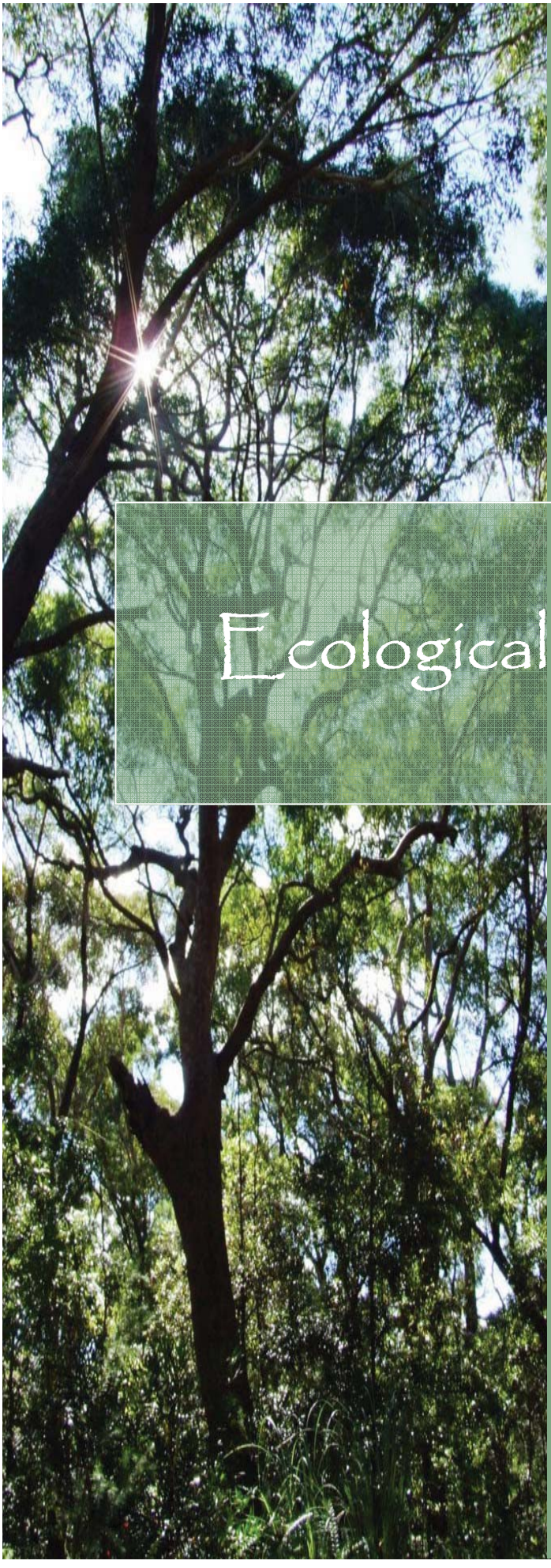

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# Ecological Assessment

**OXFORD FALLS SENIORS LIVING RESORT**

**OXFORD FALLS ROAD AND BARNES ROAD OXFORD FALLS**

**JUNE 2010**

**(REF: A10027)**

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bushfire & ecology

# ECOLOGICAL ASSESSMENT

# OXFORD FALLS ROAD AND BARNES ROAD, OXFORD FALLS

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Checked by:
Date: 8th June 2010
File: A10027



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# EXECUTIVE SUMMARY

*Travers bushfire & ecology* has been commissioned to undertake an ecological assessment designed to identify the ecological characteristics of Lots 1110, 1111, 1113 & 1336 DP 752038, Lot 20 DP 842523 and Lot 80 DP 846099, located at Oxford Falls Road and Barnes Road, Oxford Falls, within the Warringah Local Government Area.

The Concept Plan seeks approval for the uses, building envelopes and yield, the proposed development. The development has several components, including a nursing home facility, serviced apartments, self-care dwellings, community and retail facilities and 24-hour, seven-day access to medical care, through the provision of on-site doctors and health care professionals.

The proposal has been declared a Major Project under Part 3A of the *Environmental Planning and Assessment Act* and Director General Requirements (DGRs) were issued by the NSW Department of Planning (DoP) in 2006 and again in 2009. A copy of the DGRs are supplied in Appendix 2.

## Ecological Assessment

In 2009, the Department of Environment and Climate Change and Water (DECCW) reviewed the 2008 report submission. A copy of the DECCW letter is supplied in Appendix 3. This Ecological Assessment addresses issues raised by DECCW.

In respect of matters required to be considered under the *Environmental Planning & Assessment Act 1979* and relating to the species / provisions of the *Threatened Species Conservation Act 1995*, four (4) threatened fauna species, Powerful Owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Glossy Black-Cockatoo (*Calyptorhynchus lathami*) and Eastern Bentwing-bat (*Miniopterus orianae oceansis*) were recorded within the subject site.

No threatened flora species and no endangered ecological communities were recorded within or in close proximity to the site.

Criteria used to assess the potential impacts of the Project Application on the extent of suitable habitat for threatened flora and fauna species and endangered ecological communities recorded within the site or considered likely to occur within it are:

- Existing area of vegetation or habitat (ha)
- Area of vegetation / habitat to be removed (ha)
- Area of vegetation / habitat to be retained/restored (ha)
- Area of vegetation / habitat to be revegetated/offset (ha)

Threatened fauna species selected for assessment are those with potential to occur and/or identified by the DGRs (DoP 2006) and/or DECCW (2009) as explained in Section 4.9 of this report. All flora species with potential to occur have been assessed in Table 5.1.

## Summary Conclusions

1. The site passes the “Maintain or Improve” test as set out in the Biodiversity Act.

2. Development maintains three (3) vegetation corridors.

3. Development rehabilitates on site streams including the Middle Creek corridor.

4. Riparian restoration will occur on site in accordance with the Water Management Act.

5. Asset protection zones have been located external to riparian zones however they enhance arboreal connectivity with the riparian zones.

6. There is no loss of riparian habitat on the site.

7. Conserved bushland has been increased from 3.47ha to 3.80ha.

8. Native vegetation retention is improved across the site.

9. Loss of exotic grasslands on the site is of no impact on ecological outcomes.

10. Restoration of threatened species habitat is planned.

11. Restoration works on site will increase Swamp Mahogany habitat and the capability for the two threatened bird species e.g. Regent Honeyeater and Swift Parrot.

12. Restoration will also provide a greater presence of Grey Gum *E. punctata* as a koala feed tree.

13. Four (4) threatened fauna species were recorded at the site and these are Powerful Owl, Grey-headed Flying-fox, Eastern Bentwing-bat and Glossy Black-Cockatoo.

14. No threatened flora species and no endangered ecological communities within or in close proximity to the site.

15. Of the community / threatened species recorded, the site achieved an “improve” outcome on 18 out of 19 species – a very good ecological outcome.

16. Two site dams present within the site will be rehabilitated and retained.

17. Best-practice stormwater management is planned and will utilise local species and retain over 85% of the hollow-bearing trees identified on site.

18. A Vegetation Management Plan will be prepared in accordance with DECCW guidelines.

19. All buildings works are specifically designed not to impact on riparian / wildlife corridors in accordance with DECCW requirements.

20. All significant trees on site have been protected.

21. Replacement of 201 trees is proposed within conservation zones.

22. Reused hollows will be relocated to natural areas near the site and replaced at a 1:1 ratio.

23. The “maintain or improve” test has been fulfilled and therefore the proposed development will not have a significant impact on any threatened species, populations or endangered ecological communities.

24. There will not be a significant impact due to the proposed development on any matters of environmental significance

25. The conservation value of the site has been fully assessed by this report.

The following provides a basis of understanding in respect of key issues and outcomes addressed within the report.

**Maintain or Improve Test**

The 'maintain or improve' test is an ecological test applied by DECCW in order to evaluate whether a development either maintains and/or improves, or potentially degrades/removes, existing vegetation and insitu habitat resources. The test evaluates the impact of a development upon threatened species and/or their habitats.

The assessment is set out in accordance with the *DRAFT Guidelines for Threatened Species Assessment* (DEC & DPI 2005).

**Maintain or improve table – potential flora and fauna habitat**

| Community / Threatened Species | Area (ha) Pre-development | Area (ha) Post Development | Difference (ha) | Maintain / Improve / Decline |
|---|---|---|---|---|
| ***Threatened Species Recorded On Site*** | | | | |
| Powerful Owl | 3.11 | 3.8 | + 0.69 | Improve |
| Glossy Black-Cockatoo | 1.32 | 1.52 | + 0.2 | Improve |
| Grey-headed Flying-fox | 4.15 | 4.52 | + 0.37 | Improve |
| Eastern Bentwing-bat | 12.52 | 8.0 | - 4.52 | Decline |
| ***Threatened Species with Potential to occur but Not Recorded On Site*** | | | | |
| *Acacia bynoeana* | 1.89 | 2.07 | + 0.18 | Improve |
| *Darwinia biflora* | 0.30 | 0.39 | + 0.09 | Improve |
| *Epacris purpurascens var. purpurascens* | 0.30 | 0.39 | + 0.09 | Improve |
| *Eucalyptus camfieldii* | 3.35 | 3.49 | + 0.14 | Improve |
| *Lasiopetalum joyceae* | 0.54 | 0.56 | + 0.02 | Improve |
| *Melaleuca deanei* | 0.15 | 0.39 | + 0.24 | Improve |
| *Persoonia hirsuta* | 0.15 | 0.39 | + 0.24 | Improve |
| *Pimelea curviflora var. curviflora* | 0.15 | 0.39 | + 0.24 | Improve |
| *Tetratheca glandulosa* | 0.12 | 0.39 | + 0.27 | Improve |
| Red-crowned Toadlet | 0.084 | 0.092 | + 0.008 | Improve |
| Rosenberg's Goanna | 1.56 | 1.69 | + 0.13 | Improve |
| Barking Owl | 5.32 | 6.67 | + 1.35 | Improve |
| Spotted-tailed Quoll | 1.92 | 2.85 | + 0.93 | Improve |
| Southern Brown Bandicoot | 1.29 | 1.69 | + 0.4 | Improve |
| Koala | 0.31 | 0.46 | + 0.15 | Improve |

**Conservation Strategy**

Following extensive ecological survey of the landscape a conservation strategy was prepared. This plan provided protection for three (3) conservation corridors. These include;

1. The Middle Creek tributary corridor is a variable 32.5m to 75m wide native vegetation corridor. In addition the proposed vegetation enriched Asset Protection Zones (APZs) adjacent to the riparian corridor, increase the effective width canopy connectivity of the Middle Creek corridor by another 10-35m albeit a managed landscape. The current length of the corridor is approximately 575m long (including the segment outside of the subject site immediately south of Barnes Road) by up to 75m in width

(inclusive of the managed vegetation buffer – 10m). The APZs are not a deterrent to wildlife utilisation, although specific management within the APZs will be required to ensure that vegetation retention and revegetation is in accordance with acceptable fuel load levels.

2. The western (escarpment hillside and plateau edge) corridor, along the south western edge of the proposed development forms another secondary corridor linking surrounding and elevated vegetation remnant to the Middle Creek Tributary. The current size of the western corridor is approximately 300m long by a variable width of between 24-55m in width.

3. Remaining internal and fringing APZs throughout the proposed development landscape provide managed arterial tertiary corridors which permit canopy connectivity and the passage of predominantly avian and arboreal fauna species.

The movement of flora and fauna on site will be encouraged through the provision of the above terrestrial and riparian corridors, landscaped open space, vegetation enriched APZs, retention (where possible) of any significant canopy and habitat trees, and the revegetation of corridor areas that currently lack native vegetation.

The APZs will be landscaped so as to include canopy vegetation and planting of native landscape beds. Consequently, the combination of dedicated wildlife corridors and native landscape plantings within the development landscape and associated APZs will significantly enhance native vegetation cover onsite.

Currently there are 3.47ha of remnant bushland vegetation onsite (vegetation communities 1 and 4 – see Figure 1). As a result of the proposed development, the vegetation onsite will increase to approximately 3.80ha through the restoration of riparian landscapes and consolidation of remnant vegetation in the sandstone escarpment zone. Additionally, there will be small restoration works along the northern and southern boundaries that will become secondary corridors.

In achieving 3.80ha of vegetation on site, there will be an initial removal of 1.50ha of vegetation communities 1 and 4 combined, followed by restoration of approximately 1.83ha. Therefore, an overall 'Improve' outcome will be achieved in native vegetation alone. Other measures, such as habitat enhancement with artificial nest boxes, will further enhance the insitu habitat for the breeding of common and threatened fauna species on site.

An additional 1.06 ha of the subject site not currently in a vegetated state will form the proposed managed vegetated buffer. This has not been added to the calculation of 3.80ha of restoration as the managed vegetated buffer will not have a fully vegetated structure.

**Ecological Benefits of the Proposed Development**

There are many ecological benefits of the development and they are as follows:

- Enhancing habitat for insitu threatened species, threatened species habitat for migratory and or transient species and repairing fragmented threatened species habitat

- Increasing the areas of *Peppermint – Angophora Woodland / Open Forest, Aquatic Herbfield* (Creek line and dams) and *Kunzea – Tea-tree Tall Heath*

- Increasing the areas of riparian habitat on T1, T2 and the Middle Ck Tributary

- Increasing the areas of terrestrial, riparian / aquatic corridors
- Potential for increasing habitat trees for forest owls and significant tree habitat for Arboreal mammals
- Potential for increasing notable habitat trees
- Potential for resolving effluent disposal
- Potential for resolving direct impacts and indirect impacts from development.

**Mitigation Strategies**

The mitigation strategies will generally be implemented under the Vegetation Management Plan in perpetuity and are intended to result in a substantial increase in the quality, over the long term, of suitable habitat for threatened fauna species utilising the site.

In addition, revegetation and restoration works associated with the proposal will result in an improvement in vegetation connectivity across the site and hence the movement of native fauna within the site and to vegetation off site.

**Vegetation Management**

A Vegetation Management Plan (VMP) shall be prepared for the riparian restoration, the terrestrial corridor, tertiary landscape linkages and vegetation enriched APZs. The VMP will be prepared in accordance with DECCW guidelines and will be an integrated planning tool to identify the ongoing management of the wildlife corridors, habitat resources, weeds, native landscaping within the development and asset protection zones and site works to maximise the retention of existing habitat resources.

The proposed development will implement best practice stormwater management measures, will utilise locally occurring native plants within all landscaping works and will retain over 85% of the hollow-bearing trees identified within the subject site.

In addition, the proposed development as a whole will increase the visual amenity of existing bushland within the site through revegetation, weed control and consolidation of remnant patches as wildlife corridors (shown as biodiversity zones on Figure 3).

In relation to State Environment Planning Policy No. 19 – Bushland in Urban Areas (SEPP 19) the proposed development will not remove any native vegetation within designated open space areas - Lot 29 DP 829321 and Lot 21 DP 842523 (owned by Council). All aspects of the proposed development will ensure the protection of open space bushland area adjoining the site being - Lot 1334 DP 752038 to the east (owned by Council).

**Conclusion**

In accordance with the *Threatened Species Assessment Guidelines* and the *Biometric Field Methodology*, the *Maintain or Improve Test* has concluded that the proposed development will not have a significant impact on any threatened species, populations or endangered ecological communities. Therefore, a Species Impact Statement is not required for the proposed development.

In respect of matters required to be considered under the EP&A Act and relating to the species/provisions of the TSC Act*, f*our (4) threatened fauna species, Powerful Owl (*Ninox*

*strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Glossy Black-Cockatoo (*Calyptorhynchus lathami*) and Eastern Bentwing-bat (*Miniopterus orianae oceansis*) within or in close proximity to the subject site. No threatened flora species, populations or EECs were recorded within or in close proximity to the subject site

In respect of matters required to be considered under the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act), no protected migratory bird species, no threatened flora species, and no EECs were recorded within or in close proximity to the site. One (1) threatened fauna species Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded.

The proposed development is not considered to have a significant impact on matters of national environmental significance. As such, a referral to the Commonwealth *Department of the Environment, Water, Heritage and the Arts* is not required.

In respect of matters relative to the *Fisheries Management* (FM Act) *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.

It is concluded that the proposed development of Lots 1110, 1111, 1113 & 1336 DP 752038, Lot 20 DP 842523 and Lot 80 DP 846099 Oxford Falls Road and Barnes Road, Oxford Falls, is unlikely to result in a significant impact on any threatened species, populations or endangered ecological communities or their habitats.

As such, no further assessments are considered to be required under the *EP&A Act,* the *EPBC Act,* the *FM Act* or the *WM Act.*


Report prepared by:

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Licences

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

The staff of *Travers bushfire & ecology* are 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.

## 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 |
| DEWHA | Federal Department of the Environment, Water, Heritage and the Arts |
| 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 |
| OPA | outer protection area |
| PBP | *Planning for Bush Fire Protection 2006: A Guide for Councils, Planners, Fire Authorities and Developers* |
| POM | plan of management |
| RF Act | *Rural Fires Act 1997* |
| RFS | NSW Rural Fire Service |
| ROTAP | rare or threatened Australian plant |

## List of abbreviations

| | |
|---|---|
| SEPP 44 | *State Environmental Protection Policy No 44 – Koala Habitat Protection* |
| 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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**FIGURES**



**TABLES**



**APPENDICES**



**SCHEDULES**

# 1 INTRODUCTION

*Travers bushfire & ecology* was engaged by *Tiffany Developments* to undertake an ecological assessment within Lots 1110, 1111, 1113 & 1336 DP 752038, Lot 20 DP 842523 and Lot 80 DP 846099 Oxford Falls Road and Barnes Road, Oxford Falls within the Warringah LGA. The combined lots will hereafter be referred to as the subject site.

Figure 1 shows the ecological survey effort undertaken, location of vegetation communities and threatened species recorded during surveys.

Figure 2 shows the bushfire and riparian constraints

Figure 3 shows proposed corridors, restoration areas and the proposed development plan.

Previous ecological survey work has been undertaken on the site in 2004 by *Conacher Travers* and again in 2008 by *Travers environmental*.

## 1.1 Aims of the assessment

The aims of the flora and fauna assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their conditions in accordance with the guidelines adopted by Warringah Council
- Carry out a fauna survey for the detection and assessment of fauna and their habitats in accordance with the guidelines adopted by Warringah Council
- Complete target surveys for threatened species, populations and ecological communities
- Assess the conservation value of the site
- 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 Guidelines for Threatened Species Assessment issued by the DECCW.

## 1.2 Information collation

A review of the relevant information pertinent to the subject site was undertaken prior to the initiation of field surveys as background to the study.

Information sources reviewed include the following:

- Riparian Areas Assessment. *GHD (April 2010)*

- Letter to NOW *Travers bushfire & ecology*. April 6 2010

- Stormwater Concept Plan for Revised Development Application (*JMD Development Consultants*, 5 September 2008)

- Water Quality Management, Oxford Falls Road, Frenchs Forest*, May 2010*) (SECC) *Strategic Environmental and Engineering Consulting*.

- Bushfire advice provided by *Australian Bushfire Protection Planners (2009/10*).

- Unpublished Flora and Fauna Report, Oxford Falls Road and Barnes Road, Oxford Falls, *Travers environmental* (2008).

- Flora and Fauna Report, Oxford Falls Road and Barnes Road, Oxford Falls *Conacher Travers Pty Ltd* (2004).

Standard Technical Resources:

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (working draft) (*Department of Environment and Conservation 2004*)

- Aerial photographs (scale 1:25,000) and Topographical maps (scale 1:25,000)

- Google Earth Pro (2010)

- *Atlas of NSW Wildlife* (DECCW, 2010) 1:100,000 scale map sheet

- The schedules of the *Threatened Species Conservation Act, 1995*

- The schedules of the *Fisheries Management Act, 1994*

- Lists of threatened species and communities in the *Environmental Protection and Biodiversity Act 1999*

- Rare or Threatened Australian Plants (ROTAP).

Other Documentation:

- *Warringah Council Creek Management Study* (March 2004)

- *Survey of the Duffys Forest Vegetation Community* (Peter Smith and Judy Smith, 2000)

- *Warringah Natural Area Survey* (Peter Smith and Judy Smith, 2005)

- *Narrabeen Lagoon Estuary Management Plan* (2002) and the

- *Northern Beaches Stormwater Management Plan* (1999).

## 1.3 Statutory requirements

### *1.3.1 Threatened Species Conservation Act 1995*

The specific requirements of the *TSC Act* must be addressed in the assessment of flora and fauna matters. This requires the consideration of potential impacts on threatened species, populations and ecological communities.

The factors to be taken into account in deciding whether there is a significant effect on threatened species or endangered ecological communities are set out under the *Draft Guidelines for Threatened Species Assessment* (DEC & DPI 2005) for Part 3A of the *EP&A Act 1979* applications.

Part 3A, EP&A Act

The proposed development to be assessed in this report has been declared a major project under Part 3A of the EP&A Act and SEPP Major Projects, now SEPP – Major Developments.

Part 3A relates to major infrastructure and other projects which require approval by the Minister.

Section 75B outlines the types of projects to which Part 3A applies.

Under section 75U approvals that do not apply (relevant to this proposal) are:

- *Section 75U(e) an authorisation referred to in section 12 of the Native Vegetation Act (2003) or under any Act to be repealed by that Act to clear native vegetation.*

- *Section 75U(g) a bush fire safety authority under section 100B of the Rural Fires Act (1997)*

*Native Vegetation Act 2003 and Regulations*

The proposed development site is located within the Warringah LGA which is exempt from Schedule 1, Part 3, Section 13 of the *Native Vegetation Act* (2003).

### *1.3.2 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, a Species Impact Statement (SIS) is required to be prepared.

### *1.3.3 Environment Protection and Biodiversity Conservation Act 1999*

The *EPBC Act* requires that Commonwealth approval be obtained for certain actions.

The Act 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" under the EPBC are defined as projects, developments, undertakings, activities and series of activities or alteration of any of these. Actions that need Commonwealth approval are known as a "controlled actions" if the Commonwealth decides that it would have a significant effect on an NES matter.

Where a proposed activity is located in an area identified to be of NES (national environmental significance), or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, then the matter needs to be referred to the Commonwealth *Department of the Environment, Water, Heritage and the Arts (DEWHA)* for assessment. If no listed federal species are located on site then no referral is required. The onus is on the proponent to make the application.

A significant impact is regarded as being:

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

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

### 1.4 Development proposal

The Concept Plan seeks approval for the uses, building envelopes and yield, to facilitate the proposed development. The detailed design, including resolved elevations and internal layout will be provided with future Project Applications. The Seniors Living Resort will provide three levels of care within a number of types of buildings with ancillary facilities that overall will comprise:

- A four storey nursing home facility containing 60 Rooms with 80 beds, with a high level of care.
- 393 two and three bedroom independent living apartments contained within a mixture of three and four storey buildings.
- 100 x 1 bedroom serviced apartments (low level care) within a four storey building.
- Two access entry and exit points off Oxford Falls Road. No through site access to the western residential areas off Barnes Road is proposed, only emergency access and access for the two existing residential properties will be maintained.
- Amenities and facilities such as a swimming pool, gymnasium and communal areas are proposed within the basement and ground floor of the serviced apartment building.

- One existing residence within the western boundary of the site will be retained for residential purposes whilst a second in the north western corner will be removed in order to open up the western corridor.
- The existing tennis academy building on the northern portion of the site will be retained for administration, office facilities and staff accommodation.
- A bowling green will be located to the north of the site.
- Car parking spaces for residents, staff and visitors located within single level basement car parks with limited visitor parking at street level.
- A comprehensive landscaping scheme including water features to create an accessible, tranquil and natural environment setting.
- Realignment and rehabilitation of the eastern tributary and creation of a natural wetland.
- 24 hour provision of medical facilities.

The development proposes three conservation corridors;

1. The Middle Creek tributary corridor is a variable 32.5m to 75m wide native vegetation corridor. In addition the proposed vegetation enriched Asset Protection Zones (APZs) adjacent to the riparian corridor, increase the effective width canopy connectivity of the Middle Creek corridor by another 10-35m albeit a managed landscape. The current size of the corridor is approximately 575m long (including the segment outside of the subject site immediately south of Barnes Road) by up to 75m in width (inclusive of the managed vegetation buffer – 10m). The APZs are not a deterrent to wildlife utilisation, although specific management within the APZs will be required to ensure that vegetation retention and revegetation is in accordance with acceptable fuel load levels.

2. The sandstone escarpment corridor along the escarpment on the south western edge of the proposed development forms another secondary corridor linking surrounding and elevated vegetation remnant to the Middle Creek Tributary. The current size of the western corridor is approximately 300m long by a variable width of 24-55m in width.

3. Remaining internal and fringing APZs throughout the proposed development landscape provide managed arterial tertiary corridors which permit canopy connectivity and the passage of predominantly avian and arboreal fauna species.

**Subject site description**

The subject site consists of six parcels of land, totalling an area of approximately 13.6 hectares. The site is legally described as follows:

- Lot 1110 in Deposited Plan 752088
- Lot 1111 in Deposited Plan 752038
- Lot 1113 in Deposited Plan 752038
- Lot 1336 in Deposited Plan 752038
- Lot 20 in Deposited Plan 842523
- Lot 80 in Deposited Plan 846099

Additionally, Barnes Road (road reserve) is included in the calculations which then total approximately 14.7 hectares.

### 1.5 Site description

The planning and cadastral details of the subject site are provided in Table 1.1, while Table 1.2 summarises the geographical characteristics of the site.

**Table 1.1 – Site details**

| | |
|---|---|
| **Location** | Lots 1110, 1111, 1113 & 1336 DP 752038, Lot 20 DP 842523 and Lot 80 DP 846099 Oxford Falls Road and Barnes Road, Oxford Falls |
| **Description of location** | Situated on the south-western side of Oxford Falls Road and dissected by Barnes Road. The subject site has frontage to Oxford Falls Road of approximately 390m and to Barnes Road of approximately 370m. |
| **Area** | Approximately 13.6ha 1.1ha for Barnes Road (road reserve) |
| **Topographic map** | Hornsby 1:25000 |
| **Grid reference** | 337700E and 6264700N |
| **Local government area** | Warringah Council |
| **Existing land use** | Six residences and associated outbuildings, and a tennis academy have been erected within the subject site. |
| **Proposed development** | Seniors Living Development |

**Table 1.2 – Site characteristics**

| | |
|---|---|
| **Elevation** | Approximately 78-114m AHD |
| **Topography** | Situated on flat-to-undulating land. Gradients are generally 0-15%, with steeper grades of up to approximately 70% in the west. |
| **Aspect** | Various |
| **Geology and soils** | Soils; Oxford Falls – Moderate to deep soils in valleys with underlying Sandstone. Lambert – Generally shallow soils over Hawkesbury Sandstone.<br>Hawkesbury – Steep inclines, shallow soils.<br><br>Geology; Hawkesbury Sandstone. |
| **Catchment** | Middle Creek |
| **Drainage** | tributary of Middle Creek |
| **Vegetation** | Open Forest, scrub / heath and cleared areas. Refer to section 4. |

The subject site has been affected by the following impacts:

**Table 1.3 – Site disturbance**

| | |
|---|---|
| **Clearing** | Approximately 75% of the subject site is cleared vegetation for paddocks, landscaping, tennis courts and residences |
| **Agriculture / Pastoral** | Some paddocks are currently occupied by horses |
| **Earthworks** | No major earthworks have been conducted within the subject site, although some earthworks have been undertaken in conjunction with erection of buildings and modification of the watercourse |
| **Introduced weeds** | The cleared areas of the subject site are dominated by exotic species, while moderate to severe incursions of weeds have occurred within the bushland remnants |
| **Evidence of feral, introduced or domestic fauna** | Common Starling, Rock Dove, Black Rat, Cat, Dog, Horse, Rabbit, Common Myna, Red-whiskered Bulbul and Spotted Turtle-Dove were recorded during survey. These species are likely to impact on native species at various levels. |

# 2 SURVEY TECHNIQUES

## 2.1 Background

**Licencing** - Individual staff members are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Section 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* 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.

**Limitations to Survey** - 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 however, increased species frequency or richness may be observed within the subject site, outside of the nominated survey period. Habitat assessments, based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, have been used to overcome this survey limitation.

## 2.2 Survey techniques

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site a variety of assessments were undertaken to supplement previous surveys of the area and literature reviews. The methods utilised included:

- **Field surveys** - Field surveys were undertaken in accordance with DECCW guidelines.
- ***Literature review*** – A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey.
- ***Data search*** – A search of the *Atlas of NSW Wildlife* (DECCW, 2010) was undertaken to identify records of threatened flora and fauna species located within a 10km radius of the site. This enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables 4.1, 4.2 and 4.3).
- ***Aerial photograph interpretation*** – Aerial photographs at 1:25,000 scale were utilised to identify the extent of vegetation with respect to the site and surrounding areas.
- ***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). Scat and hair samples collected are sent to Barbara

Triggs / Robyn Carter for identification. Invertebrates are sent to Michael Shea at the Malacology Section of the Australian Museum.

### *2.2.1* Flora survey methodology

2004 Survey

The 2004 flora survey methodology has been adopted from the Flora and Fauna survey guidelines: *Lower Hunter Central Coast Region (Murray et al 2002).*

The flora survey was undertaken on the 8th January 2004.

Each of the identified vegetation communities were assessed using 20x20m quadrats and 10x40m quadrats for linear vegetation communities along the Middle Creek tributary. Within each quadrat vegetation structure, vegetation floristics and physical attributes were recorded for the upper, middle and lower stratums.

Random meanders were also conducted across the whole of the subject site.

Field assessment of vegetation within the forested escarpment and heath vegetation community was undertaken on 27th September 2004.

Tree surveys were undertaken on the 14th and 19th September 2004; and again on 1st September 2006.

2010 Survey

A full flora survey was undertaken on the 7th April 2010, in accordance with the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (working draft)* as set out by *Department of Environment & Conservation 2004.*

This entailed some 4.5 hours of *targeted* threatened species searches in those areas considered to contain any potential threatened species habitat, in near-to-linear-lines of 7-10m separation, subject to rock extrusions. Five (5) standardised quadrats and three (3) transects were also undertaken, as well as a wide ranging random meander (not part of the targeted survey). The locations of the 2010 survey plots are presented on Figure 1.

The flora survey targeted all vegetation communities present within the subject site. The location of the vegetation communities is shown in Figure 1 following the Bibliography of this report.

Further targeted work was also undertaken on both 5th and 12th May, 2010, around the perimeter of the proposed development area.

## 2.3 Fauna survey methodology

Previous surveys were undertaken in 2004 and recent surveys have been undertaken in 2010. Survey effort is summarised in Table 2.1. The sections below illustrate the level of survey undertaken.

### *2.3.1 Diurnal birds*

Visual observation and call identification of birds was carried out during visits to the site.

Opportunistic bird counts were also made, whilst undertaking other survey work and during spotlight surveys of the site.

Based on the comments made by Dr Stephen Ambrose in his peer review (Appendix 1) bird quadrats were undertaken. Dr Ambrose had suggested that it would be appropriate to have selected at least four (4) 2ha areas on-site and to undertake Area Search Surveys (30 minutes per area) and record bird species heard or seen.

Five 1ha (approx 50m x 200m) Area Search Surveys were considered adequate due to the linear nature of the remnants. These were undertaken within the major vegetation areas of the site. These corresponded with hair tube transects (see Figure 1); as one person placed and collected tubes on the 30th March and 6th April 2010, a second person undertook Area Search Surveys for a minimum of 30 minutes.

Birds were observed and identified using handheld binoculars. Calls were generally identified in the field by the observer. If an unknown call was heard it was cross-matched to bird call reference libraries taken into the field.

### *2.3.2 Nocturnal birds*

The presence of nocturnal birds was first determined by quiet listening after dusk for calls by individuals emerging from diurnal roosts. Following this, and provided no calls were heard, call-playback techniques were employed. This involves broadcasting recorded calls through a 15 watt Toa 'Faunatech' amplifier to evoke a response from species known to reply.

Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*) and Barking Owl (*Ninox connivens*) were targeted. Each call was played for 5-minute periods with 5-minute intervals of quiet listening for a response. This was followed with spotlighting and periods of quiet listening throughout the nocturnal survey.

Call-playback stations are provided in Figure 1 and survey effort and weather conditions are outlined in Table 2.1. A third night's effort was undertaken for various nocturnal species during recent updated surveys, due to inclement weather on the second night's effort.

Searches for evidence of Owl roosts and potential Owl roosting/breeding hollows, were made during surveys of the subject site. Any whitewash, or regurgitated pellets found, were noted.

Given the recording of a Powerful Owl during surveys habitat trees providing potential for nesting (HT9, HT11 & HT19) were targeted during the early nesting period on the 3rd June 2010. Active stag-watching of HT11 was undertaken on this occasion whilst passive remote surveillance cameras were placed at HT9 & HT19. Surveillance cameras used are Reconyx HC500 Hyperfire with infra-red and motion sensing capabilities with an illumination range up to 15m. The camera at HT19 was setup on a tripod and the camera setup at HT9 was strapped to a nearby tree with a bungee cord. Both cameras were placed within 7m of the hollows targeted.

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

### *2.3.3 Arboreal and terrestrial mammals*

2004 Survey

Elliott Type A and B Traps were used for trapping arboreal and terrestrial mammals. Trapping consisted of a total of 200 trap nights, including 100 arboreal trap nights and 100 terrestrial trap nights.

Arboreal trap-lines using 10-20m separations were placed in the most suitable trees along approximately 80m transects. Elliott Type A traps were placed onto platforms, that were attached to the trunks of trees 2-3m above the ground at an incline of 10 degrees, to facilitate drainage during inclement weather. A mixture of honey and water was then sprayed onto the trunk 3-5m above the trap and around the platform as a lure.

Terrestrial trap-lines consisting of Type A and B Elliott Traps using 10-20m separations were placed along the same line as the arboreal traps in the most suitable terrestrial habitats.
Elliot traps were baited with a mixture of rolled oats, honey and peanut butter.

Five (5) trap-lines were set on the nights of January 12th, 13th, 14th and 15th, 2004. The location of the trap-lines is shown in Figure 1 located after the bibliography of this report. Each trap-line consisted of 5 Type-A arboreal traps, 3 Type-B terrestrial traps and 2 Type-A terrestrial traps.

Cage trapping was conducted within the subject site to target the threatened species, Southern Brown Bandicoot (*Isoodon obesulus*) and Spotted-tailed Quoll (*Dasyurus maculatus*). The cage traps used were 18cm x 18cm by 45cm long.

Ten (10) cage traps were set on the nights of January 12th, 13th, 14th & 15th 2004. Cage trapping consisted of a total of 40 trap nights. Cage traps were placed in suitable in areas of dense shrub and ground cover. Cage traps were baited with a mixture of rolled oats, honey and peanut butter for the Southern Brown Bandicoot and uncooked chicken meat for the Spotted-tail quoll.

2010 survey

Hair tubes were used to survey for arboreal and terrestrial mammals from the 30th March to the 6th April 2010.

Five (5) hair tube transect lines (approx' 200m) were set for five (5) nights. Each line consisted of 15 tubes (5 arboreal and 10 terrestrial) for a significant total of 375 trap nights. All hair tubes were baited with a mixture of rolled oats, honey and peanut butter. Five (5) terrestrial tubes were also baited with White Truffle Oil to target Southern Brown Bandicoot (*Isoodon obesulus*) and suitably spaced on the transect lines. Five (5) terrestrial tubes were also baited with sardines to target Spotted-tailed Quoll (*Dasyurus maculatus*) and alternatively spaced along the transect lines. Small arboreal tubes were used to target the Eastern Pygmy Possum (*Cercatetus nanus*) and placed in most appropriate foraging area such as within Banksias.

Arboreal hair tubes were attached to the trunks of trees using rubber bands. A mixture of honey and water was then sprayed onto the trunk up to 8m above the tube as a lure. Terrestrial hair tubes were placed in suitable areas of dense shrub and ground cover and often near to signs of foraging e.g. burrows or shelters.

Double-sided tape was attached around the entry of tubes so hair samples of animals entering the tube were collected. Hair samples collected were sent to noted hair and scat identification experts Barbara Triggs or Robyn Carter for identification.

Hair tube transects were placed throughout the subject site as well as extending into connective habitats. Hair tube trapping effort amounted to a total of 175 small arboreal and 350 large terrestrial hair tube nights. See Figure 1 for hair tube transect locations.

Cage trapping was conducted within the subject site to target the threatened Southern Brown Bandicoot (*Isoodon obesulus*). The cage traps used were 18cm x 18cm by 45cm long.

Ten (10) cage traps were set for ten (10) nights between April 20-30th, 2010. Cage trapping consisted of a total of 100 trap nights. Cage traps were placed in suitable in areas of dense shrub and ground cover. Cage traps were baited with a mixture of rolled oats, honey and peanut butter for the Southern Brown Bandicoot and sprinkled with Truffle Oil drops.

*Stag-watching within the subject site*

Habitat trees HT9, HT11 & HT19 providing large hollows were targeted for early nocturnal activity on the 3rd June 2010. This was undertaken to target Powerful Owl however this method also contributes to arboreal mammal surveys. Active stag-watching of HT11 was undertaken on this occasion whilst passive remote surveillance cameras were placed at HT9 & HT19. A description of surveillance camera and stag-watching methodologies is provided in Section 2.3.2 above.

*Spotlighting within the subject site*

Spotlighting for nocturnal mammalian fauna was carried out using a hand held lamp of (75W halogen globe). This technique involved walking on the fringes of the forested areas of the subject site so that a maximum number of trees could be observed.

*Call-playback techniques for nocturnal mammals*

The presences of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) were targeted by broadcasting taped calls through a 15-Watt Toa 'Faunatech' amplifier. Calls were played for 5-minute periods during nocturnal surveys. This was followed by quiet listening and spotlighting. Call-playback stations are shown in Figure 1. The location selected for all updated nocturnal call-playbacks is central to the site such that all surrounding habitats may have equal opportunity to hear.

*Secondary indications within the subject site*

Assessment was made of found scats, markings, diggings, runways and scratches during visits to the site. Any scats or pellets not readily identifiable were collected and sent to noted hair and scat identification experts Barbara Triggs or Robyn Carter for the identification of any contents, such as hair or bone fragments. Habitat was also assessed to determine the likelihood of threatened native species of fauna occurring within the subject site.

*Koala assessment*

The subject area was assessed for activity by Koalas using the following methods:

- A search of the *Atlas of NSW Wildlife* (DECCW 2010) databases.

- Identification and assessment of the density of tree species listed as Koala feed trees in *State Environmental Protection Policy No. 44 – Koala Habitat Protection* (SEPP 44), was undertaken across the site. An estimate of the percentage density of each tree species within vegetation communities, was determined by averaging the percentage of stems counted.

- The site was surveyed on foot, with known Koala food trees being inspected for signs of use. Trees were also inspected for characteristic scratch and claw marks on the trunk and scats around the base of each tree. The proportion of trees showing signs of Koala use was calculated. Additionally, the location and density of droppings if found were documented.

- Koalas were also targeted during spotlight surveys which included the use of call-playback techniques described above.

### *2.3.4 Bats*

Micro-chiropteran bats were surveyed by echolocation, using Anabat Mk 2 and SD-1 detectors in fixed passive monitoring positions, throughout the subject site. Fixed Anabat stations were determined in order to represent different available foraging structures for various micro-chiropteran bat species. Detectors were placed in the same locations on different nights where indicated on Figure 1 for recent updated 2010 surveys.

Roving recordings were undertaken along spotlighting transects during previous 2004 surveys. Mobile active monitoring, using a PDA connected to an SD-1 recorder to identify bats in real-time, was also undertaken along spotlighting transects during updated survey on the 7th April 2010.

All bat call recordings were 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.

Anabat recoding stations and mobile recording transects are shown on Figure 1.

Mega-chiropteran bat species, such as the Grey-headed Flying-fox (*Pteropus poliocephalus*), were surveyed by targeting flowering/fruiting trees during spotlighting activities.

### *2.3.5 Amphibians*

Amphibians were surveyed by opportunistic vocal call identification, spotlighting and by targeting call activity along and adjacent to drainages, both during and following rainfall. For similar calling species, male calls were compared to recorded calls from a field reference library, for accuracy of identification. Amphibians were also surveyed by habitat searches.

Habitat searches targeting Red-crowned Toadlet (*Pseudophryne australis*) were undertaken along four (4) drainages of varying suitability for the species during surveys undertaken on the 29th, 30th March and 6th April 2010.

Twenty (20) minutes was undertaken at each drainage line on each day. This consisted of searching pools for tadpoles, turning rocks and litter, listening for calls and clapping for a call response. Searches were undertaken at each location either during or following rainfall within the previous 24 hour period.

Searches for Red-crowned Toadlet was also incorporated into 3 hours and 20 minutes of habitat searched undertaken during previous surveys in January 2004.

Any amphibians found are visually identified and when required to be examined are handled with latex gloves or placed in a plastic bag and kept moist until release. Any tadpoles requiring capture are collected with a scoop net and placed within a snaplock clear plastic bag for analysis of colour and morphological features.

### *2.3.6 Reptiles*

Searches for reptiles in likely localities such as under logs, rubbish debris and in deep-leaf litter were undertaken during diurnal visits to the site.

Spotlighting of terrestrial habitats suitable for reptiles occurred during nocturnal surveys.

Funnel traps were used to target Rosenberg's Goanna (*Varanus rosenbergii*). This method was indicated to be suitable for this species by Gerry Swan during recent works on a separate site within the Warringah LGA. Three (3) funnel trap-lines each consisting of four (4) funnel traps were set for three days between the 7- 9$^{th}$ April 2010. Funnels were placed in pairs on either side of a 10m long fence line. The fence, made of damp-proof-course, was 270mm wide and held tight and upright by wooden and steel pegs.

Weather conditions for funnel trapping effort are provided in Table 2.1

### *2.3.7 Habitat Trees*

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

A summary of hollow-bearing tree results is provided in Table 3.4.

### *2.3.8 Trees*

A tree survey and assessment of the subject area has been undertaken. The aims of the tree assessment were to review the current health and condition of trees within or in close proximity to areas proposed for development and to assess the potential life expectancy of these trees.

Trees with diameter at breast height (DBH) greater than 20cm were assessed. Individual tree assessments are listed within the Tree Details (Schedule 1) and a description of terminology used is provided as Schedule 3.

Only the trees within or in close proximity to the proposed building footprints have been individually assessed as part of this report. All other trees occurring outside the areas to be occupied by the proposed structures are expected to be retained. All individual trees surveyed have been marked using metal tags labelled with their respective number ID (except in some areas where trees were very crowded, where approximately 1 in 3 trees were tagged). Locations of surveyed trees are shown on the Tree Plan (Schedule 2).

The SULE method (acronym for *Safe Useful Life Expectancy*) of tree assessment, as outlined by *Barrell, J (1993)* has been adopted within this report. SULE categories give an indication of the safe useful life anticipated for each tree surveyed. Several factors are

considered in determining this rating such as species, location, age, condition and health of the tree. The four SULE categories are outlined in detail within Schedule 3.

***Field survey effort, times and dates***

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

**Table 2.1 – Fauna survey effort and dates**

| Fauna group | Date | Weather conditions | Survey method | Survey effort / time (24hr) |
|---|---|---|---|---|
| **Diurnal birds** | 12/01/04 | 8/8 cloud, no wind, temp 26°C, no rain | Diurnal Opportunistic | 3hr 45min 1245-1630 |
| | 13/01/04 | 2/8 cloud, no wind, temp 21°C | Diurnal Opportunistic | 4hr 50 min 0730-1220 |
| | 14/01/04 | 5/8 cloud, no wind, temp 22°C | Diurnal Opportunistic | 1hr 30min 0730-0900 |
| | 15/01/04 | 8/8 cloud, no wind, temp 20°C, no rain | Diurnal Opportunistic | 1hr 30min 0730-0900 |
| | 16/01/04 | 8/8 cloud, no wind, temp 18°C, light rain | Diurnal Opportunistic | 1hr 50min 0740-0930 |
| | 29/03/10 | 8/8 cloud, no wind, light shower, temp 26.5°C | Diurnal opportunistic | 5hr 20min 1400-1920 |
| | 30/03/10 | 8/8 cloud, no wind, raining, temp 19-22°C | Diurnal opportunistic | 6hr 15min 1215-1830 |
| | | | Area Search Surveys (5x1 ha for min 30min) | Min 2.5 hours |
| | 06/04/10 | 7/8 cloud, no wind, no rain, temp 23.8°C | Diurnal opportunistic | 6hr 1145-1745 |
| | | | Area Search Surveys (5x1 ha for min 30min) | Min 2.5 hours |
| | 07/04/10 | 6-8/8 cloud, no wind, previous rain, temp 22.5 -26°C | Diurnal opportunistic | 3hr 20min1110-1430 |
| | | 8/8 cloud, no wind, no rain, temp 24°C | Diurnal opportunistic | 1hr 1600-1700 |
| **Nocturnal birds** | 12/01/04 | 5/8 cloud, no wind, temp 22°C | Owl call playback | 50min 2045-2135 |
| | 15/01/04 | 1/8 cloud, no wind, temp 19°C | Owl call playback | 50min 2040-2130 |
| | 29/03/10 | 8/8 cloud, no wind, no rain, temp 24-23°C | Listen, Owl call playback & spotlighting | 3hr 5min 1835-2140 |
| | 06/04/10 | 8/8 cloud, no wind, light showers, temp 21-19°C | Listen, Owl call playback & spotlighting | 1hr 25min 1835-2000 |
| | 07/04/10 | 7-8/8 cloud, no wind, no rain, temp 22°C | Listen, Owl call playback & spotlighting | 1hr 50min 1835-2025 |
| | 03/06/10 | 8/8 cloud, no wind, light rain, temp 16°C | Stag-watching (1x active, 2x passive surveillance cameras) | 2hr 30min 1700-1755 |
| **Arboreal mammals** | 12/01/04 | 5/8 cloud, no wind, temp 22°C | Spotlighting | 55min 2045-2140 |
| | 12/01/04 | 2/8 cloud, no wind, temp 21°C | Elliott trapping | 25 trap nights |
| | 13/01/04 | 5/8 cloud, no wind, temp 22°C, scattered showers | Elliott trapping | 25 trap nights |
| | 14/01/04 | 8/8 cloud, no wind, temp 20°C, scattered showers | Elliott trapping | 25 trap nights |
| | 15/01/04 | 1/8 cloud, no wind, temp 19°C | Spotlighting | 1hr 0840-0940 |
| | 15/01/04 | 8/8 cloud, no wind, temp 18°C | Elliott trapping | 25 trap nights |
| | 29/03/10 | 8/8 cloud, no wind, no rain, temp 24-23°C | Spotlighting + call playback (Koala, Yellow-bellied Glider & Squirrel Glider) | 2hr 55min 1845-2140 |

| Fauna group | Date | Weather conditions | Survey method | Survey effort / time (24hr) |
|---|---|---|---|---|
| | 30/03/10-06/04/10 | Various | Hair Tubes (small) | 175 trap nights |
| | 06/04/10 | 8/8 cloud, no wind, light showers, temp 21-19°C | Spotlighting | 15min 1945 – 2000 |
| | 07/04/10 | 7-8/8 cloud, no wind, no rain, temp 22°C | Spotlighting + call playback (Koala, Yellow-bellied Glider & Squirrel Glider) | 2hr 10min 1815 – 2025 |
| | 03/06/10 | 8/8 cloud, no wind, light rain, temp 16°C | Stag-watching (1x active, 2x passive surveillance cameras) | 2hr 30min 1700-1755 |
| **Terrestrial mammals** | 12/01/04 | 5/8 cloud, no wind, temp 22°C | Spotlighting | 55min 2045-2140 |
| | 12/01/04 | 2/8 cloud, no wind, temp 21°C | Elliott trapping | 25 trap nights |
| | | | Cage trapping | 10 trap nights |
| | 13/01/04 | 5/8 cloud, no wind, temp 22°C, scattered showers | Elliott trapping | 25 trap nights |
| | | | Cage trapping | 10 trap nights |
| | 14/01/04 | 8/8 cloud, no wind, temp 20°C, scattered showers | Elliott trapping | 25 trap nights |
| | | | Cage trapping | 10 trap nights |
| | 15/01/04 | 1/8 cloud, no wind, temp 19°C | Spotlighting | 1hr 0840-0940 |
| | 15/01/04 | 8/8 cloud, no wind, temp 18°C, | Elliott trapping | 25 trap nights |
| | | | Cage trapping | 10 trap nights |
| | 29/03/10 | 8/8 cloud, no wind, no rain, temp 24-23°C | Spotlighting | 2hr 55min 1845-2140 |
| | 30/03/10-06/04/10 | Various | Hair Tubes (large) | 350 trap nights |
| | 06/04/10 | 8/8 cloud, no wind, light showers, temp 21-19°C | Spotlighting | 15min 1945 – 2000 |
| | 07/04/10 | 7/8 cloud, no wind, no rain, temp 22°C | Spotlighting | 2hr 10min 1815 – 2025 |
| | 20/04/10 | 0/8 cloud, no wind, no rain, 1/4 moon, temp 15°C | Cage trapping SBB | 10 trap nights |
| | 21/04/10 | 0/8 cloud, no wind, no rain, 2/4 moon, temp 15°C | Cage trapping SBB | 10 trap nights |
| | 22/04/10 | 0/8 cloud, no wind, no rain, 2/4 moon, temp 14.5°C | Cage trapping SBB | 10 trap nights |
| | 23/04/10 | 0-8/8 cloud, no wind, no rain, 3/4 moon, temp 19°C | Cage trapping SBB | 10 trap nights |
| | 24/04/10 | 5/8 cloud, light S wind, showers, 3/4 moon, temp 14.5°C | Cage trapping SBB | 10 trap nights |
| | 25/04/10 | 1/8 cloud, no wind, no rain, 4/4 moon, temp 11°C | Cage trapping SBB | 10 trap nights |
| | 26/04/10 | 0/8 cloud, no wind, no rain, 4/4 moon, temp 10.5°C | Cage trapping SBB | 10 trap nights |
| | 27/04/10 | 8-0/8 cloud, no wind, no rain, 4/4 moon, temp 10°C | Cage trapping SBB | 10 trap nights |
| | 28/04/10 | 0/8 cloud, no wind, no rain, 4/4 moon, temp 12°C | Cage trapping SBB | 10 trap nights |
| | 29/04/10 | 0/8 cloud, no wind, no rain, 4/4 moon, temp 12.5°C | Cage trapping SBB | 10 trap nights |

| Fauna group | Date | Weather conditions | Survey method | Survey effort / time (24hr) |
|---|---|---|---|---|
| **Bats** | 12/01/04 | 5/8 cloud, no wind, temp 22°C | Anabat II | 1hr 25min 2015-2140 |
| | 15/01/04 | 1/8 cloud, no wind, temp 19°C | Anabat II | 1hr 20min 20.20-2140 |
| | 29/03/10 | 8/8 cloud, no wind, no rain, temp 24-23°C | Anabat II x2 / SD-1 passive monitoring | 7hr 15min 1900 – 2140 |
| | | | Spotlighting | 2hr 55min 1845-2140 |
| | 06/04/10 | 8/8 cloud, no wind, light showers, temp 21-19°C | Anabat II x2 / SD-1 passive monitoring | 4hr 20min 1755 – 2000 |
| | | | Spotlighting | 15min 1945 – 2000 |
| | 07/04/10 | 7-8/8 cloud, no wind, no rain, temp 22°C | Anabat II x2 passive / SD-1 active monitoring | 6hr 45min 1750 – 2025 |
| | | | Spotlighting | 2hr 10min 1815 – 2025 |
| **Reptiles** | 12/01/04 | 5/8 cloud, no wind, temp 22°C | Spotlighting | 55min 2045-2140 |
| | 13/01/04 | 2/8 cloud, light SE wind, temp 26°C | Habitat searches | 3hr 20min 0900-1220 |
| | 15/01/04 | 1/8 cloud, no wind, temp 19°C | Spotlighting | 1hr 0840-0940 |
| | 29/03/10 | 8/8 cloud, no wind, light shower, temp 26.5°C | Habitat search, opportunistic | 5hr 20min 1400-1920 |
| | 30/03/10 | 8/8 cloud, no wind, raining, temp 19-22°C | Habitat search, opportunistic | 6hr 15min 1215-1830 |
| | 06/04/10 | 7/8 cloud, no wind, no rain, temp 23.8°C | Habitat search, opportunistic | 6hr 1145-1745 |
| | 07/04/10 | 6-8/8 cloud, no wind, prev rain, temp 22.5 -26°C | Habitat search, opportunistic | 3hr 20min 1110-1430 |
| | | 8/8 cloud, no wind, no rain, temp 24°C | Funnel traps | 12 trap days |
| | 08/04/10 | 0-2/8 cloud, light W wind, no rain, temp 21-26°C | Funnel traps | 12 trap days |
| | 09/04/10 | 0/8 cloud, light SE wind, no rain, temp 15-22°C | Funnel traps | 12 trap days |
| **Amphibians** | 12/01/04 | 5/8 cloud, no wind, temp 22°C | Spotlighting + call detection | 55min 2045-2140 |
| | 13/01/04 | 2/8 cloud, light SE wind, temp 26°C | Habitat searches (incorporating Red-crowned Toadlet Survey) | 3hr 20min 0900-1220 |
| | 15/01/04 | 1/8 cloud, no wind, temp 19°C | Spotlighting + call detection | 1hr 0840-0940 |
| | 29/03/10 | 8/8 cloud, no wind, light shower, temp 26.5°C | Target searched (Red-crowned Toadlet) | Min total 1hr 20min |
| | 30/03/10 | 8/8 cloud, no wind, raining, temp 19-22°C | Target searched (Red-crowned Toadlet) | Min total 1hr 20min |
| | 06/04/10 | 7/8 cloud, no wind, no rain, temp 23.8°C | Target searched (Red-crowned Toadlet) | Min total 1hr 20min |

# 3 SURVEY RESULTS

## 3.1 Vegetation communities

Four (4) vegetation communities were identified within the subject site through ground truthing.

- Vegetation Community 1 – Peppermint – Angophora Woodland / Open Forest
- Vegetation Community 2 – Exotic Grassland with Scattered Trees
- Vegetation Community 3 – Aquatic Herbfield (Creek line and dams)
- Vegetation Community 4 – Kunzea – Tea-tree Tall Heath

## 3.2 Flora species

A total of two hundred and sixty nine (269) flora species (159 native, 110 exotic) were observed within the subject site during the surveys in 2004 and 2010.

The plants observed within the vegetation communities of the subject site are listed in Table 3.1 below. Column 4 depicts the location of plants in communities.

**Table 3.1 – Flora observations for the subject site**

| Scientific Name | Common Name | Family | Community |
|---|---|---|---|
| **Trees** | | | |
| *Acacia implexa* | Hickory | Mimosaceae | 1 2 |
| *Allocasuarina littoralis* | Black She-oak | Casuarinaceae | 1 4 |
| *Allocasuarina torulosa* | Forest Oak | Casuarinaceae | 2 |
| *Angophora bakeri* | Narrow-leaved Apple | Myrtaceae | 2 |
| *Angophora costata* | Smooth-barked Apple | Myrtaceae | 1 2 |
| *Archontophoenix alexandrae* | Alexandra Palm | Arecaceae | 2 |
| *Brachychiton acerifolius* | Illawarra Flame Tree | Sterculiaceae | 2 |
| *Casuarina cunninghamiana* | River Oak | Casuarinaceae | 2 |
| *Casuarina glauca* | Swamp Oak | Casuarinaceae | 2 |
| *Corymbia gummifera* | Red Bloodwood | Myrtaceae | 1 |
| *Corymbia maculata* | Spotted Gum | Myrtaceae | 2 |
| *Eucalyptus botryoides* | Southern Bangalay | Myrtaceae | 1 2 |
| *Eucalyptus deanei* | Round-leaved Gum | Myrtaceae | 1 2 |
| *Eucalyptus haemastoma* | Scribbly Gum | Myrtaceae | 1 |
| *Eucalyptus paniculata* | Grey Ironbark | Myrtaceae | 2 |
| *Eucalyptus piperita* | Sydney Peppermint | Myrtaceae | 1 2 |
| *Eucalyptus punctata* | Grey Gum | Myrtaceae | 1 |
| *Eucalyptus robusta* | Swamp Mahogany | Myrtaceae | 2 |
| *Eucalyptus sieberi* | Silvertop Ash | Myrtaceae | 1 |
| *Glochidion ferdinandi* | Cheese Tree | Euphorbiaceae | 4 |
| *Livistona australis* | Cabbage Tree Palm | Arecaceae | 2 |
| *Melaleuca quinquenervia* | Broad-leaved Tea Tree | Myrtaceae | 2 |
| *Syzygium sp.* | Lillypilly | Myrtaceae | 2 |

**Table 3.1 – Flora observations for the subject site**

| Scientific Name | Common Name | Family | Community |
|---|---|---|---|
| **Shrubs** | | | |
| *Acacia decurrens* | Black Wattle | Mimosaceae | 1 |
| *Acacia floribunda* | Sally Wattle | Mimosaceae | 2 |
| *Acacia linifolia* | Flax Wattle | Mimosaceae | 1 |
| *Acacia longifolia* | Sydney Golden Wattle | Mimosaceae | 1 2 4 |
| *Acacia parramattensis* | Sydney Green Wattle | Mimosaceae | 1 2 |
| *Acacia stricta* | - | Mimosaceae | 1 |
| *Acacia suaveolens* | Sweet Scented Wattle | Mimosaceae | 1 |
| *Acacia terminalis* | Sunshine Wattle | Mimosaceae | 1 4 |
| *Acacia ulicifolia* | Prickly Moses | Mimosaceae | 1 |
| *Allocasuarina distylla* | - | Casuarinaceae | 4 |
| *Banksia ericifolia* | Heath-leaved Banksia | Proteaceae | 1 4 |
| *Banksia integrifolia* | Honeysuckle | Proteaceae | 1 |
| *Banksia oblongifolia* | - | Proteaceae | 1 |
| *Banksia serrata* | Old Man Banksia | Proteaceae | 1 2 |
| *Banksia spinulosa* | Hairpin Banksia | Proteaceae | 1 |
| *Bauera rubioides* | River Rose | Cunoniaceae | 1 |
| *Boronia ledifolia* | Sydney Boronia | Rutaceae | 1 |
| *Bossiaea heterophylla* | - | Fabaceae | 1 |
| *Bossiaea scolopendria* | - | Fabaceae | 1 |
| *Callicoma serratifolia* | Black Wattle | Cunoniaceae | 1 |
| *Callistemon citrinus* | Crimson Bottlebrush | Myrtaceae | 2 |
| *Ceratopetalum gummiferum* | Christmas Bush | Cunoniaceae | 1 2 |
| *Dillwynia floribunda* var. *floribunda* | Parrot Pea | Fabaceae | 4 |
| *Dillwynia retorta* | Eggs and Bacon | Fabaceae | 1 4 |
| *Dodonaea triquetra* | Hop Bush | Sapindaceae | 1 |
| *Elaeocarpus reticulatus* | Blueberry Ash | Elaeocarpaceae | 1 |
| *Epacris crassifolia* | - | Epacridaceae | 1 4 |
| *Epacris microphylla* | Coral Heath | Epacridaceae | 1 4 |
| *Eriostemon australasius* | Pink Wax Plant | Rutaceae | 1 |
| *Grevillea buxifolia* | Grey Spider Flower | Proteaceae | 1 4 |
| *Grevillea speciosa* | Red Spider Flower | Proteaceae | 1 2 4 |
| *Hakea sericea* | Silky Hakea | Proteaceae | 1 |
| *Hibbertia aspera* | - | Dilleniaceae | 1 4 |
| *Hibbertia bracteata* | - | Dilleniaceae | 1 4 |
| *Hibbertia empetrifolia* | - | Dilleniaceae | 1 4 |
| *Kunzea ambigua* | Tick Bush | Myrtaceae | 1 2 4 |
| *Lambertia formosa* | Mountain Devil | Proteaceae | 1 4 |
| *Lasiopetalum ferrugineum* | Rusty Velvet-bush | Sterculiaceae | 1 |
| *Leptospermum polygalifolium* | Tantoon | Myrtaceae | 1 4 |
| *Lomatia silaifolia* | Crinkle Bush | Proteaceae | 1 |
| *Melaleuca armillaris* | Bracelet Honeymyrtle | Myrtaceae | 1 2 |
| *Melaleuca ericifolia* | Swamp Paperbark | Myrtaceae | 2 |
| *Melaleuca styphelioides* | Prickly-leaved Tea Tree | Myrtaceae | 1 2 |
| *Micrantheum ericoides* | - | Picrodendraceae | 1 4 |
| *Omalanthus populifolius* | Bleeding Heart | Euphorbiaceae | 1 2 4 |
| *Ozothamnus diosmifolius* | Ball Everlasting | Asteraceae | 1 |
| *Persoonia lanceolata* | Lance-leaved Geebung | Proteaceae | 1 4 |
| *Persoonia levis* | Broad-leaved Geebung | Proteaceae | 1 |
| *Persoonia pinifolia* | Pine-leaved Geebung | Proteaceae | 1 |
| *Phebalium squamulosum* subsp. *squamulosum* | - | Rutaceae | 1 |

**Table 3.1 – Flora observations for the subject site**

| Scientific Name | Common Name | Family | Community |
|---|---|---|---|
| *Pimelea linifolia* | Slender Rice Flower | Thymeleaceae | 1 |
| *Phyllanthus hirtellus* | Thyme Spurge | Euphorbiaceae | 1 |
| *Pittosporum undulatum* | Sweet Pittosporum | Pittosporaceae | 1 2 |
| *Platylobium formosum* | Handsome Flat-pea | Fabaceae | 1 |
| *Platysace linearifolia* | Narrow-leafed Platysace | Apiaceae | 1 |
| *Pultenaea retusa* | - | Fabaceae | 1 |
| *Pultenaea stipularis* | - | Fabaceae | 1 |
| *Viminaria juncea* | Native Broom | Fabaceae | 2 |
| *Woollsia pungens* | Woolsia | Epacridaceae | 1 |
| *Zieria laevigata* | - | Rutaceae | 1 |
| **Vines** | | | |
| *Billardiera scandens* | Apple Dumplings | Pittosporaceae | 1 4 |
| *Cassytha pubescens* | Devil's Twine | Lauraceae | 1 4 |
| *Cayratia clematidea* | Slender Grape | Vitaceae | 1 2 |
| *Cissus hypoglauca* | Water Vine | Vitaceae | 1 |
| *Eustrephus latifolius* | Wombat Berry | Luzuriagaceae | 1 |
| *Smilax glyciphylla* | Sarsparilla | Smilacaceae | 1 |
| **Herbs** | | | |
| *Actinotus helianthi* | Flannel Flower | Apiaceae | 1 |
| *Austrodanthonia sp.* | Wallaby Grass | Poaceae | 1 |
| *Austrostipa pubescens* | Tall Spear Grass | Poaceae | 1 |
| *Calochilus gracillimus* | Beared Orchid | Orchidaceae | 1 |
| *Caustis flexuosa* | Curly Sedge | Cyperaceae | 1 4 |
| *Centella asiatica* | Swamp Pennywort | Apiaceae | 1 2 4 |
| *Commelina cyanea* | Scurvy Weed | Commelinaceae | 2 |
| *Cryptostylis erecta* | Bonnet Orchid | Orchidaceae | 1 4 |
| *Cyathochaeta diandra* | - | Cyperaceae | 1 4 |
| *Cynodon dactylon* | Common Couch | Poaceae | 2 4 |
| *Dianella caerulea* | Flax Lily | Phormiaceae | 1 4 |
| *Dianella prunina* | - | Phormiaceae | 1 |
| *Dichelachne crinita* | Long-hair Plume Grass | Poaceae | 1 2 |
| *Dipodium punctatum* | Hyacinth Orchid | Orchidaceae | 1 |
| *Dipodium variegatum* | Hyacinth Orchid | Orchidaceae | 1 |
| *Drosera spatulata* | Sundew | Droseraceae | 2 |
| *Echinopogon caespitosus* | Tufted Hedgehog Grass | Poaceae | 1 2 |
| *Empodisma minus* | - | Restionaceae | 1 4 |
| *Entolasia marginata* | Bordered Panic | Poaceae | 1 2 4 |
| *Entolasia stricta* | Wiry Panic | Poaceae | 1 |
| *Eragrostis brownii* | Brown's Lovegrass | Poaceae | 1 |
| *Gahnia clarkei* | Saw Sedge | Cyperaceae | 1 4 |
| *Gonocarpus micranthus* | Creeping Raspwort | Haloragaceae | 2 |
| *Gonocarpus teucroides* | Raspwort | Haloragaceae | 1 2 4 |
| *Guringalia dimorpha* | - | Restionaceae | 1 |
| *Hydrocotyle peduncularis* | Pennywort | Apiaceae | 2 3 |
| *Hypericum gramineum* | Little St Johns Wort | Clusiaceae | 2 |
| *Imperata cylindrica* | Blady Grass | Poaceae | 1 2 |
| *Juncus caespiticius* | - | Juncaceae | 2 |
| *Juncus remotiflorus* | - | Juncaceae | 1 |
| *Juncus usitatus* | Common Rush | Juncaceae | 2 3 |
| *Lachnagrostis filiformis* | Blown Grass | Poaceae | 1 |
| *Lepidosperma filiforme* | - | Cyperaceae | 1 4 |
| *Lepidosperma laterale* | Variable Sword-sedge | Cyperaceae | 1 |
| *Lepyrodia scariosa* | - | Restionaceae | 1 |

**Table 3.1 – Flora observations for the subject site**

| Scientific Name | Common Name | Family | Community |
|---|---|---|---|
| *Lomandra filiformis* | Wattle Matt-rush | Lomandraceae | 1 |
| *Lomandra glauca* | Pale Matt-rush | Lomandraceae | 1 |
| *Lomandra longifolia* | Spiky-headed Mat-rush | Lomandraceae | 1 4 |
| *Lomandra obliqua* | - | Lomandraceae | 1 |
| *Lomatia silaifolia* | Crinkle Bush | Proteaceae | 1 4 |
| *Lythrum hyssopifolia* | Hyssop's Loosestrife | Lythraceae | 2 3 |
| *Microlaena stipoides* | Weeping Grass | Poaceae | 2 |
| *Mitrasacme polymorpha* | Mitrewort | Loganiaceae | 2 |
| *Panicum bisulcatum* | Blackseed Panic | Poaceae | 3 |
| *Patersonia sericea* | Wild Iris | Iridaceae | 1 4 |
| *Persicaria hydropiper* | Water Pepper | Polygonaceae | 3 |
| *Pterostylis nutans* | Nodding Greenhood | Orchidaceae | 1 |
| *Schoenus imberbis* | Beardless Bog-rush | Cyperaceae | 1 |
| *Schoenus lepidosperma* | - | Cyperaceae | 1 |
| *Schoenus melanostachys* | Black Bog-rush | Cyperaceae | 1 |
| *Stackhousia viminea* | Slender Stackhousia | Stackhousiaceae | 1 |
| *Typha orientalis* | Broad-leaved Cumbungi | Typhaceae | 3 |
| *Veronica plebeia* | Creeping Speedwell | Scrophulariaceae | 1 |
| *Xanthorrhoea arborea* | Blackboy | Xanthorrhoeaceae | 1 |
| *Xanthorrhoea media* | - | Xanthorrhoeaceae | 1 4 |
| *Xanthosia pilosa* | - | Apiaceae | 1 4 |
| **Ferns** | | | |
| *Adiantum aethiopicum* | Common Maidenhair | Adiantaceae | 1 |
| *Adiantum diaphanum* | Filmy Maidenhair | Adiantaceae | 1 |
| *Blechnum cartilagineum* | Gristle Fern | Blechnaceae | 1 |
| *Calochlaena dubia* | Common Ground Fern | Dicksoniaceae | 1 |
| *Cyathea australis* | Rough Tree Fern | Cyatheaceae | 1 |
| *Cyathea cooperi* | Straw Treefern | Cyatheaceae | 2 |
| *Gleichenia dicarpa* | Pouched Coral Fern | Gleicheniaceae | 1 |
| *Gleichenia rupestris* | Coral Fern | Gleicheniaceae | 1 |
| *Histiopteris incisa* | Bat's-wing Fern | Dennstaedtiaceae | 1 |
| *Hypolepis muelleri* | Harsh Ground Fern | Dennstaedtiaceae | 1 2 3 |
| *Lindsaea linearis* | Screw Fern | Lindsaeaceae | 1 |
| *Psilotum nudum* | Skeleton Fork-fern | Psilotaceae | 1 |
| *Pteridium esculentum* | Bracken Fern | Dennstaedtiaceae | 1 2 |
| *Selaginella uliginosa* | Swamp Selaginella | Selaginellaceae | 1 |
| *Sticherus urceolatus* | - | Gleicheniaceae | 1 |
| *Todea barbara* | King Fern | Osmundaceae | 1 |
| **Exotic Species** | | | |
| - | Exotic Palm | Arecaceae | 2 |
| *Acacia excelsa* | Ironwood | Mimosaceae | 1 |
| *Acacia podalyriifolia* | Queensland Silver Wattle | Mimosaceae | 1 |
| *Acacia saligna* | Golden Wreath Wattle | Mimosaceae | 1 2 |
| *Acer sp.* (cultivar) | Maple | Aceraceae | 2 |
| *Acetosa sagittata* | Turkey Rhubarb | Polygonaceae | 1 2 |
| *Agapanthus praecox* | Agapanthus | Amaryllidaceae | 1 2 4 |
| *Ageratina adenophora* | Crofton Weed | Asteraceae | 1 2 3 4 |
| *Ageratum houstonianum* | Mist Flower | Asteraceae | 1 2 |
| *Amaranthus spinosus* | Needle Burr | Amaranthaceae | 1 |
| *Anagalis arvensis* | Scarlet Pimpernel | Primulaceae | 1 2 |
| *Andropogon virginicus* | Whisky Grass | Poaceae | 1 2 4 |
| *Anredera cord folia* | Madiera Vine | Basellaceae | 1 2 |
| *Araucaria heterophylla* | Norfolk Island Pine | Araucariaceae | 2 |

**Table 3.1 – Flora observations for the subject site**

| Scientific Name | Common Name | Family | Community |
|---|---|---|---|
| *Aristae ecklonii* | Blue Stars | Iridaceae | 1 2 4 |
| *Arundo donax* | Giant Reed | Poaceae | 1 |
| *Asparagus aetheopicus* | Asparagus Fern | Asparagaceae | 1 2 |
| *Avena sativa* | Oats | Poaceae | 1 2 |
| *Axonopus fissifolius* | Narrowleaf Carpet Grass | Poaceae | 1 2 |
| *Bidens pilosa* | Cobblers Pegs | Asteraceae | 2 |
| *Briza maxima* | Quaking Grass | Poaceae | 1 2 |
| *Bromus cartharticus* | Prairie Grass | Poaceae | 2 |
| *Callistemon sp.* (cultivar) | Crimson Bottlebrush | Myrtaceae | 2 |
| *Callitris sp.* | - | Cupressaceae | 2 |
| *Centaurium erythraea* | Pink Stars | Gentianaceae | 1 2 |
| *Centaurium tenuiflorum* | - | Gentianaceae | 2 |
| *Cestrum parqui* | Chilean Cestrum | Solanaceae | 2 |
| *Chlorophytum comosum* | Spider Plant | Liliaceae | 1 |
| *Cinnamomum camphora* | Camphor Laurel | Lauraceae | 1 2 |
| *Cirsium vulgare* | Spear Thistle | Asteraceae | 1 2 |
| *Citrus limonia* | Bush Lemon | Rutaceae | 2 |
| *Colocasia esculenta* | Taro | Araceae | 3 |
| *Conyza sumatrensis* | Tall Fleabane | Asteraceae | 1 2 |
| *Coreopsis lanceolata* | Coreopsis | Asteraceae | 1 2 |
| *Cortaderia selloana* | Pampas Grass | Poaceae | 1 2 4 |
| *Cotoneaster pannosus* | - | Malaceae | 1 |
| *Crocosmia X crocosmiiflora* | Montbretia | Iridaceae | 1 2 |
| *Cyperus congestus* | - | Cyperaceae | 2 3 |
| *Cyperus eragrostis* | Umbrella Sedge | Cyperaceae | 1 2 3 |
| *Delairea odorata* | Cape Ivy | Asteraceae | 2 |
| *Ehrharta erecta* | Panic Veldtgrass | Poaceae | 1 2 |
| *Erechtites valerianifolia* | Brazilian Fireweed | Asteraceae | 2 |
| *Erythrina crista-galli* | Coskspur Coral Tree | Fabaceae | 2 3 |
| *Erythrina X sykesii* | Coral Tree | Fabaceae | 2 |
| *Eucalyptus microcorys #* | Tallowwood | Myrtaceae | 2 |
| *Euphorbia peplus* | - | Euphorbiaceae | 1 2 |
| *Ficus pumila* | Creeping Fig | Moraceae | 1 |
| *Fumaria muralis* | Wall Fumitory | Fumariaceae | 2 |
| *Gamochaeta □uring□na* | Cudweed | Asteraceae | 1 2 |
| *Gamochaeta spicata* | Cudweed | Asteraceae | 1 2 |
| *Harpephyllum caffrum* | Kaffir Plum | Anarcardiaceae | 2 |
| *Hedychium gardnerianum* | Ginger Lily | Anthericaceae | 1 2 |
| *Hydrocotyle bonariensis* | Pennywort | Apiaceae | 2 3 |
| *Hypochaeris radicata* | Flatweed | Asteraceae | 1 2 4 |
| *Impatiens walleriana* | Busy Lizzie | Balsaminaceae | 3 |
| *Ipomoea indica* | Blue Morning Glory | Convolvulaceae | 1 2 |
| *Jacaranda mimosifolia* | Jacaranda | Bignoniaceae | 2 |
| *Juncus articulatus* | - | Juncaceae | 2 |
| *Juncus capillaceus* | - | Juncaceae | 1 2 |
| *Lantana camara* | Lantana | Verbenaceae | 1 2 |
| *Leptospermum sp.* | - | Myrtaceae | 2 |
| *Ligustrum lucidum* | Broad-leaved Privet | Oleaceae | 1 2 |
| *Ligustrum sinense* | Small-leaved Privet | Oleaceae | 1 2 4 |
| *Lilium formosanum* | - | Liliaceae | 1 |
| *Lonicera japonica* | Honeysuckle | Caprifoliaceae | 1 2 |
| *Lotus suaveolens* | Hairy Birds-foot Trefoil | Fabaceae | 2 |
| *Ludwigia peruviana* | - | Onagraceae | 3 |

**Table 3.1 – Flora observations for the subject site**

| Scientific Name | Common Name | Family | Community |
|---|---|---|---|
| *Modiola caroliniana* | Red-flowered Mallow | Malvaceae | 2 |
| *Monstera deliciosa* | - | Araceae | 2 |
| *Musa acuminata* | Banana | Musaceae | 2 |
| *Nephrolepis cordifolia* | Fish-bone Fern | Davalliaceae | 1 2 |
| *Paspalum dilatatum* | Paspalum | Poaceae | 1 2 |
| *Paspalum urvillei* | Vasey Grass | Poaceae | 2 3 |
| *Passiflora edulis* | Passionfruit | Passifloraceae | 1 2 |
| *Pennisetum clandestinum* | Kikuyu | Poaceae | 2 3 |
| *Phyllostachys sp.* | Bamboo | Poaceae | 1 2 |
| *Phytolacca octandra* | Inkweed | Phytolaccaceae | 2 |
| *Pinus sp.* | Exotic Pine | Pinaceae | 2 |
| *Plantago lanceolata* | Ribwort | Plantaginaceae | 1 2 |
| *Plantago major* | Large Plantain | Plantaginaceae | 2 |
| *Plantanus x acerifolia* | Plane Tree | Plantanaceae | 2 |
| *Populus alba* | White Poplar | Salicaceae | 2 |
| *Populus nigra* | Lombardy Poplar | Salicaceae | 1 2 |
| *Ranunculus repens* | Creeping Buttercup | Ranunculaceae | 1 2 3 |
| *Ricinis communis* | Castor Oil Plant | Euphorbiaceae | 1 2 |
| *Robinia pseudoacacia* | Black Locust | Fabaceae | 2 |
| *Rubus ulmifolius* | Blackberries | Rosaceae | 1 2 |
| *Rumex crispus* | Curled Dock | Polygonaceae | 2 3 |
| *Salix babylonica* | Weeping Willow | Salicaceae | 2 3 |
| *Salix sp.* | Willow | Salicaceae | 2 3 |
| *Schefflera actinophylla* | Umbrella Tree | Araliaceae | 1 2 |
| *Senecio madagascariensis* | Fireweed | Asteraceae | 1 2 3 |
| *Senna pendula* var. *glabrata* | - | Fabaceae | 1 2 3 |
| *Setaria gracilis* | Slender Pigeon Grass | Poaceae | 1 2 |
| *Sida rhombifolia* | Paddy's Lucerne | Malvaceae | 2 |
| *Silene pratensis* | White Campion | Caryophyllaceae | 1 2 |
| *Solanum americanum* | Glossy Nightshade | Solanaceae | 2 |
| *Solanum mauritianum* | Tobacco Bush | Solanaceae | 1 2 |
| *Stenotaphrum secundatum* | Buffalo Grass | Poaceae | 1 2 |
| *Taraxacum officinale* | Dandelion | Asteraceae | 1 2 |
| *Tibouchina sp.* | - | Melastomataceae | 2 4 |
| *Toxicodendron succedaneum* | Rhus Tree | Anacardiaceae | 1 |
| *Tradescantia fluminensis* | Wandering Jew | Commelinaceae | 2 3 |
| *Trifolium dubium* | Yellow Suckling Clover | Fabaceae | 1 2 |
| *Trifolium fragiferum* | Strawberry Clover | Fabaceae | 2 |
| *Trifolium repens* | White Clover | Fabaceae | 1 2 |
| *Verbascum virgatum* | Twiggy Mullein | Scrophulariaceae | 2 |
| *Verbena bonariensis* | Purple Top | Verbenaceae | 1 2 3 |
| *Verbena quadrangularis* | Flaxleaf Fleabane | Verbenaceae | 1 2 |
| *Zantedeschia aethiopica* | Arum Lily | Araceae | 2 |
| # denotes species native to Australia but exotic within the locality. | | | |

### 3.3 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** | | **Jan 2004** | **Mar-Apr 2010** |
| Australasian Grebe | *Tachybaptus novaehollandiae* | O | |
| Australian King Parrot | *Alisterus scapularis* | | O C |
| Australian Magpie | *Gymnorhina tibicen* | O C | O C |
| Australian Raven | *Corvus coronoides* | O C | C |
| Australian White Ibis | *Threskiornis molucca* | | O |
| Australian Wood Duck | *Chenonetta jubata* | O C | O C |
| Black-faced Cuckoo-shrike | *Coracina novaehollandiae* | O C | O C |
| Common Koel | *Eudynamys scolopacea* | O C | |
| Common Myna * | *Acridotheres tristis* | O | O C |
| Common Starling * | *Sturnus vulgaris* | O C | |
| Crested Pigeon | *Ocyphaps lophotes* | O C | O C |
| Dollarbird | *Eurystomus orientalis* | O | |
| Dusky Moorhen | *Gallinula tenebrosa* | O | O |
| Eastern Rosella | *Platycercus eximius* | O C | C |
| Eastern Spinebill | *Acanthorhynchus tenuirostris* | O | C |
| Eastern Whipbird | *Psophodes olivaceus* | C | O C |
| Eastern Yellow Robin | *Eopsaltria australis* | | C |
| Fan-tailed Cuckoo | *Cacomantis flabelliformis* | C | C |
| Galah | *Cacatua roseicapilla* | O C | |
| Glossy Black-Cockatoo [TS] | *Calyptorhynchus lathami* | | O C |
| Golden Whistler | *Pachycephala pectoralis* | | C |
| Goose (domestic) | *Anser anser* | | O |
| Grey Butcherbird | *Cracticus torquatus* | O C | O C |
| Grey Fantail | *Rhipidura fuliginosa* | | O C |
| Laughing Kookaburra | *Dacelo novaeguineae* | O C | O C |
| Lewin's Honeyeater | *Meliphaga lewinii* | | O C |
| Little Pied Cormorant | *Phalacrocorax melanoleucos* | O | |
| Little Wattlebird | *Anthochaera chrysoptera* | | O C |
| Magpie-lark | *Grallina cyanoleuca* | O C | O C |
| Masked Lapwing | *Vanellus miles* | O C | O C |
| New Holland Honeyeater | *Phylidonyris novaehollandiae* | O | C[PR] |
| Noisy Miner | *Manorina melanocephala* | O C | O C |
| Pacific Black Duck | *Anas superciliosa* | O | O C |
| Pied Currawong | *Strepera graculina* | O C | O C |
| Powerful Owl [TS] | *Ninox strenua* | | P Sp C |
| Rainbow Lorikeet | *Trichoglossus haematodus* | O C | O C |
| Red-browed Finch | *Neochmia temporalis* | | O C |
| Red Wattlebird | *Anthochaera carunculata* | O C | O C |
| Red-whiskered Bulbul * | *Pycnonotus jocosus* | O C | C |
| Restless Flycatcher | *Myiagra inquieta* | | O C |
| Rock Dove * | *Columba livia* | | O |
| Sacred Kingfisher | *Todiramphus sanctus* | O C | |
| Scaly-breasted Lorikeet | *Trichoglossus chlorolepidotus* | | O C[PO] |
| Scarlet Honeyeater | *Myzomela sanguinolenta* | | C |
| Silvereye | *Zosterops lateralis* | O C | O C |
| Spangled Drongo | *Dicrurus bracteatus* | | O |

**Table 3.2 – Fauna observations for the study area**

| Common name | Scientific name | Method observed | |
|---|---|---|---|
| Spotted Turtle-Dove * | *Streptopelia chinensis* | O | C |
| Striated Pardalote | *Pardalotus striatus* | | C |
| Sulphur Crested Cockatoo | *Cacatua galerita* | O C | O C |
| Superb Fairy-wren | *Malurus cyaneus* | O C | O C |
| Tree Martin | *Hirundo nigricans* | | O[PR] |
| Welcome Swallow | *Hirundo neoxena* | O | O C |
| White-browed Scrubwren | *Sericornis frontalis* | | O C |
| Willie Wagtail | *Rhipidura leucophrys* | O C | O C |
| Yellow-tailed Black-Cockatoo | *Calyptorhynchus funereus* | C | |
| **Mammals** | | | |
| Black Rat * | *Rattus rattus* | E | HT E |
| Brown Antechinus | *Antechinus stuartii* | E | HT |
| Bush Rat | *Rattus fuscipes* | | E |
| Common Brushtail Possum | *Trichosurus vulpecula* | Sp E | Sp E |
| Common Ringtail Possum | *Pseudocheirus peregrinus* | Sp | Sp HT |
| Domesticated Cat * | *Felis cattus* | | O HT |
| Domesticated Dog * | *Canis familiaris* | O | O C |
| Eastern Bentwing-bat [TS] | *Miniopterus orianae oceansis* | | A |
| Eastern Freetail-bat | *Mormopterus ridei* | | A[PO] |
| Gould's Wattled Bat | *Chalinolobus gouldii* | A | A |
| Grey-headed Flying-fox [TS] | *Pteropus poliocephalus* | Sp | Sp |
| Horse * | *Equus caballus* | O Sc | O |
| House Mouse * | *Mus musculus* | E | |
| Little Forest Bat | *Vespadelus vulturnus* | A | A |
| Long-nosed Bandicoot | *Parameles nasuta* | E | HT E |
| Rabbit * | *Oryctolagus cuniculus* | Sc O | O Sp Sc |
| Swamp Wallaby | *Wallabia bicolor* | | HT |
| **Reptiles** | | | |
| Cream-striped Shining Skink | *Cryptoblepharus virgatus* | | O |
| Delicate Skink | *Lampropholis delicata* | | O E |
| Eastern Blue Tongue Lizard | *Tiliqua scincoides* | E O | O |
| Eastern Water Dragon | *Physignathus lesueurii* | E O | O |
| Eastern Water Skink | *Eulamprus quoyii* | E O | O |
| Grass Skink | *Lampropholis guichenoti* | E O | |
| Red-Bellied Black Snake | *Pseudechis porphyriacus* | | E |
| Southern Leaf-tailed Gecko | *Phyllurus platurus* | | E |
| **Amphibians** | | | |
| Common Eastern Froglet | *Crinia signifera* | | C E |
| Dusky Toadlet | *Uperoleia fusca* | | C |
| Peron's Tree Frog | *Litoria peronii* | C | |
| Striped Marsh Frog | *Limnodynastes peronii* | C | C E |

**Table 3.2 – Fauna observations for the study area (cont.)**

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 |
| E | - | Trap (Elliott, cage, etc) | S | - | Habitat Search |
| Sp | - | Spotlight | Sc | - | Scat, Track or Sign Identification |
| HT | - | Hair tubes/ scat analysis | | | |

### 3.4 Summary of habitat types

A range of fauna habitats is present throughout the subject site and shown in Table 3.3 below.

**Table 3.3 – Habitat types**

| Habitat Type | ***Peppermint – Angophora Woodland / Open Forest*** | ***Exotic Grassland with Scattered Trees*** | ***Aquatic Herbfield*** | ***Kunzea – Tea-tree Tall Heath*** |
|---|---|---|---|---|
| Vegetated areas of woodland, forest and heath | Y | N | N | Y |
| Low density to dense shrub layers | Y | N | N | Y |
| Dense ground covers of herbs and grasses | Y | N | N | Y |
| Areas of ground cover dominated by Lantana and other exotic species | Y | N | N | Y |
| Nectar producing plants and trees, principally *Eucalyptus*, *Corymbia*, *Angophora, Banksia* and *Acacia* | Y | N | N | Y |
| Sap flows | Y | N | N | N |
| Small (<10cm), medium (10-30cm) and Large (>30cm) sized tree hollows of varying quality | Y | N | N | N |
| Fallen timber and hollow logs | Y | N | N | Y (limited) |
| Loose soil suitable for burrowing and moist areas suitable for subterranean foraging | Y | Y | N | Y |
| Sandstone rock outcroppings, cliff lines, overhangs and crevices | Y | N | N | Y |
| Sparse to dense litter layers | Y | N | N | Y |
| Aquatic Habitats characterised by farm dams and drainage lines | | N | Y | N |
| Occasional rubbish debris (corrugated iron sheets, building refuse). | Y | Y | N | N |

### 3.5 Habitat features

The vegetation communities provide a variety of habitat resources. They include:

- *Peppermint –Angophora Woodland/Open Forest* occurs in a number of portions with the subject site totalling and area of approximately 3.11ha. The open forest areas do not contain arable soil. This community is dominated by the November to December flowering *Eucalyptus piperita* (Sydney Peppermint) and *Angophora costata* (Smooth-barked Apple), and the January to April flowering *Corymbia gummifera* (Red Bloodwood). This provides foraging habitat for birds, bats and arboreal mammals. Hollow bearing trees/habitat trees (Figure 1), were observed within this vegetation community with the highest density, quality and size ranges occurring in the eastern portions along Oxford Falls Road. Hollows present provide potential roosting and nesting habitat for birds, micro-chiropteran bats, arboreal mammals, some arboreal reptile species and a low potential for owls. This community has good structural dimension between over-storey and mid-storey foliage within the eastern portion that provides suitable roosting habitat for *Ninox* owl species. A sparse to moderate shrublayer provides suitable protective and foraging habitat for birds, arboreal mammals and terrestrial mammal species. A moderate groundcover of herbs and grasses, leaf litter, fallen timber and occasional hollow logs provide suitable habitat for small terrestrial mammals, reptiles and amphibians.

- *Exotic Grassland with Scattered Trees* occurs within central portions of the subject site with arable soil totalling an area of approximately 11.05ha. This community is dominated by a variety of flowering trees which provide foraging habitat for birds, bats and arboreal mammals. Hollow bearing trees/habitat trees were observed scattered and subsequently in low density within this vegetation community. These contained small (<10cm) to medium (10 – 30cm) sized hollows, which provide potential roosting and nesting habitat for small birds, micro-chiropteran bats and arboreal mammal species. Scattered areas of sparse shrub layers provides limited protective and foraging habitat for small birds, small arboreal mammals and terrestrial mammal species. A dense groundcover of herbs and grasses as well as tree litter provides open foraging habitat for large mammals and limited habitat for small terrestrial mammals, reptiles and amphibians. This community was observed to provide foraging habitat for a very high density of rabbits throughout.

- *Aquatic Herbfield/Farm dam's* occurs along the tributary of Middle Creek and represented by three (3) farm dams that fringe the western vegetated portions. This community is characterised by a moderate to dense herbfield to a height of 1-2m with occasional exotic shrubs and aggregations of leaf litter. This provides suitable foraging habitat for birds, protective and foraging habitat for small terrestrial mammals, reptiles and amphibians. Vegetated central areas and fringes of dams provide suitable breeding habitat for amphibian species. Open surface water provided by the central and southern dam provides drinking resources for microchiropteran bats and foraging habitat for waterfowl.

- *Kunzea–Tea-tree Tall Heath* occurs within a small central portion of the connective vegetation that occurs within the western confines of the subject site. This community has a total area of approximately 0.36ha and provides dense foliage structure which in turn provides protective habitat for small to large terrestrial mammals, small birds and, to a lesser extent, reptiles.

### 3.6 Tree assessment

A total of 325 trees were assessed within or in close proximity to the proposed building footprints with SULE 1A, 2A, 2B, 2C, 2D, 3A, 3B. 3C, 3D, 4A, 4C 4D and 4E. Their ratings are given in Schedule 1 of this report.

Only the trees within or in close proximity to the proposed building footprints have been individually assessed as part of this report. All other trees occurring outside the areas to be occupied by the proposed structures are expected to be retained. All individual trees surveyed have been marked using metal tags and labelled with their respective number ID (except in some areas where trees were very crowded, where approximately 1 in 3 trees were tagged). Locations of surveyed trees are shown on the Tree Plan (c.f. Schedule 2).

The trees on this site are a mixture of endemic (naturally occurring local native) species and exotics. The tree species currently recorded include *Acacia floribunda*, *Acacia implexa, Acacia parramattensis*, *Allocasuarina torulosa*, *Angophora bakeri, Angophora costata*, *Araucaria heterophylla, Archontophoenix alexandrae, Banksia integrifolia, Brachychiton acerifolius, Callitris sp., Casuarina cunninghamiana, Casuarina glauca, Cinnamomum camphora, Corymbia gummifera, Corymbia maculata,* Dead Stag, *Erythrina sykesii, Eucalyptus deanei, Eucalyptus paniculata, Eucalyptus piperita*, *Eucalyptus punctata, Eucalyptus robusta, Eucalyptus sieberi,* Exotic Palm, *Harpephyllum caffrum, Jacarandra mimosifolia, Livistona australis, Melaleuca armilaris, Melaleuca ericifolia, Melaleuca styphelioides, Pinus elliotti, Pinus radiata, Platanus x acerifolia, Populus sp. Schefflera actinophylla, Syzygium sp.* and *Toxicodendron succedaneum.* A full list of species and their characteristics is provided in Schedule 1.

In general the majority of trees on the site are of good health and condition, however some have been disturbed by earthworks in close proximity to the roots. There are also a number of trees with a projected short life span. These trees are now left standing on a small mound of soil and many have exposed roots as a result.

A high proportion of the trees within the site have either been recently planted as part of the amenity or aesthetic improvement for the existing facility, or are newly recruited from seed. Suppressed Eucalypt trees in nature are generally naturally thinned, suppressed Eucalypt trees in a residential situation can be dangerous due to their natural decline and associated branch loss (*Florence, 1996*).

A detailed description of the SULE categories is contained in Schedule 1.

It was considered that most of the trees assessed on site may be suitable for retention with an acceptable level of risk given the SULE rating was a 1a, 1c, 2a, 2c, 2d or 3a (refer to schedules) for a large majority of the assessed trees. However given the location of most of the assessed trees as being located with a proposed development footprint, they will be removed.

It should be noted that the tree numbers prior to 300 (refer to schedules) may have been surveyed up to 5 years ago and would likely require refinement given structural defects may have occurred over that time period.

### 3.7 Habitat trees

Table 3.4 provides hollow-bearing tree data and other habitat features recorded in 2010. Figure 1 provides locations of habitat trees.

**Table 3.4 – Habitat tree data**

| Tree No | Scientific Name | Common Name | DBH (cm) | Spread (m) | Height (m) | Vigour (%) | Hollows & Other Habitat Features Recorded |
|---|---|---|---|---|---|---|---|
| HT01 | stag | stag | 65 | 5 | 12 | 0 | 2x 0-5cm branch, 1x 5-10cm branch |
| * HT02 | Sydney Peppermint | *E piperita* | 70 | 12 | 24 | 75 | 2x 5-10cm trunk (good quality) |
| HT03 | Sydney Peppermint | *E piperita* | 80 | 15 | 29 | 80 | 2x 0-5cm branch |
| * HT04 | Sydney Peppermint | *E piperita* | 70 | 15 | 27 | 80 | 2x 5-10cm trunk (good quality) |
| HT05 | Sydney Peppermint | *E piperita* | 65 | 11 | 25 | 80 | 1x 0-5cm branch |
| * HT06 | Sydney Peppermint | *E piperita* | 35 | 9 | 23 | 70 | 1x 5-10cm trunk (good quality), 1x 10-15cm branch (good quality) (wear around hollows) |
| HT07 | Sydney Peppermint | *E piperita* | 55/60 | 19 | 24 | 75 | 1x 10-15cm broken trunk |
| * HT08 | Sydney Peppermint | *E piperita* | 60 | 18 | 19 | 85 | 1x 5-10cm trunk, 1x 5-10cm branch (wear around trunk hollow) |
| * HT09 | Smooth-barked Apple | *A costata* | 120 | 14 | 24 | 65 | 2x 40-45cm trunk (good quality) |
| HT10 | Sydney Peppermint | *E piperita* | 60 | 13 | 21 | 50 | 1x 0-5cm trunk |
| * HT11 | Smooth-barked Apple | *A costata* | 95 | 22 | 30 | 70 | 1x 35-40cm branch |
| HT12 | stag | stag | 140 | 5 | 8 | 0 | 1x 10-15cm broken trunk |
| HT13 | Sydney Peppermint | *E piperita* | 100 | 28 | 35 | 65 | 2x 5-10cm branch |
| * HT14 | Sydney Peppermint | *E piperita* | 75 | 13 | 19 | 45 | 1x 5-10cm branch, 1x 25-30cm trunk |
| HT15 | Grey Gum | *E punctata* | 30/35 | 14 | 15 | 25 | 1x 0-5cm branch (scratches on trunk) |
| * HT16 | Sydney Peppermint | *E piperita* | 60 | 17 | 19 | 60 | 1x 5-10cm trunk (wear around hollow) |
| HT17 | stag | stag | 50 | 5 | 8 | 0 | 1x 0-5cm branch, 1x 0-5cm trunk |
| HT18 | Red Bloodwood | *C gummifera* | 40 | 5 | 15 | 70 | 1x 0-5cm branch |
| * HT19 | Smooth-barked Apple | *A costata* | 80 | 13 | 20 | 60 | 1x 30-35cm trunk (good quality) |
| HT20 | Coral Tree | *E sykesii* | 65/25/25/30/30 | 14 | 23 | 80 | 1x 0-5cm branch, 1x 0-5cm trunk |
| * HT21 | Sydney Peppermint | *E piperita* | 60 | 16 | 16 | 50 | 1x 5-10cm trunk (wear around hollow) |
| HT22 | Sydney Peppermint | *E piperita* | 75/15/20 | 14 | 15 | 55 | 1x 0-5cm branch |
| HT23 | Sydney Peppermint | *E piperita* | 75/60/50 | 13 | 22 | 70 | 1x 10-15cm broken trunk |
| HT24 | Lemon-scented gum? | *C citriodora* | 60 | 17 | 27 | 90 | 1x 5-10cm branch |
| HT25 | Sydney Peppermint | *E piperita* | 40 | 8 | 25 | 35 | 1x 10-15cm trunk |
| HT26 | Sydney Peppermint | *E piperita* | 70 | 19 | 21 | 40 | 1x 5-10cm trunk |
| * HT27 | Smooth-barked Apple | *A costata* | 100 | 20 | 23 | 75 | 2x 5-10cm branch, 1x 10-15cm branch, 1x 15-20cm trunk (good quality) |
| HT28 | Sydney Peppermint | *E piperita* | 45 | 12 | 19 | 20 | 1x 5-10cm branch |

**Table 3.4 – Habitat tree data**

| Tree No | Scientific Name | Common Name | DBH (cm) | Spread (m) | Height (m) | Vigour (%) | Hollows & Other Habitat Features Recorded |
|---|---|---|---|---|---|---|---|
| HT29 | Sydney Peppermint | *E piperita* | 60/45/25 | 15 | 21 | 60 | 2x 0-5cm branch |
| HT30 | Silver-top Ash | *E sieberi* | 40/20 | 9 | 7 | 30 | 1x 0-5cm branch |
| * HT31 | Smooth-barked Apple | *A costata* | 115 | 19 | 24 | 70 | 1x 10-15cm branch, 1x 25-30cm trunk |
| * HT32 | stag | stag | 60 | 4 | 11 | 0 | 1x 30-35cm broken trunk, 1x 35-40cm broken trunk |
| HT33 | Sydney Peppermint | *E piperita* | 55 | 18 | 24 | 75 | 1x 0-5cm branch, 1x 10-15cm branch |
| * HT34 | Sydney Peppermint | *E piperita* | 45 | 15 | 16 | 65 | 1x 15-20cm trunk (good quality) |
| HT35 | Sydney Peppermint | *E piperita* | 90 | 16 | 16 | 15 | 1x 0-5cm branch, 1x 0-5cm trunk, 1x 5-10cm trunk |
| HT36 | Silver-top Ash | *E sieberi* | 75 | 8 | 18 | 55 | 1x 0-5cm branch |
| HT37 | Grey Gum | *E punctata* | 40 | 7 | 9 | 50 | 1x 0-5cm branch (scratches on trunk) |

Note: Habitat trees denoted with an asterisk "*" are considered of notable significance due to the quality, size, number present and/or signs of use of hollows present.

The assessment of 37 habitat trees in Table 3.4 above reveals that the site contains no highly significant habitat trees. Fourteen (14) habitat trees of notable quality based on usable depth, use, size or number of hollows have been identified. Five (5) of these including HT2, HT14, HT16, HT19 and HT21, are either within or near to development footprints. It is recommended that trees of notable significance are protected where possible, in particular HT19.

### 3.8 Tree removal

Tree removal and site modification are unavoidable consequences of development. Older trees are less tolerant of site disturbance. Therefore any tree with potential to be retained should be semi-mature to mature and protected from development construction.

No rare or threatened trees as listed under the Schedules of the (*TSC Act*, 1995) were observed on the site.

Less than five (5) specimens of *Eucalyptus robusta* (Swamp Mahogany), listed as a significant plant species within Warringah LGA by Smith and Smith (2002), were observed on site. It appears these specimens were most likely planted (along with several of the riparian specialist trees found on site).

The proposed development has been sited so that the structure footprints are located within existing cleared areas and an effort has been made to retain as much native vegetation as possible.

Following the assessment of both the trees and extent of the proposed development, a total of approximately 201 trees have been identified for removal. Therefore 62% of the assessed trees within the proposed development envelopes are to be removed to accommodate the proposed development. These trees will be replaced at a minimum ratio of 1:1 within the proposed corridors.
The assessment suggesting a 62% removal may appear high, however it is biased in that those areas proposed for conservation did not undergo a tree assessment. These areas are

denser in vegetation and are likely to contain a significant number of trees such that the percentage of trees being removed across the subject site in its entirety is estimated at around 20%.

Several factors have the potential to affect the long-term viability of any tree with the potential to be retained, including:

- Changes to site hydrology characteristics (decreased infiltration from compaction) following development;
- Increased erosion and soil movement following clearing for development;
- Exposure of retained trees to altered wind and light intensities from the removal of neighbouring trees;
- Physical damage to retained trees from the removal of neighbouring trees;
- Damage to rooting areas from the excavation and construction of roads, dwellings and trenches for utility (water/electricity etc.) connections;
- Physical damage from development construction works; and
- Damage from future resident/land manager activities.

These, and other, measures have been considered in the proposed retention of trees.

### *3.8.1 Tree protection guidelines*

The following guidelines are proposed in relation to any trees that may be retained on the site and the proposed development:

- Implementation of an adequate *Tree Protection Zone* (TPZ) will be required surrounding any retained tree. This TPZ can generally be provided by preserving an area around a tree with a radius of at least 1.25 x the average canopy radius from the trunk (of typical tree forms) or 0.5 x the tree height (*British Standard BS 5837* 1991).
- TPZs should be adequately marked and sign posted.
- All trees not nominated for retention are to be removed prior to any construction activity or bulk earthworks. Approved tree removal operations in the vicinity of retained trees are to be undertaken in a manner that avoids canopy damage and soil compaction. Such works are to be supervised by a qualified arborist.
- Stumps are to be ground - not dozed or dug out.
- All trenches footings and major earth movement should avoid TPZs.
- Stockpiling materials and soils within TPZs is to be avoided.
- Machinery is to avoid TPZs during all operations; and
- Any trenching or construction works undertaken within TPZs should be witnessed, supervised and recorded (photographed + documented) by a qualified arborist.

# 4 ECOLOGICAL ASSESSMENT

## 4.1 Previous surveys reviewed

- *Survey of the Duffys Forest Vegetation Community* (Smith and Smith, 1999) - This was an extensive vegetation mapping survey covering parts of coastal northern Sydney. The report and associated maps did not show that the subject site contains Duffys Forest Vegetation.

- *Warringah Natural Area Survey* (Smith and Smith, 2005) - The pre-European (1750) vegetation for the subject site was shown to have most likely been commensurate with Sydney Sandstone Gully Forest. The 2000 vegetation map shows the site as containing *Disturbed Vegetation.*

## 4.2 Flora species

A total of two hundred and sixty nine (269) flora species (159 native, 110 exotic) were observed within the subject site during the survey. Not all planted specimens around existing buildings and site features were surveyed.

All species are listed in Table 3.1.

## 4.3 Vegetation communities

Four (4) vegetation communities were identified within the subject site through ground truthing.

- Vegetation Community 1 – Peppermint – Angophora Woodland / Open Forest
- Vegetation Community 2 – Exotic Grassland with Scattered Trees
- Vegetation Community 3 – Aquatic Herbfield (Creek line and dams)
- Vegetation Community 4 – Kunzea – Tea-tree Tall Heath

Vegetation Community 1 – Peppermint – Angophora Woodland / Open Forest:

**Occurrence –** This vegetation community occurs in sections of the subject site which do not contain arable soil.

**Structure –** Woodland or Open Forest with a canopy cover of approximately 10-35% and height of approximately 15-23m. The understorey consists of a variable but generally moderate shrublayer to 10m high and sparse to moderate groundcover of herbs, ferns and grasses in drier areas. In the more moist areas, where the soil depth is skeletal, the understorey consists mostly of dense fern and sedge species whilst the overstorey cover is reduced and the mid-storey replaced with those species favouring wetter conditions such as *Banksia ericifolia.* The height of the tree species in areas exposed to a high incidence of rock outcropping is reduced as is the density of trees. This is evident in the central section of the western escarpment area.

**Disturbances –** This vegetation community has been disturbed by the construction of access roads and moderate to severe incursions of weeds such as Pampas Grass, Senna and Lantana.

This community would have once been equivalent to Sydney Sandstone Gully Forest.

**Common Species**

Trees: *Eucalyptus piperita* (Sydney Peppermint), *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood).

Shrubs: *Acacia parramattensis* (Sydney Green Wattle), *Banksia ericifolia* (Heath-leaved Banksia), *Banksia spinulosa* (Hairpin Banksia), *Ceratopetalum gummiferum*, *Elaeocarpus reticulatus* (Blueberry Ash), *Leptospermum polygalifolium* (Tantoon), *Phyllanthus hirtellus* (Thyme Spurge), *Pittosporum undulatum* (Sweet Pittosporum) and *Platylobium formosum* (Handsome Flat-pea).

Groundcovers: *Cryptostylis erecta* (Bonnet Orchid), *Entolasia marginata* (Bordered Panic), *Gonocarpus teucroides* (Raspwort), *Imperata cylindrica* (Blady Grass), *Lepyrodia scariosa*, *Lomandra longifolia* (Spiky-headed Mat-rush), *Smilax glyciphylla* (Sarsparilla) and *Xanthosia pilosa*.

Weeds: *Ageratina adenophora* (Crofton Weed), *Centaurium erythraea* (Pink Stars), *Conyza albida* (Tall Fleabane), *Cortadeia selloana* (Pampas Grass), *Hedychium gardnerianum* (Ginger Lily), *Hypochaeris radicata* (Flatweed), *Ipomoea indica* (Blue Morning Glory), *Lantana camara* (Lantana), *Ligustrum sinense* (Small-leaved Privet), *Lonicera japonica* (Honeysuckle), *Nephrolepis cordifolia* (Fishbone Fern), *Plantago lanceolata* (Ribwort) and *Senna pendula* var. *glabrata*.

*Photo 1 – Peppermint – Angophora Woodland / Open Forest vegetation adjacent to Oxford Falls Road, part of the better condition vegetation.*

*Photo 2 – Peppermint – Angophora Woodland / Open Forest vegetation in the central western portion of the subject site containing a high level of exotic plant disturbance.*

*Photo 3 – Heavily impacted zone in the middle of the Peppermint – Angophora Woodland / Open Forest*

**<u>Vegetation Community 2 – Exotic Grassland with Scattered Trees</u>:**

**Occurrence –** This vegetation community occurs in the sections of the subject site with arable soil. This community is highly disturbed and it is likely that it was previously Peppermint – Angophora Woodland / Open Forest.

**Structure –** Dense groundcover of herbs and grasses with scattered trees and shrubs.

**Disturbances –** This vegetation community is the result of agricultural activities.

**Common Species**

Trees: *Angophora costata* (Smooth-barked Apple), *Casuarina cunninghamiana* (River Oak), *Eucalyptus piperita* (Sydney Peppermint) and *Eucalyptus punctata* (Grey Gum).

Shrubs: *Acacia parramattensis* (Sydney Green Wattle), *Ceratopetalum gummiferum* (Christmas Bush) and *Pittosporum undulatum* (Sweet Pittosporum).

Groundcovers: *Centella asiatica* (Swamp Pennywort) and *Cynodon dactylon* (Common Couch).

Weeds: *Acacia saligna* (Golden Wreath Wattle), *Axonopus fissifolius* (Narrow-leaf Carpet Grass), *Callistemon sp.* Cultivar (Crimson Bottlebrush), *Centaurium erythraea* (Pink Stars), *Conyza sumatrensis* (Tall Fleabane), *Euphorbia peplus*, *Gamochaeta □uring□na* (Cudweed), *Hydrocotyle bonariensis* (Pennywort), *Hypochaeris radicata* (Flatweed), *Ligustrum sinense* (Small-leaved Privet), *Modiola caroliniana* (Red-flowered Mallow), *Nephrolepis cordifolia* (Fishbone Fern), *Pennisetum clandestinum* (Kikuyu), *Plantago lanceolata* (Ribwort), and *Trifolium repens* (White Clover).

This community would have once been equivalent to Sydney Sandstone Gully Forest. There are many planted specimens of trees within this community, particularly in the northern portion of the subject site in close proximity to the tennis courts.

*Photo 4 – Some scattered trees (mostly planted) in close proximity to one of the existing dwellings.*

*Photo 5 – Planted Casuarina and Pine trees on the southern side of the tennis courts.*

**Vegetation Community 3 – Aquatic Herbfield:**

**Occurrence –** This vegetation community occurs along the tributary of Middle Creek and on the edge of the farm dam in Lot 1336. There are other dams on site just downslope of the steep section of vegetation community 1 in the west that have been included within this vegetation community.

**Structure –** Moderate to dense herbfield to a height of approximately 1-2m, together with occasional exotic shrubs.

**Disturbances –** This community has been disturbed by modification of sections of the watercourse and incursions of weeds.

**Common Species**

Native: *Hydrocotyle peduncularis* (Pennywort), *Juncus usitatus* (Common Rush), *Panicum bisulcatum* (Blackseed Panic), *Persicaria hydropiper* (Water Pepper) and *Typha orientalis* (Cumbungi).

Weeds: *Ageratina adenophora* (Crofton Weed), *Colocasia esculenta* (Taro), *Cyperus eragrostis* (Umbrella Sedge), *Hydrocotyle bonariensis* (Pennywort), *Ludwigia peruviana*, *Ranunculus repens* (Creeping Buttercup), *Salix sp.* (Willow) and *Tradescantia fluminensis* (Wandering Jew).

*Photo 6 – Riparian vegetation approximately 30 metres south of the existing car park for the tennis academy*

*Photo 7 – Intersection of main Tributary and T1 near tennis Courts*

**Vegetation Community 4 – Kunzea – Tea-tree Tall Heath:**

**Occurrence –** This vegetation community occurs near the centre of the subject site.

**Structure –** Heath or scrub type vegetation with a height of generally 2.5-4m. There are very few emergent trees within this community. The shrublayer is thick and dense to approximately 50-75% foliage cover. The understorey is variable in density but usually sparse with very few grasses but does contain low growing shrubs, herbs and sedges.

**Disturbances –** This vegetation community has some weed influences but not to the extent of vegetation community 1.

**Common Species**

Shrubs: *Acacia longifolia* (Sydney Golden Wattle), *Banksia ericifolia* (Heath-leaved Banksia), *Epacris crassifolia, Epacris microphylla* (Coral Heath), *Grevillea buxifolia* (Grey Spider Flower), *Kunzea ambigua* (Tick Bush) and *Leptospermum polygalifolium* (Tantoon).

Groundcovers: *Dianella caerulea* (Flax Lily), *Empodisma minus, Imperata cylindrica* (Blady Grass), *Lepidosperma filiforme* and *Lomandra longifolia* (Spiky-headed Mat-rush).

Weeds: *Agapanthus praecox* (Agapanthus), *Andropogon virginicus* (Whisky Grass), *Aristea ecklonii* (Blue Stars), *Asparagus aethiopicus* (Asparagus Fern), *Cortaderia selloana* (Pampas Grass) and *Ligustrum sinense* (Small-leaved Privet).

*Photo 6 – Tall Heath vegetation looking westerly on the eastern edge.*

### 4.4 Threatened flora legislation

No threatened flora species or endangered ecological communities were noted to occur within the subject site.

***Summary of other threatened species requiring target survey by the DGR's (DoP 2006) and/or DECC (2009)***

- *Acacia bynoeana*
- *Grevillea caleyi*
- *Persoonia hirsuta*
- *Pimelea curviflora* var. *curviflora*
- *Syzygium paniculatum*
- *Tetratheca glandulosa*
- *Duffy's Forest Endangered Ecological Community*

***Acacia bynoeana*** – A small shrub occurring mainly in heath or woodland from Lake Macquarie to Ku-Ring-Gai Chase NP and Blue Mountains. Known from about 30 locations with most populations of 1-5 plants. Typically occurs west of Frenchs Forest (Harden, 1992).

Parts of the subject site were considered to contain potential habitat for this species. Further targeted survey work was undertaken on the 7th April 2010 to rule out the presence of this species.

***Grevillea caleyi*** – A shrub of 1-3m tall which flowers from August – April. This species grows in woodland landscapes on laterised sandstone ridgetops in the Terrey Hills to Belrose area.

It was considered that the subject site did not provide potential habitat for this species due to the lack of laterised soils, amount of weed presence and the subject site being just outside of the known geographic distribution of the species. Additionally, the remnant vegetation is more commensurate with gully vegetation as opposed to ridgetops.

***Persoonia hirsuta*** – A spreading to decumbent shrub growing in woodland and dry sclerophyll forest, usually on sandstone. It is known from Royal National Park to Gosford on the coast and Hill Top to Glen Davis and Putty inland.

Parts of the western escarpment area provide marginal patchy habitat for this species. A further target search on the 7th April 2010 was undertaken to rule out the presence of this species.

***Pimelea curviflora* var*. curviflora*** – A small sub-shrub which is confined to coastal areas around Sydney on sandstone. It is often difficult to observe due to its small size and habit of often growing amongst grasses and sedges, but would have been relatively easy to observe in the sparse understorey of the subject site.

The weed infested areas and higher moisture content areas would not provide habitat for this species. This reduces the potential for occurrence quite significantly and it was thought initially that only a small proportion of the western woodland/open forest area may contain potential for the species. Subsequently a target search was undertaken for this species on the 7th April 2010.

***Syzygium paniculatum*** – A rainforest tree which occurs in littoral rainforest and in subtropical or gallery rainforest on sandy alluvium. Given the absence of rainforest vegetation on site, this species has no potential to occur. However the species was targeted during the 2004 survey and again in the 2010 survey, the result being that no specimens were observed.

***Tetratheca glandulosa*** – A low-growing spreading shrub which is restricted to the area between Port Jackson and Gosford and inland to the foothills of the Blue Mountains. It grows in heath and woodland in sandy soil amongst sandstone outcrops.

Potential habitat may occur in western (high elevation) drier areas of the woodland/open forest that are not highly disturbed through weed invasion. This is quite a small area restricted to the north-western corner of the subject site within areas that are proposed for retention in the western corridor (see Figure 1). The flowering time for this species is usually July to December, however there may be some intermittent flowering just outside of these months. Survey was initially conducted in early January 2004, and again on the 27th September 2004. All remnant vegetation as suitable habitat for this species is to be conserved. A further survey survey will be undertaken in late July 2010.

***Duffy's Forest Endangered Ecological Community*** – This unique vegetation unit occurs only in northern Sydney and has an open-forest or woodland structure, typically the former. It usually occurs on lateritic (ironstone) and deeply weathered shale derived soils on the ridgetops in Duffys Forest/Terrey Hills/Ingleside/Belrose area within Warringah, Pittwater and Ku-ring-gai Council areas. There are small outlier areas of the community in Manly and Hornsby. The soil type association is usually one of the Somersby Soil Landscape or Blacktown Soil Landscape.

- The subject site occurs on different soil types e.g. Oxford Falls and Lambert Soil Landscapes
- There is a lack of lateritic soils
- The species mix is more associated with a Sandstone Gully Forest. In the very north-west corner of the subject site, there is the beginning of Sandstone Ridgetop Woodland (*presence of Eucalyptus haemastoma*).
- Mapping by Smith and Smith (1999) have not mapped the site as containing this EEC. Their mapping which was also shown for 1750 vegetation (pre-European settlement) did not show the site as containing the EEC.

### *4.4.1 State legislative matters*

*TSC Act* – A search of the *Atlas of NSW Wildlife* (DECCW 2010) database indicated that thirty five (35) species have been recorded within a 10 km radius of the study area. Those species are listed in Table 4.1. Of those thirty five (35) threatened flora species, nine (9) have the potential to occur within the subject site.

Table 4.1 briefly explains the level of potential as *potential habitat* or *marginal.*

Those species with *potential habitat* include:

- *Acacia bynoeana*
- *Darwinia biflora*
- *Epacris purpurascens* var. *purpurascens*
- *Eucalyptus camfieldii*
- *Tetratheca glandulosa.*

Those species with *marginal* habitat include:

- *Lasiopetalum joyceae*
- *Melaleuca deanei*
- *Persoonia hirsuta* and
- *Pimelea curviflora* var. *curviflora.*

No threatened flora species of state significance were observed.

### *4.4.2 Endangered populations*

There are no endangered flora populations in the Warringah LGA.

### *4.4.3 National legislative matters*

A review of the schedules of the *EPBC Act* indicated the potential for eighteen (18) threatened flora species to have suitable habitat within a 10km radius of the site (Table 4.1).

Of those eighteen (18) threatened flora species, five (5) have the potential to occur within the subject site. Those species with *potential habitat* include *Acacia bynoeana, Eucalyptus camfieldii* and *Tetratheca glandulosa.*

Those species with *marginal* habitat include:

- *Melaleuca deanei,* and
- *Pimelea curviflora* var. *curviflora.*

No threatened flora species of state significance were observed.

The actions associated with the development are not likely to significantly affect any nationally listed threatened species or ecological communities.

Conclusion*:* A referral to DEWHA should not be required.

## 4.5 Regional significance

Significant plant species recorded within the subject site considered significant in the Warringah LGA include:

- *Corymbia maculata*
- *Eucalyptus robusta*
- *Lythrum hyssopifolia*

All three (3) species are considered threatened in the northern Sydney region however none have been listed as a ROTAP species or fall under the schedules of threatened species legislation.

There was five (5) *Eucalyptus robusta* within the subject site. This was most likely a planted specimens.

The *Corymbia maculata* trees occur near the western boundary of the subject site away from any proposed development area.

The *Lythrum hypssopifolia* specimens occur within the riparian zone and may be disturbed during the creek restoration works, however in the long term with weeds removed, the potential for re-establishment will be largely increased.

### 4.6 Endangered ecological communities (EECs)

No EECs have been identified on site.

There has been no previous mapping to suggest the vegetation on site is commensurate with Duffys Forest EEC or any of the riparian/floodplain EECs. Species such as Casuarinas, Melaleucas and the lone Swamp Mahogany tree would often form a riparian/floodplain EEC however most of these trees have been planted.

### 4.7 Threatened flora species habitat assessment

Table 4.1 below provides an assessment of threatened flora species habitat likely to occur within the subject site.

**Table 4.1 – Threatened flora habitat assessment**

| Scientific name | Growth form and habitat requirements | Conservation status | Comments | TSC Act | EPBC Act |
|---|---|---|---|---|---|
| *Acacia bynoeana* DECCW EPBC | Erect or spreading shrub to 0.3 m 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. | Blue Mountains NP, Royal NP, Castlereagh NR, Agnes Banks NR, Lake Macquarie SRA, Dharawal NR, Marramarra NP, Parr SRA | Nearest record is 2km away. Potential habitat exists in parts of vegetation communities 1 and 2. Not observed. | E1 | V |

**Table 4.1 – Threatened flora habitat assessment**

| Scientific name | Growth form and habitat requirements | Conservation status | Comments | TSC Act | EPBC Act |
|---|---|---|---|---|---|
| *Acacia terminalis ssp terminalis* DECCW EPBC | Erect shrub to 2m tall, flowers from March to July. Occurs in eucalypt woodland or forest, usually in sandy soil on creek banks, hillslopes or in shallow soil in rock crevices and sandstone platforms on cliffs. Typically restricted to the Port Jackson and eastern suburbs of Sydney. | Sydney Harbour NP | Nearest record is 1km away which appears disjunct from the main population some 7km away. No potential habitat present. | E1 | E |
| *Allocasuarina portuensis* DECCW | A shrub of 3-5m tall, similar to other *Casuarinaceae* species. Grows in tall shrubland on sandstone headland at Nielsen Park, Vaucluse. | Sydney Harbour NP | Nearest record 9.9km away. Outside of known geographic range. No potential habitat present. | E1 | E |
| *Apatophyllum constablei* EPBC | A small shrub up to 40cm tall that grows in dry sclerophyll forest on slopes with a north to north-westerly aspect usually near cliffs. It flowers from August to December. Most populations are restricted to Wollemi National Park near the town of Glen Davis. The species has been removed from the TSA Act since 2007. | Wollemi NP | Not recorded within 10km. No suitable habitat present. | - | E |
| *Caladenia tessellata* DECCW EPBC | Terrestrial orchid. Clay-loam or sandy soils. Distribution limits N-Swansea S-south of Eden. | Munmorah SRA, Popran NP, Wyrrabalong NP | Nearest record is 6.3km away. All recordings within 10km were made in 1945. Given the isolation and fragmentation of local areas with potential habitat for this species along with the lack of local / recent records and the high level of disturbance, there is no potential habitat present. | E1 | V |

**Table 4.1 – Threatened flora habitat assessment**

| Scientific name | Growth form and habitat requirements | Conservation status | Comments | TSC Act | EPBC Act |
|---|---|---|---|---|---|
| *Callistemon linearifolius* DECCW | Shrub to 4 m high. Dry sclerophyll forest on coast and adjacent ranges. Distribution limits N-Nelson Bay S-Georges River. | Ku-ring-gai Chase NP Lion Island NR Spectacle Island Nature Reserve Yengo NP, Brisbane Water NP, Munmorah SRA, Werakata NP | Nearest record is 8.5km away. 1 record within 10km recorded in 1957. No potential habitat present. | V | - |
| *Chamaesyce psammogeton* DECCW | Prostrate herb. Coastal dunes. Distribution limits N-Tweed Heads S-Jervis Bay | Wamberal Lagoon NR Myall Lakes NP Booti Booti NP | Nearest record is 5.4km away. No potential habitat present. | E1 | - |
| *Cryptostylis hunteriana* DECCW EPBC | Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S-south of Eden. | Gibraltar Range NP, Ku-ring-gai Chase NP, Ben Boyd NP | Nearest record is 9.3km away. Given the only heath like vegetation is small and very isolated from existing larger patches, is surrounded by heavily disturbed vegetation and has not been recorded close to the site, it is considered the subject site hosts no potential habitat for this species. | V | V |
| *Darwinia biflora* DECCW | Erect or spreading shrub to 0.8 m high. Grows in heath or understorey of woodland on or near shale-capped ridges underlain by Hawkesbury sandstone. Distribution limits N-Gosford S-Cheltenham. | Ku-ring-gai Chase NP, Lane Cove NP, Marramarra NP, Berowra Valley RP | Nearest record is 2km away. There is some patchy potential habitat in the driest portions of vegetation community 1. Not observed. | V | V |
| *Deyeuxia appressa* DECCW EPBC | Erect grass to 0.9 m high. Grows on wet ground. Distribution limits N-Hornsby S-Bankstown. | Not currently known from conservation reserves. | Nearest record is 7.5km away. No potential habitat present. | E1 | E |
| *Diuris bracteata* DECCW | An orchid that grows in dry sclerophyll woodland. Was thought to be extinct until approximately 10yrs ago. Found in the Sydney Basin Bioregion. Flowers in September. | Not Known | Nearest record is 10km away. No potential habitat present. | E1 | E |

**Table 4.1 – Threatened flora habitat assessment**

| Scientific name | Growth form and habitat requirements | Conservation status | Comments | TSC Act | EPBC Act |
|---|---|---|---|---|---|
| *Epacris purpurascens var. purpurascens* DECCW | Erect shrub to 1.5m high growing in sclerophyll forest and scrub and near creeks and swamps on Sandstone. Distribution limits N-Gosford S-Blue Mountains | Ku-ring-gai Chase NP Muogamarra NR Brisbane Water NP Berowra Valley RP Bents Basin SRA | Nearest record is 3.4km away. Marginal potential habitat exists in the western escarpment area. Not observed. | V | - |
| *Eucalyptus camfieldii* DECCW EPBC | Stringybark to 10 m 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. | Brisbane Water NP, Ku-ring-gai Chase NP, Royal NP, Sydney Harbour NP, Awabakal NR, Popran NP, Berowra Valley RP | Nearest record is 2km away. Potential habitat is present on the western side of the subject site. Not observed. | V | V |
| *Eucalyptus nicholii* DECCW | A medium-sized tree that grows in dry grassy woodland, on shallow and infertile soils, mainly on granite. Confined to the New England Tablelands. Distributed between Tenterfield and Nundle. | Not currently known from conservation reserves. | Outside of geographical range. Not observed. | V | - |
| *Eucalyptus scoparia* DECCW | Smooth-barked tree only known from vicinity of Bald Rock. | Bald Rock NP | Outside of geographical range. Not observed. | E1 | V |
| *Genoplesium baueri* DECCW | A terrestrial orchid that grows in sparse sclerophyll forest and moss gardens over sandstone. Distribution limits N – Hunter Valley S – Nowra | Not currently known from conservation reserves. | Nearest record is 1.8km away. No potential habitat present. | E1 | - |
| *Grammitis stenophylla* DECCW | A small lithophytic fern with fronds generally <5cm. Occurs in rainforest and wet sclerophyll forest in the coastal divisions of NSW. | Ku-ring-gai Chase NP | Nearest record is 5.7km away. No potential habitat present. | E1 | - |

**Table 4.1 – Threatened flora habitat assessment**

| Scientific name | Growth form and habitat requirements | Conservation status | Comments | TSC Act | EPBC Act |
|---|---|---|---|---|---|
| *Grevillea caleyi* DECCW EPBC | Shrub mostly 1-3 metres high. Grows in laterite. Distribution limits Terrey Hills-Belrose area. | Garigal NP, Ku-ring-gai Chase NP | Nearest record is 1.4km away however most are over 3km away. No laterite present and just outside of the known geographic range. Additionally the species prefers ridgetop areas. The subject site occurs more so in a gully. No potential habitat present. | E1 | E |
| *Grevillea shiressii* DECCW | Shrub 2-5 m high. Flowers mainly spring. Grows along creek banks in wet sclerophyll forest. Sandy soil on Hawkesbury sandstone. Restricted to the Gosford area. CC. | Brisbane Water National Park. | Nearest record is 10km away. Outside of known geographic range. No potential habitat present | V | V |
| *Haloragodendron lucasii* DECCW EPBC | Straggling shrub to 1.5 m high. Grows in open forest on sheltered slopes near creeks. Distribution limits Ku-ring-gai Plateau & Mt Wilson. | Wollemi NP | Nearest record is 6km away. No potential habitat present. | E1 | E |
| *Hibbertia puberula* DECCW | Shrublets with branches up to 30 cm long. Not been seen for 40 years however early records are from Hawkesbury River area in Sydney and the Blue Mountains. | Unknown | Unlikely to occur. Not observed during field survey. | E1 | - |
| *Hibbertia superans* DECCW | Small spreading shrub to 0.3 m high. Grows on sandstone, usually in or near SSTF. Distribution limits N-Glenorie S-Kellyville disjunct Mt Boss. | Nil | Nearest record is 2km away and the only record within 10km which was observed in 2008. Possibly erroneous record as it appears somewhat disjunct from the known distribution. No potential habitat. | E1 | - |

**Table 4.1 – Threatened flora habitat assessment**

| Scientific name | Growth form and habitat requirements | Conservation status | Comments | TSC Act | EPBC Act |
|---|---|---|---|---|---|
| *Kunzea rupestris* EPBC | Shrub to 1.5 m high. Grows in cracks and fissures on Hawkesbury sandstone rock platforms. Distribution limits N-Maroota S-Glenorie. | Ku-ring-gai Chase NP, Marramarra NP | No records within 10km. Outside of known geographic range. Not observed. | V | V |
| *Lasiopetalum joyceae* DECCW | Erect shrub to 2 m high. Grows in heath and open forest on Hawkesbury sandstone. Distribution limits Hornsby Plateau. | Dharug NP, Ku-ring-gai Chase NP, Berowra Valley RP | Nearest record is 6.5km away. Marginal potential habitat in vegetation community 1 and 4 although unlikely to occur given the site is generally to the south-east of known recordings. | V | V |
| *Leptospermum deanei* DECCW EPBC | Shrub to 5 m high. Grows on forested slopes. Distribution limits Near watershed of Lane Cove River. | Garigal NP, Berowra Valley RP | Nearest record is 6km away. No potential habitat present. Not observed. | V | V |
| *Melaleuca biconvexa* DECCW EPBC | 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. | Bouddi NP, Wyrrabalong NP | Nearest record is 9.7km away. No potential habitat present. | V | V |
| *Melaleuca deanei* DECCW EPBC | Shrub to 3 m high. Grows in heath on sandstone. Distribution limits N-Gosford S-Nowra. | Berowra Valley Regional Park, Brisbane Water NP, Ku-ring-gai Chase NP, Garigal NP, Lane Cove NP, Royal NP, Heathcote NP | Nearest record is 6.4km away. Potential habitat is considered marginal and patchy within vegetation community 1 on the western side of the subject site. Not recorded. | V | V |
| *Microtis angusii* DECCW EPBC | Terrestrial orchid which is known from two populations, Mona Vale and Sunny Corner. | Not recorded from any conservation reserve | Nearest record is 3.7km away. No potential habitat present. | E1 | E |

**Table 4.1 – Threatened flora habitat assessment**

| Scientific name | Growth form and habitat requirements | Conservation status | Comments | TSC Act | EPBC Act |
|---|---|---|---|---|---|
| *Persoonia hirsuta* DECCW | Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. Distribution limits N-Glen Davis S-Hill Top. | Blue Mountains NP, Wollemi NP, Dharug NP, Ku-ring-gai Chase NP, Marramarra NP, Royal NP, Sydney Harbour NP | Nearest record is 0.6km away. Marginal potential habitat in drier patches of vegetation community 1. Not observed. | E1 | E |
| *Persoonia laxa* DECCW | Decumbent or prostrate shrub. Not been seen since 1908. Once recorded in Newport and Manly. | Not currently known from conservation reserves. | Considered extinct. No potential habitat present. | E4 | Ext. |
| *Pimelea curviflora var. curviflora* DECCW EPBC | Woody herb or sub-shrub to 0.2-1.2m high. Grows on Hawkesbury sandstone near shale outcrops. Distribution Sydney. | Not currently known from conservation reserves. | Nearest record is 0.6km away. Marginal potential habitat in drier patches of vegetation community 1. Not observed. | V | V |
| *Prostanthera junonis* DECCW | Small shrub. Grows in sclerophyll forest and heath in shallow soil on sandstone. Distribution limits Somersby region. | Brisbane Water NP | Nearest record is 3.4km away. Outside of known geographic region. Not potential habitat present. | E1 | E |
| *Prostanthera marifolia* DECCW EPBC | Erect shrub to 0.3m high. Woodland dominated by Eucalyptus sieberi and Corymbia gummifera. In deeply weathered clay soil with ironstone nodules. Has been recorded previously in the Sydney Harbour region. | Not known from any conservation reserves | No potential habitat present. Not recorded during surveys. | E4a | Critic. E |
| *Sarcochilus hartmannii* DECCW | An orchid which grows on volcanic rocks, often in shallow soil in sclerophyll forest or exposed sites usually at an elevation above 500m. Distribution – north from the Richmond River in the far north of NSW. | Unknown | 1 specimen was observed in 1940 some 6.3km away. Otherwise the site is outside of the known geographic distribution. No potential habitat. | V | V |
| *Senecio spathulatus* DECCW | A low growing daisy that prefers primary dunes. Known to occur at Cape Howe and between Kurnell north to Myall Lakes National Park. Also occurs in coastal locations in eastern Victoria. | Nadgee NP | Nearest record is 5.3km away. No potential habitat present. | E | - |

**Table 4.1 – Threatened flora habitat assessment**

| Scientific name | Growth form and habitat requirements | Conservation status | Comments | TSC Act | EPBC Act |
|---|---|---|---|---|---|
| *Syzygium paniculatum* DECCW | Small tree. Subtropical and littoral rainforest on sandy soil. Distribution limits N-Forster S-Jervis Bay. | Booti Booti NP, Myall Lakes NP, Wamberal Lagoon NR, Wyrrabalong NP, Captain Cooks Landing Place HS, Jervis Bay NP, Munmorah SRA, Glenrock SRA | Nearest record is 2.3km away. No potential habitat present. | V | V |
| *Tetratheca glandulosa* DECCW EPBC | Spreading shrub to 0.2 m high. Sandy or rocky heath or scrub. Distribution limits N-Mangrove Mountain S-Port Jackson. | Berowra Valley RP, Dharug NP, Garigal NP, Ku-ring-gai Chase NP, Popran NP, Parr SRA, Cattai NP, Brisbane Water NP, Yengo NP, Cattai NP, Marramarra NP, Muogamarra NR, Wollemi NP | Nearest record is 0.4km away. Potential habitat in drier areas of vegetation community 1 (see figure 1) that is not highly disturbed through weed invasion. These exist in close proximity to the dwelling in the north-western part of the subject site. These areas will be protection and managed as part of a wildlife corridor. Not observed. | V | V |
| *Thesium australe* EPBC | Erect herb to 0.4 m high. Root parasite. Grassland or woodland often damp. Distribution limits N-Tweed Heads S-south of Eden. | Bullen Range NR, Kosciuszko NP, Namadgi NP, Crowdy Bay NP, Hat Head NP, Kattang NR | Not recorded within 10km. No potential habitat present. | V | V |
| DECCW | - 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 | | | | |
| Under the TSC Act or EPBC Act, V = vulnerable species, E/E1 = endangered species, E4 = extinct | | | | | |

## 4.8 Fauna species

A total of eighty-four (84) fauna species have been recorded to date within or in close proximity to the subject site during surveys.

This number comprised 55 species of bird, 17 species of mammal, 8 species of reptile and 4 species of amphibian.

All species are listed in Table 3.2.

## 4.9 Threatened fauna legislation

Four (4) threatened fauna species – Powerful Owl (*Ninox strenua*) 2010, Grey-headed Flying-fox (*Pteropus poliocephalus*) 2004 & 2010, Glossy Black-Cockatoo (*Calyptorhynchus lathami*) 2010 and Eastern Bentwing-bat (*Miniopterus orianae oceansis*) 2010 – were recorded within or in close proximity to the subject site. All other fauna species are considered relatively common in the local area.

It is considered that the subject site provides suitable habitat for the following threatened fauna species:

- Red-crowned Toadlet ^
- Green and Golden Bell Frog
- Rosenberg's Goanna ^
- Broad-headed Snake
- Barking Owl ^
- Powerful Owl *
- Masked Owl
- Little Lorikeet
- Glossy Black-Cockatoo *
- Gang-gang Cockatoo
- Swift Parrot
- Regent Honeyeater
- Spotted-tailed Quoll ^
- Southern Brown Bandicoot ^
- Yellow-bellied Glider
- Eastern Pygmy Possum
- Koala ^
- Long-nosed Potoroo
- Grey-headed Flying-fox *
- Yellow-bellied Sheathtail-bat
- East-coast Freetail Bat
- Large-eared Pied Bat
- Large-footed Myotis
- Greater Broad-nosed Bat
- Eastern Bentwing-bat *

Note:

* indicates species recorded within or in close proximity to the subject site during surveys.

^ indicates remaining species considered with potential to occur based on local records or requested by DGR's (DoP 2006) or DECC (2009) for detailed survey and assessment. All species indicated with ^ or * will thus be considered within the *Maintain or Improve Test* (Section 5).

***Summary of threatened fauna species recorded***

**Powerful Owl *(Ninox strenua)***

*Behavioural background* - The Powerful Owl inhabits mature rainforest and wet and dry eucalypt forest. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal mammals. Roosting is generally within dense foliage of mid-canopy trees in sheltered gullies. Large trees with hollows at least 45cm in diameter and 100cm deep are required for nesting. Mated pairs of Powerful Owl roost together or separately, maintaining several roost sites throughout their territory, which are used in rotation (Lindsey 1992), shifting with the availability of prey. 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).

*Recordings* - A Powerful Owl was recorded responding to call-playback on the 7th April 2010. An individual was spotlighted approximately half an hour after the Powerful Owl call was broadcast on this occasion. The individual was perched in a tree less than 15m from the call-playback station. When observed by spotlight, this individual flew east and perched within the neighbouring lands on the other side of Oxford Falls Road. It then flew in approximately the same distance south where it perched and called for an extended period (see Figure 1 for locations and flight direction). This individual was considered to be a female by the call description (*Pizzey & Knight, 1997*). It was heard at times from around this same location whilst undertaking spotlighting activities within the subject site.

Owl whitewash was also observed during survey at three locations within the Peppermint-Angophora Woodland/Open Forest. One location was observed within the eastern portions next to Oxford Falls Road. Two other locations were observed in the narrow vegetated strip adjacent to the large dam in the southern portions of the subject site (see Figure 1 for approximate locations).

The whitewash observed was considered consistent with *Ninox* owl species as two were located below dense foliage perches. Owl whitewash, as described by owl expert John Young, is typically scattered droppings of thicker and whiter lime content located below suitable roosting perches depending on the species. The whitewash is considered to belong to Powerful Owl as this was was the only *Ninox* owl species recorded during survey. The more common Southern Boobook (*Ninox novaeseelandiae*) is typically more vocal and gives itself up easily if present in a locality.

*Site Specific Habitat* - It is considered that the subject site provides suitable roosting, foraging and low potential nesting habitat for the Powerful Owl. Roosting habitat is best represented within areas of Peppermint-Angophora Woodland / Open Forest community particularly the larger eastern portions located along Oxford Falls Road. Suitable roosting habitat is typified by dense areas of mid-storey foliage where individuals may perch out of open view during diurnal periods.

Foraging habitat is evident within the subject site by an obvious large presence of prey species and their habitat, particularly the favoured Common Ringtail Possum (*Pseudocheirus peregrinus*). It is considered that suitable retention of prey species habitat will be provided as part of the proposal however the removal of any suitable hollows for prey species should be supplemented with the prior placement of nest boxes. The numbers, design and placement of nest boxes should be under the guidance of a fauna ecologist.

Whilst large hollows were observed during the hollow-bearing trees surveys undertaken, these were not considered ideal for nesting as they were either too small, within open paddocks or near to traffic / activity. The Powerful Owl is highly sensitive to nest disturbance during the egg and chick stages (DEC 2006). Habitat Trees HT9 and HT11 and to a lesser extent HT19 have a degree of potential for use and thus were targeted by stag-watching on the 3rd June 2010, which is during the reliable winter nesting period (egg laying may commence late May 2010 and fledgling may continue into September). No activity was recorded.

Two narrow open forest strips will be proposed for removal which total 0.49 ha. These areas would not be considered ideal for roosting had roosting evidence not been found within one of these strips. Evidence of owl roosting was recorded in the more southern strip where two nearby patches of whitewash was observed. One of these provided a low degree of whitewash below a diurnal foliage perch. This is considered an infrequent perch due to the

small amount of wash and as no additional whitewash content was observed during five consecutive days of follow-up checking. The second perch also showed no additional whitewash during follow-up checks however a larger degree of white wash below the high exposed branch suggests this site is a nocturnal outlook.

Due to the species tendency to have numerous roosting sites within seasonal foraging home ranges, the removal of such roosts within the narrow southern strip is not considered to be significant. The proposal will result in a longer-term improvement in available roosting habitat for this species and suitable amount of roosting habitat will be available within the wider eastern forest during the interim growth period. 0.84ha of open forest habitat will be added to the eastern forest portions of the site which will cater for gully forest structures and provide a lower edge to width ratio.

The 'maintain or improve' test (Section 5) considers that available foraging habitat will improve from 3.11ha to 3.8ha and available roosting habitat will improve from 1.53ha to 1.77ha. A native landscape and APZ buffer of 45m will be provided to these more suitable roosting areas within the eastern portions of the site, which will also provide noise separations during construction activities.

The Recovery Plan for the Large Forest Owls (DEC 2006) states that forest clearing and fragmentation is recognised as the greatest ongoing threat to the three (3) large forest owls in NSW. The Recovery Plan also states that the Powerful Owl, in particular, displays considerable resilience to low level habitat disturbance through its continuing and successful occupancy of bushland among the outer suburbs of major Australian cities. Habitat disturbance for this species as part of the proposal is considered short-term.

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

*Behavioural background* - The Grey-headed Flying-fox 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 et. al., 2008*). Camps can be found in riparian rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas.

Grey-headed Flying-foxes are canopy-feeding frugivores and nectarivores, inhabiting a wide range of habitats including rainforests, open forests, woodlands, Melaleuca swamps, Banksia woodlands and cultivated areas during night foraging forays. Foraging is generally within 20km of camps.

*Site Specific* - The subject site provides suitable foraging habitat for the Grey-headed Flying-fox.

On the night of January 12th 2004 at 20:35, four (4) Grey-headed Flying-fox were spotlighted foraging within trees in vegetation community 2 - Exotic Grassland with Scattered Trees. One (1) individual of this species was again recorded foraging within this community during surveys undertaken on the 29th March 2010. This individual was foraging on a bottlebrush tree located within the landscaped gardens surrounding a house near to the previous observations (see Figure 1 for locations). On this same night two (2) other individuals were observed in flight over the subject site generally heading in a north-easterly direction.

It is considered that flowering trees throughout the Peppermint-Angophora Woodland/Open Forest and Grassland with Scattered Trees vegetation communities provide suitable foraging habitat for this species. Given the extent of suitable foraging habitat within the proposed conservation areas and throughout the local area, it is considered that the removal of suitable foraging trees within the development area will not significantly impact on this

species. Future landscaping and restoration of habitat within the subject site will sufficiently supplement the short-term loss of habitat.

The 'maintain or improve' test (Section 5) considers that approximately 80% (2.49ha) of the existing forest/woodland community and 15% (1.66ha) of the grassland with scattered trees community provides a total of 4.15ha of existing suitable foraging habitat. Approximately 80% of the new combined forest/woodland and heath community and 15% of the new landscaped areas will provide an increased total of 4.52ha of suitable foraging habitat.

**Eastern Bentwing-bat (*Miniopterus orianae oceanensis*)**

*Behavioural background* - The Eastern Bentwing-bat forages above and below the canopy within open forests and woodlands, feeding on small flying insects, predominantly moths (*Dwyer 1995*). The Eastern Bentwing-bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and, in particular, caves (*Dwyer 1995*). Caves are an important resource for this species, particularly for breeding, where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (*Dwyer 1995*). Roost sites in tree hollows have not been reported within the literature reviewed.

*Site Specific* - The subject site provides suitable foraging habitat for the Eastern Bentwing-bat. Roosting habitat is not likely but should not be ruled out based on the presence of old buildings. No suitable caves, bridges or culverts were observed during survey. The site does not offer any breeding habitat.

The Eastern Bentwing-bat was recorded during each of the recent three nocturnal surveys undertaken on the 23rd March and 6th and 7th April 2010. Recordings were made from all four Anabat station locations (see Figure 1 for locations). This suggests that the subject site is utilised for foraging throughout, however it should be noted that all Anabat stations were placed on the fringes of forest, tall landscaped vegetation or next to waterbodies where foraging is more likely concentrated by this particular species.

The proposed development is generally confined to the previously cleared central open areas of the subject site. Isolated areas of habitat providing good foraging structure will be removed within these areas, however the major foraging lines along natural vegetated areas within the eastern and western confines will be retained and promoted with further connectivity. It is recommended that the two dams located along the proposed corridor edges currently providing open water drinking resources for microchiropteran bats are retained such that foraging may continue along a designated flyway. It is recognised that the large southern dam will be modified by the proposal however open water drinking resources should remain by redesign.

The 'maintain or improve' test (Section 5) indicates the Eastern Bentwing-bat is the only species with a calculated habitat decline as part of the proposal. The calculated existing available foraging habitat is 12.52ha, being almost the complete subject site (with the exception of about 20% of the grassland with scattered trees community). The available foraging habitat post development is calculated at approximately 8ha which will did include the total development area or about 20% of the remaining grassland with scattered trees community.

The Eastern Bentwing-bat is known to extend foraging areas into developed landscapes, particularly streetlights that are present in proximity to the urban/bushland interface. The lesser degree of foraging that currently occurs within the more open central areas will thus be further reduced by the presence of infrastructure, but not eliminated. Such foraging activity will likely be more confined to the proposed higher quality habitats along the margins.

All buildings apart from a central shed are currently occupied by residents and therefore detailed inspections were not undertaken during the recent survey period. It is recommended that any buildings to be removed are prior-inspected by a fauna ecologist such that appropriate action can be taken in the event of roosting activity. As building structures do not provide any suitable breeding habitat, their removal should not impact on this species provided the recommendations in Section 6.2 of this report are adopted.

**Glossy Black-Cockatoo (*Calyptorhynchus lathami*)**

*Behavioural background* - The Glossy Black-Cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of Allocasuarina. 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.

*Site Specific* - It is considered that the subject site provides suitable foraging, roosting and potential (albeit low) nesting habitat for the Glossy Black-Cockatoo. The DECCW-threatened species profiles indicate that this species nests in hollows >15cm. It is generally known that this species will select dead trees or sections of dead limbs that provide vertical hollow spouts for nesting. These hollows are described as broken trunk hollows within Table 3.4, with all such hollows located within the subject site being less than 15cm. HT32 does appear to fit the description, however its height of 4m and location along Oxford Falls Road make it also of low potential.

A trio of Glossy Black-Cockatoos were heard and then observed late in the day on the 30th March 2010, landing to perch in trees located up the slope of neighbouring native vegetation, approximately 60m to the east of the subject site (see Figure 1 for location). It appeared that this trio had flown from the south and likely over the subject site.

Target searches were undertaken below mature and seeding Allocasuarinas found within the subject site during survey with no evidence of foraging found. In general Allocasuarinas occur in low densities within the subject site with high densities of mature seeding specimens occurring almost immediately on the other side of Oxford Falls Road and extending into natural bushlands to the east.

Given that the subject site has not recorded any foraging activity and nesting habitat appears unlikely present it is considered that the proposed development will not impose any significant impacts on this species.

The ‘maintain or improve’ test (Section 5) considers that approximately 40% (1.24ha) of the existing forest/woodland community and 20% (0.07ha) of the tall heath community provides a total of 1.31ha of existing suitable foraging habitat. Approximately 40% of the new combined forest/woodland and heath community will provide an increased total of 1.52ha of suitable foraging habitat. It is recommended that *Allocasuarina* feed trees are well represented within suitable portions of the restoration areas.

***Summary of other threatened species requiring target survey by the DGR's (DoP 2006) and/or DECC (2009)***

**Giant Burrowing Frog *(Heleioporus australiacus)***

*Behavioural background* - This species is most common on the Hawkesbury Sandstone in the Sydney region. It occurs south to Victoria (*Barker .et. al. 1995*). Males call from beside smaller semi-permanent to permanent streams or dams or from burrows within the bank of streams or dams. (*Anstis M.*, *2002*). They call mainly in spring and late autumn, but also after rain in late summer. Foamy egg mass is laid in a burrow such as an old crayfish hole in a stream bank, or concealed under dense vegetation. (*Anstis M., 2002*).

*Site Specific* - The subject site does not provide suitable habitat for this species.

**Barking Owl *(Ninox connivens)***

*Behavioural background* - The Barking Owl utilises dry sclerophyll forests and woodlands of tropical, temperate and semi-arid zones, often dominated by Eucalyptus, and containing many large trees suitable for roosting or breeding. This species is both carnivorous and insectivorous, taking mainly insects outside breeding season and more birds and mammals when breeding (*Higgins, P.J. 1999*). The Barking Owl utilises Eucalypt forests and woodlands and adjacent cleared areas for foraging and large hollows for nesting and breeding (*Schodde & Tidemann 1986*).

*Site Specific* - Targeted surveys for this species are described in Section 2.3.2 and Table 2.1. Call-playback stations and hollow-bearing locations are shown on Figure 1. Hollow-bearing tree data is provided in Table 3.4.

Given the hollow characteristic utilised as described by the Barking Owl Recovery Plan (NPWS 2003), it is considered that hollow-bearing trees HT9, HT11, HT14 HT19, HT31 & HT32 provide suitable nesting habitat. Of these trees, the species is less likely to utilise those located in the open areas of the development footprint (HT14, & HT19), or near to Oxford Falls Road (HT32). The retention of HT19 is nonetheless recommended due to its high quality.

The 'maintain or improve' test (Section 5) considers that approximately all (3.11ha) of the existing forest/woodland community and approximately 20% (2.21ha) of the grassland with scattered trees community would provide a total of approximately 5.32ha of existing suitable foraging and/or roosting habitat. The combined area of the biodiversity zone, core riparian zone, managed vegetation buffer and APZ will provide an increased total of 6.67ha of considered suitable habitat.

**Koala (*Phascolarctos cinereus*)**

*Behavioural background* - Koalas are recognised to occupy both forest and woodland communities, provided that the suitable eucalypt tree species are present. Koalas inhabit both wet and dry Eucalypt forest that contain a canopy cover of between 10% and 70% as well as suitable feed trees. (*Reed et. al. 1990*). The home range of koalas varies according to the quality of habitat and number of available food trees, more so than food tree density. Studies in Port Stephens have recorded home range sizes between 0.2-500ha, with an average of 80-90ha, considering also that males tend to occupy larger areas.

*Site Specific* - Targeted surveys for this species are described in Section 2.3.3 and Table 2.1. Call-playback stations are shown on Figure 1. A habitat assessment for this species according to the definitions of *SEPP 44 - Koala Habitat Protection* is provided within this

section of the document. Under SEPP 44 the subject site is not considered to provide 'Potential Koala Habitat'.

Further to this one (1) primary food tree species (*Eucalyptus robusta*) and one (1) secondary food tree species (*Eucalyptus punctata*), as listed in Appendix 1 of the Recovery Plan for the Koala (*Phascolarctos cinereus*), were recorded within the subject site. Koalas show a higher level of use for primary tree species. If these are absent, secondary tree species may support Koala habitat at a lower carrying capacity. *E. robusta* occurs as a single recorded specimen and *E. punctata* occurs in low densities particularly within the total development footprint.

The subject site does not support Koala home ranges but could offer transient habitat to individuals in dispersal. The proposal will retain and enhance these values as it will be recommended that the two Koala feed trees recorded are more highly represented within the conservation restoration areas.

The 'maintain or improve' test (Section 5) considers that approximately 10% (0.31ha) of the existing forest/woodland community is available to provide suitable habitat for the Koala. Approximately 12% of the new combined forest/woodland and heath community will provide an increased total of 0.46ha of suitable habitat. The increased percentage is based on the recommendation that Koala feed trees are more represented within suitable portions of the restoration areas.

Koala SEPP 44 Assessment

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 1ha or has, together with any adjoining land in the same ownership, an area of more than 1ha.

The subject site is required to be considered under SEPP 44 as it falls within the Warringah LGA, which is listed on Schedule 1 of this Policy. In addition, the total area of the subject site is greater than 1ha, 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*?*

Four (4) Koala food tree species Grey Gum (*Eucalyptus punctata*), Scribbly Gum (*Eucalyptus haemastoma*), Tallowwood (*Eucalyptus microcorys*) and Swamp Mahogany (*Eucalyptus robusta*) listed on Schedule 2 of SEPP 44 were observed within the subject site. *Eucalyptus microcorys and Eucalyptus robusta* were recorded within the Grassland with Scattered Trees likely as planted specimens and not part of connective woodland forest habitats.

Grey Gum (*Eucalyptus punctata*), Scribbly Gum (*Eucalyptus haemastoma*) made up approximately 5% of trees within vegetation community 1 – *Peppermint – Angophora Woodland/Open Forest*. This is less than the 15% and as such the subject site is not

considered to comprise 'potential Koala habitat' as defined under SEPP 44 and no further assessment under this policy is required.

Step 2 – Is the land CKH*?*

No Koalas were directly recorded at the time of fauna survey, which included diurnal searches of trees, call-playback techniques and spotlighting. In addition, there was no secondary evidence of Koala habitation in the area. Secondary indications include observations for scratchings on trees and scats beneath trees.

A search of the Atlas of NSW Wildlife (DECCW 2010) database found twenty-two (22) records of Koala habitation within a 10km radius of the subject site. The record closest to the subject site was approximately 1.4km to the south-west in 1994. The most recent record within 5km was in 1997, 2.2km to the north-west.

It is therefore considered that the subject site does not comprise CKH and as such no further matters relevant to this Policy apply.

**Spotted-tailed Quoll (*Dasyurus maculatus*)**

*Behavioural background* - The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry open forests and rainforests containing rock caves, hollow logs or trees for shelter/breeding. It appears to prefer moist forest types and riparian habitat. It has been recorded from dry sclerophyll forest, open woodland and coastal heathland, and despite its occurrence in inland riparian areas, it also ranges over dry ridges (*NPWS 1999*).

The home range size of the Spotted-tailed Quoll is not known but is believed to be in the order of 500 to 1000ha, based on studies of the smaller Western Quoll (*Dasyurus geoffroyi)* in Western Australia (*Serena & Soderquist, 1989*). Watts (1993) estimates the mean home range of the Spotted-tailed Quoll as approximately 87ha. Although the size of a home range is not well known in the local area, this species is known to require large areas of relatively intact vegetation in which to forage (*NPWS, 1999*).

*Site Specific* - Targeted surveys for this species are described in Section 2.3.3 and Table 2.1. Locations of cage trapping (2004) and target method hair tube transects (2010) are shown on Figure 1. This species was not recorded during surveys.

The areas of forest removed as part of the proposal are not considered highly suitable for the species due to the narrow or disturbed nature of these portions. The total 0.36ha of Kunzea – Tea-tree Tall Heath will be removed which provides suitable foraging habitat, however, due to an absence of shelter in the form of hollows or caves within, this portion does not provide subsequent breeding habitat.

This area of Kunzea–Tea-tree Tall Heath is currently poorly connected to adjacent large remnant portions to the north-west or south as a result of fragmentation and large patches of weed infestations. Use of this western corridor is currently considered unlikely in respect of this species being known to require large areas of relatively intact vegetation in which to forage (*NPWS, 1999*). The existing open forest portions of the subject site are considered to currently provide more suitable habitat for this species.

The retention of suitable eastern portions of riparian forest and the restoration of the western corridor will improve habitat available to the Spotted-tailed Quoll.

The 'maintain or improve' test (Section 5) considers that approximately 50% (1.56ha) of the existing forest/woodland community and all (0.36ha) of the tall heath community provides a

total of 1.92ha of existing suitable habitat. Approximately 75% of the new combined forest/woodland and heath community will provide an increased total of 2.85ha of suitable foraging habitat. The increased percentage is based on improved connectivity and lower edge to width ratios within the proposed conservation areas.

**Rosenberg's Goanna (*Varanus rosenbergi*)**

*Behavioural background* - On the east coast of NSW the Rosenberg's Goanna (also known as Heath Monitor) is a Hawkesbury/Narrabeen sandstone outcrop specialist (*State Forests of NSW, 1995*). Rosenberg's Goannas are largely restricted to heath (*NPWS 1997*); inhabiting humid woodlands, dry hardwood forests and heathland where it shelters in self-dug burrows, hollow logs, rock crevices and sandstone outcrops (*Cogger 1992*), usually with a sandy substrate (*State Forests of NSW, 1997*). The Rosenberg's Goanna shelters in self-dug burrows, hollow logs, rock crevices and sandstone outcrops (*Cogger 1992*). Eggs are laid within a terrestrial termite mound.

*Site Specific* - Targeted surveys for this species are described in Section 2.3.6 and Table 2.1. Locations of target method funnel trap transects are shown on Figure 1. This species was not conclusively recorded during survey, however a large dark lizard was very briefly observed scurrying away when disturbed at the location of the far southern cage trap. A clear observation was not possible, however it was considered more likely of monitor lizard rather than dragon lizard size.

It is considered that the subject site provides suitable foraging and burrowing habitat for the Rosenberg's Goanna. Suitability is not ideal due to a lack of heath-type habitats and fragmented connectivity to those that do exist, however the species has potential to occur based on the incidence of local records and anecdotal evidence of local activity.

The Atlas of NSW Wildlife database also provides eleven (11) records of this species within approximately 2km of the subject site between 1999 and 2006. All but one (1) of these records are located to the north and north-east of the subject site, with the closest record located 100m to the north of the northern site boundary at the intersection of Oxford Falls Road and Wearden Road.

An aerial assessment of the locality shows that high quality areas of heath and neighbouring forest habitats occur to the east within and surrounding Red Hill Park reserve and extensive areas extending north into and beyond Cromer Heights. Approximately 18ha of heath and heath associated habitat exists to the immediate north of the subject site. This area extends for a smaller distance as connective forest as well as extended habitat on the other side of Wakehurst Parkway.

A local population of Rosenberg's Goanna, although more likely centred on nearby higher quality habitat, may actively utilise the eastern or western vegetated fringes of the subject site on occasion or in dispersal. The proposal will remove all of the 0.36ha Kunzea – Tea-tree Tall Heath. This habitat, although heath, is not considered ideal for the species for the following reasons:

- Whilst the immediate fringes also provide suitable habitat, these are not connected or in close proximity to further extensive heath type structure. Connectivity to the south is broken and highly fragmented. Connectivity to the north is limited by large areas of weed infestations.

- The structure is tall and dense providing minimal if any dapple light.

- There are no available shelters within.

No terrestrial termite mounds, which are considered the most suitable for nesting habitat, were observed within the subject site. Although the species has been observed to nest elsewhere, this behaviour is considered due to the unavailability of nearby mounds (pers. com. Gerry Swan). Terrestrial termite mounds were observed off-site towards the end of the hair tube transect which extended into neighbouring lands to the north-west of the site.

Funnel trapping survey targeted the presence of this species within what was considered the most suitable areas of habitat for the species within the subject site. No Rosenberg's Goannas were captured or observed opportunistically during survey meanders within all vegetated areas present.

The proposed development, whilst removing 0.36ha of Tall Heath and approximately 1.14ha of open forest/woodland will have these areas restored within the subject site area and connectivity to adjacent habitats will be improved for the species (particularly within the western portions where habitat appears more suitable) in a conservation corridor. Restoration of habitat within the north-western portions, with the removal of large weed occurrences and artificial structures, will make this area within the site more suitable for use by the species. It is recommended that restoration of the western corridor should have a focus on heath structure, also within forested portions, which will replace habitat lost.

The 'maintain or improve' test (Section 5) considers that the western portion and half of the south-western portion of open forest/woodland community (to a total of 0.93ha), about 2.5% (0.27ha) of the grassland with scattered trees community and all (0.36ha) of the tall heath community provides a total of 1.56ha of existing suitable habitat. The entire new western portion and half of the south-western portion will provide an increased total of 1.69ha of suitable habitat. The increased percentage is based on improved representation of heath connectivity and lower edge to width ratios within the proposed western conservation area.

**Southern Brown Bandicoot (*Isoodon obesulus*)**

*Behavioural background* - The Southern Brown Bandicoot has been detected in a range of habitats, including open forest, woodland, heaths, agricultural land and urban areas, preferring areas with thick ground cover which provide protection from predators (Braithwaite, 1988). Environment Australia (2000) recorded this species from a range of habitat types, though it was more typically found in heathland environments on sandy friable soils. When located in forests and woodlands, there is generally a heathy or shrubby understorey characterised by *Acacia*, *Banksia*, *Daviesia, Epacris, Hakea*, *Leptospermum*, *Melaleuca* and *Platylobium* species.

Distribution is patchy along the NSW coast and foothills with current information suggesting only two population strongholds, one in the far south-eastern corner and the other within the Northern Sydney Metropolitan Area. Research undertaken by Macquarie University indicates that the sub-populations within Ku-Ring-Gai and Garigal National Parks may have been genetically different (DEC 2006). Additionally, this species is found to display a preference for newly-regenerating natural heathland habitat following fire or clearing (*Menkhorst & Seebeck 1990; Braithwaite and Gullan 1978; Stoddart and Braithwaite 1979; Opie 1980*).

*Site specific* - Cage trapping for this species was undertaken for four (4) nights in January 2004, ten (10) nights in April 2010, as well as supplementary hair tube survey for 7 nights between March and April 2010. The 2010 surveys also used truffle oil as an additional attractant known for its increased success rate at recording this species. Despite the presence of suitable habitat this species has not been detected following these extensive targeted surveys within the subject site and nearby. Targeted surveys for this species are described in Section 2.3.6 and Table 2.1. Locations of target method funnel trap transects are shown on Figure 1.

It is considered that suitable habitat for this species is present in select locations within the western vegetated potions of the subject site. Suitability is not considered ideal due to a lack of extensive heath and dense native scrub type habitats and the fragmented connectivity between those areas that do exist. Bandicoot activity was observed during survey, however the more common Long-nosed Bandicoot (*Perameles nasuta*), more noted for its presence near disturbed areas and the urban interface, was recorded in these locations.

The proposal will remove existing heath vegetation however this amount of area will be restored within and particularly along the western fringe of the western corridor. Restoration of degraded habitats within this western corridor and more continual areas of suitable habitat throughout will provide greater potential for species occurrence.

The 'maintain or improve' test (Section 5) considers that the western portion and half of the south-western portion of open forest/woodland community (to a total of 0.93ha) and all (0.36ha) of the tall heath community provides a total of 1.29ha of existing suitable habitat. The entire new western portion and half of the south-western portion will provide an increased total of 1.69ha of suitable habitat. The increased percentage is based on improved representation of heath connectivity and lower edge to width ratios within the proposed western conservation area.

**Red-crowned Toadlet (*Pseudophryne australis*)**

*Behavioural background* - Red-crowned Toadlets use small ephemeral drainage lines, which feed water from the top of ridges to perennial creeks below. This species is totally confined to the Hawkesbury sandstone formation and is not usually found in the vicinity of permanent water (*Ehmann, 1997*). Breeding habitat is small puddles or depressions where rock or leaf litter holds back water temporarily (*Ehmann, 1997*; State Forests Threatened Species Protocol, 1997). Breeding congregations can occur deep in grass and debris beside such non-perennial creeks, gutters etc. They have also been noted to be very partial to damp shelves and cracks in sandstone where they have been observed emerging at dusk (NPWS 1997). At other times individuals disperse and are found under rocks, logs etc. on sandstone ridges (*Cogger, H.G. 2000*).

*Site Specific* - Target searches were undertaken for this species as part of the 2004 as well as recent 2010 surveys. Search areas of 2010 surveys are provided in Figure 1, with methods described in Section 2.3.5 and effort summarised in Table 2.1. Searches were undertaken during good conditions following or during rainfall.

The recent 2010 searches were undertaken along portions of all drainages within the subject site considered to provide habitat. This totalled 3 drainages within the subject site as well as one drainage line to the north and one drainage line to the south. These drainages are depicted in Figure 1.

- Drainage 1: Occurs outside of the site to the north and was considered the most ideal habitat providing small ephemeral pools fed by trickling clear water out of a small naturally vegetated catchment above.

- Drainage 2: Provides larger pools, higher flows and modifications with weed incursions. Water quality relatively high.

- Drainage 3: Is a solid sandstone slope that is feed from seepage through managed grasslands above. Flow is not too high however there were no observed suitable ponding locations for tadpole development and shelter was limited along the immediate drainage line. This flowed as a waterfall into a dam below.

- Drainage 4: Is a constructed roadside drain containing leaf litter and low flow, however was located in a highly managed setting untypical for the species. Searches were undertaken here due to calls heard which were later identified as the partial call of *Crinia signifera*.

- Drainage 5: Is a high flow perennial gully (outside of the subject site) that is fed by stormwater flows from the local urban landscape. Some side portions of low flow and pooling exist with ideal shelter opportunities but on the whole is less typical due to high volume flows. Two search locations were undertaken along this drainage line.

Drainage lines 2-5 located within the subject site are considered sub-optimal habitat for the Red-crowned Toadlet. Despite the presence of potential habitat within and near to the subject site, this species was not detected. All areas of suitable habitat will be retained within the enlarged western corridor. As the Red-crowned Toadlet is restricted to close proximity of appropriate breeding areas and there is little recolonisation or movement of populations between such sites, there is not likely to be any impacts on this species.

The 'maintain or improve' test (Section 5) considers that about 5% (0.0845ha) of the western portion of the open forest/woodland community would contribute to suitable existing habitat for this species. About 5% (0.0915ha) of the new western portion will provide an increase in available suitable habitat for the species.

### *4.9.1 State legislative matters*

*TSC Act* – A search of the *Atlas of NSW Wildlife* (DECCW, 2010) database for threatened species resulted in records of thirty-five (35) threatened fauna species within a 10km radius of the subject site. These species are listed in Table 4.2 and are considered for potential habitat within the subject site.

Strictly coastal and oceanic threatened species found within 10km have not been included.

*Fisheries Management 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.

### *4.9.2 Endangered populations*

There are no endangered fauna populations within the Warringah LGA

### *4.9.3 National legislative matters*

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

These species have been listed in Table 4.3, and those with potential to utilise the subject site will be considered in the 'maintain or improve' test within Section 5.

Of those fifteen (15) species, nine (9) were considered to have potential habitat within the subject site. Of these, one (1) nationally listed threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded foraging within the subject site during 2004 and 2010 surveys. In consideration of the assessment of this species in this section of the document, there is not likely to be any significant impact on the Grey-headed Flying-fox from the proposed development.

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 are assessed in Table 4.2.

**Table 4.2 – Migratory fauna habitat assessment**

| **COMMON NAME** ***Scientific Name*** | **PREFERRED HABITAT** | **COMMENTS** |
|---|---|---|
| White-bellied Sea Eagle (*Haliaeetus leucogaster*) | Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. *Sedentary; dispersive.* | No suitable habitat present. |
| 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.* | Suitable foraging habitat present. This species was previously believed to remain 'on the wing' during the visit time in Australia. Radio-tracking has found that the species rests in trees. Not recorded during surveys. |
| Rainbow Bee-eater (*Merops ornatus*) | Open woodlands with sandy, loamy soil; sand ridges, sandspits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. *Breeding resident in northern Australia. Summer breeding migrant to south-east & south-west Australia.* | Marginally suitable roosting, and foraging habitat present. Not recorded during surveys. |
| 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.* | Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. |
| Satin Flycatcher (*Myiagra cyanoleuca*) | Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. *Breeds mostly south-east Australia & Tasmania over warmer months, winters in north-east Qld.* | Suitable roosting and foraging habitat on migration present. Not recorded during surveys. |
| 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.* | Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. |
| Great Egret (*Ardea alba*) | Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. *Dispersive; cosmopolitan.* | Suitable roosting and foraging habitat present. Not recorded during surveys. |
| Cattle Egret (*Ardea ibis*) | Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. *Breeds in summer in warmer parts of range including NSW.* | Suitable roosting and foraging habitat present. Not recorded during surveys. |

**Table 4.2 – Migratory fauna habitat assessment**

| COMMON NAME<br>*Scientific Name* | PREFERRED HABITAT | COMMENTS |
|---|---|---|
| Latham's Snipe<br>(*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 2000m; samphire on saltmarshes; mangrove fringes. *Breeds Japan. Regular summer migrant to Australia. Some overwinter.* | Marginally suitable foraging habitat present. Not recorded during surveys. |
| Fork-tailed Swift<br>(*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.* | Suitable roosting and foraging habitat present. Not recorded during surveys. |

The actions associated with the development are not likely to significantly affect any nationally listed threatened fauna species or nationally listed migratory fauna species.

Conclusion: A referral to DEWHA is not required.

### 4.10 Threatened fauna species habitat assessment

Table 4.3 provides an assessment of threatened fauna species habitat likely to occur within the subject site.

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| COMMON NAME<br>*Scientific Name* | PREFERRED HABITAT | COMMENTS | TSC Act | EPBC Act |
|---|---|---|---|---|
| Giant Burrowing Frog<br>*Heleioporus australiacus*<br>DECCW EPBC | 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. | No suitable habitat present. | V | V |
| Green and Golden Bell Frog<br>*Litoria aurea*<br>DECCW EPBC | 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. | Marginally suitable habitat present. Not recorded during surveys. 4 records within10km, the most recent and closest record is 5km east in 2002. Not likely to occur. | E | V |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME**<br>***Scientific Name*** | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Littlejohn's Tree Frog<br>*Litoria littlejohnii*<br>EPBC | 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. | No suitable habitat present. | V | V |
| Stuttering Frog<br>*Mixophyes balbus*<br>DECCW EPBC | Terrestrial inhabitant of rainforest and wet sclerophyll forests. Distribution Limit: N-near Tenterfield S-South of Bombala. | No suitable habitat present. | E | V |
| Red-crowned Toadlet<br>*Pseudophryne australis*<br>DECCW | Prefers sandstone areas with clay lenses, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non breeding periods. Distribution Limit: N-Pokolbin. S-near Wollongong. | Sub-optimal habitat present within the drainages within the western portions of subject site, with more ideal habitat occurring nearby to the north-west. Not recorded during targeted surveys. Numerous records within 10km with 4 recorded locations within 2km. Potential but not expected to occur within the subject site itself. | V | - |
| Broad-headed Snake<br>*Hoplocephalus bungaroides*<br>EPBC | Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. Distribution Limit: N-Mudgee Park. S-Nowra. | Suitable habitat present within the retained north-western portions of the Peppermint – Angophora Woodland / Open Forest community. Not recorded during targeted surveys. No records within 10km. Not likely to occur. | E | V |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME** ***Scientific Name*** | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Rosenberg's Goanna *Varanus rosenbergi* DECCW | Hawkesbury sandstone outcrop specialist. Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops. Distribution Limit: N-Nr Broke. S-Nowra Located in scattered patches near Sydney, Nowra and Goulburn. | Suitable foraging and shelter habitat present within the north-western portions of the Peppermint – Angophora Woodland / Open Forest and Tall Heath communities. Nesting habitat was not observed within the subject site but was observed within more suitable habitat to the north-west of the subject site. Not recorded during targeted surveys. Numerous records within 10km and high quality habitat in the locality suggest that this species has potential to occur. The proposed conservation zone will increase habitat size. | V | - |
| Osprey *Pandion haliaetus* DECCW | 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. | No suitable habitat present. | V | - |
| Sooty Oystercatcher *Haematopus fuliginosus* DECCW | Exclusively coastal in distribution foraging along rocky coastlines and estuaries. Distribution Limit: N-Tweed Heads. S-South of Eden. | No suitable habitat present. | V | - |
| Pied Oystercatcher *Haematopus longirostris* DECCW | Inhabits coastal beaches and estuarine flats. Distribution Limit: N-Tweed Heads. S-South of Eden. | No suitable habitat present. | V | - |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME** ***Scientific Name*** | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Australasian Bittern *Botaurus poiciloptilus* DECCW | 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. | No suitable habitat present. | V | - |
| Black Bittern *Ixobrychus flavicollis* DECCW | Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater & brackish streams & ponds, sheltered mudflats and oyster slats. Distribution Limit: N-Tweed Heads. S-South of Eden. | No suitable habitat present. | V | - |
| Cotton Pygmy-goose *Nettapus coromandelianus* DECCW | An aquatic species found in tropical to subtropical coastal lagoons, swamps and large bodies of calm fresh water with abundant vegetation. Distribution Limit: N-Tweed Heads. S-Pambula. | No suitable habitat present. | E | - |
| Australian Painted Snipe *Rostratula australis* EPBC | 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. | No suitable habitat present. | V | V |
| Bush Stone-curlew *Burhinus grallarius* DECCW | Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. Distribution Limit: N-Border Ranges National Park. S-Near Nowra. | No suitable habitat present. | E | - |
| Wompoo Fruit-dove *Ptilinopus magnificus* DECCW | Inhabits large undisturbed patches of lowland and adjacent highland rainforest and moist eucalypt forests where it feeds on fruit. Distribution Limit: N-Tweed Heads. S-Sydney. | No suitable habitat present. | V | - |
| Superb Fruit-dove *Ptilinopus superbus* DECCW | Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. Distribution Limit: N-Border Ranges National Park. S-Bateman's Bay. | No suitable habitat present. | V | - |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME**<br>***Scientific Name*** | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Glossy Black-Cockatoo<br>*Calyptorhynchus lathami*<br>DECCW | Open forests with *Allocasuarina* species and hollows for nesting. Distribution Limit: N-Tweed Heads. S-South of Eden. | Suitable foraging, roosting and sub-optimal nesting habitat present. Recorded arriving late in the afternoon within more suitable forest with higher presence of Allocasuarina to the east of the subject site on the 30/3/10. No evidence of foraging found within the subject site itself. | V | - |
| Gang-gang Cockatoo<br>*Callocephalon fimbriatum*<br>DECCW | Prefers wetter forests and woodlands from sea level to > 2000m on Divide, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. Distribution Limit: mid north coast of NSW to western Victoria. | Suitable foraging, roosting and nesting habitat present. Not recorded during surveys. 2 records within 10km none in close proximity to the site or since 2004. Not expected to occur. | V | - |
| Little Lorikeet<br>*Glossopsitta pusilla*<br>DECCW | Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. Distribution Limit: N-Tweed Heads. S-South of Eden. | Suitable foraging, roosting and nesting habitat present. Not recorded during surveys. 4 records within 10km none within 4km of the subject site. The most recent record is 7km NE in 2008. Potential to occur. | V | - |
| Swift Parrot<br>*Lathamus discolour*<br>DECCW EPBC | Inhabits eucalypt forests and woodlands with winter flowering eucalypts. Distribution Limit: N-Border Ranges National Park. S-South of Eden. | Limited foraging habitat present. Not recorded during surveys. 15 records within 10km, no records in close proximity however records occur just beyond 2km in recent years. Low potential to occur. | E | E |
| Superb Parrot<br>*Polytelis swainsonii*<br>DECCW | Inhabits open woodland and riverine forests of inland NSW. Distribution Limit: N-Near Walgett. S-South of Deniliquin. | No suitable habitat present. | V | V |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME** ***Scientific Name*** | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Regent Honeyeater *Xanthomyza Phrygia* DECCW EPBC | 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. | Limited foraging habitat present. Not recorded during surveys. 16 records within 10km, no records within 6km or in recent years. Not likely to occur. | E | E |
| Barking Owl *Ninox connivens* DECCW | 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. | Suitable foraging, roosting and low potential nesting habitat present. Not recorded during surveys. 5 records within 10km, no records within 5km. Low potential to occur. | V | - |
| Powerful Owl *Ninox strenua* DECCW | Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. Distribution Limits: N-Border Ranges National Park. S-Eden. | Suitable foraging, roosting and low potential nesting habitat present. Recorded responding to call-playback during surveys on the 7/4/10. Also numerous records within 10km. | V | - |
| Masked Owl *Tyto novaehollandiae* DECCW | Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. Distribution Limit: N-Border Ranges National Park. S-Eden. | Suitable foraging, roosting and nesting habitat present. Not recorded during surveys. 2 records within 10km, no records within 5km or since 2000. Low potential to occur. | V | - |
| Diamond Firetail *Stagonopleura guttata* DECCW | 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. | No suitable habitat present. | V | - |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME**<br>***Scientific Name*** | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Spotted-tailed Quoll<br>*Dasyurus maculatus*<br>DECCW EPBC | Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit: N-Mt Warning National Park. S-South of Eden. | Suitable foraging, and sub-optimal denning and breeding habitat present. Not recorded during surveys. 21 records within 10km, with 2 of these at approximately 2km away. No records since 2004. Low potential to occur. | V | E |
| Southern Brown Bandicoot<br>*Isoodon obesulus*<br>DECCW EPBC | 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. | Suitable foraging, shelter and breeding habitat present. Not recorded during surveys. 36 records within 10km, with 2 records within 4km away. 1 of these just within 1km east in 2002 and a second not on Atlas but known from Warringah Council approximately 1.28km WNW in 2008. Potential to occur within the central-west and north-western portions with more suitable habitat occurring further to the north-west. | E | E |
| Long-nosed Potoroo<br>*Potorous tridactylus*<br>EPBC | Coastal heath and dry and wet sclerophyll forests with a dense understorey. Distribution Limit: N-Mt Warning National Park. S-South of Eden. | Suitable foraging, shelter and breeding habitat present. Not recorded during surveys. No records within 10km. Not likely to occur. | V | V |
| Koala<br>*Phascolarctos cinereus*<br>DECCW | Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees. Distribution Limit: N-Tweed Heads. S-South of Eden. | Marginally suitable habitat present. This is in the form of low feed tree numbers for individuals in dispersal. Not likely to occur. | V | - |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME** *Scientific Name* | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Yellow-bellied Glider *Petaurus australis* DECCW | Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-South of Eden. | Sub-optimal foraging, denning and breeding habitat present. Not recorded during surveys. 1 record just beyond 10km. Not likely to occur. | V | - |
| Eastern Pygmy Possum *Cercatetus nanus* DECCW | Found in a variety of habitats from rainforest through open forest to heath. Feeds on insects but also gathers pollen from banksias, eucalypts and bottlebrushes. Nests in banksias and myrtaceous shrubs. Distribution Limit: N-Tweed Heads. S-Eden. | Suitable foraging, nesting and breeding habitat present. Not recorded during surveys. 7 records within 10km. No records within 6km Low potential to occur. | V | - |
| Grey-headed Flying-fox *Pteropus poliocephalus* DECCW EPBC | 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. | Suitable foraging habitat present. 4 individuals recorded foraging within the Grassland with Scattered Trees vegetation community during 2004 surveys. 1 individual recorded foraging within this community and 2 other individual recorded in flight overhead during recent 2010 surveys. | V | V |
| Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* DECCW | Rainforests, sclerophyll forests and woodlands. Distribution Limit: N-North of Walgett. S-Sydney. | Suitable foraging, roosting and breeding habitat present. Not recorded during surveys. 1 record within 10km at 8km away in 2004. Low potential to occur. | V | - |
| Large-footed Myotis *Myotis macropus* DECCW | 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. | Suitable foraging, roosting and breeding habitat present. Not recorded during surveys. 1 record within 10km at 6km away in 2007. Low potential to occur. | V | - |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME** *Scientific Name* | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Eastern Bentwing-bat *Miniopterus orianae oceansis* DECCW | Prefers areas where there are caves, old mines, old buildings, stormwater drains & well timbered areas. Distribution Limit: N-Border Ranges National Park. S-South of Eden. | Suitable foraging and low potential roosting habitat present. Recorded foraging throughout the subject site during recent 2010 surveys. | V | - |
| Greater Broad-nosed Bat *Scoteanax rueppellii* DECCW | Inhabits areas containing moist river & creek systems especially tree lined creeks. Distribution Limit: N-Border Ranges National Park. S-Pambula. | Suitable foraging, roosting and breeding habitat present. Not recorded during surveys. 1 record within 10km at 4.5km away in 1996. Low potential to occur. | V | - |
| East-coast Freetail Bat *Micronomus norfolkensis* DECCW | 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. | Sub-optimal foraging, roosting and breeding habitat present. Not recorded during surveys. 1 record within 10km at 1km east in 2002. This record was previously accessed from archives and found to be erroneous. Not likely to occur. | V | - |
| Large-eared Pied Bat *Chalinolobus dwyeri* EPBC | Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. Distribution Limit: N-Border Ranges Nation Park. S-Wollongong. | Suitable foraging and roosting habitat present. Not recorded during surveys. No records within 10km. Not likely to occur. | V | V |
| Macquarie Perch *Macquaria australasica* EPBC | Occurs in south east Australia at moderate to high altitudes in rivers and reservoirs. Historical records show the species was widespread and abundant in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers and their tributaries. Allen (1989) states that introduced populations are present in Nepean River and water supply dams in the Sydney area. Occurs in lakes and flowing streams, usually in deep holes. | No suitable habitat present. | V | E |

**Table 4.3 – Threatened fauna habitat assessment**
**V = Vulnerable**
**E = Endangered**

| **COMMON NAME** *Scientific Name* | **PREFERRED HABITAT** | **COMMENTS** | **TSC Act** | **EPBC Act** |
|---|---|---|---|---|
| Australian Greyling *Prototroctes maraena* EPBC | Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (eg weirs, waterfalls). | No suitable habitat present. | Part 2, Section 19 – Protected Fish | V |

| | |
|---|---|
| DECCW | - 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 not listed within 10km searches but considered by *Travers bushfire & ecology* to have potential habitat based on regional knowledge and other records |
| NOTE: | - 'records' refer to those provided by the *Atlas of NSW Wildlife* database. Updated 1:100,000 database mapsheet requests to DECCW are undertaken every 3 months as recommended.<br>- 'close proximity' refers to distances within 2km from the subject site. |

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

### 4.11 Vegetation connectivity and wildlife corridors

In accordance with DECCW correspondence dated August 2006 (Appendix 2), this section addresses the DGRs:

> *'Address corridor values or connective importance of any vegetation on the subject land; the possible loss of connectivity to bushland areas to the south, east and west, impacts on adjoining and nearby bushland areas'.*

*Existing Vegetated Corridors*

The subject site is bound to the north and south by rural residential land, to the north-west, north-east and east by natural vegetation and to the south-west by residential land (see Figure 3 Conservation Strategy). Natural vegetation adjoining the subject site to the north-east includes recreation reserves which extend along Wakehurst Parkway and eventually into Garigal National Park.

Natural vegetation adjoining the north-west boundary of the proposed development forms a vegetation corridor along Wakehurst Parkway to the west. This corridor extends along Wakehurst Parkway to the south across Frenchs Forest Road and Warringah Road into an extensive area of natural vegetation including Manly Dam Reserve and Garigal National Park.

The subject site contains two (2) existing vegetation corridors.

- The main riparian corridor - Middle Creek tributary runs within the eastern confines of the subject site. The current size of the corridor is approximately 575m long (including the segment outside of the subject site immediately south of Barnes Road) by up to 75m in width (inclusive of the managed vegetation buffer – 10m). The area of the riparian corridor is just over 3ha inclusive of the managed vegetated buffer. The Middle Creek tributary corridor is largely cleared on its western embankment which will be significantly enhanced by riparian revegetation works inclusive of landscaped buffers and canopy revegetation within the APZs. An existing natural forest area exists on the eastern aspect of the middle creek tributary which will be retained to supplement the riparian corridor and protect any associated fauna habitat. The retained and restored vegetation significantly enhance vegetation connectivity along Middle Creek tributary.

- Sandstone escarpment – This fragmented corridor includes the along the south-western boundary of the proposed development. The length of this corridor is approximately 300m in length and has a variable width of 24-55m, occupying an estimated 1.56ha. The south-western corridor currently contains a mixture of Kunzea Tall Heath, Peppermint and Angophora Woodland/Open Forest and is severely dissected by a tennis court and road (approximately a 50-75m gap). The existing vegetation in the north western end of this corridor is a mixture of disturbed urban landscape and weedy peppermint and Angophora Open Forest set amidst sandstone rock strata. The proposed development will result in a significant enhancement of the quality of this corridor through target weed removal, revegetation of 'gaps' and bush regeneration with weed infested areas.

Miscellaneous corridor links - Minor canopy connectivity also occurs along existing road reserves and minor drainage lines through the site.

*Reason for Wildlife Corridors*

A corridor is used to ensure wildlife can move between vegetation parcels that contain habitat characteristics for insitu wildlife. Corridors are also required for mating opportunities. For some wildlife, movement opportunity is quite small as they are territorial, whilst others are more opportunistic and migrate over larger areas. For some wildlife, the dispersal (home) range is quite small, whilst others migrate over larger areas. Where wildlife numbers, particularly some populations, and diversity are in large quantities and require movement to and from large areas (ecosystems), then a suitable large corridor linkage should be provided. Likewise, if a small quantity of wildlife is known to be present then a smaller corridor may accommodate these species/populations adequately.

The DECC (2008) within *Biobanking Methodology* has advised on corridor widths (linkages) and has developed a series of categories, these being 0-5m, 5-30m, 30-100m, 100-500m and >500m. The application of these classes allows a perspective relative to wildlife movement. For example the lowest class is relative to local wildlife traffic whilst the largest class relates to macro ecological system movement and genetic diversity continuance.

The proposed corridors at Oxford Falls and their respective sizes have been selected for the following reasons:

- Threatened species survival – The higher quality areas of each of the natural vegetation communities present within the subject site as well as the Middle Creek tributary are represented within the proposed corridors. This in turn provides a

variation of suitable habitat for the recorded threatened fauna species and those with potential to occur or utilise the site for foraging purposes.

- Connectivity to adjacent remnants – the connectivity that can be achieved onsite to the north-west, south and east. Garigal National Park is located 3.5km to the north. There is other connectivity through remnant bushland into lower catchments including Middle Creek and Narrabeen Lagoon.

- Ecosystem variation – The proposed corridor layout enables continued passage to each of the adjacent large remnant bushland areas through terrestrial/rock escarpment and riparian based habitats.

***Proposed Wildlife Corridors***

The development proposes three corridor types:

1. The Middle Creek tributary corridor is a variable 32.5m to 75m wide native vegetation corridor. In addition, the proposed vegetation enriched asset protection zones adjacent to the riparian corridor, increase the effective width canopy connectivity of the Middle Creek corridor by another 10-35m albeit a managed landscape. The current size of the corridor is approximately 575m long (including the segment outside of the subject site immediately south of Barnes Road) by up to 75m in width (inclusive of the managed vegetation buffer – 10m). The APZs in themselves are not a deterrent to wildlife utilisation. Specific management within the asset protection zones will be required to ensure that vegetation retention and revegetation is in accordance with acceptable fuel load levels.

2. The sandstone escarpment corridor along the escarpment on the south western edge of the proposed development forms another secondary corridor linking surrounding and elevated vegetation remnant to the Middle Creek tributary. The current size of the western corridor is approximately 300 metres long by a variable width of 24-55m in width.

3. Remaining internal and fringing APZs throughout the proposed development landscape provide managed arterial tertiary corridors which permit canopy connectivity and the passage of predominantly avian and arboreal fauna species.

The movement of flora and fauna on site will be encouraged through the provision of the above terrestrial and riparian corridors, landscaped open space, vegetation enriched APZs, retention where possible of any significant canopy and habitat trees, and the revegetation of corridor areas that currently lack native vegetation.

The APZs will be landscaped to include canopy vegetation, and planting of native landscape beds. Consequently, the combination of dedicated wildlife corridors and native landscape plantings within the development landscape and associated APZs will significantly enhance native vegetation cover onsite.

Currently there are 3.47ha of remnant bushland vegetation onsite (vegetation communities 1 and 4). As a result of the proposed development, the vegetation onsite will increase to approximately 3.80ha through the restoration of riparian landscapes and consolidation of remnant vegetation in the sandstone escarpment zone. Additionally there will be some small restoration works along the northern and southern boundaries that will become secondary corridors.

In achieving 3.80ha of vegetation on site, there will be initial removal of 1.50ha of vegetation communities 1 and 4 combined, then restoration of approximately 1.83ha. Therefore, an overall 'Improve' outcome will be achieved in native vegetation alone. Other measures, such as habitat enhancement with artificial nest boxes, will further enhance the insitu habitat for breeding onsite for common and threatened fauna species.

Wildlife dispersal through the site can be accommodated through the following measures:

1. Retention of arboreal canopy vegetation and ground refugia (logs, rocks, dense grass and shrub layer).

2. Retention or replacement of selected vegetation to provide flight connectivity and viable flight paths for arboreal fauna.

3. Strategic tree and shrub plantings throughout the area to be restored to provide food and shelter resources.

4. Not applying solid barrier fencing with preference given to marker posts only.

5. Planting of native trees and shrubs with rain gardens or bio-retention trenches throughout the landscape. The placement of any vegetation must also be consistent with the provision of services.

### 4.12 Mitigation and management strategies

The mitigation strategies will generally be implemented under the Vegetation Management Plan (or equivalent) in perpetuity and will result in a substantial increase in the quality, over the long term, of suitable habitat for threatened fauna species utilising the subject site.

In addition, revegetation and restoration works associated with the proposal will result in an improvement in vegetation connectivity across the site and hence the movement of fauna within the site and to vegetation off site. They include:

1. Conservation of habitat within the eastern and western conservation precincts;

2. Improving connectivity along the eastern and western conservation precincts;

3. Restoration of large degraded portions within the eastern and western conservation precincts;

4. The provision of vegetated buffers to the eastern open forest conservation precinct in the form of APZs, riparian and managed landscaped buffers;

5. Creation of a heathy or shrubby understorey structure within the western conservation precinct for the Southern Brown Bandicoot and Rosenberg's Goanna;

6. Restoration of riparian areas to provide a high presence of Swamp Mahoganies (*Eucalyptus robusta*) to improve Koala and winter migratory bird species habitat. Restoration of areas adjacent to riparian areas should also provide a high presence of Grey Gum (*Eucalyptus punctata*) also to improve available Koala habitat;

7. *Allocasuarina* feed trees for Glossy Black-Cockatoos to be planted within appropriate areas of the proposed corridors to ensure the site provides a higher representation of feed trees than present;

8. Exclusion of grazing animals;

9. Supervision of hollow tree and artificial structure removal such that appropriate action may be taken for residing fauna;

10. Replacement of hollows removed via nest box installation at a ratio of 1:1;

11. Weed control works;

12. Erosion control devices;

13. Installation of protective fencing and signage;

14. Stormwater quality and quantity control (bio-retention basins, bio-swales, gross pollutant traps, rainwater tanks and revegetation of watercourses);

15. Retention of dead timber and habitat supplementation;

16. Retention of regrowth; and

17. Strategic supplementary planting.

### 4.13 Vegetation and habitat management

The creation of additional lands for conservation purposes shall be undertaken under the guidance of a 'vegetation management plan' (VMP) which will be attached to the land title by a section 88B instrument (*Conveyancing Act*).

The purpose of the VMP will be to manage the native vegetation and *in situ* habitat within the terrestrial conservation zone and the riparian zones in perpetuity. The plan will detail the manner in which management will occur throughout the pre-construction, construction and post-construction phases of the proposed development. In this way, the VMP will provide for the ongoing maintenance of habitat within the site for native flora and fauna species primarily within the conservation area(s) but also within areas of native vegetation retained as corridors between and around the proposed development areas.

The primary objective of the VMP will be to identify the:

- Landscape and heritage values that require ongoing protection of which have been identified in Section 4 and 5 of this report;

- Management strategies to enable perpetual protection of native vegetation and insitu habitat;

- Regeneration activities to be carried out within retained vegetation;

- Protect the riparian zones agreed to by the *Office of Water*;

- Ensure ongoing monitoring and maintenance activities to be carried out;

- Asset protection zones and their ongoing fuel management requirements; and

- Ongoing weed management.

It is recommended that an appropriately qualified project ecologist be appointed to oversee the ecological implementation of this VMP throughout the pre-construction, construction and post-construction phases of the development.

The project ecologist, on behalf of the land owner, shall implement the vegetation rehabilitation works in accord with the procedures identified within the VMP and environmental audit checklist. The project ecologist will be responsible for supervising these activities and ensuring the measures outlined in the VMP are implemented and that performance criteria are satisfied. The project ecologist shall assist in the engagement of rehabilitation contractors using a contract brief such as used by this form regularly.

In regard to revegetation works, it is recommended that regular monitoring inspections shall be undertaken at intervals of 6 months, 1 year and 2 years, 3 years, 4 years and 5 years after the initial weeding and plantings have been done. The annual reporting period shall be July to June.

The project ecologist shall also prepare the required monitoring report in accordance with the annual reporting period. The report must be provided to Council by the landowner within 30 days of the issuing date of the report.

The report will deal with the condition of the vegetation generally and also identify any areas suffering from disturbance, areas in need of enhanced rehabilitation, weed control, sediment or storm water control, bank and soil stabilisation or maintenance of rehabilitated or regenerating areas.

A formal review of the VMP is to take place five years after its commencement of works in order to determine its success and to allow adaptation of the plan. This review shall involve consultation between the landholders, council, the project ecologist and the stormwater/dam reconstruction engineer if considered necessary. The review shall consider the future management of the landscape and any outstanding matters that require continued monitoring and or actions.

The following management actions are required to be implemented according to the implementation stage:

| ***Pre-Construction – STAGE 1*** | |
|---|---|
| **Action** | **Responsibility** |
| • Install permanent protective fencing and interpretative signs on boundary of vegetation to be retained (TPZ) by surveyor, arborist and project ecologist. | Contractor with advice of Project Ecologist |
| • Locate vegetation areas to be retained (TPZ), boundary of APZs and boundary of national park – to be identified and marked on site by surveyor, arborist and project ecologist. | Surveyor / Project Ecologist / Arborist |
| • Erect erosion control fencing (sediment fences, hay bales) to be installed by contractor under direction from engineers and surveyors on road works and development zone areas. | Contractor |
| • Install sediment fencing parallel with the riparian zones | Contractor |
| • Rehabilitate within riparian zone in accordance with 3a permit from NSW Office of Water. | Contractor / suitably qualified Bushland Regenerator |

| | |
|---|---|
| • Identify and protect habitat trees | Project Ecologist - plans by landscape architect / architect. |
| • Commence of vegetation regeneration and weed control works. | Contractor / suitably qualified Bushland Regenerator |
| • Preparation of a landscape / tree planting program by landscape architect and contractor. | Project Landscaper / Master Plan |

| ***Construction – STAGE 2*** | |
|---|---|
| • Monitor erosion control fencing (monthly – especially after heavy rain) and replace if required by contractor under direction from engineers and surveyors using VMP. | Contractor with advice of Project Manager |
| • Monitor riparian zone and protection works by contractor under direction from engineers and surveyors using VMP. | Contractor with advice of Project Ecologist |
| • Monitor tree protection fencing and signs and replace if required by surveyor, arborist and project ecologist. | Contractor with advice of Project Ecologist |
| • Continue vegetation restoration works and weed control by contractor using VMP. | Contractor / suitably qualified Bushland Regenerator |

| ***Post-Construction (6 months) – STAGE 3*** | |
|---|---|
| • Plant new trees recognised within landscape master plan | Contractor with advice of Project Ecologist |
| • Remove tree protection fencing and signs | Contractor with advice of Project Manager |
| • Continue of vegetation restoration works and weed control | Contractor / suitably qualified Bushland Regenerator |
| • Maintain and monitoring of riparian zone | Contractor / suitably qualified Bushland Regenerator |
| • Monitor retained trees at *6 month intervals* post construction – conduct maintenance if required. | Project Ecologist / Arborist / Landowner |
| • Implement pest species advice to prospective owners and manage site by using guidelines. | Land owner with advice by Project Ecologist |

| ***Ongoing (in perpetuity)*** | |
|---|---|
| • Continue ongoing weed control. | Landowner / suitably qualified bushland regenerator |
| • Maintain and monitoring of riparian zone and other restored earthworks. | Landowner / suitably qualified bushland regenerator |

### 4.14 Review of ecological impact

The potential impacts upon ecological resources from the development are as follow:

| Impact Type | Yes / No | Affectation | Mitigation measures |
|---|---|---|---|
| 1. Potential for the extinction of known threatened species | No | None | None required |
| 2. Potential for the loss of threatened species habitat | No | None | Increased area of habitat is planned in habitat corridors |
| 3. Potential for fragmenting threatened species habitat | Partial through the APZ location of one Powerful Owl roost tree. The tree will remain in under-scrubbed landscape. | Reduced connectivity across the site from east to west. | Increased area of habitat is planned in habitat corridors which will enrich existing connectivity further around the southern site limits. |
| 4. Potential for the loss of *Peppermint – Angophora Woodland / Open Forest* | No | None | Increased area of habitat is planned in habitat corridors |
| 5. Potential for the loss of Exotic Grassland with Scattered Trees | Yes | Minor – supports very little or suboptimal habitat for most species. | Not required |
| 6. Potential for the loss of *Aquatic Herbfield* (Creek line and dams) | No | None | Increased area of habitat is planned in habitat corridors |
| 7. Potential for the loss of *Kunzea – Tea-tree Tall Heath* | No | None | Increased area of habitat is planned in habitat corridors |
| 8. Loss of riparian habitat on T1 | No | Loss of standing planted trees with no riparian / aquatic life | Formal retained and managed tributary |
| 9. Loss of riparian habitat on T2 | No | Loss of standing planted trees with no riparian / aquatic life | Formal retained and managed tributary |
| 10. Loss of riparian habitat on Middle Ck Tributary | No | None | Revegetation works Increase area from 0.1ha to 0.55 ha |
| 11. Loss of terrestrial corridor | No | None | Increase in areas from 1.50 ha to 1.83 ha |
| 12. Loss of aquatic corridor | No | None | Increase in areas from 0.21 ha to 0.35 ha |
| 13. Loss of significant habitat trees for | No | None | Replacement of |

| Impact Type | Yes / No | Affectation | Mitigation measures |
|---|---|---|---|
| forest owls | | | hollows removed via nest box installation at a ratio of 1:1 |
| 14. Loss of significant habitat trees for Arboreal mammals | No | None | Replacement of hollows removed via nest box installation at a ratio of 1:1 |
| 15. Loss of notable habitat trees | Yes | Loss of HT16 and potentially HT19 | Replacement of hollows removed via nest box installation at a ratio of 1:1 |
| 16. Loss of trees | Yes | 201 trees | Replacement in conservation areas of at least 1:1 |
| 17. Effect of effluent disposal areas | None | Not required | Not applicable |
| 18. Effect from direct impacts from development | None envisaged | None envisaged | Not applicable |
| 19. Effect from indirect impact from development | None envisaged | None envisaged | Not applicable |

### 4.15 Likely benefits from development

The likely benefits from the development are as follow:

| Impact Type | Yes / No | Medium of enhancement |
|---|---|---|
| 1. Potential for the enhancing habitat for insitu threatened species | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation / riparian zone |
| 2. Potential for enhancing threatened species habitat for migratory and or transient species | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation / riparian zone |
| 3. Potential for repairing fragmented threatened species habitat | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation / riparian zone |
| 4. Potential for increasing the areas of *Peppermint – Angophora Woodland / Open Forest* | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation zone |
| 5. Potential for increasing the areas of *Aquatic Herbfield* (Creek line and dams) | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation / riparian zone |
| 6. Potential for increasing the areas of *Kunzea – Tea-tree Tall Heath* | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation zone |
| 7. Potential for increasing the areas of riparian habitat on T1 | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation zone |
| 8. Potential for increasing the areas of riparian habitat on T2 | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation zone |
| 9. Potential for increasing the | | Restoration of existing lands and the creation |

| Impact Type | Yes / No | Medium of enhancement |
|---|---|---|
| areas of riparian habitat on Middle Ck Tributary | **Y** | of new revegetated lands in conservation zone |
| 10. Potential for increasing the areas of terrestrial corridor | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation zone |
| 11. Potential for increasing the areas of riparian / aquatic corridor | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation / riparian zone |
| 12. Potential for increasing habitat trees for forest owls | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation zone |
| 13. Potential for increasing significant tree habitat for Arboreal mammals | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation zone |
| 14. Potential for increasing notable habitat trees | **Y** | Restoration of existing lands and the creation of new revegetated lands in conservation zone |
| 15. Potential for resolving effluent disposal | **Y** | Connected to sewer system |
| 16. Potential for resolving direct impacts from development | **Y** | Through the conservation design and the vegetation management planning to be enforced by Section 898B instrument of legal and binding enforcement |
| 17. Potential for resolving indirect impact from development | **Y** | Through the conservation design and the vegetation management planning to be enforced by Section 898B instrument of legal and binding enforcement |

### 4.16 Riparian impact

In late 2009, GHD undertook negotiations with NOW in respect of the proposed riparian strategy. In November 2009, NOW advised the NSW Department of Planning that The GHD strategy was acceptable, subject to bushfire constraints being adopted.

Subsequent to that correspondence, the project team including *Travers bushfire & ecology, GHD* and *Australian Bushfire Protection Planners* prepared an integrated riparian and bushfire constraints plan for consideration at a meeting with NOW on March 18th 2010. Subsequent to that meeting a final plan commensurate with all the necessary requirements of NOW was submitted (to NOW) on April 6th 2010.

The final plan showing the bushfire and riparian constraints (see Figure 2) recognises the following; -

1. The creek channels as drawn will be allowed to meander within the Core Riparian Zones by +/- 1.5m to enable the formation of a natural stream sinuosity.

2. The existing creek channel will only be relocated and rebuilt in the northern ($S_{1B}$) and southern most portions ($T_3$) of the site as indicated on Figure 2.

3. The designed of the creek channel and the adjoining embankments will be designed to mimic a naturalised stream profile incorporating a low flow channel, a widened flood zone, rock style bed control structures to facilitate fauna passage and fully structured vegetation within the riparian zone, incorporating existing and new vegetated areas.

4. A Managed Landscape Buffer of 10m in width has been provided external to the Core riparian zone on the western embankment to provide extra protection to the proposed riparian corridor.

5. The Biodiversity Zones consist of existing native vegetation and areas to be revegetated to form a fully vegetated riparian corridor on the eastern embankments. The Biodiversity zones supplement the riparian protection provided on the main water course.

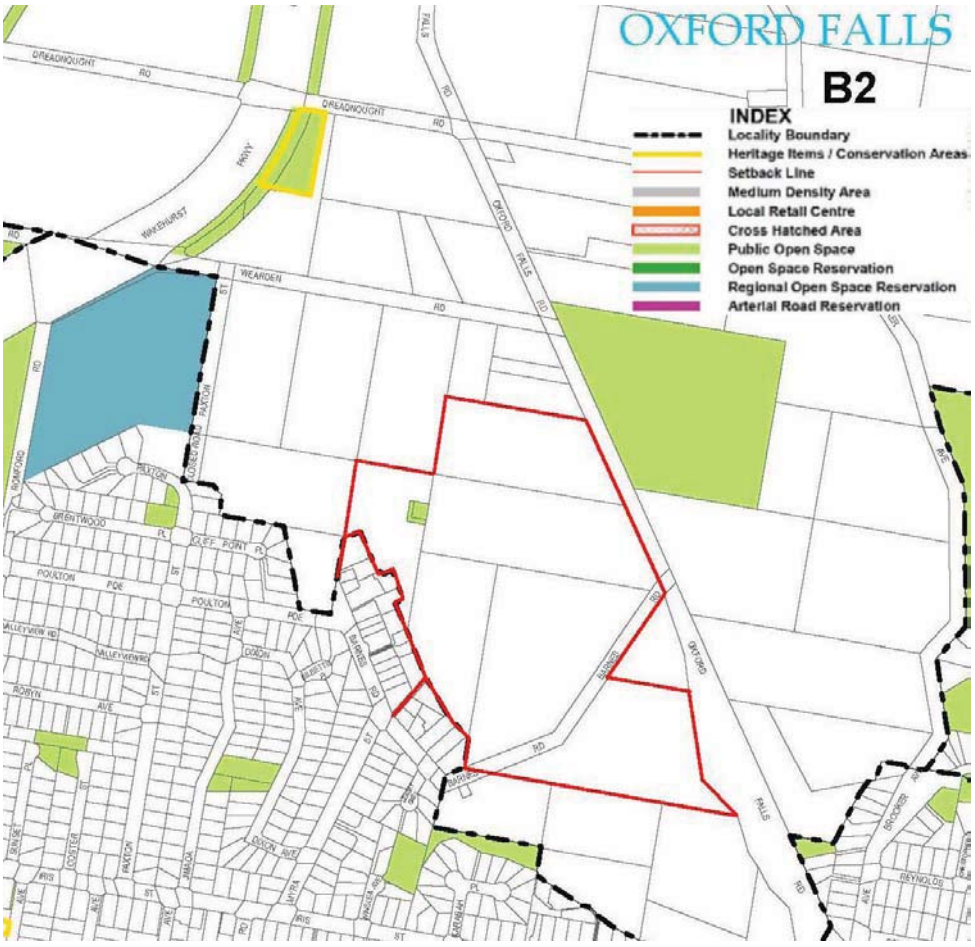
6. The required APZs can be implemented without conflicting with the proposed buildings.

### 4.17 SEPP 19 bushland in urban areas assessment

SEPP No.19 refers to natural bushland in urban areas reserved for open space. Where land adjoins Open Space, SEPP 19 must be considered.

According to Council's web site mapping (see figure below) there is SEPP 19 bushland inside of the development lands and across Oxford Falls Road to the north-east.

There is a small pocket of public open space inside of the subject site which contains a drainage reserve/water quality control dam (Lot 29 DP 829321) owned by Warringah Council. Lot 21 DP 842523 adjoins Lot 29 to the south and west and is also owned by Warringah Council totalling approximately 650m$^2$.



Plan DP 265153 is the plan that establishes the right of way over Lot 20 DP 842523 to provide access to the dam, which is the existing concrete trail that comes down past the "McKenzie" house.

This DP also sets up the easements for the Barnes Road properties to drain into this dam.

The proposal is going to provide an alternate path of travel for the water that leaves the dam, which is the relocated T2.

As such, Lot 29 DP 829321 and Lot 21 DP 842523 are owned by Warringah Council and do not form part of the subject site. The proposal however does take these lots into consideration in planning for corridors on site and will in the long term improve the value of any remnant bushland on these lots through the conservation of insitu vegetation on the neighbouring escarpment (hillside – western proposed corridor).

Bushland within urban areas is a resource of great value to the community, both as part of the natural heritage and from a recreational, psychological, educational and scientific view. Bushland areas form a valuable addition to a region's recreational opportunities including bushwalking, the study of natural history, or simply sitting and picnicking in natural surroundings. Aesthetically they contribute to the landscape quality of an area, and may provide a buffer between residential development and sources of pollution (DUAP 1989).

The specific aims of SEPP No. 19 are identified in bold print with the responses below each aim:

**(a) to protect the remnants of plant communities which were once characteristic of land now within an urban area;**

The definition of "bushland", in Clause 4 of the policy, is:

> *"land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered, is still representative of the structure and floristics of the natural vegetation."*

The vegetation within the open space area is highly disturbed through the introduction of weeds, and the dam acting as a vector for the transport of weed propagules.

The proposed development will not remove any native vegetation within Lot 29 DP 829321 and Lot 21 DP 842523 which is a drainage reserve / water quality control dam as this does not form part of the development site and is owned by Council.

The remnant is still representative of the structure and floristics of the natural vegetation within the immediate area and is therefore still considered bushland as defined by Clause 4.

Council's open space area will form part of a proposed APZ, however given that a large portion of these lots is a dam, no vegetation will be required to be removed as there would be a sufficient break in the canopy. The dam will form part of the managed stormwater treatment/riparian section of the subject site.

**(b) to retain bushland in parcels of a size and configuration which will enable the existing plant and animal communities to survive in the long term;**

The total size of Council's open space lots is an approximately 650m$^2$. This is comprised of about 50% open water body. The vegetation remaining is low in diversity, weed infested and would serve very little in adding to the value of any remnant bushland within the subject site in its entirety.

As such, the bushland within Council's open space area is not of a size and configuration which will enable the existing plant and animal communities to survive in the long term. This is why it has been proposed that two (2) conservation corridors be introduced to link vegetation and habitat in the north, to that in the south in a formal matter that will aid to the facilitation of local fauna movements. In addition, native landscape planting will be undertaken across the proposed development to encourage cross corridor movement.

**(c) to protect rare and endangered flora and fauna species;**

The amount and status of the bushland remnant within Council's open space area is not sufficient to protect rare and endangered flora and fauna species. No such species were detected in this zone.

**(d) to protect habitats for native flora and fauna;**

Council's open space area is too small and structurally unsound to protect sufficient areas of habitat for native flora and fauna.

The conservation and restoration of native vegetation within the proposed biodiversity corridors of the subject site will ensure a variety of habitats are retained or allowed to be restored through revegetation works. Most of the hollow-bearing trees (>85%) will be retained within the development area.

In achieving 3.80ha of vegetation on site, there will be initial removal of 1.50ha of vegetation communities 1 and 4 combined, then restoration of approximately 1.83ha. Therefore an overall 'Improve' outcome will be achieved in native vegetation alone. Other measures such as habitat enhancement with artificial nest boxes will further enhance the insitu habitat for breeding onsite for common and threatened fauna species.

The calculation of 3.80ha does not include supplementary restoration areas which include the managed vegetated buffer only because of its relative proximity to APZs (or within) and therefore they will not have a fully vegetated structure. Therefore, a further 1.06ha of the subject site not currently in a vegetated state, will form the proposed managed vegetated buffer.

**(e) to protect wildlife corridors and vegetation links with other nearby bushland;**

The vegetation within Council's open space area has tentative links to a large pocket of vegetation to the immediate west although it is highly weed infested and will form part of the future APZ.

Given that the open space area will also form part of the site's APZ, it will play no part in a conservation corridor that will provde vegegetation links with other nearby bushland.

The development has been designed to retain connectivity of vegetation within the subject site beyond the boundaries to surrounding vegetation. The retention of native vegetation within the wildlife corridors serves to maintain a vegetated link from vegetation to the north, to that in the south. This retained vegetation will allow for fauna movement throughout the site. There will also be the creation of habitat within the development area through the use of locally occurring vegetation to enhance cross corridor movement.

**(f) to protect bushland as a natural stabiliser of the soil surface;**

The retention of vegetation within the open space area will reduce the threat of instable soils and maintain the bushland as a natural stabiliser. The use of appropriate sediment fencing and soil erosion measures will reduce the potential of downstream impacts from the proposed development as channel works will be undertaken from the edge of the dam around the northern perimeter of the site and into the main channel (T1).

**(g) to protect bushland for its scenic values, and to retain the unique visual identity of the landscape;**

There is a small pocket of public open space within the subject site which contains a drainage reserve/water quality control dam (Lot 29 DP 829321). Lot 21 DP 842523 adjoins Lot 29 to the south and west and is also owned by Warringah Council totalling approximately 650m$^2$.

A larger area of public open space occurs to the north-east of the subject site on the eastern side of Oxford Falls Road as Lot 1334 DP 752038 (5.1ha) owned by Council.

The drainage reserve/water quality control dam and any associated vegetation will be retained insitu.

The public open space area situated on the eastern side of Oxford Falls Road from the proposed development will be retained in a vegetated condition thereby ensuring protection of visual amenity. No removal of bushland for the proposed activity will occur in those public open spaces and it is considered that the development will have an overall minimal visual impact.

The proposed development will not result in the fragmentation of any bushland area, therefore protecting the aesthetic quality.

**(h) to protect significant geological features;**

The site does not contain any significant geological features which need to be protected. The geology and soil landscape present are locally common and do not require any specific protection.

**(i) to protect existing landforms, such as natural drainage lines, watercourses and foreshores;**

The proposed conservation plan (Figure 3 of the Ecological Assessment) has sighted the two proposed corridors over the existing and proposed drainage lines as well as the more sensitive rocky escarpment / sloped areas.

Council's open space area is not considered to form part of the corridor as it is within a proposed APZ and is weed-infested. The open space area contains a dam which

overflows to the north-east carrying with it weed seed propagules and hence a large weed plume containing moisture loving species has established.

The on site drainage has been designed in accordance with the principles of Water Sensitive Urban Design (WSUD).

**(j) to protect archaeological relics;**

The report, *Aboriginal Archaeological Assessment, Oxford Falls Retirement Resort, Oxford Falls NSW* (December 2006) stated "No Aboriginal sites or evidence for past Aboriginal visitation or use of the subject lands, nor any areas of definite *Aboriginal Archaeological Potential* were located during the surveys."

**(k) to protect the recreational potential of bushland;**

Recreational potential of Council's open space area is limited due to small size and danger from water in the dam.

**(l) to protect the educational potential of bushland;**

The educational opportunities for Council's open space area is limited due to the size and current degraded form of bushland.

Within the district, educational opportunities are ample within nearby vegetated areas such as Garigal National Park and Red Hill. The subject site has no potential for use as an educational area as it is privately owned.

**(m) to maintain bushland in locations which are readily accessible to the community;**

The proposed development is on privately owned land, and is therefore not accessible to the community. Council's open space area which is a drainage reserve/water quality control dam will remain in situ however due to the hazards of drowning, the area will remain fenced and not utilised by the public.

The bushland within Council's Lot 1334 DP 752038 will remain accessible to the community causing no change to the current situation.

**(n) to promote the management of bushland in a manner which protects and enhances the quality of the bushland and facilitates public enjoyment of the bushland compatible with its conservation.**

Council's open space area will be retained. The development surrounding it provides an opportunity for vegetation management and enhancement through a vegetation management plan. There will be no impacts of the proposed development upon the bushland within Council's Lot 1334 DP 752038.

The proposed development will ensure the protection of two (2) corridors of vegetated lands that link vegetation in the north to that immediately south of the subject site. Within those corridors, a variety of habitats will be conserved that will aid in the facilitation of fauna movement within the local landscape.

The proposal will see the protection and enhancement of waterways through remediation works to realign and construct channels, removal of exotic vegetation and

enhancement through revegetation works. These will enhance the scenic quality of the riparian corridor and thus potentially public enjoyment.

Restoration works will also be undertaken within the western corridor to remove exotic vegetation and revegetate with heath where applicable to enhance the quality of the western vegetation remnant and facilitate fauna movements. These works will enhance the scenic quality of the western corridor and thus potentially public enjoyment.

Section 6.2 of the Ecological Assessment report indicates the other proposed and potential mitigation measures to be undertaken across the site in its entirety to ensure the preservation of habitats, in particular those pertaining to threatened species habitat.

### 4.18 Riparian assessment

GHD Pty Ltd (GHD) was engaged to undertake a riparian area assessment of watercourses associated with a proposed Seniors Living Development at Oxford Falls. GHD found that the site contained two different categories of stream, 1st order and 2nd order.

GHD described the streams as follows:

> *The Middle Creek Tributary runs parallel to Oxford Falls Road across the subject site in a north westerly direction (referred to as drainage line S1a, S1b and T3 in Appendix A). In addition, there are two minor drainage lines within the subject site, Drainage line T1 runs in an easterly direction towards the Middle Creek Tributary and is situated along the southern edge of the Australian Tennis Academy. Drainage line T2 extends for approximately 160m in a north-easterly direction towards the Middle Creek Tributary. The lower reach of this drainage line runs parallel to the Barnes Road reserve that connects to Oxford Falls Road (See Figure 2, Appendix A).*
>
> *The Middle Creek Tributary extends for approximately 1.5 kilometres and originates near the intersection of Iris Street and flows in a north-westerly direction parallel to Oxford Falls Road where it flows under the Wakehurst Parkway before joining Middle Creek about 150 m further west. The Middle Creek Tributary exhibits variable channel characteristics along its length.*
>
> *On the basis of the report compiled by Evans and Peck (2008), it appears that the current alignment of Middle Creek Tributary has remained substantially the same since the early 1900s. The Middle Creek Tributary is depicted on the 1:25,000 scale topographic maps for Hornsby 9130-4S (third edition 2001) and Mona Vale 9130-1S (third edition 2000), but had no tributaries joining it within or upstream of the Site.*
>
> *Since this time two (2) minor drainage lines have been constructed (referred to as T1 and T2 in Figure 2, Appendix A) on site that would fit the definition of a 'river' as per the WMA. T1 is a small drainage line in the north of the site constructed using concrete culverts to divert surface water around the tennis courts with T2 being a constructed channel using sandstone rocks placed throughout to assist with erosion control. Both these channels will be removed and replaced with reconstructed drainage lines in the locations shown in Figure 2, Appendix* A.

In relation to flood events GHD advised:

> *A preliminary flood study has been prepared for the site (JMD 2008). Delineation of flood extents is important for riparian zone selection and management,*

*particularly 100 year ARI and PMF events. GHD has considered the riparian corridor and open space network to enable the 100 year ARI event to be contained within this open space. Consistency between the riparian objectives and flood risk implications must be ensured. The riparian objectives must be integrated into the setting of flood planning levels.*

Following consultation with DECCW, the following were agreed to:

**Middle Creek Tributary**

- Re-align and reconstruct the Middle Creek Tributary upstream of Barnes Road (shown as reach T3 on Fig 2) to 'mimic', as best as possible, an endemic stream and appropriately protect and link riparian vegetation.

- Realign and reconstruct the Middle Creek Tributary downstream of the proposed access (shown as reach S1b on Figure 2) to 'mimic', as best as possible, an endemic stream and appropriately protect and link riparian vegetation.

- Revegetate and rehabilitate the riparian vegetation along the length of the Middle Creek tributary and provide a minimum CRZ of 15 m and a VB of 10 m.

- Conserve and rehabilitate the Biodiversity Zones, on the eastern side of the creek (shown in green hatching in Figure 2).

- Include an APZ of 45m (outside the CRZ) on the western side of this tributary that includes canopy and ground cover species endemic to the location plantings.

**Drainage Line T1**

- Drainage line T1 will be removed and redirected towards the northern boundary of the site.

- The channel will be reconstructed and incorporated as a Water Sensitive Urban Design (WSUD) feature. The channel will be rehabilitated with native species (canopy and groundcovers/macrophytes only) within the parameters of the APZ.

**Drainage line T2**

- Drainage line T2 will be removed and redirected towards the southern boundary of the site.

- The channel will be reconstructed and incorporated as a WSUD feature. The channel will be rehabilitated with native species (canopy and groundcovers/macrophytes only) within the parameters of the APZ.

Note: All drainage line rehabilitation works will seek to 'mimic', as best as possible, naturally occurring streams in the area.

# 5 MAINTAIN OR IMPROVE TEST

The 'maintain or improve' test is an ecological test applied by DECCW in order to evaluate whether a development either maintains and/or improves, or potentially degrades/removes, existing vegetation and insitu habitat resources. The test evaluates the impact of a development upon threatened species and/or their habitats.

The assessment is set out in accordance with the *DRAFT Guidelines for Threatened Species Assessment* (DEC & DPI 2005) and includes the following steps:

- Step 1, (Section 5.1) – evaluates the *impacts of the proposal* on the extent of endangered ecological communities and suitable habitat for threatened species.
- Step 2, (Section 5.2) – discusses the proposed *mitigation measures* used within the development to protect endangered ecological communities and threatened species.
- Step 3, (Section 5.3) – discusses the proposed *restoration* for proposed riparian and wildlife corridors.
- Step 4, (Section 5.4) – provides a summary of the *maintain or improve* assessment for endangered ecological communities and threatened flora and fauna species.
- Step 5, (Section 5.5) – evaluates the *conclusions of the assessment* against the key threshold criteria outlined in the *DRAFT Guidelines for Threatened Species Assessment* (DEC & DPI 2005).

Each step has been used to determine whether a potential significant impact will occur as a result of the proposed development.

## 5.1 Evaluation of the impacts of the proposal

Criteria used to assess the potential impacts of the proposed development on the extent of suitable habitat for threatened flora and fauna species and endangered ecological communities recorded within the subject site, or considered likely to occur within the subject site are:

- Existing area of vegetation or habitat (ha)
- Area of vegetation/habitat to be removed (ha)
- Area of vegetation/habitat to be retained/restored (ha)
- Area of vegetation/habitat to be revegetated/offset (ha)

Threatened fauna species selected for the following assessment are indicated as those with potential to occur and/or identified by the DGRs (DoP 2006) and/or DECC (2009) as explained in Section 4.13. All flora species with potential to occur have been assessed in Table 5.1.

**Table 5.1 - Maintain or improve table – potential flora and fauna habitat**

| Community / Threatened Species | Area (ha) Pre-development | Area (ha) Post Development | Difference (ha) | Maintain / Improve / Decline |
|---|---|---|---|---|
| ***Threatened Species Recorded On Site*** | | | | |
| Powerful Owl | 3.11 | 3.8 | + 0.69 | Improve |
| Glossy Black-Cockatoo | 1.32 | 1.52 | + 0.2 | Improve |
| Grey-headed Flying-fox | 4.15 | 4.52 | + 0.37 | Improve |
| Eastern Bentwing-bat | 12.52 | 8.0 | - 4.52 | Decline |
| ***Threatened Species with Potential to occur but Not Recorded On Site*** | | | | |
| *Acacia bynoeana* | 1.89 | 2.07 | + 0.18 | Improve |
| *Darwinia biflora* | 0.30 | 0.39 | + 0.09 | Improve |
| *Epacris purpurascens var. purpurascens* | 0.30 | 0.39 | + 0.09 | Improve |
| *Eucalyptus camfieldii* | 3.35 | 3.49 | + 0.14 | Improve |
| *Lasiopetalum joyceae* | 0.54 | 0.56 | + 0.02 | Improve |
| *Melaleuca deanei* | 0.15 | 0.39 | + 0.24 | Improve |
| *Persoonia hirsuta* | 0.15 | 0.39 | + 0.24 | Improve |
| *Pimelea curviflora var. curviflora* | 0.15 | 0.39 | + 0.24 | Improve |
| *Tetratheca glandulosa* | 0.12 | 0.39 | + 0.27 | Improve |
| Red-crowned Toadlet | 0.084 | 0.092 | + 0.008 | Improve |
| Rosenberg's Goanna | 1.56 | 1.69 | + 0.13 | Improve |
| Barking Owl | 5.32 | 6.67 | + 1.35 | Improve |
| Spotted-tailed Quoll | 1.92 | 2.85 | + 0.93 | Improve |
| Southern Brown Bandicoot | 1.29 | 1.69 | + 0.4 | Improve |
| Koala | 0.31 | 0.46 | + 0.15 | Improve |

The areas of suitable flora and fauna habitat considered for the above calculations are provided in Appendix 5.

**Discussion on species with potential habitat decline**

The proposed development, its associated restoration of habitats and consolidation of corridors across the subject site, will provide an improvement to the amount of usable habitat for the majority of threatened and non-threatened fauna species in the locality. This is particularly the case for terrestrial species. The proposal will thus be expected to provide a greater opportunity for threatened species utilisation of the proposed corridor areas.

There was an improvement for all threatened plant species with potential to occur because of the proposed restoration arrangements.

Improve outcomes may be subjected to particular landscaping requirements such as winter flowering resources, koala feed trees, nest boxes, etc.

The main reason for a decline for Eastern Bentwing-bat was because it was considered that this species is likely to fly throughout the large Exotic Grassland with Scattered Tree vegetation community. This community has limited value for the species, in the form of foraging space, low potential roosting and not for breeding. The improved connectivity of corridors will improve foraging lines along the fringes of these. The APZ's and larger gaps in between buildings will continue to be used for foraging area. Specific discussion on this species is provided below:

**Eastern Bentwing-bat**

The calculated decline for this species was based on foraging and roosting habitat. There is no breeding habitat for this species present.

Roosting habitat is only considered in recognition that buildings (houses and sheds) currently present on site may provide such habitat. It should be recognised that roosting has not been recorded within the site and no natural roosting habitat is considered present. So the reduction in habitat is based on artificial structures that provide a degree of 'potential' use.

Foraging habitat was considered throughout the subject site. This was reflected in the species recording in all Anabat locations during recent surveys. It should be recognised however that the egg laying, larval and pupal stages of prey items (being predominantly moths and flying insects) are restricted to leaf/bark and foliage areas. Therefore, despite this bat's high mobility to forage, foraging is fundamentally dependent on the amount of habitat that will support early life-cycle stages of prey species. The proposed vegetation restoration will provide an improvement on prey species development areas.

Although this species may forage throughout the existing managed areas of the site, foraging activity is more likely concentrated above and along the edges of forest habitats. Such flyways will be retained and enhanced by restoring previous gaps in forest linkages. The two dams which are available for drinking are again likely subject to concentrated activity, particularly given that these are located along the edge of forest remnants. These dams are recommended for retention. Alteration to the larger southern dam as part of development works will not impact on drinking water resources provided that it may still provide open water habitat along a designated open flyway.

In addition to the 'maintain or improve' assessment, the Eastern Bentwing-bat will be assessed in Section 5.5 below in accordance with the criteria provided in Appendix 3 of the Draft Guidelines for Threatened Species Assessment *(DEC & DPI 2005).*

## 5.2 Proposed mitigation measures

There is considered to be a reduction in habitat for the Eastern Bentwing-bat. Areas of revegetation and restoration across the site will result in an improvement in the quality of habitat for this and other threatened species via a number of mitigation and management strategies. In addition to mitigation measures against the Eastern Bentwing-bat, several factors to ensure an *improve* outcome in the calculations utilised in Table 1 are also presented below.

The mitigation and management strategies proposed include:

- Conservation of habitat within the retained vegetation corridors;
- Improving connectivity between the existing conservation landscapes to the west and the northeast;
- Restoration of habitat for threatened species;
- The provision of vegetated buffers to the riparian and managed landscaped buffers;
- The creation of a heathy or shrubby understorey structure for the Southern Brown Bandicoot and Rosenberg's Goanna;
- The restoration of riparian areas to provide a high presence of Swamp Mahoganies (*Eucalyptus robusta*) to improve Koala and winter migratory bird species habitat. Restoration of areas adjacent to riparian areas should also provide a high presence of Grey Gum (*Eucalyptus punctata*) also to improve available Koala habitat;

- *Allocasuarina* feed trees for Glossy Black Cockatoos to be planted within appropriate areas of the proposed corridors to ensure the site provides a higher representation of feed trees than present;
- exclusion of grazing animals;
- supervision of hollow tree and artificial structure removal such that appropriate action may be taken for residing fauna;
- replacement of hollows removed via nest box installation at a ratio of 1:1;
- weed control;
- erosion control;
- installation of protective fencing and signage;
- stormwater quality and quantity control (bio-retention basins, bio-swales, gross pollutant traps, rainwater tanks and revegetation of watercourses);
- retention of dead timber and habitat supplementation;
- retention of regrowth
- strategic supplementary planting.

These strategies will generally be implemented under the Vegetation Management Plan (or equivalent) in perpetuity and are likely to result in a substantial increase in the quality, over the long term, of suitable habitat for threatened fauna species utilising the subject site.

In addition, revegetation and restoration works associated with the proposed development will result in an improvement in vegetation connectivity across the site and hence in the movement of fauna within the site and to vegetation off site.

### 5.3 Proposed restoration for proposed riparian and wildlife corridors

The quality of habitat for both threatened flora and fauna will be improved through revegetation works within the proposed eastern and western conservation precincts of the subject site. It is considered that these areas of revegetation, in combination with the remnant native vegetation to be retained and restored, will result in a net improvement in threatened flora and fauna habitat across the site, effectively offsetting the removal of vegetation proposed by the development.

The net improvement will be:

- Riparian corridor – 3.1ha (including managed vegetation buffer, 1.9ha without)
- Terrestrial corridor – 1.6ha

### 5.4 Summary of the 'maintain or improve' assessment

*Threatened flora species*

There are no threatened flora species recorded on the site. However, the proposal will result in a short-term loss of heath and woodland/open forest vegetation providing potential habitat to the nine (9) listed flora species in Table 5.1.

Given the restoration opportunities to remove weed infestations within the woodland/open forest vegetation community along with the rehabilitation of an estimated 1.83ha of vegetation within riparian zones and around the western escarpment area to provide better environmental corridors during the development, there will be a net positive gain for all listed flora species.

*Threatened fauna species*

The proposed development will result in a short-term loss of heath and woodland/open forest vegetation available for the recorded species including Powerful Owl, Glossy Black-Cockatoo, Grey-headed Flying-fox and Eastern Bentwing-bat; as well as species with potential to occur including the Southern Brown Bandicoot, Rosenberg's Goanna, Spotted-tailed Quoll, Barking Owl, Red-crowned Toadlet and Koala.

The 'maintain or improve' calculations have concluded that there will be an overall reduction in habitat only for the Eastern Bentwing-bat following restoration works and as such these species will be considered further in Section 5.5.

## 5.5 Assessment against the key threshold criteria outlined in the *DRAFT Guidelines for Threatened Species Assessment* (DEC & DPI 2005).

This assessment has been undertaken for the Eastern Bentwing-bat.

- ***How is the proposal likely to affect the lifecycle of a threatened species and/or population?***

***a) displaces or disturbs threatened species and/or populations***

Not applicable to flora as no threatened species or populations were recorded on site.

*Eastern Bentwing-bat*

There is no breeding habitat present within the site for this species. If, in the situation that this species is roosting within houses or sheds proposed for removal, then disturbance or displacement of roosting will occur. This species will typically have a number of local roosts and as such, removal of roosting habitat should not significantly impact on the species. provided that strict deconstruction measures are outlined in the Landscape Restoration Management Plan (or equivalent). In the event that this species is recorded roosting during the deconstruction of buildings, deconstruction should cease until the roost is vacated voluntarily. Ongoing roosting would indicate a more permanent and valued roost and appropriate measures should be determined in consultation with DECCW at that time.

Foraging habitat, whilst reduced within the cleared open landscapes, will be effectively retained within the site and will continue to be well represented in the surrounding locality such that displacement of foraging is unlikely to occur. As described in Section 5.1 above, foraging activity is likely higher along the fringes and above forest strips. These will be effectively retained and enhanced. This species is also known to actively forage within urban landscapes that fringe bushland areas, including foraging for moths under street lights.

***b) disrupts the breeding cycle***

Not applicable to the site's vegetation.

*Eastern Bentwing-bat*

There is no breeding habitat for this species within or in close proximity to the subject site.

***c) disturbs the dormancy period***

Not applicable to the site's fauna. No threatened flora species were recorded on site, therefore this is not applicable.

***d) disrupts roosting behaviour***

*Eastern Bentwing-bat*

Disruption to roosting behaviour will occur if this species is found to be roosting within any of the building structures proposed for removal. Such roosting was not observed during survey, however all available roosting options may only effectively be determined during deconstruction of structures.

***e) changes foraging behaviour***

*Eastern Bentwing-bat*

Isolated areas of habitat providing good foraging structure will be removed for the Eastern Bentwing-bat, however the major foraging lines along natural vegetated areas within the eastern and western confines will be retained and promoted with further connectivity. It is recommended that the two dams located along the proposed corridor edges currently providing open water drinking resources for microchiropteran bats are retained such that foraging may continue along a designated flyway. It is recognised that the large southern dam will be modified by the proposal however open water drinking resources should remain by redesign.

The Eastern Bentwing-bat is known to extend foraging areas into developed landscapes, particularly streetlights that are present in proximity to the urban to bushland interface. The lesser degree of foraging that currently occurs within the more open central areas will thus be further reduced by the presence of infrastructure, but not eliminated. Such foraging activity will likely be more confined to the proposed higher quality habitats along the margins.

***f) affects migration and dispersal activity***

*Eastern Bentwing-bat*

There will be no affect on the migration or dispersal activity of Eastern Bentwing-bat given the high mobility of the species.

***g) disrupts pollination cycle***

Not applicable to the site's fauna.

The removal of weeds in the proposed corridors and restoration with native landscaping will provide a long-term improvement of native flora pollination which in turn will assist in the provision of food resources to fauna.

***h) disturbs seedbanks***

Not applicable to the site's fauna.

Not applicable to the site's flora as there will be no negative impacts. Notwithstanding this, there will be a loss or disruption of current vegetative seedbank. Restoration works through the removal of weed plumes will encourage the native seedbank to regenerate in the longer term.

***i) disrupts recruitment***

*Eastern Bentwing-bat*

There will be no disruption on recruitment for the Eastern Bentwing-bat given the high mobility of the species.

***j) affects the interaction between threatened species and other species in the community***

- ***How is the proposal likely to affect the habitat of a threatened species, population or ecological community?***

**a) disturbs any permanent, semi permanent or ephemeral water bodies**

Of the threatened species with potential to occur, only the Red-crowned Toadlet has a high reliance on water bodies other than for a drinking resource. The areas of habitat considered suitable for this species are all contained within the western conservation precinct. Restoration of riparian habitat along these drainages will improve habitat for the species.

The lower portions of one drainage located within the north-western corner of the subject site will be managed as an APZ. Such management will not impact on this species provided that the vegetation management plan considers this species in restoration of these areas.

There are no endangered ecological communities within the subject site that rely upon water bodies or threatened flora species.

***b) degrades soil quality***

It is assumed that all construction on site will meet the guidelines set by Warringah Council and the methodology described in *Managing Urban Stormwater: Soils and Construction (Landcom, 2004) 'The Blue Book'*, therefore any impact to degrade soil quality should be very localised, short term and not significant.

***c) clears or modifies native vegetation***

The subject site is approximately 14.7ha in size. Table 5.2 identifies each vegetation community size and the likely impact.

**Table 5.2 - Vegetation impact**

| Veg. Com. | Veg. Com. Description | Area (ha) | Area to be Removed (ha) | Proposed Replacement |
|---|---|---|---|---|
| 1 | Peppermint/Angophora Woodland / Open Forest | 3.11 | 1.14 (37%) | 1.83 (combined with veg. com. 4) |
| 2 | Exotic Grassland with Scattered Trees | 11.05 | 7.74 (70%) | Nil |
| 3 | Aquatic Herbfield | 0.21 | 0.05 (24%) | 0.19 |
| 4 | Kunzea/Tea-tree Tall Heath | 0.36 | 0.36 (100%) | 1.83 (combined with veg. com. 1) |

There will be impact on vegetation community 1 however mostly in the form of vegetation modification due to APZs.

The proposed development is centred on vegetation community 2 as this contains the least amount of ecological constraints and has little to no potential of hosting any threatened flora species. Parts of this vegetation community occur within the riparian zone and will be rehabilitated.

The aquatic herbfield community will be largely maintained/managed. The tributary of Middle Creek will be rehabilitated during the development and landscaping process. The dams will be retained and possibly modified. The width of the existing aquatic area shall be widened with two (2) small narrow tributaries off the main eastern tributary to be constructed. The retention of open water habitat in these locations is highly recommended given the recorded presence of the Eastern Bentwing-bat at the central and southern dam.

Vegetation community 4 will be largely cleared with the remainder being modified as it will occur within an APZ. The ecological attributes of this vegetation community may be replaced as part of the restoration works within the proposed western corridor. To retain the character and views for those neighbouring western residences, the revegetation works in the western portion of the western corridor should primarily focus on heath planting.

*d) removes or disturbs key habitat features such as trees with hollows, caves and rock crevices, foraging habitat*

A survey for hollow-bearing trees was re-conducted in the autumn of 2010 across the proposed development area and adjacent lands. The survey picked up 37 hollow-bearing trees in total, several more than was surveyed originally in 2004. The majority of these trees occur in lands that will form part of a future conserved corridor.

No highly significant habitat trees are considered present. Fourteen (14) habitat trees of notable significance based on the hollow(s) quality, size, number present and/or signs of use, are present. Of the 37 habitat trees recorded, 13 are either within or near to development footprints and 5 of these are of notable significance. It is recommended that trees of notable significance are protected where possible, in particular HT19.

Rock outcropping and escarpment areas in the western portion of the subject site are too steep to build on and thus will be retained as part of the future conservation corridor.

*e) affects natural revegetation and recolonisation of existing species following disturbance*

The recruitment of natural vegetation within the drainage corridor and non developed areas will be encouraged through weed control to restore degraded areas to core condition.

- ***Does the proposal affect any threatened species or population that are at the limit of its known distribution?***

The proposal does not affect any threatened species or population that are at the limit of its known distribution.

- ***How is the proposal likely to affect current disturbance regimes?***

*a) modifies the intensity and frequency of fires*

The proposed development is not expected to incorporate any fire into the management of the site or alter any existing regime.

*b) modifies flooding flows*

The riparian corridor will be managed in a way that will stabilise flows and restore a riparian environment.

- ***How is the proposal likely to affect habitat connectivity?***

*a) creates a barrier to fauna movement*

The proposal will not create a barrier to fauna movement. Fauna movement will be enhanced in the long term with the proposed corridors as shown on Figure 3.

*b) removes remnant vegetation or wildlife corridors*

Vegetation being removed is generally scattered, fragmented, isolated or planted. There will be tall heath vegetation lost near the centre of the site. The proposed development will not cause large scale vegetation clearance such as to reduce potential for fauna movement. Existing corridors of vegetation will be enhanced in the long term to increase habitat connectivity and improve fauna movement from the north-west through the site and to the south.

*c) modifies remnant vegetation or wildlife corridors*

As above (b)

- ***How is the proposal likely to affect critical habitat?***

No critical habitat is declared under the *TSC Act 1995* within the subject site.

### 5.6 Summary of evaluation against key thresholds

Key thresholds identified within Step 5 of the *Draft Guidelines for threatened species assessment (DECC & DPI 2005*) – written in *italics* – have been addressed below:

"*Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values*."

The proposal will maintain or improve biodiversity values for all but the Eastern Bentwing-bat which was recorded present during surveys. It has been concluded from Section 5 of this report and the 7-part test of significance in Appendix 4 that the reduction in habitat for this species will be such that the species will not be significantly impacted. Habitat for this species will still be well represented in the post development landscape such that the species is expected to incur only minor behavioural changes particularly in consideration to the species large foraging ranges.

"*Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community*."

Based on the results of the maintain or improvement assessment in Section 5 of this report and the 7-part test of significance in Appendix 4, it is considered that the Oxford Falls proposed development will not reduce the long-term viability of any local population of species, population or ecological community.

"*Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction*."

Based on the results of the maintain or improvement assessment in Section 5 of this report and the 7-part test of significance of this report, it is considered that the Oxford Falls proposed development will not accelerate the extinction of any species, population or ecological community or place it at risk of extinction.

"*Whether or not the proposal will adversely affect critical habitat*."

No critical habitat is declared under the *TSC Act 1995* within the subject site.

# 6 CONCLUSION AND RECOMMENDATIONS

## 6.1 Conclusions

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

The proposed development aims to maximise the level of native vegetation onsite post development such that biodiversity is enhanced for wildlife utilisation and riparian protection.

EP&A Act and TSC Act

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

- Four (4) threatened fauna species, Powerful Owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Glossy Black-Cockatoo (*Calyptorhynchus lathami*) and Eastern Bentwing-bat (*Miniopterus orianae oceansis*) within or in close proximity to the subject site
- No threatened flora species were recorded within or in close proximity to the subject site
- No EECs were recorded within or in close proximity to the subject site
- No endangered populations have been observed.

The maintain or improvement assessment has concluded that the proposed development will not have a significant impact on any threatened species, populations or endangered ecological communities.

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 migratory fauna species listed under the EPBC Act were recorded within the subject site
- No EECs were recorded within or in close proximity to the subject site
- No endangered populations have been observed.

Assessment 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 DEWHA 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 Lots 1110, 1111, 1113 & 1336 DP 752038, Lot 20 DP 842523 and Lot 80 DP 846099 Oxford Falls Road and Barnes Road, Oxford Falls, is unlikely 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 EP&A Act, EPBC Act or FM *Act.*

'Maintain or Improve' test

The proposal will maintain or improve biodiversity values for all but the Eastern Bentwing-bat which was recorded present during surveys. It has been concluded from Section 5 of this report and the 7-part test of significance in Appendix 4 that the reduction in habitat for this species will be such that the species will not be significantly impacted. Habitat for this species will still be well represented in the post development landscape such that the species is expected to incur only minor behavioural changes, particularly in consideration to the species' large foraging ranges.

Based on the results of the maintain or improvement assessment in Section 5 of this report and the 7-part test of significance in Appendix 4, it is considered that the Oxford Falls Proposed development will not reduce the long-term viability of any local population of species, population or ecological community, will not accelerate the extinction of any species, population or ecological community or place it at risk of extinction; and no critical habitat has been declared under the TSC Act within the subject site.

### 6.2 Recommendations

The following recommendations are intended to avoid or minimise any potential ecological impacts associated with the proposed retirement development.

It is recommended that a Vegetation Management Plan (VMP) be prepared for the purposes of riparian restoration, the terrestrial corridor, tertiary landscape linkages and vegetation enriched APZs.

The VMP will be an integrated planning tool to identify the ongoing management of the wildlife corridors, habitat resources, weeds, native landscaping within the development and asset protection zones and site works to maximise the retention of existing habitat resources.

The VMP will be prepared in accordance with DECCW guidelines and will include the following key conservation measures:-

- The boundaries of the conservation areas shall be clearly marked out on the site to ensure their protection. All areas of natural vegetation retention shall be protected by fencing, prior to construction, to ensure that these areas are not damaged during the construction phase.

- Existing gaps in vegetation coverage within the nominated corridors shall be revegetated and regenerated to fully structure native vegetation, using endemic native species sourced from local provenance propagation stock. The species selection is to be derived from the local vegetation communities that occur within and immediately surrounding the site.

- Maintaining and furthering existing opportunities across the site (east to west) where native linear vegetation is present is recommended. This appears most achievable along the existing vegetation of the Barnes Road Reserve, where terrestrial habitat is of relatively good condition for the majority. Street trees and native landscaping are also recommended to enhance east-to-west connectivity.

- Restoration of the western corridor shall focus on heath structure equivalent or greater than the 0.36ha loss, also within forested portions, which will improve habitat for the Southern Brown Bandicoot and Heath Monitor.

- The APZs shall be enriched with native canopy and understorey plantings such that it does not exceed fuel load management requirements. The APZs shall be landscaped to include canopy vegetation and planting of native landscape beds.

- Any proposed construction works (drainage and road works) and installations of services shall be clearly identified and are to avoid impacting on the proposed riparian/wildlife corridors. DECCW Guidelines for Controlled Activities – Riparian Corridors, are to be applied in the preparation of any VMP.

- A project ecologist shall be engaged prior to the commencement of works to certify the implementation of all the requirement protection measures in accordance with the approved management plan. This includes the auditing and certification of riparian restoration works as to be approved under the *Water Management Act 2000* and any conditions as issued on a Controlled Activity Permit from DECCW.

- Particular plant species shall be considered. Heath or shrubby understorey created for the Southern Brown Bandicoot should be characterised by locally occurring *Acacia*, *Banksia*, *Daviesia, Epacris, Hakea*, *Leptospermum*, *Melaleuca* and/or *Platylobium* species. Restoration of riparian areas should provide a presence of Swamp Mahoganies (*Eucalyptus robusta*) to improve Koala and winter migratory bird species habitat. Restoration of areas adjacent to riparian areas should also provide a presence of Grey Gum (*Eucalyptus punctata*) also to improve available Koala habitat. *Allocasuarina* feed trees for Glossy Black Cockatoos should be planted within appropriate areas of the proposed corridors to ensure the site provides a higher representation of feed trees than present.

- All staff involved with the development, shall undergo an induction and training program designed to reinforce the ecological and environmental objectives of the development.

- Construction activities on site will be supervised and monitored by a project ecologist to ensure that the recommendations of this report are implemented.

- Potential safety issues regarding retention of some trees near building envelopes shall be resolved by assessment of the tree's health nearer the time of construction. This assessment must be undertaken by a suitably qualified and experienced arborist with concurrence from the project ecologist.

- Trees of notable significance outlined in Section 3 and shown on Figure 1 are protected where possible, in particular HT19.

- The felling of all hollow-bearing trees shall be conducted under the supervision of a fauna ecologist. 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. Re-used hollows or those with likely occupation are to be relocated to natural areas within close proximity to the site. Hollows which are lost shall be replaced at a ratio of 1:1. Possum and microbat boxes should make up at least half of all small (0-10cm) to medium (10-30cm) sized hollows removed. Possums are in high numbers within the site and contribute to Powerful Owl prey availability in the locality. Nest box numbers should be determined, constructed and installed prior to development activities commence such that alternate residence may be provided and relocation opportunities exist for animals recovered during development.

- Any retained tree on site will require protection both during and after development construction, applying the following Tree Protection Guidelines.

- Valued habitat features within development areas shall be prior identified by a fauna ecologist and arranged for relocation into conservation areas.

- All areas containing natural habitat features which have been identified for retention shall be protected with fencing prior to construction.

- The two dams located in the central and southern portions of the site (along the edge of the proposed western corridor) currently provide open water drinking resources for the Eastern Bentwing-bat and other microchiropteran bats. These dams shall be retained such that foraging may continue along a designated flyway. It is recognised that the large southern dam will be modified by the proposal, however, open water drinking resources should remain by redesign.

- Should any fauna species, a nest or a roost is located during development works, be discovered then works shall cease until safe relocation can be advised by a fauna ecologist. Dismantling of building structures should consider the presence of microbat species and where any bats are disturbed (take flight) then works should cease immediately to determine any further presence. Active bats during the day are at high risk of predation. It is best practice that a fauna ecologist undertake prior inspection of buildings and be on hand during the early dismantling process of roof and wall linings. In the event that the Eastern Bentwing-bat is recorded roosting during the deconstruction of buildings, deconstruction should cease until the roost is vacated voluntarily. Ongoing roosting would indicate a more permanent and valued roost and appropriate measures should be determined in consultation with DECCW at that time. These measures are precautionary as roosting is not expected.

- A community extension program shall be implemented to ensure local residents are aware of conservation management issues and their responsibilities, such as in regard to the conservation purposes of buffer zones and the APZs.

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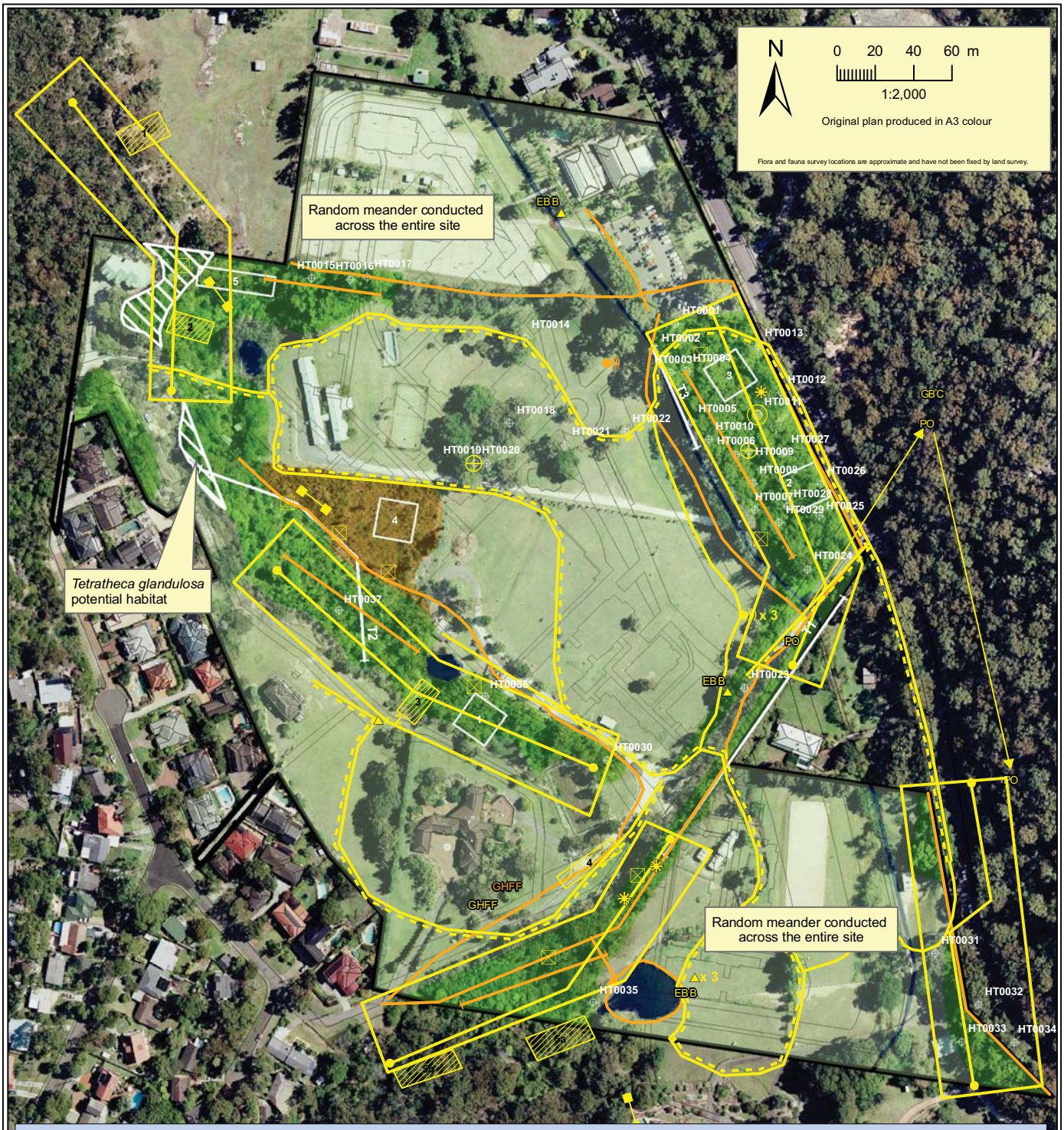
# FIGURES




## Legend

**2004 Fauna Survey**

- Spotlight & Mobile Anabat Transect
- Fauna Trapline
- Nocturnal Call Playback Station
- Anabat Station
- GHFF Grey-headed Flying-fox
- Hair-tube transect
- Funnel Trap Transect
- Bird target search quadrat (approx 200x50m)
- Red-crowned Toadlet target search areas
- Nocturnal call-playback station
- Anabat station
- Anabat (active monitoring) transect
- Spotlighting transect

**2010 Fauna Survey**

- GHFF Grey-headed Flying-fox
- GBC Glossy Black-Cockatoo
- EBB Eastern Bentwing-bat
- PO Powerful Owl
- Powerful Owl Flight Direction
- Owl whitewash
- Cage trap
- Stagwatching (Passive Camera Surveillance)
- Stagwatching (Active Surveillance)

**2010 Flora Survey**

- Flora Transects
- Habitat Tree
- Flora Quadrat
- Peppermint-Angophora Woodland/ Open Forest
- Exotic Grassland with Scattered Trees
- Aquatic Herbfield (approx. 1m wide)
- Kunzea - Tea-tree Tall Heath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# Figure 1 -

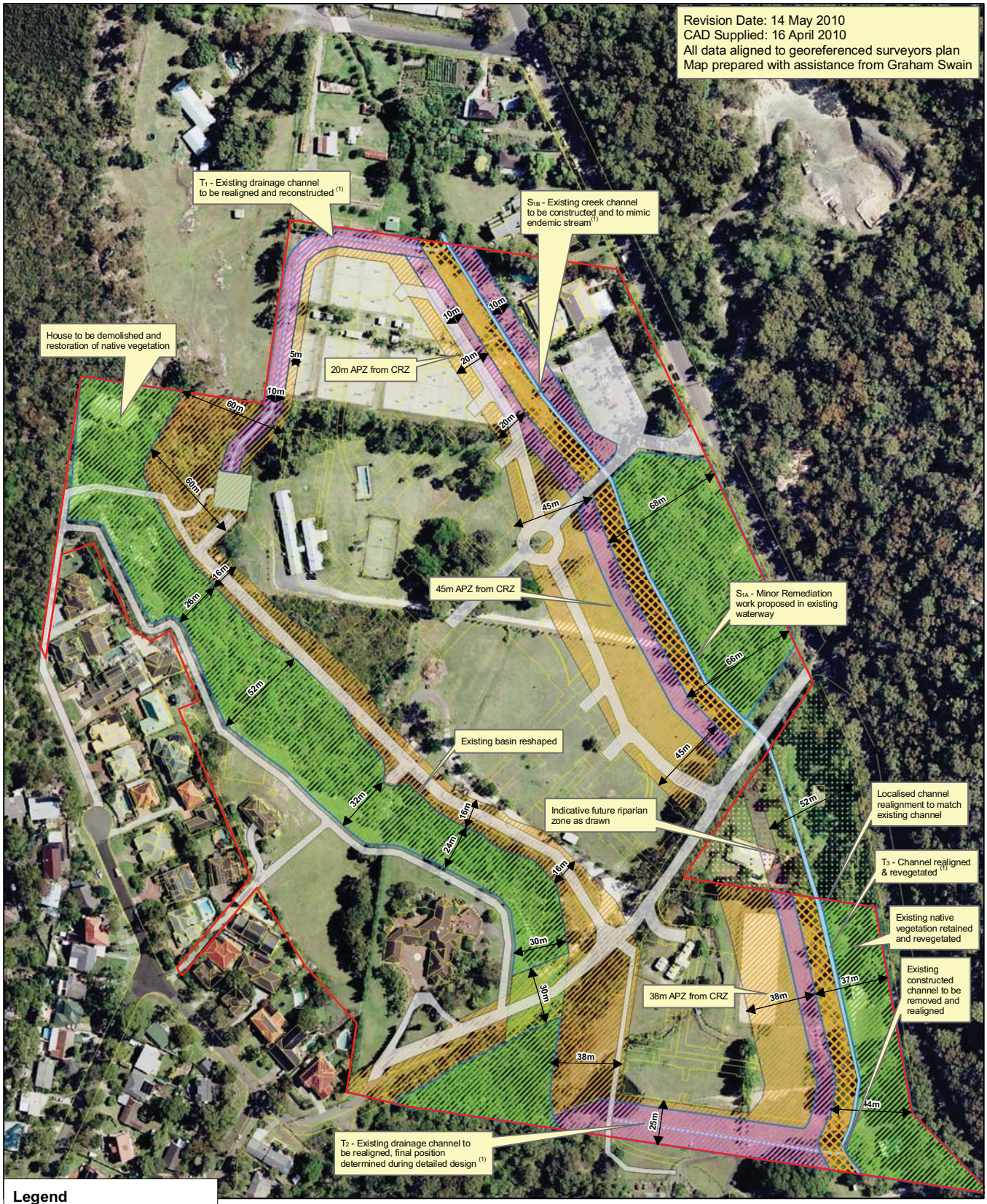
**Survey Effort, Vegetation Communities and Threatened Species Locations**

**Oxford Falls**

Ver.F1 By.KA
28/04/10
Ref.No. A10027

Source: Google Earth Pro, Satellite Imagery.

Location: N:/3166_oxford_falls/A9




Note 1: It is anticipated that the final channel, will be designed to mimic an ephemeral native stream, and will meander up to +/- 1.5 m from the existing centre line.

*Subject Site boundary subject to final survey

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# Figure 2

**Oxford Falls Retirement Resort**

## Bushfire & Riparian Constraints

**(in consultation with Danielle Williams of GHD)**

Ver.S1 By.BB
21/04/10
Ref.No.A10027

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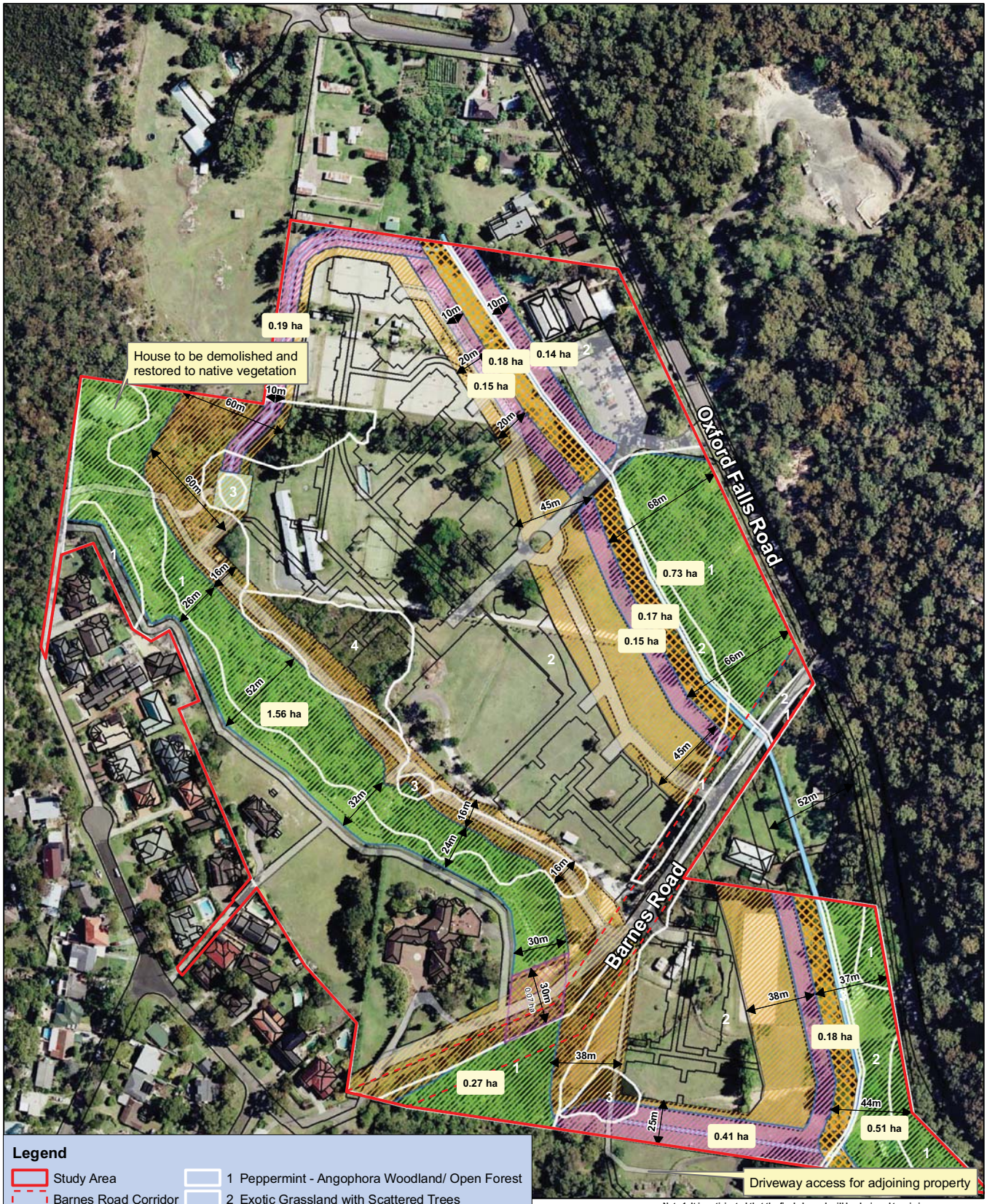


**Legend**

- Study Area
- Barnes Road Corridor
- Arboreal Corridor
- Access/ Egress
- Creek Channel
- 1 Peppermint - Angophora Woodland/ Open Forest
- 2 Exotic Grassland with Scattered Trees
- 3 Aquatic Herbfield (Creek line and dams)
- 4 Kunzea - Tea-tree Tall Heath
- Biodiversity Zone
- Core Riparian Zone
- Managed Vegetated Buffer
- Asset Protection Zone

Note 1: It is anticipated that the final channel, will be designed to mimic an ephemeral native stream, and will meander up to +/- 1.5 m from the existing centre line.
Note 2: The area measurements shown are for the entire zone (Biodiversity Zone, Core Riparian Zone or Managed Vegetated Buffer)

0 25 50 75 100 m

1:2,000

Original plan produced in A3 colour

N

*Subject Site boundary subject to final survey


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# Figure 3
## Conservation Strategy

Oxford Falls

Ver.S1 By.TM/KF
23/04/10
Ref.No.8054

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# APPENDIX 1

# PEER REVIEW

# (Ambrose Ecological Service Pty Ltd)

Susan Hill & Associates
Lawyers Pty Ltd,

1 September 2005

Dear Susan,

RE: FLORA & FAUNA ASSESSMENT: PROPOSED DEVELOPMENT OF LOTS 1108, 1110, 1111, 1113 & 1336 DP 752038, LOT 20 DP 842523 AND LOT 80 DP 846099 OXFORD FALLS ROAD AND BARNES ROAD, FRENCHS FOREST.

Thank you for inviting me to review the Flora and Fauna Assessment for the proposed development on the above-mentioned land (the "subject site").

The review is based on an inspection of the site (25 June 2005) and a review of the Flora and Fauna Assessment Report and Tree Assessment Report prepared by Conacher Travers Pty Ltd.

The findings of the review are presented below.

## ADEQUACY OF SURVEY METHODOLOGY

The following areas of survey methodology are inadequate:

- ***Flora Field Survey***

Section 2.1 states that "*a flora survey using a stratified sampling regime within each of the identified vegetation communities was undertaken on January 8th 2004*."

The "*stratified sampling regime*" is not described or defined. Therefore, it is not possible to determine if adequate flora survey techniques or efforts have been employed.

- ***Fauna Database Searches***

Section 2.2 (Fauna Survey Techniques) lists the Atlas of NSW Wildlife as the only source of threatened fauna records that have been accessed. While this is the most comprehensive of fauna databases for NSW, there are several bird databases for the Sydney region that should have also been accessed. These include:

(a) Cumberland Bird Observers' Club bird Atlas;
(b) NSW Bird Atlases database; and
(c) Birds Australia Bird Atlas.

Information from these databases have been provided to the NSW Department of Environment & Conservation (DEC) for inclusion into the Atlas of NSW Wildlife. However, there is a contractual arrangement between DEC and providers of this information (Birds Australia, NSW Bird Atlassers Inc., and the Cumberland Bird Observers Club) not to make that information available to third parties for commercial purposes. Third parties have to acquire this additional information directly from the information providers for a small commercial fee.

- ***Diurnal Bird Surveys***

Section 2.2.1 states that birds were recorded through visual observation. Many bird species are often detected by their calls rather than by sight because of the cryptic or timid behaviour of species. Therefore, it is unlikely that a complete list of bird species on the site was compiled if only visual observation was used.

Where diurnal birds recorded from opportunistic sightings, or were specific bird survey methods employed? It would have been appropriate to have selected at least four 2 ha areas on site and Area Search Surveys (30 minutes per area) and recording bird species heard or seen during the surveys. The results of these surveys should then be supplemented with the results of opportunistic bird sightings.

- ***Nocturnal Bird Surveys***

The report states that the calls of four threatened owl species were played for 3-minute periods at 3-minute intervals for 30 minutes, followed by 20 minutes of listening & spotlighting.

It is not clear from the report if call broadcasts for all four species were broadcast over a single 30-minute period, or that four separate 30-minute broadcast periods, one for each species, were surveyed. It is also not stated if the nocturnal bird surveys were conducted on a single night or over several nights.

A 30-minute survey period would only allow 15 minutes of broadcast of owl calls. This is an insufficient amount of survey effort in a single night, either for a single species or for four species. A single night's owl survey should be at least 3 hours in duration using the following methodology:

(a) In a single 60-minute period, there should be 40 minutes of broadcasting (10 minutes per species) and 20 minutes of spotlighting & listening.
(b) This procedure should be repeated at least twice in a single night (that is, a total of 3 hrs of survey effort/night).
(c) Nocturnal bird surveys should be conducted over at least three successive nights because some of the owl species (e.g. Powerful Owls) have large home ranges and may not be close to the broadcast point some nights.

No nocturnal birds were recorded during the field surveys. This may have been because the site is not used by threatened owl species or may be a result of insufficient survey effort. Given that the subject site is only 3 km from Garigal National Park, where threatened owl species have been recorded, and typical prey items occur on the subject site, it is possible that the site is used occasionally by owl species.

- ***Arboreal and Terrestrial Mammals***

The types of traps used and the densities of trapping appear adequate.

The report states that cage traps, used for surveying Brown Bandicoots and Spotted Quolls, were baited with a mix of honey, oats and peanut butter. While this is a suitable bait for bandicoots, quolls are carnivores and are not usually attracted to this type of bait; sardines and/or uncooked chicken meat is more appropriate for attracting quolls.

Four trapping nights is only just a sufficient survey period. Long-nosed Bandicoots, a species caught in cage traps in the present study, is usually easy to trap. However, Southern Brown Bandicoots are trap shy and it is my experience that it takes at least 4 or 5 successive trap nights. Both bandicoot species can sometimes co-exist in the same area.

- ***Bats***

Appropriate bat survey techniques and efforts were employed. Section 2.2.4 states that both mobile and fixed Anabat detectors were used in the surveys, but Appendix 2 (Fauna Survey Details) only acknowledges the use of a mobile detector. Where fixed detectors used and, if so, where were they located, how many were used, and how many nights were they out there?

- ***Reptile and Amphibian Surveys***

Appropriate survey techniques and efforts were employed. Section 2.2.5 needs to identify what amphibian species calls were broadcast, just as in the same manner as Section 2.2.2 identified what owl species were broadcast.

## SURVEY RESULTS

- ***Flora Species List***

There are discrepancies in the native species lists of the Flora and Fauna Report (Table A1.1) and the Tree Assessment Report (Schedule 1).

The Tree Assessment Report records 17 Tallowwoods (*Eucalyptus microcorys*), three Swamp Mahoganies (*Eucalyptus robusta*) and one Cabbage Tree Palm (*Livistona australis*) on the subject site. None of these species occur in Table A1.1 of the Flora and Fauna Assessment Report.

Conversely, the Flora and Fauna Report lists the Red Bloodwood (*Corymbia gummifera*) as occurring on the subject site, but this is not listed in Schedule 1 of the Tree Assessment Report.

Although I have visited the subject site, I have not conducted a comprehensive flora survey. Therefore, I do not know if all plant species present on the site have been recorded in either the Flora and Fauna Report or Tree Assessment Report. However, the richness and diversity of plant species recorded by Conacher Travers, including the level of invasion by weed and other exotic plant species would approximate what I would expect for a site of this type.

- ***Vegetation Communities***

The Flora and Fauna Report correctly identifies and describes the vegetation communities that are present on the subject site. Figure 1 is missing from my copy of the Flora and Fauna Report, so I do not know if the vegetation communities have been adequately mapped.

- ***Threatened Flora and Endangered Ecological Communities***

Threatened flora species and endangered ecological communities that occur within the locality have been accurately identified. No endangered ecological communities occur on the subject site. I did not find any threatened plant species on the subject site, which would support the conclusions made in the Flora & Fauna Assessment Report but, as I mentioned earlier, I did not complete a comprehensive flora survey for the purposes of reviewing the reports.

- ***Fauna Species***

I agree with the conclusion that all fauna species that were recorded on the subject site are common within the greater Sydney area. The Red-whiskered Bulbul has been identified in Table A1.4 as a native species, but is actually an exotic (introduced) species.

- ***Fauna Habitat***

The Flora and Fauna Report identifies 14 hollow-bearing trees in the Sydney Sandstone Woodland Community and seven hollow-bearing trees in the Exotic Grassland With Scattered Trees Community. The locations of these trees should be mapped within this report.

Where any of the hollow-dependent fauna recorded on the subject site (e.g. microbats, possums, marsupial mice, wood ducks) observed emerging from any of these tree hollows. If so, these trees should be identified.

The Tree Assessment Report only specifically identifies one tree (Tree No. 9) as containing hollows, but comments imply that hollows also occur in other trees. All hollow-bearing trees should be specifically identified in the final column of the Schedule 1 table.

The Flora and Fauna Assessment Report indicates that there are sap flows from trunks of some trees (especially Sydney Red Gums and Red Bloodwoods). These trees need to be identified and mapped in the Flora and Fauna Report. How prevalent are these sap flows?

- ***Threatened Fauna Species***

The Flora and Fauna Report correctly identifies threatened fauna species that occur within the locality and the availability of habitat for these species on the subject site.

In the Eight-part tests, the Flora and Fauna Report mentions that the nectar Northern Grey Ironbark (*Eucalyptus siderophloia*) and Forest Red Gum (*E. tereticornis*) would provide a potential food source for the Regent Honeyeater (p. 18). Neither of these tree species were recorded in the flora species list (Table A1.1). Potential nectar sources on the subject site for the Regent Honeyeater, especially over the autumn and winter periods, would be from the Swamp Mahogany (*E. robusta*) and the various Banksia species. The River Oak (*Casuarina cunninghamiana*) and Swamp Oak (*C. glauca*) along the creek would also act as a favoured corridor habitat for the Regent Honeyeater.

## EIGHT-PART TESTS

Despite the inadequacies of some parts of the survey methodology, I agree with the conclusions of the 8-part tests that the proposed development of the subject site is unlikely to significantly impact on the status of threatened species or their habitats. Therefore, a Species Impact Statement is probably not required in relation to the proposed development.

## SEPP 44 ASSESSMENT

Section 4.11.1 of the Flora and Fauna Report contains an accurate SEPP 44 assessment that the site is not Core Koala Habitat. I recommend that the assessment can be improved by:

- defining Core and Potential Koala Habitats, as defined in SEPP 44;
- identifying what signs of Koala activity were searched for during the fauna survey.

There is no assessment of whether the subject site is Potential Koala Habitat under SEPP 44. Given that Koalas have been recorded close to the site (1.4 km to the south-west in 1994 and 2.2 km to the north-west in 1997) and the presence of two food species on the site, Koalas may potentially use the site.

## RECOMMENDATIONS IN REPORT

Section 4.3 (Vegetation Connectivity) of the Flora and Fauna Report (p. 9) recommends that the main vegetation (wildlife) corridor runs north-west to south-east through the subject site and it would be retained. However, this is not included in the list of recommendations (Section 6.2, pp. 25-26).

The first recommendation of the report (p. 25) states that, where possible, habitat trees should be retained. However, the report does not identify those trees on the site that are significant habitat trees. Important habitat trees should be mapped in the report and justified as to why they are important, so that the developers can, where possible, avoid removing them.

The final recommendation of the report (p. 26) states that the western side of the drainage line in the eastern part of the subject site should be revegetated as a riparian zone while being maintained as an Asset Protection Zone (APZ). I am not sure how this can be achieved. This recommendation needs to be supported with a Vegetation Management Plan (VMP) that details what plant species can be planted, in what numbers and densities, how weeds and other exotic plants would be controlled, whose responsibility it would be to manage and implement the VMP, a timetable for each action, and how it would conform with the requirements of an APZ.

There should also be additional recommendations for preventing the runoff of sediments and excessive water runoff into the creek and its associated riparian zone.

## OVERALL CONCLUSION

The inadequacies and inconsistencies within the Flora and Fauna Assessment that have been identified by this review need to be addressed if the conclusions within the report are to be accepted as reasonable and supportable.

Please do not hesitate to call me on (02) 9808 1236 or on 0402 225 481 if you wish me to clarify any of the issues discussed in this letter.

Yours sincerely,

Dr Stephen Ambrose
Director
AMBROSE ECOLOGICAL SERVICES PTY LTD

# APPENDIX 2

# DGR's

# (DoP 2006)

**Table 1: Director General Requirements**

| Item | Director General Requirement | Relevant section of this report |
|---|---|---|
| **General Requirements** | | |
| *3* | A draft statement of commitments, outlining environmental management, mitigation and monitoring measures. | A Conservation Land Use Management Plan (CLUMP) (*Conacher Travers,* 2005) has been prepared for the site which demonstrates environmental management, mitigation and monitoring measures. |
| **Key Issues** | | |
| ***Threatened Species and Corridor values*** | Address impacts on threatened species having regard to the Draft Guidelines for Threatened Species Assessment and recommend offset measures to avoid or mitigate the impacts. | These guidelines have been gazetted since the issuing of DGR's. The assessment is provided at Section 4. |
| | Provide a peer review of the threatened species component of the EA prior to submission. | Undertaken by Steven Ambrose (*Ambrose Ecological Surveys Pty Ltd*). His comments have been incorporated into this document and are included as Appendix 1 to this report. |
| | Address corridor values or connective importance of any vegetation on the subject land; the possible loss of connectivity to bushland areas to the south, east and west, impacts on adjoining and nearby bushland areas. | Section 4 and Figure 3. |
| | Demonstrate adequate buffer and address long-term protection of threatened species. | An Environmental Corridor has been provided to the Middle Creek Tributary. The implementation and management of these features have been discussed in detail within the Waterway Impact Study (*Travers environmental*, 2008). The long term protection of threatened species is discussed in Sections 5. |
| | Identify mitigation measures for long term protection of threatened species. | Section 6 and CLUMP. |

DECC's Recommended EA Requirements

The proposal has been declared as a major project under Part 3A and Director General Requirements (DGR's) have been issued. Attachment 1 of the DGR's provides a list of the

DECC's recommended EA requirements. Item 1 – Impacts on threatened species and their habitats is pertinent to this flora and fauna assessment and has been addressed below. Each of the DGR's pertinent to this assessment has been provided in Table 1 above.

*b) A field survey of the site should be conducted and documented in accordance with the gazetted draft Guideline for Threatened Species Assessment and any relevant environmental impact assessment guidelines where these have been prepared by the DECC. Surveys should include targeting the following threatened species and communities:*

- *Acacia bynoeana*
- *Grevillea caleyi*
- *Syzygium paniculatum*
- *Tetratheca glandulosa*
- *Duffy's Forest Endangered Ecological Community*
- *Giant Burrowing Frog*
- *Grey-headed Flying-fox*
- *Powerful Owl*
- *Barking Owl*
- *Koala*
- *Spotted-tailed Quoll*
- *Rosenberg's Goanna*

This assessment has been undertaken in Section 4 of this report. Potential habitat for a range of threatened species, including those identified above, is considered to be present on-site. Despite the presence of potential habitat for some of the above listed species, only the Grey-headed Flying-fox and Powerful Owl were recorded during survey undertaken on the site. It should be noted that other threatened fauna species not listed above have also been recorded (Figure 1).

The disturbed nature of the site currently provides minimal habitat outside of the riparian zone. In light of this, it is considered that the proposed revegetation and rehabilitation of drainage lines across the site and conservation of remnant vegetation as corridors in the western portion of the site (Figure 3) will mean that this development will not result in a significant impact upon threatened species. It is considered that there will actually be an improvement in the quality, connectivity and diversity of habitat on this site as a result of the proposed development.

The EEC Duffys Forest was not found to occur as the native species mix on site was found to resemble most likely a sandstone gully forest complex. The north-western corner of the site was beginning to become more like Sandstone Ridgetop Woodland given the lack of *Eucalyptus piperita* and presence of a number of heath species typically restricted to ridge or mid-slope environs.

As the subject site does not support rainforest species, the potential for *Syzygium paniculatum* was ruled out. If it was to occur, it would only be via planted specimens.

*b) Describe the actions that will be taken to avoid or mitigate impacts or compensate for unavoidable impacts of the project on threatened species and their habitat. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.*

Table 2 below outlines each of the mitigation actions being taken as well as an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.

**Table 2: Mitigation Measures Proposed and Assessment of Effectiveness**

| Mitigation Action | Effectiveness and Reliability | Residual Impacts |
|---|---|---|
| Creation of an environmental corridor | The waterway is currently unprotected with the majority of the creekline overgrown with weeds. The corridor will provide a no development zone thus allowing the ability for not only ecological functioning but also open space use and scientific education opportunities on riparian and aquatic observation for local schools. This is a highly effective and reliable mitigation measure with proven benefits for water quality, habitat and vegetated connectivity.<br><br>The western remnant of vegetation will also be protected for fauna movement and will form a connective corridor of variable width between remnant bushland to the north-west and to the south.<br><br>View Figure 3. | Ongoing weed management required. This will be implemented as part of the ongoing site management requirements of the Waterway Impact Study. |
| Revegetation of drainage lines to provide habitat connectivity. | The provision of a permanent vegetated links within the corridor will enhance not only vegetated links but also ecological functioning in the form of aquatic, riparian and terrestrial habitat creation. | Ongoing weed management required and potential edge effects. The implementation of a monitoring program (weeds, plant establishment and growth) will ensure these impacts are kept to a minimum. |
| In-stream works | The creation of in-stream sequence of riffles, pools and runs will assist sustainability of instream aquatic and benthic habitat. Creek stabilisation works will ensure long term protection of creek bank and minimise erosion. Water quality will be enhanced through aeration over riffle areas and detention in pools. | Initial water quality impact during construction. No long term impacts are perceived within the site. Poor water quality upstream has potential to create negative impact within site. |
| Development design | The development has been designed to utilise the cleared portions of the site with minimal clearing of vegetation required. The development has been designed to increase the amount of native vegetation on the site and provide water quality treatment and increased habitat potential through the creation of development / creekline buffers and increased aquatic habitat.<br><br>The development is sighted away from existing hollow-bearing trees. | Increased human use of the site. Residual impact upon native flora and fauna. |
| Stormwater and water quality management | Stormwater and water quality management measures to be implemented include retention of drainage lines on-site, revegetation of Middle Creek Tributary, removal of stock grazing on site, bioretention systems, swales, rain gardens, | |

| | | |
|---|---|---|
| | porous paving, roof gardens, rainwater tanks, stormwater re-use tanks, onsite detention (OSD) tanks. | |
| Retention of hollow-bearing trees | The retention of hollow bearing trees is an effective means of preserving roosting and breeding habitat for a range of arboreal mammals, bats and birds.<br><br>Section 3 of the report (Table 3.4) lists the attributes of hollow-bearing trees assessed across the subject site. The majority of these fall within areas to be conserved portions of the site. Those within the development area are not sighted on roads or in development footprints therefore there is potential they may all be kept. | Even though hollows are away from building footprints in the development area, there could be potential loss of up to 5 trees as they are very close to the footprints and their safety for retention should be assessed at a later time to determine if they can or cannot be retained.<br><br>If 5 hollow-bearing trees were lost, there would still be a retention of greater than 85%. |

There is considered to be a reduction in habitat for the Eastern Bentwing-bat. Areas of revegetation and restoration across the site will result in an improvement in the quality of habitat for this and other threatened species via a number of mitigation and management strategies. In addition to mitigation measures against the Eastern Bentwing-bat, several factors to ensure an *improve* outcome in the calculations utilised in Table 1 are also presented below.

The mitigation and management strategies are (taken from within section 5 of the main document):

- conservation of habitat within the eastern and western conservation precincts;
- improving connectivity along the eastern and western conservation precincts;
- restoration of large degraded portions within the eastern and western conservation precincts;
- the provision of buffers to the eastern open forest conservation precinct in the form of APZ's, riparian and managed landscaped buffers;
- creation of a heathy or shrubby understorey structure within the western conservation precinct for the Southern Brown Bandicoot and Rosenberg's Monitor;
- restoration of riparian areas to provide a high presence of Swamp Mahoganies (*Eucalyptus robusta*) to improve Koala and winter migratory bird species habitat. Restoration of areas adjacent to riparian areas should also provide a high presence of Grey Gum (*Eucalyptus punctata*) also to improve available Koala habitat;
- *Allocasuarina* feed trees for Glossy Black Cockatoos to be planted within appropriate areas of the proposed corridors to ensure the site provides a higher representation of feed trees than present;
- exclusion of grazing animals;
- supervision of hollow tree and artificial structure removal such that appropriate action may be taken for residing fauna;
- replacement of hollows removed via nest box installation at a ratio of 1:1;
- weed control;
- erosion control;
- installation of protective fencing and signage;
- stormwater quality and quantity control (bio-retention basins, bio-swales, gross pollutant traps, rainwater tanks and revegetation of watercourses);
- retention of dead timber and habitat supplementation;
- retention of regrowth; and
- strategic supplementary planting.

These strategies will generally be implemented under the Landscape Restoration Management Plan (Vegetation Management Plan or equivalent) in perpetuity and are likely to result in a substantial increase in the quality, over the long term, of suitable habitat for threatened fauna species utilising the subject site.

In addition, revegetation and restoration works associated with the proposal will result in an improvement in vegetation connectivity across the site and hence the movement of fauna within the site and to vegetation off site.

# APPENDIX 3

# DECC REQUIREMENTS (2009)

# (In response to the 2008 Flora and Fauna Report)

**DECC comments on the Concept Plan – Senior Living Resort.**

**Aboriginal Cultural Heritage**

The documentation provided on the Department's website did not include the report "Aboriginal Archaeological Assessment, Oxford Falls Retirement Resort, Oxford Falls NSW" December 2006, therefore it is not possible for DECC to make comment on the adequacy of this assessment, or of the adequacy of the recommendations that it makes. In particular, the statement "No Aboriginal sites or evidence for past Aboriginal visitation or use of the subject lands, nor any areas of definite *Aboriginal Archaeological Potential* were located during the surveys." cannot be substantiated as DECC has not seen the complete assessment. This statement is directly followed with another one which states: "Three areas were assessed to possess low *Potential Archaeological Sensitivity* (Coded PAS1, 2 and 3 respectively)". This would appear to contradict the previous statement and without the complete assessment, its veracity cannot be checked. Similarly DECC cannot ascertain the reason for these apparently contradictory statement without being able to review the complete assessment.

It is noted that the development design has changed since the original assessment was undertaken in 2006 and that the reduced development footprint does not impact on PAS1. PAS2 and 3 appear to have been contained within areas identified or conservation. Without reviewing the complete assessment, DECC cannot determine if these areas do, in fact, possess 'low potential archaeological sensitivity' (which contradicts the first statement quoted above). If they do possess 'low potential archaeological sensitivity', DECC support their conservation. If, in the future, these areas are to be impacted, they should be subject to in depth archaeological assessment (including sub-surface testing where appropriate) and recording. This should be carried out in consultation with the local Aboriginal community.

**Biodiversity**

Threatened species

The *Flora and Fauna Assessment* report does not address the DoP Director General's Requirements (DGRs) which require that the impacts on threatened species be addressed having regard to the draft *Guidelines for Threatened Species Assessment* (DEC 2004). Despite the date on the front of the Flora and Fauna Assessment report (October 2008), it appears that all of the survey work was undertaken in January 2004, well before the DGRs were issued. The assessment methodology used was based on the *Flora and Fauna Survey Guidelines: Lower Hunter Central Coast Region* (Murray *et al* 2002) and not DECC's 2004 *Threatened Biodiversity Survey and Assessment Guidelines* referred to in the draft *Guidelines for Threatened Species Assessment.*

*Response:*

- *Consequent flora and fauna survey has been undertaken in March-April 2010 utilising DEC (2004) methodology.*

As a consequence, the surveys are out-of-date and do not take account of new listings since January 2004 which may be relevant to the site and the assessment methodology used is inadequate to pick up the range of threatened species and endangered ecological communities (EECs) likely to have habitat at the site. It should be noted that while DECC's *Threatened Biodiversity Survey and Assessment Guidelines* are listed in the introduction to the Flora and Fauna Assessment, they do not appear to have been used in designing and undertaking field surveys at the site nor are they listed in the bibliography.

*Response:*

- *Atlas of NSW Wildlife Database (2010) and EPBC listings were sourced immediately prior to the 2010 survey to obtain current listings of threatened species.*

The Appendices to the *Flora and Fauna Assessment* do not include Dr Stephen Ambrose's 2005 peer review. It is therefore not possible to know the extent of the deficiencies that he found in the report. However, DECC supports many of the comments he made and which are contained in Appendix 1 (response by *Travers Environmental* to the peer review). In particular, the inadequacy of the vegetation/threatened flora surveys which were undertaken over one day. This timeframe is too short to have been able to locate cryptic species such as *Tetratheca glandulosa, Pimelea curviflora* var. *curviflora, Acacia bynoeana* and *Persoonia hirsuta* or species which rely on flowering or fruiting material for positive identification. There is no information as to which threatened flora species were targeted and what methods were used to survey them.

*Response:*

- *The Dr Ambrose peer review is attached as Appendix 1 and the response is provided in Appendix 2.*
- *Specific target threatened flora survey was undertaken on 7th April 2010 for at least Pimelea curviflora* var. *curviflora, Acacia bynoeana* and *Persoonia hirsuta as well as particular species with potential to occur (Table 4.1 – Section 4). A total of 4.5 hours of survey was undertaken primarily within the Peppermint – Angophora Woodland / Open Forest and the Kunzea – Tea-tree Tall Heath vegetation communities. Targeted threatened species searches in those areas considered to contain any potential habitat were done by traversing the vegetation remnants in near to linear lines of 7-10m separation where possible. Targeted threatened flora survey was also undertaken around the perimeter of the proposed development areas on 5.5.10 and 12.5.10 during tree survey works by the Botanist.*
- *Additional quadrats (5) and transects (3) were undertaken across the site in vegetated patches to ascertain vegetation condition and potential for threatened species occurrence / potential.*
- *Targeted search for Tetratheca glandulosa should be done preferably with the recognised main flowering period of July to December. No flora survey has been conducted within this main flowering period as yet. The small amount of potential habitat present is primarily in the north-western corner of the subject site adjacent to the existing dwelling. This area will form part of the proposed conservation corridor therefore conserving all existing areas of potential habitat.*

The methods used to map the vegetation on the site are also not described. It is unclear if *Travers Environmental* referred to Warringah Council's vegetation mapping or any other relevant vegetation mapping as the vegetation 'communities' they describe are not in fact communities, but vegetation 'types'. If standard vegetation quadrats were used then the number and location of the quadrats needs to be supplied along with the results (species cover and abundance). In addition, it is unclear if the remnants of riparian vegetation qualify as any of the riparian EECs which were listed post January 2004, such as the Swamp Oak Floodplain Forest EEC or the Swamp Sclerophyll Forest EEC which were both gazetted post January 2004 and which are known from the Warringah LGA. There are plant species listed in Table 3.1 as being present at the site which are characteristic of both of these EECs. The *Flora and Fauna Assessment* lists several EECs which are likely to occur at the site but the list is not comprehensive.

*Response:*

- *Warringah Council's vegetation mapping (Peter Smith and Judy Smith) was consulted. See Section 4.1*
- *The location of quadrats and transects undertaken in April 2010 are shown on Figure 1. Whilst the cover and abundance is not indicated for each quadrat, the vegetation community descriptions (section 4.3) list those of the highest abundance/cover under the appropriate strata.*
- *No riparian / floodplain EEC occurs on site despite the presence of particular species often associated with these vegetation types. These associated species have been planted and occur mostly in rows of vegetation near to the existing tennis courts and tennis academy car park.*
- *Peter Smith and Judy Smith (2000) mapped areas of Duffys Forest vegetation in northern Sydney. This report did not show the subject site as containing Duffys Forest vegetation presently and was not expected to have contained such vegetation pre-European settlement. The existing canopy trees on site suggest that vegetation is a disturbed variant of Sydney Sandstone Gully Forest due to the marked presence of Eucalyptus piperita and Angophora costata as the main canopy species. In the north-west corner the influence of Eucalyptus piperita is reduced and there is an introduction of Eucalyptus haemastoma. Therefore the north-west corner of the subject site is starting to become more analogous to Sydney Sandstone Ridgetop Woodland.*

Fauna surveys were undertaken over three days and again were not sufficient to establish whether or not habitat at the site was being used by threatened species which have been recorded in the local area. These include the Southern Brown Bandicoot, Red-Crowned Toadlet, Glossy Black-Cockatoo, Rosenberg's Goanna and Powerful Owl.

*Response:*

- *Targeted surveys for these species were done in March – April 2010. Powerful Owl was recorded near the eastern site boundary within the subject site and flew into the larger patch of bushland to the east of Oxford Falls Road (outside of the subject site). Glossy Black-Cockatoo was recorded on the eastern side of Oxford Falls Road but not utilising the subject site. There are limited feeding resources on the subject site for Glossy Black-Cockatoo however the species would most likely have flown over the site to get to the location where is was sighted.*
- *The level of fauna survey is shown in Table 2.1 (section 2), with descriptions of effort undertaken provided in Section 2.3 and presented graphically on Figure 1.*

Given that no further survey work was taken post January 2004, it is difficult to see how Travers Environmental were able to respond to Dr Ambrose's 2005 comments about inadequacies in their survey work apart from making superficial changes to the text of the *Flora and Fauna Assessment* report.

*Response:*

- *Justification and explanatory notes were applied in the 2008 update to support the ecological assessment and fill in gaps which were not made clear initially.*
- *The March-April 2010 updated survey has taken into consideration the comments by Dr Ambrose.*

DECC strongly supports retention and ongoing protection of the main vegetation corridor running north-west to south-east through the centre of the site as it almost certainly functions as an important movement or dispersal corridor between the reserved lands to the north

west of the site and vegetation Crown lands to the east and south east, including Red Hill Reserve, both of which have important threatened species values. DECC also supports revegetation and active management of remnant riparian vegetation along the tributary of Middle Creek on the eastern edge of the site.

*Response:*

- *A riparian constraints plan has been devised (April 2010) to ensure adequate future protection of the riparian corridor. The Waterway Impact Study shows the measures to be undertaken in the restoration of the riparian zone.*
- *A further corridor shall be formalised in the western part of the subject site that will provide further conservation objectives and have a variable width of generally between 20-50 metres.*
- *Figure 3 represents graphically the site landscape and proposed corridors.*

However, it is not clear from the *Flora and Fauna Assessment* which vegetation will be removed and what level of protection will be afforded to the remaining vegetation. The figure of 0.3ha quoted in the *Flora and Fauna Assessment* underestimates the vegetation loss at the site because it does not include areas of vegetation that will be cleared or modified to create asset protection zones (APZs). Any unavoidable vegetation losses should be offset on or off-site and if the offsets include revegetation works then they should be of high enough ratios and involve a bond of some sort to ensure that they are effectively implemented. DECC would support the use of a positive covenant or planning agreement in combination with the preparation/implementation of a Vegetation Management Plan to ensure the long term protection and management of both the riparian corridor and the main vegetation corridor running north-west to south-east through the centre of the site.

- *The figure of 0.3 ha is incorrect, agreed. The current calculation will remove or modify (inclusive of asset protection zones) an estimated 1.14 ha of vegetation community 1 and 0.36 ha of vegetation community 4.*

Corridors/Bushfire Management

As noted above, DECC strongly supports retention and ongoing protection of the main vegetation corridor running north-west to south-east through the centre of the site as well as revegetation and management of remnant riparian vegetation along the tributary of Middle Creek. However, DECC is concerned that the connectivity along both of these corridors will be compromised if access roads are put through the site, as described in the *Bushfire Protection Assessment.*

The integrity of these corridors will be further compromised by the proposed APZ's which will vary in width from 48m to 19m for the nursing home complex; 14m to 8m for the residential units and 6m to 16m for the self care units and will effectively require the removal of understorey as well as trees to achieve canopy separation. DECC particularly disputes the comment in the Waterway Impact Study that *"design of the APZ is able to retain a full range of natural vegetation and habitat resources".* It is not clear how both functions (i.e. dispersal corridor and bushfire protection) can be accommodated without one or the other being compromised. By their very nature, APZs require vegetation clearing and are therefore incompatible with the protection of biodiversity values of environmental corridors.

As a minimum, the vegetation corridors will need to be buffered from any development to minimise edge effects (desiccation, disease etc.) and the indirect impacts of the development (runoff, dust, noise, light etc.) as well as the longer term impacts of the development (increased access by humans and domestic pets, rubbish dumping, weed

invasion etc.) to avoid a decline in the extent and condition of the vegetation. Modification of the vegetation to create APZs will counter any buffering effect, exacerbate edge effects and reduce the effective width of these corridors leading to a long term decline in their function.

DECC does not support the use of the main vegetation corridor (north-west to south-east through the centre of the site) and the riparian corridor along the tributary of Middle Creek for bushfire management and strongly recommends that the Concept Plan be modified to ensure that all APZs are located outside these two corridors. DECC further recommends the development layout be amended to incorporate a perimeter road. A perimeter road for the development would provide a suitable interface between the corridors and the urban development, which would minimise edge effects and could also form part of the APZ. This approach would be consistent with the *Planning for Bushfire Protection: a Guide for Councils, Planners, Fire Authorities, Developers and Homeowners* (2006) which clearly indicates that a perimeter road is the preferred option to separate bushland from urban areas.

*Response:*

- *Asset protection zones have been revised to ensure their congruence with current bushfire protection standards and have been approved. The APZs do not overlap the riparian zone.*
- *There will be some modification of the more westerly corridor to incorporate some asset protection zones however the western corridor will be enhanced and widened where possible to the west to compensate for the loss or modification of vegetation.*
- *The proposed Landscape Restoration Management Plan (or equivalent) will improve the quality of the corridors through weed control and rehabilitation such as to provide a more effective corridor for fauna movement.*

<u>In stream works</u>

It is noted that the Concept Plan proposed to install wetlands along the Middle Creek tributaries for the enhancement of water quality and regulation of flows. Concern is raised in relation to the construction of water quality/quantity structures on-line due to the potential for in-stream works to degrade the ecological integrity of riparian corridors (*Guidelines for Controlled Activities: In-Stream Works,* DWE, 2008). It is noted that details for the proposed wetlands (including size, design and location) have not been provided with the Concept Plan documentation. DECC recommends that if the Concept Plan is approved that it be modified to require the future design of any necessary flood and/or water quality treatment structures be located offline and outside riparian and environmental corridors.

*Response: This is not proposed – see GHD report by Daniel Williams.*

<u>Public Access</u>

It is noted that the *Waterway Impact Study* (prepared by Travers Environmental, October 2008) recommends *'the erection of signs around conservation areas…to encourage appropriate activities suited within and adjacent to bushland or significant vegetation stands'.* While DECC supports the use of suitable signage to encourage protection and management conservation areas, DECC's preference is for any Concept Plan approval to ensure that public access is located in areas that will avoid potential adverse impacts on the values of conservation areas.

*Response: This is now not proposed*

**Floodplain Risk Management**

Any development should be in accordance with the State Government's Floor Prone Land Policy as outlined in the *NSW Government's Floodplain Development Manual* (2005) and should have regard to the Section 117 Direction (4.3 Flood Prone Land). *Planning Circular PS07-003 New Guideline and Changes to Section 117 direction and EP&A Regulation of Flood Prone Land* also indicates the need to consider the *Guidelines on Development Controls on Low Flood Risk Areas* (Guideline) which supplements the Manual.

Oxford Falls Valley is dissected by a number of watercourses, including Middle Creek. With the smaller catchments in the Oxford Falls Valley, flooding occurs from very short duration storm events. As a result, the flood hazard can be exacerbated because of fast flowing floodwaters and rapid rates of rise. Because of this, there is a lack of warning which may, in some cases, make egress away from dwellings during flooding unsafe. The aged are more vulnerable because of lack of mobility and the evacuation requirements will therefore need to be given greater consideration than for the general population. The State Emergency Service should be consulted regarding the choice of appropriate evacuation strategies.

Floodplain Risk Management is normally the prime responsibility of the relevant local Council, in this case Warringah Council. Key issues to be considered and addressed include the impact of flooding on the development, the impact of the development on flood behaviour, the impact of existing and planned development in the area on flood behaviour, the impact of flooding on the safety of people/uses of the development; and the implications of the full range of floods, up to the probable maximum flood (PMF). Such considerations should cover the cumulative impacts of all potential development as well as the effects of climate change (i.e. sea level rise and increased rainfall intensities / volume). It is preferable for credible flooding assessments to be made early in the land capability / planning process.

Warringah Council's Catchment Management Team have a program of flood studies and floodplain risk management studies / plans which are been progressed under the Government's Floodplain Risk Management Program. Warringah Council should be consulted in regard to existing and planned flood studies / plans for the Oxford Falls Valley area.

*Response: Noted.*

# APPENDIX 4

# 7-PART TEST OF SIGNIFICANCE (SECTION 5A EPA ACT 1979)

# APPENDIX 4 - 7 Part Test of Significance (Section 5A EPA Act 1979)

Council is required to consider the impact upon threatened species, populations and / or EECs from any development or activity 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*
- *Darwinia biflora*
- *Epacris purpurascens* var. *purpurascens*
- *Eucalyptus camfieldii*
- *Lasiopetalum joyceae*
- *Melaleuca deanei*
- *Persoonia hirsuta*
- *Pimelea curviflora* var. *curviflora*
- *Tetratheca glandulosa*

***Endangered ecological communities***

- nil

***Threatened fauna***

- Red-crowned Toadlet
- Green and Golden Bell Frog
- Rosenberg's Goanna
- Broad-headed Snake
- Barking Owl
- Powerful Owl *
- Masked Owl
- Little Lorikeet
- Glossy Black-Cockatoo *
- Gang-gang Cockatoo
- Swift Parrot
- Regent Honeyeater
- Spotted-tailed Quoll
- Southern Brown Bandicoot
- Yellow-bellied Glider
- Eastern Pygmy Possum
- Koala
- Long-nosed Potoroo
- Grey-headed Flying-fox *
- Yellow-bellied Sheathtail-bat
- East-coast Freetail Bat
- Large-eared Pied Bat
- Large-footed Myotis
- Greater Broad-nosed Bat
- Eastern Bentwing-bat *

***Endangered populations***

- nil

Species indicated with a "*" were recorded within the subject site during surveys. Despite the presence of potential habitat, the remaining listed species were not recorded during the flora and fauna survey. It is considered that 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.

An assessment of threatened fauna species recorded and those with most potential to occur is provided with Section 4.13

***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***

There are no endangered flora or fauna populations within the Warringah 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***

There are no endangered ecological communities present within the subject site.

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

Not applicable.

***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, Darwinia biflora, Epacris purpurascens* var. *purpurascens, Eucalyptus camfieldii, Lasiopetalum joyceae, Melaleuca deanei, Persoonia hirsuta, Pimelea curviflora* var. *curviflora, Tetratheca glandulosa,* Red-crowned Toadlet, Green and Golden Bell Frog, Rosenberg's Goanna, Broad-headed Snake, Barking Owl, Powerful Owl, Masked Owl, Little Lorikeet, Glossy Black-Cockatoo, Gang-gang Cockatoo, Swift Parrot, Regent Honeyeater, Spotted-tailed Quoll, Southern Brown Bandicoot, Yellow-bellied Glider, Eastern Pygmy Possum, Koala, Long-nosed Potoroo, Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat, East-coast Freetail Bat, Large-eared Pied Bat, Large-footed Myotis, Greater Broad-nosed Bat and Eastern Bentwing-bat.

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

The subject site has as area of approximately 13.6 hectares plus 1.1 hectares for Barnes Road (road reserve). The proposed development is likely to remove potential habitat for the aforementioned species (see Table A5.1).

**Table A5.1 – Removal and modification of habitat**

| Community / Threatened Species | Area (ha) Pre-development | Area (ha) Lost or Modified to Development |
|---|---|---|
| ***Threatened Species Recorded On Site*** | | |
| Powerful Owl | 3.11 | 1.14 |
| Glossy Black-Cockatoo | 1.31 | 0.53 |
| Grey-headed Flying-fox | 4.15 | 1.16 |
| Eastern Bentwing-bat | 12.52 | 7.7 |
| ***Threatened Species with Potential to occur but Not Recorded On Site*** | | |
| *Acacia bynoeana* | 1.89 | 1.06 |
| *Darwinia biflora* | 0.30 | 0.11 |
| *Epacris purpurascens var. purpurascens* | 0.30 | 0.11 |
| *Eucalyptus camfieldii* | 3.23 | 0.79 |
| *Lasiopetalum joyceae* | 0.54 | 0.42 |
| *Melaleuca deanei* | 0.15 | 0.06 |
| *Persoonia hirsuta* | 0.15 | 0.06 |
| *Pimelea curviflora var. curviflora* | 0.15 | 0.06 |
| *Tetratheca glandulosa* | 0.12 | 0.00 |
| Red-crowned Toadlet | 0.0845 | none |
| Rosenberg's Goanna | 1.56 | 0.55 |
| Barking Owl | 5.32 | 2.69 |
| Spotted-tailed Quoll | 1.92 | 0.93 |
| Southern Brown Bandicoot | 1.29 | 1 |
| Koala | 0.31 | 0.11 |

In contrast, the proposed development will retain areas of remnant vegetation with greater habitat importance. In particular, vegetation to be retained along the western and southern sides of the subject site provides corridors to extensive vegetation further offsite.

***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***

Vegetation extending from the western boundary, towards the central and southern ends of the subject site will be retained within the proposed development. This vegetation currently forms a corridor with an extensive area of vegetation offsite. This vegetation extends to the north west forming Garigal National Park. Vegetation at the southern end on the subject site will also be retained as part of the development proposal and will continue to form a corridor with an extensive area of vegetation towards the south.

In addition, vegetation along the eastern boundary of the subject site within the Environmental Corridor will be retained and enhanced. This vegetation is currently divided from extensive vegetation further east by Oxford Falls Road.

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

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

The habitat to be removed or modified by the proposed development consists predominantly of cleared grasslands, much of which has been invaded by a variety of weeds and is considered to be of low importance as habitat.

The portions of Peppermint-Angophora Woodland/Open Forest and Kunzea – Tea Tree Tall Heath to be removed has not been recorded to provide valued habitat central to the ecology of threatened species recorded, nor likely value to those with potential to occur. This conclusion cannot be completely determined for the Southern Brown Bandicoot or Spotted-tailed Quoll until analysis results from hair tube surveys are completed.

Vegetation to be retained by the proposed development to the west, south and east is considered to be of greater importance due to its connectivity to extensive areas of habitat offsite. In addition, the Eastern Corridor along the Middle Creek Tributary and drainage lines will be rehabilitated and will enhance habitat within the subject site.

Furthermore, habitat for the aforementioned species is well represented within the immediate locality such that it may support short-term displacement until on-site habitat restoration works are completed.

In essence, the amount of vegetation removal / modification is estimated to be 1.50 ha whilst the rehabilitation works will offer another future 1.83 ha of vegetation. Additionally, a vegetation management plan or equivalent will be enforced to ensure the removal of weeds and increase habitat potential therefore effectively adding to potential threatened species habitat post development.

***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 (1995). 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 recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Barking Owl (*Ninox connivens*) (NPWS 2003)
- Green and Golden Bell Frog (*Litoria aurea*) (DEC 2005)
- Koala (*Phascolarctos cinereus*) (NPWS 2003)

Approved 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).
- Southern Brown Bandicoot (*Isoodon obesulus*) (DEC 2006)
- Yellow-bellied Glider (*Petaurus australis*) (NPWS 2003)

There are plans in preparation for the following flora species within potential to occur on site;

- *Acacia bynoeana*
- *Darwinia biflora*
- *Melaleuca deanei*
- *Persoonia hirsuta*

It is considered that the proposed development is generally consistent with the objectives or actions of the above mentioned draft and approved recovery plans. It is considered that the small amount of vegetation removed as part of the proposal should not be considered as an opposing objective to any of the aforementioned 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 | | ✓ | |
| 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 | | | ✓ |
| Ecological consequences of high frequency fires | | | ✓ |
| Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments | | | ✓ |
| Herbivory and environmental degradation caused by feral deer | | | ✓ |
| Human-caused Climate Change | | | ✓ |
| 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 fungus causing the disease chytridiomycosis | | | ✓ |
| Infection of native plants by *Phytophthora cinnamomi* | | ✓ | |
| Introduction of the large earth bumblebee (*Bombus terrestris*) | | | ✓ |

| 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** |
| Invasion of the Yellow Crazy Ant (*Anoplolepis gracilipes*) | | | ✓ |
| Invasion and establishment of the Cane Toad (*Bufo marinus*) | | | ✓ |
| Invasion and establishment of exotic vines and scamblers | | | ✓ |
| Invasion of native plant communities by bitou bush & boneseed *Chrysanthemoides monilifera* | | | ✓ |
| Invasion of native plant communities by exotic perennial grasses | | | ✓ |
| Invasion, establishment and spread of *Lantana camara* | | ✓ | |
| Loss and/or degradation of sites used for hill-topping by butterflies | | | ✓ |
| Loss of Hollow-bearing Trees | ✓ | | |
| Predation by the Feral Cat (*Felis catus*) | | ✓ | |
| Predation by the European Red Fox (*Vulpes vulpes*) | | | ✓ |
| 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 from Feral pigs (*Sus scofa*) | | | ✓ |
| Removal of dead wood and dead trees | | ✓ | |

“Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands” is a Key Threatening Process and as such the proposal is of a class of development recognised as potentially adding to the threatening process. This is because of the proposed re-alignment and alteration to the existing riparian area. There will be an improvement overall to the functioning of this riparian area in the long term due to the proposed rehabilitation concepts.

“Clearing of native vegetation” is a Key Threatening Process and as such the proposal is of a class of development recognised as a threatening process. The removal of native vegetation on the subject site is not likely to significantly affect the biodiversity of the local area due to the extent of better quality natural vegetation within the site being enhanced and the small area of vegetation to be removed.

“Competition and grazing by the feral European rabbit” is a key threatening process under the *TSC Act*. It is expected that the proposed development will provide an opportunity to manage the area with regard to feral European rabbit invasion.

“Infection of native plants by *Phytophthora cinnamomi”* is listed as key threatening processes under the *TSC Act*. The precautionary principal is applied in this instance to suggest that the development may increase the potential for this infection to occur on site. It is somewhat difficult to detect and ameliorate therefore it cannot be neglected.

“Invasion, establishment and spread of *Lantana camara*” is a key threatening process under the *TSC Act*. 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 a bushland management plan or equivalent.

The “Loss of Hollow-bearing Trees” is a Key Threatening Process. Thirty-seven (37) hollow-bearing trees were observed within the subject site. Three (3) of these trees, numbers 15, 16 and 17 will be required to be removed. The removal of this tree would constitute the proposal as being a class of development recognised as a threatening process. However, as at least 85% of the hollow-bearing trees are to be retained with the majority of them being protected within the Environmental Corridor (except tree #14 – see Figure 1), a significant impact is not considered likely.

No highly significant habitat trees are considered present. Fourteen (14) habitat trees of notable significance based on the hollow(s) quality, size, number present and/or signs of use, are present. Of the 37 habitat trees recorded, 13 are either within or near to development footprints and 5 of these are of notable significance. It is recommended that trees containing the above characteristics are protected where possible in particular HT19.

“Predation by feral cat (*Felis catus*)” is listed as a key threatening process under the *TSC Act.* The proposed development may alter impacts on adjoining lands by increasing the numbers of domestic cat ownership and as such the action proposed may increase the impact of this threatening process.

# APPENDIX 5

# FLORA & FAUNA CALCULATIONS OF SUITABLE HABITAT FOR THE MAINTAIN OR IMPROVE TEST

| Species | Vegetation Community | Potential Portion of Community | Initial Extent of Habitat (ha) | Post Development Extent (ha) |
|---|---|---|---|---|
| **FLORA** | | | | |
| Acacia bynoeana | 1 | 25 | 1.89 | 2.07 (Eastern corridor, 10% of western corridor and 10% of remnant vegetation community 2 in the far west) |
| | 2 | 10 | | |
| Darwinia biflora | 1 (west) | 20 | 0.30 | 0.39 (25% of proposed western corridor) |
| Epacris purpurascens var. purpurascens | 1 (west) | 20 | 0.30 | 0.39 (25% of proposed western corridor) |
| Eucalyptus camfieldii | 1 (west and south-west) | 50 | 3.35 | 3.49 (100% of western corridor, 100% of western private land and 100% of remnant vegetation in south-west corner) |
| | 2 (west) | 100 | | |
| Lasiopetalum joyceae | 1 (west and south-west) | 10 | 0.54 | 0.56 (25% of proposed western corridor and remnant vegetation in south-west corner) |
| | 4 | 100 | | |
| Melaleuca deanei | 1 (west) | 10 | 0.15 | 0.39 (25% of proposed western corridor) |
| Persoonia hirsuta | 1 (west) | 10 | 0.15 | 0.39 (25% of proposed western corridor) |
| Pimelea curviflora var. curviflora | 1 (west) | 10 | 0.15 | 0.39 (25% of proposed western corridor) |
| Tetratheca glandulosa | 1 (west) | refer to figure 1 | 0.12 | 0.39 (25% of proposed western corridor) |
| **FAUNA** | | | | |
| Red-crowned Toadlet | 1 | 5% of west portions | 0.0845 | 0.0915 (5% of new west portions) |
| Rosenberg's Goanna | 1 | west portion + 1/2 of SW portion | 0.93 | 1.69 (all of new west portion + 1/2 of SW portion) |
| | 2 | 2.50% | 0.27 | |
| | 4 | 100% | 0.36 | |
| Barking Owl | 1 | 100% | 3.11 | 6.67 (Conservation area + APZ area + Managed veg buffer) |
| | 2 | 20% | 2.21 | |
| Powerful Owl | 1 | 100% | 3.11 (1.53 roosting) | 3.8 (Open forest / woodland areas), 1.77 roosting (in the eastern gully forests) |
| Glossy Black-Cockatoo | 1 | 40% | 1.244 | 1.52 (40% of com 1&4 combined) |
| | 4 | 20% | 0.072 | |
| Spotted-tailed Quoll | 1 | 50% | 1.56 | 2.85 (75% of com 1&4 combined) |
| | 4 | 100% | 0.36 | |
| Southern Brown Bandicoot | 1 | west portion + 1/2 of SW portion | 0.93 | 1.69 (all of new west portion + 1/2 of SW portion) |
| | 4 | 100% | 0.36 | |
| Koala | 1 | 10 | 0.31 | 0.46 (12% of fnew com 1&4) |

| | | | | |
|---|---|---|---|---|
| Grey-headed Flying-fox | 1 | 80% | 2.49 | 4.52 (80% of new com 1&4 combined + 15% of new landscaped area) |
| | 2 | 15% | 1.66 | |
| Eastern Bentwing-bat | 1 | 100% | 3.11 | 8 ha (Conservation area + APZ area + Managed veg buffer+ 80% 0f private western lots) |
| | 2 | 80% | 8.84 | |
| | 3 | 100% | 0.21 | |
| | 4 | 100% | 0.36 | |

# SCHEDULES

**SCHEDULE 1 – Tree Details**

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| 1 | *Eucalyptus piperita* | Sydney Peppermint | 100 | 16 | 16 | 75 | 2D | small deadwood, poor form, leaning | Removed |
| 2 | *Eucalyptus piperita* | Sydney Peppermint | 10, 6, 6, 8 | 8 | 9 | 90 | 2D | poor form | Removed |
| 3 | *Eucalyptus punctata* | Grey Gum | 40 | 10 | 10 | 85 | 2A | small deadwood | Removed |
| 4 | *Eucalyptus piperita* | Sydney Peppermint | 30 | 13 | 8 | 70 | 2D | exposed roots, leaning | Removed |
| 5 | *Erythrina sykesii* | Coral Tree | 60,80,40,30 | 12 | 15 | 80 | 2D | exposed roots, poor form | Removed |
| 6 | *Eucalyptus piperita* | Sydney Peppermint | 90 | 16 | 18 | 70 | 2D | exposed roots, crown dieback | Removed |
| 7 | *Angophora costata* | Sydney Red Gum | 70, 30 | 18 | 14 | 90 | 2D | exposed roots | Removed |
| 8 | *Eucalyptus punctata* | Grey Gum | 45 | 15 | 14 | 90 | 2A | | Removed |
| 9 | *Eucalyptus piperita* | Sydney Peppermint | 100 | 18 | 8 | 30 | 4C | hollow trunk, exposed roots | Removed |
| 10 | *Eucalyptus sieberi* | Silvertop Ash | 35 | 18 | 6 | 90 | 2A | | Retained |
| 11 | *Acacia parramattensis* | Sydney Green Wattle | 25 | 8 | 8 | 90 | 2A | | Retained |
| 12 | *Acacia parramattensis* | Sydney Green Wattle | 25 | 12 | 10 | 90 | 2A | | Retained |
| 13 | *Acacia parramattensis* | Sydney Green Wattle | 20 | 12 | 9 | 90 | 2A | | Removed |
| 14 | *Eucalyptus punctata* | Grey Gum | 20, 20 | 6 | 9 | 85 | 2D | poor form | Removed |
| 15 | *Acacia floribunda* | Sally Wattle | 30 | 7 | 9 | 85 | 2A | small deadwood | Removed |
| 16 | *Eucalyptus punctata* | Grey Gum | 10, 10 | 5 | 8 | 85 | 2D | poor form | Retained |
| 17 | *Allocasuarina torulosa* | Forest Oak | 40 | 18 | 12 | 90 | 2A | | Retained |
| 18 | *Allocasuarina torulosa* | Forest Oak | 15 | 12 | 5 | 90 | 2D | suppressed, poor form | Retained |
| 19 | *Allocasuarina torulosa* | Forest Oak | 60 | 18 | 16 | 90 | 2A | | Retained |
| 20 | *Corymbia maculata* | Spotted Gum | 20 | 10 | 8 | 80 | 2D | suppressed, poor form | Retained |
| 21 | *Allocasuarina torulosa* | Forest Oak | 35 | 15 | 8 | 90 | 2A | | Retained |
| 22 | *Allocasuarina torulosa* | Forest Oak | 40 | 18 | 9 | 90 | 2A | | Retained |
| 23 | *Allocasuarina torulosa* | Forest Oak | 30 | 15 | 10 | 90 | 2A | | Retained |
| 24 | *Allocasuarina torulosa* | Forest Oak | 40 | 15 | 12 | 90 | 2A | | Retained |
| 25 | *Allocasuarina torulosa* | Forest Oak | 55 | 15 | 14 | 90 | 2A | | Retained |
| 26 | *Archontophoenix alexandrae* | Alexandra Palm | 30 | 6 | 6 | 90 | 2A | | Removed |
| 27 | *Archontophoenix alexandrae* | Alexandra Palm | 30 | 6 | 6 | 90 | 2A | | Removed |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| 28 | *Archontophoenix alexandrae* | Alexandra Palm | 35 | 6 | 6 | 90 | 2A | | Removed |
| 29 | *Archontophoenix alexandrae* | Alexandra Palm | 30 | 6 | 6 | 90 | 2A | | Removed |
| 30 | *Archontophoenix alexandrae* | Alexandra Palm | 15 | 6 | 6 | 70 | 2D | | Removed |
| 31 | *Archontophoenix alexandrae* | Alexandra Palm | 20 | 6 | 6 | 90 | 2A | | Removed |
| 32 | *Archontophoenix alexandrae* | Alexandra Palm | 35 | 6 | 6 | 90 | 2A | | Removed |
| 33 | *Livistona australis* | Cabbage Palm | 40 | 5 | 5 | 90 | 2A | | Removed |
| 34 | *Banksia integrifolia* | Coast Banksia | 10, 15 | 10 | 8 | 90 | 2A | | Removed |
| 35 | *Banksia integrifolia* | Coast Banksia | 20 | 10 | 8 | 90 | 2A | | Removed |
| 36 | *Banksia integrifolia* | Coast Banksia | 15 | 10 | 8 | 90 | 2A | | Removed |
| 37 | *Banksia integrifolia* | Coast Banksia | 20 | 10 | 8 | 90 | 2A | | Removed |
| 38 | *Banksia integrifolia* | Coast Banksia | 20 | 10 | 8 | 90 | 2A | | Removed |
| 39 | *Eucalyptus paniculata* | Grey Ironbark | 18 | 12 | 9 | 85 | 2D | suppressed | Retained |
| 40 | *Eucalyptus paniculata* | Grey Ironbark | 35 | 16 | 14 | 90 | 2A | | Retained |
| 41 | *Eucalyptus piperita* | Sydney Peppermint | 20 | 14 | 3 | 30 | 4A | 70% of crown is dead | Removed |
| 42 | *Eucalyptus paniculata* | Grey Ironbark | 15 | 15 | 9 | 90 | 2A | | Retained |
| 43 | *Casuarina glauca* | Swamp Oak | 30, 25 | 18 | 10 | 90 | 2A | | Retained |
| 44 | *Casuarina glauca* | Swamp Oak | 20 | 18 | 8 | 90 | 2C | crowded | Retained |
| 45 | *Casuarina glauca* | Swamp Oak | 20 | 16 | 6 | 90 | 2C | crowded | Retained |
| 46 | *Casuarina glauca* | Swamp Oak | 20 | 15 | 6 | 90 | 2C | crowded | Retained |
| 47 | *Eucalyptus sieberi* | Silvertop Ash | 25 | 18 | 10 | 90 | 2C | crowded | Retained |
| 48 | *Eucalyptus sieberi* | Silvertop Ash | 25 | 18 | 12 | 90 | 2A | | Retained |
| 49 | *Casuarina glauca* | Swamp Oak | 35 | 18 | 8 | 90 | 2A | | Retained |
| 50 | *Casuarina glauca* | Swamp Oak | 20 | 15 | 6 | 90 | 2A | | Retained |
| 51 | *Casuarina glauca* | Swamp Oak | 35 | 18 | 10 | 90 | 2A | | Retained |
| 117 | *Casuarina cunninghamiana* | River She-oak | 40 | 18 | 8 | 90 | 2A | small dead wood | Removed |
| 118 | *Casuarina cunninghamiana* | River She-oak | 30 | 8 | 6 | 80 | 2C | suppressed, poor form | Removed |
| 119 | *Pinus elliotti* | Slash Pine | 12 | 9 | 5 | 80 | 2C | suppressed | Retained |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| 120 | *Pinus elliotti* | Slash Pine | 25 | 12 | 5 | 80 | 2C | suppressed | Retained |
| 121 | *Pinus elliotti* | Slash Pine | 15 | 8 | 4 | 80 | 2C | suppressed | Retained |
| 122 | *Casuarina cunninghamiana* | River She-oak | 50 | 18 | 9 | 90 | 2A | | Removed |
| 123 | *Eucalyptus deanei* | Round-leaved Gum | 90 | 24 | 16 | 90 | 2A | | Removed |
| 124 | stag | stag | 75 | 10 | 5 | 0 | 4A | dead | Removed |
| 125 | *Eucalyptus deanei* | Round-leaved Gum | 75 | 22 | 15 | 90 | 2A | | Removed |
| 126 | *Eucalyptus piperita* | Sydney Peppermint | 100 | 20 | 20 | 90 | 2C | suppressed, canopy entangled with tree 127 | Removed |
| 127 | *Eucalyptus deanei* | Round-leaved Gum | 30 | 18 | 10 | 80 | 2C | suppressed, canopy entangled with tree 126 | Removed |
| 128 | *Eucalyptus punctata* | Grey Gum | 25 | 14 | 10 | 80 | 2C | leaning & poor form | Retained |
| 129 | *Eucalyptus deanei* | Round-leaved Gum | 35 | 20 | 12 | 90 | 2A | | Retained |
| 130 | *Eucalyptus punctata* | Grey Gum | 60 | 15 | 16 | 85 | 2A | small dead wood | Retained |
| 131 | *Eucalyptus piperita* | Sydney Peppermint | 10 | 8 | 6 | 90 | 2A | | Retained |
| 132 | *Eucalyptus punctata* | Grey Gum | 30, 30 | 8 | 10 | 50 | 4C | 1x trunk dead, poor form | Retained |
| 133 | *Eucalyptus punctata* | Grey Gum | 35 | 15 | 8 | 70 | 4C | large dead wood | Retained |
| 134 | *Eucalyptus punctata* | Grey Gum | 40 | 20 | 10 | 90 | 2A | | Retained |
| 135 | *Eucalyptus punctata* | Grey Gum | 30, 30 | 7 | 6 | 20 | 4C | 1x trunk dead, 1x trunk 70% dead | Removed |
| 136 | *Eucalyptus sieberi* | Silvertop Ash | 50 | 15 | 12 | 40 | 4C | large dead wood, epicormic growth at base of trunk, stressed | Removed |
| 137 | *Eucalyptus sieberi* | Silvertop Ash | 20 | 5 | 8 | 50 | 4C | leaning, poor form, dieback | Removed |
| 138 | *Eucalyptus punctata* | Grey Gum | 40 | 15 | 15 | 75 | 4C | large dead wood, poor form | Removed |
| 139 | *Harpephyllum caffrum* | Kaffir Plum | 10, 10, 9 | 7 | 7 | 0 | 4A | fallen | Removed |
| 140 | *Harpephyllum caffrum* | Kaffir Plum | 5, 8 | 4 | 4 | 70 | 2C | roots exposed, poor form | Removed |
| 141 | *Harpephyllum caffrum* | Kaffir Plum | 4 | 4 | 3 | 70 | 2C | roots exposed, poor form | Removed |
| 142 | *Allocasuarina torulosa* | Forest Oak | 5 | 8 | 3 | 90 | 2A | | Removed |
| 143 | *Allocasuarina torulosa* | Forest Oak | 9 | 9 | 3 | 90 | 2A | | Removed |
| 144 | *Allocasuarina torulosa* | Forest Oak | 9 | 8 | 3 | 90 | 2A | | Retained |
| 145 | *Allocasuarina torulosa* | Forest Oak | 12 | 8 | 6 | 90 | 2A | | Removed |
| 146 | *Allocasuarina torulosa* | Forest Oak | 6 | 6 | 4 | 70 | 4C | poor form, leaning s | Retained |
| 147 | *Eucalyptus robusta* | Swamp Mahogany | 25 | 15 | 8 | 90 | 2A | | Removed |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| 148 | *Eucalyptus piperita* | Sydney Peppermint | 30 | 18 | 9 | 80 | 4C | epicormic growth at base of trunk, roots exposed | Removed |
| 149 | *Eucalyptus robusta* | Swamp Mahogany | 40 | 22 | 8 | 80 | 2D | damaged at base | Removed |
| 150 | stag | stag | 35 | 16 | 8 | 0 | 4A | dead | Removed |
| 151 | *Populus sp* | Poplar | 25 | 18 | 10 | 90 | 2A | | Removed |
| 152 | *Populus sp* | Poplar | 25 | 18 | 10 | 90 | 2A | | Removed |
| 153 | *Eucalyptus piperita* | Sydney Peppermint | 150 | 18 | 14 | 60 | 4C | 1x large broken trunk, poor form | Removed |
| 154 | *Pinus elliotti* | Slash Pine | 30 | 15 | 10 | 90 | 2A | | Removed |
| 155 | *Pinus elliotti* | Slash Pine | 40 | 15 | 12 | 90 | 2A | | Removed |
| 156 | *Toxicodendron succedanium* | Rhus Tree | 10,10,10,10,15 | 6 | 6 | 80 | 4C | poor form, toxic hazard | Removed |
| 157 | *Toxicodendron succedanium* | Rhus Tree | 15,15,10 | 7 | 7 | 80 | 4C | poor form, toxic hazard | Removed |
| 158 | *Toxicodendron succedanium* | Rhus Tree | 10,15,10,15 | 7 | 7 | 80 | 4C | poor form, toxic hazard | Removed |
| 159 | *Araucaria heterophylla* | Norfolk Island Pine | 25 | 8 | 8 | 90 | 2A | | Retained |
| 160 | *Eucalyptus piperita* | Sydney Peppermint | 20 | 6 | 6 | 90 | 2A | | Removed |
| 161 | *Eucalyptus piperita* | Sydney Peppermint | 25 | 7 | 6 | 90 | 2A | | Removed |
| t200 | *Eucalyptus sieberi* | Silvertop Ash | 43 | 13 | 8 | 80 | 2B | in powerlines | Removed |
| t201 | *Eucalyptus sieberi* | Silvertop Ash | 25 | 13 | 3 | 80 | 2D | leans s | Removed |
| t202 | *Eucalyptus sieberi* | Silvertop Ash | 28, 25 | 14 | 6 | 50 | 3D | larger trunk rotten | Removed |
| t203 | *Eucalyptus sieberi* | Silvertop Ash | 33, 27 | 13 | 12 | 70 | 2D | slight lean | Removed |
| t204 | *Angophora costata* | Smooth Barked Apple | 75 | 22 | 15 | 80 | 2A | minor dead wood, small kino | Removed |
| t205 | *Eucalyptus piperita* | Sydney Peppermint | 60, 30, 20 | 17 | 15 | 90 | 1A | good health and form | Removed |
| t206 | *Eucalyptus piperita* | Sydney Peppermint | 55 | 18 | 13 | 75 | 2D | slight lean e | Removed |
| t207 | stag | stag | 25 | 11 | 3 | 0 | 4A | dead | Removed |
| t208 | *Eucalyptus sieberi* | Silvertop Ash | 35 | 21 | 10 | 85 | 1A | good form | Removed |
| t209 | *Eucalyptus piperita* | Sydney Peppermint | 35 | 17 | 7 | 60 | 3D | moderate dead wood | Removed |
| t210 | *Eucalyptus sieberi* | Silvertop Ash | 40 | 21 | 9 | 40 | 3D | moderate dead wood | Removed |
| t211 | stag | stag | 35 | 21 | 5 | 0 | 4A | dead | Removed |
| t212 | *Angophora Costata* | Smooth Barked Apple | 40 | 17 | 15 | 15 | 4A | declined health | Removed |
| t213 | *Erythrina sykesii* | Coral Tree | 40, 35 | 9 | 16 | 60 | 3D | stabilibilising creek bank | Removed |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| t214 | *Eucalyptus sieberi* | Silvertop Ash | 40, 15 | 18 | 7 | 55 | 3D | large dead branch | Removed |
| t215 | *Angophora Costata* | Smooth Barked Apple | 40 | 26 | 11 | 55 | 3D | moderate dead wood | Removed |
| t216 | stag | stag | 50 | 23 | 6 | 0 | 4A | dead | Removed |
| t217 | *Eucalyptus sieberi* | Silvertop Ash | 38 | 22 | 8 | 60 | 3D | moderate dead wood, good form | Removed |
| t218 | *Eucalyptus sieberi* | Silvertop Ash | 30 | 21 | 5 | 80 | 2D | slight lean e | Removed |
| t219 | *Eucalyptus piperita* | Sydney Peppermint | 20 | 16 | 4 | 90 | 1A | good form | Removed |
| t220 | *Eucalyptus sieberi* | Silvertop Ash | 42 | 15 | 15 | 60 | 3D | moderate lean nw | Removed |
| t221 | *Eucalyptus sieberi* | Silvertop Ash | 35, 15 | 23 | 5 | 0 | 4A | dead | Removed |
| t222 | *Eucalyptus sieberi* | Silvertop Ash | 35 | 22 | 10 | 70 | 2D | slight lean sw, minor dead wood | Removed |
| t223 | *Eucalyptus sieberi* | Silvertop Ash | 45, 25 | 16 | 8 | 25 | 3D | large trunk dead, smaller, healthy | Removed |
| t224 | *Eucalyptus sieberi* | Silvertop Ash | 27 | 7 | 3 | 0 | 4A | dead | Removed |
| t225 | stag | stag | 27 | 14 | 5 | 0 | 4A | dead | Removed |
| t226 | *Eucalyptus sieberi* | Silvertop Ash | 27 | 11 | 9 | 75 | 2A | good form | Removed |
| t227 | *Angophora costata* | Smooth Barked Apple | 38 | 23 | 16 | 85 | 2A | kino excretion on trunks | Removed |
| t228 | *Eucalyptus piperita* | Coast Grey Box | 55 | 22 | 12 | 75 | 2A | good form | Removed |
| t229 | *Eucalyptus piperita* | Coast Grey Box | 60 | 22 | 18 | 85 | 1A | good form | Removed |
| t230 | *Erythrina sykesii* | Coral Tree | 25, 25 | 12 | 12 | 75 | 3A | weed spp | Removed |
| t231 | *Eucalyptus punctata* | Grey Gum | 30 | 18 | 8 | 85 | 2A | good form, suppressed a little | Removed |
| t232 | *Angophora costata* | Smooth Barked Apple | 37 | 24 | 17 | 85 | 2A | kino excretion in branches | Retained |
| t233 | *Eucalyptus punctata* | Grey Gum | 30 | 12 | 10 | 70 | 2A | suppressed | Removed |
| t234 | *Angophora costata* | Smooth Barked Apple | 40 | 20 | 8 | 90 | 1A | good form | Removed |
| t235 | *Allocasuarina torulosa* | Forest Oak | 26 | 7 | 5 | 70 | 3A | old tree, minor dead wood | Retained |
| t236 | *Melaleuca ericifolia* | Swamp Paperbark | 30 | 6 | 5 | 85 | 3A | old tree, good form | Retained |
| t237 | *Melaleuca styphelioides* | Prickly-leaved Paperbark | 24 | 5 | 5 | 85 | 2A | good form | Retained |
| t238 | *Melaleuca ericifolia* | Swamp Paperbark | 35 | 7 | 7 | 75 | 3A | old tree, good form | Retained |
| t239 | *Melaleuca styphelioides* | Prickly-leaved Paperbark | 27 | 7 | 5 | 80 | 2A | good form | Retained |
| t240 | *Casuarina glauca* | Swamp Oak | 22 | 18 | 5 | 90 | 1A | good form | Retained |
| t241 | *Casuarina glauca* | Swamp Oak | 22 | 13 | 5 | 90 | 1A | good form | Retained |
| t301 | *Eucalyptus deanei* | Mountain Blue Gum | 40 | 23 | 6 | 90 | 1A | Good health and form | Retained |
| t302 | *Eucalyptus deanei* | Mountain Blue Gum | 30 | 23 | 4 | 90 | 1A | Good health and form | Retained |
| t303 | *Eucalyptus deanei* | Mountain Blue Gum | 28 | 23 | 4 | 90 | 1A | Good health and form | Retained |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| t304 | *Eucalyptus deanei* | Mountain Blue Gum | 30 | 24 | 4 | 90 | 1A | Good health and form | Retained |
| t305 | *Eucalyptus deanei* | Mountain Blue Gum | 33 | 23 | 4 | 90 | 1A | Good health and form | Retained |
| t306 | *Eucalyptus deanei* | Mountain Blue Gum | 33 | 23 | 4 | 90 | 1A | Good health and form | Retained |
| t307 | *Eucalyptus deanei* | Mountain Blue Gum | 23 | 23 | 3 | 90 | 1A | Good health and form | Retained |
| t308 | *Eucalyptus deanei* | Mountain Blue Gum | 23 | 21 | 2.5 | 75 | 2C | Suppressed | Retained |
| t309 | *Eucalyptus deanei* | Mountain Blue Gum | 30 | 17 | 5 | 75 | 2A | Good health and form | Retained |
| t310 | *Acacia implexa* | Hickory | 30,27 | 13 | 7 | 55 | 3A | Old tree with short lifespan | Removed |
| t311 | *Acacia implexa* | Hickory | 25 | 5 | 3 | 15 | 4C | Only one limb alive | Removed |
| t312 | *Acacia implexa* | Hickory | 25 | 10 | 4 | 20 | 4C | Dying and decaying | Removed |
| t313 | *Casuarina cunninghamiana* | River Oak | 40 | 14 | 7 | 90 | 1A | Good health and form | Retained |
| t314 | *Casuarina cunninghamiana* | River Oak | 33 | 15 | 6 | 90 | 1A | Good health and form | Retained |
| t315 | *Casuarina cunninghamiana* | River Oak | 35 | 14 | 6 | 90 | 1A | Good health and form | Retained |
| t316 | *Casuarina cunninghamiana* | River Oak | 40 | 14 | 6 | 90 | 1A | Good health and form | Retained |
| t317 | *Casuarina cunninghamiana* | River Oak | 25 | 13 | 6 | 90 | 1A | Good health and form | Retained |
| t318 | *Casuarina cunninghamiana* | River Oak | 40 | 15 | 7 | 90 | 1A | Good health and form | Retained |
| t319 | *Eucalyptus punctata* | Grey Gum | 38 | 12 | 6 | 35 | 3B | Moderate dieback and deadwood | Retained |
| t320 | *Eucalyptus punctata* | Grey Gum | 38 | 13 | 4 | 40 | 3A | Moderate deadwood | Removed |
| t321 | *Eucalyptus deanei* | Mountain Blue Gum | 40,30 | 24 | 5 | 90 | 1A | Good health and form | Retained |
| t322 | *Eucalyptus deanei* | Mountain Blue Gum | 27 | 24 | 4 | 90 | 1A | Good health and form | Removed |
| t323 | *Eucalyptus deanei* | Mountain Blue Gum | 28 | 24 | 3 | 90 | 1A | Good health and form | Removed |
| t324 | *Eucalyptus deanei* | Mountain Blue Gum | 33 | 21 | 4 | 85 | 1A | Minor deadwood | Removed |
| t325 | *Eucalyptus deanei* | Mountain Blue Gum | 25 | 21 | 3 | 90 | 1A | Good health and form | Removed |
| t326 | *Eucalyptus deanei* | Mountain Blue Gum | 42 | 25 | 6 | 90 | 1A | Good health and form | Removed |
| t327 | *Cinnamomum camphora* | Camphor Laurel | many | 7 | 6 | 75 | 2B | Weed species, previously trimmed | Removed |
| t328 | *Eucalyptus deanei* | Mountain Blue Gum | 20 | 13 | 3 | 65 | 2C | Moderately suppressed | Removed |
| t329 | *Eucalyptus deanei* | Mountain Blue Gum | 35,35,35 | 26 | 6 | 90 | 1A | Good health and form | Removed |
| t330 | *Eucalyptus deanei* | Mountain Blue Gum | 30 | 25 | 4 | 90 | 1A | Good health and form | Removed |
| t331 | *Eucalyptus deanei* | Mountain Blue Gum | 25 | 16 | 3 | 60 | 2C | Moderately suppressed | Removed |
| t332 | *Eucalyptus deanei* | Mountain Blue Gum | 33 | 17 | 5 | 75 | 2A | Minor suppression | Removed |
| t333 | *Eucalyptus deanei* | Mountain Blue Gum | 25 | 13 | 4 | 60 | 2C | Moderately suppressed | Removed |
| t334 | *Eucalyptus deanei* | Mountain Blue Gum | 45 | 17 | 11 | 75 | 2A | Good health and form | Removed |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| t336 | *Eucalyptus deanei* | Mountain Blue Gum | 32 | 19 | 4 | 90 | 1A | Good health and form | Removed |
| t335 | *Eucalyptus deanei* | Mountain Blue Gum | 32 | 21 | 5 | 75 | 2A | Minor deadwood | Removed |
| t337 | *Eucalyptus deanei* | Mountain Blue Gum | 28 | 17 | 4 | 90 | 1A | Good health and form | Removed |
| t338 | *Eucalyptus deanei* | Mountain Blue Gum | 28 | 16 | 5 | 80 | 1A | Minor suppression | Removed |
| t339 | *Acacia parramattensis* | Parramatta Green Wattle | 25,20 | 10 | 8 | 50 | 3A | Short lifespan | Removed |
| t340 | *Acacia parramattensis* | Parramatta Green Wattle | 27 | 9 | 6 | 50 | 3A | Short lifespan | Removed |
| t341 | *Acacia parramattensis* | Parramatta Green Wattle | 22 | 11 | 4 | 35 | 3C | Strong lean north | Removed |
| t342 | *Acacia parramattensis* | Parramatta Green Wattle | 25 | 11 | 5 | 35 | 3C | Strong lean north | Removed |
| t343 | *Acacia parramattensis* | Parramatta Green Wattle | 30 | 11 | 7 | 40 | 3A | Slight lean east | Removed |
| t344 | *Acacia parramattensis* | Parramatta Green Wattle | 27 | 8 | 6 | 35 | 4D | Very strong lean east | Removed |
| t345 | *Acacia parramattensis* | Parramatta Green Wattle | 32 | 11 | 7 | 60 | 3A | Short lifespan | Removed |
| t346 | *Acacia parramattensis* | Parramatta Green Wattle | 27 | 9 | 5 | 45 | 3C | Moderate lean south, suppressed | Removed |
| t347 | *Acacia implexa* | Hickory | 33 | 13 | 5 | 50 | 3B | Weed species | Removed |
| t348 | *Acacia implexa* | Hickory | 23 | 12 | 4 | 45 | 3B | Weed species | Removed |
| t349 | *Acacia implexa* | Hickory | 22 | 10 | 4 | 40 | 3B | Weed species. Suppressed | Removed |
| t351 | *Acacia parramattensis* | Parramatta Green Wattle | 30 | 18 | 6 | 75 | 2A | Good health and form | Removed |
| t350 | *Acacia implexa* | Hickory | 27 | 12 | 4 | 40 | 3B | Weed species. Strong lean south-east | Removed |
| t352 | *Acacia parramattensis* | Parramatta Green Wattle | 40 | 18 | 7 | 40 | 3B | Strong lean north | Removed |
| t353 | *Acacia implexa* | Hickory | 30 | 14 | 4 | 10 | 4C | Almost dead | Removed |
| t354 | *Acacia implexa* | Hickory | 27,27 | 17 | 7 | 60 | 2B | Weed species | Removed |
| t355 | *Acacia implexa* | Hickory | 30 | 13 | 5 | 5 | 4C | Almost dead | Removed |
| t356 | *Casuarina glauca* | Swamp Oak | 44 | 20 | 4 | 70 | 2A | Some roots exposed | Removed |
| t357 | *Casuarina glauca* | Swamp Oak | 35 | 20 | 5 | 75 | 2A | Good health and form | Removed |
| t358 | *Casuarina glauca* | Swamp Oak | 25 | 14 | 4 | 75 | 2A | Good health and form | Removed |
| t359 | *Pinus radiata* | Radiata Pine | 22 | 14 | 5 | 65 | 2A | Slightly suppressed | Removed |
| t360 | *Pinus radiata* | Radiata Pine | 22 | 11 | 5 | 70 | 2A | Suppressed canopy | Removed |
| t361 | *Casuarina glauca* | Swamp Oak | 30 | 23 | 4 | 70 | 2A | Slight lean west | Removed |
| t362 | *Casuarina glauca* | Swamp Oak | 48 | 20 | 4 | 80 | 2A | Good health and form | Removed |
| t363 | *Casuarina glauca* | Swamp Oak | 25 | 16 | 4 | 65 | 2C | Suppressed to west | Removed |
| t364 | *Pinus radiata* | Radiata Pine | 28 | 12 | 4 | 85 | 1A | Good health and form | Removed |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| t365 | *Pinus radiata* | Radiata Pine | 28 | 14 | 4 | 65 | 2C | Suppressed to west | Removed |
| t366 | *Casuarina glauca* | Swamp Oak | 30,25 | 13 | 8 | 60 | 3A | Suppressed to east | Removed |
| t367 | *Casuarina glauca* | Swamp Oak | 28 | 14 | 4 | 60 | 2A | Slight lean west | Removed |
| t368 | *Casuarina glauca* | Swamp Oak | 33 | 17 | 6 | 40 | 3B | Moderate canopy dieback | Removed |
| t369 | *Casuarina glauca* | Swamp Oak | 33,30 | 20 | 5 | 80 | 2A | Minor deadwood | Removed |
| t370 | *Melaleuca styphelioides* | Prickly-leaved Paperbark | 37,12 | 12 | 5 | 60 | 2A | Moderate suppression to east | Retained |
| t371 | *Melaleuca styphelioides* | Prickly-leaved Paperbark | 35 | 10 | 4 | 60 | 2A | Suppressed to west | Retained |
| t373 | *Casuarina glauca* | Swamp Oak | 45 | 23 | 5 | 75 | 2A | Slightly suppressed | Retained |
| t372 | *Casuarina glauca* | Swamp Oak | 33 | 26 | 5 | 90 | 1A | Good health and form | Retained |
| t374 | *Casuarina glauca* | Swamp Oak | 22 | 15 | 2 | 70 | 2C | Suppressed | Retained |
| t375 | *Casuarina glauca* | Swamp Oak | 35 | 24 | 4 | 90 | 1A | Good health and form | Retained |
| t376 | *Casuarina glauca* | Swamp Oak | 42 | 22 | 6 | 80 | 1A | Good health and form | Retained |
| t377 | *Casuarina glauca* | Swamp Oak | 37 | 22 | 5 | 80 | 1A | Good health and form | Retained |
| t378 | *Casuarina glauca* | Swamp Oak | 23 | 17 | 2 | 60 | 2C | Moderately suppressed | Retained |
| t379 | *Acacia parramattensis* | Parramatta Green Wattle | 28 | 10 | 6 | 50 | 3A | Minor deadwood. Short lifespan | Retained |
| t380 | *Eucalyptus punctata* | Grey Gum | 45,25 | 13 | 11 | 65 | 2A | Slightly suppressed | Removed |
| t381 | *Angophora costata* | Smooth-barked Apple | 65,35 | 22 | 8 | 80 | 1A | Kino at 3m on west side | Removed |
| t382 | *Corymbia gummifera* | Red Bloodwood | 40 | 15 | 5 | 70 | 2A | Minor deadwood | Removed |
| t383 | *Angophora costata* | Smooth-barked Apple | 60 | 22 | 10 | 75 | 1A | Good health and form | Removed |
| t384 | *Angophora costata* | Smooth-barked Apple | 33 | 15 | 7 | 70 | 2A | Moderate form | Retained |
| t385 | *Erythrina sykesii* | Coral Tree | 50,30 | 15 | 10 | 60 | 2B | Weed species | Removed |
| t386 | *Erythrina sykesii* | Coral Tree | 55 | 15 | 7 | 40 | 3B | Weed species. Leans slightly north | Removed |
| t387 | *Erythrina sykesii* | Coral Tree | many | 15 | 7 | 60 | 2B | Weed species | Removed |
| t388 | *Angophora costata* | Smooth-barked Apple | 40 | 16 | 5 | 60 | 2A | Twisted main trunk | Retained |
| t389 | *Erythrina sykesii* | Coral Tree | many | 14 | 12 | 75 | 2B | Weed species | Removed |
| t390 | *Angophora costata* | Smooth-barked Apple | 33 | 18 | 6 | 50 | 3B | Partly choked by Coral Trees. Exposed roots | Removed |
| t391 | *Erythrina sykesii* | Coral Tree | many | 16 | 12 | 75 | 2B | Weed species | Removed |
| t392 | *Angophora costata* | Smooth-barked Apple | 50 | 22 | 11 | 75 | 1A | Good health and form | Removed |
| t393 | *Angophora costata* | Smooth-barked Apple | 80 | 20 | 13 | 60 | 2A | Moderate deadwood. Very large tree | Removed |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| t394 | *Angophora costata* | Smooth-barked Apple | 30 | 18 | 5 | 65 | 2A | Slightly suppressed | Retained |
| t395 | *Angophora costata* | Smooth-barked Apple | 30,30,30 | 22 | 7 | 85 | 1A | Good health and form | Retained |
| t396 | *Angophora costata* | Smooth-barked Apple | 27 | 11 | 5 | 55 | 2C | Heavily suppressed | Retained |
| t397 | *Eucalyptus piperita* | Sydney Peppermint | 50,40,40,35 | 23 | 11 | 70 | 2A | Small kinos at 1-2m | Retained |
| t398 | *Eucalyptus punctata* | Grey Gum | 30 | 14 | 5 | 55 | 2C | Heavily suppressed to north | Removed |
| t399 | *Angophora costata* | Smooth-barked Apple | 35 | 11 | 5 | 40 | 3B | Extremely suppressed. Poor form | Removed |
| T400 | *Eucalyptus piperita* | Sydney Peppermint | 40 | 16 | 6 | 70 | 2A | Minor deadwood | Removed |
| T401 | stag | stag | 50 | 20 | 7 | 0 | 4A | Dead tree | Removed |
| T402 | *Eucalyptus piperita* | Sydney Peppermint | 50,50 | 22 | 9 | 65 | 2A | Minor decay lower portion of south trunk | Retained |
| T403 | *Eucalyptus piperita* | Sydney Peppermint | 55 | 14 | 7 | 25 | 4D | Main trunk dead | Removed |
| T404 | *Eucalyptus piperita* | Sydney Peppermint | 55 | 16 | 6 | 50 | 3A | Moderate deadwood | Removed |
| T405 | *Corymbia gummifera* | Red Bloodwood | 32,25 | 20 | 5 | 70 | 2A | Minor deadwood. Kino on smaller trunk | Removed |
| T406 | *Eucalyptus piperita* | Sydney Peppermint | 55,45 | 25 | 11 | 55 | 2D | Kino on larger trunk. Tree weight to east | Removed |
| T407 | stag | stag | 60 | 19 | 6 | 0 | 4D | Dead tree leaning north east | Removed |
| T408 | *Eucalyptus piperita* | Sydney Peppermint | 38 | 22 | 7 | 70 | 2A | Slight lean south | Retained |
| T409 | *Eucalyptus piperita* | Sydney Peppermint | 55 | 17 | 6 | 50 | 3B | Strong lean south west over dam edge | Removed |
| T410 | *Eucalyptus piperita* | Sydney Peppermint | 55,35 | 22 | 7 | 65 | 2A | Minor deadwood. Moderate health | Retained |
| T411 | *Eucalyptus piperita* | Sydney Peppermint | 45,20,15 | 21 | 6 | 60 | 2D | Minor deadwood. Minor decay on main trunk | Retained |
| T412 | *Corymbia gummifera* | Red Bloodwood | 30 | 20 | 3 | 50 | 2C | Kino on main trunk, minor deadwood. Suppressed | Retained |
| T413 | stag | stag | 40 | 7 | 4 | 0 | 4A | Dead tree | Removed |
| T414 | *Angophora costata* | Smooth-barked Apple | 37 | 20 | 5 | 80 | 1A | Good health and form. Kino at 4m | Removed |
| T415 | *Eucalyptus sieberi* | Silvertop Ash | 75 | 18 | 8 | 55 | 2B | Strong lean north east. Minor deadwood | Removed |
| T416 | *Angophora costata* | Smooth-barked Apple | 45 | 18 | 7 | 55 | 2C | Suppressed canopy and western side | Retained |
| T417 | *Eucalyptus piperita* | Sydney Peppermint | 28,28,20 | 12 | 5 | 20 | 3B | Declining health | Removed |
| T418 | *Angophora costata* | Smooth-barked Apple | 60 | 23 | 10 | 75 | 1A | Minor deadwood | Removed |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| T419 | *Eucalyptus piperita* | Sydney Peppermint | 85 | 18 | 13 | 55 | 2B | Minor deadwood. Strong lean north | Removed |
| T420 | *Angophora costata* | Smooth-barked Apple | 50 | 17 | 9 | 50 | 2B | Moderate deadwood. Strong lean east | Removed |
| T421 | *Angophora costata* | Smooth-barked Apple | 30 | 8 | 6 | 40 | 3C | Strongly suppressed | Removed |
| T422 | *Eucalyptus piperita* | Sydney Peppermint | 75,55 | 22 | 9 | 40 | 3B | Major deadwood and some trunk rot | Removed |
| T423 | *Eucalyptus piperita* | Sydney Peppermint | 45 | 17 | 6 | 50 | 3B | Moderate deadwood. Strong lean south east | Removed |
| T424 | *Eucalyptus piperita* | Sydney Peppermint | 40,28 | 15 | 4 | 35 | 3B | Roots exposed. Moderate lean west | Removed |
| T425 | *Eucalyptus piperita* | Sydney Peppermint | 60 | 15 | 7 | 60 | 2A | Minor deadwood | Removed |
| T426 | *Eucalyptus sieberi* | Silvertop Ash | 40,20 | 7 | 9 | 30 | 3B | Poor form. Previously trimmed | Removed |
| T427 | *Angophora costata* | Smooth-barked Apple | 25,25 | 8 | 6 | 50 | 2C | Suppressed | Removed |
| T428 | *Schefflera actinophylla* | Umbrella Tree | 25 | 7 | 3 | 75 | 1A | Exotic species | Removed |
| T429 | *Eucalyptus robusta* | Swamp Mahogany | 23 | 12 | 4 | 70 | 2A | Slightly suppressed | Removed |
| T430 | *Eucalyptus punctata* | Grey Gum | 75,30 | 18 | 10 | 65 | 2D | Minor deadwood | Removed |
| T431 | *Eucalyptus piperita* | Sydney Peppermint | 40 | 9 | 5 | 50 | 2C | Heavily suppressed | Removed |
| T432 | *Eucalyptus piperita* | Sydney Peppermint | 42 | 18 | 6 | 70 | 4E | Growing through powerlines | Removed |
| T433 | *Eucalyptus piperita* | Sydney Peppermint | 42 | 15 | 6 | 40 | 3B | Canopy dieback | Removed |
| T434 | *Melaleuca armillaris* | Bracelet Honeymyrtle | 30 | 6 | 4 | 70 | 2A | Good health and form | Retained |
| T435 | *Eucalyptus piperita* | Sydney Peppermint | 75,60,50 | 22 | 13 | 70 | 1A | Good health. Minor deadwood | Retained |
| T436 | *Eucalyptus piperita* | Sydney Peppermint | 27 | 16 | 5 | 80 | 1A | Good health and form | Retained |
| T437 | stag | stag | 42 | 14 | 4 | 0 | 4A | Dead tree | Removed |
| T438 | *Corymbia gummifera* | Red Bloodwood | 55 | 18 | 10 | 75 | 1A | Minor deadwood | Retained |
| T439 | *Jacaranda mimosifolia* | Jacaranda | 35 | 10 | 8 | 80 | 1A | Exotic species | Removed |
| T440 | *Eucalyptus piperita* | Sydney Peppermint | 32 | 14 | 4 | 30 | 3B | Poor health | Removed |
| T441 | stag | stag | 28,25 | 11 | 5 | 0 | 4A | Dead tree | Removed |
| T442 | *Exotic Pine* | Exotic Pine | 50 | 18 | 7 | 75 | 1A | Exotic species | Removed |
| T443 | *Brachychiton acerifolius* | Illawarra Flame Tree | 28 | 7 | 4 | 80 | 1A | Exotic species | Removed |
| T444 | *Angophora costata* | Smooth-barked Apple | 48 | 16 | 5 | 15 | 3B | Almost dead | Removed |
| T445 | *Erythrina sykesii* | Coral Tree | 50,45 | 6 | 7 | 40 | 3B | Exotic species. Decaying trunk | Removed |

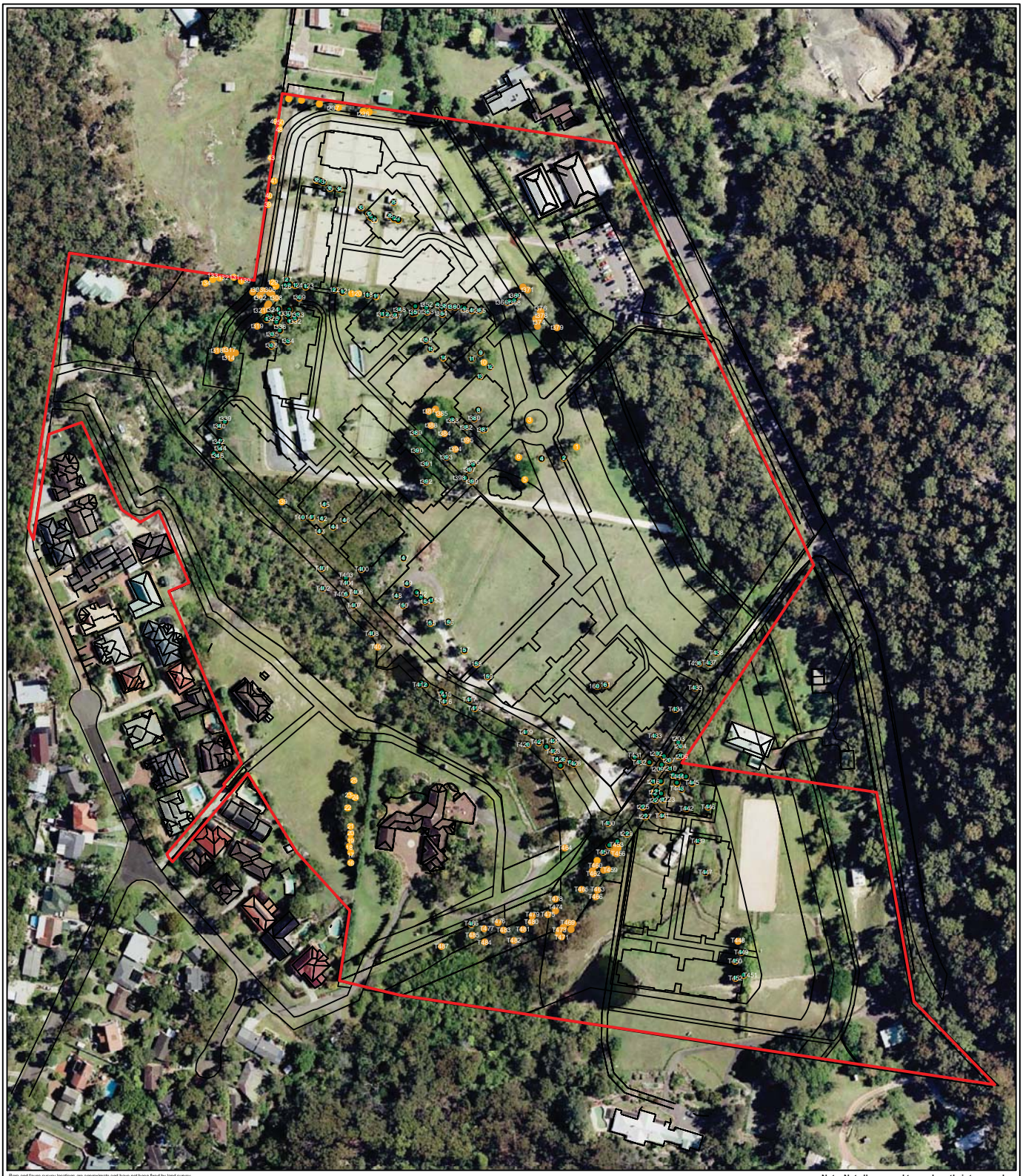
| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| T446 | *Syzygium sp* | Lillypilly | many | 7 | 7 | 90 | 1A | Good health and form | Removed |
| T447 | *Corymbia maculata* | Spotted Gum | 45 | 24 | 7 | 90 | 1A | Good health and form | Removed |
| T448 | *Plane tree* | Plane Tree | 40 | 8 | 6 | 75 | 2A | Exotic species | Retained |
| T449 | *Plane tree* | Plane Tree | 50 | 9 | 6 | 80 | 2A | Exotic species | Removed |
| T450 | *Plane tree* | Plane Tree | 45 | 9 | 6 | 80 | 2A | Exotic species | Removed |
| T451 | *Plane tree* | Plane Tree | 40 | 9 | 7 | 80 | 2A | Exotic species | Removed |
| T452 | *Plane tree* | Plane Tree | 40 | 9 | 6 | 80 | 2A | Exotic species | Removed |
| T453 | *Eucalyptus punctata* | Grey Gum | 33 | 17 | 4 | 60 | 2A | Some suppression | Retained |
| T454 | *Angophora costata* | Smooth-barked Apple | 50 | 22 | 7 | 80 | 1A | Kino on lower part of main trunk | Retained |
| T455 | *Eucalyptus punctata* | Grey Gum | 25 | 12 | 4 | 60 | 2C | Suppressed | Retained |
| T456 | *Eucalyptus punctata* | Grey Gum | 28 | 10 | 4 | 40 | 3C | Strongly suppressed | Retained |
| T457 | *Eucalyptus punctata* | Grey Gum | 38 | 12 | 6 | 50 | 3A | Suppressed | Retained |
| T458 | *Eucalyptus punctata* | Grey Gum | 35,25 | 14 | 6 | 55 | 2D | Moderate deadwood. Slightly suppressed | Retained |
| T459 | *Angophora costata* | Smooth-barked Apple | 40 | 25 | 6 | 75 | 1A | Good health and form | Retained |
| T460 | *Eucalyptus punctata* | Grey Gum | 40 | 17 | 6 | 60 | 2D | Moderate deadwood | Retained |
| T461 | *Eucalyptus punctata* | Grey Gum | 40 | 15 | 7 | 60 | 2A | Minor deadwood | Retained |
| T462 | *Angophora costata* | Smooth-barked Apple | 50 | 24 | 8 | 60 | 2A | Minor deadwood. Burl at 2m | Retained |
| T463 | *Eucalyptus sieberi* | Silvertop Ash | 23,18 | 8 | 4 | 70 | 2A | Slight lean south | Retained |
| T465 | *Eucalyptus punctata* | Grey Gum | 35 | 16 | 8 | 65 | 2A | Minor deadwood | Removed |
| T466 | *Eucalyptus sieberi* | Silvertop Ash | 28 | 8 | 5 | 70 | 2A | Slight lean east | Retained |
| T467 | *Eucalyptus sieberi* | Silvertop Ash | 45 | 14 | 4 | 40 | 3B | Strong lean south. Moderate deadwood | Retained |
| T468 | *Eucalyptus sieberi* | Silvertop Ash | 45,30 | 22 | 7 | 70 | 2A | Slight lean south east | Retained |
| T469 | *Eucalyptus sieberi* | Silvertop Ash | 70,70 | 21 | 11 | 65 | 2D | Minor deadwood | Retained |
| T470 | *Eucalyptus sieberi* | Silvertop Ash | 22 | 8 | 4 | 75 | 2A | Twisted main trunk | Retained |
| T471 | *Eucalyptus sieberi* | Silvertop Ash | 25 | 13 | 2 | 50 | 2C | Heavily suppressed | Retained |
| T472 | *Eucalyptus sieberi* | Silvertop Ash | 25 | 9 | 4 | 50 | 2B | Strong lean south west | Retained |
| T473 | stag | stag | 25 | 13 | 2 | 0 | 4A | Dead tree | Retained |
| T474 | *Eucalyptus sieberi* | Silvertop Ash | 35 | 15 | 6 | 60 | 2A | Some suppression | Retained |
| T475 | *Eucalyptus sieberi* | Silvertop Ash | 60,32 | 20 | 10 | 70 | 2D | Smaller trunk to remove, leans strongly | Retained |

| Tree No | Scientific Name | Common Name | DBH (cm) | Height (m) | Spread (m) | Vigour % | SULE | Comments & Recommendations | Retained / Removed |
|---|---|---|---|---|---|---|---|---|---|
| T464 | *Angophora bakeri* | Narrow-leaved Apple | 35 | 17 | 6 | 20 | 3B | Heavy dieback. Possibly mis-identified | Retained |
| T476 | *Eucalyptus punctata* | Grey Gum | 30,30 | 14 | 7 | 70 | 2A | Minor deadwood | Retained |
| T477 | *Eucalyptus punctata* | Grey Guu | 27,25 | 11 | 6 | 60 | 2A | Average form | Retained |
| T478 | *Eucalyptus punctata* | Grey Gum | 30 | 12 | 5 | 40 | 3B | Moderate suppression and deadwood | Retained |
| T479 | *Eucalyptus sieberi* | Silvertop Ash | 50 | 18 | 7 | 80 | 1A | Good health and form | Retained |
| T480 | *Acacia parramattensis* | Parramatta Green Wattle | 27 | 14 | 7 | 90 | 2A | Good health and form. Short lifespan | Retained |
| T481 | *Eucalyptus punctata* | Grey Gum | 30 | 13 | 5 | 50 | 2C | Suppressed | Retained |
| T482 | *Eucalyptus sieberi* | Silvertop Ash | 35,12,7 | 9 | 8 | 30 | 3B | Main trunk is parallel to ground | Retained |
| T483 | *Eucalyptus punctata* | Grey Gum | 32 | 14 | 5 | 60 | 2A | Slightly suppressed | Retained |
| T484 | *Eucalyptus punctata* | Grey Gum | 30 | 10 | 5 | 30 | 3B | Poor form | Retained |
| T485 | *Angophora costata* | Smooth-barked Apple | 50,30 | 16 | 10 | 75 | 1A | Minor deadwood | Retained |
| T486 | *Callitris sp* | Callitris Pine | 28 | 7 | 4 | 65 | 2A | Exotic species | Retained |
| T487 | *Angophora costata* | Smooth-barked Apple | 22 | 9 | 3 | 70 | 2B | Growing 1m from overhead wires | Removed |

* Note - Trees numbered 51 - 116 have been removed from the assessment as this area (Lot 1108 DP 752038) no longer forms part of the proposal.

**SCHEDULE 2**

**Tree Plan**



Flora and fauna survey locations are approximate and have not been fixed by land survey.

**Note: Not all surveyed trees show their tree number due to overlapping of labels**

0 20 40 60 80 m

1:2,000

Original plan produced in A3 colour

N

**Legend**

- Study Area
- Surveyed Tree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# Schedule 2 -
## Tree Plan
### Oxford Falls

*Ver.FX By.BB*
*23/04/10*
*Ref.No. A10027*

*Source: Google Earth Pro, Satellite Imagery.*

*Location: N:\3166\A9*

**SCHEDULE 3 – SULE Determinations and Terminology**

**SULE** (an acronym for **Safe Useful Life Expectancy**). Particular consideration is given to the following points when making the final SULE assessment for each tree;

- Obvious past influences (suppression)
- Present health and condition and future potential in current position
- Estimated age at assessment in relation to the life expectancy for the species
- Observed and potential structural defects which may influence potential life expectancy
- Potential remedial work which may allow retention in the existing location.

An outline of the four relevant SULE categories and their subgroups used in this report is as follows:

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**1** Long **SULE** (Trees that appear to be retainable at the time of assessment for more than 40 years with an acceptable level of risk)

**A** A structurally sound tree, located where potential future growth can be accommodated

**B** A damaged of defective tree that could be made suitable in the long term (40+ years) where remedial care is given

**C** A tree of particular significance (historical / commemorative merit or rarity) that warrants extensive efforts in securing long term retention.

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**2** Medium **SULE** (Trees that appear to be retainable at the time of assessment for 15 to 40 years with an acceptable level of risk)

**A** A tree predicted to only live between 15 and 40 more years

**B** A tree that may live for more than 40 years but should be removed to prevent safety or nuisance problems.

**C** A tree that may live for more than 40 years but should be removed to prevent competition with more suitable individuals or to provide space for new planting

**D** A damaged of defective tree that could be made suitable in the medium term (15-40 years) where remedial care is given.

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**3** Short **SULE** (Trees that appear to be retainable at the time of assessment for 5 to 15 years with an acceptable level of risk)

**A** A tree predicted to only live between 5 and 15 more years

**B** A tree that may live for more than 15 years but should be removed to prevent safety or nuisance problems

**C** A tree that may live for more than 15 years but should be removed to prevent competition with more suitable individuals or to provide space for new planting

**D** A damaged of defective tree that could be only made suitable in the short term (5-15 years) and would require significant remedial work.

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**4 Removals** (Trees with a high level of risk and should be removed within the next 5 years)

- **A** A dead, dying, suppressed or declining tree
- **B** A dangerous tree through instability or recent loss of neighbouring trees
- **C** A dangerous tree through structural defects (cavities, decay, included bark, wounds or poor form)
- **D** A damaged tree that is clearly not safe to retain
- **E** A tree that is damaging or may cause damage to existing structures within 5 years
- **F** A tree that will become dangerous after removal of neighbouring trees for the reasons given in A) to E).

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*SULE ratings given to any tree in this report assumes that appropriate maintenance (if required) will be provided by a qualified arborist. Incorrect tree work practices can significantly accelerate tree suppression and increase hazard potential*

**EXPLANATION OF TERMINOLOGY USED**

**DBH** - An acronym for Bole **Diameter** at **Breast Height** (1.4 m from ground level).

**Health -** An indication of the vigour of a tree and is determined by the observed crown colour, density and insect attack, the percentage of dead or dying branches and the amount epicormic growth. The health of the canopy and that of the root system is interdependent and significant loss of tree vigour can result through both root and canopy (pruning, suppression) damage.

Suppressed, unhealthy trees have reduced ability to initiate internal defence systems (by the process of compartmentalisation) thus predisposing them to attack by insects and pathogenic decay organisms which increase the potential to drop dangerous branches.

**Condition -** An evaluation of the structural integrity of a tree, including defects that may affect the useful life of an otherwise healthy individual. Such influencing factors include cavities and decay, weak unions between branches or trunks and faults of form or habit.

**Kino** - A dark reddish exudate, rich in polyphenols (tannins), developed in the cambial region of eucalypts often as a result of injury; incorrectly called gum (Boland *Et. Al.*, 1992).

**Deadwood** - The mature crown of a eucalypt maintains itself by the continual production of new crown units, which die in turn. Thus there will always be some dead branches in a healthy mature crown (Florence, 1996). Minor deadwood refers to dead branchlets, Major deadwood refers to main branches from the trunk.