

A vertical photograph of a grey squirrel climbing a tree trunk. The squirrel is positioned on the left side of the image, facing upwards with its mouth open. Its front paws are gripping the bark, and its hind legs are also visible. The tree bark is rough and textured. The background is a solid blue gradient.

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Biodiversity Assessment Report

Cumberland State Forest
(Castle Hill Road and Oratava Avenue)
West Pennant Hills

May 2019
(REF: 18FCNSW02)



Biodiversity Assessment Report

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(Castle Hill Road and Oratava Avenue)
West Pennant Hills**

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File:	18FCNSW02

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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 are to be confirmed by a registered surveyor.

Executive Summary

Travers bushfire & ecology has been engaged to prepare a biodiversity assessment report (BAR) for the proposed rezoning of two (2) portions of the Cumberland State Forest lands at Castle Hill Road, and Oratava Avenue, West Pennant Hills for residential development (R2 zoning). There is currently residential development adjacent to both proposed rezoning sites that are currently zoned R2.

The lands and natural bushland contained within the Cumberland State Forest and considered for suitability of habitat for threatened species will be referred to as the 'study area'. The 'subject site' alternatively refers to the two areas under potential direct impacts associated with the rezoning. Given that these are two separate locations at the northern and southern extremities of the study area and that more detailed ecological investigations were undertaken within and immediately surrounding these two sites, then the study area was ideally separated into a northern and southern study area. Figure 1.4 shows the study area and subject sites and Figure 2 shows the 'detailed investigation areas' both in the north and south where survey was concentrated.

Planning proposal

The proponent intends to de-register and divest the land. The envisioned development outcome is low density residential, consistent with the adjoining land.

It is appropriate to submit a planning proposal to Council seeking to rezone both sites (Castle Hill Road and Oratava Avenue). Subdivision would occur through the development application process following rezoning. It is appropriate to seek a rezoning from RU3 Forestry to R2 Low Density for both sites (Castle Hill Road and Oratava Avenue).

Recorded biodiversity

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979 (EP&A Act)*, the *Biodiversity Conservation Act 2016 (BC Act)*, the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* and the *Fisheries Management Act 1994 (FM Act)*.

In respect of matters required to be considered under the *EP&A Act* and relating to the species / provisions of the *BC Act*, five (5) threatened fauna species including Little Lorikeet (*Glossopsitta pusilla*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Greater broad-nosed Bat (*Scoteanax rueppellii*), one (1) threatened flora species, *Eucalyptus scoparia* (planted specimen) and two (2) threatened ecological communities (TECs), Blue Gum High Forest and Sydney Turpentine Ironbark Forest were recorded within the study area. The Powerful Owl and Greater Broad-nosed Bat were both recorded only to a 'probable' level of certainty.

In respect of matters required to be considered under the *EPBC Act*, one (1) threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), one (1) protected migratory bird species White-throated Needletail (*Hirundapus caudacutus*), one (1) threatened flora species, *Eucalyptus scoparia* (planted specimen) and two (2) TECs, Blue Gum High Forest and Turpentine Ironbark Forest threatened ecological communities listed under this Act were recorded within the study area.

In respect of matters relative to the *FM Act*, no suitable habitat for threatened marine or aquatic species was observed within the subject site.

Biodiversity Offsets Scheme (BOS) – Threshold Assessment

The proposed rezoning and subsequent future development will impact on areas mapped as containing biodiversity values, therefore biodiversity offsets are required under the Biodiversity Offsets Scheme (BOS).

Constraints analysis

The potential direct, indirect and cumulative impacts of development associated with the rezoning have been considered in Section 5.2 of this report. Recommendations have been outlined within Section 5.3 to avoid/minimise/offset these impacts.

The rezoning area will impact on areas that have been mapped as a sensitive biodiversity area by OEH, and consequently will require assessment through the Biodiversity Offset Scheme (BOS).

As the proposed layout is not finalised, an assessment of significance has not been undertaken. Although there is only a small amount of vegetation to be impacted, being less than 0.5ha of native vegetation, and it does not cause fragmentation or isolation of TECs, both are highly cleared vegetation types and any impact may be considered to be significant. The proposal must demonstrate measures of avoidance, minimisation of impacts and offset measures. If a proposed activity will have a significant impact or will be carried out in an area of outstanding biodiversity value, and the proponent does not opt in to the Biodiversity Offsets Scheme, a SIS must be prepared and agreement sought from the Chief Executive of Office of Environment and Heritage.

The requirements of an SIS are set out in s.7.6 of the Biodiversity Conservation Regulation 2017. The proponent must also seek and comply with the Office of Environment and Heritage Chief Executive's requirements for SIS preparation.

The proposal is not likely to have a significant impact upon threatened species as it will not be causing a detrimental impact upon breeding habitat.

The principles for determining serious and irreversible impacts (SAIIs) are set out under Section 6.7.2 of the *BC Regulation 2017*. These principles will be reviewed for the development application, not for rezoning purposes. The TECs are both listed as potential SAIIs, as well as some microbat species with potential to occur. These microbats have no breeding habitat present thus are not likely to offer constraint.

A significance assessment will need to be conducted under the *EPBC Act* as the proposal will impact on TECs which are nationally listed. Given the small area of impact, it may not require a referral.

There will be no significant impact on matters listed under the *FM Act*.

Biodiversity 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:

The direct impacts of the proposal within the subject site are considered as:

- Removal of hollows with low potential use by threatened species
- 0.136ha of PCT 1237 (Blue Gum High Forest)

- 0.344ha of PCT 1281 (Sydney Turpentine Ironbark Forest)
- Up to 0.48ha loss of vegetated habitat for threatened species

The potential indirect impacts of the proposal are considered as:

- Edge effects such as weed incursions into the adjacent natural habitat areas.
- Increased spill-over from noise, activity, scent and lighting effects into the adjacent quality natural habitat areas.
- Increased soil nutrients from changes to runoff that may provide further opportunities for weed plumes.
- Concentrated stormwater runoff from solid surfaces and increased flows.

Conclusions

Impacts on the areas ecology are limited to just below 0.5ha and surrounded by adjoining >40ha of bushland of Sydney Turpentine Ironbark Forest and Blue Gum High Forest in the Cumberland State Forest and adjoining former IBM land (immediately west). They don't host naturally occurring threatened flora species, and do not host important breeding habitat for threatened fauna species.

The proposed rezoning from RU3 to R2 is suitable for the locality, however will be subject to the BOS (or Species Impact Statement), will require a full Biodiversity Development Assessment Report (BDAR), assessment of SAILs and an assessment upon *EPBC Act* matters.

List of abbreviations

APZ	asset protection zone
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BC Act	<i>Biodiversity Conservation Act (2016)</i>
BC Reg	<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
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 OEH from April 2011)
DEWHA	Commonwealth Department of Environment, Water, Heritage & the Arts (superseded by SEWPAC)
DOEE	Commonwealth Department of Environment & Energy
EEC	endangered ecological community
EPA	Environmental Protection Agency
EP&A Act	<i>Environmental Planning and Assessment Act (1979)</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act (1999)</i>
FM Act	<i>Fisheries Management Act</i>
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	local environmental plan
LGA	local government area
LLS Act	<i>Local Land Services Act (2013)</i>
NES	national environmental significance
NPW Act	<i>National Parks and Wildlife Act (1974)</i>
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage
PCT	plant community type
RFS	NSW Rural Fire Service
ROTAP	rare or threatened Australian plants
SAII	Serious And Irreversible Impacts
SEPP	State Environmental Planning Policy
SEWPAC	Commonwealth Dept. of Sustainability, Environment, Water, Population & Communities (superseded by DOEE)
SIS	species impact statement
SULE	safe useful life expectancy
TEC	threatened ecological community
TPZ	tree preservation zone
TSC Act	<i>Threatened Species Conservation Act (1995) – Superseded by the Biodiversity Conservation Act (2016)</i>
VMP	vegetation management plan

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Introduction

1

Travers bushfire & ecology has been engaged to prepare a Biodiversity Assessment Report (BAR) for the proposed rezoning of two (2) portions of the Cumberland State Forest lands at Castle Hill Road, and Oratava Avenue, West Pennant Hills for residential development (R2 zoning). There is currently residential development adjacent to both proposed rezoning sites that are currently zoned R2.

The lands and natural bushland contained within the Cumberland State Forest and considered for suitability of habitat for threatened species will be referred to as the 'study area'. The 'subject site' alternatively refers to the two areas under potential direct impacts associated with the rezoning. Given that these are two (2) separate locations at the northern and southern extremities of the study area and that more detailed ecological investigations were undertaken within and immediately surrounding these two sites, then the study area was ideally separated into a northern and southern study area. Figure 1.4 shows the study area and subject sites and Figure 2 shows the 'detailed investigation areas' both in the north and south where survey was concentrated.

1.1 Purpose

The purpose of this Biodiversity Assessment Report (BAR) are to:

- Carry out a botanical survey to describe the vegetation communities and their conditions
- Carry out a fauna habitat survey for the detection and assessment of fauna and their potential habitats
- Complete targeted surveys for threatened species, populations and ecological communities
- Prepare a biodiversity constraints analysis in accordance with the requirements of the:
 - a) *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*,
 - b) *Biodiversity Conservation Act 2016 (BC Act)*,
 - c) *Biodiversity Conservation Regulation 2017 (BCR)*, and
 - d) *Fisheries Management Act 1994 (FM Act)*.

Terminology

Throughout this report the terms subject site and study area are used. It is important to have a thorough understanding of these terms as they apply to the assessment.

Subject site means the area directly affected by the proposal.

Study area means the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly. The study area should extend as far as is necessary to take all potential impacts into account. For this site a more 'detailed investigation zone' has been surveyed both within a northern and southern study area within the Cumberland State Forest given the separation distance of the two subject sites.

Direct impacts are those that directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.

Indirect impacts occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development.

1.2 Site description

1.2.1 Site overview

Table 1.1 provides an overview the planning, cadastral and topographical details of the study area and an overview of the site and surrounds is shown on Figures 1.5 and 1.6 (site and location maps).

Table 1.1 – Site features

Location	Part Lot 4, 5, 6, 7, 15, 16 and 17 DP 11133. Castle Hill Road and Oratava Avenue, West Pennant Hills.
Location description	There are two (2) sites, northern area and southern area, both located within the Cumberland State Forest at West Pennant Hills. The northern area includes part Lot 4, 5, 6 and 7 adjacent to the northern boundary of the State Forest along Castle Hill Road. The southern area includes part Lot 15, 16 and 17.
Area	Impact area is approximately 0.75ha, including 0.48ha of remnant degraded or modified native vegetation.
Local government area	The Hills
Zoning	RU3 Forestry
Grid reference MGA-56	Northern area - 318300E 6264900N / Southern area – 318500E 6263900N
Elevation	Northern area – approx.. 160m / Southern area – approx.. 110m AHD
Topography	Northern area - situated on a moderate sloping ridgetop / Southern area – situated on a relatively flat slope leading towards a riparian line.
Catchment	Catchment – Darling Mills Creek
Existing land use	There are some existing dwellings and previous vegetation clearance within the proposed rezoning areas.

1.2.2 Landscape features

Table 1.2 examines the landscape features of the proposed development site in accordance with the BAM.

Table 1.2 – Landscape features

Operational footprint	As shown in Figure 1.5 – subject site
Construction footprint	Unknown
IBRA bioregions and subregions	Sydney Basin bioregion – Cumberland subregion (Figure 1.5 and 1.6)
NSW landscape region and area	Pennant Hills Ridges
Native vegetation extent in the buffer area	192 ha approx..
Percent native vegetation cover in the landscape (1500m buffer)	18%
Evidence to support differences between mapped vegetation extent and aerial imagery	Regional mapping Ground truthed vegetation mapped
Rivers and streams classified according to stream order	The site map (Figure 1.3) shows the local streams and their stream orders. The northern area is approximately 250m from a 1 st order stream. The southern area is approximately 100m south of a 2 nd order stream.
Wetlands within, adjacent to and downstream of the site	There are no wetlands within either the northern or southern areas or in close proximity.
Connectivity features	The Cumberland State Forest and adjoining former IBM land contains extensive Sydney Turpentine Ironbark Forest and Blue Gum High Forest. There is fragmented connectivity along Castle Hill Road to the east, and along tributaries of Darling Mills Creek to the south-west.
Areas of geological significance and soil hazard features	Geology; Wianamatta Shales cover most of the Cumberland State Forest, with Hawkesbury Sandstone near the southern boundary. Soils; Glenorie Soil Landscape The sites are not located in areas of geological significance or upon significant soils hazard areas.
Identification of method applied (i.e. linear or site-based)	Site based assessment

1.2.3 Zoning

The site is currently zoned RU3 under The Hills LEP of 2012 which is for forestry. The proposal seeks to amend the zoning to R2 for residential development, the same as the immediately adjoining areas.

1.3 Proposed rezoning

The proponent intends to de-register and divest the land. The envisioned development outcome is low density residential, consistent with the adjoining land.

It is appropriate to submit a planning proposal to Council seeking to rezone both sites (Castle Hill Road and Oratava Avenue). Subdivision would occur through the development application process following rezoning. It is appropriate to seek a rezoning from RU3 Forestry to R2 Low Density for both sites (Castle Hill Road and Oratava Avenue).

1.3.1 Identification of development site footprint

The identification of the development site footprint (in the future) will be constrained to within the proposed rezoning areas in the north and the south within the Cumberland State Forest. Future development and impacts are expected to be contained within the rezoning areas.

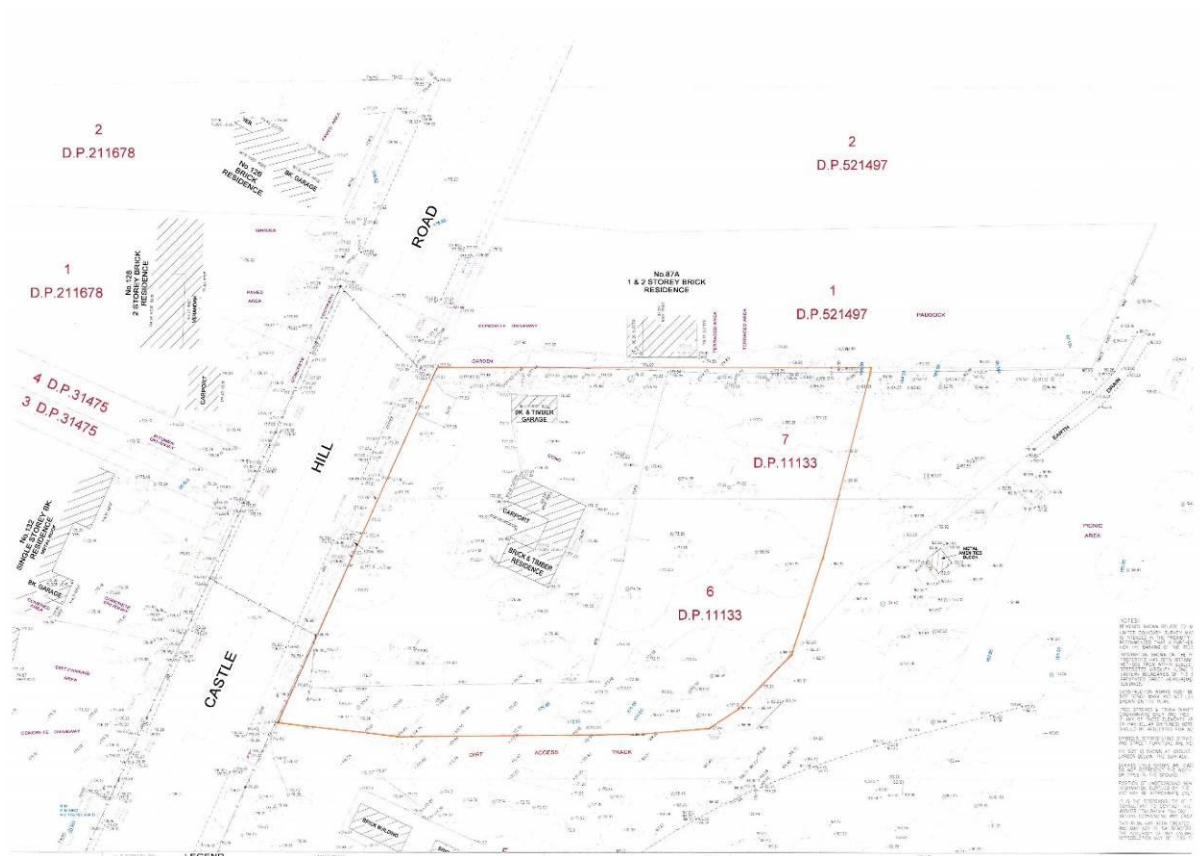


Figure 1.1 – Proposed rezoning area off Castle Hill Road

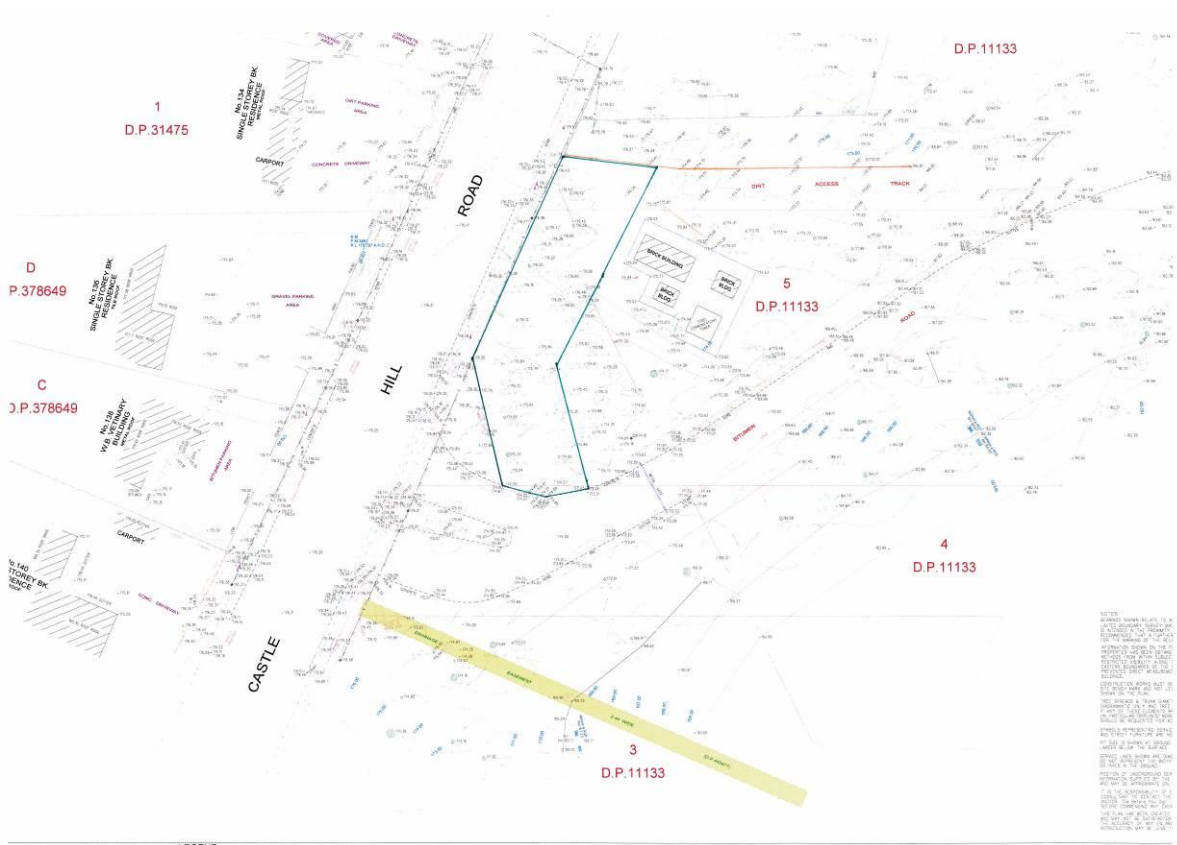


Figure 1.2 – Proposed easement adjacent to the rezoning area off Castle Hill Road

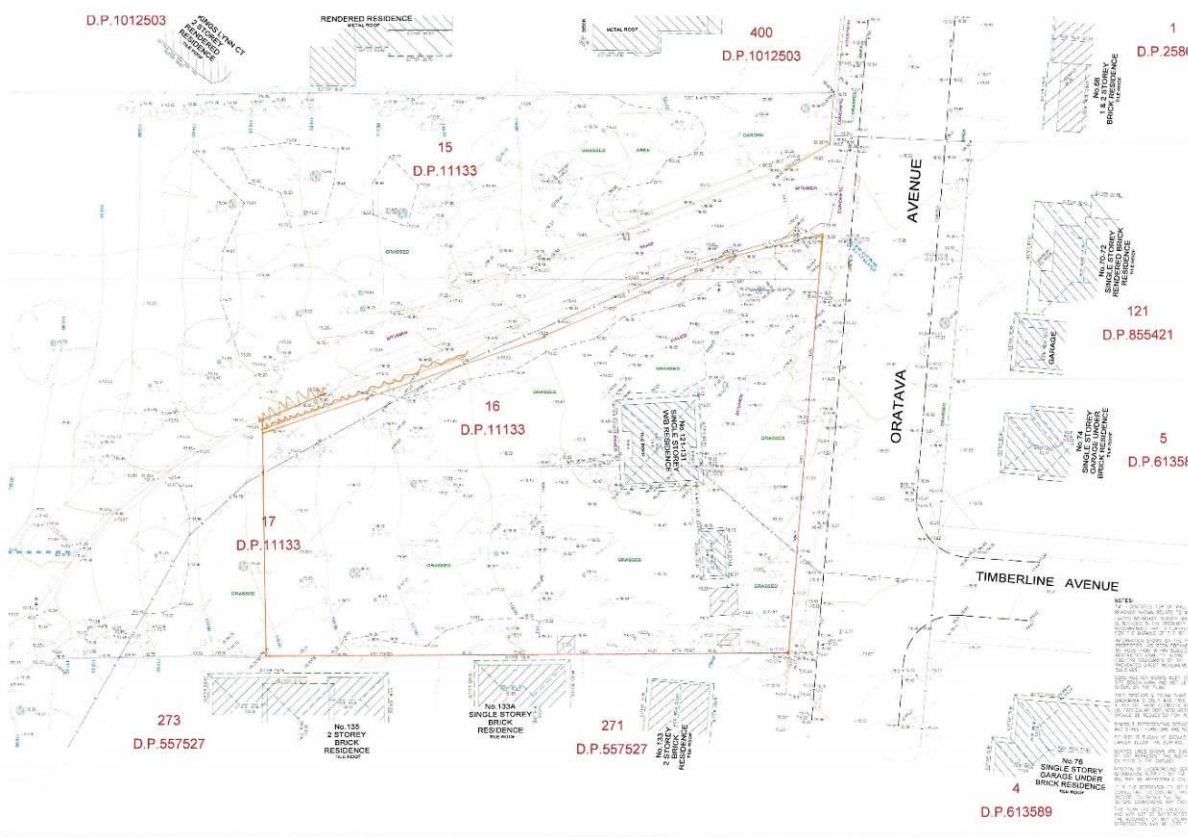


Figure 1.3 – Proposed rezoning area off Oratava Avenue

1.4 Statutory assessment requirements

1.4.1 Environmental Planning and Assessment Act 1979 (EPA Act)

Prior to any development taking place in New South Wales a formal assessment needs to be made of the proposed work to ensure it complies with relevant planning controls and, according to its nature and scale, confirm that it is environmentally and socially sustainable. State, regional and local planning legislation indicates the level of assessment required, and outlines who is responsible for assessing the development. The development assessment and consent system is outlined in Part 4 and the infrastructure and environmental impact assessment system is outlined in Part 5 of the *EP&A Act*.

1.4.2 Biodiversity Conservation Act 2016 (BC Act)

The *BC Act* repeals 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*.

The *BC Act* and the *Biodiversity Conservation Regulation 2017* establishes a regulatory framework for assessing and offsetting impacts on biodiversity values due to proposed developments and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme. 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).

For local development, the BOS includes two (2) elements to the threshold test – an area trigger and a Sensitive Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the Biodiversity Offset Scheme applies to the proposed clearing.

Development consent cannot be granted for non-State significant development under Part 4 of the *EP&A Act* if the consent authority is of the opinion it is likely to have serious and irreversible impacts (SAIL) on biodiversity values. The determination of SAIL is to be made in accordance with principles prescribed section 6.7 of the *BC Regulation 2017*. The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales.

The threatened species test of significance is used to determine if a development or activity is likely to significantly affect threatened species or ecological communities, or their habitats. It is applied as part of the Biodiversity Offsets Scheme entry requirements and for Part 5 activities under the *EP&A Act*.

The test of significance is set out in s.7.3 of the *BC Act*. If the activity is likely to have a significant impact, or will be carried out in a declared area of outstanding biodiversity value, the proponent must either apply the Biodiversity Offsets Scheme or prepare a species impact statement (SIS).

The environmental impact of activities that will not have a significant impact on threatened species will continue to be assessed under s.111 of the *EP&A Act*.

1.4.3 Fisheries Management Act 1994 (FM Act)

The *FM Act* provides a list of threatened aquatic species that require consideration when addressing the potential impacts of a proposed development. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect

threatened species, populations, ecological communities, or their habitats, an SIS is required to be prepared.

1.4.4 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The *EPBC Act* requires that Commonwealth approval be obtained for certain actions. It provides an assessment and approvals system for actions that have a significant impact on matters of *national environmental significance* (NES). These may include:

- World Heritage Properties and National Heritage Places
- Wetlands of International Importance protected by international treaty
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species
- Commonwealth marine environment

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on an NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, then the matter needs to be referred to the Commonwealth Department of Environment and Energy (DOEE) for assessment. In the case where no listed federal species are located on site then no referral is required. The onus is on the proponent to make the application and not the Council to make any referral.

A threshold criterion apply to specific NES matters which may determine whether a referral is or is not required, such as for the *EPBC Act* listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with DOEE may be required to determine whether a referral is or is not required. If there is any doubt as to the significance of impact or whether a referral is required, a referral is generally recommended to provide a definite decision under the *EPBC Act* thereby removing any further obligations in the case of 'not controlled' actions.

A significant impact is regarded as being:

important, notable, or of consequence, having regard to its context or intensity and depends upon the sensitivity, value, and quality of the environment which is impacted and upon the duration, magnitude, and geographical extent of the impacts. A significant impact is likely when it is a real or not a remote chance or possibility.

Source: EPBC Policy Statement

Guidelines on the correct interpretation of the actions and assessment of significance are located on the department's web site <http://www.environment.gov.au/epbc/publications>.

1.4.5 Coastal Management Act 2016 (CM Act)

The *Coastal Management Act* (CM Act, 2016) establishes the framework and overarching objects for coastal management in New South Wales. The Act commenced on 29 June 2018 and replaces the previous *Coastal Protection Act* (1979).

The purpose of the *CM Act* is to manage the use and development of the coastal environment in an ecologically sustainable way, for the social, cultural and economic well-being of the people of New South Wales.

The *CM Act* also supports the aims of the *Marine Estate Management Act 2014*, as the coastal zone forms part of the marine estate.

The *CM Act* defines the coastal zone, comprising four (4) coastal management areas:

1. coastal wetlands and littoral rainforests area; areas which display the characteristics of coastal wetlands or littoral rainforests that were previously protected by SEPP 14 and SEPP 26
2. coastal vulnerability area; areas subject to coastal hazards such as coastal erosion and tidal inundation
3. coastal environment area; areas that are characterised by natural coastal features such as beaches, rock platforms, coastal lakes and lagoons and undeveloped headlands. Marine and estuarine waters are also included
4. coastal use area; land adjacent to coastal waters, estuaries and coastal lakes and lagoons.

The *CM Act* establishes management objectives specific to each of these management areas, reflecting their different values to coastal communities.

1.4.6 Licences

Individual staff members of *Travers bushfire & ecology* are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Sections 120 & 131 of the *National Parks and Wildlife Act 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: SL100848.

Travers bushfire & ecology staff are licensed under an Animal Research Authority issued by the NSW Department of Primary Industries. This authority allows *Travers bushfire & ecology* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

1.4.7 Local government planning instruments (LEP's & DCP's)

The land is currently zoned RU3 Forestry, under The Hills Shire Council Local Environment Plan (LEP, 2012). The provisions under The Hills Shire Council LEP 2012 and Development Control Plain (DCP, 2012) will apply to the proposal.



Figure 1.4 – Study area (red) and subject site (yellow)

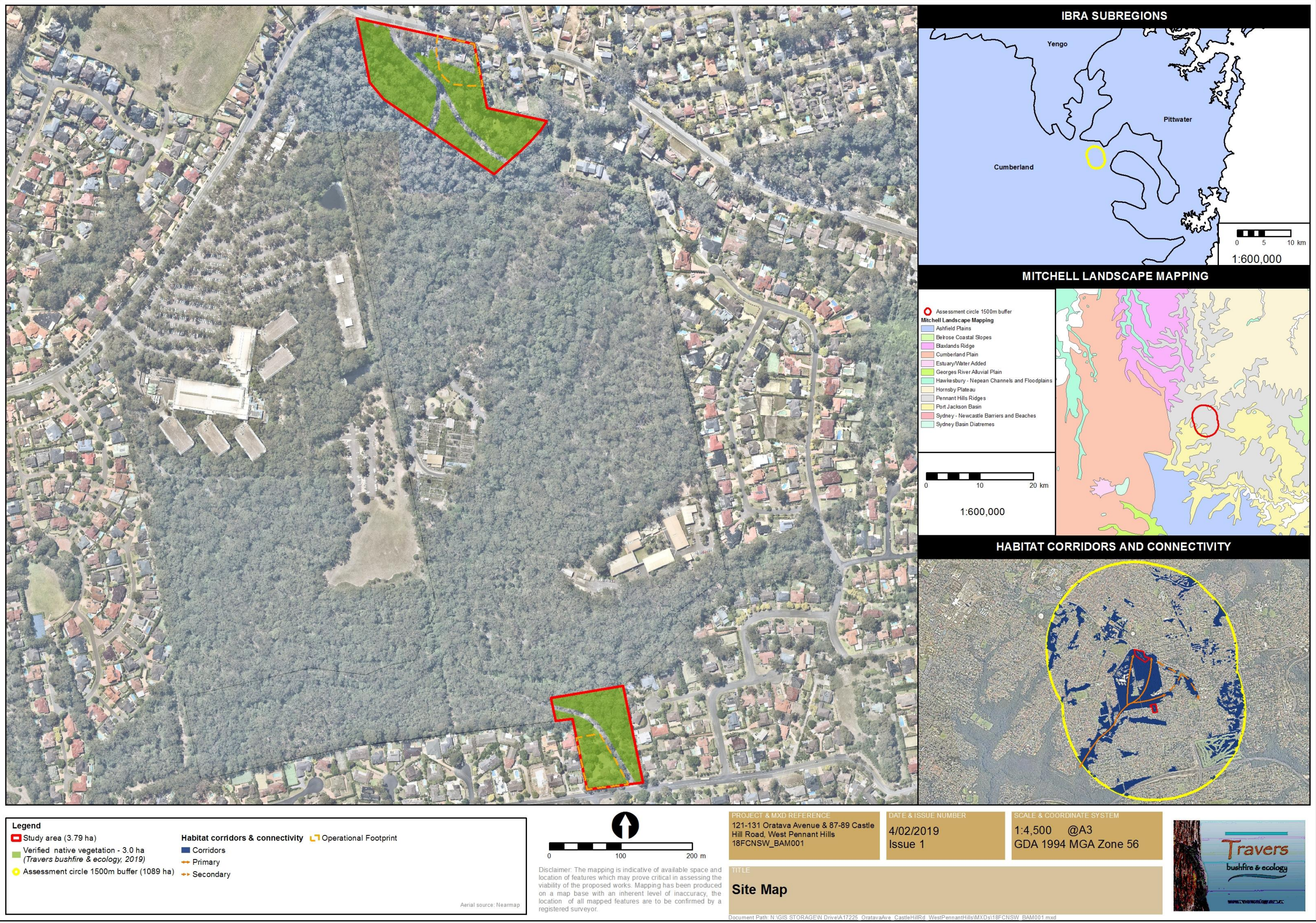


Figure 1.5 – Site map

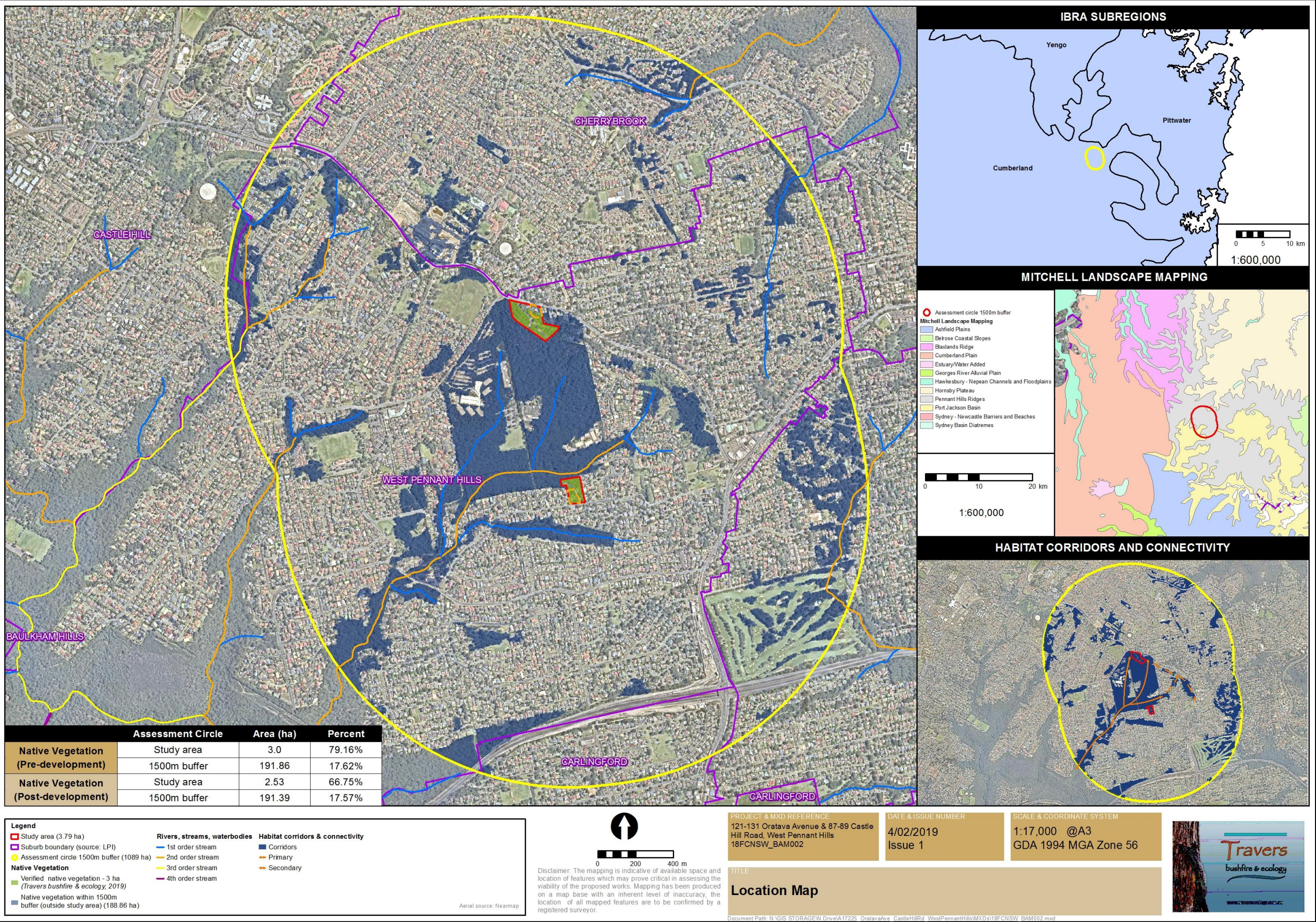


Figure 1.6 – Location map

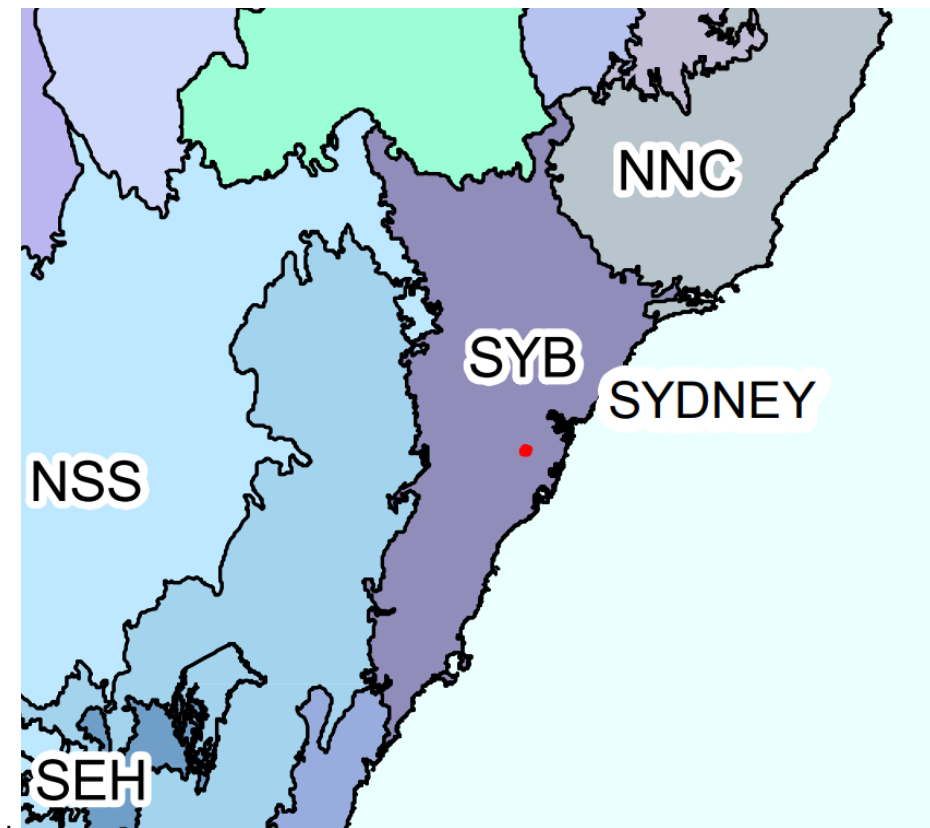


Figure 1.7 – IBRA bioregions

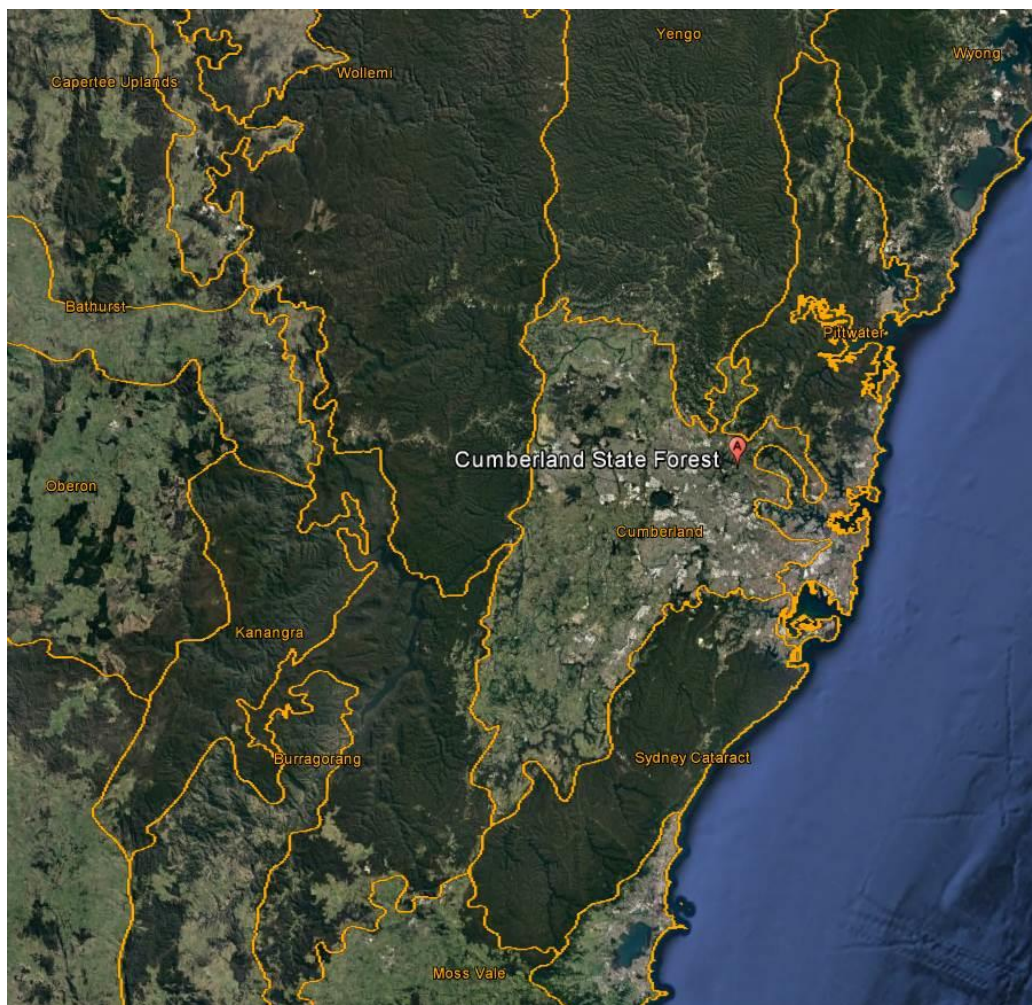


Figure 1.8 – IBRA subregions



Figure 1.9 – Mitchell Landscapes



Figure 1.10 – Local geology

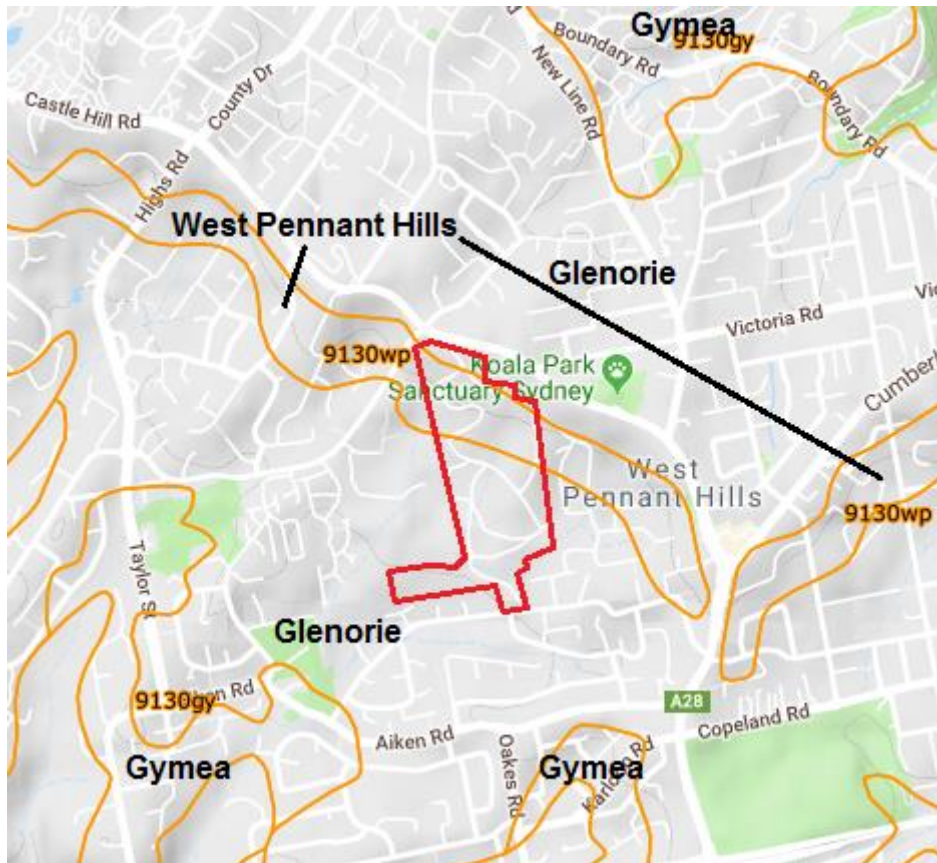


Figure 1.11 – Local soil landscapes



Figure 1.12 – Regional vegetation mapping (NPWS 2002)

- Blue Gum High Forest
- Sydney Turpentine Ironbark Forest
- Turpentine - Ironbark Margin Forest

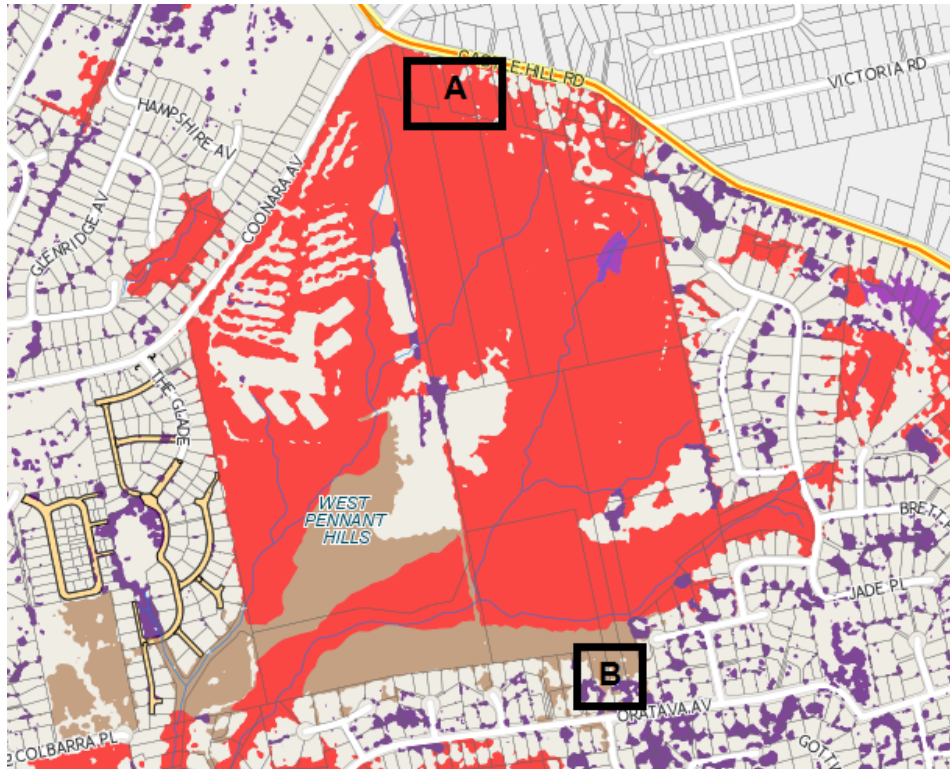


Figure 1.13 – The Hills Shire Council vegetation mapping (2008)

*Bright red/pink denotes Blue Gum High Forest
Brown denotes Sydney Turpentine Ironbark Forest*

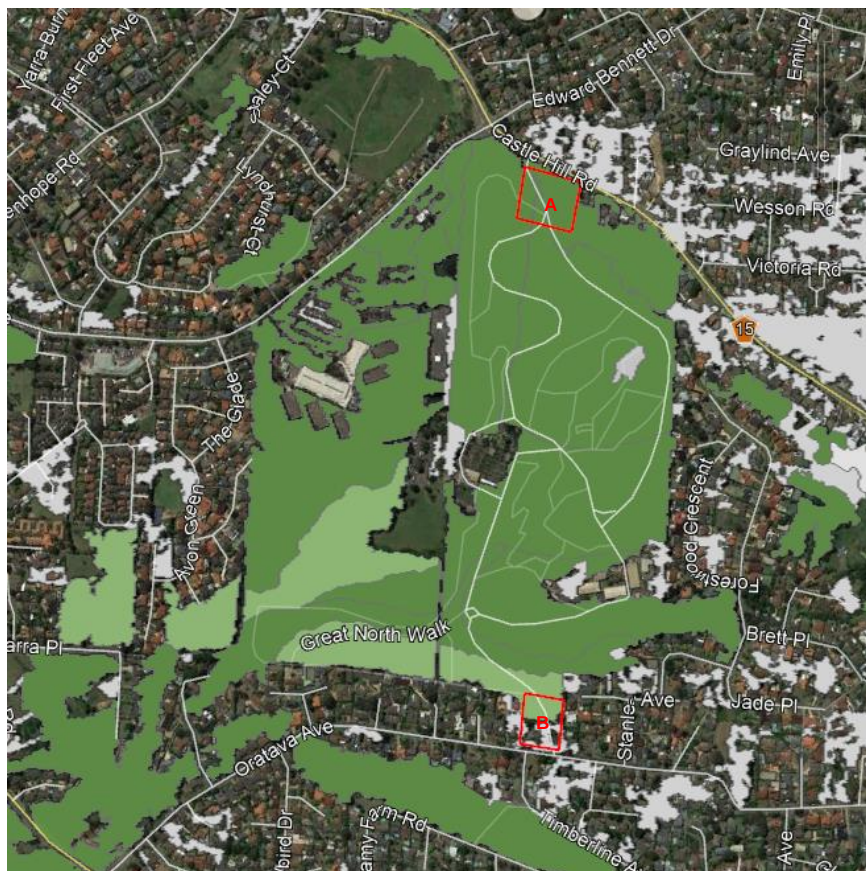


Figure 1.14 – OEH vegetation mapping (2013)

*Dark green denotes Blue Gum High Forest
Light green denotes Sydney Turpentine Ironbark Forest*



Survey Methodology

2

2.1 Pre-survey information collation & resources

A review of the relevant information pertinent to the subject site was undertaken.

Standard technical resources utilised:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities 2004* (working draft), Department of Environment and Conservation (DEC)
- <http://www.environment.nsw.gov.au/threatenedspecies/surveymethodsfauna.htm>
- Aerial photographs (Google Earth Pro / Spatial Information Exchange / NearMap)
- Topographical maps (scale 1:25,000)
- LiDAR data for contours (Land and Property Information, est. 2015 estimated)
- *Biodiversity Conservation Act 2016* (BC Act)
- *Biodiversity Conservation Regulation 2017* (BCR)
- *Fisheries Management Act 1994* (FM Act)
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- NSW Office of Environment and Heritage's BioNet - Atlas of NSW Wildlife, which holds data from a number of custodians. Data obtained January 2019.
- EPBC Protected Matters Search Tool - DOEE (2019)
- Royal Botanic Gardens flora database (2019)
- Bionet Vegetation Classification System

Desktop assessment:

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site, desktop assessments were undertaken including:

- **A literature review** – A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey.
- **A data search** – A search of the *Atlas of NSW Wildlife* (OEH 2019) was undertaken to identify records of threatened flora and fauna species located within a 10km radius of the site. Searches were also undertaken on the DOEE – 'protected matters search tool' website to generate a report that will help determine whether matters of national environmental significance or other matters protected by the *EPBC Act* are likely to occur in the area of interest. The search was broadened to a 10km radius like the Atlas search. These two (2) searches combined, enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables A2.1, A2.2 and A2.3).

2.2 Flora survey methodology

Initial flora survey was undertaken on 9 February 2018. A random meander search was undertaken in accordance with Cropper (1993) to create a broad species list. Whilst a large number of exotic landscaping species were noted and identified during the random meander searches, no specific survey was undertaken for these species. Therefore, not all of the exotic species within the study area will appear on the species list in Table 3.1.

A review of the Atlas of NSW Wildlife, Bionet (OEH January 2018) was undertaken prior to the botanical survey to identify threatened species previously recorded within 10km of the subject site and determine whether target searches were needed to be undertaken. Target searches for relevant threatened species were undertaken where applicable during the random meander and stratified surveys. Three (3) plots of 20x20m were undertaken to assist in determining the vegetation types present.

In January 2019 the database was reviewed again prior to re-collection of data in accordance with BAM. Three (3) BAM plots were undertaken and threatened flora species searches within the proposed rezoning sites.

All observed plant species are listed in Table 3.1.

BAM plots collect the following information:

- Native overstorey, mid-storey and ground cover recorded for all observed species and an estimate of stems
- Stratum (and layer): stratum and layer in which each species occurs
- Growth form: growth form for each recorded species
- Species name: scientific name and common name
- Percent projected foliage cover of the understorey strata and exotic vegetation

The following information was collected at each of the three (3) 20m x 50m transect plot sites:

- Number of trees with hollows visible from the ground within the 20m x 50m plot
- The total length of fallen logs >10 cm in diameter within the 20m x 50m plot
- The proportion of regenerating overstorey species within the vegetation zone
- Number of large trees
- Estimates of leaf litter cover, bare ground, cryptograms and rocks in 1x1m subplots at five (5) locations along the 50m central transect

The vegetation types observed in the study area were converted to their relevant biometric vegetation type identification code (BVTID) and plant community type (PCT). They were then stratified based on vegetation type and condition was taken into consideration when locating the plots and transects.

Initial survey in 2018 identified the vegetation in the southern study area as a combination of Blue Gum High Forest and Planted / Landscaped and Managed. A plot in this area confirms that it is Sydney Turpentine Ironbark Forest in a managed / modified format.

The native vegetation types on site were considered to be either Blue Gum High Forest or Sydney Turpentine Ironbark Forest, both threatened ecological communities under the *BC Act* and *EPBC Act*.

Further information on the vegetation communities is in section 3.

All plot sheets utilised for the BAM calculator are in Appendix 3.

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.1 and are depicted on Figure 2.

Current standard fauna survey techniques employed by *Travers bushfire & ecology* in line with relevant survey guidelines as well as current survey knowledge are provided in Appendix 1. Site specific fauna survey techniques that have been tailored to the study area are described below.

Diurnal birds

Two (2) diurnal bird census points were undertaken within the northern study area and another two (2) census points were undertaken within the southern study area during January 2018 survey. The census points undertaken closest to the road frontage for both locations were both replicated during January 2019 survey. A minimum of 30 minutes of survey was undertaken at each census point in an area radiating out to between 30-50m.

Bird census points were selected to give an even spread and representation across the site and its communities (see Figure 1). Census points were also commenced in locations where bird activity was apparent, as often different small bird species are found foraging together. Opportunistic diurnal bird survey was conducted between census points and whilst undertaking other diurnal surveys.

All seeding *Allocasuarina* trees located within the detailed investigation areas were searched for chewed cones indicating foraging activity.

Nocturnal birds

Given the suitability of habitat present Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*) and Sooty Owl (*Tyto tenebricosa*) were targeted by call-playback techniques during nocturnal survey on 31st January 2018.

The 2018 surveys included searches for significant habitat trees within the detailed investigation zones. Two of these trees were identified as significant given their large hollows and potential suitability for nesting by Powerful Owl. A search for owl activity around these hollows was undertaken during survey however both survey did not align with the Powerful Owl breeding period. Dense areas of mid-storey foliage, predominantly provided by Sweet Pittosporum and Turpentine trees were searched below for whitewash indicating Powerful Owl roosting habitat.

Bats

Passive ultrasonic recording for microbats was undertaken during the nocturnal survey period on 31st January 2018. Overnight passive ultrasonic recording was undertaken for two consecutive nights from the 8th January 2019.

Significant Habitat Tree (SHT1) is a large stag that has had limbs cut and managed next to the communications tower in the northern study area. As this was the closest potential microbat roost to the development footprint this tree was stag-watched in the dusk period during January 2018 survey and an ultrasonic bat recorder was placed below.

Invertebrates

The study area contains vegetation communities that support habitat for the Dural Land Snail (*Pommerhelix duralensis*) therefore target searches in suitable habitat locations was undertaken. This predominantly included turning of logs, stumps, artificial refuse and rocks where present.

Habitat trees

Significant habitat trees were initially identified during January 2018 surveys. 'Significant' habitat trees are defined as trees containing only large hollows suitable for use by owls and/or containing a number of good quality hollows typically consisting of more than one medium (10-30cm) sized hollow. A tree may also be considered significant where evidence of use by select fauna is found such as Yellow-bellied Glider sap feed tree, raptor nest, or owl roost.

Data such as the number of hollows present in each size category (or other reason for selection), tree species, diameter at breast height, canopy spread and overall height were collected on a *Trimble* handheld GPS unit and a metal tag with the significant habitat tree number placed on the trunk for field relocation purposes.

More recent January 2019 survey included searches for all other hollows located only within the two subject site areas and thus potentially directly impacted cavities.

A summary of significant habitat tree results within the detailed investigations areas as well as all other hollow-bearing trees within both subject sites is provided in Table 3.5.

2.4 Field survey effort

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the subject site.

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Time effort (24hr)
Diurnal birds	31/1/18	8/8 cloud, light-mod S wind, no rain, temp 21°C	Diurnal census x4 & opportunistic	6hrs 5min 1325 - 2030
	8/1/19	1/8 cloud, light NE wind, no rain, temp 26°C	Diurnal census x2 & opportunistic	3hrs 20min 1100 - 1420
Nocturnal birds	31/1/18	8/8 cloud, mod-gusty S wind, no rain, temp 20-19°C	Spotlighting	1hr 40min 2030 - 2210
			Call playback (Section 2.5 species)	Commenced @ 2050
Arboreal mammals	31/1/18	8/8 cloud, mod-gusty S wind, no rain, temp 20-19°C	Spotlighting	1hr 40min 2030 - 2210
			Call playback (Section 2.5 species)	Commenced @ 2110
Terrestrial mammals	31/1/18	8/8 cloud, mod-gusty S wind, no rain, temp 20-19°C	Spotlighting	1hr 40min 2030 - 2210
Bats	31/1/18	8/8 cloud, mod-gusty S wind, no rain, temp 20-19°C	Spotlighting	1hr 40min 2030 - 2210
			Ultrasonic microbat recording (Passive monitoring) x2	3hrs 2030 - 2200
	8-9/1/19	Mostly fine	Ultrasonic microbat recording (Passive monitoring) x2	Overnight for x2 nights
Reptiles	31/1/18	8/8 cloud, light-mod S wind, no rain, temp 21°C	Habitat search, opportunistic	6hrs 5min 1325 - 2030
	8/1/19	1/8 cloud, light NE wind, no rain, temp 26°C	Habitat search, opportunistic	3hrs 20min 1100 - 1420
Amphibians	31/1/18	8/8 cloud, mod-gusty S wind, no rain, temp 20-19°C	Spotlighting & call identification	1hr 40min 2030 - 2210
Molluscs	31/1/18	8/8 cloud, light-mod S wind, no rain, temp 21°C	Habitat search, opportunistic	6hrs 5min 1325 - 2030
	8/1/19	1/8 cloud, light NE wind, no rain, temp 26°C	Habitat search, opportunistic	3hrs 20min 1100 - 1420

Table 2.2 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	- Survey of the boundaries of all communities – field verification, plotting vegetation boundaries on aerial photographs.	9 Feb 2018, 2 Jan 2019
Stratified sampling	- Three (3) 20m x 20m quadrats spaced throughout the subject site in areas of bushland. Opportunistic observations of flora species during all on-foot traverses of the subject site. - Three (3) BAM plots. Opportunistic observations of flora species during all on-foot traverses of the subject site.	9 Feb 2018, 2 Jan 2019
Targeted searches	- Targeted searches in known or potential habitats. - Opportunistic searches during all on-foot traverses across the site.	9 Feb 2018, 2 Jan 2019

Table 2.3 – Plot and transect survey effort – subject site

Veg zone no.	Vegetation type	PCT	Condition	Area (Ha)	Minimum plot transect sites required	Plot transect sites sampled
1	Blue Gum High Forest	1237	Moderate_good	0.113	1	1
2	Blue Gum High Forest	1237	Managed_modified	0.023	1	1
3	Sydney Turpentine Ironbark Forest	1281	Managed_modified	0.344	1	1

2.5 Survey limitations

It is important to note that field survey data collected during the survey period is representative of species occurring within the subject site for that occasion. Due to effects of fire, breeding cycles, migratory patterns, camouflage, weather conditions, time of day, visibility, predatory and / or feeding patterns, increased species frequency or richness may be observed within the subject site outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to minimise the implications of this survey limitation.

Given the limited potential for threatened species to occur on site because of the heavily disturbed (and partly removed understorey), together with long-term and ongoing management of quite a bit of the subject site, it is unlikely that there are any significant limitations of this study.

Flora survey limitations

The species list does not include all household or exotic garden / landscaping species and those species which could not be identified at the time of the survey past genus level. Cryptic species not flowering at the time of the survey may not be observed during survey outside of peak flowering periods. Likewise cryptic orchid species are generally only recognisable when flowering. Survey has been undertaken in the months of January and February therefore potentially overlooking cryptic species that flower in cooler months.

It is not expected that there are any limitations to threatened flora species survey which could change the outcomes of significance assessment as survey has been undertaken at a time when most are readily flowering or can be observed. In addition, the very types and condition don't typically provide host too many known threatened flora species.

Fauna survey limitations

The previous survey and constraints analysis identified that further survey for Powerful Owl would be necessary during the winter breeding period to ensure that two nearby large hollows (SHT3 & SHT4) are not in current use. This survey has not yet been undertaken. In either case the Powerful Owl breeding pair that are known to nest within the Cumberland State Forest and large adjacent private lands to the west are well conditioned to the local urban surrounds.

One known breeding hollow for this pair was located in the old IBM private lands only 30m from the edge of a treeless urban landscape to the west. The two large hollow-bearing trees identified during survey in the northern study area are both located beyond 75m from the proposed rezoning for development edge. The main entry road is located within this separation and there are plenty of other available roosting opportunities surrounding the hollows. Therefore any future development of the subject site is not expected to cause any notable additional impact on any breeding behaviour, if they did use either of these two hollows. Nonetheless, winter survey for breeding presence is recommended as this may guide further recommended measures to avoid and minimise indirect impacts.

2.6 Accuracy of identification

Specimens of threatened or suspected threatened flora species were sent to Sydney Royal Botanic Gardens for confirmation or a positive identification.

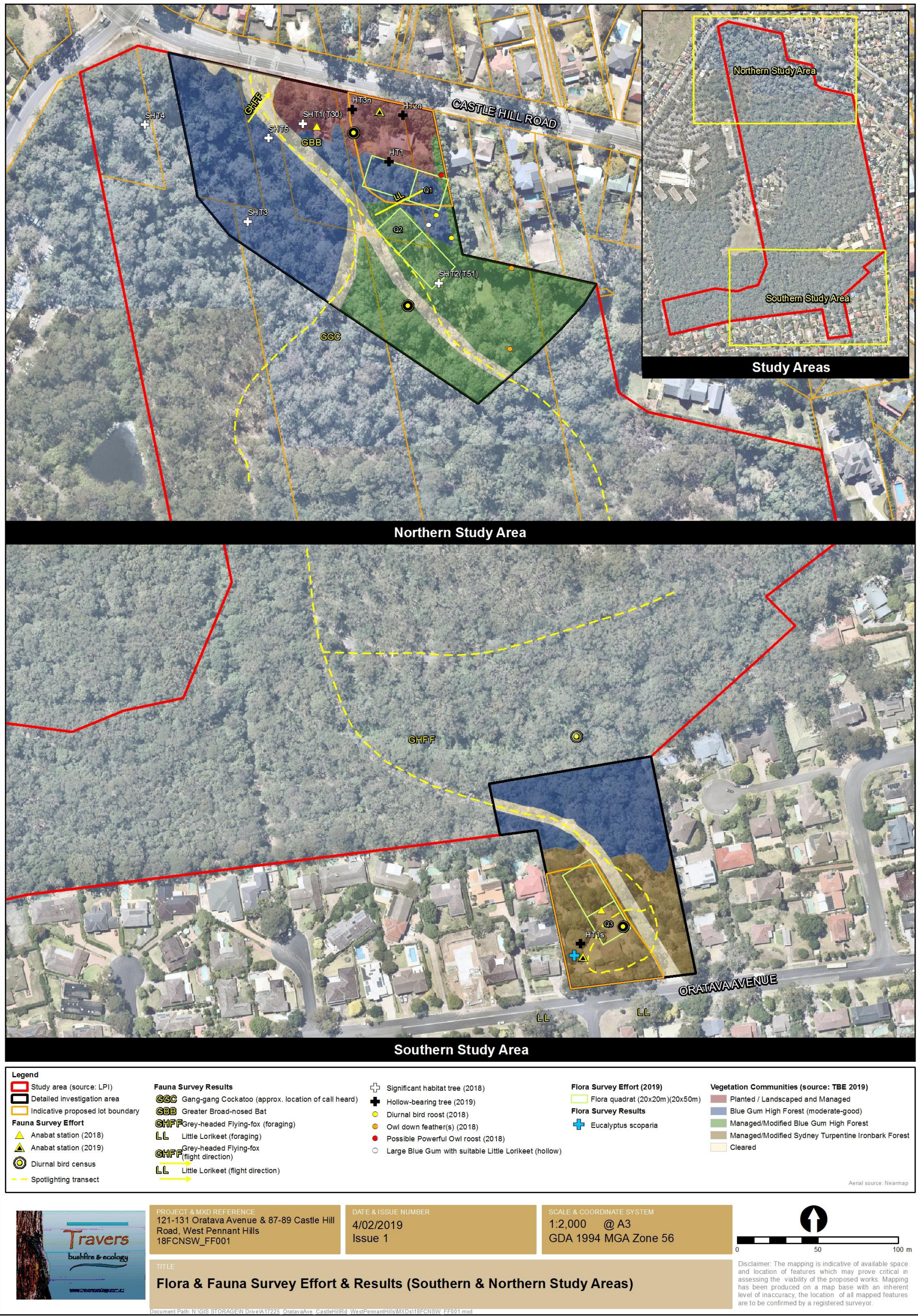


Figure 2 – Flora and fauna survey effort and results



Survey Results

3

3.1 Flora results

3.1.1 Native vegetation extent

The native vegetation extent within the subject site has been ground-truthed. The amount of native vegetation is 0.48ha. It is a combination of the threatened ecological communities (TECs) Blue Gum High Forest and Sydney Turpentine Ironbark Forest.

3.1.2 Flora species

The plants observed within the vegetation communities of the study area are listed in Table 3.1 below.

Table 3.1 – Flora observations for the subject site

Family	Scientific name	Common name
Trees		
Mimosaceae	<i>Acacia decurrens</i>	Black Wattle
Mimosaceae	<i>Acacia parramattensis</i>	Parramatta Wattle
Mimosaceae	<i>Acacia schinoides</i>	-
Aceraceae	<i>Acer</i> sp. (cultivar)*	Maple
Myrtaceae	<i>Acmena smithii</i>	Lillypilly
Casuarinaceae	<i>Allocasuarina littoralis</i>	Black She-oak
Casuarinaceae	<i>Allocasuarina torulosa</i>	Forest Oak
Rhamnaceae	<i>Alphitonia excelsa</i>	Red Ash
Myrtaceae	<i>Angophora bakeri</i>	Narrow-leaved Apple
Myrtaceae	<i>Angophora costata</i>	Smooth-barked Apple
Myrtaceae	<i>Angophora floribunda</i>	Rough-barked Apple
Araucariaceae	<i>Araucaria</i> sp.	-
Sterculiaceae	<i>Brachychiton acerifolius</i>	Illawarra Flame Tree
Cunoniaceae	<i>Callicoma serratifolia</i>	Black Wattle
Fabaceae	<i>Castanospermum australe</i>	Black Bean
Ulmaceae	<i>Celtis sinensis</i> *	Chinese Hackberry
Lauraceae	<i>Cinnamomum camphora</i> *	Camphor Laurel
Rutaceae	<i>Citrus</i> sp.*	-
Myrtaceae	<i>Corymbia citriodora</i>	Lemon-scented Gum
Myrtaceae	<i>Corymbia maculata</i>	Spotted Gum
Myrtaceae	<i>Corymbia</i> sp.	-
Malaceae	<i>Eriobotrya japonica</i> *	Loquat
Myrtaceae	<i>Eucalyptus fibrosa</i>	Broad Leaved Ironbark

Family	Scientific name	Common name
Myrtaceae	<i>Eucalyptus microcorys</i>	Tallowwood
Myrtaceae	<i>Eucalyptus pilularis</i>	Blackbutt
Myrtaceae	<i>Eucalyptus saligna</i>	Sydney Blue Gum
Myrtaceae	<i>Eucalyptus scoparia</i> ^{TS}	Wallangarra White Gum
Myrtaceae	<i>Eucalyptus</i> sp.	-
Santalaceae	<i>Exocarpos cupressiformis</i>	Native Cherry
Moraceae	<i>Ficus coronata</i>	Sandpaper Fig
Oleaceae	<i>Fraxinus angustifolia</i> *	Claret Ash
Phyllanthaceae	<i>Glochidion ferdinandi</i>	Cheese Tree
Proteaceae	<i>Grevillea robusta</i>	Silky Oak
Bignoniaceae	<i>Jacaranda mimosifolia</i> *	Jacaranda
Lythraceae	<i>Lagerstroemia indica</i> *	Crepe Myrtle
Hamamelidaceae	<i>Liquidambar styraciflua</i> *	Sweet Gum
Proteaceae	<i>Macadamia integrifolia</i>	Macadamia Nut
Myrtaceae	<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree
Meliaceae	<i>Melia azedarach</i> var. <i>australasica</i>	White Cedar
Pinaceae	<i>Pinus radiata</i> *	Radiata or Monterey Pine
Pittosporaceae	<i>Pittosporum undulatum</i>	Sweet Pittosporum
Myrtaceae	<i>Syncarpia glomulifera</i>	Turpentine
Shrubs		
Mimosaceae	<i>Acacia floribunda</i>	Sally Wattle
Mimosaceae	<i>Acacia implexa</i>	Hickory
Euphorbiaceae	<i>Breynia oblongifolia</i>	Coffee Bush
Pittosporaceae	<i>Bursaria spinosa</i> var. <i>spinosa</i>	Native Blackthorn
Myrtaceae	<i>Callistemon viminalis</i>	Weeping Bottlebrush
Asteliaceae	<i>Cordyline stricta</i>	Narrow-leaf Palm Lily
Fabaceae	<i>Genista monspessulana</i> *	Montpellier Broom
Proteaceae	<i>Grevillea</i> sp. (cultivar)	-
Malvaceae	<i>Hibiscus</i> sp. (cultivar)*	Hibiscus
Euphorbiaceae	<i>Homalanthus populifolius</i>	Bleeding Heart
Verbenaceae	<i>Lantana camara</i> *	Lantana
Myrtaceae	<i>Leptospermum petersonii</i> *	Lemon Scented Tea-tree
Epacridaceae	<i>Leucopogon juniperinus</i>	Prickly Beard-heath
Oleaceae	<i>Ligustrum lucidum</i> *	Large-leaved Privet
Oleaceae	<i>Ligustrum sinense</i> *	Small-leaved Privet
Araceae	<i>Monstera deliciosa</i> *	Fruit-salad Plant
Rutaceae	<i>Murraya paniculata</i> *	Orange Jessamine
Berberidaceae	<i>Nandina domestica</i> *	Sacred Bamboo
Oleaceae	<i>Notelaea longifolia</i>	Mock Olive
Ochnaceae	<i>Ochna serrulata</i> *	Mickey Mouse Plant
Oleaceae	<i>Olea europaea</i> subsp. <i>cuspidata</i> *	African Olive
Pittosporaceae	<i>Pittosporum multiflorum</i>	Orange Thorn
Pittosporaceae	<i>Pittosporum revolutum</i>	Yellow Pittosporum
Plumbaginaceae	<i>Plumbago</i> sp.*	-
Araliaceae	<i>Polyscias sambucifolia</i>	Elderberry Panax

Family	Scientific name	Common name
Rhamnaceae	<i>Pomaderris</i> sp.	-
Malaceae	<i>Rhaphiolepis indica</i> *	Indian Hawthorn
Ericaceae	<i>Rhododendron</i> sp. (cultivar)*	Azalea
Rosaceae	<i>Rubus fruticosus</i> sp. agg.*	Blackberry Complex
Rosaceae	<i>Rubus parvifolius</i>	Native Raspberry
Fabaceae	<i>Senna septemtrionalis</i>	Arsenic bush
Solanaceae	<i>Solanum mauritianum</i> *	Wild Tobacco
Ulmaceae	<i>Trema tomentosa</i> var. <i>aspera</i>	Native Peach
Lamiaceae	<i>Westringia fruticosa</i>	Coast Westringia
Rutaceae	<i>Zieria smithii</i>	Sandfly Zieria
Groundcovers		
Malvaceae	<i>Abutilon oxycarpum</i>	Straggly Lantern-bush
Rosaceae	<i>Acaena novae-zelandiae</i>	Bidgee-widgee
Asteraceae	<i>Ageratina adenophora</i> *	Crofton Weed
Asparagaceae	<i>Asparagus aethiopicus</i> *	Asparagus Fern
Asparagaceae	<i>Asparagus plumosus</i> *	
Poaceae	<i>Axonopus fissifolius</i> *	Narrow-leaved Carpet Grass
Asteraceae	<i>Bidens pilosa</i> *	Cobbler's Pegs
Blechnaceae	<i>Blechnum cartilagineum</i>	Gristle Fern
Poaceae	<i>Bromus cartharticus</i> *	Prairie Grass
Dicksoniaceae	<i>Calochlaena dubia</i>	Rainbow Fern
Cyperaceae	<i>Carex fascicularis</i>	Tassel Sedge
Apiaceae	<i>Centella asiatica</i>	Indian Pennywort
Commelinaceae	<i>Commelina cyanea</i>	Native Wandering Jew
Asteraceae	<i>Conyza bonariensis</i> *	Flaxleaf Fleabane
Asteraceae	<i>Conyza sumatrensis</i> *	Fleabane
Poaceae	<i>Cynodon dactylon</i>	Common Couch
Phormiaceae	<i>Dianella caerulea</i> var. <i>caerulea</i>	Flax Lily
Convolvulaceae	<i>Dichondra repens</i>	Kidney Weed
Poaceae	<i>Digitaria sanguinalis</i> *	Crab Grass
Blechnaceae	<i>Doodia aspera</i>	Rasp Fern
Poaceae	<i>Ehrharta erecta</i> *	Panic Veldtgrass
Chenopodiaceae	<i>Einadia trigonos</i> subsp. <i>trigonos</i>	Fishweed
Poaceae	<i>Eleusine tristachya</i> *	Goose Grass
Poaceae	<i>Entolasia marginata</i>	Bordered Panic
Poaceae	<i>Entolasia stricta</i>	Wiry Panic
Poaceae	<i>Eragrostis brownii</i>	Brown's Lovegrass
Poaceae	<i>Eragrostis curvula</i> *	African Lovegrass
Euphorbiaceae	<i>Euphorbia peplus</i> *	Spurge
Asteraceae	<i>Gamochaeta spicata</i> *	Cudweed
Asteraceae	<i>Hypochaeris radicata</i> *	Flatweed
Poaceae	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass
Juncaceae	<i>Juncus usitatus</i>	Common Rush
Asteraceae	<i>Lagenifera stipitata</i>	-
Liliaceae	<i>Lilium formosanum</i> *	Formosan Lily

Family	Scientific name	Common name
Lomandraceae	<i>Lomandra hyrstix</i>	Mat-rush
Lomandraceae	<i>Lomandra longifolia</i>	Spiky-headed Mat-rush
Fabaceae	<i>Lotus suaveolens</i> *	Hairy Bird's Foot Trefoil
Primulaceae	<i>Lysimachia arvensis</i> *	Scarlet Pimpernel
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass
Malvaceae	<i>Modiola caroliniana</i> *	Red-flowered Mallow
Davalliaceae	<i>Nephrolepis cordifolia</i> *	Fish-bone Fern
Poaceae	<i>Oplismenus aemulus</i>	Basket Grass
Poaceae	<i>Oplismenus imbecillis</i>	-
Oxalidaceae	<i>Oxalis corniculata</i> *	Yellow Wood Sorrel
Poaceae	<i>Paspalum urvillei</i> *	Vasey Grass
Sinopteridaceae	<i>Pellaea falcata</i>	Sickle Fern
Poaceae	<i>Pennisetum clandestinum</i> *	Kikuyu
Plantaginaceae	<i>Plantago debilis</i>	Slender Plantain
Plantaginaceae	<i>Plantago lanceolata</i> *	Ribwort
Lamiaceae	<i>Plectranthus parviflorus</i>	Cockspur Flower
Lobeliaceae	<i>Pratia purpurascens</i>	Whiteroot
Acanthaceae	<i>Pseuderanthemum variabile</i>	Pastel Flower
Dennstaedtiaceae	<i>Pteridium esculentum</i>	Bracken
Rubiaceae	<i>Richardia stellaris</i> *	-
Malvaceae	<i>Sida rhombifolia</i> *	Paddy's Lucerne
Asteraceae	<i>Sigesbeckia orientalis</i>	Indian Weed
Solanaceae	<i>Solanum nigrum</i> *	Black Nightshade
Solanaceae	<i>Solanum pseudocapsicum</i> *	-
Poaceae	<i>Sporobolus africanus</i> *	Parramatta Grass
Poaceae	<i>Stenotaphrum secundatum</i> *	Buffalo Grass
Gleicheniaceae	<i>Sticherus flabellatus</i>	Umbrella Fern
Asteraceae	<i>Taraxacum officinale</i> *	Dandelion
Commelinaceae	<i>Tradescantia fluminensis</i> *	Wandering Jew
Fabaceae	<i>Trifolium repens</i> *	White Clover
Asteraceae	<i>Vernonia cinerea</i> var. <i>cinerea</i>	-
Agavaceae	<i>Yucca</i> sp.*	-
Vines		
Apocnyaceae	<i>Araujia sericifera</i> *	Mothvine
Vitaceae	<i>Cayratia clematidea</i>	Native Grape
Ranunculaceae	<i>Clematis aristata</i>	Old Man's Beard
Fabaceae	<i>Desmodium varians</i>	-
Luzuriagaceae	<i>Eustrephus latifolius</i>	Wombat Berry
Fabaceae	<i>Glycine clandestina</i>	Twining Glycine
Fabaceae	<i>Glycine tabacina</i>	Variable Glycine
Fabaceae	<i>Hardenbergia violacea</i>	False Sarsparilla
Oleaceae	<i>Jasminum polyanthum</i> *	Jasmine
Rubiaceae	<i>Morinda jasminoides</i>	-
Bignoniaceae	<i>Pandorea pandorana</i>	Wonga Vine
Apocynaceae	<i>Parsonsia straminea</i>	Common Silkpod

Family	Scientific name	Common name
Passifloraceae	<i>Passiflora edulis</i> *	Common Passionfruit
Passifloraceae	<i>Passiflora suberosa</i> *	Cork Passionflower
Smilacaceae	<i>Smilax australis</i>	Lawyer Vine
Menispermaceae	<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine
* denotes exotic species		
TS denotes threatened species		

3.1.3 Vegetation descriptions of observed communities

The following vegetation communities were identified within the study area through ground truthing. Endangered ecological communities are denoted with 'EEC'.

- Vegetation Community 1 – Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin Bioregion- EEC
- Vegetation Community 2 – Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion - EEC
- Vegetation Community 3 – Planted, Landscaped and Managed

Blue Gum High Forest - Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin Bioregion

This vegetation community is located in the northern and southern study areas, however restricted more closely to the riparian line in the southern study area.

Canopy – *Eucalyptus saligna*, *Syncarpia glomulifera*, *Angophora floribunda* and *Eucalyptus pilularis* are the most dominant canopy species to a height of 20-40m tall. The projected foliage cover averages approximately 30-40%.

Mid-storey – *Pittosporum undulatum*, *Acacia implexa*, *Polyscias sambucifolia*, *Trema tomentosa*, *Brachychiton acerifolius*, *Allocasuarina torulosa*, *Alphitonia excelsa*, *Pittosporum revolutum*, *Glochidion ferdinandi*, *Acacia decurrens* and *Ficus coronata* with a height generally below 12m and a highly variable projected foliage cover dependent upon the level of disturbance. Weed species were very frequent within the northern study area which included species such as *Celtis sinensis*, *Cinnamomum camphora*, *Ligustrum sinense* and *Ligustrum lucidum*.

Ground layer and vines – *Pteridium esculentum*, *Clematis aristata*, *Eustrephus latifolius*, *Morinda jasminoides*, *Entolasia marginata*, *Pandorea pandorana*, *Calochlaena dubia*, *Pellaea falcata*, *Cayratia clematidea*, *Commelina cyanea*, *Dianella caerulea*, *Entolasia stricta*, *Blechnum cartilagineum*, *Plectranthus parviflorus*, *Stephania japonica*, *Dichondra repens*, *Doodia aspera*, *Microlaena stipoides*, *Oplismenus imbecillis* and *Pratia purpurascens*.



Photo 1 – Eucalyptus saligna with moderate cover of Pittosporum undulatum in the mid-storey on the northern high side of the entrance road



Photo 2 – Managed edge of Blue Gum High Forest with occasional plantings (quadrat 2 location)



Photo 3 – Young Blue Gum High Forest in the southern study area near the riparian zone

Sydney Turpentine Ironbark Forest - Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion

The community is located in the southern study area as a managed/modified vegetation type with a mixture of native and planted trees, cleared patches and impacted ground layer (weeds and lawn).

Canopy - *Eucalyptus saligna*, and *Eucalyptus pilularis* with planted *Eucalyptus microcorys* and other *Corymbia* species to a height of 20-33m tall. The projected foliage cover averages approximately 10-20% due to previous clearing and disturbances.

Mid-storey – There is an irregular mid-storey containing *Pittosporum undulatum*, *Bursaria spinosa*, *Melia azedarach*, *Acacia implexa*, *Allocasuarina torulosa* and *Acacia parramattensis*. There are other planted shrubs such as *Callistemon viminalis* and *Murraya paniculata* that make up the mid-storey. The projected foliage cover for native species is less than 10%.

Ground layer – *Microlaena stipoides*, *Wahlenbergia gracilis*, *Pandorea pandorana*, *Eragrostis brownii*, *Dichondra repens*, *Cayratia clematidea*, *Veronica plebeia*, *Clematis aristata*, *Oplismenus aemulus*, *Desmodium varians*, *Glycine clandestina*, *Commelina cyanea*, *Leucopogon juniperinus*, *Oplismenus imbecillis*, *Pratia purpurascens*, *Lomandra longifolia*, *Echinopogon caespitosus* and *Eustrephus latifolius*.



Photo 4 – Managed and modified Sydney Turpentine Ironbark Forest in the southern study area (quadrat 3)

Planted, Landscaped and Managed

This describes areas within the study area that generally have little native species presence that don't confirm or are not likely to be representative of any current plant community type (PCT). Typically, these areas contain landscaping plants with very few scattered remnant trees or shrubs, and with a managed, cleared or landscaped understorey. Given the low importance of these areas, they will not be described in detail.

3.1.4 Plant community types (PCTs)

Table 3.2 provides a summary of the PCT occurring within the development site, including vegetation formation, percent cleared within and extent within the development site.

All plot sheets utilised for the BAM calculator are in Appendix 3.

Table 3.2 – PCTs

PCT code	PCT name	Species relied upon	Vegetation formation	Vegetation class	% Cleared	Area within development site (ha)	TEC status
1237	Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin Bioregion	<i>E. saligna</i> , <i>E. pilularis</i> and understorey vines	Wet Sclerophyll Forests (Shrubby sub-formation)	North Coast Wet Sclerophyll Forests	90	0.136 to be impacted	Critically endangered under the BC Act and EPBC Act
1281	Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	Geological change and <i>E. pilularis</i> , <i>S. glomulifera</i> , <i>B. spinosa</i>	Wet Sclerophyll Forests (Grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	90	0.344 to be impacted	Sydney Turpentine Ironbark Forest EEC under the BC Act, Turpentine Ironbark Forest listed as critically endangered under the EPBC Act

Evidence used to identify a PCT

Evidence used to identify the PCTs on site: A combination of regional mapping and ground-truthing was applied. There are three (3) regional vegetation mapping reports which cover the study area, including NPWS 2002, Native Vegetation Mapping of the Cumberland Plain, mapping by The Hills Shire Council (2008) and OEH 2016, Sydney Metropolitan Catchment Management Area. Dominant canopy species were utilised to assist in reducing the number of potential PCTs down to a small number.

Figures 1.12, 1.13 and 1.14 shows each of the regional vegetation maps.

The native species for each plot were imported into a tool that assists in determining vegetation types of the Sydney area (Greg Steenbeeke's tool using Tozer) to determine if the vegetation is Blue Gum High Forest or Sydney Turpentine Ironbark Forest. Plots 1 and 2 were Blue Gum High Forest, and Plot 3 was Sydney Turpentine Ironbark Forest.

PCT descriptions

PCT 1237

Plant Community Type ID (PCT ID):

1,237

PCT Classification Confidence Level: High

PCT Common Name: Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin Bioregion

PCT Common Usage Name: Blue Gum high forest

PCT Scientific Name: *Allocasuarina torulosa*, *Angophora costata*, *Elaeocarpus reticulatus*, *Eucalyptus saligna* / *Breynia oblongifolia*, *Pittosporum undulatum*, *Leucopogon juniperinus*, *Maytenus silvestris* / *Lomandra longifolia*, *Adiantum aethiopicum*, *Entolasia marginata*, *Pseuderanthemum variabile*

Data Entry Operator: System

Data Entry Date: 27/06/2011

Last Modified By: HAGERT

Last Modified Date: 20/04/2017

Vegetation Description: Blue Gum High Forest (Benson and Howell 1990) is a tall wet sclerophyll forest found on fertile shale soils in the high rainfall districts of Sydney's north shore. It is dominated by Sydney blue gum (*Eucalyptus saligna*), blackbutt (*Eucalyptus pilularis*) and turpentine (*Syncarpia glomulifera*) with a number of other eucalypts occurring patchily. A sparse to open cover of small trees is found at most sites and includes a variety of sclerophyllous and mesophyllous species. The ground layer is variable in both composition and cover. It may be ferny, grassy or herbaceous depending on topographic situation and disturbance history. At some sites vines and climbers are prolific. Blue Gum High Forest is found on a range of shale or shale-influenced substrates in areas receiving between 900 and 1300 millimetres of mean annual rainfall. This includes elevated gullies, ridgelines, crests and slopes underlain by Wianamatta shales as well as small gully heads where downslope movement of shale soil lies above sandstone bedrock. In these latter situations sandstone outcrops may be present, although occupying only a minor component of the site. Typically the community occurs at altitudes above 117 metres above sea level although it is known to occur as low as 30 metres and as high as 185 metres. It is most common across the ridgelines between Castle Hill and St Ives with small areas occurring in Ryde, Lane Cove and Willoughby where it is found at lower elevations.

Rain fall: Not Assessed

Elevation: Not Assessed

Emergent species: None

Upper Stratum Species: *Allocasuarina torulosa*; *Angophora costata*; *Elaeocarpus reticulatus*; *Eucalyptus saligna*; *Eucalyptus pilularis*;

Mid Stratum Species: *Breynia oblongifolia*; *Pittosporum undulatum*; *Leucopogon juniperinus*; *Maytenus silvestris*; *Clerodendrum tomentosum*; *Platylobium formosum*; *Pittosporum revolutum*; *Eustrephus latifolius*; *Myrsine variabilis*; *Polyscias sambucifolia* subsp. A; *Rapanea variabilis*;

Ground Stratum Species: *Lomandra longifolia*; *Adiantum aethiopicum*; *Entolasia marginata*; *Pseuderanthemum variabile*; *Dianella caerulea*; *Calochlaena dubia*; *Oplismenus imbecillis*; *Poa affinis*;

Tree Growth Form Species:

Shrub Growth Form Species:

Grass and grasslike Growth Form Species:

Forb Growth Form Species:

Fern Growth Form Species:

Other Growth Form Species:

Diagnostic Species: Not Assessed

Height Class (Walker & Hopkins 1990): 7 - Range:12.01-20.00m (Tall)

Vegetation Formation: Wet Sclerophyll Forests (Shrubby sub-formation);

Vegetation Class: North Coast Wet Sclerophyll Forests;

NSW Landscape Name: Not Assessed

Classification source:

Authority: Vegetation of the Sydney Metropolitan CMA

Pre-European Mapped Or Modelled: Not Assessed

Current Extent Mapped Or Modelled: Not Assessed

Adequacy of plot sampling: None

Number of Plots: Not Assessed

IBRA Bioregion: Sydney Basin (>70%);

IBRA Sub-Region: Yengo (Not known); Pittwater (Not known); Cumberland (Not known); Sydney Cataract (Not known);

LGA: Gosford (Not known); Hawkesbury (Not known);

Lithology: Not Assessed

Landform Pattern: Not Assessed

Landform Element: Not Assessed

Pre-European Extent: 1800 ha ?70%. Modelled from sound site or polygon data

Pre-European Extent Accuracy: 70

Pre-European Comments:

Current Extent: Not Assessed

Current Extent Accuracy: >90

Current Extent Comments:

PCT Percent Cleared: 90.00

% accuracy (of PCT % cleared estimate): Not Assessed

Variation and Natural Disturbance:

Fire Regime:

PCT associated with TEC: Yes

Associated TEC Names: Listed TSC Act,CE: Blue Gum High Forest in the Sydney Basin Bioregion (Equivalent) is; Listed EPBC Act,CE: Blue Gum High Forest in the Sydney Basin Bioregion (Equivalent) is;

Associated TEC Degree of Fit:

Associated TEC Comments:

Citations: (Tozer M. et al., 2010 ; OEH (2013) ; Tozer M. et al., 2010 ; OEH (2013))

Full Reference Details: (854; 947; 854; 947;). Tozer, M.G., Turner, K., Simpson, C., Keith, D.A., Beukers, P., MacKenzie, B., Tindall, D. & Pennay, C., 2010 Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Version 1.0; OEH (2013) The Native Vegetation of the Sydney Metropolitan Area Version 2.0 NSW Office of Environment and Heritage Sydney; Tozer, M.G., Turner, K., Simpson, C., Keith, D.A., Beukers, P., MacKenzie, B., Tindall, D. & Pennay, C., 2010 Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. Version 1.0; OEH (2013) The Native Vegetation of the Sydney Metropolitan Area Version 2.0 NSW Office of Environment and Heritage Sydney;

Profile source: S_WSF01;

PCT Definition Status: Approved

PCT 1281

Plant Community Type ID (PCT ID):

1,281

PCT Classification Confidence Level: High

PCT Common Name: Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion

PCT Common Usage Name: Sydney Turpentine - Ironbark forest

PCT Scientific Name: *Syncarpia glomulifera*, *Eucalyptus punctata*, *Eucalyptus pilularis*, *Eucalyptus paniculata* subsp. *paniculata* / *Pittosporum undulatum*, *Polyscias sambucifolia* subsp. *A*, *Acacia parramattensis*, *Breynia oblongifolia* / *Dianella caerulea*, *Lomandra longifolia*, *Microlaena stipoides* var. *stipoides*, *Pratia purpurascens*

Data Entry Operator: System

Data Entry Date: 27/06/2011

Last Modified By: STEENBG

Last Modified Date: 17/02/2017

Vegetation Description: Sydney Turpentine-Ironbark Forest (Benson and Howell 1990) is a tall open forest found on shale and shale-enriched sandstone soils on the coast and hinterland of Sydney. It has been extensively cleared but was once widely distributed between Sutherland and the Hornsby plateau with outlying examples found on shale-rich deposits at Campbelltown, Menai, Kurradjong and Heathcote. The primary distribution of this forest is in areas receiving between 900 and 1250 millimetres of mean annual rainfall at elevations between 10 and 180 metres above sea level. The forest is characterised by open midstrata of mesic and sclerophyllous shrubs and small trees with a grassy ground cover. The composition of the canopy is variable depending on location and substrate. Typically it is recognised by a canopy dominated by turpentine (*Syncarpia glomulifera*), red mahogany (*Eucalyptus resinifera*) and various ironbarks of which *Eucalyptus paniculata* is most often recorded. On the north shore these forests are found on shale-enriched sheltered sandstone slopes where ironbarks are less common and blackbutt (*Eucalyptus pilularis*) is prevalent. In the western suburbs drier forms of this forest are found at Concord, Bankstown and Auburn although remnants are small and highly disturbed. This map unit is referable to a community of the same name in Tozer et al. 2010 and includes some sites previously identified as Sydney Turpentine Ironbark Margin Forest in NPWS (2002b) and Tozer (2003).

Rain fall: Not Assessed

Elevation: Not Assessed

Emergent species: None

Upper Stratum Species: *Syncarpia glomulifera*; *Eucalyptus punctata*; *Eucalyptus pilularis*; *Eucalyptus paniculata* subsp. *paniculata*; *Angophora costata*;

Mid Stratum Species: *Pittosporum undulatum*; *Polyscias sambucifolia* subsp. *A*; *Acacia parramattensis*; *Breynia oblongifolia*; *Ozothamnus diosmifolius*; *Pittosporum revolutum*; *Allocasuarina torulosa*; *Leucopogon juniperinus*; *Notelaea longifolia*;

Ground Stratum Species: *Dianella caerulea*; *Lomandra longifolia*; *Microlaena stipoides* var. *stipoides*; *Pratia purpurascens*; *Entolasia marginata*; *Dichondra repens*; *Entolasia stricta*; *Pseuderanthemum variabile*; *Imperata cylindrica* var. *major*; *Oplismenus imbecillis*;

Tree Growth Form Species:

Shrub Growth Form Species:

Grass and grasslike Growth Form Species:

Forb Growth Form Species:

Fern Growth Form Species:

Other Growth Form Species:

Diagnostic Species: Not Assessed

Height Class (Walker & Hopkins 1990): 7 - Range:12.01-20.00m (Tall)

Vegetation Formation: Wet Sclerophyll Forests (Grassy sub-formation);

Vegetation Class: Northern Hinterland Wet Sclerophyll Forests;

NSW Landscape Name: Not Assessed

Classification source:

Authority: PADACS - archive

Pre-European Mapped Or Modelled: Not Assessed

Current Extent Mapped Or Modelled: Not Assessed

Adequacy of plot sampling: None

Number of Plots: Not Assessed

IBRA Bioregion: Sydney Basin (Not known);

IBRA Sub-Region: Wollemi (Not known); Yengo (Not known); Pittwater (Not known); Cumberland (Not known); Burratorang (Not known); Sydney Cataract (Not known);

LGA: Sutherland (Not known); Bankstown (Not known); Fairfield (Not known); Ryde (Not known); Ku-ring-gai (Not known); Hornsby (Not known); Hawkesbury (Not known); Blue Mountains (Not known); Wollondilly (Not known); Lithgow (Not known);

Lithology: Not Assessed

Landform Pattern: Not Assessed

Landform Element: Not Assessed

Pre-European Extent: 23000 ha 7%. Modelled from sound site or polygon data

Pre-European Extent Accuracy: Not Assessed

Pre-European Comments:

Current Extent: Not Assessed

Current Extent Accuracy: Not Assessed

Current Extent Comments:

PCT Percent Cleared: 90.00

% accuracy (of PCT % cleared estimate): Not Assessed

Variation and Natural Disturbance:

Fire Regime:

PCT associated with TEC: Yes

Associated TEC Names: Listed TSC Act,E: Sydney Turpentine-Ironbark Forest (Equivalent) is; Listed EPBC Act,CE: Shale Sandstone Transition Forest in the Sydney Basin Bioregion (Part) partially subset of; Listed EPBC Act,CE: Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion (Part) partially subset of; Listed TSC Act,CE: Shale Sandstone Transition Forest in the Sydney Basin Bioregion (Part) partially subset of; Listed TSC Act,E: Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion (Part) partially subset of; Listed EPBC Act,CE: Sydney Turpentine-Ironbark Forest (Equivalent) wholly subset of;

Associated TEC Degree of Fit:

Associated TEC Comments:

Citations: (Tozer, M.G., Turner, K., Keith, D.A., Tindall, D., Pennay, C., Simpson, C., MacKenzie, B., Beukers, M. and Cox, S., 2010 ; NSW Scientific Committee, 1998c ; Department of Sustainability, Environment, Water, Population and Communities, 2011g ; OEH (2013))

Full Reference Details: (691; 918; 919; 947;). Tozer, M.G., Turner, K., Keith, D.A., Tindall, D., Pennay, C., Simpson, C., MacKenzie, B., Beukers, M. and Cox, S. (2010) Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11(3): 359-406; NSW Scientific Committee. (1998c). Sydney Turpentine-Ironbark Forest, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps , Final Determination; Department of Sustainability, Environment, Water, Population and Communities (2011g). Turpentine-Ironbark Forest in the Sydney Basin Bioregion in Community and Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: <http://www.environment.gov.au/sprat>; OEH (2013) The Native Vegetation of the Sydney Metropolitan Area Version 2.0 NSW Office of Environment and Heritage Sydney;

Profile source: WSF p87 (Tozer et al. 2006);

PCT Definition Status: Approved

3.1.5 Vegetation integrity assessment

A vegetation integrity assessment is an assessment on the site's condition. Vegetation patches are broken into zones of roughly equal quality and then surveyed by transect plots. The number of required transect plots is dependent upon the size of the zone.

Vegetation zone area (ha)	Minimum number of plots/transects
<2	1 plot/transect
>2–5	2 plots/transects
>5–20	3 plots /transects
>20–50	4 plots/transects
>50–100	5 plots/transects
>100–250	6 plots/transects
>250–1000	7 plots/transects; more plots may be needed if the condition of the vegetation is variable across the zone
>1000	8 plots/transects; more plots may be needed if the condition of the vegetation is variable across the zone

Based on the area of impact, there will be three (3) zones, two (2) of PCT 1237 relating to moderate-good condition vegetation, and a modified version that is 'park like'. There is a third zone of Sydney Turpentine Ironbark Forest which is modified and 'park like'. Based on the size of each zone, one (1) plot is required in each zone.

Once data from the transect plot has been collected, the composition of native plant species per growth form is assessed, along with numbers of stems, percentages of exotic or high threat exotic species present, number and sizes of Eucalypt and non-Eucalypt tree stems, litter cover, rock cover, cryptogram cover, hollows and fallen logs. Therefore the vegetation integrity assessment is a measure of composition, structure and function.

The vegetation integrity score is obtained using equations and weightings based upon a number of entities to calculate scores for composition, structure and function, for an overall current vegetation integrity score. The scores have not been assessed for this report, but will be undertaken for the future development application.

3.2 Fauna results

Table 3.3 – Fauna observations for the study area

Common name	Scientific name	Method observed
Birds		Jan 2018 & Jan 2019
Australian King Parrot	<i>Alisterus scapularis</i>	O W
Australian Raven	<i>Corvus coronoides</i>	O W
Bell Miner	<i>Manorina melanophrys</i>	O W
Brown Thornbill	<i>Acanthiza pusilla</i>	O W
Eastern Rosella	<i>Platycercus eximius</i>	O W
Eastern Yellow Robin	<i>Eopsaltria australis</i>	O W
Galah	<i>Eolophus roseicapillus</i>	O W
Gang-gang Cockatoo ^{TS}	<i>Callocephalon fimbriatum</i>	W
Grey Butcherbird	<i>Cracticus torquatus</i>	O W
Grey Fantail	<i>Rhipidura albiscapa</i>	O W

Common name	Scientific name	Method observed	
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	O W	
Little Lorikeet ^{TS}	<i>Glossopsitta pusilla</i>	O W	
Musk Lorikeet	<i>Glossopsitta concinna</i>	O W	
Noisy Miner	<i>Manorina melanocephala</i>	O W	
Pied Currawong	<i>Strepera graculina</i>	W	
Powerful Owl ^{TS}	<i>Ninox strenua</i>	H ^{PR}	
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	O W	
Silvereye	<i>Zosterops lateralis</i>	O W	
Spotted Turtle-Dove *	<i>Streptopelia chinensis</i>	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	
White-browed Scrubwren	<i>Sericornis frontalis</i>	O W	
White-throated Needletail	<i>Hirundapus caudacutus</i>	O W	
Mammals			
Cat (feral)*	<i>Felis catus</i>	O	
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	O	
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	O	
Domesticated Dog *	<i>Canis lupus familiaris</i>	O	
Eastern Freetail-bat	<i>Mormopterus ridei</i>	U ^{PR}	
Gould’s Wattled Bat	<i>Chalinolobus gouldii</i>	U	
Greater Broad-nosed Bat ^{TS}	<i>Scoteanax rueppellii</i>	U ^{PR}	
Grey-headed Flying-fox ^{TS}	<i>Pteropus poliocephalus</i>	O	
Little Forest Bat	<i>Vespadelus vulturnus</i>	U	
White-striped Mastiff-bat	<i>Austronomus australis</i>	U	
Reptiles			
Delicate Skink	<i>Lampropholis delicata</i>	O	
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	O	
Amphibians			
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	W ^{PR}	
Note: * indicates introduced species ^{TS} indicates threatened species All species listed are identified to a high level of certainty unless otherwise noted as: ^{PR} indicates species identified to a ‘probable’ level of certainty – more likely than not ^{PO} indicates species identified to a ‘possible’ level of certainty – low-moderate level of confidence			
E - Nest/roost	H - Hair/feathers/skin	P - Scat	W - Heard call
F - Tracks/scratchings	K - Dead	Q - Camera	X - In scat
FB - Burrow	O - Observed	T - Trapped/netted	Y - Bone/teeth/shell
G - Crushed cones	OW - Obs & heard call	U - Anabat/ultrasound	Z - In raptor/owl pellet

3.3 Habitat results

3.3.1 Fauna habitat observations

The fauna habitats present within the site are identified within the following table.

Table 3.4 – Observed fauna habitat

Topography													
Flat	✓	Gentle	✓	Moderate	✓	Steep		Drop-offs					
Vegetation structure													
Closed Forest		Open Forest		✓	Woodland		Heath		Grassland	✓			
Disturbance history													
Fire			Under-scrubbing				✓	Cut and fill works			✓		
Tree clearing			✓	Grazing									
Soil landscape													
DEPTH:		Deep		✓	Moderate		✓	Shallow		Skeletal			
TYPE:		Clay		✓	Loam		✓	Sand		Organic	✓		
VALUE:		Surface foraging			✓	Sub-surface foraging			✓	Denning/burrowing		✓	
WATER RETENTION:		Well Drained		✓	Damp / Moist			Water logged		Swamp / Soak			
Rock habitat													
CAVES:		Large		Small			Deep		Shallow				
CREVICES:		Large		Small			Deep		Shallow				
ESCARPMENTS:		Winter / late sunny aspects					Shaded winter / late aspects						
OUTCROPS:		High Surface Area Hides			Med. Surface Area Hides			Low Surface Area Hides					
SCATTERED / ISOLATED:		High Surface Area Hides			Med. Surface Area Hides			Low Surface Area Hides					
Feed resources													
FLOWERING TREES:		Eucalypts			✓	Corymbias			✓	Melaleucas			
		Banksias				Acacias			✓				
SEEDING TREES:		Allocasuarinas			✓	Conifers							
WINTER FLOWERING EUCALYPTS:		C. maculata		✓	E. crebra			E. globoidea		E. sideroxylon			
		E. squamosa			E. grandis			E. multicaulis		E. scias			
		E. robusta			E. tereticornis			E. agglomerata		E. siderophloia			
FLOWERING PERIODS:		Autumn		✓	Winter		✓	Spring		✓	Summer	✓	
OTHER:		Mistletoe		✓	Figs / Fruit			Sap / Manna		✓	Termites		
Foliage protection													
UPPER STRATA:		Dense			✓	Moderate			✓	Sparse			
MID STRATA:		Dense			✓	Moderate			✓	Sparse			
PLANT / SHRUB LAYER:		Dense				Moderate			✓	Sparse		✓	
GROUNDCOVERS:		Dense			✓	Moderate			Sparse				
Hollows / logs													
TREE HOLLOWs:		Large			✓	Medium			✓	Small		✓	
TREE HOLLOW TYPES		Spouts / branch		✓	Trunk	✓	Broken Trunk		✓	Basal Cavities		Stags	✓
GROUND HOLLOWs:		Large				Medium			Small		✓		
Vegetation debris													
FALLEN TREES:		Large			✓	Medium			✓	Small		✓	
FALLEN BRANCHES:		Large			✓	Medium			Small		✓		
LITTER:		Deep				Moderate			✓	Shallow		✓	
HUMUS:		Deep				Moderate			✓	Shallow		✓	

Drainage catchment						
WATER BODIES	Wetland(s)	Soak(s)	Dam(s)	Drainage line(s)	Creek(s) ✓	River(s)
RATE OF FLOW:	Still ✓		Slow ✓		Rapid	
CONSISTENCY:	Permanent		Perennial ✓		Ephemeral ✓	
RUNOFF SOURCE:	Urban / Industrial	Parkland ✓		Grazing	Natural ✓	
RIPARIAN HABITAT:	High quality	Moderate quality ✓		Low quality	Poor quality	
Artificial habitat						
STRUCTURES:	Sheds ✓		Infrastructure		Equipment	
SUB-SURFACE	Pipe / culvert(s)		Tunnel(s)		Shaft(s)	
FOREIGN MATERIALS:	Sheet		Pile / refuse ✓			

3.3.2 Habitat tree data

Significant habitat trees were initially identified within the northern and southern detailed investigation areas during January 2018 survey. This data is provided in the first part of Table 3.5. Significant habitat trees are defined as trees containing large hollows suitable for use by owls and/or containing a number of good quality hollows typically consisting of more than one medium (10-30cm) sized hollow. A tree may also be considered significant where evidence of specific use by a threatened fauna is found.

All other hollow-bearing trees were identified in the two subject site areas (under potential direct impacts from the rezoning) during January 2019 survey. This data is provided in the second part of Table 3.5.

Table 3.5 – Habitat tree data

Significant Habitat Trees in detailed investigation areas						
Tag no.	Common name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows recorded
SHT1 (T30)	Stag	95	1	20	0	1x 0-5cm trunk split, 2x 5-10cm trunk hollows, 2x 10-15cm trunk hollows
SHT2 (T51)	Blackbutt	33	7	21	50	1x 0-5cm low trunk hollow, wear & cleared cavity indicating potential microbat use
SHT3	Sydney Blue Gum	130	21	38	70	2x 10-15cm branch spout, 1x 15-20cm branch hollow (good), 1x 15-20cm branch spout hollow (good), 1x 20-30cm trunk hollow (good & large internal cavity)
SHT4	Sydney Blue Gum	80	20	45	60	1x 5-10cm branch spout, 1x 10-15cm branch spout, 1x 20-30cm trunk hollow (good)
SHT5	Sydney Blue Gum	120	26	34	65	1x 5-10cm trunk, 2x 10-15cm branch spout
Hollow-bearing Trees in subject site						
HT1s	Snow In Summer	35,45	11	12	90	1x 0-5cm low trunk
HT1n	stag	60	1	8	0	1x 0-5cm cut branch, 1x 10-15cm trunk, much exfoliated bark
HT2n	Lemon-scented Gum	39	12	20	80	1x 0-5cm cut branch
HT3n	stag	23,24, 25,30	10	12	0	1x 0-5cm trunk



Biodiversity Assessment

4

4.1 BOS thresholds

The BOS includes two (2) elements to the threshold test – an area trigger and a Sensitive Biodiversity Values Land Map trigger. If clearing exceeds either trigger, the Biodiversity Offset Scheme applies to the proposed clearing.

4.1.1 Sensitive Biodiversity Values Land

The study area is located on lands mapped as Sensitive Biodiversity Values Land (refer to Figure 3) – therefore an offset will be required as an outcome of this threshold test.

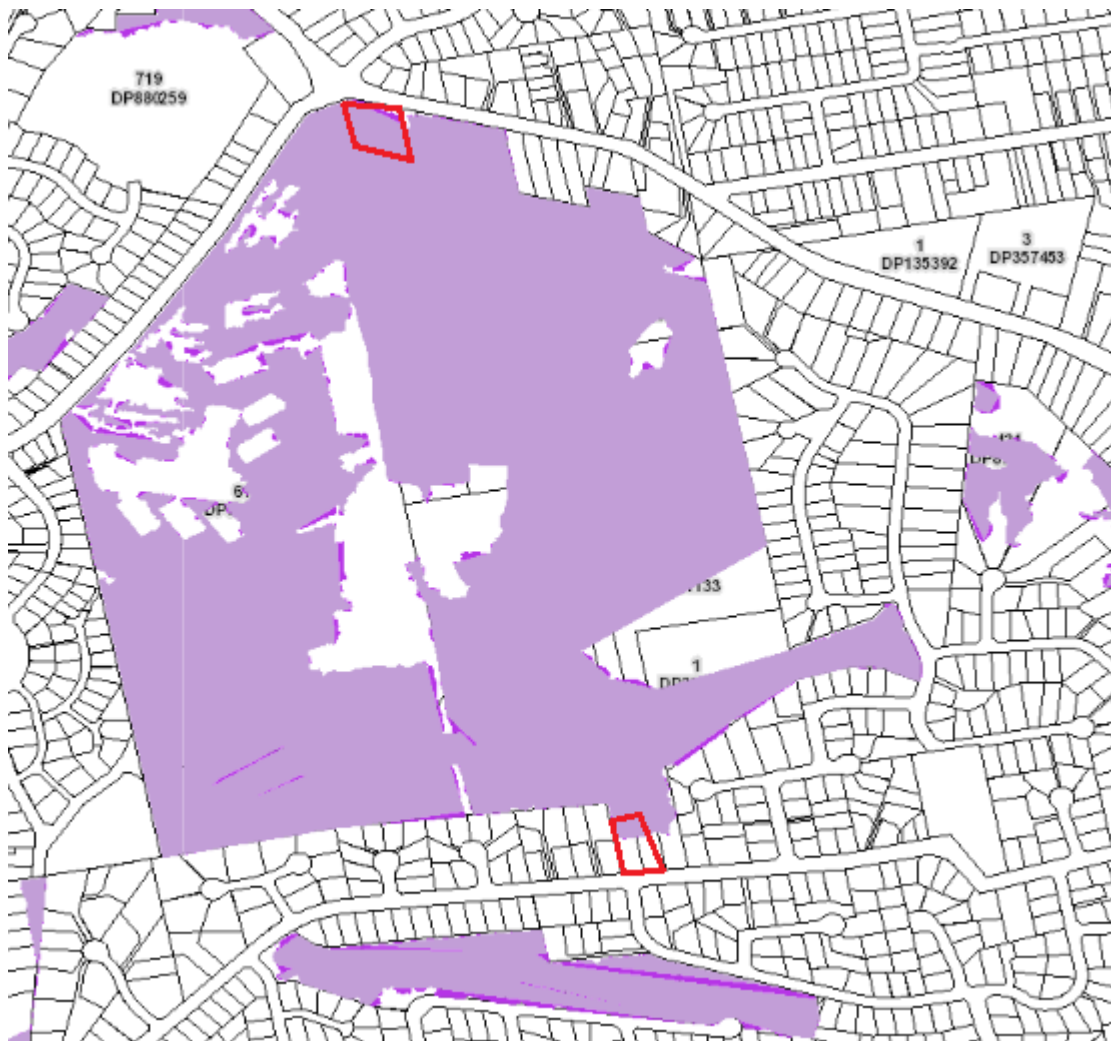


Figure 3 – Sensitive Biodiversity Land Map (purple) – indicative impact area shown in red
(source: <https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap>)

4.1.2 Area clearing threshold

The area threshold varies depending on the minimum lot size (shown in the Lot Size Maps made under the relevant Local Environmental Plan (LEP)), or actual lot size (where there is no minimum lot size provided for the relevant land under the LEP).

The area threshold applies to all proposed native vegetation clearing associated with a development proposal – for example in the case of a subdivision; all future clearing across the lots subject to the subdivision, must be considered. Thresholds outlined under the BOS are outlined in the table below.

Table 4.1 – Area clearing thresholds to trigger offsetting under BOS

Minimum lot size associated with the property	Threshold for clearing, above which the BAM and offsets scheme apply
Less than 1 ha	0.25 ha or more
Less than 40ha but not less than 1ha	0.5 ha or more
Less than 1000ha but not less than 40ha	1 ha or more
1000 ha or more	2 ha or more

The minimum lot size associated with the Cumberland State Forest is 40ha and thus in accordance with Table 1, up to 2ha may be cleared without the BOS applying.

However, following rezoning, the minimum lot size for R2 lands may be 700m² such as for surrounding lots and the future threshold would be 0.25ha.

Either way, the proposed development will impact upon areas of sensitive biodiversity values and will require offsetting under the BOS (or a species impact statement).

4.1.3 Serious and Irreversible Impacts

An impact is to be regarded as serious and irreversible if it is likely to contribute significantly to the risk of a threatened species or ecological community most at risk of extinction. Threatened species and communities that are potential for serious and irreversible impacts are outlined in Appendix 2 of *Guidance to assist a decision-maker to determine a serious and irreversible impact* (OEH 2017). The principles for determining serious and irreversible impacts are set out under Section 6.7.2 of the *Biodiversity Conservation Regulation 2017*.

Impacts upon Blue Gum High Forest and Sydney Turpentine Ironbark Forest are listed as a potential SAI (Reference - *Guidance to assist a decision-maker to determine a serious and irreversible impact* Office of Environment & Heritage 2017). All efforts to minimise impact are required.

Candidate species recorded or with potential to occur within the study area include:

Table 4.2 – Candidate SAI species

Scientific name	Common name	BC Act	Potential to occur
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	E1	recorded on site – only as a planted species, not naturally occurring in the Sydney Basin Bioregion.
<i>Anthochaera phrygia</i>	Regent honeyeater	E	unlikely
<i>Lathamus discolor</i>	Swift parrot	E	✓
<i>Miniopterus schreibersii</i> <i>subsp. oceanensis</i>	Eastern bentwing-bat	E	✓
<i>Miniopterus australis</i>	Little bentwing-bat	E	unlikely

The additional impact assessment provisions for threatened species are outlined under Section 10.2.3 of the BAM (2017).

As part of the rezoning process, we will not be undertaking a significance assessment upon any entities. We do advise however that as the *Eucalyptus scoparia* are planted specimens, we believe they do not require consideration as an SAI.

The subject site also does not likely support any breeding habitat or likely important roosting/foraging for candidate fauna species with potential to occur. Based on the principles for determining SAI the proposal is not likely to be constrained by any serious and irreversible impacts.

4.2 Flora

A small number of landscaping and planted species were observed within both study areas. Not all specimens were identified and included within the species list (Table 3.1).

Two (2) species of *Eucalyptus scoparia* were recorded in the southern study area. Both specimens are planted. No other threatened flora species were observed during the studies.

All species are listed in Table 3.1.

4.2.1 State legislative flora matters

(a) Threatened flora species (NSW)

Biodiversity Conservation Act, 2016 (BC Act) – A search of the *Atlas of NSW Wildlife* (OEH, 2019) indicated a list of species that have been recorded within a 10 km radius of the subject site.

Environmental Protection and Biodiversity Conservation Act (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 10km radius of the subject site.

Table 4.3 – Threatened flora species with suitable habitat present

Scientific name	BC Act	Potential to occur
<i>Acacia bynoeana</i>	E1	very low, very few local records, not expected
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	V	low, more likely to be in areas with more sandstone influence near the southern study area
<i>Syzygium paniculatum</i>	E1	low-moderate, possibly better habitat in creek line adjacent to the southern study area
<i>Tetratheca glandulosa</i>	V	potential habitat across parts of the State Forest but none within the study areas

Acacia bynoeana, *Epacris purpurascens* var. *purpurascens* and *Syzygium paniculatum* searches were undertaken. No species were observed.

There appears to be 2x *Eucalyptus scoparia* planted near the south-west corner of the southern study area. This vulnerable listed species does not naturally occur in the Sydney Basin Bioregion and is unlikely to have the same genetic make-up as those in their natural environment. These specimens should not be a constraint to future development.

One (1) state listed threatened flora species, *Eucalyptus scoparia*, was observed during surveys undertaken. As the specimens are planted and do not naturally occur in the Sydney Basin Bioregion, an assessment upon their future impact is considered to be 'not significant'.

(b) Endangered flora populations (NSW)

The following endangered flora populations are known from The Hills (formerly, Baulkham Hills) local government area:

- *Dillwynia tenuifolia* population, Baulkham Hills Shire Local Government Area
- *Wahlenbergia multicaulis* population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas
- *Darwinia fascicularis* subsp. *oligantha* population, Baulkham Hills and Hornsby local government areas

Populations of *Pomaderris prunifolia* and *Marsdenia viridiflora* var. *viridiflora* occur within 10km of the study area however they are not listed as occurring in The Hills.

None of the above-listed endangered populations are represented within the northern or southern rezoning areas. The habitat attributes are lacking for each and considered highly unlikely to have potential habitat.

(c) Threatened ecological communities (NSW)

Two (2) TECs were located within the study areas, these include

- Blue Gum High Forest (critically endangered)
- Sydney Turpentine Ironbark Forest (endangered)

The Blue Gum High Forest covers the majority of the Cumberland State Forest. The southern study area adjacent to Oratava Avenue is Sydney Turpentine Ironbark Forest which grades to

Blue Gum High Forest in the riparian zone to the immediate north. The full extent of the northern study area is Blue Gum High Forest.

(d) Endangered wetland communities

A number of wetland communities have been listed as TECs under the NSW *BC Act*. We note that 'wetlands' are included in the definition of 'waterfront lands' in accordance with the *Water Management Act 2000* due to their inclusion in the definition of a 'lake' under the same Act. TEC's that are considered to be an endangered protected wetland are as follows:

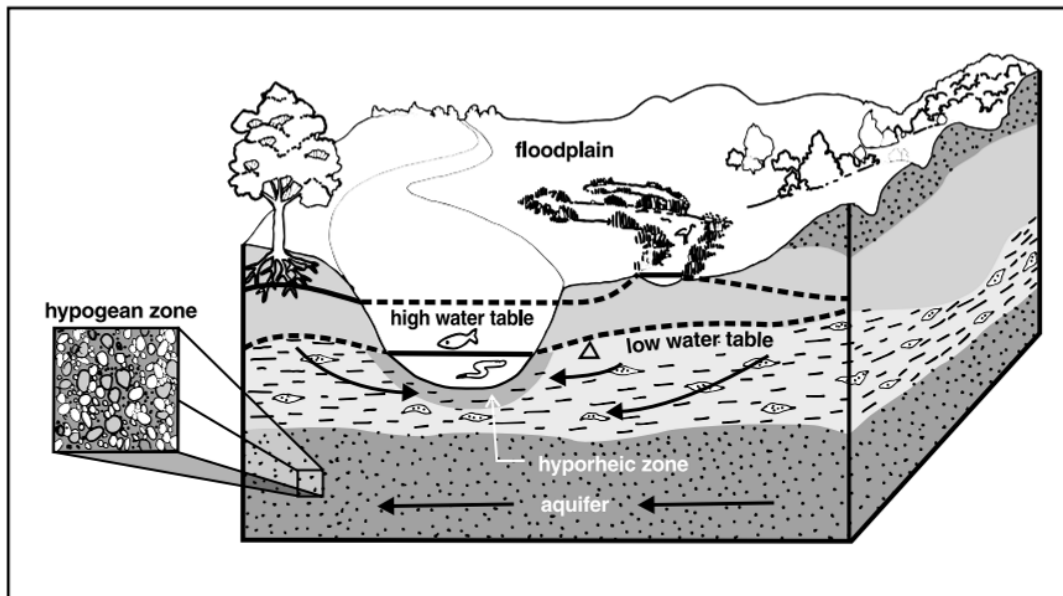
- Artesian springs ecological community
- Castlereagh Swamp Woodland Community
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions
- Coastal Upland Swamp in the Sydney Basin bioregion
- Coolibah–Black Box woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain and Mulga Lands bioregions
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East 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 South East Corner bioregions
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East 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
- Wingecarribee Swamp

No endangered wetland communities were present within the subject site and therefore a referral to WaterNSW is not required.

(e) Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) 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.



Alluvial groundwater system discharging into a river

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

GDEs were not observed within the subject site and therefore the policy does not require any further consideration. A referral to WaterNSW is not required.

(f) Coastal wetlands

Wetlands on site or adjacent

The new interactive mapping tool provides updated mapping of the former SEPP 14 wetlands. There are no wetlands within 7.5km of the site.

(g) State Environmental Planning Policy (Coastal Management) 2018

State Environmental Planning Policy (Coastal Management) 2018 updates and consolidates into one integrated policy SEPP 14 (Coastal Wetlands), SEPP 26 (Littoral Rainforests) and SEPP 71 (Coastal Protection), including clause 5.5 of the Standard Instrument – Principal Local Environmental Plan. These policies are now repealed.

The Coastal Management SEPP gives effect to the objectives of the *CM Act* from a land use planning perspective, by specifying how development proposals are to be assessed if they fall within the coastal zone.

An integrated and coordinated approach to land use planning is promoted by the new SEPP. It defines the four coastal management areas in the Act through detailed mapping and specifies assessment criteria that are tailored for each coastal management area. Councils and other consent authorities must apply these criteria when assessing proposals for development that fall within one or more of the mapped areas. The Coastal Management SEPP identifies development controls for consent authorities to apply to each coastal management area to achieve the objectives of the *CM Act*.

The Coastal Management SEPP establishes the approval pathway for coastal protection works.

The study area is not affected by this policy.

4.2.2 Matters of national environmental significance - flora

(a) Threatened flora species (national)

A review of the schedules of the *EPBC Act* indicated the potential for a list of threatened flora species to occur within a 10km radius of the site. These species have been considered for habitat presence and potential to occur within Appendix 2.1.

Based on the habitat assessment within Appendix 2.1, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened flora species:

Table 4.4 – Nationally listed threatened flora species with suitable habitat present

Scientific name	<i>EPBC Act</i>	Potential to occur
<i>Acacia bynoeana</i>	✓	very low, very few local records, not expected
<i>Syzygium paniculatum</i>	✓	low-moderate, possibly better habitat in creek line adjacent to the southern study area

No nationally listed threatened flora species were observed within the subject site.

(b) Endangered ecological communities (national)

Blue Gum High Forest and Turpentine Ironbark Forest are TECs under the *EPBC Act*. The rezoning will see an impact of 0.136ha upon Blue Gum High Forest and 0.344ha upon Turpentine Ironbark Forest.

There will be a requirement for further assessment under the *EPBC Act* and potentially a referral to DOEE.

At the assessment stages of this project the *EPBC Act* (1999) Environmental Offsets Policy (2012) states that the impacts of a proposed action must be fully understood. At the assessment stage the decision maker considers the following issues in detail. The impact areas are not final for the rezoning process therefore determination of a referral will not be made until the numbers (impacts) are finalised for the development application. The assessment will need to answer the following questions:

- What is the nature of the likely impacts on protected matters?
- Can impacts on protected matters be avoided?
- Can impacts on protected matters be mitigated?
- Are the residual impacts likely to be significant?
- Are offsets a suitable approach?

4.3 Fauna

All fauna species recorded during survey(s), key fauna habitat observations and habitat tree data are provided in Section 3.

4.3.1 Key fauna habitat

Most notable habitat features for threatened fauna species considered with most potential to occur include:

- Large hollows (30+cm) suitable for nesting by Powerful Owl at more than 75m from the subject site edge
- Medium hollows (10-30cm)
- Small hollows (<10cm)
- Dense mid-storey trees (Turpentine) suitable for roosting by Powerful Owl
- Seeding Allocasuarinas present in very low numbers
- Diverse seasonal flowering opportunities for nectivorous species.
- Winter flowering trees
- High quality and expansive areas of adjacent open forest

Five (5) significant habitat trees, based on presence of medium or large hollows, were identified within or proximate to the northern investigation area. A Powerful Owl breeding pair is known to have an established breeding area within the Cumberland State Forest (CSF) and adjacent area, therefore particular consideration was made to potential nesting opportunities within large hollows that may be directly or indirectly impacted by the proposal.

No significant or notable habitat trees have been recorded within or proximate to the southern investigation area. Having said this, Grey-headed Flying-fox was recorded in numbers up to 4 foraging in the adjacent gully to the north (just beyond the investigation area) and Little Lorikeet was recorded foraging in two Blackbutt trees directly across Oratava Avenue to the south, outside of the study area.

Significant habitat tree data is provided in Table 3.5. Of these SHT3 & SHT4 have some potential for use by Powerful Owl (refer to Figure 2 for locations). Whilst the internal cavities for these large hollows appear sufficient the entry size is not typically ideal. Nonetheless, given that large suitable hollows appear to be a highly limited resource within the CSF and adjacent connective lands to the west, and given also that the current nesting location is unknown, further survey of these trees during the winter breeding period is recommended.

Other trees of notable habitat value are indicated within and proximate to the northern investigation area as shown on Figure 2. One of these includes whitewash consistent with Powerful Owl. This may also be a diurnal bird roost (eg Kookaburra) which was also found nearby, however likely Powerful Owl down feathers located elsewhere nearby suggest that Powerful Owl activity is apparent.

The planted Turpentine trees along the eastern boundary of the northern investigation area (separating residences further east) do provide potential Powerful Owl roosting habitat. Such roosting habitat is otherwise extensive throughout the non-burnt gullies and dense mid-storey forest areas throughout the connective remnant. Therefore impacts on these trees will not be likely significant. Given that they provide suitable roosting opportunity but also existing screening from the urban landscape, their retention is recommended.

Other hollow-dependent threatened fauna species recorded present during survey included the Greater Broad-nosed bat and Little Lorikeet. One smooth-barked Sydney Blue Gum tree

within the northern investigation area has potential knolls that may be utilised by Little Lorikeet for nesting. Such holes were however discrete from the ground and no activity suggested use during survey. Little Lorikeet was only recorded in flight overhead during survey in the northern investigation area.

SHT1 is a large stag that has had limbs cut and managed next to the communications tower. As this was the closest potential microbat roost to the development footprint this tree was stag-watched in the dusk period during survey and an ultrasonic bat recorder was placed below. No fauna was observed emerging from these hollows at this time. A smaller dead trees containing a small hollow was recorded to the rear of the cottage also.

Hollow-dependent threatened fauna species recorded during previous or recent surveys include the Powerful Owl (*Ninox strenua*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Little Lorikeet (*Glossopsitta pusilla*), and Greater Broad-nosed Bat (*Scoteanax rueppellii*).

A more detailed hollow-bearing tree survey within the two subject site areas did not locate any hollows of likely notable value to the abovementioned threatened fauna. Overall natural hollows within the connective remnant are in low density and a development application should therefore include relocating quality hollows from the development footprint into the adjacent forest. Such hollows have been demonstrated to receive far more fauna species use and diversity than nest boxes. This particularly also given that there is limited of threatened microbats utilising bat boxes.

4.3.2 Local fauna matters

One (1) fauna species recorded present during survey, the White-throated Needletail, is listed as a regionally significant species within the *Native Fauna of Western Sydney - Urban Bushland Biodiversity Survey* (NPWS 1997).

The White-throated Needletail is also a listed migratory species under the EPBC Act and has been considered for impact in Table A2.3. The subject site provides no suitable breeding or habitat otherwise of importance for this species.

4.3.3 State legislative fauna matters

(a) Threatened fauna species (NSW)

BC Act – A search of the *Atlas of NSW Wildlife* (OEH 2019) provided a list of threatened fauna species previously recorded within a 10km radius of the subject site. These species are listed in Table A2.2 (Appendix 2) and are considered for potential habitat within the subject site. Strictly estuarine and oceanic threatened species found within 10km have not been included as no marine / aquatic / wetland habitats occur within the areas under detailed investigation.

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following state listed threatened fauna species:

Table 4.5 – State listed threatened fauna species with suitable habitat present

Common name	BC Act	Potential to occur
Gang-gang Cockatoo	V	recorded
Little Lorikeet	V	recorded
Powerful Owl	V	recorded
Grey-headed Flying-fox	V	recorded
Greater Broad-nosed Bat	V	recorded
Square-tailed Kite	V	✓
Swift Parrot	E	✓
Varied Sittella	V	✓
Dusky Woodswallow	V	✓
Yellow-bellied Sheath-tail-bat	V	✓
East-coast Freetail Bat	V	✓
Eastern Falsistrelle	V	✓
Little Bentwing-bat	V	✓
Eastern Bentwing-bat	V	✓
Little Eagle	V	low
Glossy Black-Cockatoo	V	low
Red-crowned Toadlet	V	unlikely
Barking Owl	V	unlikely
Regent Honeyeater	E4A	unlikely
Scarlet Robin	V	unlikely
Flame Robin	V	unlikely
Dural Land Snail	E	unlikely

Note: Full habitat descriptions for these species are provided in Appendix 2.

Five (5) threatened fauna species including Little Lorikeet (*Glossopsitta pusilla*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Greater broad-nosed Bat (*Scoteanax rueppellii*) were recorded within the northern and southern study areas. The Powerful Owl and Greater Broad-nosed Bat were both recorded only to a 'probable' level of certainty.

The subject site areas do not contain any likely breeding or habitat otherwise of potential importance for these species, therefore there is not likely to be any direct impacts on such habitat. Two large hollows potentially suitable for Powerful Owl have been identified approximately 75m away and beyond. Further survey during the winter breeding period is recommended to determine any potential indirect impacts and advise of any subsequent measures to avoid and minimise impacts. These hollows may also be suitable for Gang-gang Cockatoo however recent surveys were undertaken during the breeding period and no breeding activity for this species was identified.

FM Act – No habitats suitable for threatened aquatic species were observed within the subject site and as such the provisions of this act do not require any further consideration.

(b) Endangered fauna populations (NSW)

There are no endangered fauna populations within the The Hills LGA.

(c) SEPP 44 Koala Habitat Protection

The subject site is not required to be considered under SEPP 44 as it falls within The Hills LGA, which is not listed on Schedule 1 of this Policy.

(d) Local data

Local data has not been used in this case.

(e) Expert reports

Expert reports have not been utilised for fauna on this project.

4.3.4 Matters of national environmental significance - fauna

(a) Threatened fauna species (National)

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 10km radius of the subject site. These species have been listed in Table A2.2 (Appendix 2), and those with potential habitat within the subject site are considered in the seven-part test within Appendix 3.

Based on the habitat assessment within Appendix 2, it is considered that the subject site provides varying levels of potential habitat for the following nationally listed threatened fauna species:

Table 4.6 – Nationally listed threatened fauna species with suitable habitat present

Common name	EPBC Act	Potential to occur
Grey-headed Flying-fox	V	recorded
Swift Parrot	E	✓
Regent Honeyeater	CE	unlikely
Greater Glider	V	unlikely
Dural Land Snail	E	unlikely

One (1) nationally listed threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded during January 2018 surveys. About four individuals were heard foraging within the gully to the north of the southern subject site area (refer to Figure 2).

As the subject site does not contain any likely camp roosting or subsequent breeding habitat and foraging habitat will remain well represented in the locality, there will not be any significant impact on this species, or likely on any other nationally listed threatened fauna species with potential to occur, as a result of development from the rezoning.

(b) 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 10km radius of the subject site. The habitat potential of migratory species is considered in Table A2.3 (Appendix 2).

One (1) nationally protected migratory bird species the White-throated Needletail (*Hirundapus caudacutus*) was recorded present during the January 2019 survey, flying above the northern study area.

As the subject site does not contain any likely roosting, breeding or other habitat of importance, and given that foraging habitat will remain well represented in the locality, there will not be any significant impact on White-throated Needletail, or likely on any other nationally protected migratory bird species with potential to occur, as a result of development from the rezoning.

4.4 Vegetation connectivity

The study area and the adjacent Mirvac lands to the west (as well as a few small fringing lots) contribute to an overall patch of approximately 45ha of connective local natural forest. This forest has notable value as providing core breeding habitat for a pair of Powerful Owls but also other threatened bird and bat species use. This bushland is however isolated from other contiguous local natural bushland. Some degree of fragmented connectivity through residential areas extends along Darling Mills Creek to the south-west and eventually into Darling Mills State Forest and Excelsior Reserve.

Developments associated with the proposed rezoning will be located at the outer northern and southern extent of this patch. The development areas are also already highly modified such that any removal of habitat associated with the rezoning will not affect existing connectivity values in the local landscape.

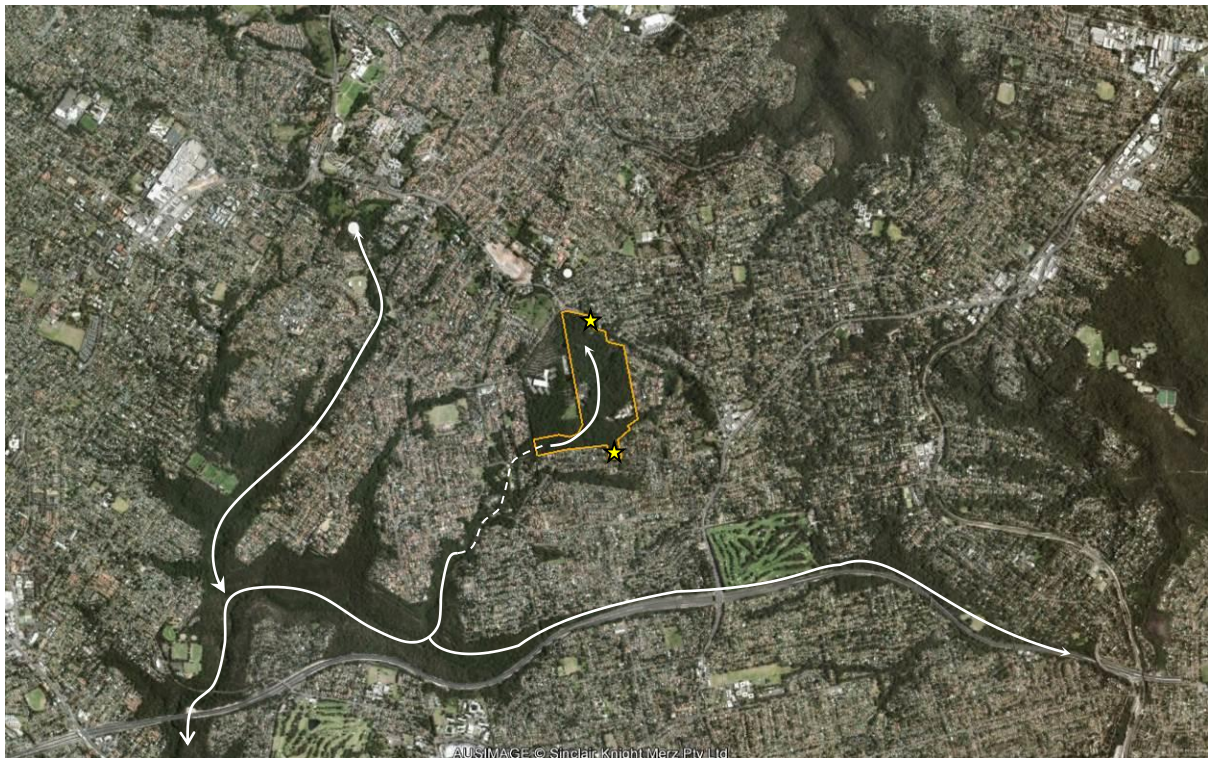


Figure 4 – Local connectivity



Conclusion

5

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *EP&A Act*, the *BC Act*, the *EPBC Act* and the *Fisheries Management Act 1994*.

5.1 Legislative compliance

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979* and relating to the species / provisions of the *Biodiversity Conservation Act 2016*, five (5) threatened fauna species including Little Lorikeet (*Glossopsitta pusilla*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Greater broad-nosed Bat (*Scoteanax rueppellii*), one (1) threatened flora species, *Eucalyptus scoparia* and two (2) TECs, Blue Gum High Forest and Sydney Turpentine Ironbark Forest were recorded within the study area.

Whilst an assessment of significance has not been undertaken, the proposed rezoning will have only minor impacts upon the local ecology. The TECs will not be placed at risk of local extinction because the impact areas are less than 0.5ha in total, and more than 30ha of both TECs combined are protected within the Cumberland State Forest. There is also approximately 12ha of conserved bushland on the immediately adjacent block to the west (former IBM site). Despite this, both TECs are over-cleared vegetation types, therefore any impact on these may be considered as significant and a species impact statement would be required, or offsetting the impacts through the BOS.

Under the *BC Act*, the development must consider that both TECs are listed as potential SAI's and an assessment upon each (and any recorded threatened species) will be required under Section 10.2.3 of the BAM. The proposed rezoning areas do not provide any breeding or other habitat of likely importance for recorded state listed threatened species.

The rezoning areas in the northern study area is upon land that is mapped as containing sensitive biodiversity values and will require offsetting in accordance with BAM.

In respect of matters required to be considered under the *EPBC Act*, one (1) threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), one (1) protected migratory bird species White-throated Needletail (*Hirundapus caudacutus*), no threatened flora species, and two (2) TECs, Blue Gum High Forest and Turpentine Ironbark Forest listed under this Act were recorded within the study area.

An assessment under the *EPBC Act* will need to be undertaken to determine if a referral to DOEE is required. Based upon the small level of impact and that impacts are upon already partly managed vegetation, it makes it less significant, however a referral may be required. A discussion with OEH should be undertaken to determine this, and a separate assessment addressing *EPBC Act* matters will be required. The proposed rezoning areas do not provide

any breeding or other habitat of likely importance for recorded nationally listed threatened or protected migratory species.

In respect of matters relative to the *Fisheries Management Act 1994*, no suitable habitat for threatened marine or aquatic species was observed within the subject site and there are no matters requiring further consideration under this Act.

In respect to considerations and the threshold tests for entry into the BOS, future development within the proposed rezoning area will require offsetting. A full biodiversity development assessment report (BDAR), including offset calculations, will need to be undertaken for a development application upon the site.

5.2 Potential 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:

The direct impacts of the proposal within the subject site are considered as:

- Removal of small branch hollows and bark exfoliations
- 0.136ha of PCT 1237 (Blue Gum High Forest)
- 0.344ha of PCT 1281 (Sydney Turpentine Ironbark Forest)
- Up to 0.48ha loss of vegetated habitat for potential seasonal foraging by recorded nectarivore threatened species

The potential indirect impacts of the proposal are considered as:

- Edge effects such as weed incursions into the adjacent natural habitat areas
- Increased spill-over from noise, activity, scent and lighting effects into the adjacent quality natural habitat areas. This may have effect on adjacent hollows supporting potential breeding habitat by Powerful Owl.
- Increased soil nutrients from changes to runoff that may provide further opportunities for weed plumes.
- Concentrated stormwater runoff from solid surfaces and subsequent increased flows.

5.3 Mitigation measures

The following recommendations are made 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.

- Undertake weed control measures surrounding the rezoning areas to reduce edge effects from future development.
- Landscaping within the property is to use locally occurring native species commensurate with Blue Gum High Forest or Sydney Turpentine Ironbark Forest

<http://www.environment.nsw.gov.au/determinations/bluegumhighforest36a.htm>

<https://www.environment.nsw.gov.au/determinations/SydneyTurpentineIronbarkForestEndComListing.htm>

This website provides the final determination characteristics of the community with a list of species helped to determine the community that should form the majority of replanted species in landscape beds.

- It is recommended that a VMP be prepared to identify the ongoing management of habitat resources, weeds, future landscaping and site works to retain mature trees and habitat within and adjacent to the rezoning areas.
- Retain trees within the rezoning areas if possible. Undertake an arborist assessment of all trees within the rezoning area and immediately adjacent that may be impacted to see if any may be retained, subject to the development layout.
- Erosion control measures are to be in place to reduce temporary erosion and sedimentation risks to adjacent TEC vegetation and any nearby drainage channel.
- Any hollow that is required to be removed should be replaced as a nest box within the adjoining conserved bushland area.
- All areas containing natural habitat features which have been identified for retention are to be protected with fencing prior to construction.
- If any fauna species, a nest or roost is located during development works, such as microbats during building demolition, then works should cease until safe relocation can be advised by a contact fauna ecologist.

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Fauna Survey Methodologies

A1

The fauna survey methods outlined within this Appendix are techniques employed by *Travers bushfire & ecology*, based on industry standards as well as additional methods found to be effective for select fauna groups. The fauna survey techniques deployed for each specific site are outlined within the survey effort table in the main body of this report. The techniques selected will depend upon the site characteristics and extent of available habitat as well as restrictions such as available survey time and weather conditions.

If any additional or target survey techniques for fauna species are undertaken, beyond the methods outlined within this Appendix, the details of these will be described within the main body of this report.

1 Standard survey techniques

1.1 Diurnal birds

Diurnal birds are typically identified visually and / or by calls during diurnal surveys. Habitat searches to identify nests, feathers, eggs, or signs of foraging may be utilised more specifically for identifying threatened diurnal bird species.

Visual observations are made more accurate with the use of binoculars and where necessary or practical, with the use of a spotting scope. Binoculars are carried by the fauna surveyor at all times during nocturnal and diurnal fauna surveys. A birding field guide is always available in the field when required for verifications.

Calls are identified in the field by the fauna surveyor. If an unknown call is heard it is cross-matched to comprehensive bird call reference libraries taken into the field. A call library of birds occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

Diurnal bird census points may be undertaken at large sites where the total area may not be effectively covered during the survey period, or as a measure to ensure focused bird only survey.

Song-meters may also be used for remote diurnal bird call surveys in pre-selected diurnal periods (particularly during the dawn chorus) over the deployment period. Song-Scope or Kaleidoscope software is used to analyse recorded .wav and .wac files. Kaleidoscope – may be used to batch similar recorded files as clusters for a faster group analysis of different calls as well as to re-scan recordings for pairwise calls to determine other times a similar call was made.

1.2 Nocturnal birds

Searches for evidence of Owl roosts, key perches and potential Owl roosting / breeding hollows are made during diurnal site searches. Whitewash, feathers or regurgitated pellets

give key information. Pellets are sent for analysis of contents to assist in identification where necessary.

Generally, the presence of nocturnal birds during the nocturnal period is first determined by quiet listening after dusk for calls by individuals emerging from diurnal roosts. Following this, and provided no calls are heard, call-playback techniques are employed for threatened species that have suitable habitat present.

Threatened nocturnal birds known to provide response to call-playback techniques include Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Sooty Owl (*Tyto tenebricosa*), Grass Owl (*Tyto longimembris*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*).

Each call is typically played for five minute periods with five minute intervals of quiet listening for a response. This is followed with spotlighting and periods of quiet listening throughout the nocturnal survey.

Separation distances between broadcasting stations during a single night of survey are advised for different species within survey guidelines. These include 1km between Owl calls and 3km between Bush Stone-curlew calls. Subsequent to this, separate broadcasting stations will be deployed on the same night where sites of significant size are surveyed. Separations for bitterns are not advised and these may be broadcast at a number of stations along suitable habitat areas.

Where an owl species has been recorded or is known to occur, call-playback techniques will not be deployed for that species to prevent disturbance of breeding activity. Where a threatened owl is known to occur appropriate additional effort will be undertaken to identify appropriate nesting/roosting trees and identify signs of use as per the methods guided by owl specialist John Young. These techniques vary pending the time of year but all with a focus to identify key breeding and roosting habitat trees and areas.

Stag-watching at appropriate times of year will also be undertaken where suitable large hollows for Owl nesting / roosting show signs of activity or are located within development areas. Full covert or semi-covert *Reconyx*TM surveillance cameras may be mounted at suspected hollows to target owl use and behaviour.

Song-meters may also be used to remotely target presence of owls by recording calls in selected nocturnal periods (particularly after dusk and before dawn) in the early breeding period.

1.3 Arboreal mammals

Arboreal mammals may be surveyed using Elliott type A, B and / or C traps, small and / or large hair tubes, surveillance cameras, video endoscope, spotlighting, call-playback techniques, scat searches or searches for other signs of activity.

Baiting and layout for Elliott trapping and hair tubing are typically incorporated into terrestrial trapping and hair tubing effort, unless where target survey is undertaken. Standard baiting and layout is therefore described in Section A1.4 below within terrestrial survey methods. Where gliders are targeted, the standard bait mix may be additionally laced with a nectarivor powder mix used for feeding captive birds. Where Brush-tailed Phascogales are targeted the standard bait mix may be additionally laced with an insectivore powder mix. Where Eastern Pygmy Possum is targeted, the bait mix will be more heavily laced with honey.

Elliott traps for arboreal captures are placed onto tree mounted platforms that are attached to the trunk 2-3m above the ground, at an incline to facilitate drainage during inclement weather. Plastic sleeves are placed around or over traps when wet weather is forecast. Arboreal hair tubes are attached to the trunk of trees using rubber bands with the tube entry facing down, preventing water entry.

For all arboreal traps and hair tubes a mixture of honey and water is sprayed onto the trunk up to 8m above the trap and around the trap as a lure. Where Eastern Pygmy Possum is targeted, a high concentrate honey water mix is also sprayed from the base of trunk up and along connective branches.

Arboreal traps and hair tubes are placed in trees selected to bias target species. These are often flowering or sap flow trees for gliders, rough-barked trees for the Brush-tailed Phascogale and Banksias for the Eastern Pygmy Possum.

Surveillance cameras may be used to target arboreal mammals in instances where the camera can be placed targeting a location on a tree where baiting is placed. This method may utilise the efforts of tree climbers to permit placement at a good height, particularly in instances where scratches indicate regular usage patterns, or a hollow is a suspected den.

A videoscope is used for active observations of hollow cavities for the presence of arboreal mammals (and other hollow-dependent fauna). Where a cavity extends beyond the cable distance an angle drill hole is made from the outside so sections can be viewed down to the base. Single photo or video footage may be recorded to assist identification or where only nest bedding material is recorded. This may also be used for later verification of identification.

Where habitat is suitable, the presences of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) may be targeted by call-playback techniques. Calls are played for five minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting. Arboreal gliders are also identified from characteristic sap feeding scars on select tree species.

1.3.1 Koala survey

Koala survey is undertaken where the site is considered to provide potential habitat under the definitions of SEPP 44 - Koala Habitat Protection, or in the presence of feed trees listed in Appendix 1 of the Recovery Plan for the Koala. Habitat may also be defined according to locally prepared Koala Plans of Management.

SEPP 44 is applied to land within Local Government Areas (LGAs) listed under Schedule 1 of the Policy. Part 2 is applied to land which has an area of greater than 1ha or has, together with any adjoining land in the same ownership, an area of more than 1ha.

To determine Potential Koala Habitat (PKH) under the definitions of SEPP 44 an estimate of the percentage density of each tree species within vegetation communities is determined by averaging the percentage of stems counted. PKH is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the Policy.

Where Koala habitat is considered to be present, the site will be surveyed on foot, with known Koala food trees being inspected for signs of use. Trees are inspected for characteristic scratch and claw marks on the trunk and scats around the base of each tree. Koalas may also be targeted during nocturnal survey involving call-playback techniques and spotlighting.

For large sites, predetermined survey grids may be employed within portions of communities where feed trees are present. At each vertex on the grid, pellet searches in accordance with the Spot Assessment Technique (SAT) (*Phillips & Callaghan 2008*) are undertaken. Alternatively search quadrats may be undertaken to determine presence / absence. All Koala feed trees within quadrats are searched for signs of activity including characteristic claw 'pock' marks on the trunk and faecal pellets around the base. For any survey technique, the location and density of Koala droppings, if found, are documented.

1.4 Terrestrial mammals

Various traps may be used to survey for the presence of terrestrial mammals. These include Elliott trapping, medium and large cage trapping, small and large hair tubing and pitfall traps. Other survey methods for terrestrial mammals include the use of surveillance cameras, song-meters, spotlighting and activity searches.

Arboreal and terrestrial Elliott traps and hair tubes are placed in grids, or more commonly along trap-lines of 5-10 traps separated by distances of 20-50m, depending on site size and variation of habitat. Trap or hair tube sizes selected at each trap station may alternate or may have an emphasis on certain sizes according to target species.

Selection of terrestrial Elliott trap, cage trap, hair tube or pitfall trap locations has an emphasis on nearby foliage, runways, shelters and signs of activity.

Standard bait mix for all Elliott traps, medium cage traps and hair tubes is a mixture of rolled oats, honey and peanut butter. Standard bait mix may be supplemented with sardines in large hair tubes or cage traps to simultaneously target Spotted-tailed Quoll. Cage traps may also be baited solely with meat, chicken or roadkill to target Spotted-tailed Quoll. Where Potoroos or Bandicoots are targeted, truffle oil may be used to lace the standard bait mix or used on its own.

Surveillance cameras are used in terrestrial mammal surveys particularly for detection of a broad target group or shy species. The surveillance camera is mounted on a tree and directed towards a closed baited trap or canister. Surveillance cameras may also be used to detect use or monitor activity at burrows, hollows, nests, runways, etc.

Song-meters may be used as a supplementary surveying tool to identify mammal calls including Yellow-bellied Glider, Squirrel Glider and Spotted-tailed Quoll.

During diurnal site searches, assessment is made of 'found' scats, markings, diggings, runways and scratches located. Any scats or pellets not readily identifiable (particularly predator scats) may be collected and sent to Barbara Triggs for identification of contents, hair or bone fragments.

1.5 Bats

Micro-chiropteran bats are surveyed by echolocation using ultrasonic recording detectors or trapped using harp (Constantine) traps, mist nets or trip lines. Microchiropteran bats are also surveyed by searches of subterranean habitats such as caves, tunnels or shafts where present, or by searching structures such as under bridges and abandoned buildings or wall / ceiling cavities, where entry is possible.

Ultrasonic recording detectors are used in fixed passive monitoring positions. Active monitoring may also be used in conjunction with spotlighting or during stag-watching for greater accuracy of recorded call identification. Active monitoring utilises a handheld sonograph recording microbat calls in real-time. Spotlighting of the microbat is then used to

determine size and wing morphology to assist in finer differentiation between species with similar call shape and frequencies.

Harp traps and mist nets are placed along suitable 'flyways' such as along open narrow road / river corridors to maximise the likelihood of captures. Traps may be purpose set to capture bats emerging from roosts by being placed at the entry of tunnels / caves or draped over the edge of bridges. Trip lines are placed over water to trip low flying drinking bats into the water. These bats are collected as they swim to the waters edge.

Harp traps are checked during early nocturnal survey, as well as each morning. Mist nets and trip lines require constant monitoring. Captured bats are identified using field identification guides. Bats are released at the point of capture after dusk or placed under trunk bark / splits of nearby trees.

Mega-chiropteran bat species, such as Grey-headed Flying-fox, are surveyed by targeting flowering / fruiting trees during spotlighting activities and by listening to distinctive vocalisations. Suitable roosting habitat is searched for presence of small or large established camps during diurnal survey periods.

1.6 *Amphibians*

Amphibians are surveyed by vocal call identification, call-playback, spotlighting along the edge of water-bodies, pitfall trapping, funnel trapping, by driving along sealed roads near waterways, habitat searches and collection of tadpoles.

Calls are identified in the field by the fauna surveyor. For similar calling species, or if an unknown male call is heard, it is cross-matched to frog call reference libraries taken into the field. A call library of frogs occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

Threatened frog species that call in chorus may be targeted by use of call-playback techniques where suitable habitat exists, with some species more reliable than others in providing a response. Red-crowned Toadlet may also be targeted by clapping and loud retort along suitable habitat drainages in order to evoke a call response.

Any amphibians found are visually identified and, when required to be examined, are handled with latex gloves and kept moist until release. Any tadpoles requiring capture are collected with a scoop net and placed within a snap-lock clear plastic bag for analysis of colour and morphological features. Where tadpole identification cannot be made in the field tadpoles are placed in a small glass box with laminated grid paper and dorsal and lateral photos are taken. These are supplied to Marion Anstis or Dr Arthur White for identification.

Song-meters may also be used to remotely record frog calls in selected periods (particularly during dusk) close to breeding areas over a preselected recording period.

Amphibian survey yields best results during, or following, wet periods with seasonal breeding and subsequent male calling varying according each species. Targeted survey is thus undertaken in appropriate seasons.

1.7 Reptiles

Reptiles are surveyed opportunistically during diurnal site visit(s), but also by habitat searches, pitfall trapping, funnel trapping, by driving along roads on humid nights and by camera surveillance at burrows.

Habitat searches for reptiles are undertaken in likely localities such as under logs, rocky slabs on rock surfaces, under sheet debris, under bark exfoliations and leaf litter at the base of trees and along the edge of wetlands. Aspect and land surface thermal properties are considered to determine best search locations particularly along rocky escarpments.

During warmer months, spotlighting may assist survey effort particularly during humid conditions.

1.8 Invertebrates

Target survey is undertaken for Cumberland Plain Land Snail (*Meridolum corneovirens*) or Dural Land Snail (*Pommerhelix duralensis*) when in proximity to previous *Bionet* records and particularly where typical host vegetation communities are present. The most appropriate areas of observed habitat are searched. Dense areas of leaf litter with likely moisture retaining properties are scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks are also turned over. In large survey areas, search quadrats are undertaken evenly across highest quality habitat areas to estimate population size.

The top (spiral side), side (showing aperture) and underside (showing umbilicus) of snail specimens found are photographed and sent to Michael Shea or Frank Koehler of the Australian Museum Malacology Unit for confirmation of identification.

2 Habitat trees

Hollow-bearing tree surveys use a *Trimble* handheld GPS unit to log both field reference locations as well as tree data. Data such as hollow types, hollow size, tree species, diameter at breast height, canopy spread and overall height are documented. A metal tag with the tree number is placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging are also noted.

3 Survey effort table descriptors:

Target - Where effort is specifically concentrated towards an individual species. Selected target species will be identified within the survey effort table and where necessary described within the report.

Opportunistic - Where birds are identified by observation, call or indirect methods as the opportunity arises.

Habitat search - Where suitable areas of habitat for selected fauna groups such as frogs, reptiles and invertebrates are specifically searched.

Diurnal bird census point(s) - Bird surveys are undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. Size and time will be specified in the survey effort table. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently census points are selected to adequately represent each of the habitat areas present and particularly areas designated for proposed development. Often census points are commenced at locations where bird activity is noticeably high.

Spotting-scope outlook - A *Nikon* spotting scope with 16~47 zoom at x60 magnification on a mounted tripod is used for distant inspections of diurnal birds. This is undertaken at wetlands for viewing waterfowl and waders but also other difficult to access areas. It may also be used for inspecting activity at nests, hollows and combined with spotlight for a panoramic search in open areas.

Call-playback - This involves broadcasting pre-recorded calls from CD through a 15 watt *Toa 'Faunatech'*TM amplifier to evoke a response from a target species known to reply. Species selected for call-playback will be indicated in the survey effort table.

Spotlighting - Is carried out using a hand held LED spotlight with varied light intensity settings. This technique involves walking amongst the woodland areas, forest fringes, along roads, trails and fence lines so that a maximum number of trees can be observed. Intensity is regulated depending on the vegetation structure and distances viewed to enable eyeshine without retina damage to observed animals. Spotlighting around water-bodies and particularly along the shallow fringes is used for finding frogs. Spotlighting is used in combination with binoculars or spotting scope for closer night inspections.

Stag-watching - Involves watching hollows in the dusk period approximately 15 minutes prior to dark until 30 minutes following dark. Placement of the observer on the ground allows for a silhouette of any emerging fauna to be seen against the lighter sky background such that a spotlight is not required, which would likely to disrupt emergence behaviour. Where any movement is observed, a spotlight may then be used for identification purposes.

Search quadrats - Are undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently quadrats are selected to adequately represent each of the suitable habitat areas present and particularly areas designated for proposed development. The use of this technique simply as an initial time-effective suitable indicator of presence / absence of Koalas has been discussed with Koala expert, Stephen Phillips.

Koala Spot Assessment Technique (SAT) - Method outlined by *Phillips & Callaghan* (2008) and accepted by the Australian Koala Foundation to determine Koala activity levels. Activity levels are calculated from the proportion of trees showing signs of Koala use as indicated by the presence of scats as well as site location within the state.

Elliott trapping - Using *Elliott* type A (33x10x10cm) and Type B (45x15x15cm), B and / or Type C traps for trapping small sized mammals. Trapping nights' effort will be indicated in the survey effort table. Trapping layout, trap sizes, baiting and trapping period will be outlined within the site specific methodology section.

Medium cage trapping - Using medium sized cage traps (17x17x45cm foldout cages with tread-plate mechanism or 22x25x58cm rigid cage with tread-plate mechanism) for trapping up to cat/bandicoot sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Large cage trapping - Using large sized cage traps (25x25x50cm foldout cages with pull lever (meat) mechanism, 28x28x60cm foldout cages with tread-plate mechanism or 30x30x70cm rigid cage with tread-plate mechanism) for trapping up to quoll sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Hair tubing - Using small (40mm diameter x 120mm long) and/or large (90mm diameter x 200mm long) PVC pipe sections for collecting mammal hair samples. At one end of each tube is an enclosed chamber where the bait is placed and capped. Small drill holes in the inside face of the chamber allow the smell of the bait to permeate out through the tube without allowing access to the bait. At the other open entry end, double-sided tape is attached around the inner rim so hair samples of animals entering the tube are collected.

Hair samples collected are sent to Barbara Triggs for identification. Trapping layout, tube sizes, baiting and trapping period will be outlined within the site specific methodology section.

EPP denning tubes - Using (80mm diameter x 240mm long) PVC pipe sections to provide a nesting/denning opportunity for Eastern Pygmy Possum. Both ends are covered and sealed with PVC caps. A 60mm diameter cardboard post-pack tube wrapped in bubble wrap for insulation and capped at the base is placed inside the PVC pipe. A 33mm drill hole on the side at one end permits access and *Velcro*TM or similar tape stuck down the internal cylinder allows the animal to climb down to the base. Cut lines around the outer surface of the tube permit small mammals to climb up the outside. Denning tubes are placed vertically in shrub trees (preferably flowering banksias). If no animals are found residing within the tube after a prolonged survey period (generally 6 weeks) use may then instead also be identified from bedding material present. Pygmy Possums use fine bedding material such as *Isopogon* and *Banksia ericifolia* by comparison to Feather-tail Gliders and Antechinus which use eucalypt leaves.

Pitfall trapping - Is used to survey for small terrestrial mammals, frogs, reptiles and invertebrates. Pitfall trapping involves the use of 15cm diameter and 60cm long PVC stormwater pipe sections placed vertically into pre-dug holes. The pipe is placed and set firm with surrounding soil so that the top rim is level with the ground surface. Drift fences made of damp-proof-course 270mm wide are held tight and upright by wooden and steel pegs and run along the length of each trap-line. Drift fences are run over the middle of each pit in the trap line ensuring at least 5m of fencing is run along each side of each pit. Ground fauna passing beyond the pitfall transect are diverted towards the pits along the fence line.

Funnel trapping - Is used to survey mainly for frogs and reptiles. Funnel traps are 18cm x 18cm x 75cm long and constructed of shade cloth with an internal spring and wire frame in a similar design to yabby traps. At each end an inward facing funnel directs fauna through a 4cm hole and into the trap. Herpetofauna search the walls and corners for an exit and discover it difficult to re-find the internal exit hole. As with pitfall traps, funnel traps are used with drift fences that divert fauna towards the trap entry. At least 5m of fencing is run between each funnel trap which may be placed on either side of the fence. Trapping layout, target species, fence lengths and trapping period will be outlined within the site specific methodology section.

Passive microbat monitoring - Involves leaving the *Anabat*TM (Mk2 or SD-2) or *SM4Bat*TM zero-crossing recorders in a fixed mounted position to record call-sequences of passing bats. Recording locations are determined in order to represent different available foraging structures for various micro-chiropteran bat species. Dams, cleared flyways, high insect activity areas, forest edges and ecotones are particularly targeted. Bat call recordings are analysed using *Analook*TM 3.7.23 computer software.

Active microbat monitoring - Is a method of active microbat recording during stag-watching or during nocturnal spotlighting survey. Active monitoring involves walking with an *Echo Meter Touch*TM microphone allied to a mobile acoustics spectrogram app on *iPhone*TM for viewing call-sequences in real-time. When calls are heard, the transducer microphone is actively directed towards the calling animal with the aid of a spotlight, so longer and clearer call sequences may be recorded. When calls of a potential threatened species are observed on the sonograph a view by spotlight of the bat size and wing morphology is attempted for greater identification accuracy.

Active vehicle microbat monitoring - Is a method of active microbat recording deployed when large distances need to be covered in a nocturnal survey period. A *Hi-mic*TM extension cable allows the transducer microphone to be placed on a bracket on the roof of a travelling vehicle so calls may be viewed whilst driving. The vehicle travels at no more than 40km/h to prevent wind interference. When calls of a potential threatened species are observed on the dash mounted PDA screen, active spotlighting is undertaken.

Harp trapping - Is used to capture microchiropteran bats. Harp traps have an aluminium frame with a two-bank 4.2m² area and calico capture bag set along the base area.

Mist netting - Is used to capture microchiropteran bats. The mist net capture area is 2.4m high, 9m wide and supported by two 3.5m poles which are braced with ropes and pegs. Design is a 0.08mm ultrafine nylon monofilament thread arranged in a 14x14mm mesh, with four horizontal capture pockets. These features are specific for the use to capture microchiropteran bat species and are provided from the only known supplier in Poland.

Trip lining - Is used to capture microchiropteran bats. Fishing line is strung tight on pegs in a zig-zag pattern across open water-bodies just above the water surface to trip drinking bats into the water.

Surveillance camera - Is used to remotely monitor activity at burrows, hollows, etc. or to survey for species presence at baited stations. A *Reconyx Hyperfire*TM HC500, HC550 or HC600 digital weatherproof camera with a passive motion detector and a night-time infrared illuminator is used depending on the target outcome. Full covert or semi-covert cameras will be used to maximise recordings or for behaviour, whilst white-flash cameras will be used for colour identification. The camera is mounted on a tree or tripod and takes three consecutive photo frames on the detection of movement up to 30m away or the detection of a heat/cold source different to the ambient temperature.

Song-meters - are used to remotely record animal calls. SM4 bioacoustics song-meters may be programmed to record during select periods in the day depending on the targeted activity. *Song Scope*TM software may be used to create a recogniser file and determine the frequency of calls over the recorded period, which may be effective in determining local breeding activity, numbers and locations.

Videoscope - is used for active observations of hollow cavities for the presence of arboreal mammals and other hollow-dependent fauna. A *Dellon*TM industrial endoscope with a 1m cable and rotational camera head and LED light allow real-time inspection down irregular shaped cavities to be viewed on the attached LCD screen. Single photo or video footage may be recorded.

Weather conditions - Survey effort for each fauna group accounting for methods undertaken, duration, and weather conditions are provided in the survey effort table. Weather details are documented for all survey techniques and include:

- air temperature
- cloud cover
- rain (e.g. none, light drizzle, heavy drizzle, heavy rain)
- recent rain events (where relevant)
- wind strength e.g. calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns)
- wind direction
- moon (where relevant) (e.g. none, 1/4 moon, 1/2 moon, 3/4 moon)



Threatened & Migratory Species Habitat Assessment

A2

Table A2.1 provides an assessment of potential habitat within the subject site for state and nationally listed threatened flora species recorded within 10km on the Atlas of NSW Wildlife (OEH) or indicated to have potential habitat present within 10km on the *EPBC Act* Protected Matters Tool.

Table A2.1 – Threatened flora habitat assessment

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements <i>Distribution limit</i>	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
<i>Acacia bynoeana</i> OEH EPBC	E1	V	Erect or spreading shrub to 0.3m high growing in heath and dry sclerophyll open forest on sandy soils. Often associated with disturbed areas such as roadsides. <i>Distribution limits N-Newcastle S-Berrima.</i>	x	x	-	-	very low, very few local records, not expected	x
<i>Acacia clunensis-rossiae</i> OEH	V	-	Shrub to 2m tall, flowering in September. Grows in dry sclerophyll forest in valleys and on rocky slopes from the Kowmung River and adjacent Coffs River district.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
<i>Acacia pubescens</i> OEH EPBC	V	V	Spreading shrub 1-4m high open sclerophyll growing in open forest and woodlands on clay soils. <i>Distribution limits N-Bilpin S-Georges River.</i>	x	x	-	-	x	x
<i>Allocasuarina glareicola</i> EPBC	E1	E	Small shrub 1-2m high growing in open sclerophyll forest on lateritic soils derived from tertiary alluviums. <i>Distribution limits Castlereagh NR region.</i>	x	x	-	-	x	x
<i>Asterolasia elegans</i> EPBC	E1	E	Erect shrub 1-3m high growing in moist sclerophyll forests on Hawkesbury sandstone slopes hillsides. <i>Distribution limits Maroota region.</i>	x	x	-	-	x	x
<i>Caladenia tessellata</i> EPBC	E1	V	Terrestrial orchid. Clay-loam or sandy soils. LHCCREMS guidelines suggest the species grows in Map Unit 34 – Coastal Sand Wallum Woodland - Heath. Flowers in September – November. <i>Distribution limits N-Swansea S-south of Eden.</i>	x	x	-	-	x	x
<i>Callistemon linearifolius</i> OEH	V	-	Shrub to 4m high. Dry sclerophyll forest on coast and adjacent ranges. <i>Distribution limits N-Nelson Bay S-Georges River.</i>	x	x	-	-	x	x
<i>Cryptostylis hunteriana</i> EPBC	V	V	Saprophytic orchid. Grows in swamp heath on sandy soils. <i>Distribution limits N-Gibraltar Range S-south of Eden.</i>	x	x	-	-	x	x
<i>Cynanchum elegans</i> EPBC	E1	E	Climber or twiner to 1m. Grows in rainforest gullies, scrub & scree slopes. <i>Distribution limits N-Gloucester S-Wollongong.</i>	x	x	-	-	x	x

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements <i>Distribution limit</i>	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
<i>Darwinia biflora</i> OEH EPBC	V	V	Erect or spreading shrub to 0.8m high. Grows in heath or understorey of woodland on or near shale-capped ridges underlain by Hawkesbury sandstone. <i>Distribution limits N-Gosford S-Cheltenham.</i>	x	x	-	-	x	x
<i>Darwinia peduncularis</i> OEH	V	-	Divaricate shrub to 1.5m high. Grows in dry sclerophyll forest on sandstone hillsides and ridges. <i>Distribution limits N-Glen Davis S-Hornsby.</i>	x	x	-	-	x	x
<i>Epacris purpurascens</i> var. <i>purpurascens</i> OEH	V	-	Erect shrub to 1.5m high growing in sclerophyll forest and scrub and near creeks and swamps on sandstone. <i>Distribution limits N-Gosford S-Blue Mountains.</i>	x	marginal	~300 within 10km radius, nearest is less than 1km away	✓	low, more likely to be in areas with more sandstone influence near the southern study area	✓
<i>Eucalyptus camfieldii</i> OEH EPBC	V	V	Stringybark to 10m high. Grows on coastal shrub heath and woodlands on sandy soils derived from alluviums and Hawkesbury sandstone. <i>Distribution limits N-Norah Head S-Royal NP.</i>	x	x	-	-	x	x
<i>Eucalyptus nicholii</i> OEH	V	-	This species is widely planted as an urban street tree and in gardens but is quite rare in the wild. <i>It is confined to the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield, largely on private property.</i>	x	x	-	-	x	x

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
<i>Eucalyptus scoparia</i> OEH	E1	V	Smooth-barked tree only known from vicinity of Bald Rock.	✓	x	3 records within 10km radius, nearest is less than 1km away	✓	planted specimens only	✓
<i>Eucalyptus</i> sp. Cattai OEH	E1	-	Tree to 4.5m high. Rare emergent in scrub heath and low woodland on sandy soils usually flat areas or ridge tops. <i>Distribution limits N-Colo Heights S-Castle Hill.</i>	x	x	-	-	x	x
<i>Galim australe</i> OEH	E1	-	A straggling and inter-twining herb. Flowers in late spring to early autumn. Records in Sydney are yet to be confirmed after a recent taxonomic revision.	x	x	-	-	x	x
<i>Genoplesium baueri</i> OEH EPBC	E1	E	A terrestrial orchid that grows in sparse sclerophyll forest and moss gardens over sandstone. Flowers Feb–Mar. <i>Distribution limits N – Hunter Valley S – Nowra.</i>	x	x	-	-	x	x
<i>Genoplesium plumosum</i> OEH	E4a	E	Terrestrial Orchid that grows on shallow soils exclusively in heathland, generally dominated by Violet Kunzea (<i>Kunzea parvifolia</i>), Common Fringe-myrtle (<i>Calytrix tetragona</i>) and parrot-peas (<i>Dillwynia</i> spp.). Flowers late Feb – Mar. <i>Tallong area and Moreton NP.</i>	x	x	-	-	x	x
<i>Grammitis stenophylla</i> OEH	E1	-	A small lithophytic fern with fronds generally <5cm. <i>Occurs in rainforest and wet sclerophyll forest in the coastal divisions of NSW.</i> Usually grown on rocks.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
<i>Grevillea caleyi</i> OEH EPBC	E1	E	Shrub mostly 1-3m high. Grows in laterite. <i>Distribution limits Terrey Hills-Belrose area.</i>	X	X	-	-	X	X
<i>Haloragis exalata</i> subsp. <i>exalata</i> EPBC	V	V	Shrub to 1.5m high. Grows in damp places near watercourses. <i>Distribution limits N-Tweed Heads S-south of Eden.</i>	X	X	-	-	X	X
<i>Haloragodendron lucasii</i> OEH	E1	E	Straggling shrub to 1.5m high. Grows in open forest on sheltered slopes near creeks. <i>Distribution limits Ku-ring-gai Plateau and Mt Wilson.</i>	X	X	-	-	X	X
<i>Hibbertia spanantha</i> EPBC	E4a	CE	Grows in forest with canopy species including <i>E. pilularis</i> , <i>E. resinifera</i> , <i>C. gummifera</i> and <i>A. costata</i> . The understorey is open with species of Poaceae, Orchidaceae, Fabaceae and Liliaceae. Flowers Oct-Nov with odd flowers throughout the year. Substrate is identified as a light clay occurring on a shale sandstone soil transition.	X	X	-	-	X	X
<i>Hibbertia superans</i> OEH	E1	-	Small spreading shrub to 0.3m high. Grows on sandstone, usually in or near SSTF. <i>Distribution limits N-Glenorie S-Kellyville disjunct Mt Boss.</i>	X	X	-	-	X	X
<i>Isotoma fluviatilis</i> subsp. <i>fluviatilis</i> OEH	-	X	Previously referred to as <i>Hypsela sessiliflora</i> . A prostrate herb with white-pale purple flower occurring in spring but also when conditions are suitable at other times of the year. Known from Erskine Park. Previous sightings are all from western Sydney, at Homebush and Agnes Banks.	X	X	-	-	X	X

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
<i>Kunzea rupestris</i> OEH	V	V	Shrub to 1.5m high. Grows in cracks and fissures on Hawkesbury Sandstone rock platforms. <i>Distribution limits N-Maroota S-Glenorie.</i>	X	X	-	-	X	X
<i>Lasiopetalum joyceae</i> OEH EPBC	V	V	Erect shrub to 2m high. Grows in heath and open forest on Hawkesbury sandstone. <i>Distribution limits Hornsby Plateau.</i>	X	X	-	-	X	X
<i>Leptospermum deanei</i> OEH	V	V	Shrub to 5m high. Grows on forested slopes. <i>Distribution limits near watershed of Lane Cove River.</i>	X	X	-	-	X	X
<i>Leucopogon fletcheri</i> subsp. <i>fletcheri</i> OEH	E1	-	Shrub to 1.8m high growing in woodland on lateritic soils. <i>Distribution limits N-St Albans S-Springwood.</i>	X	X	-	-	X	X
<i>Melaleuca biconvexa</i> OEH EPBC	V	V	Tall shrub. Grows in wetlands adjoining perennial streams and on the banks of those streams, generally within the geological series known as the Terrigal Formation. <i>Distribution limits N-Port Macquarie S-Jervis Bay.</i>	X	X	-	-	X	X
<i>Melaleuca deanei</i> OEH EPBC	V	V	Shrub to 3m high. Grows in heath on sandstone. <i>Distribution limits N-Gosford S-Nowra.</i>	X	X	-	-	X	X
<i>Pelargonium striatellum</i> sp. EPBC	E1	E	Herb to 90cm tall which grows in damp places especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. <i>Varied distribution from SE NSW to QLD.</i>	X	X	-	-	X	X

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements <i>Distribution limit</i>	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
<i>Persoonia hirsuta</i> OEH EPBC	E1	E	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. <i>Distribution limits N-Glen Davis S-Hill Top.</i>	x	x	-	-	x	x
<i>Persoonia mollis</i> subsp. <i>maxima</i> OEH EPBC	E1	E	Erect to prostrate shrub. Grows in moist to wet sclerophyll forests on Hawkesbury sandstone. <i>Distribution limits N-Cowan S-Hornsby.</i>	x	x	-	-	x	x
<i>Pimelea curviflora</i> var. <i>curviflora</i> OEH EPBC	V	V	Woody herb or sub-shrub to 0.2-1.2m high. Grows on Hawkesbury Sandstone near shale outcrops. <i>Distribution Sydney.</i>	x	x	-	-	x	x
<i>Pimelea spicata</i> OEH EPBC	E1	E	Decumbent or erect shrub to 0.5m high. Occurs principally in woodland on soils derived from Wianamatta Shales. <i>Distribution limits N-Lansdowne S-Shellharbour.</i>	x	x	-	-	x	x
<i>Pomaderris brunnea</i> OEH	V	V	Shrub to 3m high. <i>Confined to Upper Nepean and Colo Rivers where it grows in open forest.</i>	x	x	-	-	x	x
<i>Prostanthera marifolia</i> OEH	E4a	CE	Erect shrub to 0.3m high. Woodland dominated by Eucalyptus sieberi and Corymbia gummifera. In deeply weathered clay soil with ironstone nodules. <i>Has been recorded previously in the Sydney Harbour region.</i>	x	x	-	-	x	x
<i>Pterostylis gibbosa</i> EPBC	E1	E	Terrestrial orchid which occurs near Wollongong and in Hunter Valley in sclerophyll forest, sometimes with paperbarks.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
<i>Pterostylis nigricans</i> OEH	V	-	Terrestrial orchid. Prefers coastal heathland with Heath Banksia (<i>Banksia ericifolia</i>), and lower-growing heath with lichen-encrusted and relatively undisturbed soil surfaces, on sandy soils. <i>The Dark Greenhood occurs in north-east NSW north from Evans Head, and in Queensland.</i>	x	x	-	-	x	x
<i>Pterostylis saxicola</i> OEH	E1	E	Terrestrial orchid. Grows in shallow sandy soil above rock shelves, usually near Wianamatta / Hawkesbury transition. <i>Distribution limits N-Hawkesbury River S-Campbelltown.</i>	x	x	-	-	x	x
<i>Syzygium paniculatum</i> OEH EPBC	V	V	Small tree. Subtropical and littoral rainforest on sandy soil. <i>Distribution limits N-Forster S-Jervis Bay.</i>	x	marginal	31 records within 10km radius, nearest is 2km away	✓	low-moderate, possibly better habitat in creek line adjacent to the southern study area	✓

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
<i>Tetradlea glandulosa</i> OEH	V	-	Spreading shrub to 0.2m high. Sandy or rocky heath or scrub. <i>Distribution limits N-Mangrove Mountain S-Port Jackson.</i>	x	potential habitat across parts of the State Forest but none within the study areas	-	-	x	x
<i>Thesium australe</i> EPBC	V	V	Erect herb to 0.4m high. Root parasite. Themeda grassland or woodland often damp. <i>Distribution limits N-Tweed Heads S-south of Eden.</i>	x	x	-	-	x	x
<i>Triplarina imbricata</i> OEH	E1	E	A shrub to 2.8m tall, flowers from Nov-Dec. Occurs in heath, often in damp places along creek lines; coast and adjacent ranges. <i>Known from the Tabulum and Nymboida districts in NE NSW.</i>	x	x	-	-	x	x
<i>Wilsonia backhousei</i> OEH	V	-	Perennial subshrub with procumbent branches. Grows in coastal saltmarshes. <i>Wilsonia backhousei</i> is salt tolerant and is found in intertidal saltmarshes and, more rarely, on seacliffs. In New South Wales <i>Wilsonia backhousei</i> is scattered along the coast, reaching a northern limit at Wamberal Lagoon. In the Sydney region there has been a considerable decline in the abundance of the species over the last 100yrs, largely as a result of loss of habitat. <i>Distribution limits N-Sydney S-South of Eden.</i>	x	x	-	-	x	x

Scientific name DATABASE SOURCE	BC Act	EPBC Act	Growth form and habitat requirements Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
<i>Zannichellia palustris</i> OEH	E1	-	Submerged herb. Fresh or slightly saline stationary or slow-flowing water. <i>Distribution limits N-Tweed Heads S-Newcastle.</i>	x	x	-	-	x	x
OEH	- Denotes species listed within 10km of the subject site on the <i>Atlas of NSW Wildlife</i>								
EPBC	- Denotes species listed within 10km of the subject site in the <i>EPBC Act</i> 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 subject site 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								

Table A2.2 provides an assessment of potential habitat within the subject site for state and nationally listed threatened fauna species recorded within 10km on the *Atlas of NSW Wildlife* (OEH) or indicated to have potential habitat present within 10km on the *EPBC Act* Protected Matters Tool.

Table A2.2 – Threatened fauna habitat assessment

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Giant Burrowing Frog <i>Heleioporus australiacus</i> OEH 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>	x	x	-	-	x	x
Stuttering Frog <i>Mixophyes balbus</i> EPBC	E	V	Terrestrial inhabitant of rainforest and wet sclerophyll forests. <i>Distribution limit: N-near Tenterfield S-South of Bombala.</i>	x	x	-	-	x	x
Red-crowned Toadlet <i>Pseudophryne australis</i> OEH	V	-	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non-breeding periods. <i>Distribution limit: N-Pokolbin. S-near Wollongong.</i>	x	marginal	x	✓	unlikely	✓
Green and Golden Bell Frog <i>Litoria aurea</i> OEH EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. <i>Distribution limit: N-Byron Bay S-South of Eden.</i>	x	x	-	-	x	x

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Littlejohn's Tree Frog <i>Litoria littlejohnii</i> EPBC	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1,000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. <i>Distribution limit: N-Hunter River S-Eden.</i>	X	X	-	-	X	X
Rosenberg's Goanna <i>Varanus rosenbergi</i> OEH	V	-	Hawkesbury sandstone outcrop specialist. Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops. <i>Distribution limit: N-Nr Broke. S-Nowra Located in scattered patches near Sydney, Nowra and Goulburn.</i>	X	X	-	-	X	X
Broad-headed Snake <i>Hoplocephalus bungaroides</i> 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>	X	X	-	-	X	X
Freckled Duck <i>Stictonetta naevosa</i> OEH	V	-	Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. <i>Distribution limit: N- Tenterfield. S-Albury.</i>	X	X	-	-	X	X

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Superb Fruit-dove <i>Ptilinopus superbus</i> OEH	V	-	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. <i>Distribution limit: N-Border Ranges National Park. S-Batemans Bay.</i>	x	✓	✓	x	Not likely	x
Black-necked Stork <i>Ephippiorhynchus asiaticus</i> OEH	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. <i>Distribution limit: N-Tweed Heads. S-Nowra.</i>	x	x	-	-	x	x
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>	x	x	-	-	x	x
Black Bittern <i>Ixobrychus flavicollis</i> OEH	V	-	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater and brackish streams and ponds, sheltered mudflats and oyster slats. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x
Spotted Harrier <i>Circus assimilis</i> OEH	V	-	Utilises grassy plains, crops and stubblefields; saltbush, spinifex associations; scrublands, mallee, heathlands; open grassy woodlands. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
White-bellied Sea Eagle <i>(Haliaeetus leucogaster)</i> OEH	V	-	Occupies coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs. <i>Sedentary; dispersive. N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x
Little Eagle <i>Hieraaetus morphnoides</i> OEH	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>	x	marginal	✓	✓	low	✓
Square-tailed Kite <i>Lophoictinia isura</i> OEH	V	-	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. <i>Distribution limit: N-Goondiwindi. S-South of Eden.</i>	x	✓	✓ Study area	✓	✓	✓
Eastern Osprey <i>Pandion cristatus</i> OEH	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>	x	x	-	-	x	x
Grey Falcon <i>Falco hypoleucos</i> OEH	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>	x	x	-	-	x	x

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Australian Painted Snipe <i>Rostratula australis</i> OEH EPBC	E	E	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i> OEH	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>	✓	-	-	-	-	✓
Glossy Black-Cockatoo <i>Calyptorhynchus lathami</i> OEH	V	-	Open forests with <i>Allocasuarina</i> species and hollows for nesting. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	low	✓
Little Lorikeet <i>Glossopsitta pusilla</i> OEH	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	✓	-	-	-	-	✓
Swift Parrot <i>Lathamus discolor</i> OEH 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>	x	✓	✓	✓	✓	✓

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Superb Parrot <i>Polytelis swainsonii</i> OEH	V	V	Inhabits open woodland and riverine forests of inland NSW. <i>Distribution limit: N-Near Walgett. S-South of Deniliquin.</i>	x	x	-	-	x	x
Barking Owl <i>Ninox connivens</i> OEH	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. <i>Distribution limit: N-Border Ranges National Park. S-Eden.</i>	x	marginal	x	✓	unlikely	✓
Powerful Owl <i>Ninox strenua</i> OEH	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>	✓	-	-	-	-	✓
Grass Owl <i>Tyto longimembris</i> OEH	V	-	Inhabits grassland, coastal heath and lignum swamps, sheltering in dense grass tussocks by day. <i>Distribution limit: N-Tweed Heads. S-Lithgow.</i>	x	x	-	-	x	x
Masked Owl <i>Tyto novaehollandiae</i> OEH	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>	x	x	-	-	x	x
Sooty Owl <i>Tyto tenebricosa</i> OEH	V	-	Tall, dense, wet forests containing trees with very large hollows. <i>Distribution limit: N-Border Ranges National Park. S-South of Eden.</i>	x	marginal	x	x	Not likely	x

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Brown Treecreeper <i>Climacteris picumnus victoriae</i> OEH	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>	X	X	-	-	X	X
Eastern Bristlebird <i>Dasyornis brachypterus</i> EPBC	E	E	Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	X	X	-	-	X	X
Regent Honeyeater <i>Xanthomyza Phrygia</i> OEH 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>	X	✓	X	X	unlikely	✓
White-fronted Chat <i>Epithianura albifrons</i> OEH	V	-	Found in open damp ground, grass clumps, fencelines, heath, samphire saltmarshes, mangroves, dunes, saltbush plains. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	X	X	-	-	X	X

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Painted Honeyeater <i>Grantiella picta</i> 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>	X	X	-	-	X	X
Black-chinned Honeyeater <i>Melithreptus gularis gularis</i> OEH	V	-	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. <i>Distribution limit: N-Cape York Pen. Qld. S-Victor H. Mt Lofty Ra & Flinders Ra. SA.</i>	X	X	-	-	X	X
Varied Sittella <i>Daphoenositta chrysoptera</i> OEH	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>	X	✓	✓	✓	✓	✓

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Dusky Woodswallow <i>Artamus cyanopterus cyanopterus</i> OEH	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>	x	✓	✓	✓	✓	✓
Hooded Robin <i>Melanodryas cucullata cucullata</i> OEH	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>	x	x	-	-	x	x
Scarlet Robin <i>Petroica boodang</i> OEH	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. <i>Distribution limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	Unlikely	✓
Flame Robin <i>Petroica phoenicea</i> OEH	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>	x	✓	✓	x	Unlikely	✓

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Pink Robin <i>Petroica rodinogaster</i> OEH	V	-	Found in dense gullies, rainforests and open forests, dispersing into drier more open habitats in winter. <i>Distribution limit: N-Sydney. S-South of Eden.</i>	x	Sub-optimal	x	x	Not likely	x
Diamond Firetail <i>Stagonopleura guttata</i> OEH	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>	x	x	-	-	x	x
Spotted-tailed Quoll <i>Dasyurus maculatus</i> OEH 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>	x	x	-	-	x	x
Southern Brown Bandicoot <i>Isodon obesulus</i> OEH EPBC	E	E	Utilises a range of habitats containing thick ground cover - open forest, woodland, heath, cleared land, urbanised areas and regenerating bushland. <i>Distribution limit: N-Kempsey. S-South of Eden.</i>	x	x	-	-	x	x
Koala <i>Phascolarctos cinereus</i> OEH 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>	x	x	-	-	x	x

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Eastern Pygmy Possum <i>Cercatetus nanus</i> OEH	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>	x	x	-	-	x	x
Greater Glider <i>Petauroides volans</i> OEH 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>	x	✓	x	x	Unlikely	✓
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>	x	x	-	-	x	x
Grey-headed Flying-fox <i>Pteropus poliocephalus</i> OEH 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>	✓	-	-	-	-	✓

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Yellow-bellied Sheathtail-bat <i>Saccolaimus flaviventris</i> OEH	V	-	Rainforests, sclerophyll forests and woodlands. <i>Distribution limit: N-North of Walgett. S-Sydney.</i>	x	✓	✓	x	✓	✓
East-coast Freetail Bat <i>Micronomus norfolkensis</i> OEH	V	-	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. <i>Distribution limit: N-Woodenbong. S-Pambula.</i>	x	✓	✓	✓	✓	✓
Large-eared Pied Bat <i>Chalinolobus dwyeri</i> OEH 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>	x	marginal	x	x	Not likely	x
Eastern Falsistrelle <i>Falsistrellus tasmaniensis</i> OEH	V	-	Recorded roosting in caves, old buildings and tree hollows. <i>Distribution limit: N-Border Ranges National Park. S-Pambula.</i>	x	✓	✓	x	✓	✓
Little Bentwing-bat <i>Miniopterus australis</i> OEH	V	-	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. <i>Distribution limit: N-Border Ranges National Park. S-Sydney.</i>	x	✓	✓	✓	✓	✓

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Eastern Bentwing-bat <i>Miniopterus orianae oceanensis</i> OEH	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>	x	✓	✓	✓	✓	✓
Large-footed Myotis <i>Myotis macropus</i> OEH	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>	x	x	-	-	x	x
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> OEH	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. <i>Distribution limit: N-Border Ranges National Park. S-Pambula.</i>	✓	-	-	-	-	✓
Eastern Chestnut Mouse <i>Pseudomys gracilicaudatus</i> OEH	V	-	Inhabits heathland including dense wet heath and swampy areas, occasionally in woodland with grassy understorey. <i>Distribution limit: N-Border Ranges National Park. S-Brisbane Water National Park.</i>	x	x	-	-	x	x

Common name Scientific name Database source	BC Act	EPBC Act	Preferred habitat Distribution limit	Recorded on site (✓)	If not recorded on site				Assessment of significance test required for development consent (✓)
					Suitable habitat present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	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>	x	x	-	-	x	x
Cumberland Plain Land Snail <i>Meridolum corneovirens</i> OEH	E	-	Inhabits remnant eucalypt woodland of the Cumberland Plan. Shelters under logs, debris, clumps of grass, around base of trees and burrowing into loose soil. <i>Distribution limit: Cumberland Plain of Sydney Basin Bioregion.</i>	x	x	-	-	x	x
Dural Land Snail <i>Pommerhelix duralensis</i> OEH EPBC	E	E	Occurs on shale-sandstone transitional forest landscapes within the Blue Mountains, Penrith, The Hills, Wollondilly, Hornsby and Parramatta LGA's. Occurs in low abundance and shelters under rocks or inside curled-up bark, beneath leaves and light woody debris. <i>Distribution limit: St Albans to Mulgoa with most records from The Hills LGA.</i>	x	marginal	✓	✓	unlikely	✓

Table A2.3 provides an assessment of potential habitat within the subject site for nationally *protected* migratory fauna species recorded within 10km on the *EPBC Act* Protected Matters Tool. Nationally *threatened* migratory species are considered in Table A2.2.

Table A2.3 – Migratory fauna habitat assessment

Common name <i>Scientific name</i>	Preferred habitat <i>Migratory breeding</i>	Suitable habitat present (✓)	Recorded on site (✓)	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.	x	-	-
White-throated Needletail (<i>Hirundapus caudacutus</i>)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies often forage along favoured hilltops and timbered ranges. <i>Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.</i>	✓	✓	No potential breeding habitat or other habitat of potential importance will be impacted.
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.	✓	x	-
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 south east Australia, otherwise uncommon.</i>	✓	x	-
Spectacled Monarch (<i>Monarcha trivirgatus</i>)	Understorey of mountain / lowland rainforest, thickly wooded gullies, waterside vegetation, mostly well below canopy. <i>Summer breeding migrant to south-east Qld and north-east NSW down to Port Stephens from Sept / Oct to May. Uncommon in southern part of range.</i>	✓	x	-
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 north east Qld.</i>	✓	x	-
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>	✓	x	-
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.	x	-	-

Common name <i>Scientific name</i>	Preferred habitat <i>Migratory breeding</i>	Suitable habitat present (✓)	Recorded on site (✓)	Comments
Latham's Snipe (<i>Gallinago hardwickii</i>)	Soft wet ground or shallow water with tussocks and other green or dead growth; wet parts of paddocks; seepage below dams; irrigated areas; scrub or open woodland from sea-level to alpine bogs over 2,000m; samphire on saltmarshes; mangrove fringes. <i>Breeds Japan. Regular summer migrant to Australia. Some overwinter.</i>	x	-	-



Plot Datasheets

A3

BAM Site – Field Survey Form Site Sheet no: 1 of 1

Date		Survey Name		Plot Identifier		Recorders	
02/01/19		18+000002 Gamberland State Forest		Q1		LH	
Zone	Datum	IBRA region	Photo #		Zone ID		
56	GDA96						
Easting	Northing	Dimensions	Orientation of midline from the 0 m point		Magnetic		
		20x20/50x20m					
Vegetation Class		Confidence:					
Hot sclerophyll		H M L					
Plant Community Type		EEC: ☒ 8+HFF					
		H M L					

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
 Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)		Sum values	
Count of Native Richness	Trees		
	Shrubs		
	Grasses etc.		
	Forbs		
	Ferns		
	Other		
Sum of Cover of native vascular plants by growth form group	Trees		
	Shrubs		
	Grasses etc.		
	Forbs		
	Ferns		
	Other		
High Threat Weed cover			

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately * includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia † Record total number of stems by size class with hollows (including dead stems/trees)	
dbh	Euc*	Non Euc	Hollows†		
large trees for Euc* & Non Euc	80 + cm	1	Non Euc		Hollows†
	50 – 79 cm	6			
30 – 49 cm	✓				
20 – 29 cm	✓				
10 – 19 cm	✓				✓ 1
5 – 9 cm	✓				n/a
< 5 cm	✓				n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)		Tally space			total 23

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	75	70	40	70	80	5	2	2	2	2	2	2	2	2	2	0	0	0	0	0
Average of the 5 subplots	67					2.6					2					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	Landform Element	Landform Pattern	Microrelief
Lithology	Soil Surface Texture	Soil Colour	Soil Depth
Slope	Aspect	Site Drainage	Distance to nearest water and type

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	2	0	Some open canopy
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage	1	R	Large branches down
Weediness	3	R	Many species of weeds and annual 50% cover
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m ² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 02/01/19	BRONS602 Gardens SE	Q1	LN

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
1	<i>Syncarpia glomulifera</i>	N	12	4	C	
2	<i>Tradescantia fluminensis</i>	HTE	20	1000	G	
3	<i>Solanum pseudocapsicum</i>	E	2	120	G	
4	<i>Pithecolitium undulatum</i>	N	10	7	M	
5	<i>Grevillea robusta</i>		2.5	1	C	
6	<i>Sida rhombifolia</i>	E	1.5	170	G	
7	<i>Cayratia clematidea</i>	N	4	250	G	
8	<i>Solanum mauritianum</i>	E	0.8	2	M	
9	<i>Eucalyptus saligna</i>	N	10	3	C	
10	<i>Pteridium esculentum</i>	N	0.3	12	G	
11	<i>Eucalyptus</i> sp. (peppermint like)	N	2.5	1	C	
12	<i>Eustrephus latifolius</i>	N	1	30	G	
13	<i>Acacia implexa</i>	N	1	1	M	
14	<i>Clematis aristata</i>	N	3	100	M	
15	<i>Polygala combucifolia</i>	N	0.5	2	M	
16	<i>Ligustrum sinense</i>	HTE	2	70	M	
17	<i>Uncaria tomentosa</i>	E	2	2	M	
18	<i>Bractychiton acerifolius</i>	N	8	16	M	
19	<i>Ligustrum lucidum</i>	HTE	2	40	M	
20	<i>Asparagus setaceus</i>	HTE	1	2	G	
21	<i>Morinda jasminoides</i>	N	0.4	4	M	
22	<i>Passiflora edulis</i>	E	0.4	5	M	
23	<i>Vernonia cinerea</i>	N	0.1	1	G	
24	<i>Ehrharta erecta</i>	E	4	440	G	
25	<i>Celtis sinensis</i>	E	4	13	M	
26	Hardy shrub	N	0.3	2	G	
27	<i>Aravija sericifera</i>	HTE	1.5	35	M	
28	<i>Nephrolepis cordifolia</i>	E	0.2	6	G	
29	<i>Sticherus flabellatus</i>	N	0.1	2	G	
30	<i>Abutilon</i>	E	0.7	4	M	
31	<i>Cinnamomum camphora</i>	HTE	1.5	14	M	
32	<i>Asparagus plumosus</i>	E	0.2	1	M	
33	<i>Yucca</i> sp	E	0.5	6	M	
34	<i>Entolasia marginata</i>	N	5	1200	G	
35	<i>Pandorea pandorana</i>	N	0.6	12	M	
36	<i>Calceolaria dubia</i>	N	1.5	65	G	
37	<i>Microlaena stipoides</i>	N	0.8	125	G	
38	<i>Eriobotrya japonica</i>	E	0.3	1	M	
39	<i>Olea europaea</i> / <i>insp. data</i>	HTE	0.1	1	M	
40	<i>Melin azedarach</i>	N	1	1	M	

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

400 m ² plot: Sheet <u> </u> of <u> </u>	Survey Name	Plot Identifier	Recorders
Date <u>02/01/19</u>	<u>18FCN2402</u> <u>Cumbeana SP</u>	<u>Q</u>	<u>LH</u>

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
1	<i>Pellaea falcata</i>	N	0.1	6	G	
2	<i>Ficus virens</i>	N	1.5	3	M	
3	<i>Trema fomentosa</i>	N	0.5	3	M	
4	<i>Rubus fruticosus</i>	HTE	15	150	G	
5	<i>Oplismenus nemoralis</i>	N	0.5	40	G	
6	<i>Nandina domestica</i>	E	0.1	1	G	
7	<i>Lomandra longifolia</i>	N	0.2	3	G	
8	<i>Oplismenus imbecilis</i>	N	2.5	350	G	
9	<i>Alphitonia excelsa</i>	N	0.7	1	M	
10	<i>Lantana camara</i>	HTE	0.2	9	M	
11	<i>Stephania japonica</i>	N	2.5	20	BA	
12	<i>Dioscorea aspera</i>	N	0.3	60	G	
13	<i>Eucalyptus pilularis</i>	N	4	1	C	
14	<i>Dichoneta repens</i>	N	2	200	G	
15	<i>Bidens pilosa</i>	E	0.2	70	G	
16	<i>Ageratina adenophora</i>	HTE	0.3	13	G	
17	<i>Dianella caerulea</i>	N	0.1	3	G	
18	<i>Fraxinus argentea</i>	E	0.1	1	G	
19	<i>Oxalis</i> sp. (<i>Clatifolia</i> possibly)	HTE	0.1	5	G	
20	<i>Sigesbeckia orientalis</i>	N	0.1	1	G	
21	<i>Pratia purpurascens</i>	N	0.4	50	G	
22	<i>Ochna serrulata</i>	E	0.3	15	G	
23						
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40						

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF – circle code if 'top 3'.
Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...

BAM Site – Field Survey Form Site Sheet no: 1 of 1

Date		Survey Name		Plot Identifier		Recorders	
02/01/19		18FCNSW 02 Gumbril SF		02		LH	
Zone	Datum	IBRA region	Photo #		Zone ID		
5b	GDA 94						
Easting	Northing	Dimensions		Orientation of midline from the 0 m point		Magnetic	
		20x20/50x20					
Vegetation Class						Confidence:	
						H M L	
Plant Community Type						Confidence:	
						H M L	

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m² plot)		Sum values
Count of Native Richness	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
Sum of Cover of native vascular plants by growth form group	Trees	
	Shrubs	
	Grasses etc.	
	Forbs	
	Ferns	
	Other	
High Threat Weed cover		

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately
dbh	Euc*	Non Euc	Hollows†	
large trees for Euc* & Non Euc	80+ cm	4		
	50 – 79 cm	1		
	30 – 49 cm	5		
	20 – 29 cm	5		
	10 – 19 cm	x		✓ 1
	5 – 9 cm	x		n/a
	< 5 cm	x		n/a
Length of logs (m) (≥10 cm diameter, >50 cm in length)		Tally space		total
				4

* includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia
† Record total number of stems by size class with hollows (including dead stems/trees)

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30, ..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogam cover (%)	Rock cover (%)
Subplot score (% in each)	20 75 40 45 45	4 5 40 10 40	2 1 1 2 1	0 0 0 0 0
Average of the 5 subplots	44	27	1.6	0

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	Landform Element	Landform Pattern	Microrelief
Lithology	Soil Surface Texture	Soil Colour	Soil Depth
Slope	Aspect	Site Drainage	Distance to nearest water and type

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	3	0	Managed park-like landscape
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage			
Weediness	3	L	
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m ² plot: Sheet _ of _		Survey Name	Plot Identifier	Recorders
Date	02/01/19	18FCN002 Cumberland SF	02	LH

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
1	<i>Conyza maculata</i>	N	4	2	G	
2	<i>Eucalyptus saligna</i>	N	7	4	G	
3	<i>Eucalyptus (peppermint)</i>	N	1.2	1	M	
4	Exotic like Sapium	E	1.2	1	M	
5	<i>Pandorea pandarum</i>	N	1.2	7	M	
6	<i>Chenopodium arifolium</i>	N	1	8	M	
7	<i>Bonchus oleraceus</i>	E	0.1	3	G	
8	<i>Microseris stipitata</i>	N	5	1100	G	
9	<i>Oxalis corniculata</i>	HTE	0.2	120	G	
10	<i>Lagenaria stipitata</i>	N	1	150	G	
11	<i>Echtharta erecta</i>	HTE	8	1500	G	
12	<i>Axonopus fissifolius</i>	E	0.3	50	G	
13	<i>Sporobolus africanus</i>	G	0.1	25	G	
14	<i>Geranium holcense</i>	N	0.3	45	G	
15	<i>Sida rhomboides</i>	HTE	0.2	50	G	
16	<i>Cyperus gracilis</i>	N	0.1	25	G	
17	<i>Solanum nigrum</i>	E	0.2	40	G	
18	<i>Lomandra longifolia</i>	N	0.2	2	G	
19	<i>Centella asiatica</i>	N	0.2	60	G	
20	<i>Dianella caerulea</i>	N	0.2	6	G	
21	<i>Taraxacum officinale</i>	E	4	750	G	
22	<i>Trema lamarckiana</i>	N	0.3	1	M	
23	<i>Conyza clementis</i>	N	0.3	12	M	
24	<i>Dichondra repens</i>	N	0.8	150	G	
25	<i>Asparagus reticulatus</i>	HTE	0.1	1	G	
26	<i>Stephania japonica</i>	N	0.2	2	G	
27	<i>Tradescantia fluminensis</i>	HTE	0.2	40	G	
28	<i>Erinacea polygonoides</i>	N	0.2	40	G	
29	<i>Commelina cyanea</i>	N	0.2	20	G	
30	<i>Sigesbeckia orientalis</i>	N	0.1	5	G	
31	<i>Paspalum urvillei</i>	E	0.5	80	G	
32	<i>Modiola caroliniana</i>	E	0.3	60	G	
33	<i>Cynodon dactylon</i>		3	500	G	
34	<i>Veronica plebeia</i>	N	0.3	100	G	
35	<i>Glyceria tabacina</i>	N	0.1	15	G	
36	<i>Plantago lanceolata</i>	E	0.1	3	G	
37	<i>Gonolobus spicata</i>	E	0.1	1	G	
38	<i>Euphorbia peplus</i>	E	0.1	2	G	
39	<i>Pennisetum clandestinum</i>	HTE	35	5000	G	
40	<i>Digitaria sanguinalis</i>	E	0.2	30	G	

GF Code: see Growth Form definitions in Appendix 1 N: native, E: exotic, HTE: high threat exotic GF - circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ..., 100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

Form version 5 - designed March 2017
Trifolium repens
Hemolantus populneus
Arabis flabellata
Grasshopper sp.
Lomandra myrsinites
Artemisia cantharidis

Printed 31 August 2017

Acronia smithii

GF - circle code if 'top 3'
 0.3 15 30
 1 1 1
 0.1 3 30
 0.2 3 30
 0.1 3 30

BAM Site – Field Survey Form Site Sheet no: 1 of 1

Date		Survey Name		Plot Identifier		Recorders	
02/01/15		18 FENSWOZ Cumberland sf		Q3		LH	
Zone	Datum	IBRA region	Photo #		Zone ID		
56	ADA 74						
Easting	Northing	Dimensions		Orientation of midline from the 0 m point		Magnetic	
		20 x 20 / 50 x 20 m					
Vegetation Class						Confidence:	
						H M L	
Plant Community Type						EEC:	
						H M L	

Record easting and northing from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (Shape) of 0.04 ha base plot inside 0.1 ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute (400 m ² plot)		Sum values	
Count of Native Richness	Trees		
	Shrubs		
	Grasses etc.		
	Forbs		
	Ferns		
	Other		
Sum of Cover of native vascular plants by growth form group	Trees		
	Shrubs		
	Grasses etc.		
	Forbs		
	Ferns		
	Other		
High Threat Weed cover			

BAM Attribute (20 x 50 m plot)		# Tree Stems Count		Record number of living eucalypt* (Euc*) and living native non-eucalypt (Non Euc) stems separately * includes all species of Eucalyptus, Corymbia, Angophora, Lophostemon and Syncarpia † Record total number of stems by size class with hollows (including dead stems/trees)	
dbh	Euc*	Non Euc	Hollows†		
large trees for Euc* & Non Euc	80 + cm	1			
	50 – 79 cm				
	30 – 49 cm	✓			
	20 – 29 cm	✓			
	10 – 19 cm	✓			
	5 – 9 cm				n/a
	< 5 cm			n/a	
Length of logs (m) (≥10 cm diameter, >50 cm in length)		Tally space		total	
				11	

Counts must apply to each size class when the number of living tree stems within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is > 10. Estimates should draw from the number series: 10, 20, 30, ..., 100, 200, 300

For a multi-stemmed tree, only the largest living stem is included in the count/estimate. For hollows count only the presence of a stem containing hollows, not the count of hollows in that stem. Only count as 1 stem per tree where tree is multi-stemmed. The hollow-bearing stem may be a dead stem.

BAM Attribute (1 x 1 m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogam cover (%)					Rock cover (%)				
Subplot score (% in each)	20	20	20	50	25	2	5	5	15	7	0	0	0	0	0	0	0	0	0	0
Average of the 5 subplots	27					6.8					1					0				

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1 m x 1 m plots located on alternate sides and 5 m from the plot midline at the locations 5, 15, 25, 35, and 45 m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10 cm in diameter). Within these 1 m x 1 m plots assessors may also record the cover of rock, bare ground and cryptogam soil crusts. Collection of these data is optional - the data do not currently contribute to assessment scores, they hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological Type	Landform Element	Landform Pattern	Microrelief
Lithology	Soil Surface Texture	Soil Colour	Soil Depth
Slope	Aspect	Site Drainage	Distance to nearest water and type

Plot Disturbance	Severity code	Age code	Observational evidence:
Clearing (inc. logging)	3	0	
Cultivation (inc. pasture)			
Soil erosion			
Firewood / CWD removal			
Grazing (identify native/stock)			
Fire damage			
Storm damage	2	R	
Weediness	3	R	
Other			

Severity: 0=no evidence, 1=light, 2=moderate, 3=severe

Age: R=recent (<3yrs), NR=not recent (3-10yrs), O=old (>10yrs)

400 m ² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 02/01/19	18 January 2019 Cumberland SF	Q3	LH

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
1	<i>Eucalyptus saligna</i>	N	8	4	C	
2	<i>Thalictrum acaule</i>	N	0.7	1	M	
3	<i>Ptilotheca uncinata</i>	N	8	8	M	
4	<i>Axonopus fissifolius</i>	E	0.3	30	G	
5	<i>Taraxacum officinale</i>	E	1.5	500	G	
6	<i>Oxalis corniculata</i>	HTE	0.2	100	G	
7	<i>Acacia implexa</i>	N	0.1	1	M	
8	<i>Hahnenbergia gracilis</i>	N	0.1	1	G	
9	<i>Modiola caroliniana</i>	HTE	0.1	25	G	
10	<i>Microseris stipoides</i>	N	0.7	150	G	
11	<i>Eragrostis hastata</i>	N	0.1	4	G	
12	<i>Pandorea pandorana</i>	N	4	15	M	
13	<i>Amurcia sericea</i>	HTE	0.7	25	M	
14	<i>Solanum nigrum</i>	E	0.1	3	G	
15	<i>Murraya paniculata</i>	E	1.2	2	M	
16	<i>Stenotaphrum secundatum</i>	E	65	2500	G	
17	<i>Eragrostis brownii</i>	N	0.1	10	G	
18	<i>Asparagus orthocarpus</i>	HTE	0.1	3	G	
19	<i>Conyza discoloris</i>	E	0.1	12	G	
20	<i>Conyza maculata</i>	N	3	1	C	
21	<i>Dichoneta repens</i>	N	0.5	150	G	
22	<i>Cynopsis clausenii</i>	N	0.5	20	G	
23	<i>Jasminum polyanthum</i>	E	1	20	M	
24	<i>Nandina domestica</i>	E	0.1	1	M	
25	<i>Argemone bakeri</i>	N	0.5	1	M	
26	<i>Callistemon viminalis</i>		0.6	1	M	
27	<i>Eriochloa erecta</i>	HTE	0.3	100	G	
28	<i>Richardia stellaris</i>	E	0.1	40	G	
29	<i>Albizia leonensis</i>	N	0.8	1	M	
30	<i>Eucalyptus microcarpa</i>	N	3	1	C	
31	<i>Isopogon strigosus</i>	N	0.3	100	G	
32	<i>Paspalum virgatum</i>	HTE	0.6	100	G	
33	<i>Veronica peltata</i>	N	0.2	50	G	
34	<i>Acacia nova-zealandia</i>	N	0.1	50	G	
35	<i>Lysimachia arvensis</i>	E	0.1	15	G	
36	<i>Opismenus acuminatus</i>	N	1	125	G	
37	<i>Sonchus oleraceus</i>	E	0.1	1	G	
38	<i>Clematis aristata</i>	N	0.4	12	G	
39	<i>Hypochaeris radicata</i>	E	0.1	15	G	
40	<i>Desmodium illinoense</i>	N	1.5	200	G	

GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

GF – circle code if 'top 3'.

Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ..., 100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m
Abundance: 1, 2, 3, ..., 10, 20, 30, ..., 100, 200, ..., 1000, ...

400 m ² plot: Sheet _ of _	Survey Name	Plot Identifier	Recorders
Date 02/05/19	18FCN4102 Cumberland SF	Q3	LM

GF Code	Top 3 native species in each growth form group: Full species name mandatory All other native and exotic species: Full species name where practicable	N, E or HTE	Cover	Abund	stratum	voucher
1	<i>Glycine clandestina</i>	N	0.3	30	G	
2	<i>Acacia parramattensis</i>	N	2	2	M	
3	<i>Lignitum sinense</i>	HTE	0.2	5	M	
4	<i>Tradescantia fluminensis</i>	HTE	0.2	20	G	
5	<i>Echinochloa crusgallus</i>	N	0.1	2	G	
6	<i>Lomandra longifolia</i>	N	0.8	2	G	
7	<i>Pratia purpurascens</i>	N	0.5	100	G	
8	<i>Achras senegalensis</i>	E	0.2	15	M	
9	<i>Ficus hepatica pilularis</i>	N	0.5	1	C	
10	<i>Lignitum lucidum</i>	HTE	0.1	2	M	
11	<i>Eustrophus latifolius</i>	N	0.3	2	G	
12	<i>Lilium formosum</i>	E	0.1	3	G	
13	<i>Sporobolus africanus</i>	E	0.1	10	G	
14	<i>Acacia implexa</i>	N	0.1	1	M	
15	<i>Ophionomys umbellatus</i>	N	0.1	5	G	
16	<i>Bidens pilosa</i>	E	0.1	1	G	
17	<i>Commelina cyanea</i>	N	0.1	2	G	
18	<i>Persea spinosa</i>	N	0.1	1	M	
19	<i>Leucospora juniperinus</i>	N	0.2	3	G	
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GF Code: see Growth Form definitions in Appendix 1

N: native, E: exotic, HTE: high threat exotic

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Cover: 0.1, 0.2, 0.3, ..., 1, 2, 3, ..., 10, 15, 20, 25, ...100% (foliage cover); Note: 0.1% cover represents an area of approximately 63 x 63 cm or a circle about 71 cm across, 0.5% cover represents an area of approximately 1.4 x 1.4 m, and 1% = 2.0 x 2.0 m, 5% = 4 x 5 m, 25% = 10 x 10 m

Abundance: 1, 2, 3, ..., 10, 20, 30, ... 100, 200, ..., 1000, ...