Executive Summary

This Ecological Constraints Report has been prepared by *Travers bushfire & ecology* to identify the potential ecological constraints of a vacant property at 90 Thirlmere Way, Tahmoor, NSW. The proposal is to rezone the land from RU4 Rural Small Holdings to R2 Low Density Residential.

Ecological survey and assessment has been undertaken in accordance with relevant legislation including the *Environmental Planning and Assessment Act 1979*, the *Threatened Species Conservation Act 1995*, the *Environment Protection and Biodiversity Conservation Act 1999* and the *Fisheries Management Act 1994*.

In respect of matters required to be considered under the *Environmental Planning and Assessment Act 1979* and relating to the species / provisions of the *Threatened Species Conservation Act 1995* no threatened fauna species or threatened flora species were recorded within the subject site. A small area of regrowth Shale-Sandstone Transition Forest occurs on site. This is listed as an endangered ecological community.

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. There is no evidence of watercourses within the site and no suitable habitat for threatened fish species. There is a man-made drainage line running immediately parallel to the southern side of Thirlmere Way and a swale running adjacent to the western boundary for approximately 160-180m.

Endangered Ecological Communities

Regrowth vegetation on site is considered to be commensurate with the EEC Shale-Sandstone Transition Forest which is recognised under the *TSC Act (1995)* and EPBC Act (1999). There are a number of mature or semi-mature Eucalypts and canopy species however there is a distinct lack of a native mid-storey layer. There are some Acacia trees present but in low proportions. The under-storey is a mixture of native and exotic species which is heavily influenced by a high water table (moist soils). Low growing Melaleuca and Leptospermum species are present, both of which are not characteristic of the Shale-Sandstone Transition Forest EEC.

The canopy vegetation where present is definitive of the EEC, as is the combination of geological and soil landscape attributes. The site is on sandstone geology, approximately 600m from the edge of the shale geology. The soil landscape is Lucas Heights which are moderately deep soils over alternating bands of shale and sandstone.

There are young regenerating Eucalypt species emerging within the northern portion of the property. The SSTF vegetation present on site is an isolated patch of Shale Sandstone Transition Forest. The vegetation is in low condition, has less than 10% canopy cover, and approximately 75 % of the understorey is non-native. The patch is less than 5 ha in size, is not part of contiguous vegetation, contains at least one tree per hectare of greater than 80 cm dbh and has a hollow, and has a perennial understorey vegetation cover of 25%

Based on the above size and condition *Travers bushfire & ecology* concludes that the vegetation present is in a low condition and of low conservation value. As such the proposed works will not impact on an area of EEC of conservation value. Subject to completion of a 7 part test of significance, a future subdivision of the site is not likely to

require preparation of a species impact statement. Also subject to completion of a significance assessment under the EPBC Act (1999), the proposal is not likely to require a referral to the Department of *Sustainability, Environment, Water, Populations and Communities (SEWPC)* under the EPBC Act.

Threatened Flora & Fauna Species

Despite potential habitat for state or nationally listed species, the subject site was not found to contain any threatened flora or fauna species. As such, there are no confirmed threatened flora or fauna constraints. There are no known threatened species records on immediately adjoining properties. The site may be utilised by threatened micro-chiropteran bats and to a lesser extent threatened birds. Due to the dominant presence of Noisy Miners, the site is not expected to provide significant habitat for threatened birds.

Riparian Constraints

Despite there being a mapped watercourse in the north-western corner of the subject site, it has been diverted into roadside drainage. There is also a very small swale approximately 1-2m from the western boundary on the adjoining lot, however, this is not considered to be a watercourse and riparian setbacks will not affect any portion of the subject site.

Conclusion

The immediate land within the first 20m of Thirlmere Way is not constrained by any vegetation or fauna habitats. The southern portion of the site (lower 175m of the site) is unconstrained by vegetation however there are some large trees that contain hollow-bearing resources.

34% (0.8 ha) of the site is affected by regrowth EEC – Shale Sandstone Transition Forest.

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List of abbreviations

APZ	asset protection zone
BPA	bushfire protection assessment
CLUMP	conservation land use management plan
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation (superseded by DECC from 4/07)
DECC	NSW Department of Environment and Climate Change (superseded by DECCW from 10/09)
DECCW	NSW Department of Environment, Climate Change and Water (superseded by OEH from 4/11)
EEC	endangered ecological community
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESMP	ecological site management plan
FF	flora and fauna assessment
FM Act	*Fisheries Management Act 1994*
FMP	fuel management plan
HTA	habitat tree assessment
IPA	inner protection area
LEP	Local Environment Plan
LGA	local government area
NES	national environmental significance
NPWS	NSW National Parks and Wildlife Service
NSW DPI	NSW Department of Industry and Investment
OEH	Office of Environment and Heritage (part of the NSW Department of Premier and Cabinet)
OPA	outer protection area
PBP	*Planning for bush fire protection 2006: A Guide for Councils, Planners, Fire Authorities and Developers*
POM	plan of management
RF Act	*Rural Fires Act*
RFS	*NSW Rural Fire Service*
ROTAP	rare or threatened Australian plants
SEPP 44	*State Environmental Protection Policy No 44 – Koala Habitat Protection*

SEWPAC	Federal Department of Sustainability, Environment, Water, Population and Communities
SIS	species impact statement
SULE	safe useful life expectancy
TPO	tree preservation order
TPZ	tree preservation zone
TRRP	tree retention and removal plan
TSC Act	*Threatened Species Conservation Act 1995*
VMP	vegetation management plan

Table of Contents

Figures

Tables

Appendices

Introduction 1

Travers bushfire & ecology has been engaged to identify the potential ecological constraints upon an existing rural allotment at 90 Thirlmere Way, Tahmoor. The proposal is to rezone the land from RU4 Rural Small Holdings to R2 Low Density Residential.

An indicative concept subdivision plan (Figure 1) identifies that the site can support 20 low density residential lots ranging in size from 703 - 833 m^2 (smaller lots) with two larger lots with a size of 3710 & 3719m^2.

1.1 Aims of the assessment

The aims of the flora and fauna assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their conditions
- Carry out a fauna survey for the detection and assessment of fauna and their habitats
- Complete target surveys for threatened species, populations and ecological communities
- Prepare an ecological assessment in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*), the *Environmental Planning and Assessment Act 1979 (EPA Act),* the *Threatened Species Conservation Act 1995* (*TSC Act*), the *Fisheries Management Act 1994* (*FM* Act) and guidelines issued by the *Department of Environment and Conservation* (Dec. 2004)

1.2 Statutory requirements

1.2.1 Threatened Species Conservation Act 1995

The specific requirements of the *TSC Act* must be addressed in the assessment of impacts on threatened flora and fauna, populations and ecological communities. The factors to be taken into account in deciding whether there is a significant effect are set out in Section 5A of the *Environmental Planning and Assessment Act 1979* (EPA Act) and are based on a 7 part test of significance. 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, a Species Impact Statement (SIS) is required to be prepared.

1.2.2 Fisheries Management Act 1994

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.

1.2.3 Environment Protection and Biodiversity Conservation Act 1999

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 *Department of Sustainability, Environment, Water, Population and Communities (SEWPAC)* 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 listed ecological communities Cumberland Plain Woodland and Shale-Gravel transition Forest. Consultation with SEWPAC 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 1999 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.

1.3 Site description

Table 1.1 provides a summary of the planning, cadastral, topographical, and disturbance details of the subject site.

Table 1.1 – Site features

Location	90 Thirlmere Way, Tahmoor
LGA	Wollondilly
Grid reference	277200E 6210600N
Elevation	290m AMSL
Topography	Situated on a gentle slope which is south-facing. Generally between 0-2 degrees
Geology and soils	Geology; Sandstone. Soils; Lucas Heights – residual type of moderate depth over layers of sandstone and shale
Catchment / drainage	Tributary off Myrtle Creek
Vegetation	Woodland vegetation with a moist heathy understorey that is largely regrowth where present
Existing land use	Vacant
Clearing	65% is presently clear of any native vegetation

Survey Methodology 2

2.1 Survey constraints

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 overcome this survey limitation.

2.2 Information collation, technical resources, desktop assessments, specialist identification and licences

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)
- Aerial photographs (*Google Earth Pro/ Spatial Information Exchange/ NearMaps*)
- Topographical maps (scale 1:25,000)
- *Threatened Species Conservation Act 1995 (TSC Act)*
- *Fisheries Management Act 1994 (FM Act)*
- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*
- Rare or Threatened Australian Plants (ROTAP)
- The natural vegetation maps for the subject site including Vegetation Mapping of the Cumberland Plain (NPWS 2002).

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 2012) 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 SEWPAC – '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 as per the *Atlas of NSW Wildlife* search. These two 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).

Accuracy of identification:

Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation were made according to Specht *et al* (1995).

***Licences*:**

Individual staff members 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: S10359.

The staff of *Travers bushfire & ecology* are also licensed under an Animal Research Authority issued by the Department of Agriculture. 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.

2.3 Flora survey methodology

Flora survey was undertaken over approximately a 5hr time frame on 10 August 2012. A random meander search was undertaken in accordance with Cropper (1993) to create a broad species list.

Six (6) 20mx20m floristic quadrats were assessed where there was native remnant vegetation present within the subject site and a target search was undertaken for threatened species where applicable. Searches for threatened species were also undertaken during the initial random meander prior to the stratified sampling.

A further two (2) transects were undertaken within the southern portion of this subject site in cleared areas.

A review of the *Atlas of NSW Wildlife* database (OEH 2012) 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 required.

2.4 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.1 and are depicted in Figure 1.

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. Fauna survey techniques that have been tailored to the site are provided in Section 2.6.

2.5 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)	Survey effort / time (24hr)
Diurnal birds	8/8/12	0/8 cloud, light NW wind, no rain, temp 19-13°C	Diurnal opportunistic	5hrs 15min 1230 - 1745
Nocturnal birds	8/8/12	high 6/8 cloud, no wind, no rain, temp 13-12°C	Spotlighting Call playback (Section 2.6 species)	1hr 40min 1800 - 1940 Commenced @ 1820
Arboreal mammals	8/8/12	high 6/8 cloud, no wind, no rain, temp 13-12°C	Spotlighting Call playback (Section 2.6 species)	1hr 40min 1800 - 1940 Commenced @ 1830
Terrestrial mammals	8/8/12	high 6/8 cloud, no wind, no rain, temp 13-12°C	Spotlighting	1hr 40min 1800 - 1940
Bats	8/8/12	high 6/8 cloud, no wind, no rain, temp 13-12°C	Spotlighting Anabat SD-1 (Active monitoring) Anabat II (Passive monitoring)	1hr 40min 1800 - 1940 1hr 35min 1755 - 1930 Overnight from 1750
Reptiles	8/8/12	0/8 cloud, light NW wind, no rain, temp 19-13°C	Habitat search, opportunistic	5hrs 15min 1230 - 1745
Amphibians	8/8/12	high 6/8 cloud, no wind, no rain, temp 13-12°C	Spotlighting and call identification	1hr 40min 1800 - 1940

Table 2.2 – Flora survey effort

Flora survey	Survey technique(s)	Dates
Vegetation communities	Survey of the boundaries of all communities – field verification and aerial photographic interpretation Vegetation condition assessment – Biometric field method	10/08/12
Stratified sampling	20mx20m quadrats in all existing bushland or remnant areas	10/08/12
Target searches	Target searches in known habitats	10/08/12

2.6 Site specific survey techniques

Diurnal birds

Four (4) diurnal bird census points were undertaken within the subject site and an additional census point was undertaken within adjacent quality open forest habitat to the west (see Figure 1). A minimum of 25 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). Opportunistic diurnal bird survey was conducted between census points and whilst undertaking other diurnal surveys.

Nocturnal birds

Given a degree of habitat suitability present, Masked Owl (*Tyto novaehollandiae*), Barking Owl (*Ninox connivens*), and Bush Stone-curlew (*Burhinus grallarius*) were targeted by call-playback techniques.

Arboreal and terrestrial mammals

Given a degree of habitat suitability present, Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) were targeted by call-playback techniques.

Habitat Trees

Hollow-bearing trees were identified and recorded within the subject site on a *Trimble* handheld GPS unit during surveys. All data such as hollow types, hollow size, tree species, diameter at breast height, canopy spread and overall height were collected and a metal tag with the tree number placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging were also noted.

A summary of hollow-bearing tree results is provided in Table 4.3.

2.7 Specific Survey limitations

Microbat activity is typically low during late winter when survey was undertaken, as many species are in torpor or hibernation at this time. Survey during warmer months will better determine site utilisation by microbats.

Survey Results 3

3.1 Flora results

3.1.1 Flora species

The plants observed within the vegetation communities of the subject site are listed in the Table 3.1 below.

Table 3.1 – Flora observations for the subject site

Family	Scientific Name	Common Name
TREES		
Mimosaceae	*Acacia decurrens*	Black Wattle
Mimosaceae	*Acacia implexa*	Hickory
Lauraceae	*Cinnamomum camphora**	Camphor Laurel
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark
Myrtaceae	*Eucalyptus globoidea*	White Stringybark
Myrtaceae	*Eucalyptus parramattensis ssp. parramattensis*	Parramatta Red Gum
Myrtaceae	*Eucalyptus punctata*	Grey Gum
Myrtaceae	*Eucalyptus sclerophylla*	Scribbly Gum
Myrtaceae	*Eucalyptus sparsifolia*	Narrow-leaved Stringybark
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Proteaceae	*Grevillea robusta*	Silky Oak
SHRUBS		
Mimosaceae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush
Fabaceae	*Daviesia squarrosa*	-
Apocnynaceae	*Gomphocarpus fruticosus**	Narrow Leaf Cotton Bush
Proteaceae	*Hakea sericea*	Needlebush
Myrtaceae	*Kunzea ambigua*	Tick Bush
Myrtaceae	*Leptospermum continentale*	-
Myrtaceae	*Leptospermum polygalifolium*	Tantoon
Myrtaceae	*Leptospermum squarrosum*	-
Oleaceae	*Ligustrum sinense**	Small-leaved Privet
Myrtaceae	*Melaleuca thymifolia*	Thyme Honey Myrtle
Fabaceae	*Mirbelia rubiifolia*	Heathy Mirbelia
Rosaceae	*Rubus fruticosus* spp. agg.	Blackberry
GROUNDCOVERS		
Polygonaceae	*Acetosella vulgaris**	Sheep Sorrel
Poaceae	*Andropogon virginicus**	Whisky Grass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Poaceae	*Austrodanthonia tenuior*	Wallaby Grass
Poaceae	*Austrostipa pubescens*	Tall Speargrass
Poaceae	*Axonopus fissifolius**	Narrow-leafed Carpet Grass

Family	Scientific Name	Common Name
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Poaceae	*Briza maxima**	Quaking Grass
Poaceae	*Bromus cartharticus**	Prairie Grass
Asteraceae	*Cirsium vulgare**	Spear Thistle
Asteraceae	*Conyza sumatrensis**	Fleabane
Asteraceae	*Coreopsis lanceolata**	-
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Cyperaceae	*Cyperus rotundatus**	-
Poaceae	*Deyeuxia decipiens*	Devious Bent-grass
Phormiaceae	*Dianella caerulea* var. *assera*	Flax Lily
Phormiaceae	*Dianella revoluta* var. *revoluta*	Spreading Flax Lily
Poaceae	*Dichelachne rara*	
Poaceae	*Entolasia stricta*	Wiry Panic
Asteraceae	*Epaltes australis*	-
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Poaceae	*Eragrostis curvula**	African Lovegrass
Asteraceae	*Euchiton sphaericus*	Cudweed
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-rush
Haloragaceae	*Gonocarpus tetragynus*	Poverty Raspwort
Goodeniaceae	*Goodenia bellidifolia*	Daisy-leaved Goodenia
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Ivy-leaved Goodenia
Poaceae	*Holcus lanatus**	Yorkshire Fog
Asteraceae	*Hypochaeris radicata**	Flatweed
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Juncaceae	*Juncus prismatocarpus*	Branching Rush
Juncaceae	*Juncus subsecundus*	Finger Rush
Juncaceae	*Juncus usitatus*	Common Rush
Restionaceae	*Lepyrodia scariosa*	Scale Rush
Poaceae	*Lolium perenne**	Perennial Ryegrass
Lomandraceae	*Lomandra confertifolia* subsp. *rubiginosa*	-
Lomandraceae	*Lomandra filiformis* subsp. *coriacea*	Wattle Mat-rush
Fabaceae	*Lotus suaveolans**	Hairy Bird's Foot Trefoil
Fabaceae	*Medicago polymorpha**	Burr Medic
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Poaceae	*Panicum capillare**	-
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Pennisetum clandestinum**	Kikuyu
Poaceae	*Phalaris aquatica**	Phalaris
Plantaginaceae	*Plantago lanceolata**	Ribwort
Polygonaceae	*Rumex crispus**	Curled Dock
Cyperaceae	*Schoenus apogon*	Fluke Bog-rush
Cyperaceae	*Schoenus brevifolius*	Bog-rush
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	-
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Poaceae	*Sporobolus africanus**	Parramatta Grass

Family	Scientific Name	Common Name
Lamiaceae	*Stachys arvensis**	Stagger Weed
Asteraceae	*Taraxacum officinale**	Dandelion
Poaceae	*Themeda australis*	Kangaroo Grass
Fabaceae	*Trifolium repens**	White Clover
Verbenaceae	*Verbena bonariensis**	Purpletop
Verbenaceae	*Verbena litoralis**	Coastal Verbena
VINES		
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle
Fabaceae	*Vicia sativa* subsp. *sativa**	Common Vetch
* denotes exotic species		

3.1.2 Vegetation communities

Three (3) vegetation communities were observed and are described below.

- Vegetation Community 1 – Regrowth Woodland
- Vegetation Community 2 – Cleared or Pasture

NPWS (2002) *Vegetation Mapping of the Cumberland Plain* does not cover the subject site. The outermost surveyed area occurs immediately north of the subject site. The vegetation immediately north, which has been mapped, has been described as mostly map unit 2, Shale-Sandstone Transition Forest (high sandstone influence).

Regrowth Woodland

The canopy is sparse to moderate with a few sparse canopy trees around 13-20m tall. There are not very many full-sized canopy trees within the site however the species present were of a mix that is typical of what might be expected within the EEC Shale-Sandstone Transition Forest, for example, the presence of *E. crebra, E. punctata, E. sclerophylla* and *E. sparsifolia.*

The mid-storey is almost absent. There may be a few remnant Acacia species however that tends to be the only shrub or small tree species above 2.5m tall.

The ground layer of vegetation comprises of a matrix of sparse to moderately dense shrubs such as *Leptospermum* sp. and *Melaleuca thymifolia.* Other occasional small shrubs are also present in low numbers and proportions. There are very few native grasses present, but there may be native herbs such as *Gonocarpus tetragynus* and sedge species such as *Lepyrodia scariosa.* The ground layer of vegetation is moderately impacted upon by the presence of non-native grasses and perennials such as *Pennisetum clandestinum, Paspalum dilatatum* and *Eragrostis curvula*. In some areas, the non-native species may comprise up to 75% of the understorey, but more so approximately 30-50%.

Photo 1 – Woodland vegetation in northern portion of the site

Photo 2 – Woodland remnant just south of photo 1

In areas with an absent canopy *Acacia decurrens* is present only to 6-8m tall. Regrowth Eucalypt species are up to 5m tall but mostly 2-4m. The density of the regrowth Eucalypts is less than 10% projected foliage cover.

Photo 3 – Regrowth vegetation in the northern portion of the site showing young scattered Eucalypts and a moderately dense layer of Melaleuca to 0.8m tall

Cleared or Pasture

This describes all cleared or pasture areas within the southern portion of the subject site. There were only 4-5 trees present over the space of nearly 1.5ha and no mid-storey. The ground layer has been previously grazed and comprises various grasses and non-native perennials. There are some patches of Blackberry present.

Photo 4 – Cleared vegetation along the northern boundary

Photo 5 – Cleared vegetation looking north from approximately 30m from the southern boundary

3.2 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed in Table 3.2 below.

Table 3.2 – Fauna observations for the subject site and immediate surrounds

Common name	Scientific name	Method Observed
Birds		**Aug 2012**
Australian King Parrot	*Alisterus scapularis*	O C
Australian Magpie	*Gymnorhina tibicen*	O C
Australian Raven	*Corvus coronoides*	O C
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O C
Black-shouldered Kite	*Elanus axillaris*	O C
Brown-headed Honeyeater	*Melithreptus validirostris*	O C
Common Bronzewing	*Phaps chalcoptera*	O C
Common Myna *	*Acridotheres tristis*	O C
Eastern Rosella	*Platycercus eximius*	O C
Galah	*Cacatua roseicapilla*	O C
Grey Butcherbird	*Cracticus torquatus*	O C
Grey Fantail	*Rhipidura fuliginosa*	O C
Laughing Kookaburra	*Dacelo novaeguineae*	O C
Little Wattlebird	*Anthochaera chrysoptera*	O C
Magpie-lark	*Grallina cyanoleuca*	O C
Noisy Miner	*Manorina melanocephala*	O C

Common name	Scientific name	Method Observed
Olive-backed Oriole	*Oriolus sagittatus*	O C
Pied Currawong	*Strepera graculina*	O C
Rainbow Lorikeet	*Trichoglossus haematodus*	O C
Spotted Pardalote	*Pardalotus punctatus*	O C
Striated Thornbill	*Acanthiza lineata*	O C
Superb Fairy-wren	*Malurus cyaneus*	O C
Yellow Thornbill	*Acanthiza nana*	O C
Yellow-faced Honeyeater	*Lichenostomus chrysops*	O C
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	O C
Mammals		
Common Brushtail Possum	*Trichosurus vulpecula*	I^{PR}
Domesticated Dog *	*Canis familiaris*	O
Horse *	*Equus caballus*	O
Reptiles		
Grass Skink	*Lampropholis guichenoti*	O
Amphibians		
Common Eastern Froglet	*Crinia signifera*	C
Mollusc		
Common Garden Snail *	*Helix aspersa*	H

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
^{PO} indicates species identified to a 'possible' level of certainty

A	-	Anabat II/SD-1	C	-	Call Identification
O	-	Observation	P	-	Call-playback Response
T	-	Trap (Elliott, cage, etc)	H	-	Habitat Search
S	-	Spotlight	I	-	Scat, Track or Sign Identification

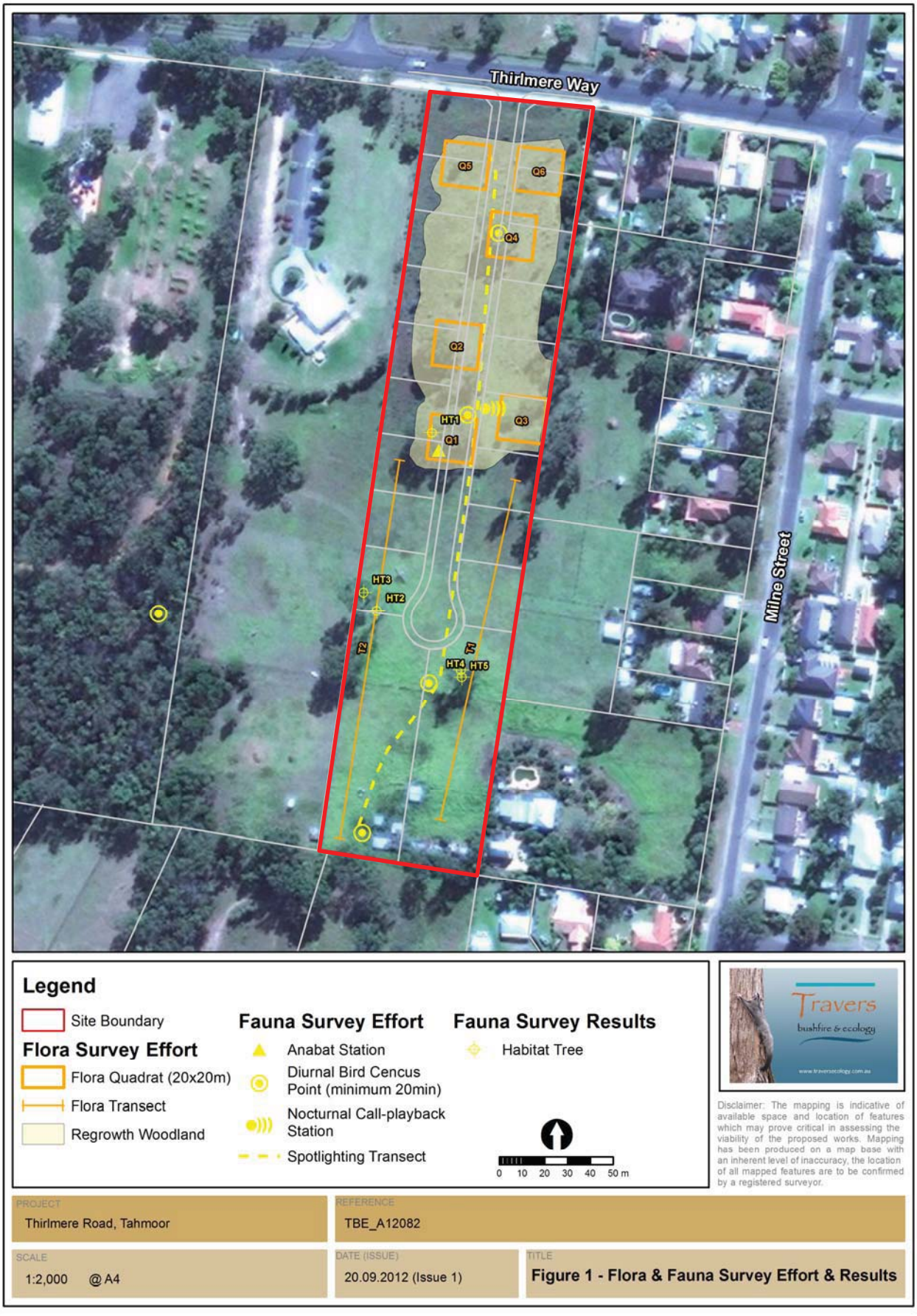

Figure 1 – Flora and Fauna Survey Effort & Results

Ecological Assessment 4

4.1 Flora

All species observed are listed in Table 3.1. No threatened flora species were observed.

A list of all threatened flora species recorded within an approximate 10km radius on the *Atlas of NSW Wildlife* database (OEH 2012 / *Bionet*) are assessed as having potential habitat. Nationally listed species which are also listed as having potential habitat within a 10km radius from the *EPBC* coordinate searches are also included in the potentially affected species list. These are listed in Appendix 2.

4.1.1 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH 2012) database indicated a list of species that have been recorded within a 10km radius of the subject site. Those species are considered for suitable habitat and potential to occur in Table A2.1 (Appendix 2).

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 state listed threatened flora species:

- *Grevillea parviflora* var. *parviflora*

Note: Full habitat descriptions for these species are provided in Appendix 2.1.

No state listed threatened flora species were observed during the survey undertaken.

(b) Endangered flora populations (NSW)

There are no listed endangered flora populations in the Wollondilly LGA.

(c) Endangered ecological communities (NSW)

One EEC, Shale-Sandstone Transition Forest was recorded within the subject site. There are small patches of mature vegetation, largely comprising of canopy specie/s which are consistent with the final determination for this vegetation community. The mid-storey has been cleared in the past and managed by grazing.

Since the removal of grazing animals and general occupation of the site, there has regrowth in the northern portion of the subject site which generally comprises small Eucalypts up to 5m tall, however, most are more likely to be 2-3m. There is little or no mid-storey layer, however there is a moderately dense layer of small shrubs such as *Melaleuca thymifolia* and *Leptospermum* species to 0.8m tall as well as native herbs and grasses.

The ground layer is moderately disturbed throughout any remnant or regrowth patches of vegetation due to these past activities within the subject site, noted by the presence of non-native grasses, exotic annuals and perennials and some disturbed soils.

It was found that approximately 34% of the site contained either disturbed mature stands of vegetation or regrowth.

4.1.2 Matters of national environmental significance - flora

(a) Threatened flora species (National)

A review of the schedules of the *EPBC Act* indicated the potential for 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:

- *Grevillea parviflora* var. *parviflora*

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

(b) Endangered ecological communities (EPBC Act (1999))

Shale-Sandstone Transition Forest is a nationally listed EEC under the *EPBC Act (1999).*

The SSTF vegetation present on site is an isolated patch of Shale Sandstone Transition Forest. The vegetation is in low condition, has less than 10% canopy cover, and approximately 75 % of the understorey is non-native. The patch is less than 5 ha in size, is not part of contiguous vegetation, contains at least one tree per hectare of greater than 80 cm dbh and has a hollow, and has a perennial understorey vegetation cover of 25%

Based on the above size and condition *Travers bushfire & ecology* concludes that the vegetation present is in a low condition and of low conservation value. As such the proposed works will not impact on an area of EEC of conservation value and does not require a referral under the EPBC Act.

A referral is not likely to be required to the *Department of Sustainability, Environment, Water, Populations and Communities* for assessment under the *EPBC Act (1999)*.

4.1.3 Flora and EEC assessment conclusions

No threatened flora species occur within the subject site. There is however a state and nationally listed EEC present, Shale-Sandstone Transition Forest which occupies approximately 0.8 ha of the site. The southern portion of the subject site is unconstrained by native vegetation. Given the small area of mature vegetation and the low condition of the vegetation present, it is expected that the SSTF vegetation can be removed subject to development consent without causing a significant impact.

4.2 Fauna

All fauna species recorded during survey are listed in Table 3.2.

4.2.1 Fauna habitat

The fauna habitats present within the site are identified within Table 4.1.

Table 4.1 – 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 & fill works		
Tree clearing ✓	Grazing ✓			
Soil Landscape				
DEPTH:	Deep	Moderate ✓	Shallow	Skeletal
TYPE:	Clay	Loam ✓	Sand	Organic
VALUE:	Foraging	Denning	Roosting	Digging
WATER RETENTION:	Well Drained ✓	Damp / Moist	Water logged	Swamp / Soak
Rock Habitat				
CAVES:	Large	Small	Deep	Shallow
CREVACES:	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 ✓	
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	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)	
FORREIGN MATERIALS:	Sheet	Pile / Refuse		

4.2.2 Habitat trees

A complete assessment of the location of habitat trees and the size of hollows within was undertaken as part of surveys. Table 4.2 below provides hollow-bearing tree data and other habitat features recorded. Figure 1 provides locations of habitat trees.

Table 4.2 – Habitat tree data

Tree No	Scientific Name	Common Name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Hollows & Other Habitat Features Recorded
HT1	Grey Gum	*Eucalyptus punctata*	70/65	14	21	40	20cm nest
HT2	Drooping Red Gum	*Eucalyptus parramattensis*	80	13	27	20	1x 5-10cm trunk hollow (good quality)
HT3	Drooping Red Gum	*Eucalyptus parramattensis*	55/60	13	28	65	1x 0-5cm trunk split
HT4	stag	stag	25	1	7	0	2x 0-5cm branch hollows
HT5	Forest Red Gum	*Eucalyptus tereticornis*	65	11	29	50	2x 0-5cm branch hollows, bark exfoliations

4.2.3 Local fauna matters

There are no locally or regionally significant fauna identified by Wollondilly Shire Council. Therefore there are no other fauna species recorded during survey which are likely to offer any constraint to development.

4.2.4 State legislative fauna matters

(a) Threatened species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH, 2012) database 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 habitats occur within the subject site.

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 4.3 – State listed threatened fauna species with suitable habitat present

COMMON NAME	TSC Act	POTENTIAL TO OCCUR
Little Eagle	V	low
Square-tailed Kite	V	✓
Bush Stone-curlew	E	unlikely
Gang-gang Cockatoo	V	unlikely
Little Lorikeet	V	low
Swift Parrot	E	low
Turquoise Parrot	V	low
Barking Owl	V	low

COMMON NAME	TSC Act	POTENTIAL TO OCCUR
Powerful Owl	V	low
Masked Owl	V	low
Brown Treecreeper	V	✓
Speckled Warbler	V	low
Black-chinned Honeyeater	V	✓
Regent Honeyeater	E4A	unlikely
Varied Sittella	V	low
Hooded Robin	V	low
Scarlet Robin	V	low
Diamond Firetail	V	unlikely
Yellow-bellied Glider	V	low
Grey-headed Flying-fox	V	low
East-coast Freetail Bat	V	✓
Large-eared Pied Bat	V	low
Eastern Falsistrelle	V	unlikely
Eastern Bentwing-bat	V	✓
Greater Broad-nosed Bat	V	✓

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

No state listed threatened fauna species were recorded within the subject site during surveys.

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 populations (NSW)

There are no endangered fauna populations within the Wollondilly LGA.

(c) SEPP 44 Koala Habitat Protection

SEPP 44 Koala Habitat Protection applies to land within Local Government Areas (LGAs) listed under Schedule 1 of the Policy. In addition, Part 2 of the Policy outlines a three (3) step process to assess the likelihood of the land in question being potential or core koala habitat. Part 2 applies to land which has an area of greater than 1 hectare or has, together with any adjoining land in the same ownership, an area of more than 1 hectare.

The subject site is required to be considered under SEPP 44 as it falls within the Wollondilly LGA listed on Schedule 1 of SEPP44. In addition, the total area of the subject site is greater than 1 hectare, hence Part 2 – Development Control of Koala Habitats, of the Policy applies.

Potential Koala Habitat (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.

Core Koala Habitat (CKH) is defined as an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of, and historical records of, a population.

Step 1 – Is the land PKH?

Two Koala food tree species (*Eucalyptus punctata, Eucalyptus haemastoma, Eucalyptus microcorys and Eucalyptus robusta*) listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection, were observed within the subject site. *Eucalyptus microcorys and Eucalyptus robusta* make up approximately 5% of trees within the Regrowth Woodland. This is less than the 15% indicated by SEPP 44, therefore the subject site is not considered to be PKH.

Two Koala food tree species – Grey Gum (*Eucalyptus punctata)* and Forest Red Gum (*Eucalyptus tereticornis),* as listed on Schedule 2 of SEPP 44 – were found within the subject site. These trees comprise less than 15% of the total number of trees present. As such the subject site is not considered to comprise 'potential Koala habitat' as defined under SEPP 44 and no further consideration under this policy is required. The absence of habitat is supported by an absence of Koala records within 3km of the subject site.

4.2.5 National environmental significance - fauna

(a) Threatened 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 7 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 4.4 – Nationally listed threatened fauna species with suitable habitat present

COMMON NAME	TSC Act	EPBC Act	POTENTIAL TO OCCUR
Swift Parrot	E	E	low
Regent Honeyeater	E4A	E	unlikely
Grey-headed Flying-fox	V	V	low
Large-eared Pied Bat	V	V	low

No nationally listed threatened fauna species were recorded within the subject site during surveys undertaken.

(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. These migratory species are considered in Table A2.3 (Appendix 2). Threatened migratory species are assessed in Table A2.2 (Appendix 2).

4.2.6 Fauna constraints assessment conclusions

Despite any potential habitat for state or nationally listed species, the subject site and immediate surrounds was not found to contain any threatened fauna species. As such, there are no confirmed fauna constraints present within the site. There are no known records on

adjoining properties. The site may be utilised by threatened micro-chiropteran bats and to a lesser extent threatened birds. Due to the dominant presence of Noisy Miners, the site is not expected to provide significant habitat for threatened birds.

Microbat activity is typically low during late winter when fauna survey was undertaken, as many species are in torpor or hibernation at this time. Survey during warmer months will better determine utilisation of the site by micro-chiropteran bats. In any case, provided that a strict hollow dismantling process is undertaken then microbats are not likely offer a constraint to development on this site. Hollow dismantling includes supervision by a fauna ecologist so that any fauna recovered can be effectively relocated along with the hollow.

Conclusions & Recommendations 5

5.1 Conclusions

This document forms the basis of assessment required under Section 5A of the *EPA Act*. This assessment determines if future development of the site is likely to have a significant effect on threatened species, populations and / or EECs.

EPA Act and TSC Act

In respect of matters required to be considered under the *EPA Act* and relating to the species / provisions of the *TSC Act.*

- No threatened fauna species were recorded within or in close proximity to the subject site
- No threatened flora species were recorded within the subject site
- One EEC, Shale-Sandstone Transition Forest was recorded within the subject site
- No endangered populations have been observed

Subject to completion of a 7 part test of significance, it is expected that the removal of SSTF vegetation onsite is not significant and a species impact statement is not likely to be required.

EPBC Act

In respect of matters required to be considered under the *EPBC Act:*

- No threatened fauna species were recorded within or in close proximity to the subject site
- No protected migratory fauna species listed under the *EPBC Act* were recorded within, or in close proximity, to the subject site
- No threatened flora species were recorded within the subject site
- One EEC listed under the *EPBC Act* was recorded within the subject site

Subject to a significance assessment a referral to the Department of *Sustainability, Environment, Water, Populations and Communities (SEWPC)* is not likely to be required for assessment under the *EPBC Act (1999).*

FM Act

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

Conclusion

The removal of 0.8 ha of low condition Shale Sandstone Transition Forest (SSTF) is not expected to be significant. The subject site contains limited habitat features that may be utilised by threatened fauna species on a seasonal basis. The only potential ecological impact on fauna for this site would be the presence of a microbat roost (and potential breeding) site within the limited number of hollows present.

Subject to completion of a 7 part test of significance, a future subdivision of the site is not likely to require preparation of a species impact statement. Subject to completion of a significance assessment under the EPBC Act (1999), the proposal is not likely to require a referral to the Department of *Sustainability, Environment, Water, Populations and Communities (SEWPC)* under the EPBC Act.

5.2 Recommendations

Flora

- Removal of the Shale Sandstone Transition Forest is considered appropriate given the low condition of the vegetation onsite.
- Given the limited number of trees onsite, landscaping should be used as the main mechanism by which trees are replaced onsite, using canopy species typical of Shale-Sandstone Transition Forest.
- Revegetation of SSTF species is recommended within larger lots or as part of landscaping within the proposed subdivision.

Fauna

- The supervised removal of hollow bearing trees is recommended to minimise impacts on any hollow dependent fauna.

Riparian

- Despite there being a mapped watercourse in the north-western corner of the subject site, it has been diverted into roadside drainage. There is also a very small swale approximately 1-2m from the western boundary on the adjoining lot, however, this is not considered to be a watercourse and riparian setbacks will not affect any portion of the subject site.

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Standard Survey Methodology

A1

The survey methods outlined within this Appendix are standard techniques employed by *Travers bushfire & ecology.* 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 standard 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.

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.

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 capensis*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*).

Each call is typically played for 5-minute periods with 5-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.

Stag-watching will be undertaken where suitable large hollows for owl nesting / roosting show signs of activity, or are located within development areas. Stag-watching of nesting trees should be undertaken during the recognised nesting period for owls with potential to occur.

1.3 Arboreal mammals

Arboreal mammals may be surveyed using Elliott type A, B and / or C traps, small and / or large hair tubes, 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 A1.3.2 below, within terrestrial survey methods. Where gliders are targeted, the standard bait mix may be additionally laced with a nectaivore 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 there is a possibility of wet weather 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.

Where habitat is suitable, the presence 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 5-minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting.

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 1 ha.

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, Koala search quadrats may be employed within portions of communities where feed trees are present at suitable densities. All Koala feed trees within quadrats are searched for signs of activity including characteristic claw marks on the trunk and faecal pellets around the base. Pellet searches are undertaken according to the tree base search methods described in *Phillips & Callaghan* (2008). Search quadrats are less labour intensive than the SAT techniques described below but may only be an initial survey effort to determine presence / absence.

Where any Koala activity is recorded, the complete Spot Assessment Technique (SAT) described by *Phillips & Callaghan* (2008) may be undertaken as a measure of Koala 'activity'. This technique may also be employed in the first instance as an indicator of presence / absence, particularly where a site has potential Koala activity based on previous records.

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 camera surveillance, 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 have 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 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.

Where difficult to access, sensitive or extended trapping periods are undertaken; surveillance cameras can be used in terrestrial mammal surveys. The surveillance camera is mounted on a tree and directed towards a closed baited cage trap. Surveillance cameras may also be used to detect use or monitor activity at burrows, hollows, nests, etc.

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 recognised expert, Barbara Triggs for identification of contents, hair or bone fragments.

1.5 Bats

Micro-chiropteran bats are surveyed by echolocation using Anabat 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.

Anabat Mk 2 and SD-1 detectors are used in fixed passive monitoring positions and / or during active nocturnal monitoring. Active monitoring is used in conjunction with spotlighting or during stag-watching for greater accuracy of recorded call identification.

Bat call recordings are interpreted through Anabat V and Anabat CF Storage and Interface Module ZCAIM devices and analysed using Anabat 6 and Analook 3.3q computer software packages.

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 water's 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.

All threatened frog species 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.

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 the Cumberland Plain Land Snail (*Meridolum corneovirens*) when in proximity to previous *Atlas of NSW Wildlife* database records and particularly where its typical host vegetation community is 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 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 location 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) - Are bird surveys 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 recorded calls through a 15 watt Toa 'Faunatech' amplifier to evoke a response from 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 55 watt spotlight powered by a 12 volt rechargeable battery. 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. 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 be 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 (33cmx10cmx10 cm) and Type B (45cmx15cmx15 cm), 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 (17cmx17cmx45cm foldout cages with tread-plate mechanism or 22cmx25cmx58cm 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 (25cmx25cmx50cm foldout cages with pull lever (meat) mechanism, 28cmx28cmx60cm foldout cages with tread-plate mechanism or 30cmx30cmx70cm 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 recognised expert, Barbara Triggs for identification. Trapping layout, tube sizes, baiting and trapping period will be outlined within the site specific methodology section.

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 within 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 to 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 Anabat monitoring - involves leaving the bat recorder 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.

Active Anabat monitoring - is a method of active microbat recording during stag-watching or during complete nocturnal survey. Active monitoring involves an SD-1 recorder allied with a PDA 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 PDA screen a view by spotlight of the bat size and wing morphology is attempted for greater identification accuracy.

Active vehicle Anabat monitoring - is a method of active microbat recording deployed when large distances need to be covered in a nocturnal survey period. A Hi-mic 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 4.2m^2 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 and 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 micro-chiropteran bat species and are sourced 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.

Camera surveillance - is used to monitor activity at burrows, hollows, etc. or to survey for species presence at baited stations. A *Reconyx Hyperfire* digital weatherproof camera is used with a passive infrared motion detector and a night-time infrared illuminator. 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.

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 (eg none, light drizzle, heavy drizzle, heavy rain);
- Recent rain events (where relevant);
- Wind strength eg calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns).
- Wind direction
- Moon (where relevant) (eg none, 1/4 moon, 1/2 moon, 3/4 moon, full moon);

Threatened & Migratory Species Habitat Assessment

A2

Table A2.1 below 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* database (OEH) or indicated to have potential habitat present within 10km on the *EPBC Protected Matters Tool.*

Table A2.1 – Threatened flora habitat assessment

Scientific Name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				LIKELY TO BE CONSIDERED IN FUTURE 7 PART TEST (✓)
					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	
Acacia bynoeana 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. Distribution limits N-Newcastle S-Berrima.	x	x	-	-	x	x
Acacia flocktoniae			A shrub to 3m high, flowers mostly between June and September. Grows in dry sclerophyll forest over sandstone. Blue Mountains to Picton.	x	limited	x	x	unlikely (no records within 10km)	x
Asterolasia elegans EPBC	-	E	Erect shrub 1-3m high growing in moist sclerophyll forests on Hawkesbury sandstone slopes hillsides. Distribution limits Maroota region.	x	x	-	-	x	x

Scientific Name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				LIKELY TO BE CONSIDERED IN FUTURE 7 PART TEST (✓)
					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	
Bothriochloa biloba OEH EPBC	V	V	Erect or decumbent grass to 1m high growing in Woodlands on poorer soils. Distribution limits N-Tweed Heads S-Sydney.	x	x	-	-	x	x
Caladenia tessellata OEH EPBC	E1	V	Terrestrial orchid. Clay-loam or sandy soils. Distribution limits N-Swansea S-south of Eden.	x	x	-	-	x	x
Cynanchum elegans OEH EPBC	E1	E	Climber or twiner to 1m. Grows in rainforest gullies, scrub & scree slopes. Distribution limits N-Gloucester S-Wollongong.	x	x	-	-	x	x
Darwinia peduncularis OEH	V	-	Divaricate shrub to 1.5m high. Grows in dry sclerophyll forest on sandstone hillsides and ridges. Distribution limits N-Glen Davis S-Hornsby.	x	x	-	-	x	x
Epacris purpurascens var. *purpurascens* OEH	V	-	Erect shrub to 1.5m high growing in sclerophyll forest and scrub and near creeks and swamps on Sandstone. Distribution limits N-Gosford S-Blue Mountains.	x	x	-	-	x	x
Genoplesium baueri OEH	E1	-	A terrestrial orchid that grows in sparse sclerophyll forest and moss gardens over sandstone. Distribution limits N – Hunter Valley S – Nowra	x	x	-	-	x	x
Grevillea parviflora subsp. *parviflora* OEH EPBC	V	V	Open to erect shrub to 1m. Grows in woodland on light clayey soils Distribution limits N-Cessnock S-Appin.	x	limited	✓	✓	low because of past disturbances	✓

Scientific Name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				LIKELY TO BE CONSIDERED IN FUTURE 7 PART TEST (✓)
					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	
Leucopogon exolasius OEH EPBC	V	V	Erect shrub to 2m high. Rocky hillsides and creek banks in Sydney Sandstone Gully Forest. Confined to Woronora and Georges Rivers and Stokes Creek.	x	x	-	-	x	x
Melaleuca deanei OEH EPBC	V	V	Shrub to 3m high. Grows in heath on sandstone. Distribution limits N-Gosford S-Nowra.	x	x	-	-	x	x
Pelargonium sp. *Striatellum* 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. Varied distribution from SE NSW to QLD.	x	x	-	-	x	x
Persicaria elatior OEH EPBC			Herb to 90cm tall which grows in damp places especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Varied distribution from SE NSW to QLD.	x	x	-	-	x	x
Persoonia acerosa OEH EPBC	V	V	Erect to spreading shrub. Grows in heath or dry sclerophyll forest on sandstone. Distribution limits N-Bilpin S-Hill Top.	x	x	-	-	x	x
Persoonia bargoensis OEH EPBC	E1	V	Erect shrub to 1m high. Grows in woodland to Dry sclerophyll forest, on sandstone and laterite. Restricted to the Bargo area.	x	marginal	x	✓	unlikely	x
Persoonia glaucenscens OEH EPBC	E1	V	An erect shrub with moderately hairy young branchlets. Restricted to small populations in the Southern Highlands between Picton and Berrima.	x	x	-	-	x	x

Scientific Name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				LIKELY TO BE CONSIDERED IN FUTURE 7 PART TEST (✓)
					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	
Persoonia hirsuta OEH EPBC	E1	E	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. Distribution limits N-Glen Davis S-Hill Top.	x	x	-	-	x	x
Pimelea spicata OEH EPBC	E1	E	Decumbent or erect shrub to 0.5m high. Occurs principally in woodland on soils derived from Wianamatta Shales. Distribution limits N-Lansdowne S-Shellharbour.	x	x	-	-	x	x
Pomaderris brunnea OEH EPBC	V	V	Shrub to 3m high. Confined to Upper Nepean and Colo Rivers where it grows in open forest.	x	x	-	-	x	x
Pterostylis saxicola OEH EPBC	E1	E	Terrestrial orchid. Grows in shallow sandy soil above rock shelves, usually near Wianamatta / Hawkesbury transition. Distribution limits N-Hawkesbury River S-Campbelltown.	x	x	-	-	x	x
Pultenaea glabra OEH EPBC	V	V	Erect shrub. Grows in moist, sheltered section of dry sclerophyll forest on sandstone in Higher Blue Mountains and Glen Davis areas.	x	x	-	-	x	x
Rulingia prostrata OEH EPBC	E1	E	Prostrate shrub forming dense mats to 0.5m. Grows in gullies along the escarpment. Distribution limits N-Picton S-south of Eden. Also from dry heath and dry sclerophyll forest on coastal sands at Tomago.	x	x	-	-	x	x

Scientific Name DATABASE SOURCE	TSC Act	EPBC Act	GROWTH FORM AND HABITAT REQUIREMENTS	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				LIKELY TO BE CONSIDERED IN FUTURE 7 PART TEST (✓)
					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	
Streblus pendulinus EPBC	-	E	A small tree or shrub. Grows in well developed rain forest, gallery forest and drier, more seasonal rain forest. North Qld to NSW, Norfolk Island, Hawaii and Melanesia.	x	x	-	-	x	x
Thelymitra sp. 'Kangaloon' EPBC	-	Critic. E	A terrestrial orchid with dark blue flowers, presented in mid-late spring. Only known from the Robertson area in the Southern Highlands. Often in association with the endangered ecological community Temperate Highland Peat Swamps on Sandstone.	x	x	-	-	x	x

OEH	- Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife* database
EPBC	- Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search
TBE	- Denotes additional species considered by *Travers bushfire & ecology* to have potential habitat based on regional knowledge and other records
V	- Denotes vulnerable listed species under the relevant Act
E or E1	- Denotes endangered listed species under the relevant Act
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 *Atlas of NSW Wildlife* database. 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle.

Table A2.2 below 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* database (OEH) or indicated to have potential habitat present within 10km on the *EPBC Protected Matters Tool.*

Table A2.2 – Threatened fauna habitat assessment

COMMON NAME ***Scientific Name*** DATABASE SOURCE	**TSC Act**	**EPBC Act**	**PREFERRED HABITAT** ***Distribution Limit***	**RECORDED ON SITE (✓)**	**IF NOT RECORDED ON-SITE**				**CONSIDERED IN 7 PART TEST (✓)**
					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 *Heleioporus australiacus* OEH EPBC	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. Distribution Limit: N-Near Singleton S-South of Eden.	×	×	-	-	×	×
Stuttering Frog *Mixophyes balbus* EPBC	E	V	Terrestrial inhabitant of rainforest and wet sclerophyll forests. Distribution Limit: N-near Tenterfield S-South of Bombala.	×	×	-	-	×	×
Red-crowned Toadlet *Pseudophryne australis* 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. Distribution Limit: N-Pokolbin. S-near Wollongong.	×	×	-	-	×	×
Green and Golden Bell Frog *Litoria aurea* EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. Distribution Limit: N-Byron Bay S-South of Eden.	×	×	-	-	×	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓)
					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 *Litoria littlejohnii* EPBC	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. Distribution Limit: N-Hunter River S-Eden.	×	×	-	-	×	×
Broad-headed Snake *Hoplocephalus bungaroides* EPBC	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. Distribution Limit: N-Mudgee Park. S-Nowra.	×	×	-	-	×	×
Malleefowl *Leipoa ocellata* EPBC	E	V	Inhabits cool to warm temperate mallee communities and other semi-arid eucalypt woodlands. Distribution Limit: N-Near Bourke. S-Wentworth.	×	×	-	-	×	×
Australasian Bittern *Botaurus poiciloptilus* 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. Distribution Limit: N-North of Lismore. S- Eden.	×	×	-	-	×	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓)
					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	
Little Eagle *Hieraaetus morphnoides* OEH	V	-	Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. Distribution Limit - N-Tweed Heads. S-South of Eden.	×	✓	×	-	low	✓
Square-tailed Kite *Lophoictinia isura* 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. Distribution Limit: N-Goondiwindi. S-South of Eden.	×	✓	✓	✓	✓	✓
Red Goshawk *Erythrotriorchis radiatus* EPBC	E	V	Inhabits tall open forests and woodlands. Breeds in tall trees adjacent to watercourses of wetlands. Distribution Limit: N-Border Ranges National Park. S-Foster.	×	×	-	-	×	×
Bush Stone-curlew *Burhinus grallarius* OEH	E	-	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. Distribution Limit: N-Border Ranges National Park. S-Near Nowra.	×	✓	✓	×	unlikely	✓
Australian Painted Snipe *Rostratula australis* EPBC	E	V	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. Distribution Limit: N-Tweed Heads. S-South of Eden.	×	×	-	-	×	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓)
					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	
Gang-gang Cockatoo *Callocephalon fimbriatum* OEH	V	-	Prefers wetter forests and woodlands from sea level to > 2000m on the Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. Distribution Limit: mid north coast of NSW to western Victoria.	×	Sub-optimal	×	×	unlikely	✓
Glossy Black-Cockatoo *Calyptorhynchus lathami* OEH	V	-	Open forests with *Allocasuarina* species and hollows for nesting. Distribution Limit: N-Tweed Heads. S-South of Eden.	×	×	-	-	×	×
Little Lorikeet *Glossopsitta pusilla* OEH	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. Distribution Limit: N-Tweed Heads. S-South of Eden.	×	✓	×	-	low	✓
Swift Parrot *Lathamus discolour* OEH EPBC	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. Distribution Limit: N-Border Ranges National Park. S-South of Eden.	×	✓	×	-	low	✓
Turquoise Parrot *Neophema pulchella* OEH	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. Distribution Limit: N-Near Tenterfield. S-South of Eden.	×	✓	×	-	low	✓

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					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	
Barking Owl *Ninox connivens* OEH	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. *Distribution Limits:* N-Border Ranges National Park. S-Eden.	×	✓	×	-	low	✓
Powerful Owl *Ninox strenua* OEH	V	-	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. Distribution Limits: N-Border Ranges National Park. S-Eden.	×	✓	✓	✓	low	✓
Masked Owl *Tyto novaehollandiae* OEH	V	-	Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. Distribution Limit: N-Border Ranges National Park. S-Eden.	×	✓	×	-	low	✓
Sooty Owl *Tyto tenebricosa* OEH	V	-	Tall, dense, wet forests containing trees with very large hollows. Distribution Limit: N-Border Ranges National Park. S-South of Eden.	×	×	-	-	×	×
Brown Treecreeper *Climacteris picumnus victoriae* OEH	V	-	Occupies Eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. Distribution Limit:(Sub species victoriae) Central NSW west of Great Dividing Range, Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.	×	✓	✓	✓	✓	✓

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					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 Bristlebird *Dasyornis brachypterus* EPBC	E	E	Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. Distribution Limit: N-Tweed Heads. S-South of Eden.	×	×	-	-	×	×
Speckled Warbler *Chthonicola sagittata* OEH	V	-	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. Distribution Limit: N-Urbanville. S-Eden.	×	✓	×	-	low	✓
Black-chinned Honeyeater *Melithreptus gularis gularis* 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. Distribution Limit: N-Cape York pen. Qld. S-Victor H. Mt Lofty Ra & Flinders Ra. SA.	×	✓	✓	✓	✓	✓
Regent Honeyeater *Xanthomyza Phrygia* OEH EPBC	E4A	E	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. Distribution Limit: N-Urbanville. S-Eden.	×	✓	×	×	unlikely	✓
Varied Sittella *Daphoenositta chrysoptera* OEH	V	-	Open eucalypt woodlands/forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. Distribution Limit: N-Border Ranges National Park. S-South of Eden.	×	✓	×	✓	low	✓

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					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	
Hooded Robin *Melanodryas cucullata cucullata* OEH	V	-	Found in Eucalypt woodlands, *Acacia* scrubland, open forest, and open areas adjoining large woodland blocks, with areas of dead timber. Distribution Limit: N-Central Qld. S-Spencer Gulf SA.	×	✓	×	×	low	✓
Scarlet Robin *Petroica boodang* OEH	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. Distribution Limit: N-Tweed Heads. S-South of Eden.	×	✓	×	✓	low	✓
Diamond Firetail *Stagonopleura guttata* OEH	V	-	Found in Eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Dividing Range also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. Distribution Limit: N-Rockhampton Q. S-Eyre Pen Kangaroo Is. SA.	×	✓	×	×	unlikely	✓
Spotted-tailed Quoll *Dasyurus maculatus* OEH EPBC	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit: N-Mt Warning National Park. S-South of Eden.	×	×	-	-	×	×

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					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	
Koala *Phascolarctos cinereus* OEH EPBC	V	V	Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees. Distribution Limit: N-Tweed Heads. S-South of Eden.	×	✓ isolated	×	✓	unlikely	×
Eastern Pygmy Possum *Cercatetus nanus* 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. Distribution Limit: N-Tweed Heads. S-Eden.	×	×	-	-	×	×
Yellow-bellied Glider *Petaurus australis* OEH	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-South of Eden.	×	✓	×	×	low	✓
Brush-tailed Rock-wallaby *Petrogale penicillata* OEH EPBC	E	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. Distribution Limit: N-North of Tenterfield. S-Bombala.	×	×	-	-	×	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓)
					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	
Grey-headed Flying-fox *Pteropus poliocephalus* 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. Distribution Limit: N-Tweed Heads. S-Eden.	×	✓	×	×	low	✓
East-coast Freetail Bat *Micronomus norfolkensis* 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. Distribution Limit: N-Woodenbong. S-Pambula.	×	✓	✓	✓	✓	✓
Large-eared Pied Bat *Chalinolobus dwyeri* 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. Distribution Limit: N-Border Ranges Nation Park. S-Wollongong.	×	✓	✓	✓	low	✓
Eastern Falsistrelle *Falsistrellus tasmaniensis* OEH	V	-	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit: N-Border Ranges National Park. S-Pambula.	×	✓	×	×	unlikely	✓

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓)
					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 *Miniopterus orianae oceansis* OEH	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains & well-timbered areas. Distribution Limit: N-Border Ranges National Park. S-South of Eden.	×	✓	✓	✓	✓	✓
Large-footed Myotis *Myotis macropus* OEH	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. Distribution limits: N-Border Ranges National Park. S-South of Eden.	×	×	-	-	×	×
Greater Broad-nosed Bat *Scoteanax rueppellii* OEH	V	-	Inhabits areas containing moist river & creek systems especially tree lined creeks. Distribution Limit: N-Border Ranges National Park. S-Pambula.	×	✓	✓	✓	✓	✓
New Holland Mouse *Pseudomys novaehollandiae* 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. Distribution Limit: N-Border Ranges National Park. S-South of Eden.	×	×	-	-	×	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓)
					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	
Cumberland Plain Land Snail *Meridolum corneovirens* 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. Distribution Limit: Cumberland Plain of Sydney Basin Region.	×	×	-	-	×	×
Macquarie Perch *Macquaria australasica* EPBC	V	E	Occurs in south east Australia at moderate to high altitudes in rivers and reservoirs. Historical records show the species was widespread and abundant in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers and their tributaries. Allen (1989) states that introduced populations are present in Nepean River and water supply dams in the Sydney area. Occurs in lakes and flowing streams, usually in deep holes.	×	×	-	-	×	×

OEH	-	Denotes species listed within 10km of the subject site on the *Atlas of NSW Wildlife* database
EPBC	-	Denotes species listed within 10km of the subject site in the *EPBC Act* habitat search
V	-	Denotes vulnerable listed species under the relevant Act
E	-	Denotes 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 *Atlas of NSW Wildlife* database.
	3.	'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle.

A detailed assessment in accordance with Section 5A of the *EPA Act* will be completed for these species in Appendix 3 of this report.

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

Table A2.3 – Migratory fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT *Migratory Breeding*	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. Sedentary; dispersive.	×	-	-
White-throated Needletail (*Hirundapus caudacutus*)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.	✓	×	-
Rainbow Bee-eater (*Merops ornatus*)	Open woodlands with sandy, loamy soil; sandridges, sandspits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. Breeding resident in northern Australia. Summer breeding migrant to south-east and south-west Australia.	×	-	-
Black-faced Monarch (*Monarcha melanopsis*)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. Summer breeding migrant to coastal south-east Australia, otherwise uncommon.	×	-	-
Satin Flycatcher (*Myiagra cyanoleuca*)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. Breeds mostly south-east Australia & Tasmania over warmer months, winters in north-east Qld.	×	-	-
Rufous Fantail (*Rhipidura rufifrons*)	Undergrowth of rainforests/wetter eucalypt forests/gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. Breeding migrant to south-east Australia over warmer months. Altitudinal migrant in north-east NSW in mountain forests during warmer months.	✓	×	-
Great Egret (*Ardea alba*)	Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. Dispersive; cosmopolitan.	×	-	-
Cattle Egret (*Ardea ibis*)	Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. Breeds in summer in warmer parts of range including NSW.	✓	×	-