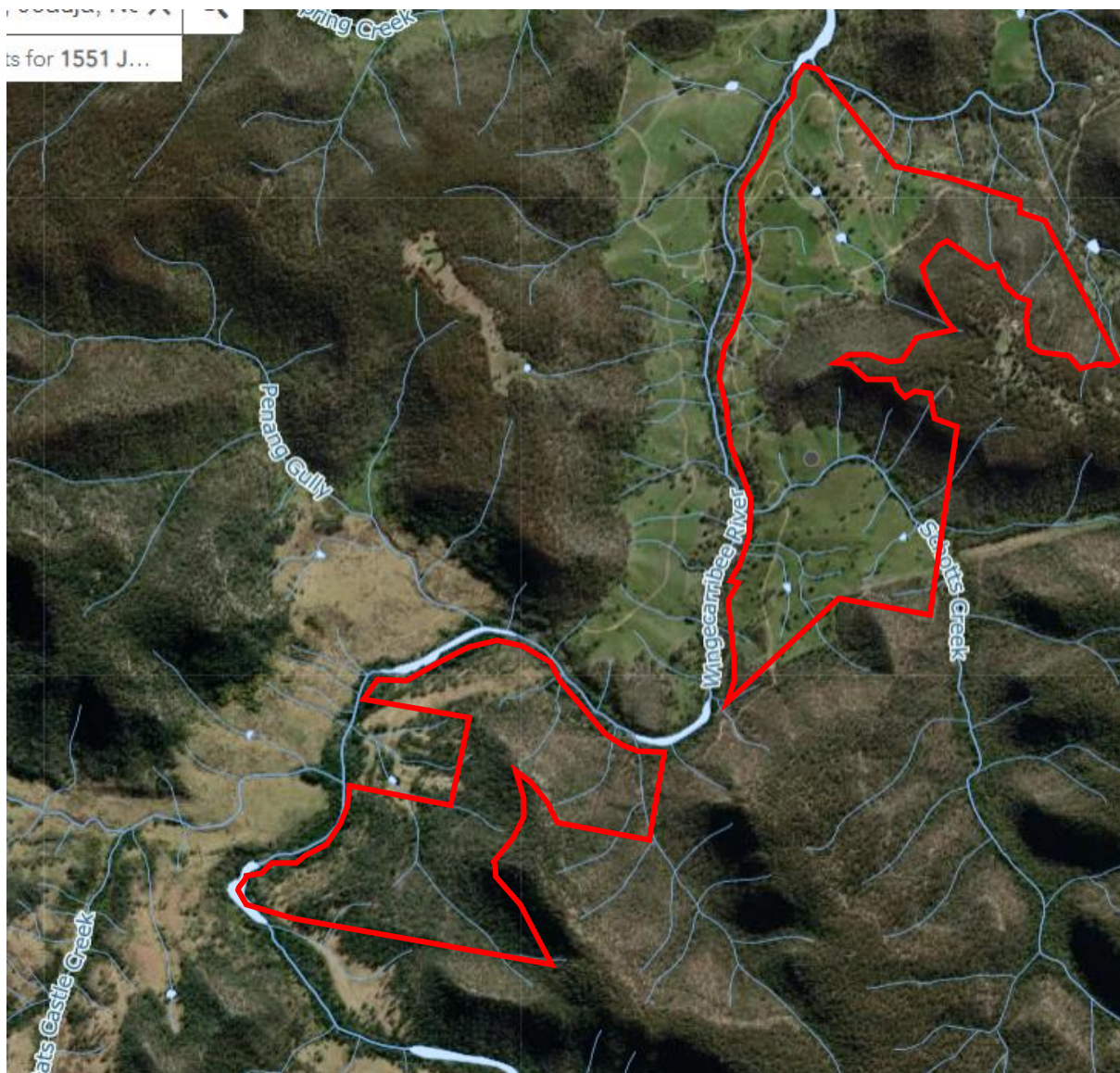


Figure 4-2 - Hydroline spatial data
(Source: Water Management (General Regulation) 2018 Hydroline Spatial Data 1.0)

4.4 Resilience and Hazards SEPP 2021

State Environmental Planning Policy (Resilience and Hazards) 2021 – also known as the Resilience and Hazards SEPP – officially began on 1 March 2022. The Coastal Management SEPP 2018 was replaced. It is now Chapter 2 (Coastal Management) of the Resilience and Hazards SEPP 2021.

NSW DPIE *Coastal Wetlands and Littoral Rainforest* mapping identified that the site is not mapped as “coastal wetlands” or “proximity area for coastal wetlands” (Figure 4-3). Further consideration of this SEPP is therefore not required.

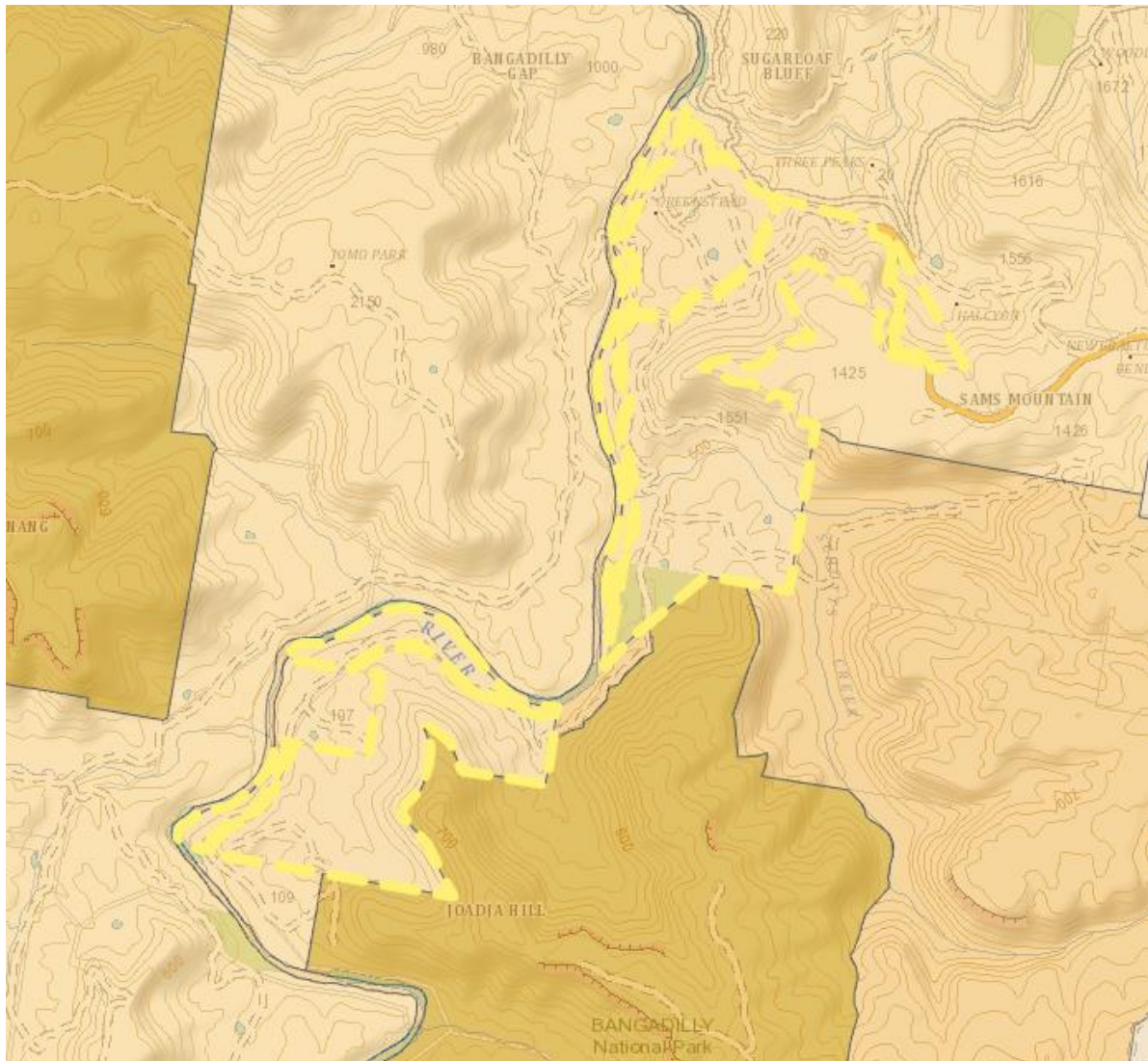


Figure 4-3 - Coastal wetlands area map (study area in yellow)

(Source: (<http://webmap.environment.nsw.gov.au/>))

5. BIODIVERSITY IMPACT ASSESSMENT

5.1 Biodiversity Offsets Scheme (BOS)

The *BC Act* repealed the *Threatened Species Conservation Act* 1995, the *Nature Conservation Trust Act* 2001 and the animal and plant provisions of the *National Parks and Wildlife Act* 1974. Together with the *Biodiversity Conservation Regulation* 2017, the *BC Act* establishes a new regulatory framework for assessing and offsetting biodiversity impacts on proposed developments and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme (BOS). Where development consent is granted, the authority may impose, as a condition of consent, an obligation to retire a number and type of biodiversity credits determined under the Biodiversity Assessment Method (BAM).

Where development consent is granted, the authority may impose as a condition of consent an obligation to retire a number and type of biodiversity credits determined under the BAM. The Biodiversity Offsets Scheme applies to:

- local development (assessed under Part 4 of the *Environmental Planning and Assessment Act* 1979) that triggers the Biodiversity Offsets Scheme Threshold or is likely to significantly affect threatened species based on the test of significance in section 7.3 of the *Biodiversity Conservation Act* 2016.
- state significant development and state significant infrastructure projects, unless the Secretary of the Department of Planning, Industry and Environment and the environment agency head determine that the project is not likely to have a significant impact.
- biodiversity certification proposals.
- clearing of native vegetation in urban areas and areas zoned for environmental conservation that exceeds the Biodiversity Offsets Scheme threshold and does not require development consent clearing of native vegetation that requires approval by the Native Vegetation Panel under the *Local Land Services Act* 2013, and
- activities assessed and determined under Part 5 of the *Environmental Planning and Assessment Act* 1979 (generally, proposals by government entities) if proponents choose to 'opt in' to the Scheme.

Proponents will need to supply evidence relating to the triggers for the Biodiversity Offsets Scheme Threshold and the test of significance (where relevant) when submitting their application to the consent authority.

5.2 Threshold assessment

The BOS includes three (3) elements to the threshold test – an Area trigger, a Biodiversity Values Land Map trigger, and the Test of Significance. If impacts exceed at least one of these triggers, the Biodiversity Offset Scheme applies to the proposed clearing.

5.2.1 Biodiversity values land map (BV)

Biodiversity Values Land has been mapped within the study area. A DA that impacts on native vegetation in biodiversity values mapped lands would require an offset under this trigger. Figure 5-1 below shows the entire study area in relation to those areas (purple) mapped as Biodiversity Values Land. Stage 1 lands are located in top northern portion of the site where there are no biodiversity values currently mapped.

The Wingecarribee River and Schott's Creek are mapped as Biodiversity Values Land. Therefore, a Biodiversity Development Assessment Report (BDAR) may be required with any development application which potentially impacts Biodiversity Lands. The study area for Stage 1 will not impact upon Biodiversity Values Land and therefore, in itself does not trigger requirements of a BDAR.

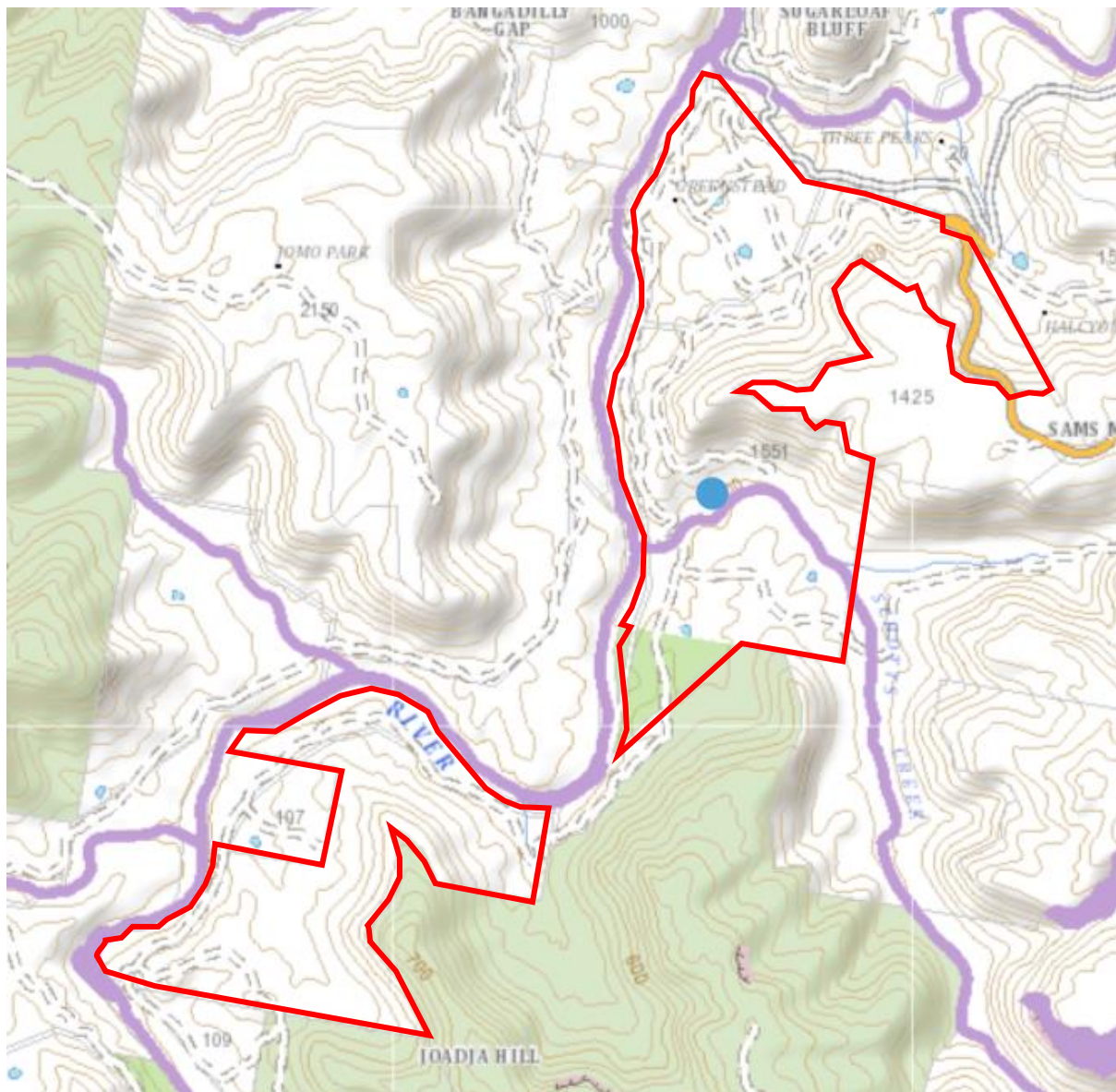


Figure 5-1 – Biodiversity Values Land Map
(Source: www.lmhc.nsw.gov.au)

5.2.2 Area clearing threshold

As shown in Table 5-1, a threshold for clearing applies to this land 0.5 ha based on a minimum lot size of 2.8 ha. Any clearing of native vegetation of 5,000 m² (0.5 ha) or greater (including management as APZs and areas of native grasslands), will trigger entry into the BOS. It is understood that whilst the proposed ecotourist facilities are being placed in open paddock areas, the required asset protection zones and general maintenance of the ground layer will likely result in the clearing of native vegetation greater than 0.5 ha and therefore, the BOS would be triggered based on this factor. Clearing in this case, and for APZ maintenance doesn't necessarily imply full clearing, but more likely maintenance and thinning. This type of maintenance can lead to a reduced native soil seedbank and inadvertently lead to natural attrition, thus most Council's or authorizing agencies will assume all vegetation is lost in APZs.

Table 5-1 – Biodiversity Values Map and Threshold Report

Biodiversity Values Map and Threshold Report		
Date of Report Generation		14/09/2023 11:24 AM
Biodiversity Values (BV) Map Threshold - Results Summary		
1	Does the development Footprint intersect with BV mapping?	yes
2	Was ALL of the BV Mapping within the development footprint added in the last 90 days? (dark purple mapping only, no light purple mapping present)	no
3	Date of expiry of dark purple 90 day mapping*	N/A
4	Is the Biodiversity Values Map threshold exceeded?	yes
Area Clearing Threshold - Results Summary		
5	Size of the development or clearing footprint	2,985,570.4 sqm
6	Native Vegetation Area Clearing Estimate (NVACE)	2,131,921.8 sqm
7	Method for determining Minimum Lot Size	Lot size
8	Minimum Lot Size (10,000sqm = 1ha)	28,377 sqm
9	Area Clearing Threshold (10,000sqm = 1ha)	5,000 sqm
10	Is the Area Clearing Threshold exceeded?	yes
Is the proposed development assessed above the Biodiversity Offsets Schema (BOS) threshold? Exceeding the BOS threshold will require completion of a Biodiversity Development Assessment Report (BDAR). More details provided on page 2.		yes

5.2.3 Test of Significance

As the site potentially contains habitat for threatened species, a test of significance will be required for any proposal that impacts native vegetation but does not trigger the BOS. In this case the impacts are not expected to be significant.

5.2.4 Areas of Outstanding Biodiversity Value (AOBV)

Areas of Outstanding Biodiversity Value are special areas with irreplaceable biodiversity values that are important to the whole of NSW, Australia or globally. The relevant legislative provisions for AOBV are Part 3, *BC Act 2016* and Part 3, *BC reg. 2017*.

AOBV declarations in New South Wales include the following:

- Gould's Petrel – critical habitat declaration.
- Little penguin population in Sydney's North Harbour – critical habitat declaration.
- Mitchell's Rainforest Snail in Stott's Island Nature Reserve – critical habitat declaration, and
- Wollemi Pine – critical habitat declaration.

No AOBV occur within the development footprint or will be indirectly impacted.

5.3 Mitigation measures

The following mitigation measures are recommended to avoid, minimise, or ameliorate the above potential ecological impacts, address threatening processes and to guide a more positive ecological outcome for threatened species and their associated habitats.

Table 5-2 – Recommended mitigation measures

Action / Technique	Outcome	Timing Frequency /	Responsibility
Sediment and erosion control measures in accordance with Managing Urban Stormwater: Soils and Construction (Landcom 2004) to minimise impact of possible sedimentation to local drainage lines.	Maintain integrity of nearby bushland habitat and natural topsoil by preventing deposition	Prior to any clearing works. Ongoing during all exposed soil stages until landscaping is completed	Project Ecologist / Contractors
Temporary fencing - All areas of natural vegetation retention shall be protected by fencing, prior to construction, to ensure that these areas are not damaged during the construction phase.	Maintain integrity of remaining natural habitat	Prior to construction / habitat clearance	Project Ecologist / Contractors

Action / Technique	Outcome	Timing / Frequency	Responsibility
Preparation of a vegetation management plan integrating with APZ requirements inclusive of recommend revegetation for enrichment of fauna and flora habitat including the following measures: Planting of koala foraging trees to enhance the local landscape and to bring Koalas into the landscape such as <i>Eucalyptus punctata</i> (Grey Gum), <i>Eucalyptus tereticornis</i> (Forest Red Gum) as primary foraging species within and supplementary foraging species <i>Eucalyptus bosistoana</i> (Coast Grey Box), <i>Eucalyptus eugenioides</i> (Thin-leaved Stringybark). Protecting habitat for the rare Mintbush (<i>Prostanthera rugosa</i>) and use within landscaping (a propagatable species). Planting of <i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i> (River Oak), Forest Oak (<i>Allocasuarina torulosa</i>) and Black Oak (<i>Allocasuarina littoralis</i>) for Glossy Black Cockatoo along drainage lines and in open areas. Enrichment of nesting habitat by the augmentation of hollows in existing trees. Planting of a diverse range of high value foraging shrub species in landscape beds	Enrichment of fauna and flora habitat supporting Koalas, Glossy Black Cockatoo and other recorded species	Approved prior to Construction certificate	Ecological consultant
Prior to any habitat removal, a comprehensive search for fauna and habitat is to be undertaken to relocate any terrestrial individuals and identify any important nesting to be protected until fledging.	Reduce potential for impact on native species	Immediately prior to land clearance	Project Ecologist

Action / Technique	Outcome	Timing Frequency /	Responsibility
Management of hollows and hollow-dependent fauna: The felling of hollow-bearing trees is to be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are taken, particularly for threatened species. Hollows of high quality or with fauna recorded residing within should be dismantled for relocation and all hollows should be inspected for occupation, signs of previous activity and potential for reuse.	Protection of hollow-dependent wildlife	At time of removal. Note, that no hollow-bearing trees were observed in the development footprint at the time of survey, however they may appear after storm activity breaks through a trunk or branch	Project Ecologist
Subsequent hollows of retention value are to be relocated to nearby conserved habitat areas. If these are placed as on ground habitat and are not reattached to a new recipient tree, then they are to be replaced with appropriately sized nest boxes affixed to a retained tree.	Maintain quality denning / hollow shelter opportunities	At time of removal	Project Ecologist
Constructed nest boxes should as priority target recorded hollow-dependent threatened species (and their prey species). Boxes should be constructed in weatherproof timber (marine ply), fasteners and external paint and appropriately affixed to a recipient tree under the guidance of a fauna ecologist.	Protection of hollow-dependent wildlife	Prior to hollow removal	Project Ecologist
If a threatened species is found to be occupying the hollow at the time of removal, then this hollow section is to be reattached to a recipient tree within the nearby conservation areas as selected and directed by the fauna ecologist. The welfare and temporary holding of the residing animal(s) is at the discretion of the fauna ecologist.	Priority protection of hollow-dependent threatened species	At time of removal	Project Ecologist
The relocated hollow section and nest boxes should be well secured in the recipient tree in a manner that will not compromise the current or future health of that tree.	Ensure hollow integrity is maintained	Time of installation	Project Ecologist

Action / Technique	Outcome	Timing Frequency	Responsibility
Monitoring of nest boxes and relocated hollows	Ensure hollow integrity is maintained	Each year for 5 years	Project Ecologist
Management of any other displaced fauna	Prevent direct impacts on nesting and terrestrial native fauna species	Prior to and during habitat removal / Adaptive management required	Project Ecologist
If any fauna species, a nest, or roost is located during development works, then works should cease until safe relocation can be advised by a contact fauna ecologist	Prevent direct impacts on nesting and terrestrial native fauna species	At time of removal / Adaptive management required	Project Ecologist / Contractors

5.4 Avoidance and minimisation actions

To promote positive environmental outcomes and either avoid or minimise impacts on biodiversity values, the following actions have been undertaken:

- The position of the Arrival Centre, and associated communities have been located to use already cleared areas, and to minimise impacts on native vegetation. Some refinement may be able to be achieved to minimise overlap of the required asset protection zones with existing canopy vegetation.
- The proposal avoids clearing of trees and incorporates existing trees into the landscape design, and
- Proposal has avoided vegetation loss or clearing in proximity to farm dams and riparian vegetation of Wingecarribee River to reduce impact on the watercourse.

Further minimisation of impacts on native vegetation is likely possible given the future impact of asset protection zones for communities 2, 3 and 4.

The final location of future effluent treatment areas for future stages should be placed in areas with no remnant trees and shrubs where possible.

5.5 Ecological impacts

The direct, indirect, and cumulative ecological impacts have been considered in respect to recorded biodiversity, threatening processes, and extent of impact as a result of the proposed works.

5.5.1 Direct impacts

The likely direct impacts on native vegetation and associated habitat as a result of the proposed Masterplan is as follows:

Table 5-3 – Direct impacts

Direct impact	BC Act status	SAIL entity	Project phase/timing of impact	Extent (ha)
PCT3483 – Central Gorges Box-Red Gum Grassy Forest	Not associated with a TEC	Not an SAIL	Asset protection zones	1.30 or 0.78 for Stage 1
PCT3498 – Wingecarribee Gorges Stringybark-Grey Gum Forest	Not associated with a TEC	Not an SAIL	No impact	Nil
PCT4063 – Central and Southern Tableland River Oak Forest.	Not associated with a TEC	Not an SAIL	No impact	Nil
Exotic Planted Vegetation	Not associated with a TEC	Not an SAIL	No impact	0.26 all in Stage 1
Pasture/Grassland	Not associated with a TEC	Not an SAIL	Asset protection zones and proposed works	7.49 not measured for Stage 1
Removal of potential foraging resources for threatened species including Dusky Woodswallow, Large Bent-winged Bat, Southern Myotis, Large-eared Pied Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Glossy Black-Cockatoo, Powerful Owl, Speckled Warbler, Varied Sittella, New Holland Mouse, Hooded Robin, Diamond Firetail, Grey-headed Flying-fox, Scarlet Robin, Flame Robin, Yellow-bellied Glider, Greater Glider, Gang-gang Cockatoo and Grey-crowned Babbler.	Various	Yes	Demolition / clearing	1.30 estimated

Exact numbers will need to be confirmed at the appropriate DA stage.

5.5.2 Indirect impacts

Table 5-4 – Indirect impacts

Indirect impact description	Impacted entities (PCT, species, TEC)	Frequency	Duration	Project phase / timing of impact	Likelihood and consequences
Edge effects	All retained vegetation within c. 10 m of development	Constant	Lifetime of development	Clearing, construction and ongoing	• Increased soil nutrients from changes to runoff that may provide further opportunities for weeds. • Spill-over from noise, activity, scent, and lighting effects. • Inappropriate use of remaining native vegetation areas such as additional clearing, dumping of materials and waste.
Concentrated stormwater runoff from solid surfaces and subsequent increased flows	All retained vegetation, watercourses, and habitat downslope of the development	During rainfall events	Lifetime of development	Clearing, construction and ongoing	• Potential increased flow, nutrient and sediment loads that may provide further opportunities for weeds within retained vegetation. • Potential increased flow, nutrient and sediment loads within watercourses on site.
Reduced inter-site connectivity	Small species bird and arboreal mammals	Once	Lifetime of development	Clearing, construction	• Reduced cross-site movements by local and transient fauna

5.5.3 Cumulative impacts

Table 5-5 – Cumulative impacts

Indirect impact description	Impacted entities (PCT, species, TEC)	Frequency	Duration	Project phase/ timing of impact	Likelihood and consequences
Cumulative loss of native vegetation within the local area	All retained vegetation within c. 10 m of development	Constant	Lifetime of development	Clearing, construction and ongoing	- Increased soil nutrients from changes to runoff that may provide further opportunities for weeds to colonise. - Spill-over from noise, activity, scent, and lighting effects may impact fauna. - Inappropriate use of remaining native vegetation areas such as additional clearing, dumping of materials and waste
Increased risk of weed invasion and fungal mobilisation or infections	All retained vegetation within c. 10 m of development	Constant	Lifetime of development	Clearing, construction and ongoing	- Reduction in regrowth of native vegetation. - Weed infiltration into native regrowth areas.
Cumulative loss of foraging habitat for native fauna	N/A	Constant	Lifetime of development	Clearing, construction and ongoing	Impacts for asset protection zones and pasture management
Increased varied human presence and activity	All retained vegetation within c. 10 m of development	Constant	Lifetime of development	Clearing, construction and ongoing	Reduction in suitability of habitat for sensitive fauna.

6. CONCLUSION

6.1 Recorded biodiversity

In respect of matters required to be considered under the *EP&A Act* and relating to the provisions of the *BC Act*, two (2) threatened fauna species Southern Myotis (*Myotis Macropus*) and Large Bent-winged Bat (*Miniopterus orianae oceanensis*), no threatened flora species, and no threatened ecological communities (TECs) were recorded within the Stage 1 study area i.e., Arrival Village, Community 1, and Community 2.

In respect of matters required to be considered under the *EPBC Act*, no threatened fauna species), no threatened flora species and no threatened ecological communities listed under this Act were recorded within the Stage 1 study area i.e., Arrival Village, Community 1, and Community 2.

6.2 Impact summary

Direct impacts are associated with clearing for development and Bushfire APZs. The impact area is summarised below:

Table 6-1 – Summary of impact area on native vegetation PCTs

	Impact area (ha)	PCT 3483 (ha)	PCT 3498 (ha)	PCT 4063 (ha)	Exotic (ha)
Arrival & Community 2	3.69	0.52	0.00	0.00	0.00
Community 1 & Homestead	1.21	0.13	0.00	0.00	0.26
Community 3	0.79	0.00	0.00	0.00	0.00
Community 4	3.14	0.59	0.00	0.00	0.00
Wastewater	1.14	0.14	0.00	0.00	0.00
TOTAL	9.97	0.79	0.00	0.00	0.26

6.3 Avoidance of impacts

The following points identify avoidance actions:

- The proposal generally avoids areas of native vegetation and does not require significant removal of trees for the required asset protection zones.
- Potential impacts within riparian corridors for mapped watercourses
- Impacts on soil quality and native flora and fauna will be minimal.
- The proposal avoids mapped Biodiversity Values Land.
- The proposal utilises cleared land and grazing land for buildings, and
- The proposal will refurbish current buildings rather than remove native vegetation.

6.4 Biodiversity Offset Scheme (BOS)

The BOS will be triggered by the proposed development. As shown in Table 5-1, there is a threshold for clearing on this land. Any clearing of native vegetation of 0.5 ha or greater (including management as APZs based on a minimum lot size of 2.8 ha, would trigger the BOS.

However, Biodiversity Values (BV) Land has been mapped within the study area. Therefore, any subsequent DA would need to provide evidence of no impact on this land (riparian land), otherwise, it is likely to require an offset under this trigger.

No AOBV occur within the development footprint or will be indirectly impacted.

6.5 Recommendation for design, assessment, and habitat enrichment.

The following recommendations pertain to important design and assessment:

- A development is likely to trigger the BOS and cause biodiversity offsetting subject to degree of impact on native vegetation (including native pasture) and avoidance of impacts demonstrated by the design.
- Consolidate facilities to minimise impacts on native pasture and remnant trees.
- A BDAR is required for impacts on native vegetation.
- Native pasture mapping and biometric plots will be required to determine the quality of native pasture and determine whether its calculated vegetation integrity score (VIS) will cause biodiversity offsets.
- Seasonal survey for flora and fauna will need to be undertaken to assess presence or absence of candidate threatened species associated with the PCT's on site.

The following strategies are recommended landscape improvements to support local flora and fauna species: -

- Planting of koala foraging trees to enhance the local landscape and to bring Koalas into the landscape such as *Eucalyptus punctata* (Grey Gum), *Eucalyptus tereticornis* (Forest Red Gum) as primary foraging species within and supplementary foraging species *Eucalyptus bosistoana* (Coast Grey Box), *Eucalyptus eugenioides* (Thin-leaved Stringybark).
- Protecting habitat for the rare *Mintbush* (*Prostanthera rugosa*) and use within landscaping (a propagatable species).
- Planting of *Casuarina cunninghamiana* subsp. *cunninghamiana* (River Oak), Forest Oak (*Allocasuarina torulosa*) and Black Oak (*Allocasuarina littoralis*) for Glossy Black-Cockatoo along drainage lines and in open areas.
- Enrichment of nesting habitat by the augmentation of hollows in existing trees.
- Planting of a diverse range of high value foraging shrub species in landscape beds.

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Appendix 1. Flora & Fauna Species Lists

Table A1-1 – Native flora species recorded Arrival Village

Family	Scientific name	Common name	Broader Study Area	Stage 1 DA
TREES				
Sterculiaceae	<i>Brachychiton populneus</i> subsp. <i>populneus</i>	Kurrajong	✓	
Casuarinaceae	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	River Oak	✓	✓
Myrtaceae	<i>Eucalyptus beyeriana</i>	Beyer's Ironbark		✓
Myrtaceae	<i>Eucalyptus bosistoana</i> (*K)	Coast Grey Box	✓	
Myrtaceae	<i>Eucalyptus bridgesiana</i>	Apple Box	✓	
Myrtaceae	<i>Eucalyptus cinerea</i>	Argyle Apple	✓	✓
Myrtaceae	<i>Eucalyptus elata</i>	River Peppermint	✓	
Myrtaceae	<i>Eucalyptus eugenioides</i> (*K)	Thin-leaved Stringybark	✓	
Myrtaceae	<i>Eucalyptus macrorhyncha</i> (*K)	Red Stringybark	✓	✓
Myrtaceae	<i>Eucalyptus punctata</i> (*K)	Grey Gum	✓	
Myrtaceae	<i>Eucalyptus tereticornis</i> (*K)	Forest Red Gum	✓	✓
SHRUBS				
Fabaceae (Mimosoideae)	<i>Acacia deanei</i> subsp. <i>paucijuga</i>	Green Wattle	✓	✓
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i>	Golden Wattle		✓
Pittosporaceae	<i>Bursaria spinosa</i>	Native Blackthorn	✓	✓
Myrtaceae	<i>Callistemon subulatus</i>	Dwarf Bottlebrush	✓	
Asteraceae	<i>Cassinia longifolia</i>		✓	✓
Epacridaceae	<i>Lissanthe strigosa</i>	Peach Heath	✓	✓
Proteaceae	<i>Lomatia myricoides</i>	River Lomatia	✓	
Asteraceae	<i>Olearia viscidula</i>	Wallaby Weed	✓	✓
Violaceae	<i>Melicytus dentatus</i>	Tree Violet	✓	
GROUND LAYER				
Poaceae	<i>Anisopogon avenaceus</i>	Oat Speargrass	✓	
Chenopodiaceae	<i>Atriplex</i> spp.	A Saltbush	✓	
Poaceae	<i>Austrostipa pubescens</i>	Tall Speargrass	✓	

Family	Scientific name	Common name	Broader Study Area	Stage 1 DA
Poaceae	<i>Austrostipa</i> sp.	A Speargrass	✓	
Fabaceae (Faboideae)	<i>Bossiaea buxifolia</i>		✓	
Asteraceae	<i>Brachyscome</i> sp.	Daisy	✓	
Poaceae	<i>Bromus cartharticus</i> *	Prairie Grass	✓	
Asteraceae	<i>Calotis lappulacea</i>	Yellow burr-daisy		
Sinopteridaceae	<i>Cheilanthes distans</i>	Bristly Cloak Fern		
Asteraceae	<i>Chrysocephalum apiculatum</i>	Common Everlasting	✓	
Asteraceae	<i>Conyza bonariensis</i> *	Flax-leaf Fleabane	✓	
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed	✓	✓
Poaceae	<i>Echinopogon caespitosus</i>	Bushy Hedgehog-grass	✓	✓
Chenopodiaceae	<i>Einadia hastata</i>	Berry Saltbush	✓	✓
Poaceae	<i>Eragrostis</i> sp.	Lovegrass	✓	
Geraniaceae	<i>Erodium crinitum</i>	Storksbill	✓	
Asteraceae	<i>Euchiton sphaericus</i>	-	✓	
Cyperaceae	<i>Gahnia aspera</i>	Saw Sedge	✓	✓
Geraniaceae	<i>Geranium homeanum</i>	Northern Cranesbill	✓	✓
Haloragaceae	<i>Gonocarpus</i> spp.	Raspwort	✓	
Goodeniaceae	<i>Goodenia hederacea</i> subsp. <i>hederacea</i>	Ivy-leaved Goodenia	✓	
Asteraceae	<i>Helichrysum</i> spp.	Paper Daisy	✓	
Apiaceae	<i>Hydrocotyle laxiflora</i>	Stinking Pennywort	✓	
Asteraceae	<i>Hypochaeris radicata</i> *	Flatweed	✓	
Anthericaceae	<i>Laxmannia gracilis</i>	Slender Wire Lily	✓	
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush	✓	✓
Lomandraceae	<i>Lomandra micrantha</i> subsp. <i>tuberculata</i>	Small-flowered Mat-rush	✓	✓
Fabaceae (Faboideae)	<i>Medicago</i> spp.*	A Medic	✓	
Poaceae	<i>Microlaena stipoides</i>	Weeping Grass	✓	✓
Poaceae	<i>Panicum simile</i>	Two Colour Panic	✓	
Polygonaceae	<i>Persicaria decipiens</i>	Water Pepper		✓
Polygonaceae	<i>Persicaria hydropiper</i>	Water Pepper	✓	

Family	Scientific name	Common name	Broader Study Area	Stage 1 DA
Phyllanthaceae	<i>Phyllanthus occidentalis</i>		✓	
Plantaginaceae	<i>Plantago debilis</i>	Slender Plantain	✓	
Plantaginaceae	<i>Plantago lanceolata</i> *	Ribwort	✓	
Rubiaceae	<i>Pomax umbellata</i>	Pomax	✓	
Lamiaceae	<i>Prostanthera rugosa</i>^	Moss Vale Mintbush		
Poaceae	<i>Rytidosperma bipartitum</i>	Wallaby Grass	✓	
Poaceae	<i>Rytidosperma racemosum</i> var. <i>racemosum</i>	Wallaby Grass	✓	
Poaceae	<i>Setaria</i> spp.*	Pigeon Grass	✓	
Solanaceae	<i>Solanum aviculare</i>	Kangaroo Apple	✓	
Solanaceae	<i>Solanum linearifolium</i>	Mountain Kangaroo Apple		✓
Solanaceae	<i>Solanum nigrum</i> *	Black-berry Nightshade	✓	
Poaceae	<i>Themeda triandra</i>	Kangaroo Grass	✓	✓
Anthericaceae	<i>Tricoryne elatior</i>	Yellow Rush Lily	✓	
Scrophulariaceae	<i>Verbascum thapsus</i> subsp. <i>thapsus</i> *	Aarons Rod, Great Mullein	✓	
Scrophulariaceae	<i>Verbascum virgatum</i> *	Twiggy Mullein	✓	
Verbenaceae	<i>Verbena bonariensis</i> *	Purpletop	✓	
Verbenaceae	<i>Verbena officinalis</i> *	Common Verbena	✓	
Scrophulariaceae	<i>Veronica plebeia</i>	Creeping Speedwell	✓	✓
Poaceae	<i>Vulpia</i> spp.*	Rat's-tail Fescue	✓	
Campanulaceae	<i>Wahlenbergia gracilis</i>	Australian Bluebell	✓	
Campanulaceae	<i>Wahlenbergia</i> spp.	Bluebell	✓	
Asteraceae	<i>Xerochrysum bracteatum</i>	Golden Everlasting	✓	✓
VINES				
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard	✓	✓
Fabaceae/Faboideae	<i>Glycine tabacina</i>	Twining Glycine	✓	
Fabaceae/Faboideae	<i>Hardenbergia violacea</i>	False Sarsparilla	✓	✓
Convolvulaceae	<i>Polymeria calycina</i>	Bindweed	✓	
Polygonaceae	<i>Persicaria hydropiper</i>	Water Pepper	✓	

* Denotes exotic species

^ Denotes local endemic

Family	Scientific name	Common name	Broader Study Area	Stage 1 DA
*K Denotes koala feed tree				

It should be noted that not all garden, cultivar or landscape species were identified as part of this assessment.

Table A1-2 – Fauna species recorded (Appendix 1)

Common name	Scientific name	Method observed 13-14 Jan 2022
Birds		
Australian King Parrot	<i>Alisterus scapularis</i>	O W
Australian Magpie	<i>Cracticus tibicen</i>	O W
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	O
Australian Raven	<i>Corvus coronoides</i>	O W
Australian Wood Duck	<i>Chenonetta jubata</i>	O W
Azure Kingfisher	<i>Ceyx azureus</i>	O W
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	O W
Black-shouldered Kite	<i>Elanus axillaris</i>	O W
Brown Goshawk	<i>Accipiter fasciatus</i>	O
Common Bronzewing	<i>Phaps chalcoptera</i>	O W
Common Koel	<i>Eudynamys scolopacea</i>	O W
Common Myna *	<i>Sturnus tristis</i>	O W
Crested Pigeon	<i>Ocyphaps lophotes</i>	O W
Crimson Rosella	<i>Platycercus elegans</i>	O W
Dusky Woodswallow ^{TS}	<i>Artamus cyanopterus</i>	O
Eastern Rosella	<i>Platycercus eximius</i>	O W
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	O W
Eastern Whipbird	<i>Psophodes olivaceus</i>	O W
Galah	<i>Eolophus roseicapillus</i>	O W
Grey Butcherbird	<i>Cracticus torquatus</i>	O W
Grey Fantail	<i>Rhipidura albiscapa</i>	O W
Grey Teal	<i>Anas gracilis</i>	O
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	O W
Magpie-lark	<i>Grallina cyanoleuca</i>	O W
Masked Lapwing	<i>Vanellus miles</i>	O W
Noisy Friarbird	<i>Philemon corniculatus</i>	O W
Noisy Miner	<i>Manorina melanocephala</i>	O W
Pied Butcherbird	<i>Cracticus nigrogularis</i>	O W
Pied Currawong	<i>Strepera graculina</i>	O W
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	O W
Rose Robin	<i>Petroica rosea</i>	O W
Sacred Kingfisher	<i>Todiramphus sanctus</i>	O W
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>	O W
Striated Thornbill		O W
Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	O W
Superb Fairy-wren	<i>Malurus cyaneus</i>	O W
Tawny Frogmouth	<i>Podargus strigoides</i>	O W
Welcome Swallow	<i>Hirundo neoxena</i>	O W
White-cheeked Honeyeater	<i>Phylidonyris niger</i>	O W
White-throated Gerygone	<i>Gerygone olivacea</i>	O W
White-throated Treecreeper	<i>Cormobates leucophaea</i>	O W

Common name	Scientific name	Method observed 13-14 Jan 2022
White-winged Chough	<i>Corcorax melanorhamphos</i>	O
Willie Wagtail	<i>Rhipidura leucophrys</i>	O W
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	O W
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>	O W
Mammals		
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	O
Common Wombat	<i>Vombatus ursinus</i>	O
Domesticated Cattle *	<i>Bos taurus</i>	O
Domesticated Dog *	<i>Canis lupus familiaris</i>	O
Large Bent-winged Bat ^{TS}	<i>Miniopterus orianae oceanensis</i>	U
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	O
European Red Fox *	<i>Vulpes vulpes</i>	O
Fallow Deer *	<i>Dama dama</i>	O
Gould's Long-eared Bat	<i>Nyctophilus gouldii</i>	U ^{PO}
Large Forest Bat	<i>Vespadelus darlingtoni</i>	U ^{PO}
Lesser Long-eared Bat	<i>Nyctophilus geoffroyii</i>	U ^{PO}
Little Forest Bat	<i>Vespadelus vulturnus</i>	U ^{PO}
Southern Myotis ^{TS}	<i>Myotis macropus</i>	U ^{PO}
Swamp Wallaby	<i>Wallabia bicolor</i>	O
White-striped Mastiff-bat	<i>Austronomus australis</i>	W
Reptiles		
Delicate Skink	<i>Lampropholis delicata</i>	O
Eastern Long-necked Turtle	<i>Chelodina longicollis</i>	O
Eastern Water Skink	<i>Eulamprus quoyii</i>	O
Lace Monitor	<i>Varanus varius</i>	O
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	O
Amphibians		
Bleating Tree Frog	<i>Litoria quiritatus</i>	O W
Common Eastern Froglet	<i>Crinia signifera</i>	W
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>	W
Peron's Tree Frog	<i>Litoria peronii</i>	O W
Striped Marsh Frog	<i>Limnodynastes peronii</i>	W
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	W
Fish		
Mosquitofish *	<i>Gambusia holbrooki</i>	O
Mollusc		
Brown Garden Snail *	<i>Cornu aspersum</i>	O
Asian Tramp Snail *	<i>Bradybaena similis</i>	O
Semi-slug (Helicarionidae)	<i>Stanisicarion freycineti</i>	O

Appendix 2. Threatened Flora & Fauna Habitat Assessment

Table A2-1 – Threatened flora species habitat assessment (Appendix 2)

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site. (y/n)	If not recorded on site			
					Suitable habitat present (y/n)	Nearby and / or high number of record(s) (y/n) Notes 1,2 & 3	Record(s) from recent years (y/n) Notes 1,2 & 3	Potential to occur
<i>Acacia bynoeana</i> DPE EPBC	E1	V	Erect or spreading shrub to 30 cm high growing in heath and dry sclerophyll open forest on sandy soils. Often associated with disturbed areas such as roadsides. NR. <i>Distribution limits N-Newcastle S-Berrima.</i>	no	no	no	1 record in 2002 in Joadja NR.	unlikely
<i>Commersonia prostrata</i> EPBC	E1	E	Ground-hugging shrub that forms mats to more than 1 m across. Occurs on sandy, sometimes peaty soils in a wide variety of habitats mainly associated with post-disturbance. In the southern tablelands, it is found to habit open forest and open heath, on sandy soils. <i>Distribution limits: Southern Highlands to North Coast (Tomago).</i>	no	no	no	25 records Belanglo SF 2017.	unlikely
<i>Eucalyptus aggregata</i> DPE	V	-	Small or medium sized tree to approximately 18 m tall. Grows usually on alluvial soils, on cold, poorly drained flats and hollows adjacent to creeks and small rivers and sandy loam over sandstone. May be dependent on groundwater. Higher altitude species. <i>Distributed near to Blayney, Crookwell, Goulburn, Braidwood, and Bungendore.</i>	no	Possibly on valley floor	no	Records south, east, and west of Berrima.	unlikely
<i>Eucalyptus cannonii</i> DPE	V	-	Tree to 15 m high; bark persistent throughout, grey to red-brown, stringy. Locally frequent but restricted, in sclerophyll woodland on shallow soil on rises. <i>Distribution: Known northwest of Lithgow. Rylstone to upper Wolgan Valley.</i>	no	no	no	no	unlikely

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site. (y/n)	If not recorded on site			
					Suitable habitat present (y/n)	Nearby and / or high number of record(s) (y/n) Notes 1,2 & 3	Record(s) from recent years (y/n) Notes 1,2 & 3	Potential to occur
<i>Eucalyptus glaucina</i> DPE EPBC	V	V	Tree to 30 m high; bark smooth, white or grey, shedding in large plates or flakes. Grassy Woodland on deep moderately fertile soil. <i>Distribution: Lake Burragorang, Casino, Taree to Broke.</i>	no	no	no	no	unlikely
<i>Grevillea raybrownii</i> DPE	V	-	Bushy shrub to 1.5 m high. Leaves bipinnatisect. Occurs in open forest and woodland with a shrubby understorey on sandy, gravelly loam soils derived from sandstone (Hawkesbury Sandstone and Mittagong Formation) that are low in nutrients. <i>Restricted to an area bounded by Dapto, Robertson, and Berrima, possibly also Bungonia.</i>	no	no	Yes, 890 records, on ridgetops.	Joadja Fire trail complex	unlikely
<i>Helichrysum calvertianum</i> DPE	V	-	Perennial paper daisy to 30 cm high with white flowers. Occurs in dry sclerophyll forest and heathland with rock outcrops, predominantly on Hawkesbury sandstone soils. <i>Distribution limits: Wingecarribee Shire.</i>	no	no	Yes, but on rocky outcrops.	Near Joadja Road 2021-22	unlikely
<i>Kunzea cabbagei</i> DPE EPBC	V	V	Prostrate shrub. West of Berrima on Wingecarribee River, restricted to damp, sandy soils in wet heath on sandstone outcrops. Flowers September to November.	no	no	no	West of Berrima.	unlikely
<i>Leucochrysum albicans</i> var. <i>tricolor</i> DPE EPBC	E	E	A perennial everlasting daisy. Stems are 10–15 cm tall. Occurs in a wide variety of grassland, woodland, and forest habitats, generally on relatively heavy soils, but principally grasslands and grassy woodlands on relatively fertile soils, often clays or clay-loams derived from basalt or dolerite, or at higher altitudes, from sedimentary parent material. Can occurs on lowlands in grassy	no	no	no	Berrima 2016	Possible based on habitat but not on

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site. (y/n)	If not recorded on site			
					Suitable habitat present (y/n)	Nearby and / or high number of record(s) (y/n) Notes 1,2 & 3	Record(s) from recent years (y/n) Notes 1,2 & 3	Potential to occur
			woodland. <i>Distribution limits: In NSW it currently occurs on the Southern Tablelands in an area roughly bound by Albury, Bega, and Goulburn, with a few scattered localities known from beyond this region.</i>					previous records
<i>Persoonia glaucescens</i> DPE EPBC	V	V	Erect shrub to 3m. Leaves greyish green. Occurs on ridge-tops, plateaux and upper slopes. Now rare, though inadequately surveyed on private lands. Most specimens have been located along disturbance margins. <i>Distribution limits: Thirlmere Lakes to Berrima.</i>	no	no	2 records within 10 km.	Joadja Fire Trail complex 2021.	unlikely
<i>Persoonia hirsuta</i> DPE EPBC	E	E	Long coarse hairs on flowers and branchlets and short stiff hairs on leaves. Primarily on the Mittagong Formation and on the upper Hawkesbury Sandstone. <i>Distribution limits: Singleton, Blue Mountains to Hilltop.</i>	no	no	no	no	unlikely
<i>Persoonia oxycoccoides</i> EPBC	E	-	Prostrate to spreading shrub. Found on swamp margins and with <i>Eucalyptus sclerophylla</i> . <i>Distribution limits: Colo Vale to Tallong.</i>	no	no	no	no	unlikely
<i>Persoonia mollis</i> subsp. <i>revoluta</i> DPE	V	-	Prostrate to decumbent shrub, 10–50 cm high, up to 4 m diameter. Occurs on relatively deep sandy soils on broad ridgetops and upper slopes. <i>Currently known to occur in seven populations, primarily in the area between Mittagong, Paddy's</i>	no	no	6 records within 10 km.	Joadja Fire Trail complex 2021.	unlikely

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site. (y/n)	If not recorded on site			
					Suitable habitat present (y/n)	Nearby and / or high number of record(s) (y/n) Notes 1,2 & 3	Record(s) from recent years (y/n) Notes 1,2 & 3	Potential to occur
			<i>River, and High Range in the Southern Highlands with an outlying population in the Bindook Highlands.</i>					
<i>Phyllota humifusa</i> DPE EPBC	V	V	Prostrate shrub. Occurs in dry sclerophyll forest, sometimes near swamps, in deep sandy soils or gravelly loams over a sandstone substrate. <i>Known from the southern Blue Mountains (Bimlow Tableland), the Joadja area west of Mittagong and Penrose area near Paddys River.</i>	no	no	Yes. 3 records within 10 km.	Wombeyan Caves Road, 2016	unlikely
<i>Pomaderris brunnea</i> DPE EPBC	V	V	Shrub to 3 m high. Confined to Upper Nepean and Colo Rivers where it grows in open, shale forest and on plateau.	no	no	no	no	unlikely
<i>Pomaderris cotoneaster</i> DPE EPBC	E1	E	Shrub to 4 m tall. Occurs in forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs. <i>Known from the Nungatta area, northern Kosciuszko National Park (near Tumut), the Tantawangalo area in South-East Forests National Park and adjoining freehold land, Badgery's Lookout near Tallong, Bungonia State Conservation Area, the Yerranderie area, Kanangra-Boyd National Park, the Canyonleigh area and Ettrema Gorge in Morton National Park.</i>	no	no	23 records within 10 km.	Tugalong 2019. Canyonleigh 2017.	unlikely
<i>Pomaderris pallida</i> DPE EPBC	V	V	Shrub 1–2 m high, stems shortly whitish stellate-tomentose. Open Forest. <i>Distribution: Restricted to Cotter and Paddy's Rivers district in the A.C.T.</i>	no	no	no	no	unlikely

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site. (y/n)	If not recorded on site			
					Suitable habitat present (y/n)	Nearby and / or high number of record(s) (y/n) Notes 1,2 & 3	Record(s) from recent years (y/n) Notes 1,2 & 3	Potential to occur
<i>Rhizanthella slateri</i> DPE EPBC	V	E	Highly cryptic orchid. Flowers below ground or just 2cm above. Flowers September to November. <i>Distribution: southeast Queensland to southeast NSW.</i>	no	no	no	no	unlikely
<i>Solanum armourense</i> DPE	E	-	Erect shrub 1–1.8 m high, with very densely stellate-hairy branchlets; prickles usually sparse on branches and leaves; sometimes present on calyx, absent elsewhere. Eucalypt woodland with shrubby understorey, on rocky hillsides. <i>Distribution: Restricted from Yerranderie to Wombeyan Caves.</i>	no	no	yes	Yes, within 10 km.	possible
<i>Solanum celatum</i> DPE	E	-	Erect shrub 1–2.5 m high, very densely stellate-tomentose; prickles sparse on stems, rare on petioles and calyces, usually absent elsewhere. Grows on hills and slopes in eucalypt woodland; commonly found after fire or disturbance. <i>Distribution: Restricted to Wollongong, Nowra and west to Bungonia Nature Reserve.</i>	no	no	no	no	unlikely
<i>Thelymitra kangaloonica</i> DPE EPBC	CE	CE	Sun Orchid. Swamps and sedgelands over grey, silty loam soils. Flowers late October to early November. <i>Distribution limit: Central Tablelands, in the Fitzroy Falls-Robertson-Kangaloon area.</i>	no	no	no	no	unlikely

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site. (y/n)	If not recorded on site			
					Suitable habitat present (y/n)	Nearby and / or high number of record(s) (y/n) Notes 1,2 & 3	Record(s) from recent years (y/n) Notes 1,2 & 3	Potential to occur
<i>Thesium australe</i> DPE EPBC	V	V	Erect herb to 0.4 m high. Root parasite. <i>Themeda</i> grassland or woodland often damp. <i>Distribution limits N-Tweed Heads S-south of Eden.</i>	no	yes	no	no	unlikely

DPE Denotes species listed within 10km of the development footprint on the BioNet Atlas of NSW Wildlife (2023).

EPBC Denotes species listed within 10km of the development footprint in the EPBC Act habitat search.

V Denotes vulnerable listed species under the relevant Act.

E or E1 Denotes endangered listed species under the relevant Act.

E4a or CE Denotes critically endangered listed species under the relevant Act.

NOTE:

1. This field is not considered if no suitable habitat is present within the development footprint.

2. 'records' refer to those provided by the BioNet Atlas of NSW Wildlife (2023).

3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle.

Table A2-2 – Threatened fauna species habitat assessment (Appendix 2)

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (y/n)	If not recorded on site				Further consideration required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) Notes 1,2 & 3	Record(s) from recent years (y/n) Notes 1,2 & 3	Potential to occur	
Giant Burrowing Frog <i>Heleioporus australiacus</i> DPE EPBC	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. <i>Distribution limit: N-Near Singleton S-South of Eden.</i>	no	sub optimal	no	no	low	no
Pink-tailed Legless Lizard <i>Aprasia parapulchella</i> DPE EPBC	V	V	Inhabits open areas of native grasses and rocky outcrops and scattered rocks. <i>Distribution from Central tablelands, Southern tablelands, Central Western Slopes, and Southwest Slopes.</i>	no	optimal	no	no	low	no
Striped Legless Lizard <i>Delma impar</i> DPE EPBC	V	V	Found primarily in natural temperate grasslands and secondary grasslands nearby with significant content of exotic grasses and/ or surface rock. <i>Distribution limit: ACT and surrounds.</i>	no	optimal	no	no	low	no
Broad-headed Snake <i>Hoplocephalus bungaroides</i> DPE EPBC	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. <i>Distribution limit: N-Mudgee Park. S-Nowra.</i>	no	sub optimal	no	no	low	no
Australasian Bittern <i>Botaurus poiciloptilus</i> EPBC	E	E	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands. <i>Distribution limit: N-North of Lismore. S- Eden.</i>	no	optimal	no	no	low	no

Common name <i>Scientific name</i> Database source	BC Act	EPBC Act	Preferred habitat <i>Distribution limit</i>	Recorded on site (y/n)	If not recorded on site				Further consideration required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) <i>Notes 1,2 & 3</i>	Record(s) from recent years (y/n) <i>Notes 1,2 & 3</i>	Potential to occur	
White-bellied Sea Eagle <i>(Haliaeetus leucogaster)</i> DPE	V	-	Occupies coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs. <i>Sedentary; dispersive. N-Tweed Heads. S-South of Eden.</i>	no	Marginal	no	no	low	no
Little Eagle <i>Hieraaetus morphnoides</i> DPE	V	-	Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. <i>Distribution limit - N-Tweed Heads. S-South of Eden.</i>	no	optimal	no	no	low	no
Eastern Osprey <i>Pandion cristatus</i> DPE	V	-	Utilises waterbodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	no	sub optimal	no	no	low	no
Grey Falcon <i>Falco hypoleucos</i> DPE	V	-	Occurs over mainly inland drainage systems of open plains and lightly timbered country including the acacia scrub, spinifex and tussock grasslands. <i>Distribution limit: N-Mullumbimby. S-Bega.</i>	no	sub optimal	no	no	low	no
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i> DPE	V	-	Prefers wetter forests and woodlands from sea level to > 2,000m on the Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. <i>Distribution limit: mid north coast of NSW to western Victoria.</i>	no	marginal	yes	no	moderate	no
Glossy Black-Cockatoo	V	-	Open forests with <i>Allocasuarina</i> species and hollows for nesting. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	no	marginal	yes	yes	high	yes

Common name <i>Scientific name</i> Database source	BC Act	EPBC Act	Preferred habitat <i>Distribution limit</i>	Recorded on site (y/n)	If not recorded on site				Further consideration required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) <i>Notes 1,2 & 3</i>	Record(s) from recent years (y/n) <i>Notes 1,2 & 3</i>	Potential to occur	
<i>Calyptorhynchus lathamii</i> DPE									
Little Lorikeet <i>Glossopsitta pusilla</i> DPE	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbelts, and street trees. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	no	marginal	no	no	low	no
Swift Parrot <i>Lathamus discolor</i> DPE EPBC	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. <i>Distribution limit: N-Border Ranges National Park. S-South of Eden.</i>	no	sub optimal	no	no	low	no
Turquoise Parrot <i>Neophema pulchella</i> DPE	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. <i>Distribution limit: N-Near Tenterfield. S-South of Eden.</i>	no	sub optimal	no	no	low	no
Powerful Owl <i>Ninox strenua</i> DPE	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. <i>Distribution limits: N-Border Ranges National Park. S-Eden.</i>	no	marginal	yes	yes	high	yes
Masked Owl <i>Tyto novaehollandiae</i> DPE	V	-	Open forest and woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. <i>Distribution limit: N-Border Ranges National Park. S-Eden.</i>	no	marginal	no	no	low	no
White-throated Needletail ^{MS} <i>Hirundapus caudacutus</i> DPE EPBC	-	V	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies often forage along favoured hilltops and timbered ranges. Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern	no	sub optimal	no	no	low	no

Common name <i>Scientific name</i> Database source	BC Act	EPBC Act	Preferred habitat <i>Distribution limit</i>	Recorded on site (y/n)	If not recorded on site				Further consideration required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) <i>Notes 1,2 & 3</i>	Record(s)) from recent years (y/n) <i>Notes 1,2 & 3</i>	Potential to occur	
			Australia. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>						
Brown Treecreeper <i>Climacteris picumnus victoriae</i> DPE	V	-	Occupies eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. <i>Distribution limit: (Sub species victoriae) Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.</i>	no	marginal	no	no	low	no
Striated Fieldwren <i>Calamanthus fuliginosus</i> DPE	V	-	Inhabits low shrubs, tussock, swamp fringes, alpine, coastal heaths and dune-vegetation. <i>Distributed in coastal SE Australia and Tasmania from NW of Sydney through the S and E of Victoria inland to the Grampians NP in S.A.</i>	no	sub optimal	no	no	low	no
Speckled Warbler <i>Chthonicola sagittata</i> DPE	V	-	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland, and urban areas with mature eucalypts. <i>Distribution limit: N-Urbanville. S-Eden.</i>	no	optimal	yes	yes	high	yes
Regent Honeyeater <i>Xanthomyza Phrygia</i> DPE EPBC	E4A	CE	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland, and urban areas with mature eucalypts. <i>Distribution limit: N-Urbanville. S-Eden.</i>	no	sub optimal	no	no	low	no
Painted Honeyeater <i>Grantiella picta</i> DPE EPBC	V	V	A nomadic bird occurring in low densities within open forest, woodland and scrubland feeding on mistletoe fruits. Inhabits primarily Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. <i>Distribution limit: N-Boggabilla. S-Albury with greatest occurrences on the inland slopes of the Great Dividing Range.</i>	no	optimal	no	no	low	no

Common name <i>Scientific name</i> Database source	BC Act	EPBC Act	Preferred habitat <i>Distribution limit</i>	Recorded on site (y/n)	If not recorded on site				Further consideration required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) <i>Notes 1,2 & 3</i>	Record(s) from recent years (y/n) <i>Notes 1,2 & 3</i>	Potential to occur	
Grey-crowned Babbler <i>Pomatostoomus temporalis temporalis</i> DPE	V	-	Found in dry open forests, woodland scrubland, farmland with isolated trees. Distribution Limit mostly west of Great Dividing Range except Hunter Valley. <i>Distribution limit: N-Qld widespread. S-Mornington Pen. E-se SA.</i>	no	optimal	no	no	moderate	no
Varied Sittella <i>Daphoenositta chrysoptera</i> DPE	V	-	Open eucalypt woodlands / forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. <i>Distribution limit: N-Border Ranges National Park. S-South of Eden.</i>	no	optimal	yes	yes	high	yes
Dusky Woodswallow <i>Artamus cyanopterus cyanopterus</i> DPE	V	-	Found in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests, very occasionally in moist forests or rainforests. Prefers habitat with an open understorey. Often observed in farmland tree patches or roadside remnants. <i>Widespread in eastern, southern and south-western Australia.</i>	yes	-	-	-	-	yes
Hooded Robin <i>Melanodryas cucullata cucullata</i> DPE	V	-	Found in eucalypt woodlands, <i>Acacia</i> scrubland, open forest, and open areas adjoining large woodland blocks, with areas of dead timber. <i>Distribution limit: N-Central Qld. S-Spencer Gulf SA.</i>	no	optimal	yes	yes	high	yes
Scarlet Robin <i>Petroica boodang</i>	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum	no	optimal	yes	no	moderate	no

Common name <i>Scientific name</i> Database source	BC Act	EPBC Act	Preferred habitat <i>Distribution limit</i>	Recorded on site (y/n)	If not recorded on site				Further consideratio n required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) <i>Notes 1,2 & 3</i>	Record(s)) from recent years (y/n) <i>Notes 1,2 & 3</i>	Potential to occur	
DPE			woodlands, golf courses, parks, orchards, gardens. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>						
Flame Robin <i>Petroica phoenicea</i> DPE	V	-	Summer: forests, woodlands, scrubs, from sea-level to c. 1800 m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. <i>Distribution limit: N northern NSW tablelands. S-South of Eden.</i>	no	optimal	yes	no	moderate	no
Diamond Firetail <i>Stagonopleura guttata</i> DPE	V	-	Found in eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. <i>Distribution limit: N-Rockhampton Q. S-Eyre Pen Kangaroo Is. SA.</i>	no	marginal	yes	yes	high	yes
Spotted-tailed Quoll <i>Dasyurus maculatus</i> DPE EPBC	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. <i>Distribution limit: N-Mt Warning National Park. S-South of Eden.</i>	no	optimal	no	no	low	no
Koala <i>Phascolarctos cinereus</i> DPE EPBC	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	no	marginal	yes	yes	high	yes
Eastern Pygmy Possum <i>Cercatus nanus</i> DPE	V	-	Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts and bottlebrushes. Nests in banksias and myrtaceous shrubs. <i>Distribution limit: N-Tweed Heads. S-Eden.</i>	no	sub optimal	no	no	low	no
Yellow-bellied Glider <i>Petaurus australis</i>	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. <i>Distribution limit: N-Border Ranges National Park. S-South of Eden.</i>	no	marginal	yes	no	moderate	no

Common name <i>Scientific name</i> Database source	BC Act	EPBC Act	Preferred habitat <i>Distribution limit</i>	Recorded on site (y/n)	If not recorded on site				Further consideration required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) <i>Notes 1,2 & 3</i>	Record(s)) from recent years (y/n) <i>Notes 1,2 & 3</i>	Potential to occur	
DPE									
Squirrel Glider <i>Petaurus norfolcensis</i> DPE	V	-	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. <i>Distribution limit: N-Tweed Heads. S-Albury.</i>	no	sub optimal	no	no	low	no
Greater Glider <i>Petauroides volans</i> EPBC	-	V	Favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species. Population density is optimal at elevation levels at 845 m above sea level. Prefer overstorey basal areas in old-growth tree stands. Highest abundance typically in taller, montane, moist eucalypt forests, with relatively old trees and abundant hollows <i>Distribution limit: N-Border Ranges National Park. S- South of Eden.</i>	no	marginal	yes	no	moderate	no
Long-nosed Potoroo <i>Potorous tridactylus</i> DPE EPBC	V	V	Coastal heath and dry and wet sclerophyll forests with a dense understorey. <i>Distribution limit: N-Mt Warning National Park. S-South of Eden.</i>	no	sub optimal	no	no	low	no
Brush-tailed Rock-wallaby <i>Petrogale penicillata</i> EPBC	E	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. <i>Distribution limit: N-North of Tenterfield. S-Bombala.</i>	no	optimal	no	no	low	no
Grey-headed Flying-fox <i>Pteropus poliocephalus</i> DPE EPBC	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. <i>Distribution limit: N-Tweed Heads. S-Eden.</i>	no	marginal	yes	yes	high	yes

Common name <i>Scientific name</i> Database source	BC Act	EPBC Act	Preferred habitat <i>Distribution limit</i>	Recorded on site (y/n)	If not recorded on site				Further consideration required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) <i>Notes 1,2 & 3</i>	Record(s)) from recent years (y/n) <i>Notes 1,2 & 3</i>	Potential to occur	
Large-eared Pied Bat <i>Chalinolobus dwyeri</i> DPE EPBC	V	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. <i>Distribution limit: N-Border Ranges National Park. S-Wollongong.</i>	no	optimal	yes	yes	high	yes
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i> DPE	V	-	Recorded roosting in caves, old buildings and tree hollows. <i>Distribution limit: N-Border Ranges National Park. S-Pambula.</i>	no	optimal	yes	yes	high	yes
Large Bent-winged Bat <i>Miniopterus orianae oceanensis</i> DPE	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. <i>Distribution limit: N-Border Ranges National Park. S-South of Eden.</i>	yes	-	-	-	-	yes
Southern Myotis <i>Myotis macropus</i> DPIE	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. <i>Distribution limit: N-Border Ranges National Park. S-South of Eden.</i>	yes	-	-	-	-	yes
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> DPE	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. <i>Distribution limit: N-Border Ranges National Park. S-Pambula.</i>	no	optimal	yes	yes	high	yes
Yellow-bellied Sheath-tail Bat				yes	-	-	-	-	yes

Common name <i>Scientific name</i> Database source	BC Act	EPBC Act	Preferred habitat <i>Distribution limit</i>	Recorded on site (y/n)	If not recorded on site				Further consideration required (y/n)
					Suitable habitat present (y/n)	Nearby and/or high number of record(s) (y/n) <i>Notes 1,2 & 3</i>	Record(s)) from recent years (y/n) <i>Notes 1,2 & 3</i>	Potential to occur	
New Holland Mouse <i>Pseudomys novaehollandiae</i> EPBC	-	V	Occurs in heathlands, woodlands, open forest and paperbark swamps and on sandy, loamy or rocky soils. Coastal populations have a marked preference for sandy substrates, a heathy understorey of leguminous shrubs less than 1m high and sparse ground litter. Recolonise of regenerating burnt areas. <i>Distribution limit: N-Border Ranges National Park. S-South of Eden.</i>	no	optimal	yes	yes	high	yes
DPE	- Denotes species listed within 10 km of the development footprint on the <i>Atlas of NSW Wildlife</i>								
EPBC	- Denotes species listed within 10 km of the development footprint in the <i>EPBC Act</i> habitat search								
TBE	- Denotes additional species considered by <i>Travers bushfire & ecology</i> to have potential habitat based on regional knowledge and other records								
V	- Denotes vulnerable listed species under the relevant Act								
E or E1	- Denotes endangered listed species under the relevant Act								
E4a or CE	- Denotes critically endangered listed species under the relevant Act								
NOTE:	1. This field is not considered if no suitable habitat is present within the development footprint 2. 'records' refer to those provided by the <i>Atlas of NSW Wildlife</i> 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle								
Unlikely	Represents such a low margin but not enough to 100% rule it one. A test of significance is required.								
Not likely	Means 0% change of occurring, despite there being potential habitat. A test of significance is not applied to these species.								

Table provides an assessment of potential habitat within the study area for nationally protected migratory fauna species recorded within 10 km on the *EPBC Act* Protected Matters Tool. Nationally *threatened* migratory species are instead considered above in Table .

Table A2-3 – Protected migratory bird habitat assessment (Appendix 2)

Common name <i>Scientific name</i>	Preferred habitat <i>Migratory breeding</i>	Suitable habitat present (y/n)	Recorded on site (y/n)	Comments
Oriental Cuckoo (<i>Cuculus optatus</i>)	Mainly inhabits forests, occurring in coniferous, deciduous and mixed forest. It feeds mainly on insects and their larvae, foraging for them in trees and bushes as well as on the ground.	marginal	no	See Section 3.3.5 for assessment.
Fork-tailed Swift (<i>Apus pacificus</i>)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. Breeds Siberia, Himalayas, east to Japan south east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.	sub optimal	no	-
Rainbow Bee-eater (<i>Merops ornatus</i>)	Open woodlands with sandy, loamy soil; sandridges, sandspits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. <i>Breeding resident in northern Australia. Summer breeding migrant to south east and south west Australia.</i>	marginal	no	See Section 3.3.5 for assessment.
Black-faced Monarch (<i>Monarcha melanopsis</i>)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. <i>Summer breeding migrant to coastal southeast Australia, otherwise uncommon.</i>	sub optimal	no	-
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. <i>Breeds mostly south-east Australia and Tasmania over warmer months, winters in northeast Qld.</i>	sub optimal	no	-
Rufous Fantail (<i>Rhipidura rufifrons</i>)	Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. <i>Breeding migrant to south-east Australia over warmer months. Altitudinal migrant in north-east NSW in mountain forests during warmer months.</i>	sub optimal	no	-
Yellow Wagtail (<i>Motacilla flava</i>)	The yellow wagtail typically forages in damp grassland and on relatively bare open ground at edges of rivers, lakes and wetlands, but also feeds in dry grassland and in fields of cereal crops.	marginal	no	See Section 3.3.5 for assessment.

Appendix 3. Test of Significance

Flora and fauna survey and habitat assessments of the study area have resulted in the identification of suitable habitat for the following threatened biodiversity that was recorded present or considered otherwise with varying potential to occur. The potential for any direct or indirect impacts on species has been considered and noted.

Table A3-1 – Threatened flora impact summary (Appendix 3)

Scientific name	BC Act	Potential to occur	Potential habitat impact
<i>Leucochrysum albicans</i> var. <i>tricolor</i>	E	Unlikely	nil
<i>Solanum armourense</i>	E	Unlikely	nil

Table A3-2 – Threatened fauna impact summary (Appendix 3)

Common name	BC Act	Potential to occur	Potential habitat impact
Dusky Woodswallow	V	recorded	None anticipated
Large Bent-winged Bat	V	recorded	None anticipated
Southern Myotis	V	recorded	Direct – on potential roosting habitat
Large-eared Pied Bat	V	high	None anticipated
Eastern False Pipistrelle	V	high	Direct – on potential roosting habitat
Greater Broad-nosed Bat	V	high	Direct – on potential roosting habitat
Glossy Black-Cockatoo	V	high	None anticipated
Powerful Owl	V	high	None anticipated
Speckled Warbler	V	high	None anticipated
Varied Sittella	V	high	None anticipated
New Holland Mouse	-	high	None anticipated
Hooded Robin	V	high	None anticipated
Diamond Firetail	V	high	None anticipated
Grey-headed Flying-fox	V	high	None anticipated
Scarlet Robin	V	moderate	None anticipated
Flame Robin	V	moderate	None anticipated
Yellow-bellied Glider	V	moderate	None anticipated
Greater Glider	-	moderate	None anticipated
Gang-gang Cockatoo	V	moderate	None anticipated

Common name	BC Act	Potential to occur	Potential habitat impact
Grey-crowned Babbler	V	moderate	None anticipated

Endangered populations

- *Eucalyptus aggregata* in the Wingecarribee local government area.

Threatened ecological communities.

- None.

BC ACT 2016 - SECTION 7.3 TEST OF SIGNIFICANCE

As outlined in Section 7.2 of the *BC Act* development or an activity is *likely to significantly affect threatened species* if:

- It is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in Section 7.3, or
- The development exceeds the threshold if the BOS applies to the impacts of the development on biodiversity values, or
- It is carried out in a declared area of outstanding biodiversity value.

With respect to (a) above, and outlined in Section 7.3 of the *BC Act*, the following *test of significance* is a set of five main considerations, with sub-considerations for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats.

- In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,**

The direct and indirect impacts of the proposal are considered within Section 5.2.

With consideration to the relative direct and indirect impacts on all threatened species with varying potential to occur, it is considered that the proposal is unlikely to disrupt the life cycle of any listed species such that a viable local population would be placed at risk of extinction. Species recorded present during survey, previously recorded nearby or with high potential to occur and requiring further discussion given potential impacts are further discussed in detail below.

Summary of threatened species recorded

Southern Myotis

The Southern Myotis inhabits rainforests and open forests containing creeks and lakes over which it feeds and roosts in tree hollows, caves, mines, under bridges, in tunnels and occasionally buildings (Richards 1995). The Southern Myotis predominantly forages along creek lines and over waterbodies where it takes insects and small fish from on and just below the water surface (Richards 1995).

This species has a strong association with streams and permanent waterways, most frequently at low elevations and in flat or undulating country and usually in areas that are vegetated rather than cleared. They will live in most habitat types if it is near water (Churchill 2008).

This species was recorded during ultrasonic recording and visual survey foraging over dams during 2022.

It is unknown how many suitable hollows will require removal with the development footprint that may provide potentially suitable roosting and breeding habitat for the Southern Myotis. This is based on the presence of hollows of various types, most notably bark exfoliations, branch spouts and trunk splits. Given the high mobility of these species, represented individuals in the locality would be part of a population that extends well beyond the immediate locality.

The locating of hollow bat roost sites by survey is often an exhaustive, costly and unreliable process, particularly as these species often changes roosting locations. Therefore, in the absence of recordings within proposed development areas the assessment for hollow-dependent threatened microbats is often based on the available habitat present and retained for the species within the locality that would support the local population. In this respect the proposed conservation areas as well as other areas of nearby local habitat will remain extensive.

Careful habitat removal measures, relocation of suitable hollows and provision of supplementary roosting habitat measures for these species have been considered and incorporated into the mitigation and amelioration of impacts outlined in Section 5.4. Such measures will ensure that if a colony is found to be roosting within the development footprint at the time of habitat removal, this will be safely recovered and effectively relocated within the relevant hollow section. Suitable hollows within the development landscape will, where possible, also be similarly relocated to reduce the total impact of hollow removal in the immediate area.

Re-used hollows or those with likely occupation are to be relocated to conservation areas within proximity to the site. All other hollows removed should be replaced with nest boxes. Every second box should be a design suitable for microbat species. Boxes should be constructed all weatherproof timber (marine ply), fasteners and external paint.

Large Bent-winged Bat

The Large Bent-winged Bat forages above and below the canopy within open forests and woodlands, feeding on small flying insects, predominantly moths (Dwyer 1995). Large Bent-winged Bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and caves (Dwyer 1995). This species has not been identified as utilising culverts for maternity roosts. Maternity roosts rather are occupied by up to 100 000 females with only 12 maternity roosts known throughout the complete range (Hoy & Hall 2008). Roost sites in tree hollows have not been reported within the literature reviewed.

For this species caves are an important resource, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer 1995).

Given the highly mobile nature of this species, the absence of any important habitat within or in proximity to the development footprint, their known ability to move across and utilise some urban landscapes and that the proposed development will not inhibit local movements and dispersal, no abovementioned species will be likely significantly impacted by the proposed habitat clearance.

Dusky Woodswallow

The Dusky Woodswallow is often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests (Higgins and Peter 2002).

At sites where Dusky Woodswallows are recorded the understorey is typically open with sparse eucalypt saplings, acacias, and other shrubs, including heath (Higgins and Peter 2002). The ground cover may consist of grasses, sedges, or open ground, often with coarse woody debris (Higgins and Peter 2002). Birds are also often observed in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber (Higgins and Peter 2002; M. Schulz *in litt.* November 2014).

Fledglings appear to disperse with the flock but return to the birth site in subsequent years (Higgins and Peter 2002). Nesting is usually solitary but occasionally occurs in loose colonies of up to 20 nests (Higgins and Peter 2002). The Dusky Woodswallow is monogamous and nests in pairs although cooperative breeding sometimes occurs (Higgins and Peter 2002). Although Dusky Woodswallows have large home ranges, individuals may spend most of their time in about a 2-ha range and defend an area about 50 m around the nest (Higgins and Peter 2002).

The Dusky Woodswallow primarily eats invertebrates, mainly insects, which are captured whilst hovering and sallying above the canopy or over water (Higgins and Peter 2002). BirdLife International (2014) estimated the generation length to be five years.

Studies have shown Dusky Woodswallows occur in greater abundance within remnant forest and woodlands compared with other vegetation types. Paddocks without remnant trees had no occurrence of this species (Hannah et al. 2007).

The Dusky Woodswallow was observed within the development footprint in 2022 survey. Given that the retention of vegetated areas, and existing habitat within their home range is otherwise well represented, it is not expected that the proposal will have a significant effect on Dusky Woodswallow.

(b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

i. Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

The Threatened Species Test of Significance Guidelines (OEH 2018c) define local occurrence as:

“The ecological community that occurs within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.”

PCT3483 Central Gorges Box-Red Gum Grassy Forest does is not associated with an endangered ecological community. Therefore, it is considered that the proposed development is unlikely to have an adverse effect on the extent of any ecological community such that its local occurrence is likely to be placed at risk of extinction.

- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

PCT3483 Central Gorges Box-Red Gum Grassy Forest is not associated with an endangered ecological community. Therefore, it is considered that the proposed development is unlikely to have an adverse effect on the extent of any ecological community such that its local occurrence is likely to be placed at risk of extinction.

(c) In relation to the habitat of threatened species or ecological community:

It is considered that the habitat attributes of the development footprint provide known or potential habitat for Dusky Woodswallow, Large Bent-winged Bat, Southern Myotis, Large-eared Pied Bat, Eastern False Pipistrelle, Greater Broad-nosed Bat, Glossy Black-Cockatoo, Powerful Owl, Speckled Warbler, Varied Sittella, New Holland Mouse, Hooded Robin, Diamond Firetail, Grey-headed Flying-fox, Scarlet Robin, Flame Robin, Yellow-bellied Glider, Greater Glider, Gang-gang Cockatoo and Grey-crowned Babbler.

- i. The extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and**

The proposed development is likely to remove or modify approximately 1.3 ha of poor-moderately disturbed vegetation and 7.49 ha of pasture.

- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and**

The development footprint is covered by a mixture of disturbed natural bushland, cleared areas and a former residence, now used as an office. The proposal will not fragment or isolate currently connected areas of habitat. The proposed development has been designed to be located predominantly within the existing cleared areas of the site.

Therefore, it is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated or fragmented as a result of the proposal.

- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality**

In respect to threatened fauna species recorded or with potential to occur the proposed area of impact is not likely of high quality or central to the home range requirements of any species such that behaviour or ecology of these species will be significantly altered in any way. However, it should be noted that it is unknown how many trees require removal for the development proposal and if these trees contain any hollows that may provide potential roosting habitat for the recorded Southern Myotis. Given that highly suitable foraging and roosting habitat will remain in high abundance within the subject lots and in surrounding lands, the development proposal is not expected to have a significant impact habitat considered of breeding importance.

The planning proposal is likely to impact approximately 1.3 ha of PCT 3483 – Central C=Gorges Box-Red Gum Grassy Forest in poor-moderate condition and 7.49 ha of pasture.

Given the occurrence of at least 500 ha of similar vegetation adjoining the development footprint and the retention of 98% of the existing habitats within the site, the importance of the habitat to be removed, modified, fragmented, or isolated to the long-term survival of the species, population and ecological communities in the locality is considered to be minimal.

(d) Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

The development footprint is not within any declared area of outstanding biodiversity value. Therefore, the proposal will not have any adverse effects on any declared area of outstanding biodiversity value (either directly or indirectly).

(e) Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

A key threatening process is defined as a process that threatens, or could threaten, the survival or evolutionary development of species, populations, or ecological communities.

The current list of key threatening processes, and whether the proposed activity is recognised as a threatening process, is shown below.

Listed key threatening process	Development a threatening process?		
	Likely	Possible	Unlikely
Aggressive exclusion of birds by Noisy Miners (<i>Manorina melanoccephala</i>)			✓
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic Climate Change			✓
Bushrock removal		✓	
Clearing of native vegetation			✓
Competition and habitat degradation by feral goats			✓
Competition and grazing by the feral European Rabbit (<i>Oryctolagus cuniculus</i>)			✓
Competition from feral honeybees			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life-cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants into NSW			✓

Listed key threatening process	Development a threatening process?		
Infection by <i>Psittacine circoviral</i> (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis		✓	
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae		✓	
Infection of native plants by <i>Phytophthora cinnamomi</i>		✓	
Introduction of the large earth bumblebee (<i>Bombus terrestris</i>)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch Broom (<i>Cytisus scoparius</i>)			✓
Invasion and establishment of the Cane Toad (<i>Bufo marinus</i>)			
Invasion, establishment and spread of <i>Lantana camara</i>			✓
Invasion of native plant communities by bitou bush & boneseed <i>Chrysanthemoides monilifera</i>			
Invasion of native plant communities by exotic perennial grasses			✓
Invasion of native plant communities by African Olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>)			✓
Invasion of the Yellow Crazy Ant (<i>Anoplolepis gracilipes</i>)			
Loss of Hollow-bearing trees			✓
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants			✓
Loss and/or degradation of sites used for hill-topping by butterflies			✓
Predation and hybridisation by feral dogs (<i>Canis lupus familiaris</i>)			✓
Predation by the European Red Fox (<i>Vulpes vulpes</i>)			✓
Predation by the Feral Cat (<i>Felis catus</i>)			✓
Predation by <i>Gambusia holbrooki</i> Girard, 1859 (plague minnow or mosquito fish)			✓
Predation by the Ship Rat (<i>Rattus rattus</i>) on Lord Howe Island			✓
Predation, habitat degradation, competition & disease transmission from Feral pigs (<i>Sus scrofa</i>)			✓
Removal of dead wood and dead trees			✓

The above key threatening processes have been considered in reference to the proposal. It was considered that the proposal may contribute to a small degree to a number these processes as described below. It was not considered that the proposal will have a large or significant impact on any of the following key threatening processes. Some mitigation measures have been listed under each process to minimise or reduce such impacts upon those processes.

Summary of “likely” or “possible” Key Threatening Processes

This section identifies what mitigation measures can be implemented to address threatening processes.

Aggressive exclusion of birds by Noisy Miners (Manorina melanocephala)

Noisy Miners have been recorded present within the study area. It is likely that Noisy Miners from within the study area may be slightly displaced as a result of habitat removal for the development, resulting in increased impacts from this species on other native birds in the nearby surrounds. Given the high degree of disturbance in the local surrounds it is expected that the Noisy Miner is already at impacting numbers in these areas.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

In accordance with the Water Management Act, consideration is to be given to the impact of the proposed action on local watercourses and native vegetation riparian buffers and stormwater measures will need to be implemented in accordance with a required Controlled Activity Approval issued by the NRAR. The proposal is unlikely to modify and re-divert stormwater runoff from development areas (impermeable road and property surfaces) and concentrate this increased flow into Wingecarribee River.

Anthropogenic Climate Change

The proposal will require the removal of a small amount of vegetation which will result in a negative or positive contribution to climate change. Vegetation is considered to act as a sink for a range of greenhouse gases but in particular Carbon Dioxide. The maintenance of native vegetation cover is a key strategy to combat the contributing impacts of the proposed action on Climate Change. Increased risk of bushfire, flooding and storms are to be considered as part of the proposed action. Vegetation also acts as a heat sink, and provides important shade, particularly in urban areas. This issue requires total systems management including consideration of energy use throughout the lifecycle of the proposed action including all aspects of the actions processes, materials supply and production. Whilst almost insignificant in size, the proposal is part of the accumulative effect and thus should be considered as contributing to this threatening process.

Bushrock removal

The proposed building envelopes are not located over any high-quality rocky outcrop habitat areas particularly valued rock on rock habitat. The proposal may remove naturally occurring surface bushrock within the development and access road areas and as such would be a class of development or activity that is recognised as a threatening process. The proposal should where possible maintain bush rock cover onsite. Where bushrock will be disturbed this should be relocated over other locations where surface outcrops occur closer to continuous terrestrial habitats.

Clearing of native vegetation

The proposal is of a class of development recognised as a threatening process. It is generally recommended that all sites should aim to achieve a maintain or improve outcome on the quality and quantity of native vegetation cover through protection and restoration measures. The vegetation management process is to be undertaken in accordance with the conditions of consent and any required vegetation and tree management plans for the proposed development. Offsetting the loss of native vegetation including trees is to be considered as part of the proposed works. The removal of native vegetation on the development footprint is not likely to significantly affect the biodiversity of the local area due to the extent of better-quality natural vegetation within the local area and the small area of vegetation to be removed.

Competition and grazing by the feral European rabbit

It is expected that the proposed development will increase or decrease the potential for rabbit invasion. Rabbit management and control such as through exclusion fencing, destruction of warrens and target “Pindone” baiting is recommended as a standard protocol.

Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis

The proposal is of a class of development recognised as a threatening process due to the increased possibility of chytrid fungus cross-contamination from pedestrian and vehicle activity during the construction phase, and to a lesser extent post development. It would be recommended to ensure that equipment working within wet areas does not enter the site in a wet state and is left to dry before any movement to wet areas on other sites. In addition, all machinery, tracks and wheels, and footwear of persons or equipment entering the site should be treated with fungicides in accordance with the *Hygiene Protocol for the Control of Diseases in Frogs* (DECC 2008).

High frequency fire resulting in the disruption of life-cycle processes in plants and animals and loss of vegetation structure and composition.

The proposal will result in increased human presence surrounding the local bushland interface which is a vegetation structure susceptible to fire. Increased human presence results in increased potential for ignition points for fires into the surrounding landscape.

Infection of native plants by *Phytophthora cinnamomi*

The proposal may temporarily increase the risk of fungal infection on site as it may be spread via vehicular movement and relocation of soil and vegetation. Consequently, standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres or tracks. Any equipment found to contain soil or vegetation material from offsite is to be cleaned in a quarantined work area or wash station and treated with fungicides prior to commencing work.

Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

‘Myrtle Rust’ may be spread via machinery, animals, and humans as well as by environmental factors such as wind. The presence of machinery and construction works is likely to slightly increase the potential for spread of this key threatening process. Similar protocols as to *Phytophthora cinnamomi* should be applied.

Invasion of native plant communities by exotic perennial grasses

The proposed development is not expected to significantly increase the prevalence of exotic perennial grasses. It is expected that the proposed development will provide an opportunity to manage the area with regard to weed invasion. It is recommended that native ground covers be utilised as part of the future landscaping works and weed control is applied to reduce spread and establishment of exotic perennial grasses into remnant native vegetation.

Loss of hollow-bearing trees

Hollow-bearing trees were not surveyed during the fauna survey. Hollow-bearing trees observed during opportunistic survey were found to contain good quality small to medium hollows. None of these hollows are considered suitable for threatened large forest owls or

Cockatoos however, without further in-depth survey over the entire site it cannot be determined that large hollows suitable for the abovementioned species are absent.

The hollows noted through survey may however be suitable for hollow-dependent threatened species with considered potential to occur including Southern Myotis, Eastern False Pipistrelle, Greater Broad-nosed Bat, Yellow-bellied Sheath-tailed Bat and Squirrel Glider. Of these species one the Southern Myotis was recorded during survey however, without further survey during warmer temperatures and variable locations across the study site additional species may be detected. With this in consideration, such hollows may be utilised for roosting and breeding. Therefore, we recommend retention of hollows where possible within the development landscape.

Predation by the European red fox

It is expected that the proposed development will provide an opportunity to manage the area with regard to European red fox invasion. European red fox management is encouraged for the retained vegetated areas of the development footprint.

Predation by Plague Minnow or Mosquito Fish (*Gambusia holbrooki*)

This pest fish species was recorded present within the dams during fauna surveys. The study area has highly diminished habitat value for Green and Golden Bell Frogs where Plague Minnow is present. It is expected that the proposed master plan could provide an opportunity to manage the area with regard to Plague Minnow invasion.

The proposal will require the implementation of stormwater management methods which may include open water swales. Such areas will be susceptible to invasion by Plague Minnow if of a permanent nature. The Threat Abatement Plan for Predation by The Plague Minnow (NPWS 2003) states that the only effective control measures to achieve effective control of *Gambusia* is to drain and dry out the basin. This process will kill all fish species present and often other fauna species. Given the level of earthworks proposed for the south-eastern dam and drainage system it may be a viable option to drain and dry the waterbodies present.

Removal of dead wood and dead trees

The proposal will not require the removal of deadwood or dead trees and as such is of a class of development recognised as a threatening process. Threatened fauna species with potential habitat within the development footprint and likely dependent on dead wood or dead trees include Varied Sittella and Scarlet Robin. These species have not been recorded to date within the study area. Given the availability of habitat associated with deadwood and dead trees present within lands surrounding the development areas, the removal of dead wood and dead trees is not considered likely to impact on threatened species or the biodiversity of the local area.

Appendix 4. EPBC Significance Assessment Criteria

Under the *EPBC Act* an action will require approval from the Australian Government Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. The following significant impact criteria were sourced from the *EPBC Act* Policy Statement 1.1 (May 2006):

CRITICALLY ENDANGERED AND ENDANGERED SPECIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population.
- Reduce the area of occupancy of the species.
- Fragment an existing population into two or more populations.
- Adversely affect habitat critical to the survival of a species.
- Disrupt the breeding cycle of a population.
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.
- Introduce disease that may cause the species to decline, or
- Interfere with the recovery of the species.

What is a population of a species?

A 'population of a species' is defined under the *EPBC Act* as an occurrence of the species in a particular area. In relation to critically endangered, endangered, or vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within a particular bioregion.

What is habitat critical to the survival of a species or ecological community?

- What is habitat critical to the survival of a species or ecological community?
- '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.

Such habitat may be but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the *EPBC Act*.

VULNERABLE SPECIES

Significant impact criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species.
- reduce the area of occupancy of an important population.
- fragment an existing important population into two or more populations.
- adversely affect habitat critical to the survival of a species.
- disrupt the breeding cycle of an important population.
- modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.
- introduce disease that may cause the species to decline or
- interfere substantially with the recovery of the species.

What is an important population of a species?

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.

CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- Reduce the extent of an ecological community.
- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.
- Adversely affect habitat critical to the survival of an ecological community.
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.
- 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.
- 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
- Interfere with the recovery of an ecological community.

MIGRATORY SPECIES

Significant impact criteria

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

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

What is an ecologically significant proportion?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species-specific behavioural patterns (for example, site fidelity and dispersal rates).

What is the population of a migratory species?

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

Appendix 5. Microbat Call Analysis

SUMMARY OF RESULTS			
ID Method	Result	Threatened	Confidence (Probability low to high)
Characteristic frequency + up-sweeping tail	<i>Vespadelus vulturnus</i>	x	High
Down-sweeping tail + irregular pulse intervals	<i>Miniopterus orianae oceanis</i>	✓	High
Characteristic frequency + even pulses + down-sweeping tail.	<i>Vespadelus darlingtoni</i>	x	High
Characteristic frequency + call shape	<i>Nyctophilus sp or Myotis macropus</i>	✓ (Myotis only)	Probable
Characteristic frequency + call shape	<i>Nyctophilus sp 2.</i>	x	Probable

HABITAT & SURVEY CONDITIONS
Survey was conducted in an open habitat. One positioned over a dam and the second positioned overlooking Wingecarribee River. The weather at the time of survey was 8/8 cloud, 15km/h NE wind, 2.6ml rain, 2/4 moon, 16.9°C.

METHOD DESCRIPTION
Two Anabat Swift (full spectrum) with omnidirectional microphones were used to record bat calls. All recorded files were run through a decision tree in Anabat Insight which filtered out non-bat files and labelled bat files with either a species or species complex. Each automatically labelled file was then manually verified. The call from each species/species complex that was most confidently identified was selected to be used as the image in the “Results” section of this report. All images were taken from within Anabat Insight and shown in either compressed or uncompressed mode, depending on which image best highlights diagnostic features. All full-spectrum recordings are shown in full-spectrum with a zero-crossing overlay.

CALL REFERENCE LIBRARY
Calls were identified using the “Bat Calls of NSW” by Pennay <i>et al.</i> (2004) regional guide, the “Key to the bat calls of south-east Queensland and north-east New South Wales” by Reinhold <i>et al.</i> (2001), and the “Bat Calls of Central Eastern NSW” by Titley Scientific (2009). Additional call metrics have also been collected for specific bat species from discussions with recognised bat experts including Michael Pennay, Brad Law and Greg Ford.

RESULTS

The calls of three species and one species complex were identified from the Joadja recordings. One threatened species (*Miniopterus schreibersii oceanensis*) was identified.

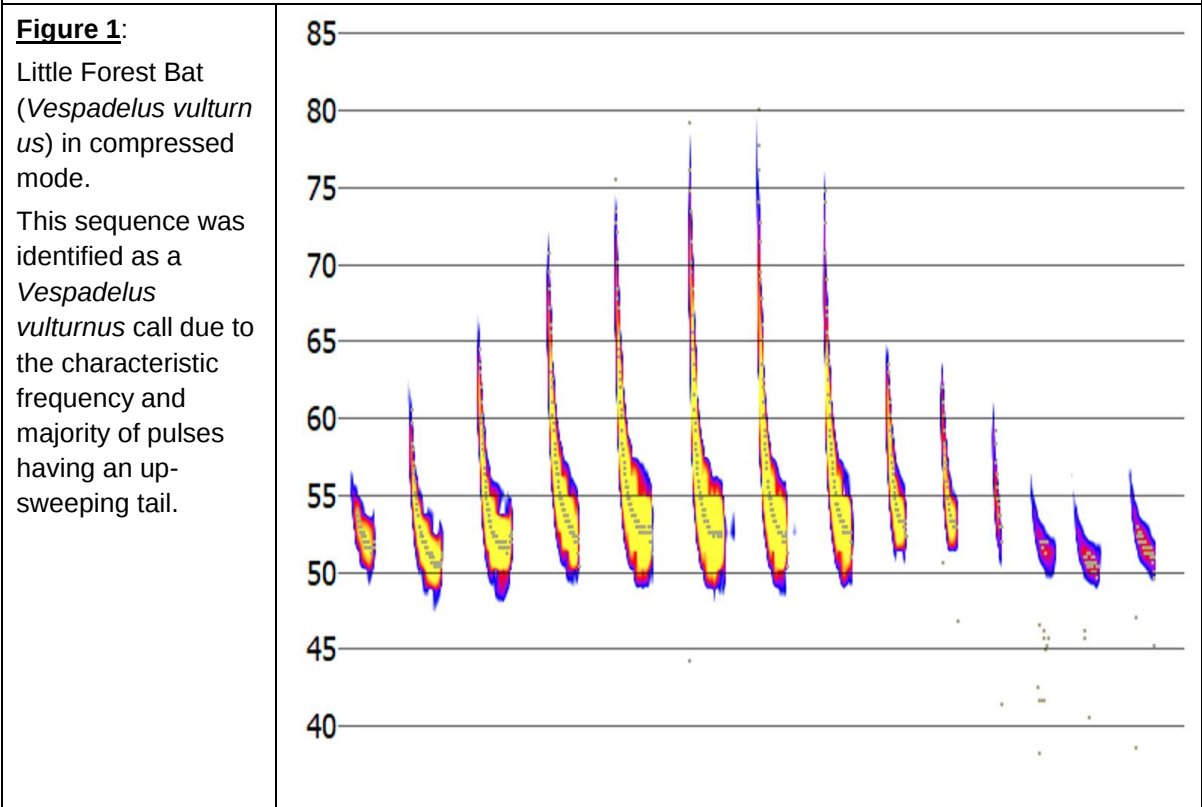


Figure 2:

Large bent-winged Bat (*Miniopterus orianae oceansis*) in uncompressed mode.

This sequence was identified as *M. o. oceansis* call due to the majority of pulses having a down-sweeping tail and a characteristic frequency of 47 kHz.

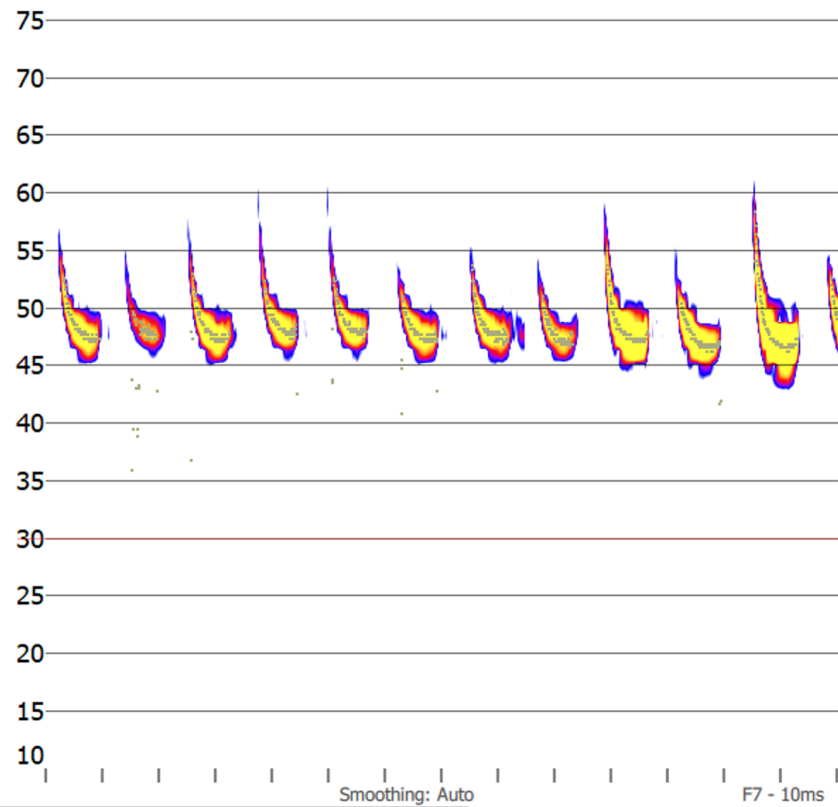


Figure 3:

Large Forest Bat
(*Vespadelus
darlingtoni*) in
compressed mode.

This sequence was
identified as a
*Vespadelus
darlingtoni* call due
to the characteristic
frequency and the
majority of pulses
being even ,
consecutive and
displaying a down-
sweeping tail.

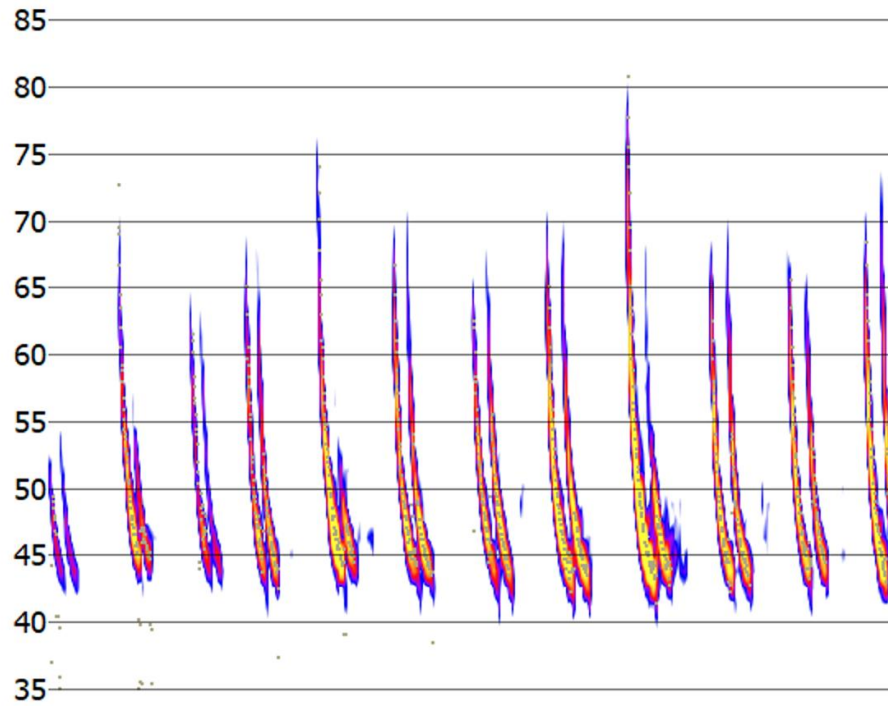


Figure 4:
Unidentified Long-eared Bat (*Nyctophilus spp.*) or Southern Myotis (*Myotis Macropus*)

This sequence was identified as *Nyctophilus spp.* or *Myotis* call due to the steep vertical call starting between 65-80 kHz and dropping off between 35-43 kHz with a pulse interval between 95-300 OPS. Characteristic frequencies of *Nyctophilus species* and *Myotis* call shape and frequencies overlap and can be indistinguishable from each other.

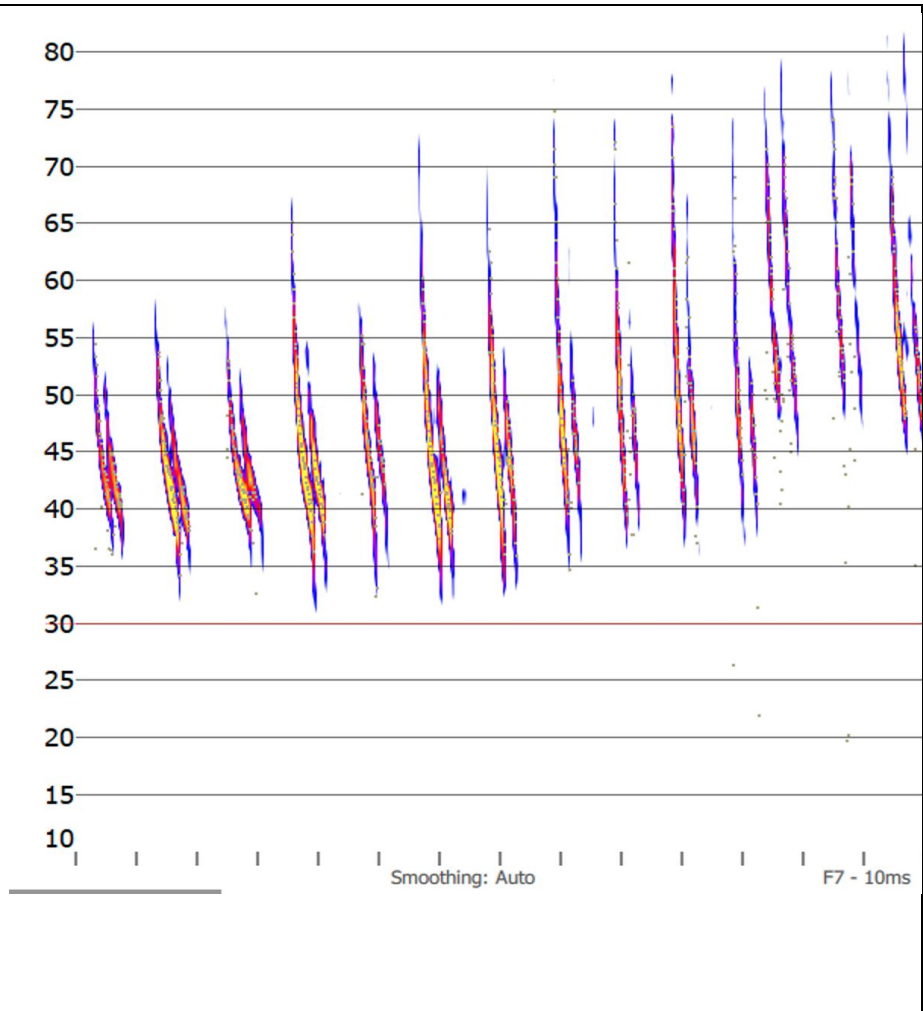


Figure 5:

Unidentified Long-eared Bat (*Nyctophilus spp.*) in compressed mode.

This sequence was identified as another *Nyctophilus spp.* call due to the steep vertical call starting between 65-80 kHz and dropping off between 35-43 kHz with a pulse interval between 95-300 OPS. Characteristic frequencies of *Nyctophilus species* call shape and frequencies overlap and can be indistinguishable from each other.

