Travers

bushfire & ecology

flora & fauna assessment update

Woolworths Retail Facility
Lot 521 DP 594725
Warnervale Town Centre

April 2013

Flora & Fauna Assessment Update

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Warnervale Town Centre

APRIL 2013

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

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Executive Summary

Travers bushfire & ecology has been engaged by *Woolworths Ltd* to undertake a flora and fauna assessment update for a proposed commercial development within the southern portions of Lot 521 DP 594725, Warnervale.

The impact area of the proposed retail Facility also includes a temporary 30 APZ extension area into the neighbouring lot to the east, is referred to as the 'subject site'. The 'study area' will hereafter be referred to as the full area of Lot 521 plus the asset protection zone.

The proposal is a portion of the larger proposed Warnervale Town Centre which incorporates much of the surrounding area. Whilst the study area covers a portion of the main access road off Sparks Road, this access road is subject to a separate assessment.

Recorded threatened flora and fauna species and EEC's

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*, four (4) threatened fauna species, Varied Sittella (*Daphoenositta chrysoptera*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Glossy Black-Cockatoo (*Calyptorhynchus lathami*), no threatened flora species, and no EECs were recorded within the study area. The Glossy Black-Cockatoo was recorded by evidence of foraging.

In accordance with Section 5A of the *Environmental Planning and Assessment Act 1979*, the 7 part test of significance concluded that the proposed development is not likely to have a significant impact on any threatened species, populations or EECs. Mitigation measures are undertaken to ensure hollows within and close to the subject site are investigated for use by hollow dependent threatened fauna prior to clearing. Therefore, a Species Impact Statement should not be required for the proposal.

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act 1999*, one threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*), no protected migratory bird species, no threatened flora species, and no EECs listed under this Act were recorded within the study area.

The proposed development is not considered to have a significant impact on matters of national environmental significance. As such a referral to Department of Sustainability, Environment, Water, Populations and Communities should not be required.

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.

Ecological Impacts

The key ecological impacts are as follows:

- **Impact on habitat of recorded and potential threatened fauna species** – Three (3) threatened fauna species have been recorded utilising the available habitat within the subject site. These include the Grey-headed Flying-fox, Glossy Black-Cockatoo (foraging evidence) and Greater Broad-nosed Bat. Other threatened fauna species recorded nearby and potentially to utilise the available habitat within the subject site include Little Lorikeet, Varied Sittella, Powerful Owl and Squirrel Glider.

- **Impact on habitat of potential threatened flora species habitat** – No threatened flora species have been identified within the vegetation studies to date, however the railway line embankment adjacent to the site is known to host *Rutidosis heterogama.* Thus potential habitat areas for this species are likely to be present within the narrow remnant vegetation strip between the study area and the railway line. The bushland where the temporary APZ is to be placed 30m into Lot 1 DP 376264 may provide suitable habitat for in particular *Tetratheca juncea.* The extent of habitat for the species would be inhibited somewhat by the allelepathic effects of the relatively dense sub-canopy of *Allocasuarina littoralis.*

- **Impact on habitat of Hollow dependent threatened species habitat -** There is suitable available hollows present within the site for all hollow-dependent threatened fauna species recorded or with potential to occur. In the case that Powerful Owl or Glossy Black-Cockatoo are utilising the available hollows present for nesting, then removal of the hollow or indirect disturbance of breeding activity would cause local breeding pairs to relocate and disrupt their breeding activity for at least one season. Site survey to date have found no evidence to suggest that these hollows are currently being used for nesting however it would be prudent to investigate this potential during the recognised breeding season for both species. The use of hollows by hollow dependent threatened species can be determined by use of a tree climber to observe the internal chambers for evidence of nesting use by these species.

Mitigation measures

Mitigation measures are recommended to ensure that the nesting activity of hollow-dependent threatened species is not affected by the proposed works. It is noted that in the event that a large Forest Owl species is observed within impacted hollows, then appropriate advice is to be sought from an owl specialist to identify the level of use and the mitigation measures required to ensure that the breeding activity is not disrupted. Protection of nest sites during the breeding season is highly recommended and relocation of the existing hollow and provision of alternative artificial breeding habitats is recommended to ensure that future breeding can occur within suitable locations.

The following mitigation measures are considered to be important to minimise the risk of impacts on hollow dependent threatened species:

- Based on current survey effort it is not expected that the identified large hollows present within the subject site are being utilised by Glossy Black-Cockatoo or Powerful Owl, however survey has not been undertaken in the overlapping breeding period for both species (May - July). Based on the nearby recording of these species, trees identified as suitable for nesting should be visually inspected by a tree climber

to investigate any evidence of past or present nesting activity by such hollow dependent threatened species. Where the chamber is too deep for inspection, a viewing hole in the side of the trunk may be cut by chainsaw. This process is to be undertaken under the guidance of a fauna ecologist. In the absence of signs of nesting activity by these species then these trees can be removed with confidence or no indirect impacts of the proposal may be concluded.

- Vegetation management for APZ purposes is to be limited to minimise impacts on potential threatened fauna habitat. No more than 50% of the existing canopy should be removed for asset protection purposes. However the understorey is to be fully managed with a maximum retention of up 20% shrub cover in the understorey. *Allocasuarina* trees are to be selectively retained within the APZ i.e. mature fruiting trees, to minimise impacts of foraging Glossy Black-Cockatoo.

- Removal of hollow-bearing trees is to be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are taken, particularly for threatened species. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse.

- Any wildlife that is captured or removed by the fauna ecologist is to be relocated into adjoining protected Council reserves.

- Good quality hollows are to be relocated or replaced by robust nest boxes with a long life span within proposed open space areas and/or reserves within the surrounding lands.

- Standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment onsite found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal herbicides.

- Undertake noxious weed management as appropriate in the study area.

Conclusion

It is concluded that the proposed retail development of the subject site (part of Lot 521 DP 594725 and part of Lot 1 DP 376264, Warnervale), is not likely to result in a significant impact on any threatened species, populations or EECs or their habitats.

As such no further assessments are considered to be required under the *Environmental Planning and Assessment Act 1979*, the *Environment Protection and Biodiversity Conservation Act 1999* or the *Fisheries Management Act 1994*.

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 bushfire 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

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Introduction 1

Travers bushfire & ecology has been engaged by *Woolworths Ltd* to undertake a flora and fauna assessment for a proposed commercial development within the southern portions of Lot 521 DP 594725, Warnervale.

The impact area of the proposed retail Facility also includes a temporary 30 APZ extension area into the neighbouring lot to the east, is referred to as the 'subject site'. The 'study area' will hereafter be referred to as the full area of Lot 521 plus the asset protection zone (Figure 4).

The proposal is a portion of the larger proposed Warnervale Town Centre which incorporates much of the surrounding area. Whilst the study area covers a portion of the main access road, the main access road is subject to a separate assessment.

1.1 Aims of the assessment

The aims of the flora and fauna assessment are to:

- Update previous ecological assessments to take into consideration any new threatened species, populations and ecological communities;
- 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; and
- Prepare a flora and fauna impact assessment in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), the *Threatened Species Conservation Act 1995* (TSC Act), the *Fisheries Management Act 1994* (FM Act) and Threatened species assessment guidelines, the assessment of significance (DECC 2007).

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 Proposed works

The proposal seeks to develop a Woolworths Retail facility involving the construction of Woolworths, Big W, numerous specialty retail shops, cinema, food court and associated car parking. The development is to occur within the southern portion of the site (refer Figure 1, 2 and 3).

Figure 1 – Aerial Appraisal of Lot 521
(Source: NSW Department of Lands)

Within the Warnervale Town Centre (WTC) area, Woolworths is proposing the development of a retail facility within the southern portion of Lot 521 DP 594725 No. 262 – 282 Hakone Road, Warnervale. The site is adjoined by a railway corridor in the west, which is proposed to be a future railway station, residential to the south and community facilities to the east.

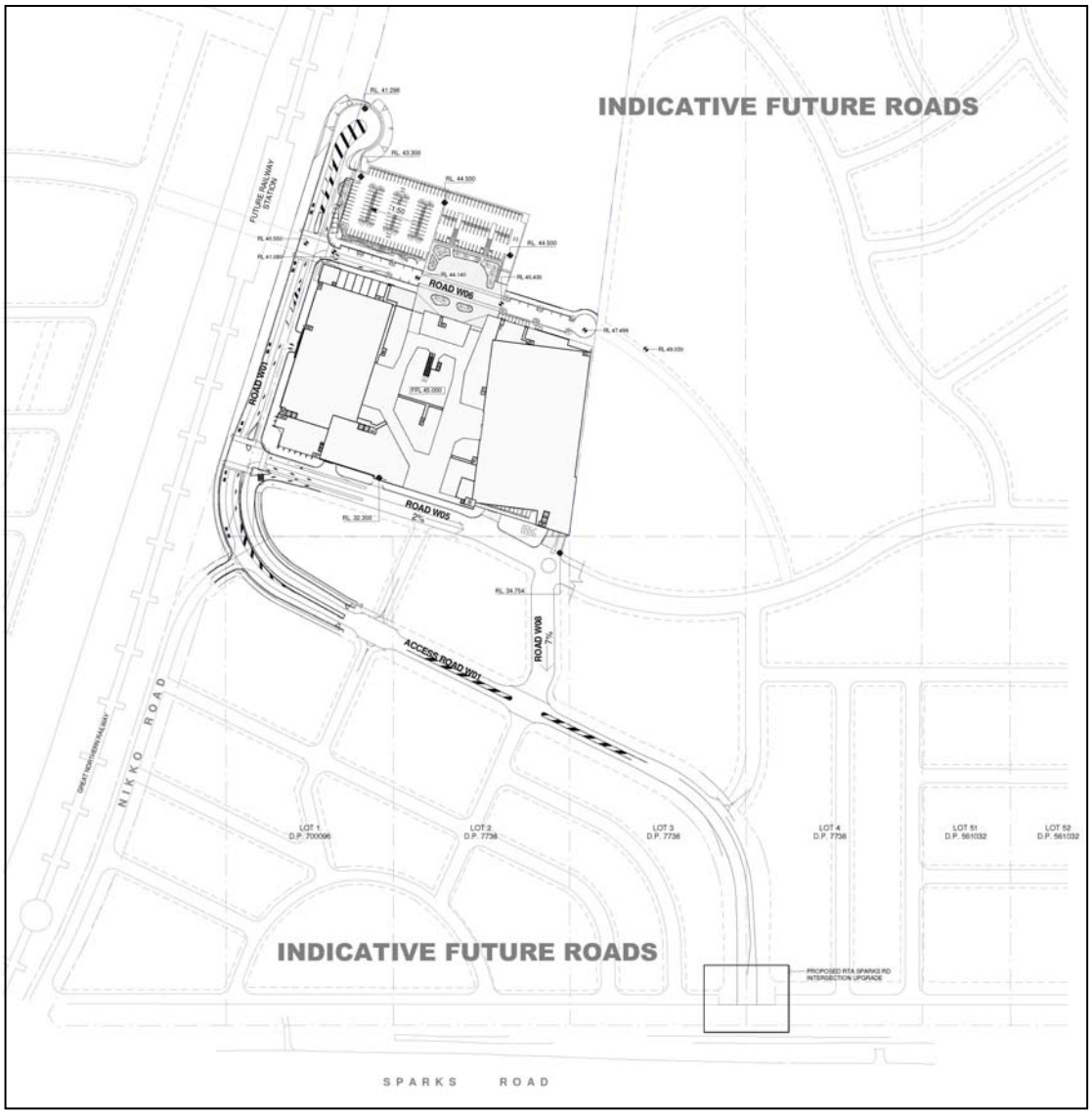

Figure 2 – Lot and Boundary Plan Proposed and Indicative Roads
(Source: BN Group)

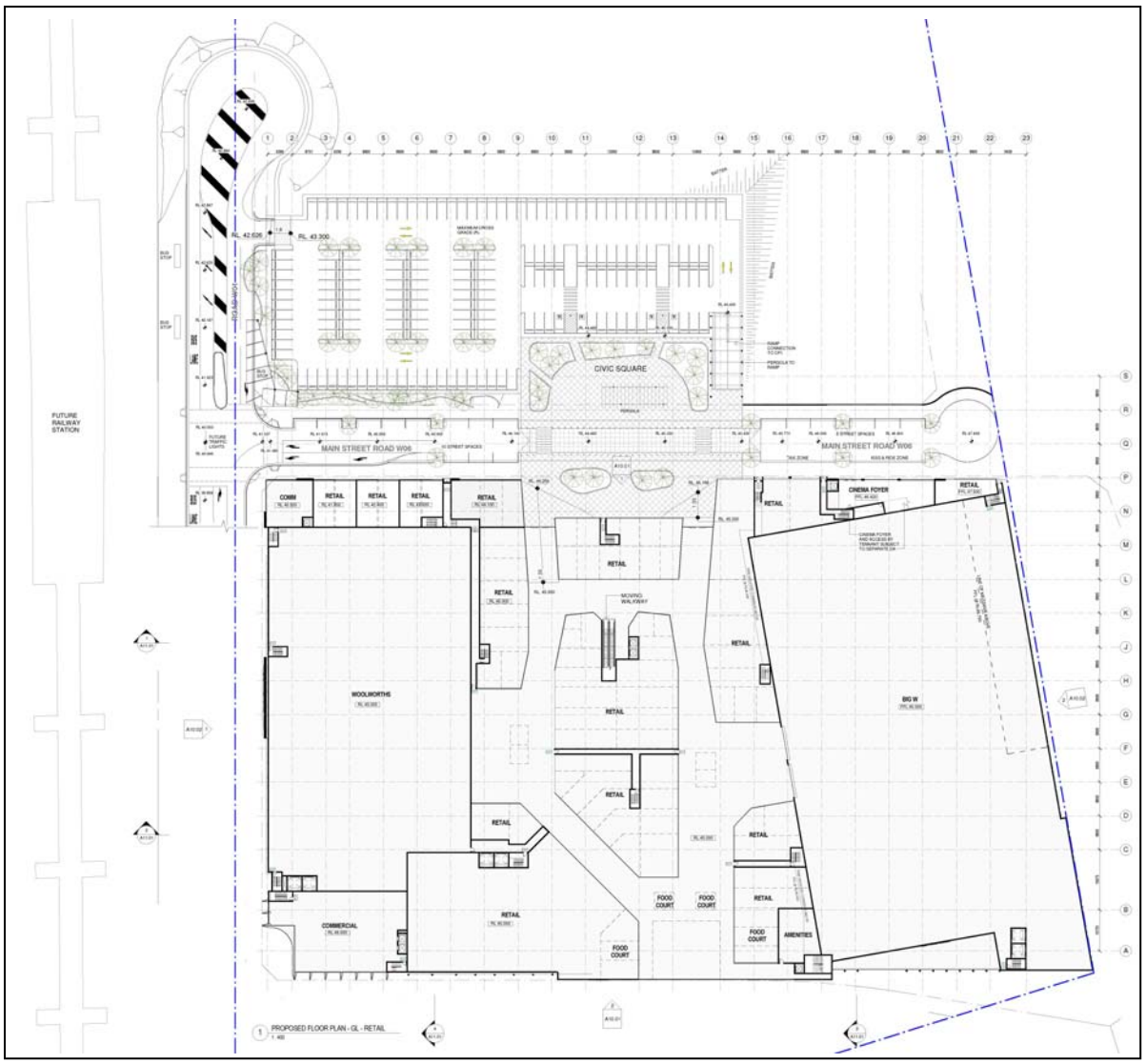

Figure 3 – Proposed Floor Plan
(Source: BN Group)

1.4 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	Lot 521 DP 594725, within the proposed Warnervale Town Centre, Warnervale.
Size (subject site)	Approximate 20m x 5m area containing proposed works
Local government	Wyong.
Grid reference	356700E 6321350N.
Topography	Gentle topography of a 5-10 degree slope in some areas with the high point being near the western boundary south of Hakone Road. There has been extensive cut and fill within the middle of the site for previous land uses, including several dams with moderate to steep side slopes.
Geology and soils	Geology; Combination of Patonga Claystone and Tuggerah Formation geology. Soils; Woodburys Bridge residual soil landscape – deep red podzolic soils with some soloths in poorly drained soils on claystone bedrock or shallow to moderately deep yellow podzolic soils on sandstone bedrock.
Catchment and drainage	Unnamed tributary off Wallarah Creek which flows north-west into Budgewoi Lake.
Vegetation	Disturbed open forest and cleared with occasional scattered trees.
Existing land use	Vacant.
Clearing	The entire site has undergone past clearing, although remnant trees are present in a number of patches. There is limited mid-storey present in areas containing canopy vegetation.

Survey Methodology 2

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

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

Client documents and other relevant documents reviewed:

- Flora and Fauna Investigations, Proposed Warnervale Town Centre, Wyong Shire (Murray and Bell, 2004)
- Biodiversity Certification Application: Warnervale Town Centre (EcoLogical Australia, 2008)
- Biodiversity Certification Assessment of Warnervale Town Centre (EcoLogical Australia, 2012)
- Wyong LEP 1991
- Warnervale Town Centre DCP (2012)
- Flora and Fauna Assessment Report, Proposed Development, Lot 1 DP 700096 and Lots 2 & 3 DP 7738 Sparks Road, Woongarrah (2012)

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)
- 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)
- Vegetation mapping for Wyong (Bell 2002) and LHCCREMS (2003)

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 2013) 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 like the Atlas 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 of *Travers bushfire & ecology* are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Sections 120 & 131 of the *National Parks and Wildlife Act 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: S10359.

Travers bushfire & ecology staff is 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.

2.2 Flora survey methodology

A review of the Atlas of NSW Wildlife database (OEH 2013) was undertaken prior to the site visit to determine threatened species previously recorded within 10km of the subject site.

Botanical survey was undertaken on 30th of January 2013 over a time frame of approximately 3.5hrs. The survey included four (4) vegetation quadrats of 20x20m, a random meander in accordance with *Cropper* (2003) and target searches for, in particular *Rutidosis heterogama.* As there are is a known population of this species within the adjoining railway corridor from approximately 100m south of Sparks Road to the approximate location of the proposed future railway station, the target area was largely along the fringing vegetation to the rail corridor. There was very limited vegetation within Lot 521 along the boundary adjoining the rail corridor, thus the potential for this species to occur is also limited. Other general target survey for threatened flora species was also conducted throughout the site during the random meander and quadrat surveys.

Further botanical survey was undertaken adjoining the south-eastern boundary of Lot 521 for a proposed 30m temporary asset protection zone. This survey included the placement of two (2) more quadrats, a random meander to add further species to the master species list, and target threatened species survey as applicable. The field component of this inspection of March 22nd, 2013 was undertaken over approximately 2hrs.

2.3 Fauna survey methodology

Site survey effort accounting for techniques deployed, duration, and weather conditions are outlined in Table 2.1 and are depicted on Figure 5.

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 2.7.

2.4 Field survey effort

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

Table 2.1 – Fauna survey effort

Fauna group	Date	Weather conditions	Survey technique(s)	Survey effort / time (24hr)
Diurnal birds	4/2/13 25/3/13 26/3/13	2/8 cloud, light SW wind, no rain, temp 27-25^{o}C 0/8 cloud, light W-no wind, no rain, temp 25-28^{o}C 6/8 cloud, no wind, no rain, temp 26^{o}C	Diurnal sensus points (x6) / opportunistic Diurnal opportunistic Diurnal opportunistic	4hrs 1400 - 1800 9hrs 10min 0950 - 1900 1hr 1800 - 1900
Nocturnal birds	4/2/13 25/3/13 26/3/13	0/8 cloud, no wind, no rain, temp 21-19^{o}C 0/8 cloud, no wind, no rain, temp 22-21^{o}C 4/8 cloud, no wind, no rain, temp 24-23^{o}C	Stag-watching / spotlighting Call playback (Section 2.6 species) Stag-watching / spotlighting Stag-watching / spotlighting Call playback (Section 2.6 species)	2hrs 45min 2000 - 2245 Commenced @ 2100 1hr 30min 1900 - 2030 2hr 30min 1900 - 2130 Commenced @ 2100
Arboreal mammals	4/2/13 25/3/13 26/3/13	0/8 cloud, no wind, no rain, temp 21-19^{o}C 0/8 cloud, no wind, no rain, temp 22-21^{o}C 4/8 cloud, no wind, no rain, temp 24-23^{o}C	Stag-watching / spotlighting Call playback (Section 2.6 species) Stag-watching / spotlighting Stag-watching / spotlighting Call playback (Section 2.6 species)	2hrs 45min 2000 - 2245 Commenced @ 2120 1hr 30min 1900 - 2030 2hr 30min 1900 - 2130 Commenced @ 2115
Terrestrial mammals	4/2/13 25/3/13 26/3/13	0/8 cloud, no wind, no rain, temp 21-19^{o}C 0/8 cloud, no wind, no rain, temp 22-21^{o}C 4/8 cloud, no wind, no rain, temp 24-23^{o}C	Spotlighting Spotlighting Spotlighting	2hrs 45min 2000 - 2245 1hr 30min 1900 - 2030 2hr 30min 1900 - 2130
Bats	4/2/13 25/3/13 26/3/13	0/8 cloud, no wind, no rain, temp 21-19^{o}C 0/8 cloud, no wind, no rain, temp 22-21^{o}C 4/8 cloud, no wind, no rain, temp 24-23^{o}C	Spotlighting Anabat SD-1 (Active monitoring) Anabat SD-1 (Passive monitoring) Spotlighting Spotlighting	2hrs 45min 2000 - 2245 2hrs 2030 - 2230 2hrs 20min 2010 - 2230 1hr 30min 1900 - 2030 2hr 30min 1900 - 2130
Reptiles	4/2/13 25/3/13	2/8 cloud, light SW wind, no rain, temp 27-25^{o}C 0/8 cloud, light W-no wind, no rain, temp 25-28^{o}C	Habitat search, opportunistic Opportunistic	4hrs 1400 - 1800 9hrs 10min 0950 - 1900
Amphibians	4/2/13 25/3/13 26/3/13	0/8 cloud, no wind, no rain, temp 21-19^{o}C 0/8 cloud, no wind, no rain, temp 22-21^{o}C 4/8 cloud, no wind, no rain, temp 24-23^{o}C	Spotlighting & call identification Spotlighting & call identification Spotlighting & call identification	2hrs 45min 2000 - 2245 1hr 30min 1900 - 2030 2hr 30min 1900 - 2130

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	30/1/13, 22/3/13
Stratified sampling	20x20m quadrats in all existing bushland or remnant areas	30/1/13, 22/3/13
Target searches	Target searches in known habitats	30/1/13, 22/3/13

2.5 Previous ecological surveys

The information below has been extracted from the Biodiversity Certification Assessment (2012) prepared by Eco Logical Australia.

An extensive flora and fauna study was undertaken for the greater study area (Bell and Murray 2004), and included a range of survey techniques including plot and transect based flora surveys, targeted threatened species survey, vegetation mapping, diurnal and nocturnal fauna surveys, trapping and spotlighting.

Bell and Murray (2004) conducted 14 visits to the broader Warnervale Town Centre (WTC) study area (11 of which occur within the Biodiversity Certification Assessment Area - BCAA) to complete flora surveys, including general reconnaissance, targeted terrestrial orchid surveys, other cryptic species survey and plot based surveys. Surveys included reconnaissance, targeted survey and random meander techniques, with plot data collected undertaken within 0.04ha quadrats. General reconnaissance was conducted on the site in August 2003, whilst targeted flora surveys were conducted between September 2003 and February 2004.

Bell and Murray (2004) also conducted a significance assessment of threatened fauna, with surveys undertaken by targeting the following fauna groups; birds, mammals, reptiles and amphibians. Survey sites were established to sample each fauna habitat type. Three survey sites within the current WTC site were surveyed, along with two other sites that are located outside the current BCAA. Fauna surveys were conducted in October and November 2003.

In addition to the general fauna survey sites Bell and Murray (2004) also conducted targeted fauna surveys for a number of threatened fauna species considered likely to occur within the study area. Surveys completed include (Bell and Murray (2004)):

- Bird surveys, including diurnal 20 minute census recording all bird species observed or heard at each survey site, opportunistic sampling whilst undertaking other activities and nocturnal census involving quiet listening for calls of nocturnal birds followed by playback of pre-recorded calls of threatened owls;
- Surveys for the presence of mammals including trapping for small terrestrial and arboreal mammals, spotlighting for terrestrial and arboreal mammals, examination of scratch marks on tree trunks, searches for characteristic diggings, burrows and other indirect evidence including collection of scats and analysis of hair samples collected in hair tubes;
- Trapping undertaken at each of the fauna survey sites with Elliott Type A traps (8 x 10 x 33 centimetre) baited with a mixture of peanut butter, rolled oats and honey. At each site, 25 small traps were set for three consecutive nights. In addition, five cage (cat size) traps were also set for three nights;
- Arboreal trapping for possums and gliders was undertaken with Elliott Type B (15 x 16 x 45 cm) folding aluminium traps mounted on platforms attached to the tree trunk. Spotlight searches were undertaken by foot at each survey site for 30 - 40 minutes with a 55 watt spotlight, followed by quiet listening in darkness to detect any animal movements or vocalisations. Arboreal mammal trapping and spotlight surveys were conducted during the October and November 2003 surveys;
- SEPP 44 (Koala Habitat) Assessment;

- Surveying for the presence of large terrestrial mammals included spotlight searches undertaken by foot at each survey site for 30 - 40 minutes with a 55 watt spotlight, followed by quiet listening in darkness to detect any animal movements or vocalisations. Searches were also conducted of all adjoining bushland areas. Searches for indirect evidence to suggest the presence of a species, including collection of scats, examination of burrows, diggings and hair tube samples;

- Surveys for mega-chiropteran (flying foxes) and micro-chiropteran (insectivorous) bat species consisted of harp trapping undertaken at suitable sites for two nights to determine the presence of sub-canopy species, detection of echolocation calls via Anabat II detectors onto audio cassettes and digital memory cards for subsequent computer analysis and spotlighting for flying foxes and large micro-chiropteran bats.

- Diurnal investigations for reptiles involved searching beneath ground litter, such as sheets or iron, fallen timber, leaf litter, decorticated bark on tree trunks and on the ground, tuft of vegetation and stones. Searches incorporated both opportunistic searches as well as intensive searches within an area for approximately 30 to 60 minutes. Nocturnal spotlight searches for reptiles were undertaken on foot in conjunction with arboreal mammals.

- Surveys were undertaken of water bodies (i.e. dams) and drainage lines of the area to identify frog species, which may include those species not recorded during other surveys. Nocturnal searches involved walking along drainage lines and through swamp habitat involving standard techniques such as spotlighting around water bodies and along creek lines, identification of individuals present by audible call, eliciting of responses to play-back of calls and searches in likely microhabitats.

2.6 2013 Site survey by *Travers bushfire & ecology*

Diurnal birds

Six (6) diurnal bird census points were undertaken within the subject site during February 2013 survey. A minimum of 15 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 5). Census points were undertaken in locations where bird activity was apparent, as often different bird species are seen foraging together. Opportunistic diurnal bird survey was conducted between census points and whilst undertaking other diurnal surveys.

Following initial recording of Glossy Black-Cockatoo (*Calyptorhynchus lathami*) by foraging evidence further detailed searches for signs of foraging activity were carried out. GPS reference points were collected at locations where foraging evidence was found.

Nocturnal birds

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

Given that a nearby hollow-bearing tree (marked as HT15/SHT7) provided highly suitable roosting habitat for Masked Owl, stag-watching was undertaken on two nights of survey in early February and late March 2013. Stag-watching was also undertaken at the other suitable Masked Owl roosting trees within the subject site (HT18/SHT4) on a single night in late March 2013. Both stag-watching locations were proximate to other high potential large

forest owl roost/nesting trees located outside of the subject site (see Figure 5). Therefore the time spent stag watching also included surveying for any other Owl activity in this area.

Bats

Active Anabat recording was undertaken during stag-watching and throughout the nocturnal survey undertaken on the 4th February 2013.

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 are also noted.

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

A summary of habitat tree results is provided in Table 4.3. Habitat trees (including those defined as significant) are shown on Figure 5.

Previous survey of the Warnervale Town Centre area has been conducted by Bell and Murray (2004) and by EcoLogical Australia (2005, 2008 and 2010). Section 2.1 of this report is an extract from the Biodiversity Certification Assessment (2012) by Eco Logical Australia. Note that whilst opportunistic survey would have been undertaken within the current Lot 521 subject site, no specific survey points were noted within Lot 521.

2.7 Survey limitations

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

Flora survey limitations

Given the relatively extensive survey over the Warnervale Town Centre lands by Murray and Bell in 2004, EcoLogical (over various years) and Conacher Environmental Group (2012) over various times of the year, it is expected that threatened flora species have been well surveyed and documented.

Species with short flowering periods that are inconspicuous such as orchids may be overlooked during surveys. With respect to threatened orchid species, survey has been undertaken during the flowering period for *Cryptostylis hunteriana* although it is considered that the habitat is not suitable for this species. The habitat attributes within Lot 521 are also

not likely to be suitable for other cryptic orchid species such as *Diuris praecox, Genoplesium insignis* and *Thelymitra* sp. Adorata.

Fauna survey limitations

Survey to date within the subject site has not included the following effort for species that have potential to occur and may offer constraint if recorded present:

- **Trapping effort for Squirrel Glider** and other small threatened mammal species with potential to occur such as the Eastern Chestnut Mouse. The Squirrel Glider has been previously recorded within the greater study area in similar Smooth-barked Apple Woodland by Bell and Murray (2004) and Payne and Murray (2001).

- **Checks on suitable owl nesting trees during the Forest Owl breeding periods**. Powerful Owl was previously recorded nearby to the east with considered nearby nesting potential by Bell and Murray (2004). Recent site survey by *Travers bushfire & ecology* (2013) has identified potential nesting trees in close proximity to the proposed development and within the north portion of the subject site worthy of further survey during the breeding period (May-September). However we do note that the most recent survey has not identified any owl activity close to these resources leading up to the upcoming breeding period.

- **Site utilisation by Little Lorikeet for nesting**. This species was recorded by *Conacher Environmental Group* (2012) approximately 25m to the south of the subject site boundary. Site survey has not been undertaken during the breeding period (July - January). Site visits to date have not recorded presence of this species which may roost within nesting hollows throughout the entire year.

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 species observed within the study area

Family	Scientific Name	Common Name
TREES		
Mimosaceae	*Acacia irrorata* subsp. *irrorata*	Green Wattle
Mimosaceae	*Acacia parramattensis*	Parramatta Wattle
Aceraceae	*Acer negundo**	Box Elder
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak
Myrtaceae	*Angophora costata*	Smooth-barked Apple
Proteaceae	*Banksia serrata*	Old Man Banksia
Myrtaceae	*Corymbia gummifera*	Red Bloodwood
Eleocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash
Myrtaceae	*Eucalyptus capitellata*	Brown Stringybark
Myrtaceae	*Eucalyptus elata*	River Peppermint
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark
Myrtaceae	*Eucalyptus pilularis*	Blackbutt
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany
Myrtaceae	*Eucalyptus saligna*	Sydney Blue Gum
Myrtaceae	*Eucalyptus siderophloia*	Northern Grey Ironbark
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany
Santalaceae	*Exocarpos cupressiformis*	Native Cherry
Euphorbiaceae	*Glochidion ferdinandi*	Cheese Tree
Proteaceae	*Grevillea robusta**	Silky Oak
Arecaceae	*Livistona australis*	Cabbage Tree Palm
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum
Anacardiaceae	*Schinus molle* var. *areira**	Pepper Tree
SHRUBS		
Mimosaceae	*Acacia falcata*	Sickle Wattle
Mimosaceae	*Acacia linifolia*	Flax Wattle
Mimosaceae	*Acacia longifolia* var. *longifolia*	Sydney Golden Wattle
Mimosaceae	*Acacia myrtifolia*	Red Stem Wattle
Mimosaceae	*Acacia podalyriifolia**	Queensland Silver Wattle
Mimosaceae	*Acacia saligna**	Orange Wattle
Mimosaceae	*Acacia suaveolens*	Sweet Scented Wattle
Mimosaceae	*Acacia terminalis*	Sunshine Wattle
Mimosaceae	*Acacia ulicifolia*	Prickly Moses
Asparagaceae	*Asparagus officinalis**	Asparagus
Proteaceae	*Banksia spinulosa*	Hairpin Banksia

Table 3.1 – Flora species observed within the study area

Family	Scientific Name	Common Name
Fabaceae	*Bossiaea obcordata*	Spiny Bossiaea
Euphorbiaceae	*Breynia oblongifolia*	Coffee Bush
Polygalaceae	*Comesperma ericinum*	Matchheads
Fabaceae	*Daviesia squarrosa*	-
Fabaceae	*Dillwynia retorta* var. *retorta*	Eggs and Bacon
Sapindaceae	*Dodonaea triquetra*	Hop Bush
Epacridaceae	*Epacris pulchella*	NSW Coral Heath
Apocnynaceae	*Gomphocarpus fruticosus**	Narrow Leaf Cotton Bush
Fabaceae	*Gompholobium latifolium*	Broad-leaf Wedge-pea
Proteaceae	*Hakea dactyloides*	Broad-leaved Hakea
Myrtaceae	*Kunzea ambigua*	Tick Bush
Proteaceae	*Lambertia formosa*	Mountain Devil
Verbenaceae	*Lantana camara**	Lantana
Myrtaceae	*Leptospermum polygalifolium*	Tantoon
Myrtaceae	*Leptospermum trinervium*	Flaky-barked Tea-tree
Myrtaceae	*Melaleuca nodosa*	Ball Honey Myrtle
Myrtaceae	*Melaleuca sieberi*	-
Fabaceae	*Mirbelia rubiifolia*	-
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood
Proteaceae	*Persoonia linearis*	Narrow-leaved Geebung
Phytolaccaceae	*Phytolacca octandra**	Inkweed
Fabaceae	*Podolobium scandens*	Netted Shaggy Pea
Fabaceae	*Pultenaea paleacea*	-
Fabaceae	*Pultenaea retusa*	-
Fabaceae	*Senna pendula* var. *glabrata**	-
Solanaceae	*Solanum mauritianum**	Wild Tobacco
GROUNDCOVERS		
Asteraceae	*Actinotus minor*	Lesser Flannel Flower
Poaceae	*Andropogon virginicus**	Whisky Grass
Asteraceae	*Ageratina adenophora**	Crofton Weed
Myrsinaceae	*Anagallis arvensis**	Scarlet Pimpernel
Iridaceae	*Aristea ecklonii**	Blue Stars
Poaceae	*Aristida ramosa*	Wire Grass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Orchidaceae	*Arthrochilus prolixus*	Wispy Elbow Orchid
Asphodelaceae	*Asphodelus fistulosus**	Onion Weed
Poaceae	*Austrostipa pubescens*	Tall Speargrass
Poaceae	*Axonopus fissifolius**	Narrow-leafed Carpet Grass
Restionaceae	*Baloskion gracile*	-
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Poaceae	*Briza maxima**	Quaking Grass
Acanthaceae	*Brunoniella pumilio*	Dwarf Blue Trumpet
Colchicaceae	*Burchardia umbellata*	Milkmaids
Dicksoniaceae	*Calochlaena dubia*	Rainbow Fern
Poaceae	*Chloris gayana**	Rhodes Grass
Asteraceae	*Cirsium vulgare**	Spear Thistle
Commelinaceae	*Commelina cyanea*	Native Wandering Jew
Asteraceae	*Conyza sumatrensis**	Fleabane
Asteraceae	*Coreopsis lanceolata**	-
Poaceae	*Cortaderia selloana**	Pampas Grass
Cyperaceae	*Cyathochaeta diandra*	-
Poaceae	*Cymbopogon refractus*	Barbwire Grass
Poaceae	*Cynodon dactylon*	Common Couch

Table 3.1 – Flora species observed within the study area

Family	Scientific Name	Common Name
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge
Cyperaceae	*Cyperus polystachyos*	-
Goodeniaceae	*Dampiera stricta*	Blue Dampiera
Phormiaceae	*Dianella caerulea* var. *producta*	Blue Flax Lily
Convolvulaceae	*Dichondra repens*	Kidney Weed
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Asteraceae	*Epaltes australis*	-
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Asteraceae	*Euchiton sphaericus*	Cudweed
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-rush
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge
Cyperaceae	*Gahnia radula*	Saw Sedge
Cyperaceae	*Gahnia sieberiana*	Red-fruit Saw-sedge
Asteraceae	*Gamochaeta spicata**	Cudweed
Geraniaceae	*Geranium homeanum*	Northern Cranesbill
Haloragaceae	*Gonocarpus teucroides*	Raspwort
Goodeniaceae	*Goodenia hederacea* subsp. *hederacea*	Ivy-leaved Goodenia
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower
Apiaceae	*Hydrocotyle bonariensis**	Kurnell Curse / Pennywort
Apiaceae	*Hydrocotyle peduncularis*	Pennywort
Asteraceae	*Hypochaeris radicata**	Flatweed
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass
Poaceae	*Joycea pallida*	Silvertop Wallaby Grass
Juncaceae	*Juncus continuus*	-
Juncaceae	*Juncus prismatocarpus*	Branching Rush
Juncaceae	*Juncus* sp.	-
Juncaceae	*Juncus usitatus*	Common Rush
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge
Restionaceae	*Lepyrodia scariosa*	Scale Rush
Lindsaeaceae	*Lindsaea linearis*	Screw Fern
Lindsaeaceae	*Lindsaea microphylla*	Lacy Wedge-fern
Lomandraceae	*Lomandra confertifolia*	-
Lomandraceae	*Lomandra filiformis*	Wattle Mat-rush
Lomandraceae	*Lomandra glauca*	-
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Lomandraceae	*Lomandra obliqua*	Twisted Mat-rush
Onagraceae	*Ludwigia peploides*	Water Primrose
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass
Davalliaceae	*Nephrolepis cordifolia**	Fish-bone Fern
Oxalidaceae	*Oxalis perennans*	-
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Paspalum quadrifarium**	Tussock Paspalum
Poaceae	*Paspalum urvillei**	Vasey Grass
Iridaceae	*Patersonia sericea*	Wild Iris
Thymelaeaceae	*Pimelea linifolia* subsp. *linifolia*	Slender Rice Flower
Plantaginaceae	*Plantago lanceolata**	Ribwort
Alismataceae	*Sagittaria graminea* subsp. *platyphylla**	-
Goodeniaceae	*Scaevola ramosissima*	Purple Fan Flower
Cyperaceae	*Schoenoplectus mucronatus*	River Clubrush
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria parviflora**	-
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne

Table 3.1 – Flora species observed within the study area

Family	Scientific Name	Common Name
Caryophyllaceae	*Stellaria media**	Common Chickweed
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass
Poaceae	*Themeda australis*	Kangaroo Grass
Acanthaceae	*Thunbergia alata**	Black-eyed Susan
Fabaceae	*Trifolium repens**	White Clover
Liliaceae	*Tulbaghia violacea**	Society Garlic
Typhaceae	*Typha orientalis*	Cumbungi
Verbenaceae	*Verbena bonariensis**	Purpletop
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell
Xanthorrhoaceae	*Xanthorrhoea media*	-
VINES		
Pittosporaceae	*Billardiera scandens* var. *scandens*	Apple Dumplings
Lauraceae	*Cassytha pubescens*	Common Devil's Twine
Fabaceae	*Desmodium rhytidophyllum*	-
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Glycine microphylla*	-
Fabaceae	*Hardenbergia violacea*	False Sarsparilla
Convolvulaceae	*Ipomoea cairica**	Coastal Morning Glory
Convolvulaceae	*Ipomoea indica**	Morning Glory
Fabaceae	*Kennedia rubicunda*	Dusky Coral Pea
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle
Apocynaceae	*Marsdenia rostrata*	Common Milk Vine
Bignoniaceae	*Pandorea pandorana*	Wonga Vine
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Passifloraceae	*Passiflora edulis**	Common Passionfruit
* denotes exotic species		

3.1.2 Vegetation communities

Four (4) vegetation communities were recorded within the study area:

- Disturbed Smooth-barked Apple – Brown Stringybark Open Forest
- Disturbed Smooth-barked Apple – Brown Stringybark – Paperbark Forest
- Cleared with Scattered Remnant Trees
- Dams with Fringing Aquatic Vegetation

None of the vegetation communities correspond with any locally occurring EEC.

<u>Disturbed Smooth-barked Apple – Brown Stringybark Open Forest</u>

- Extensive on site where native vegetation is present.
- Main canopy species includes *Angophora costata* and *Eucalyptus capitellata.* Less common species include *Eucalyptus umbra, Corymbia gummifera* and *Eucalyptus eugenioides.*
- Canopy projected foliage cover was up to 35% in the more intact areas but generally 15-25%. The maximum height was typically 20-25m with occasional emergent just over 30m tall.
- Mid-storey is generally lacking or at a diversity and density much less than intact vegetation. The mid-storey may include young *Allocasuarina littoralis, Acacia longifolia, Glochidion ferdinandi, Daviesia squarrosa, Dillwynia retorta* and *Pittosporum undulatum.*

- The ground layer is highly variable in respect to the proportion of natives versus exotics. There was a moderate to high proportion of exotic species throughout much of this vegetation community except for around the large dam (ex-quarry) in the south-east of the site. Common species include *Entolasia stricta, Imperata cylindrica, Themeda australis, Gonocarpus teucrioides, Glycine clandestina, Pimelea linifolia, Pteridium esculentum, Epaltes australis Centella asiatica* and various Lomandra species and Juncus species.

Photo 1 – Disturbed Smooth-barked Apple – Brown Stringybark Open Forest in the south-east corner of the site

Disturbed Smooth-barked Apple – Brown Stringybark – Paperbark Forest

- Occurs mostly in the south-western corner of the site at the lowest contours where the clay soils are most waterlogged after heavier rainfall events.
- The main canopy species includes young specimens of *Angophora costata.* Adjoining the site on the railway property are more mature tree specimens of *Angophora costata* and *Eucalyptus capitellata.*
- Canopy projected foliage cover is generally less than 10% and there are few trees above 10m tall.
- Mid-storey vegetation comprises a mixture of Paperbark species to 6m and *Allocasuarina littoralis* with variable projected foliage cover averaging 40% where present.
- The ground layer contains a moderate diversity of herbs, ferns, grasses, vines, sedges and small shrubs. Some common species include *Imperata cylindrica, Themeda australis, Gonocarpus teucrioides, Mirbelia rubiifolia, Gahnia radula, Centella asiatica, Dianella caerulea* var. *producta, Calochlaena dubia* and *Dichondra repens.*

Photo 2 - Disturbed Smooth-barked Apple – Brown Stringybark – Paperbark Forest in the south-west corner of the site (photo taken off site in nearby similar vegetation)

Cleared with Scattered Remnant Trees

- Occurs over the vast majority of the site.
- The canopy is a mixture of mature and regrowth Eucalyptus / Angophora / Corymbia species with projected foliage cover less than 5%. The mid-storey is typically absent or is regrowth only.
- The ground layer of vegetation is heavily disturbed with a limited proportion of native species.

Photo 3 – Cleared vegetation in the central portion of the site

Dams with Fringing Aquatic Vegetation

- Most of the dams have sedges and aquatic plants in the shallower portions.
- The vegetation present within the dams was not consistent; no two dams had similar vegetation.
- Common species observed include *Typha orientalis, Schoenoplectus mucronatus, Ludwigia peploides, Juncus continuus* and *Juncus usitatus.*

Photo 4 – Aquatic vegetation within the largest dam(s) (ex-quarry)

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 study area

Common name	Scientific name	Method Observed
Birds		**Feb/ Mar 2013**
Australian Pelican	*Pelecanus conspicillatus*	O
Australian Raven	*Corvus coronoides*	C
Australian Wood Duck	*Chenonetta jubata*	O C S
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	C
Black-shouldered Kite	*Elanus axillaris*	O
Brown-headed Honeyeater	*Melithreptus brevirostris*	O C
Brown Thornbill	*Acanthiza pulsilla*	O C
Crested Pigeon	*Ocyphaps lophotes*	O
Eastern Spinebill	*Acanthorhynchus tenuirostris*	O C
Eastern Whipbird	*Psophodes olivaceus*	C
Eastern Yellow Robin	*Eopsaltria australis*	O C
Golden Whistler	*Pachycephala pectoralis*	O
Grey Butcherbird	*Cracticus torquatus*	C
Grey Fantail	*Rhipidura fuliginosa*	O C
Grey Goshawk	*Accipiter novaehollandiae*	O
Leaden Flycatcher	*Myiagra rubecula*	O C
Noisy Friarbird	*Philemon corniculatus*	C
Noisy Miner	*Manorina melanocephala*	C
Pacific Black Duck	*Anas superciliosa*	O
Peregrine Falcon	*Falco peregrinus*	O
Pied Butcherbird	*Cracticus nigrogularis*	C
Pied Currawong	*Strepera graculina*	C
Rainbow Lorikeet	*Trichoglossus haematodus*	C
Red-browed Finch	*Neochmia temporalis*	O C
Rufous Whistler	*Pachycephala rufiventris*	O C
Sacred Kingfisher	*Todiramphus sanctus*	O C
Scarlet Honeyeater	*Myzomela sanguinolenta*	O
Silvereye	*Zosterops lateralis*	O C
Spotted Pardalote	*Pardalotus punctatus*	C
Striated Thornbill	*Acanthiza lineata*	O C
Tawny Frogmouth	*Podargus strigoides*	O
Varied Sittella [TS]	*Daphoenositta chrysoptera*	O C
Variegated Fairy-wren	*Malurus lamberti*	O C
Yellow Thornbill	*Acanthiza nana*	O C
Yellow-faced Honeyeater	*Lichenostomus chrysops*	O C
Mammals		
Chocolate Wattled Bat	*Chalinolobus morio*	A[PO]
Common Brushtail Possum	*Trichosurus vulpecula*	S
Common Ringtail Possum	*Pseudocheirus peregrinus*	S
Domesticated Dog *	*Canis familiaris*	C
Eastern Broad-nosed Bat	*Scotorepens orion*	A[PO]
Eastern Grey Kangaroo	*Macropus giganteus*	S

Common name	Scientific name	Method Observed
European Red Fox *	*Vulpes vulpes*	S
Forest Bat	*Vespadelus sp.*	A
Gould's Wattled Bat	*Chalinolobus gouldii*	A
Glider	*Petaurus sp.*	I
Greater Broad-nosed Bat [TS]	*Scoteanax rueppelli*	A[PR]
Grey-headed Flying-fox [TS]	*Pteropus poliocephalus*	S
Horse *	*Equus caballus*	C
Rabbit *	*Oryctolagus cuniculus*	S
Reptiles		
Delicate Skink	*Lampropholis delicata*	O
Jacky Lizard	*Amphibolurus muricatus*	O
Amphibians		
Broad-palmed Frog	*Litoria latopalmata*	H C
Common Eastern Froglet	*Crinia signifera*	C
Dusky Toadlet	*Uperoleia fusca*	C
Dwarf Tree Frog	*Litoria fallax*	C
Laughing Tree Frog	*Litoria tyleri*	C
Peron's Tree Frog	*Litoria peronii*	C
Striped Marsh Frog	*Limnodynastes peronii*	C

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

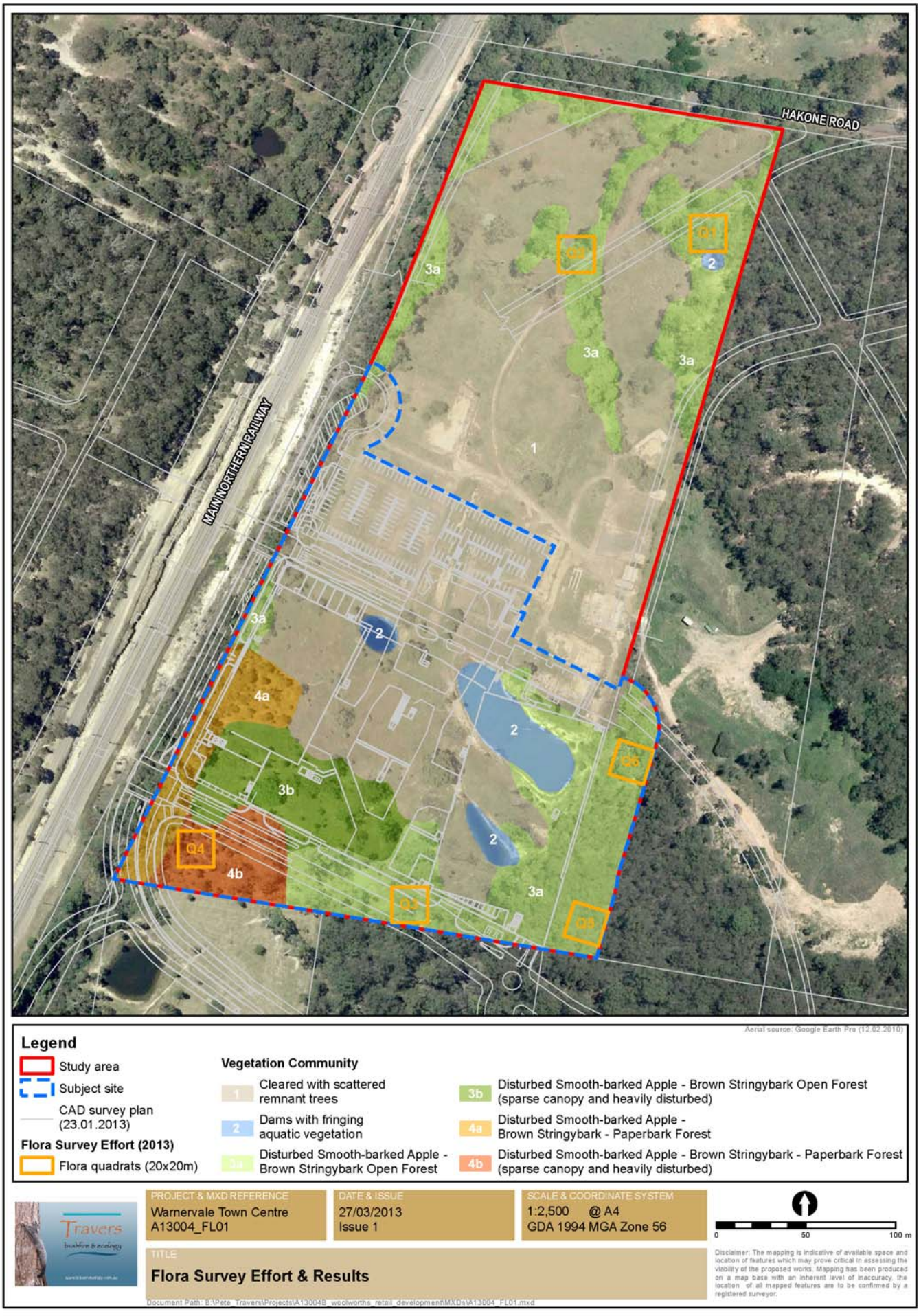

Figure 4 – Flora Survey Effort and Results

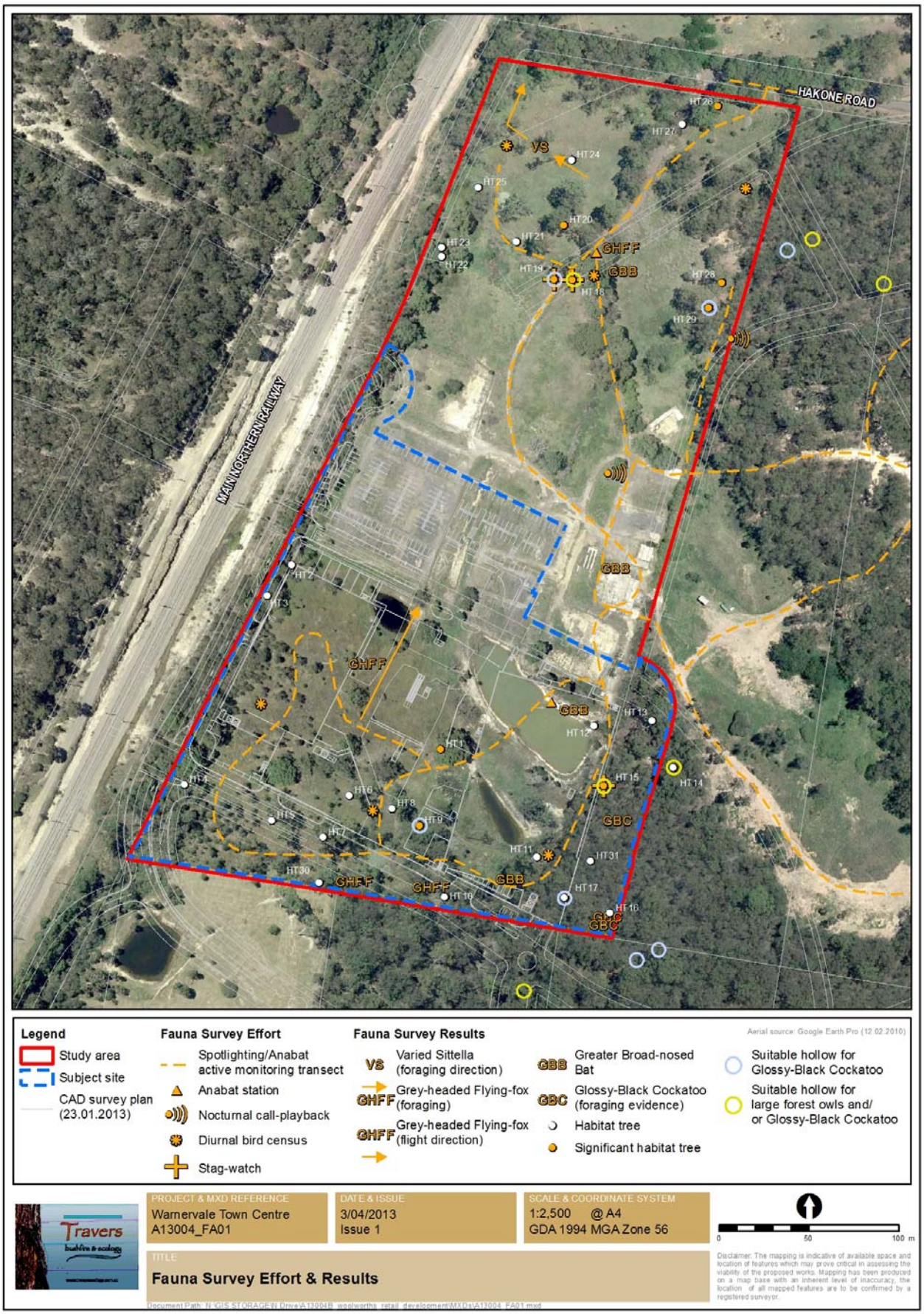

Figure 5 – Fauna Survey Effort and Results

Ecological Assessment 4

4.1 Previous surveys reviewed

The studies of *Bell* and *EcoLogical Australia* have covered the site, most likely as a brief random meander and targeted threatened species searches in the more intact vegetation. Their survey times have covered a number of months that parallel the flowering times for the more cryptic species such as the orchids and *Tetratheca juncea.*

We are of the opinion that the vegetation survey is adequate to define the vegetation communities present, and all threatened flora species have been surveyed at an appropriate time or to an appropriate intensity. No newly listed species since these assessments have potential habitat within the site.

Bell has undertaken extensive survey of *Thelymitra* sp 'Adorata'. *Travers bushfire & ecology* was also involved with survey work for this species in 2008 at Wadalba where many specimens were observed. Whist *Thelymitra* sp 'Adorata' was not listed under the TSC Act at the time of survey by Bell in 2004, it was a ROTAP species. The vegetation association of this species is not present within our site, although it does occur on adjoining properties.

Map Unit 28 by LHCCREMS (2003), Scribbly Gum – Dwarf Apple Woodland (Bell 2004 more closely resembles that of Map Unit 30, Coastal Plains Smooth-barked Apple Forest.

Bell and *Eco Logical Australia* did not describe any portion of vegetation on site as being commensurate with any locally occurring EEC. Our recent survey concurs with this conclusion. The Paperbark remnant in the south-western corner is devoid of mature canopy species, however the immediate adjoining vegetation that is more intact contains *Eucalyptus capitellata* and *Angophora costata.* The composition of the understorey is still not too dissimilar to that of Map Unit 30. It is not comparable to that of Map Units 42 and 43 that are more heavily riparian influenced and likely to be part of the Swamp Sclerophyll Forest on Coastal Floodplains EEC.

4.2 Flora

One hundred and sixty three (163) species have been identified within the study area. During surveys undertaken by *Travers bushfire & ecology,* no threatened flora species have been observed within the study area.

The site was once utilised as part of a plant nursery operation and a few garden escape plants may still exist on the terraced portions near the middle of the study area which have not been identified.

All species are listed in Table 3.1.

4.2.1 Local / Regional flora matters

One (1) specimen of *Eucalyptus robusta,* which is classed as a regionally significant species by Wyong Council, was observed during the survey in the south-western corner of the study area.

The following species, listed as Keystone Species in Development Control Plan (DCP) 14 Tree Management, were observed within the study area:

Botanical Name	Common Name	Potential Schedule 1 or 2 Fauna
Acacia irrorata and other 'gum' producing *Acacia* species	Wattle	Squirrel Glider
Acacia longifolia	Sydney Golden Wattle	Squirrel Glider
Angophora costata	Smooth-barked Apple	Squirrel Glider
Banksia spinulosa	Hairpin Banksia	Squirrel Glider
Eucalyptus pilularis	Blackbutt	Koala / Greater Glider
Eucalyptus robusta	Swamp Mahogany	Yellow-bellied Glider / Squirrel Glider / Koala / Regent Honeyeater
Eucalyptus umbra	Broad-leaved White Mahogany	Squirrel Glider
Melaleuca biconvexa and other local Melaleuca species		Ringtail Possum
Xanthorrhoea spp.	Grass Tree	Squirrel Glider

Species of local conservation significance are listed under DCP 14 (section 7.2.4). None of these species were observed within the study area.

4.2.2 State legislative flora matters

(a) Threatened flora species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH 2013) database for threatened species resulted in records of fifteen (15) threatened flora species within a 10km radius of the subject site. These species are listed in Attachment Table A2.1 and are considered for potential habitat within the subject site.

EPBC Act – A review of the schedules of the *EPBC Act* identified the presence of fifteen (15) threatened flora species or species habitat likely to occur within a 10km radius of the subject site.

These species have been listed in Attachment Table A2.1, and the following threatened flora species are considered to have potential habitat within the subject site. These species will be considered in the seven-part test within Attachment 3:

Table 4.1 – State listed threatened flora species with suitable habitat present

- *Acacia bynoeana*
- *Angophora inopina*
- *Grevillea parviflora* subsp. *parviflora*
- *Rutidosis heterogama*
- *Tetratheca juncea*

Despite the potential habitat, none of these species were observed during the flora survey.

Acacia bynoeana was considered to have only marginal habitat given the type of vegetation present, its condition, and the lack of records within a 3km radius of the site.

Angophora inopina occurs more readily to the north of the site however there are many records and recent records within a 3km radius. The vegetation is suitable although the maintenance regime and previous clearing would reduce the chance of any regeneration of this species if it was once present.

Grevillea parviflora subsp. *parviflora* prefers clay type soils. These are present on site and there have been local recordings in recent years. Given the long history of vegetation clearance on site and extensive weed invasion, the potential for occurrence was considered to be low.

Rutidosis heterogama is known to occur as a rather large population within the rail corridor and on lands immediately adjacent to the west. Target searches for the species found none to be present within the site despite moderate to high potential along the western fringe of the site in some places.

Tetratheca juncea can occur in a variety of vegetation types from dry sclerophyll to the fringes of swamp sclerophyll communities. The soil types present on site are not their most preferred and there are few records within 3km. The most intact remnants of vegetation may provide low quality habitat for the species, inclusive of the bushland which will be utilised as a temporary APZ. The survey *by Travers bushfire & ecology* was conducted one (1) month outside of the recognised flowering period. Previous surveys have not located the species within the broader study area.

(b) Endangered flora populations (NSW)

Eucalyptus parramattensis subsp. *parramattensis* occurs as an endangered population within the Wyong and Lake Macquarie LGA. There is a high density of this species within the coastal swamp areas immediately east of the Warnervale Airport. The species prefers to grow in areas where inundation is common on clay soils.

The Smooth-barked Apple – Brown Stringybark – Paperbark Forest may provide some level of potential habitat for the population to exist, however no specimens have been observed.

There endangered population of *Eucalyptus oblonga* at Bateau Bay within the Wyong LGA is well outside of the recognised geographical range of this endangered population.

No endangered flora populations are represented within the study area.

(c) Endangered ecological communities (NSW)

The Paperbark remnant in the south-western corner is devoid of mature canopy species, however the immediate adjoining vegetation that is more intact contains *Eucalyptus capitellata* and *Angophora costata.* The composition of the understorey is still not too dissimilar to that of Map Unit 30. It is not comparable to that of Map Units 42 and 43 that are more heavily riparian influenced and likely to be part of the Swamp Sclerophyll Forest on Coastal Floodplains EEC.

4.2.3 SEPP 14, SEPP 26 & SEPP 71

SEPP 14 Coastal Wetlands – The site is not located within an area affected by this SEPP.

SEPP 26 Littoral Rainforest - The site is not located within an area affected by this SEPP.

SEPP 71 Coastal Protection - The site is not located within an area affected by this SEPP.

4.2.4 Matters of national environmental significance - flora

(a) Threatened flora species (national)

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

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

Table 4.2 – Nationally listed threatened flora species with suitable habitat present

- *Acacia bynoeana*
- *Angophora inopina*
- *Grevillea parviflora* subsp. *parviflora*
- *Tetratheca juncea*

No nationally listed threatened flora species were observed within the study area.

(b) Endangered ecological communities (national)

No nationally listed endangered ecological communities occur within the study area.

4.2.5 Flora and EEC assessment conclusions

In accordance with Section 5A of the *EPA Act 1979*, the 7 part test of significance (Appendix 3) concluded that the proposed development will not have a significant impact on any state listed threatened species, populations or EECs. Therefore, a Species Impact Statement should not be required for the proposed development in respect to flora.

The proposed development was not considered to have a significant impact on matters of national environmental significance listed under the *EPBC Act 1999*. As such a referral to Department of Sustainability, Environment, Water, Populations and Communities should not be required in respect to flora.

4.3 Fauna

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

4.3.1 Fauna Habitat

The fauna habitats present within the site are identified within Table 4.3.

Table 4.3 – Observed fauna habitat

Topography				
Flat ✓	Gentle ✓	Moderate ✓	Steep	Drop-offs
Vegetation structure				
Closed Forest	Open Forest ✓	Woodland ✓	Heath	Grassland ✓
Disturbance History				
Fire	Under-scrubbing ✓	Cut and fill works ✓		
Tree clearing ✓	Grazing ✓			
Soil Landscape				
DEPTH:	Deep ✓	Moderate ✓	Shallow	Skeletal
TYPE:	Clay ✓	Loam ✓	Sand	Organic
VALUE:	Surface foraging	Sub-surface foraging	Denning/burrowing ✓	
WATER RETENTION:	Well Drained ✓	Damp / Moist ✓	Water logged	Swamp / Soak
Rock Habitat				
CAVES:	Large	Small	Deep	Shallow
CREVICES:	Large	Small	Deep	Shallow
ESCARPMENTS:	Winter / late sunny aspects		Shaded winter / late aspects	
OUTCROPS:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides	
SCATTERED / ISOLATED:	High Surface Area Hides	Med. Surface Area Hides	Low Surface Area Hides	
Feed Resources				
FLOWERING TREES:	Eucalypts ✓	Corymbias ✓	Melaleucas ✓	
	Banksias ✓	Acacias ✓		
SEEDING TREES:	Allocasuarinas ✓	Conifers		
WINTER FLOWERING EUCALYPTS:	C. maculata	E. crebra	E. globoidea	E. sideroxylon
	E. squamosa	E. grandis	E. multicaulis	E. scias
	E. robusta ✓	E. tereticornis	E. agglomerata	E. siderophloia
FLOWERING PERIODS:	Autumn ✓	Winter ✓	Spring ✓	Summer ✓
OTHER:	Mistletoe ✓	Figs / Fruit	Sap / Manna ✓	Termites ✓
Foliage Protection				
UPPER STRATA:	Dense	Moderate ✓	Sparse ✓	
MID STRATA:	Dense	Moderate ✓	Sparse ✓	
PLANT / SHRUB LAYER:	Dense	Moderate ✓	Sparse ✓	
GROUNDCOVERS:	Dense ✓	Moderate ✓	Sparse ✓	
Hollows / Logs				
TREE HOLLOWS:	Large ✓	Medium ✓	Small ✓	
TEE HOLLOW TYPES	Spouts / branch ✓	Trunk ✓	Broken Trunk ✓	Basal Cavities ✓	Stags ✓
GROUND HOLLOWS:	Large ✓	Medium ✓	Small ✓	
Vegetation Debris				
FALLEN TREES:	Large ✓	Medium ✓	Small ✓	
FALLEN BRANCHES:	Large ✓	Medium ✓	Small ✓	
LITTER:	Deep	Moderate ✓	Shallow ✓	
HUMUS:	Deep	Moderate ✓	Shallow ✓	
Drainage Catchment				
WATER BODIES	Wetland(s)	Soak(s) ✓	Dam(s) ✓	Drainage line(s)	Creek(s)	River(s)
RATE OF FLOW:	Still	Slow	Rapid	
CONSISTENCY:	Permanent ✓	Perennial	Ephemeral ✓	
RUNOFF SOURCE:	Urban / Industrial	Parkland ✓	Grazing	Natural ✓
RIPARIAN HABITAT:	High quality	Moderate quality ✓	Low quality ✓	Poor quality
Artificial Habitat				
STRUCTURES:	Sheds	Infrastructure	Equipment	
SUB-SURFACE	Pipe / culvert(s)	Tunnel(s)	Shaft(s)	
FOREIGN MATERIALS:	Sheet ✓	Pile / refuse		

4.3.2 Habitat trees

A complete survey of the location of habitat trees and the size of hollows within was undertaken as part of March 2013 surveys. Prior to this only significant habitat trees had been identified as part of February 2013 surveys. Significant habitat trees are defined as trees containing large hollows suitable for use by owls/cockatoos and/or containing a number of good quality hollows typically consisting of more than one medium (10-30cm) sized hollow. A tree may also be considered significant where evidence of use by select fauna is found such as a Yellow-bellied Glider sap feed tree, raptor nest, or owl roost.

Table 4.3 below provides all hollow-bearing tree data and other habitat features recorded. Habitat trees located within the subject site are indicated, all remaining habitat trees are located within the study area with one (HT14) identified just outside of the site. Significant habitat trees are indicated with a SHT reference number also. Figure 5 provides locations of habitat trees and indicates those identified as significant within the site or with potential for use by threatened owls and/or cockatoos in close proximity to the site.

Table 4.4 – Habitat tree data

Tree No	Common Name	Scientific Name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Subject Site	Hollows & Other Habitat Features Recorded
HT1/ SHT9	Smooth-barked Apple	Angophora costata	100	17	27	95	✓	1x 30-35cm trunk split (possible)
HT2	Smooth-barked Apple	Angophora costata	60	19	26	5	✓	1x 0-5cm branch, 1x 5-10cm branch (suitable for squirrel glider), 1x 10-15cm broken trunk (suitable for squirrel glider),
HT3	Smooth-barked Apple	Angophora costata	50	16	20	80	✓	1x 10-15cm trunk (suitable for squirrel glider), 1x 15-20cm trunk (good), (suitable for squirrel glider), 1x 15-20cm broken trunk (suitable for squirrel glider)
HT4	Smooth-barked Apple	Angophora costata	35	8	18	75	✓	1x 0-5cm branch
HT5	Broad-leaved White Mahogany	Eucalyptus umbra	60	17	22	55	✓	1x 5-10cm branch (good), (suitable for squirrel glider)
HT6	Smooth-barked Apple	Angophora costata	70	12	27	50	✓	1x 0-5cm branch, 1x 5-10cm branch (possibly suitable for squirrel glider), Sap flows
HT7	Smooth-barked Apple	Angophora costata	100	24	28	60	✓	1x 05cm branch (suitable for squirrel glider), 1x 5-10cm branch (suitable for squirrel glider), 1x 10-15cm branch, Sap flows
HT8	Smooth-barked Apple	Angophora costata	80	14	25	70	✓	1x 0-5cm branch, 1x 10-15cm branch
HT9/ SHT8	Smooth-barked Apple	Angophora costata	90	10	16	45	✓	2x 15-20cm branch (good), 1x 25-30cm trunk (possible), 1x 30-35cm branch (possible), Highly suitable for squirrel gliders, Not suitable for Large Forest Owls
HT10	Broad-leaved White Mahogany	Eucalyptus umbra	40	13	20	50	✓	1x 5-10cm broken trunk
HT11	Smooth-barked Apple	Angophora costata	70	12	26	70	✓	2x 05cm branch, 1x5-10cm branch
HT12	Brown Stringy Bark	Eucalyptus capitellata	50	11	23	70	✓	1x 0-5cm trunk
HT13	stag	stag	80	10	26	0	✓ APZ	5x 0-5cm branch, 1x 5-10cm branch, 2x 10-15cm branch (suitable for squirrel glider)
HT14	stag	stag	120	3	17	0	×	1x >50cm broken trunk
HT15/ SHT7	stag	stag	95	4	17	0	✓ APZ	1x 45-50cm branch (good), 1x 45-50cm broken trunk (good) possibly linked Termite infected
HT16	stag	stag	60	13	30	0	✓ APZ	1x 0-5cm branch
HT17	stag	stag	100	1	7	0	✓ APZ	1x >50cm broken trunk

Tree No	Common Name	Scientific Name	DBH (cm)	Spread (m)	Height (m)	Vigour (%)	Subject Site	Hollows & Other Habitat Features Recorded
HT18/ SHT4	Smooth-barked Apple	Angophora costata	120	18	28	80	×	1x 15-20cm branch, 1x 35-40cm trunk (good, suitable for large forest owl), 1x 40-45cm branch (good, suitable for large forest owl)
HT19/ SHT5	Smooth-barked Apple	Angophora costata	100	12	25	70	×	1x 10-15cm branch possum scratches, 3x 15-20cm branch (good), 1x branch (good) some potential for Large Forest Owl
HT20/ SHT6	Smooth-barked Apple	Angophora costata	70	15	20	80	×	1x 0-5cm branch, 1x 5-10cm tree, 1x 10-15cm branch (good) with wear, Extremely suitable for squirrel gliders, Possible scratches
HT21	stag	stag	70	5	17	0	×	1x 5-10cm branch, 1x 10-15cm branch, 1x 20-25cm broken trunk
HT22	Smooth-barked Apple	Angophora costata	45	12	19	80	×	1x 0-5cm branch
HT23	stag	stag	45	3	17	0	×	2x 0-5cm branch
HT24	stag	stag	65	10	22	0	×	2x 5-10cm branch,
HT25	stag	stag	45/30	13	21	0	×	1x 0-5cm branch
HT26/ SHT1	Smooth-barked Apple	Angophora costata	105	16	25	80	×	1x 5-10cm branch (good), 3x 10-15cm branch (good), 1x 15-20cm broken trunk (not suitable for large forest owls), Sap flows, Glider scratches
HT27	Brown Stringy Bark	Eucalyptus capitellata	80	13	20	70	×	1x 5-10cm branch (good), (suitable for squirrel glider),
HT28/ SHT2	Smooth-barked Apple	Angophora costata	60	14	19	85	×	1x 0-5cm branch (wear around entry), 1x 15-20cm branch (possum inside), 1x 20-25cm branch (good), Scratches
HT29/ SHT3	Smooth-barked Apple	Angophora costata	100	16	24	80	×	2x 5-10cm branch, 1x 15-20cm branch (possum inside), 1x 20-25cm branch (good), 1x 25-30cm branch (good, but low owl roost potential), Scratches
HT30	Smooth-barked Apple	Angophora costata	50	16	24	85	✓	1x 0-5cm branch, 1x 5-10cm trunk (good), (suitable for squirrel glider)
HT31	Brown Stringy Bark	Eucalyptus capitellata	65	12	23	70	✓ APZ	1x 20-25cm trunk (good), (suitable for squirrel glider),

Note: HT 30 & 31 were tagged in the field as HT9 & 15 respectively.

Nine (9) significant habitat trees were recorded within the study area. Four (4) of these are located within the subject site. Three (3) of these are identified as suitable for threatened cockatoos or owls. A further six (6) trees with potential for use by threatened owls or cockatoos were identified close to the study area (out to approximately 50m from the southern and eastern boundary), which are also considered to be significant habitat trees. Four (4) of these are located in close proximity to the subject site. Use of these trees by threatened owls or cockatoos may be indirectly impacted by development within the study area.

In consideration to all trees that may be directly affected by the proposal, two significant habitat trees (HT15 & HT18) are considered to be most potentially suitable for use by the threatened large forest owls (eg. the previously recorded Powerful Owl and Masked Owl in the area but not the subject site).

HT18 is located in the northern portion of the site and HT 15 is located on the south eastern boundary. HT 18 will not be removed for the current proposed retail facility but is located in a future road corridor. HT 15 (a stag) is likely to be removed as part of the proposed retail facility. HT15 is highly affected by termites and is unsafe to retain in close proximity to the proposed works.

HT15 was stag-watched during the dusk one two separate occasions in February and March 2013 with a Common Brushtail Possum recorded emerging from this hollow.

Habitat tree (HT18) was considered to contain a high quality hollow for threatened large forest owls however its isolation from continuous forest habitat means that it is less likely to be used by large forest owls. This tree was stag-watched in March 2013 with a Common Brushtail Possum recorded emerging.

A threatened species impact assessment needs to consider both direct and indirect impacts of a proposal on threatened species. As the Powerful Owl is known to be susceptible to nest disturbance from surrounding activities, indirect impacts of the proposal are considered. Six hollow bearing trees suitable for nesting by threatened owls and/or cockatoos were identified within approximately 50m of the study area boundary (Figure 5). These trees are located within the future development landscape of the Warnervale Town Centre and are not directly impacted by the proposed retail facility. The most northern of these trees is considered to have highest potential for use by Powerful or Masked Owls of all trees observed during survey. All of the trees considered with any degree of potential for use by threatened owls were investigated for any signs of surrounding activity during survey. Although the breeding period for the Powerful Owl had not commenced at the time of survey, no signs of use were found.

All significant habitat trees directly impacted by the proposal with the exception of SHT7 were Smooth-barked Apple (*Angophora costata*) and were of good health and structural integrity. Some Smooth-barked Apple trees as well as Red Bloodwood (*Corymbia gummifera*) trees were observed to provide sap flows from chew marks initiated by small gliders. Whilst not recorded, these trees may be utilised by the threatened Squirrel Glider for seasonal foraging.

4.3.3 Local fauna matters

4.3.3.1 Squirrel Glider habitat assessment

Squirrel Glider habitat on the subject site should be assessed according to Wyong Shire Councils *Interim Ecological Assessment Information Required to Assess Clearing Impacts within Squirrel Glider Habitat in Wyong Shire* (Wyong Shire Council, August 2000). A standardized field proforma providing consideration to this document is filled out during field surveys undertaken within the Wong LGA. This is provided in Appendix 1.

The assessment of Squirrel Glider habitat considers the following:

(a) Habitat quality (vegetation type);
(b) Remnant patch size;
(c) Density of habitat trees;
(d) Abundance of food plants;
(e) Habitat vulnerability;
(f) Disturbance factors.

(a) Habitat Quality

Whilst the available habitat for Squirrel Gliders within the subject site is all the result of previous disturbance and under-scrubbing, the remaining trees are nonetheless regarded as highly suitable for use by Squirrel Gliders. This conclusion is based on the following arguments:

- Presence of Squirrel Gliders records within similar type habitat and condition.
- Presence of trees species identified to be preferred habitat for Squirrel Gliders.
- Presence of year-round flowering resources for foraging. We note that there is a deficiency of winter flowering Swamp Mahogany with only one small tree observed on site.
- The presence of Acacia and melaleuca regrowth in the understorey (only in the far south-western corner.
- That connectivity via gliding is not limited within the remaining patches where mature trees still exist.
- The availability and density of suitable hollows present.
- The availability of other habitat features within the nearby connective range.

Squirrel Gliders can persist in a disturbed landscape, are highly capable of gliding separated distances and will actively utilise artificially constructed boxes for denning etc. However it is concluded that the quality of overall habitat for fauna is quite low for the following reasons:

- The degree of fragmentation to remaining remnants.
- The extent of disturbance to the existing remnants, particularly given that most patches contain no foraging species or a natural vegetation structure in the understorey.
- The extent of total foraging resources has been significantly reduced in remnants.
- The species will be more exposed to predation in open disturbed landscapes.

(b) Remnant Patch Size

The available habitat for Squirrel Gliders within the subject site is calculated for the disturbed forest portions totalling 5.39 ha. These areas are connected or fragmented from extensive areas of remnant and disturbed open forest habitat within the nearby locality, particularly to the east.

(c) Density Habitat Trees

The density of habitat trees within the Open Forest remnant is approximately 2 per hectare and is likely to be a higher density in surrounding natural remnants.

(d) Abundance of Food Plants of Squirrel Glider

The abundance of Squirrel Glider food resources within the subject site is provided in Table 4.5 for the communities where some degree of habitat for foraging exists.

Table 4.5 – Squirrel Glider food resource abundance

Food Plants	Food Item	Estimated Average No. of Plants / Hectare in		
		Cleared	3a/b	4a/b
Eucalyptus robusta	Sap, nectar & pollen	0	0	1
Eucalyptus siderophloia	Sap, nectar & pollen	0	2	0
Eucalyptus paniculata	Sap, nectar & pollen	0	0	0
Eucalyptus fibrosa	Sap, nectar & pollen	0	0	0
Corymbia maculata	Nectar & pollen	0	0	0
Melaleuca spp	Nectar & insects	0	20	250
Acacia spp.	Seeds & gum	5	50	50
Xanthorrhoea spp.	Nectar & gum	0	10	5

(e) Edge to Width Ratio

The complete Lot 521 area has been previously cleared or disturbed resulting in a very high edge to width ratio within the study area.

(f) Habitat Disturbance

The complete Lot 521 area has been previously cleared or disturbed. The proposed APZ area extending into Lot 1 DP 376264 is the only area containing remnant open forest habitat however this is subject to weed incursions adjacent to the cleared/disturbed perimeter.

(g) Proximity to Existing or Future Residential Development

The entire study area and lands extending to the east as well as some lands to the west of the Great Northern Railway Line are subject to the Warnervale Town Centre proposal (see Figure 6). A 8ha reserve to the west and a separate 5.6ha riparian corridor to the east are proposed within the entire Town Centre area however these have limited regional connective values and reduced habitat extent for Squirrel Gliders.

Conclusion of Squirrel Glider Assessment

It is considered that the habitat available within the surrounding locality for Squirrel Gliders is high. This is particularly so within the lower fertile landscapes that extend initially to the south-east from the subject site and also along the southern fringes of Hakone Road. Much of this suitable habitat is proposed for removal as part of the Warnervale Town Centre proposal.

The study area itself within Lot 521 has been subject to previous extensive clearance or disturbance resulting in a highly modified habitat for Squirrel Gliders. The extent of the available habitat proposed for removal within the subject site is minimal by comparison to the remaining areas of suitable (and particularly natural) areas of habitat in the remaining nearby lands. It is beyond the scope of this assessment to consider the future development areas of the proposed Warnervale Town Centre.

No Squirrel Gliders have been recorded present within the subject site during spotlighting surveys however no trapping effort has been undertaken within the site to date. Trapping surveys in adjacent higher quality habitat to the south (by *Conacher Environmental Group* 2012) did not record Squirrel Gliders. Based on the available habitat, connectivity and previous records it is considered that there is potential for Squirrel Gliders to be utilising the available habitat seasonally, however such habitat is not expected to be central or of high importance to the local population.

4.3.4 State legislative fauna matters

(a) Threatened species (NSW)

TSC Act – A search of the *Atlas of NSW Wildlife* (OEH, 2013) 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.

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. Of these, the species marked with a "*" have not been previously considered in the

Bell and Murray (2004) ecological assessment, as these species had not been recorded in the locality or were not listed as threatened at this time.

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

COMMON NAME	TSC Act	POTENTIAL TO OCCUR
Varied Sittella*	V	recorded
Grey-headed Flying-fox	V	recorded
Greater Broad-nosed Bat	V	recorded
Glossy Black-Cockatoo	V	recorded
Stephens' Banded Snake*	V	✓
Square-tailed Kite*	V	✓
Little Lorikeet*	V	✓
Swift Parrot	E	✓
Powerful Owl	V	✓
Masked Owl	V	✓
Spotted-tailed Quoll*	V	✓
Squirrel Glider	V	✓
Yellow-bellied Sheathtail-bat	V	✓
East-coast Freetail Bat	V	✓
Eastern Falsistrelle	V	✓
Little Bentwing-bat	V	✓
Eastern Bentwing-bat	V	✓
Large-footed Myotis	V	✓
Eastern Chestnut Mouse*	V	✓
Wallum Froglet	V	low
Black-necked Stork	E	low
Little Eagle*	V	low
Gang-gang Cockatoo*	V	low
Barking Owl	V	low
Koala	V	low
Regent Honeyeater	E4A	unlikely
Scarlet Robin*	V	unlikely
Flame Robin*	V	unlikely
Diamond Firetail*	V	unlikely
Yellow-bellied Glider*	V	unlikely
Long-nosed Potoroo*	V	unlikely
Large-eared Pied Bat*	V	unlikely

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

Four (4) state listed threatened fauna species – Varied Sittella (*Daphoenositta chrysoptera*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Glossy Black-Cockatoo (*Calyptorhynchus lathami*) – were recorded within the subject site during surveys. These species have been assessed in detail within Appendix 3.

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 Wyong 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 Wyong LGA, which is listed on Schedule 1 of this Policy. 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?

One (1) Koala food tree species was observed within the study area – Swamp Mahogany (*Eucalyptus robusta*) – as listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection. This species was a observed as a single small tree located within the far south-western corner of the site along the paperbark forest edge. This is less than 15% of the total number of trees, therefore the subject site is not considered to be PKH as defined under SEPP 44 and no further assessment under this policy is required.

The site may form transient habitat for Koalas in dispersal at the very least and will not form part of any Koala home ranges despite previous nearby records in the locality as recent as 2005.

4.3.5 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 seven-part test within Appendix 3.

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

Table 4.7 – Nationally listed threatened fauna species with suitable habitat present

COMMON NAME	EPBC Act	POTENTIAL TO OCCUR
Grey-headed Flying-fox	V	recorded
Swift Parrot	E	✓
Spotted-tailed Quoll*	E	✓
Koala	V	low

COMMON NAME	EPBC Act	POTENTIAL TO OCCUR
Regent Honeyeater	E	unlikely
Long-nosed Potoroo*	V	unlikely
Large-eared Pied Bat*	V	unlikely
New Holland Mouse	V	unlikely

One (1) nationally listed threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded foraging within the subject site during surveys undertaken. This is a state listed fauna species and a detailed assessment under state legislation (EPA Act 1979) is undertaken within the 7 part test (Appendix 3).

Grey-headed Flying-fox

The Significant Impact Criteria for a vulnerable species listed under the EPBC Act 1999 (Appendix 4) was reviewed to assess the impacts on this species as a result of the proposed subdivision layout within the subject site. As the subject site does not contain any likely roosting habitat for large camps or subsequent breeding habitat and foraging habitat will remain well represented in the surrounding locality, it is concluded that there will not be any significant impact on this species, or other nationally listed threatened fauna species with potential to occur, as a result of the subdivision proposal.

(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 for habitat suitability in Table A2.3 (Appendix 2). Threatened migratory species are assessed for habitat suitability in Table A2.2 (Appendix 2). No listed protected migratory species were recorded present during survey.

4.3.6 Fauna assessment conclusions

In accordance with Section 5A of the *EPA Act 1979*, the 7 part test of significance (Appendix 3) concluded that the proposed development will not have a significant impact on any state listed threatened fauna species or threatened fauna populations. A Species Impact Statement should not be required for the proposed development in respect to fauna.

Mitigation measures are recommended to ensure that the nesting activity of hollow-dependent threatened species is not affected by the proposed works. It is noted that in the event that a large Forest Owl species is observed within impacted hollows, then appropriate advice is to be sought from an owl specialist to identify the level of use and the mitigation measures required to ensure that the breeding activity is not disrupted. Protection of nest sites during the breeding season is highly recommended and relocation of the existing hollow and provision of alternative artificial breeding habitats is recommended to ensure that future breeding can occur within suitable locations.

Based on the current survey data and records, the proposed development was not considered to have a significant impact on threatened or migratory fauna species listed as matters of national environmental significance under the *EPBC Act 1999*. As such a referral to Department of Sustainability, Environment, Water, Populations and Communities should not be required in respect to fauna.

4.4 Vegetation connectivity and wildlife corridors

Remnant vegetation within the study area is highly disturbed and in some instances there is sparse canopy and a lack of native mid-storey. Vegetation within the study area is not part of any vital linkage or a gateway for fauna movement given the presence of the main northern railway corridor, a managed landscape immediately north, partly managed landscape immediately south and better quality remnant vegetation immediately east.

Part of the vegetation adjoining the site on the eastern boudanry will become part of an open space corridor which shall adjoin a riparian protection area a further 150m east. The very north-western tip of the study area will be used as open space. The vegetation adjoining the site in the location of the temporary APZ will be impacted upon in the long term by high density town centre development. Approximately 70% of the vegetation on the western side of the railway line will be retained as part of a reserve for the protection of *Rutidosis heterogama.* Figure 6 shows the location of these proposed open space and reserve areas in green.

The study area is not currently part of any regional corridor identified by Council or OEH for the movement of fauna, and the limited and disturbed vegetation present would also limit the value upon threatened flora and fauna species within the locality and make it less suitable as a corridor for movement. We do however recognise that the site does contain value resources for in particular, hollow-dependent fauna, and thus the mitigation measures proposed within the next section of the document are aimed quite specifically towards those fauna species and in line with Warnervale Town Centre DCP biodiversity objectives and controls.

Figure 6 – Warnervale Town Centre DCP overview

4.5 Potential ecological impact

The key ecological impacts are as follows:

- **Impact on habitat of recorded and potential threatened fauna species** – Three (3) threatened fauna species have been recorded utilising the available habitat within the subject site. These include the Grey-headed Flying-fox, Glossy Black-Cockatoo (foraging evidence) and Greater Broad-nosed Bat. Other threatened fauna species recorded nearby and potentially to utilise the available habitat within the subject site include Little Lorikeet, Varied Sittella, Powerful Owl and Squirrel Glider.

- **Impact on habitat of potential threatened flora species habitat** – No threatened flora species have been identified within the vegetation studies to date, however the railway line embankment adjacent to the site is known to host *Rutidosis heterogama.* Thus potential habitat areas for this species are likely to be present within the narrow remnant vegetation strip between the study area and the railway line. The bushland where the temporary APZ is to be placed 30m into Lot 1 DP 376264 may provide suitable habitat for in particular *Tetratheca juncea.* The extent of habitat for the species would be inhibited somewhat by the allelepathic effects of the relatively dense sub-canopy of *Allocasuarina littoralis.*

- **Impact on habitat of Hollow dependent threatened species habitat -** There is suitable available hollows present within the site for all hollow-dependent threatened fauna species recorded or with potential to occur. In the case that Powerful Owl or Glossy Black-Cockatoo are utilising the available hollows present for nesting, then removal of the hollow or disturbance of breeding activity would cause local breeding pairs to relocate and disrupt their breeding activity for at least one season. Site survey to date have found no evidence to suggest that these hollows are currently being used for nesting however it would be prudent to investigate this potential during the recognised breeding season for both species. The use of hollows by hollow dependent threatened species can be determined by use of a tree climber to observe the internal chambers for evidence of nesting use by these species.

4.6 Mitigation measures

Mitigation measures are recommended to ensure that the nesting activity of hollow-dependent threatened species is not affected by the proposed works. It is noted that in the event that a large Forest Owl species is observed within impacted hollows, then appropriate advice is to be sought from an owl specialist to identify the level of use and the mitigation measures required to ensure that the breeding activity is not disrupted. Protection of nest sites during the breeding season is highly recommended and relocation of the existing hollow and provision of alternative artificial breeding habitats is recommended to ensure that future breeding can occur within suitable locations.

Adjoining open space areas or corridors as proposed for the Warnervale Town Centre should be considered for future hollow relation areas or for enhancement with artificial hollows for hollow dependent threatened species. An example of recent hollow relocation works has been undertaken within the Wadalba Wildlife Corridor in 2012 with the approval of Wyong Shire Council.

The following mitigation measures are considered to be important to minimise the risk of impacts on hollow dependent threatened species:

- Based on current survey effort it is not expected that the identified large hollows present within the subject site are being utilised by Glossy Black-Cockatoo or Powerful Owl, however survey has not been undertaken in the overlapping breeding period for both species (May - July). Based on the nearby recording of these species, trees identified as suitable for nesting should be visually inspected by a tree climber to investigate any evidence of past or present nesting activity by such hollow dependent threatened species. Where the chamber is too deep for inspection, a viewing hole in the side of the trunk may be cut by chainsaw. This process is to be undertaken under the guidance of a fauna ecologist. In the absence of signs of nesting activity by these species then these trees can be removed with confidence or no indirect impacts of the proposal may be concluded.

- Vegetation management for APZ purposes is to be limited to minimise impacts on potential threatened fauna habitat. No more than 50% of the existing canopy should be removed for asset protection purposes. However the understorey is to be fully managed with a maximum retention of up 20% shrub cover in the understorey. *Allocasuarina* trees are to be selectively retained within the APZ i.e. mature fruiting trees, to minimise impacts of foraging Glossy Black-Cockatoo.

- Removal of hollow-bearing trees is to be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are taken, particularly for threatened species. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse.

- Any wildlife that is captured or removed by the fauna ecologist is to be relocated into adjoining protected Council reserves.

- Good quality hollows are to be relocated or replaced by robust nest boxes with a long life span within proposed open space areas and/or reserves within the surrounding lands.

- Standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment onsite found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal herbicides.

- Undertake noxious weed management as appropriate in the study area.

4.7 Habitat tree management strategy

The management of habitat trees and the associated hollows for a retail facility which involves removal of all vegetation onsite is by its nature focussed on the mitigation of the loss of hollows (a threatening process), minimise impacts on hollow dependent species and the management of animal welfare so as to avoid loss of wildlife and to minimise disruption to breeding.

Based on the above mitigation strategies the process of removing hollow bearing trees is based on the following tasks:

- Identification of all hollow bearing trees, dimensions, condition and quality;

- Identifying hollows that require relocation and or replacement with artificial nest boxes;
- Installing nest boxes in identified relocation sites at a minimum 1:1 ratio for all hollows onsite;
- Inspection of all hollows within the affected areas immediately prior to and during key breeding periods of hollow dependent threatened species, identify any active use;
- Delay removal of trees for hollow dependent threatened species actively using habitat trees onsite; and
- Removal of any existing wildlife from hollows and managing the welfare of affected fauna.

The relocation site for all high quality hollows and or artificial nest boxes is to be determined in consultation with Wyong Shire Council. Proposed reserves as part of the Warnervale town Centre are the immediate candidates for recipient sites but further more distant reserves may else be appropriate.

Initial hollow inspections of existing hollows by a tree climber should be undertaken to determine whether there is any evidence of past or present nesting activity by hollow dependent threatened species in the affected trees. If inconclusive, survey for nesting use of large hollows by Glossy Black-Cockatoo or Powerful Owl should be undertaken during the breeding season for these species. The absence of Owls in the breeding season means that the nests are not within the site and hollows can be removed with confidence. The overlapping period for this is May - July. Nesting use of hollows may be determined prior to the breeding period via direct inspection of hollows by a tree climber. Where the chamber is too deep for inspection, a viewing hole in the side of the trunk may be cut by chainsaw. This process is to be undertaken under the guidance of a fauna ecologist.

Conclusions & Recommendations 5

5.1 Conclusions

The document forms the basis of assessment required under Section 5A of the *EPA Act* and Matters of National Significance under the *EPBC Act*. These assessments determine 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:*

- Four (4) threatened fauna species – Varied Sittella (*Daphoenositta chrysoptera*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Glossy Black-Cockatoo (*Calyptorhynchus lathami*) were recorded within or in close proximity to the study area. The Glossy Black-Cockatoo was recorded by evidence of foraging;

- No threatened flora species were recorded within the study area. Note that a large population of *Rutidosis heterogama* occurs primarily on the western side of the railway line (to the west) within lands owned by Railcorp and private lands forming part of the Warnervale Town Centre, extend south to approximately 200m south of the Sparks Road overpass;

- No EECs were recorded within the study area; and

- No endangered populations have been observed.

The 7 part test of significance (Appendix 3) has concluded that the proposed development will not have a significant impact on any threatened species, populations or EECs. Mitigation measures are proposed to minimise potential impacts on breeding hollow dependent threatened species. Subsequently, an SIS should not be required for the proposed development.

EPBC Act

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

- One (1) threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded within 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 study area;

- No EECs were recorded within the study area; and

- No endangered populations have been observed.

Consideration of these species within Section 4 of this report concluded that the proposed development was not considered to have a significant impact on matters of NES. As such a referral to SEWPAC should not be required.

FM Act

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

Conclusion

It is concluded that the proposed development of by *Woolworths Ltd* upon Lot 521 DP 594725 off Hakone Road, Warnervale is unlikely to result in a significant impact on any threatened species, populations or EECs or their habitats. A Species Impact Statement should not be required for the proposed development in respect to fauna. As such no further assessments are considered to be required under the *EPA Act, EPBC Act or FM Act.*

5.2 Recommendations

The potential ecological impacts on this site relate to tree removal, a small reduction in the total area of remnant disturbed bushland within the local area, potential hydrological changes, construction and implementation of APZs, loss of hollow-bearing and foraging resources for fauna and removal of dams.

The following recommendations are made to minimise the potential ecological impacts particularly on hollow dependent threatened species, address threatening processes and to create a positive ecological outcome for threatened species and their associated habitats:

- Based on current survey effort it is not expected that the identified large hollows present within the subject site are being utilised by Glossy Black-Cockatoo or Powerful Owl, however survey has not been undertaken in the overlapping breeding period for both species (May - July). Based on the nearby recording of these species, trees identified as suitable for nesting should be visually inspected by a tree climber to investigate any evidence of past or present nesting activity by such hollow dependent threatened species. Where the chamber is too deep for inspection, a viewing hole in the side of the trunk may be cut by chainsaw. This process is to be undertaken under the guidance of a fauna ecologist. In the absence of signs of nesting activity by these species then these trees can be removed with confidence or no indirect impacts of the proposal may be concluded.

- Vegetation management for APZ purposes is to be limited to minimise impacts on potential threatened fauna habitat. No more than 50% of the existing canopy should be removed for asset protection purposes. However the understorey is to be fully managed with a maximum retention of up 20% shrub cover in the understorey. *Allocasuarina* trees are to be selectively retained within the APZ i.e. mature fruiting trees, to minimise impacts of foraging Glossy Black-Cockatoo.

- Removal of hollow-bearing trees is to be conducted under the supervision of a fauna ecologist to ensure appropriate animal welfare procedures are taken, particularly for

threatened species. Hollows of high quality or with fauna recorded residing within should be sectionally dismantled and all hollows should be inspected for occupation, activity and potential for reuse.

- Any wildlife that is captured or removed by the fauna ecologist is to be relocated into adjoining protected Council reserves.

- Good quality hollows are to be relocated or replaced by robust nest boxes with a long life span within proposed open space areas and/or reserves within the surrounding lands.

- Prepare a hollow and nest box management plan as a condition of consent which clearly identifies any active use of hollow bearing trees. Relocation sites for wildlife and recipient sites for replacement nest boxes. This plan is to be prepared in consultation with and approved by Wyong Shire Council.

- Standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment onsite found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal herbicides.

- Undertake noxious weed management as appropriate in the study area.

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Fauna Survey Methodologies

A1

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

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

1 Standard survey techniques

1.1 Diurnal birds

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

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

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

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

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

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

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 nectarivor powder mix used for feeding captive birds. Where Brush-tailed Phascogales are targeted the standard bait mix may be additionally laced with an insectivore powder mix. Where Eastern Pygmy Possum is targeted, the bait mix will be more heavily laced with honey.

Elliott traps for arboreal captures are placed onto tree mounted platforms that are attached to the trunk 2-3m above the ground, at an incline to facilitate drainage during inclement weather. Plastic sleeves are placed around or over traps when there is a possibility of wet weather in the 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 presences of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) may be targeted by call-playback techniques. Calls are played for five minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting.

1.3.1 Koala survey

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

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

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

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

For large sites, 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 has an emphasis on nearby foliage, runways, shelters and signs of activity.

Standard bait mix for all Elliott traps, medium cage traps and hair tubes is a mixture of rolled oats, honey and peanut butter. Standard bait mix may be supplemented with sardines in large hair tubes or cage traps to simultaneously target Spotted-tailed Quoll. Cage traps may also be baited solely with meat 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 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 waters edge.

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

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

1.6 Amphibians

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

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

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 likely to disrupt emergence behaviour. Where any movement is observed, a spotlight may then be used for identification purposes.

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

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

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

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

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

Hair tubing - using small (40mm diameter x 120mm long) and/or large (90mm diameter x 200mm long) PVC pipe sections for collecting mammal hair samples. At one end of each tube is an enclosed chamber where the bait is placed and capped. Small drill holes in the inside face of the chamber allow the smell of the bait to permeate out through the tube without allowing access to the bait. At the other open entry end, double-sided tape is attached around the inner rim so hair samples of animals entering the tube are collected. Hair samples collected are sent to Barbara Triggs for identification. Trapping layout, tube sizes, baiting and trapping period will be outlined within the site specific methodology section.

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

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

Passive 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 provided from the only known supplier in Poland.

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

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 (e.g. none, light drizzle, heavy drizzle, heavy rain);
- Recent rain events (where relevant);
- Wind Strength e.g. calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns).
- Wind direction
- Moon (where relevant) (e.g. none, 1/4 moon, 1/2 moon, 3/4 moon, 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**				**CONSIDERED IN A 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	marginal	✓	✓	very low	✓
Angophora inopina OEH EPBC	V	V	Small tree in open sclerophyll forest growing on deep sandy soils with associated lateritic outcrops. Distribution limits N-Wyee S-Gorokan.	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**				**CONSIDERED IN A 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**	
Caladenia tessellata OEH EPBC	E1	V	Terrestrial orchid. Clay-loam or sandy soils. LHCCREMS guidelines suggest the species grows in Map Unit 34 – Coastal Sand Wallum Woodland - Heath. Distribution limits N-Swansea S-south of Eden.	x	x	-	-	x	x
Callistemon linearifolius OEH	V	-	Shrub to 4m high. Dry sclerophyll forest on coast and adjacent ranges. Distribution limits N-Nelson Bay S-Georges River.	x	x	-	-	x	x
Cryptostylis hunteriana OEH EPBC	V	V	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S-south of Eden.	x	x	-	-	x	x
Diuris praecox EPBC	V	V	Terrestrial orchid. Grows in sclerophyll forest near the coast. Distribution limits N-Nelson Bay S-Ourimbah.	x	x	-	-	x	x
Eucalyptus camfieldii OEH EPBC	V	V	Stringybark to 10m high. Grows on coastal shrub heath and woodlands on sandy soils derived from alluviums and Hawkesbury sandstone. Distribution limits N-Norah Head S-Royal NP.	x	x	-	-	x	x
Genoplesium insignis OEH	E1	-	Terrestrial orchid. Found in *Themeda* patches among shrubs and sedges in heathland and forest. Known from 3 localities in Wyong-Charmhaven area.	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	marginal	✓	✓	limited	✓
Maundia triglochinoides OEH	V	-	A reed-like herb which grows in swamps and shallow fresh water on clay. Distribution Limits N-Qld border S-Wyong.	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				CONSIDERED IN A 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	
Melaleuca biconvexa OEH EPBC	V	V	Tall shrub. Grows in wetlands adjoining perennial streams and on the banks of those streams, generally within the geological series known as the Terrigal Formation. Distribution limits N-Port Macquarie S-Jervis Bay.	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
Prostanthera askania OEH	E1	E	Erect shrub. Grows in sclerophyll forest on ridges in or adjacent to Rainforest. Distribution limits Strickland SF region.	x	x	-	-	x	x
Prostanthera junonis EPBC	E1	E	Small shrub. Grows in sclerophyll forest and heath in shallow soil on sandstone. Distribution limits Somersby region.	x	x	-	-	x	x
Rhizanthella slateri EPBC	V	E	Underground orchid that is poorly known. Grows in sclerophyll forests. Usually only seen if the soil is disturbed. Flowers in Oct – Nov.	x	x	-	-	x	x
Rutidosis heterogama OEH	V	V	Erect herb to 30cm. Grows mostly in heath, often along roadsides. Distribution limits N-Maclean S-Hunter Valley.	x	✓	✓	✓	✓	✓
Streblus pendulinus EPBC	-	E	Tree or large shrub to 6m tall. Coastal species along watercourses in warmer rainforest area.	x	x	-	-	x	x
Syzygium paniculatum OEH EPBC	V	V	Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N-Forster S-Jervis Bay.	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				CONSIDERED IN A 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	
Tetratheca juncea OEH EPBC	V	V	Prostrate shrub to 1m high. Dry sclerophyll forest and heath. Distribution limits N-Bulahdelah S-Port Jackson.	x	marginal	✓	✓	✓	✓
Thelymitra sp. *'Adorata'* OEH	E4	-	*Thelymitra sp. 'Adorara'* is a hairless terrestrial herb of the Orchidaceae family. A single linear to linear-lanceolate leaf emerges from the ground in about May, dying off in late November. The flowering period for this species is usually around September. The flowering stem is bluish-purple up to 60cm tall with fragrant pale to dark blue flowers. The extent of occurrence is about 5km2 bounded by Wyong, Warnervale and Wyongah. The species occurs from 10-40m a.s.l. in woodland with grassy understorey in well-drained clay loam or shale derived soils, associated with Dooralong Spotted Gum – Ironbark Forest with an open to dense shrub layer of *Melaleuca nodosa.*	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
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. Updated 1:100,000 database mapsheet requests to OEH are undertaken every 3 months as recommended. 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 A2.2 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 A 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**	
Wallum Froglet *Crinia tinnula* OEH	V	-	Found in acidic paperbark swamps and wallum country with dense groundcover. Breeds in temporary and permanent pools and ponds of high acidity. *Distribution Limit: N-Tweed Heads S-Kurnell.*	×	marginal	✓	✓	Low - on-site	✓
Giant Burrowing Frog *Heleioporus australiacus* 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* OEH EPBC	E	V	Terrestrial inhabitant of rainforest and wet sclerophyll forests. *Distribution Limit: N-near Tenterfield S-South of Bombala*.	×	×	-	-	×	×
Giant Barred Frog *Mixophyes iteratus* OEH EPBC	E	E	Terrestrial inhabitant of rainforest and open forests. *Distribution Limit: N-Border Ranges National Park. S-Narooma.*	×	×	-	-	×	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN A 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	
Green and Golden Bell Frog *Litoria aurea* OEH 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.*	×	×	-	-	×	×
Green-thighed Frog *Litoria brevipalmata* OEH	V	-	Found in rainforests and open forests within or at the edge of streams, swamps, lagoons, dams and ponds. *Distribution Limit: N-Border Ranges National Park. S-Near Gosford.*	×	×	-	-	×	×
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.*	×	×	-	-	×	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN A 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	
Stephens' Banded Snake *Hoplocephalus stephensii* OEH	V	-	A nocturnal and partly arboreal species that inhabits open and closed forest communities sheltering under bark, in hollows and under exfoliating slabs of granite. *Distribution Limit: N-Border Ranges National Park. S-Gosford.*	×	✓	✓ x1 nearby	✓	✓	✓
Rose-crowned Fruit-dove *Ptilinopus regina* OEH	V	-	Occurs in dense rainforests with a substantial understorey where it feeds entirely on fruit. *Distribution Limit" N-Tweed Heads. S-Wollongong.*	×	×	-	-	×	×
Superb Fruit-dove *Ptilinopus superbus* OEH	V	-	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. *Distribution Limit: N-Border Ranges National Park. S-Bateman's Bay.*	×	×	-	-	×	×
Black-necked Stork *Ephippiorhynchus asiaticus* OEH	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. *Distribution Limit: N-Tweed Heads. S-Nowra.*	×	✓	✓	×	low	✓

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN A 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	
Australasian Bittern *Botaurus poiciloptilus* OEH 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.*	×	×	-	-	×	×
Black Bittern *Ixobrychus flavicollis* OEH	V	-	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater and brackish streams and ponds, sheltered mudflats and oyster slats. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	×	-	-	×	×
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.*	×	✓	✓	✓	✓	✓

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN A 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	
Osprey *Pandion haliaetus* OEH	V	-	Utilises waterbodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. *Distribution Limit: N-Tweed Heads. 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.*	×	×	-	-	×	×
Comb-crested Jacana *Irediparra gallinacean* OEH	V	-	Floating vegetation of deep and permanent vegetation-choked tropical and warm temperate wetlands and dams. Occasionally feeds along muddy wetland margins. *Distribution Limit: N-Tweed Heads. S-Ku-ring-gai Chase National Park.*	×	×	-	-	×	×
Australian Painted Snipe *Rostratula australis* EPBC	V	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 A 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 > 2,000m on 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.*	×	✓	×	✓	low	✓
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.*	×	✓	×	×	low	✓
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*.	×	✓	✓	✓	✓	✓
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*.	×	✓	×	×	✓	✓
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.*	×	✓	×	×	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 A 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	
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 and densely vegetated gullies for roosting. *Distribution Limits: N-Border Ranges National Park. S-Eden.*	×	✓	✓	✓	✓	✓
Masked Owl *Tyto novaehollandiae* OEH	V	-	Open forest and woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. *Distribution Limit: N-Border Ranges National Park. S-Eden.*	×	✓	✓	✓	✓	✓
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 Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.*	×	×	-	-	×	×

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN A 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 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.*	×	✓	×	×	unlikely	×
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.*	×	×	-	-	×	×
White-fronted Chat *Epithianura albifrons* OEH	V	-	Found in open damp ground, grass clumps, fencelines, heath, samphire saltmarshes, mangroves, dunes, saltbush plains. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	✓	×	×	unlikely	×
Painted Honeyeater *Grantiella picta* OEH	V	-	A nomadic bird occurring in low densities within open forest, woodland and scrubland feeding on mistletoe fruits. Inhabits primarily Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. *Distribution Limit: N-Boggabilla. S-Albury with greatest occurrences on the inland slopes of the Great Dividing Range.*	×	✓	×	×	unlikely	×
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	✓

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN A 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-crowned Babbler *Pomatostoomus temporalis temporalis* OEH	V	-	Found in dry open forests, woodland scrubland, farmland with isolated trees. Distribution Limit mostly west of Great Dividing Range except Hunter Valley. *Distribution Limit: N-Qld widespread. S-Mornington Pen. E-se SA.*	×	×	-	-	×	×
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*.	✓	-	-	-	-	✓
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.*	×	✓	×	×	unlikely	✓
Flame Robin *Petroica phoenicea* OEH	V	-	Summer: forests, woodlands, scrubs, from sea-level to *c.* 1800m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. *Distribution Limit: N northern NSW tablelands. S-South of Eden.*	×	✓	×	×	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 A 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	
Diamond Firetail *Stagonopleura guttata* OEH	V	-	Found in Eucalypt woodlands, forests and mallee where there is grassy understorey west of the Great Div. also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence River Valleys. *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.*	×	✓	✓	✓	✓	✓
Southern Brown Bandicoot *Isoodon obesulus* OEH	E	E	Utilises a range of habitats containing thick ground cover - open forest, woodland, heath, cleared land, urbanised areas and regenerating bushland. *Distribution Limit: N-Kempsey. S-South of Eden.*	×	×	-	-	×	×
Koala *Phascolarctos cinereus* OEH EPBC	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. *Distribution Limit: N-Tweed Heads. S-South of Eden.*	×	Dispersal only	✓	2005	low	✓

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN A 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	
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*.	×	✓	×	-	unlikely	✓
Squirrel Glider *Petaurus norfolcensis* OEH	V	-	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. *Distribution Limit: N-Tweed Heads. S-Albury*.	×	✓	✓	✓	✓	✓
Long-nosed Potoroo *Potorous tridactylus* OEH EPBC	V	V	Coastal heath and dry and wet sclerophyll forests with a dense understorey. *Distribution Limit: N-Mt Warning National Park. S-South of Eden.*	×	✓	×	-	unlikely	✓
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 A 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.*	✓	-	-	-	-	✓
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* OEH	V	-	Rainforests, sclerophyll forests and woodlands. *Distribution Limit: N-North of Walgett. S-Sydney.*	×	✓	✓	2005	✓	✓
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 National Park. S-Wollongong.*	×	marginal	×	-	unlikely	✓

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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 Falsistrelle *Falsistrellus tasmaniensis* OEH	V	-	Recorded roosting in caves, old buildings and tree hollows. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	×	✓	✓	✓	✓	✓
Golden-tipped Bat *Kerivoula papuensis* OEH	V	-	Rainforest and adjoining moist open forest habitats, roosting in tree hollows and dense vegetation. *Distribution Limit: N-Border Ranges Nation Park. S-South of Eden.*	×	×	-	-	×	×
Little Bentwing-bat *Miniopterus australis* OEH	V	-	Roosts in caves, old buildings and structures in the higher rainfall forests along the south coast of Australia. *Distribution Limit: N-Border Ranges National Park. S-Sydney.*	×	✓	✓	✓	✓	✓
Eastern Bentwing-bat *Miniopterus orianae oceansis* OEH	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and 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.*	×	✓	✓	✓	✓	✓

COMMON NAME *Scientific Name* DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT *Distribution Limit*	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN A 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	
Greater Broad-nosed Bat *Scoteanax rueppellii* OEH	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. *Distribution Limit: N-Border Ranges National Park. S-Pambula.*	✓	-	-	-	-	✓
Eastern Cave Bat *Vespadelus troughtoni* OEH	V	-	Inhabits drier open forests and woodlands. Roosts in well-lit parts of caves and mineshafts. *Distribution Limit: Along GDR from N-Tweed Heads. S-Kempsey.*	×	marginal	×	-	unlikely	×
Eastern Chestnut Mouse *Pseudomys gracilicaudatus* TBE	V	-	Inhabits heathland including dense wet heath and swampy areas, occasionally in woodland with grassy understorey. *Distribution Limit: N-Border Ranges National Park. S-Brisbane Water National Park.*	×	✓	unverified	-	✓	✓
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.*	×	✓	×	-	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 A 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 Dragonfly *Petalura gigantean* OEH	E	-	Inhabits large relatively deep permanent swamps and bogs with high water quality and moss or other soft vegetation along the edge for egg laying. *It occurs in the far NE NSW, south to Kempsey, & in a patch between Gosford & Nowra.*	×	×	-	-	×	×

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	-	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 and 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.*	✓	×	-

COMMON NAME *Scientific Name*	PREFERRED HABITAT *Migratory Breeding*	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
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*.	✓	×	-
Latham's Snipe (*Gallinago hardwickii*)	Soft wet ground or shallow water with tussocks and other green or dead growth; wet parts of paddocks; seepage below dams; irrigated areas; scrub or open woodland from sea-level to alpine bogs over 2,000m; samphire on saltmarshes; mangrove fringes. *Breeds Japan. Regular summer migrant to Australia. Some overwinter.*	✓	×	-
Fork-tailed Swift (*Apus pacificus*)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. *Breeds Siberia, Himalayas, east to Japan south east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.*	✓	×	-

7 Part Test of Significance

A3

The impact upon threatened species, populations and / or EECs from any development or activity is required to be considered via the process of a 7 part test of significance. The significance of the assessment is then used to determine the need for a more detailed species impact statement (SIS).

The following 7 part test of significance relies on the ecological assessment provided in Sections 3 and 4 of this report and should be read as such.

The 7 part test of significance is as follows.

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

Detailed flora and fauna investigations of the subject site, together with habitat assessments, have resulted in the identification of potential habitat for a variety of threatened species. An assessment of these species is as follows:

Threatened flora

- *Acacia bynoeana*
- *Angophora inopina*
- *Grevillea parviflora* subsp. *parviflora*
- *Rutidosis heterogama*
- *Tetratheca juncea*

Endangered ecological communities

- none

Threatened fauna

Species denoted by * were recorded in surveys by *Travers bushfire & ecology*

Varied Sittella*
Grey-headed Flying-fox*
Greater Broad-nosed Bat*
Stephens' Banded Snake
Square-tailed Kite
Little Lorikeet
Swift Parrot
Powerful Owl
Masked Owl
Spotted-tailed Quoll
Squirrel Glider
Yellow-bellied Sheathtail-bat
East-coast Freetail Bat
Eastern Chestnut Mouse
Wallum Froglet
Black-necked Stork
Little Eagle
Gang-gang Cockatoo
Glossy Black-Cockatoo*
Barking Owl
Koala
Regent Honeyeater
Scarlet Robin
Flame Robin
Diamond Firetail
Yellow-bellied Glider

Eastern Falsistrelle
Little Bentwing-bat
Eastern Bentwing-bat
Large-footed Myotis
Long-nosed Potoroo
Large-eared Pied Bat
New Holland Mouse

Endangered populations

- *Eucalyptus parramattensis* subsp. *parramattensis* in the Wyong and Lake Macquarie LGAs.
- *Eucalyptus oblonga* at Bateau Bay

Flora Statement

Surveys of the subject site have failed to locate the presence of any threatened flora species despite the variable potential for each species to occur. As such, the proposal is unlikely to disrupt the life cycle for any of these listed species such that a viable local population would be placed at risk of extinction.

Fauna Statement

It is considered that the proposal is unlikely to disrupt the life cycle for any threatened fauna species recorded or with potential to occur such that a viable local population of these species would be placed at risk of extinction.

Summary of threatened fauna species recorded

Glossy Black-Cockatoo *(Calyptorhynchus lathami)*

The Glossy Black-Cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of *Allocasuarina*. They feed almost exclusively on the fruit of *Allocasuarina* species (*Lindsey* 1992). They choose trees with larger cone crops but show no sign of selecting trees on the basis of cone size – concentrating foraging in trees with a high ratio of total seed weight to cone weight. (Clout 1989). They breed in hollow trees or stumps usually in Eucalypts.

The subject site provides suitable nesting and foraging habitat for the Glossy Black-Cockatoo. This species was recorded present by evidence of foraging at three locations within the proposed APZ. Highly suitable nesting hollows have been identified within the study area and nearby and are shown on Figure 5. The most suitable tree considered for nesting potential is HT15 which I located within the recorded foraging dense grove of *Allocasuarinas*. This hollow was subsequently targeted twice during stag-watching survey. This species was not recorded during previous surveys within the proposed Warnervale Town Centre area.

The breeding period for Glossy Black-Cockatoo is between March-August (Pizzey 1997). The species may vary nesting within this period however typically the breeding pair will visit the nesting hollow regularly leading up to the nesting period for maintenance and ownership. Such visits typically occur late in the day prior to retreating to night time perches.

Given that recent March fauna survey included late afternoon listening for arriving birds (during stag-watching) both within the northern and southern portions of the study area, it is currently considered that the species is not utilising the suitable hollows within the subject site and nearby for nesting. Given that nesting may be taking place later in the breeding period this cannot be guaranteed. If a nesting hollow is removed or nesting activity is

disturbed by nearby development then this may be regarded as a significant impact given the species loyalty to nesting hollows and low population dynamics within the locality.

It will be recommended that further investigation is undertaken to ensure the site or nearby is not being utilised for nesting by Powerful Owl and an assessment conclusion can also be made for the Glossy Black-Cockatoo at this same time. As with the Powerful Owl, an assessment conclusion may be made immediately following the use of a tree climber to inspect hollows for evidence of previous nesting use by these species. Such inspections may require cutting into the side of the trunk for viewing contents and should be undertaken under the direction of a fauna ecologist.

Greater Broad-nosed Bat *(Scoteanax rueppellii)*

The Greater Broad-nosed Bat inhabits a variety of habitats including moist gullies in mature coastal forest, rainforest, open woodland, *Melaleuca* swamp woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree lined creeks in open areas (Churchill 2008). The Greater Broad-nosed Bat predominantly forages within open forest, woodlands, along vegetated creeklines and small river systems (Hoye and Richards 1995). This species roost in tree hollows, cracks and fissures in trunks and dead branches, under exfoliating bark as well as the roof of old buildings (Chuchill 2008, Hoye & Richards 1995).

The Greater Broad-nosed Bat feeds on large slow flying beetles and moths (Dwyer 1965; Vestjens and Hall 1977). This species is a slow flier and generally hunts for insects over understorey vegetation as well as foraging along the interface of clearings and paddocks with forested areas and along tree-lined creeks (Richards 1988).

The subject site provides suitable foraging, roosting and breeding habitat for the Greater Broad-nosed Bat.

The Greater Broad-nosed Bat was recorded to a high level of activity suggesting that a roost site may well be present within the subject site, or nearby. This would highlight the need for a supervised habitat removal process such that a roosting colony may be effectively recovered and relocated by a fauna ecologist. Such a recommendation would be required to prevent a significant impact outcome particularly based on recorded level of activity.

Typically microbats are assessed according to the extent of remaining habitat in a locality following any development proposal. In this regard there will be no significant impact on a local population of Greater Broad-nosed Bat in the short-term. It is beyond this assessment to consider future development of the total Warnervale Town Centre area.

Varied Sittella (*Daphoenositta chrysoptera*)

Varied Sittellas inhabit open eucalypt woodlands/ forests (except heavier rainforests), mallee, inland acacia, coastal tea-tree scrubs, golfcourses, shelterbelts, orchards, parks, scrubby gardens (Pizzey & Knight 1999).

Varied Sittella's feed mainly by gleaning arthropods from crevices on tree trunks or small branches and twigs in the tree canopy, moving downwards or along branches, searching for insects. They prefer rough or decorticating bark barked trees like stringybarks and ironbarks, standing dead trees, or mature trees with hollows or dead branches. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.

The subject site provides suitable foraging, roosting and nesting habitat for the Varied Sittella.

A family party of Varied Sittella was recorded during February 2013 survey foraging within the north-western extent of the study area. The study area itself provides only fragmented habitat for this species and this family group is expected to utilise the more extensive natural forest landscapes in the nearby surrounds. Available habitat will remain well represented beyond the subject site following development, including the recorded location. This species is adept to making a shift in nest site selection over consecutive years.

Therefore, there will be no significant impact on a local population of Varied Sittella as a result of the proposal within the subject site. It is beyond this assessment to consider future development proposals of the total Warnervale Town Centre area.

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

Grey-Headed Flying-foxes are canopy feeding frugivores and nectarivores, inhabiting a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. This species roosts in camps, which may contain tens of thousands of individuals.

Camps are commonly formed in gullies, typically not far from water and usually in vegetation with a dense canopy (Tidemann 1998). Camps can be found in riparian rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas. Loyalty to a site is high and some camps in NSW have been used for over a century (NSW NPWS 2001). Some camps are used at the same time every year by hundreds of thousands of flying-foxes while others are used sporadically by a few hundred individuals (Strahan 1995). Generally foraging is within 20km of camps but individuals are known to commute up to 50km to a productive food source.

The subject site provides suitable foraging habitat for the Grey-headed Flying-fox. The subject site and nearby surrounds does not support suitable habitat for roosting in camps and subsequent breeding habitat. Foraging habitat will remain well represent in the locality following the development proposal. Therefore the proposal will not likely significantly impact on this species such that a local population would be placed at risk of extinction.

Summary of threatened fauna species not recorded within the subject site but previously recorded nearby or with a considered high potential to occur

Powerful Owl *(Ninox strenua)*

The Powerful Owl breeds in open or closed sclerophyll forests and woodlands, including wet sclerophyll forest and dry sclerophyll forest and woodlands. They nest in hollows in large old trees; usually living Eucalyptus (Higgins 1999). A pair is generally faithful to a traditional nesting hollow. Powerful Owls form pairs for life, and are strongly territorial. Estimates of the home range of this species vary greatly, but territories are thought to range from 800 to 1500 hectares (Kavanagh 1997). Powerful Owls feed mainly on those medium-sized species of arboreal marsupials that are most readily available at any given locality. (Lavazanian et.al. (1994).

The subject site provides suitable roosting, nesting and foraging habitat for the Powerful Owl. Roosting habitat is limited and is only present in the far south-eastern and south-western vegetated extent. Suitable nesting trees are identified on Figure 5. The Powerful Owl was recorded on Lot 1 (DP 357408) in November 2003 during survey by Forest Fauna Surveys (2004).

Described recording by Forest Fauna Surveys

A roost of the Powerful Owl (Ninox strenua) was located in forest on Lot 55 (DP 7527) located to the east of the subject site described then as a Council Quarry off Hakone Road. An inspection of all habitat trees within 100m radius of the roost located a mature Blackbutt (Eucalyptus pilularis) with a large hollow suitable as a nesting site for the species.

An individual was observed foraging in the Planning NSW land west of the Main Northern Railway on the evening of 20 November 2003. The individual flew east over the railway line into the disused Quarry site off Hakone Road. No evidence of the species was noted by surveys using playback of pre-recorded calls of the species.

During recent surveys all potential nesting trees within the study area and nearby to the east and south were identified. This survey was undertaken in February and March (prior to the breeding season). At this time searches for owl activity was undertaken throughout the survey period with particular attention around suitable nesting trees. A total of three nights of survey included stag-watching of most suitable hollows within or close to the study area which included quiet listening after dark for nearby calls. The species is known to call at this time of year leading up to the breeding season. No evidence of recent or previous owl activity was recorded.

Based on these finding it is not expected that nesting activity is taking place within or close to the study area. It is however too early to confidently conclude this and a precautionary approach is prudent for the following reasons:

- This species is long-lived (up to and possibly over 30 years) and is loyal to home range areas. If one of a breeding pair dies the other of the pair will retain the home range and attempt to pick up a younger mate in dispersal. Therefore the area to the immediate east of the subject site may be of high value to a local pair as previously considered by *Forest Fauna Surveys* (2004).
- The local pair was only evident based on two observations and there was no recording by call or response by this pair to call playback. This is more likely due to time of year.
- The tree identified as a likely nest was located within 200m of the subject site. A tree was identified as a high potential nest tree for Powerful Owl during recent survey which was located within 40m of the eastern boundary to the study area. This is the most northern tree with a yellow circle marked on Figure 5. Other potential nest trees area also noted.
- Removal or disturbance of a nesting site may be regarded as a significant impact to a local population given the species loyalty to nesting hollows and low population dynamics within any locality.

Surveys during the breeding season (mid-May to September) are recommended to determine site significance for Powerful Owl. This survey may be combined with survey for Glossy Black-Cockatoo nesting activity at this time. An owl specialist may determine site significance for Powerful Owl as early as mid-April.

A more immediate determination can be made by use of a tree climber to inspect the suitable hollows under the supervision of a fauna ecologist. In this case where the chamber floor is too deep for inspection, a viewing hole may be cut by chainsaw in the trunk. Previous breeding activity is evident in the hollow by owl pellets from young, feathers/down and or egg shell particles.

A final assessment conclusion should be made for this species following hollow inspection or target survey during the recognised breeding period. In the case that nesting is taking place

within 50m of the proposed development then a significant impact may be concluded. This outcome is not currently expected based on observations to date.

Masked Owl *(Tyto novaehollandiae)*

The Masked Owl is widespread through forests and woodlands. The Masked Owl is known to utilise forest margins and isolated stands of trees within agricultural land. The Masked Owl is distributed most widely along forested areas of coast, escarpment and tablelands, although it occurs at lower population densities in drier forests and woodlands of NSW western slopes. It is most frequently encountered in open forest with a sparse understorey or ground cover, or at the ecotone between closed forest and open forest or woodland. This species is often found in heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained. The Masked Owl is dependent upon hollow bearing trees all year round requiring old mature trees with large hollows for breeding and as diurnal roosting sites.

Nesting hollows selected are greater than 40cm wide and greater than 100cm deep and are not found to be located with any proximity requirements to streams. Nesting hollow entrances are at least 3 metres above the ground in trees greater than 90cm diameter at breast height. Pairs are faithful to a traditional nesting hollow, but may also use alternate hollows in the breeding territory in different years (Schode and Mason 1980, Kavanagh and Murray 1996, Kavanagh and Murray 1996, Kavanagh 2002, Mooney 1997, Higgins 1999).

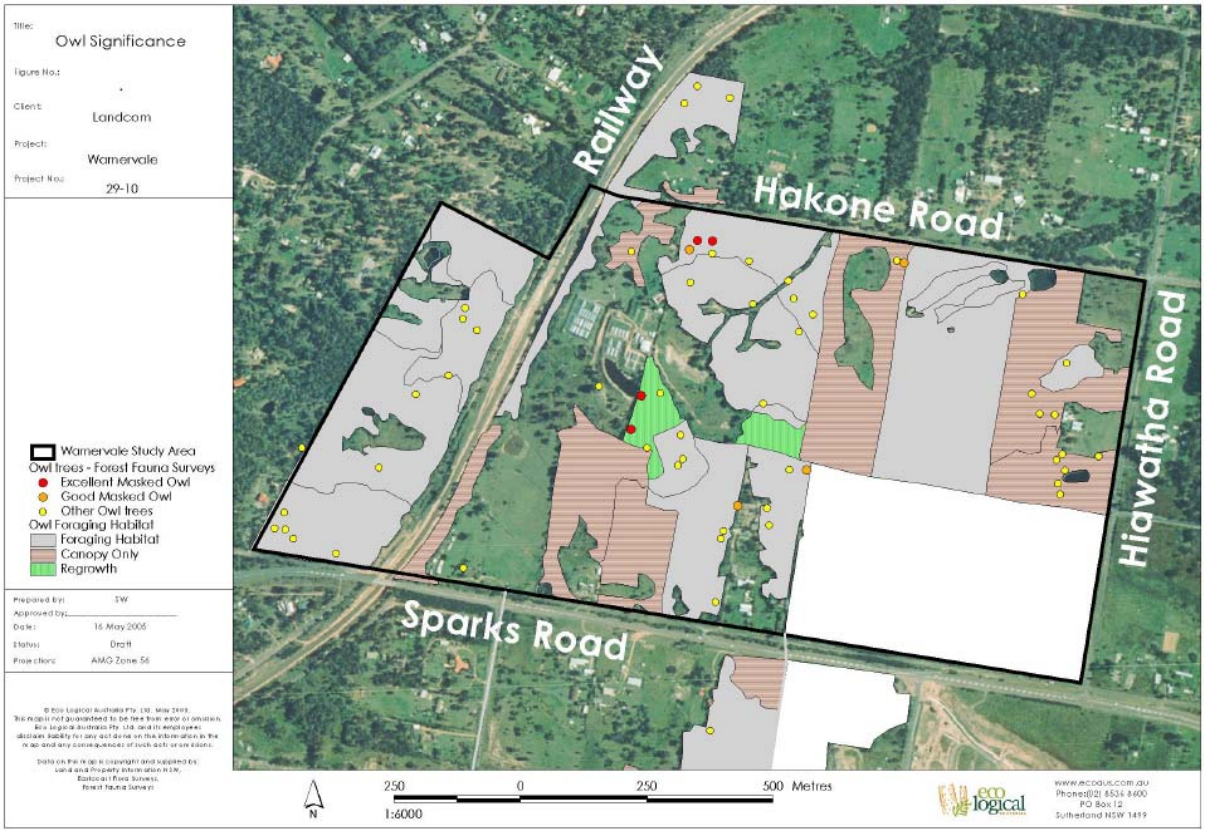
It is unclear why the Masked Owl was outlined as a potentially impacted species in previous assessments by *Bell and Murray* (2004) and *Ecological* (2005, 2008 & 2012). *Bell and Murray* (2004) indicated that the Masked Owl was located in the wider Warnervale District during the 2001 investigations, but was not located in the study area during 2003. One tree considered as a suitable roost or nest tree was located within the Warnervale Town Centre area during this study.

DEC (2004b) requested additional information for the assessment of conservation values across the Warnervale Town Centre area, with the following investigation listed as one to be considered as “highest in priority”:

- “*mapping of habitat trees across the site, including identification of any Powerful Owl (and Masked Owl) nest trees, and Powerful Owl, Masked Owl and threatened bat roost trees.”*

The following habitat tree map (Insert 1) was prepared by Ecological (2008) but only addressed potential habitat trees for Masked Owl. *Travers bushfire & ecology* have undertaken an assessment of trees within the subject site and identified those trees also suitable for Powerful Owls and Glossy Black Cockatoo.

Masked Owl and Powerful Owl have not been recorded within the site to date including the most recent surveys by *Travers bushfire and ecology*.



Insert 1: Threatened owl trees, highlighting those trees noted by FFS 2005 as being of potentially higher quality for the Masked Owl (Source: Ecological 2008)

This figure indicates that four trees were selected to be excellent Masked Owl trees within the entire Warnervale Town Centre area. These trees are all located along the eastern boundary of the current study area (Lot 521) or nearby and were identified during recent surveys of potential owl trees. The figure highlights that other trees within the Warnervale Town Centre area under previous investigations may not be as suitable for use by owls.

The considerations for Masked Owl are therefore consistent with that of Powerful Owl. A final assessment conclusion should be made for this species following hollow inspection or target survey during the recognised breeding period. In the case that nesting is taking place within 50m of the proposed development then a significant impact may be concluded. This outcome is not currently expected based on observations to date.

Squirrel Glider (*Petaurus norfolcensis*)

Squirrel Gliders inhabit mixed aged stands of eucalypt forest & woodlands including gum barked and high nectar producing species with hollow bearing trees. Its diet varies seasonally and consists of nectar, pollen, plant exudates and invertebrates (Menkhorst & Collier 1987). According to Quin (1995) the home-ranges of Squirrel Gliders have been estimated at between 0.65 and 8.55 ha, the movement of males being greater than that of females. Nightly movements are estimated at between 300 and 500 m. Quin (1995) found that the home-range of a family group is likely to vary according to habitat quality and availability of resources. The presence of mature, hollow-bearing eucalypts is a critical characteristic of habitat occupied by Squirrel Gliders as they are utilised for nesting and breeding (Suckling, 1995).

It is considered that the subject site provides suitable foraging, denning and breeding habitat for the Squirrel Glider. A detailed Squirrel Glider habitat assessment has been prepared in Section 4.3.3 of this report. This assessment concludes the following:

It is considered that the habitat available within the surrounding locality for Squirrel Gliders is high. This is particularly within the lower fertile landscapes that extend initially to the south-east from the subject site and also along the southern fringes of Hakone Road. Much of this suitable habitat is proposed for removal as part of the Warnervale Town Centre proposal.

The study area itself particularly within Lot 521 has been subject to previous extensive clearance or disturbance resulting in usable but not natural portions of available habitat for Squirrel Gliders. The extent of the available habitat proposed for removal within the subject site is minimal by comparison to the remaining areas of suitable (and particularly natural) areas of habitat in the remaining nearby surrounds. It is beyond the scope of this assessment to consider the future development areas of the proposed Warnervale Town Centre.

No Squirrel Gliders have been recorded present within the subject site during spotlighting surveys however no trapping effort has been undertaken within the site to date. Trapping surveys in adjacent higher quality habitat to the south (by Conacher Environmental Group 2012) did not record any presence of Squirrel Gliders. Based on the available habitat, connectivity and previous records it is considered that there is potential for Squirrel Gliders to be utilising the available habitat seasonally or in future population movements, however such habitat is not expected to be central or of high importance to the local population.

Based on this assessment it is concluded that the proposal will not likely significantly impact on this species such that a local population would be placed at risk of extinction. It is recommended that a fauna ecologist is to supervise the removal of identified habitat trees suitable for use by Squirrel Gliders during the tree clearance works. This is to ensure that any resident gliders may be effectively recovered and relocated into surrounding appropriate habitat.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

- *Eucalyptus parramattensis* subsp. *parramattensis* in the Wyong and Lake Macquarie LGAs

The Smooth-barked Apple – Brown Stringybark – Paperbark Forest may provide some level of potential habitat for the population to exist, however no specimens have been observed.

- *Eucalyptus oblonga* at Bateau Bay

This population occurs a long distance from the site and is not recognised within the local area geographically.

There are no endangered fauna populations currently recognised in the Wyong LGA.

Therefore, it is considered that the action proposed is not likely to have an adverse effect on the life cycle of these species that constitute the endangered populations such that a viable local population of these species is likely to be placed at risk of extinction.

c) In the case of a critically endangered or endangered ecological community, whether the action proposed:

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

Vegetation within the site is not commensurate with any locally occurring EEC.

It is therefore considered that the proposed development is unlikely to have an adverse effect on the extent of any ecological community such that its local occurrence is likely to be placed at risk of extinction.

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

Vegetation within the site is not commensurate with any locally occurring EEC.

d) In relation to the habitat of threatened species, populations or ecological community:

It is considered that the habitat attributes of the subject site provide known or potential habitat for *Acacia bynoeana, Angophora inopina, Grevillea parviflora* subsp. *parviflora, Rutidosis heterogama, Tetratheca juncea,* Varied Sittella, Grey-headed Flying-fox, Greater Broad-nosed Bat, Stephen's Banded Snake, Square-tail Kite, Little Lorikeet, Swift Parrot, Powerful Owl, Masked Owl, Spotted-tailed Quoll, Squirrel Glider, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Eastern Falsistrelle, Little Bentwing-bat, Eastern Bentwing-bat, Large-footed Myotis, Eastern Chestnut Mouse, Wallum Froglet, Black-necked Stork, Little Eagle, Gang-gang Cockatoo, Glossy Black-Cockatoo, Barking Owl, Koala, Regent Honeyeater, Scarlet Robin, Flame, Robin, Diamond Firetail, Yellow-bellied Glider, Long-nosed Potoroo, Large-eared Pied Bat and New Holland Mouse.

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

It is likely that all vegetation will be removed or modified in the long term providing habitat for the aforementioned species. This will include the removal or modification of an estimated;

- 2.54 ha of disturbed Smooth-barked Apple – Brown Stringybark +/- Paperbark Forest
- 0.31 ha of dam habitat

Note, the dam habitat is not likely to be central to the needs of any of the aforementioned species and only a few of the species are likely to make foraging use upon such habitat.

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

The vegetation on site is largely regrowth or contains remnant canopy with a managed or lack of mid-storey vegetation. The site is not central to any connective values, and the loss of vegetation within the site is unlikely to fragment or isolate a threatened species.

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

With respect to flora, the importance is not considered to be high as the vegetation is highly disturbed and is not currently supporting any known threatened flora species. The vegetation is not part of any recognised EEC and there are no endangered flora populations present. The site is not recognised as a biodiversity corridor for fauna.

The subject site is not currently considered to be central or of significance to any local population of threatened fauna species. This is on the assumption that suitable large hollows for nesting are not being utilised by the Glossy Black-Cockatoo or Powerful Owl. In this case the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population and ecological communities in the locality is considered to be minimal.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

The site has not been identified as critical habitat within the provisions of the TSC Act. Therefore this matter does not require any further consideration at this time.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Draft state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Barking Owl (*Ninox connivens*) (NPWS 2003)

Approved state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Large Forest Owls ((Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*)) (DEC 2006).
- Yellow-bellied Glider (*Petaurus australis*) (NPWS 2003)

It is considered that the proposed development is generally consistent with the objectives or actions of the above-mentioned draft and approved recovery plans.

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

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

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

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic Climate Change			✓
Bushrock removal			✓
Clearing of native vegetation	✓		
Competition and habitat degradation by feral goats			✓
Competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*)			✓
Competition from feral honeybees			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life-cycle processes in plants and animals and loss of vegetation structure and composition			✓
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants into NSW			✓
Infection by *Psittacine circoviral* (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis			✓
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae		✓	
Infection of native plants by *Phytophthora cinnamomi*		✓	
Introduction of the large earth bumblebee (*Bombus terrestris*)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch Broom (*Cytisus scoparius*)			✓
Invasion and establishment of the Cane Toad (*Bufo marinus*)			✓
Invasion, establishment and spread of *Lantana camara*		✓	
Invasion of native plant communities by bitou bush & boneseed *Chrysanthemoides monilifera*			✓
Invasion of native plant communities by exotic perennial grasses		✓	
Invasion of native plant communities by African Olive (*Olea europaea* subsp. *cuspidata*)			✓
Invasion of the Yellow Crazy Ant (*Anoplolepis gracilipes*)			✓
Loss of Hollow-bearing trees	✓		
Loss and/or degradation of sites used for hill-topping by			✓

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
butterflies			
Predation and hybridisation by feral dogs (*Canis lupus familiaris*)			✓
Predation by the European Red Fox (*Vulpes vulpes*)			✓
Predation by the Feral Cat (*Felis catus*)			✓
Predation by Plague Minnow or Mosquito Fish (*Gambusia holbrooki*)			✓
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island			✓
Predation, habitat degradation, competition & disease transmission from Feral pigs (*Sus scofa*)			✓
Removal of dead wood and dead trees	✓		

Summary of "likely" or "possible" Key Threatening Processes

Clearing of native vegetation

The proposal is of a class of development recognised as a threatening process. It is generally recommended that all sites should aim to achieve a maintain or improve outcome on the quality and quantity of native vegetation cover through protection and restoration measures. In the case of the Warnervale Town Centre, a Biodiversity Conservation Assessment Report has been prepared by Eco Logical Australia (2012) to address the conservation needs of threatened species and EECs via the biobanking calculator.

Infection of native plants by Phytophthora cinnamomi

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

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

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

Invasion, establishment and spread of Lantana camara

The site currently contains this species, however it is expected that the proposed development will provide an opportunity to remove, control and manage this species throughout the whole of the site by the application of suitable weed control methods.

Invasion of native plant communities by *Chrysanthemoides monilifera*

This species is present on the subject site. The proposed development may provide an opportunity to ameliorate the effect of this key threatening process by the application of suitable weed control measures.

Invasion of native plant communities by exotic perennial grasses

The site currently contains invasive perennial grasses such as Kikuyu and Tussock Paspalum, however it is expected that the proposed development will provide an opportunity to remove, control and manage this species throughout the whole of the site by the application of suitable weed control methods.

Loss of Hollow-bearing Trees

Hollow-bearing tree surveys identified fourteen hollow-bearing trees containing large (30cm+), medium (10-30cm) and small (0-10cm) sized hollows within the proposed development area requiring removal. A further four hollow-bearing trees were identified within the proposed APZ to the east. Three of these are dead trees and will also require removal. As such the proposal is of a class of development recognised as a threatening process.

Threatened species with potential habitat within the site and dependant on hollows of this nature include Stephens Banded Snake, Glossy Black-Cockatoo, Gang-gang Cockatoo, Barking Owl, Powerful Owl, Masked Owl, Little Lorikeet, Spotted-tailed Quoll, Squirrel Glider, Eastern Falsistrelle, Yellow-bellied Glider, East-coast Freetail Bat, Greater Broad-nosed Bat, Large-footed Myotis and Yellow-bellied Sheathtail-bat. The Glossy Black-Cockatoo was recorded during surveys undertaken and the Powerful Owl, Little Lorikeet and Squirrel Glider have been previously recorded nearby. The replacement of hollows with nest boxes is recommended to supplement the loss of natural hollows.

Removal of dead wood and dead trees

The proposal will require the removal of deadwood and dead trees and as such is of a class of development recognised as a threatening process. Threatened fauna species with potential habitat within the subject site and likely dependent on dead wood or dead trees include Varied Sittella, Scarlet Robin and Flame Robin. The Varied Sittella was recorded present during survey. Relocating deadwood into proposed conservation areas is a costly initiative that typically is not recommended. Therefore removal of deadwood and dead tree habitat within the subject site is calculated as a loss of this habitat resource.

National - Significant Impact Criteria

A4

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

CRITICALLY ENDANGERED AND ENDANGERED SPECIES

Significant impact criteria

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

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

>> What is a population of a species?

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

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

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

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- To maintain genetic diversity and long term evolutionary development; or
- For the reintroduction of populations or recovery of the species or ecological community.

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

VULNERABLE SPECIES

Significant impact criteria

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

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

>> What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES

Significant impact criteria

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

- Reduce the extent of an ecological community;
- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- Adversely affect habitat critical to the survival of an ecological community;
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
  - assisting invasive species, that are harmful to the listed ecological community, to become established; or
  - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- Interfere with the recovery of an ecological community.

MIGRATORY SPECIES

Significant impact criteria

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

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

>> What is important habitat for a migratory species?

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

>> What is an ecologically significant proportion?

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

>> What is the population of a migratory species?

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