THE PROPOSED REDEVELOPMENT OF "WAHROONGA ESTATE" FOX VALLEY ROAD AND COMENARRA PARKWAY, WAHROONGA

Flora and Fauna Assessment for a Part 3A Assessment

For:

JOHNSON PROPERTY GROUP

March 2009

Final Report

Cumberland Ecology
PO Box 2474, Carlingford Court 2118

Report No. 8036RP2

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Approved by:	David Robertson
Position:	Project Director
Signed:	
Date:	*10 March, 2009*

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INTRODUCTION

The purpose of this report is to the assess the ecological values and predict potential impacts on flora and fauna, of the proposed redevelopment of the Seventh Day Adventist Church Wahroonga Estate located at the intersection of the Comenarra Parkway and Fox Valley Road, Wahroonga; under Part 3A of the *Environmental Planning and Assessment Act 1979*. The proposed redevelopment of the "subject site" includes an upgrade and expansion of the existing hospital and provision of new educational, commercial and residential facilities with associated roads and infrastructure. The subject site consists of largely disturbed areas of grassland with scattered trees as well as considerable areas of native vegetation. The impact of edge effects on these areas of bushland is obvious with some locations containing a high proportion of exotic weeds. The subject site also contains several streams that flow through largely urbanised catchments.

METHODS

Initial surveys of the subject site were carried out from June to August 2008. These included a flora quadrat survey and fauna surveys with hair funnels. Tree hollow surveys, spotlighting, call playback, reptile, frog and bird surveys were conducted concurrently. Further vegetation condition assessment surveys were conducted during January 2009.

Background literature and threatened species databases were also consulted to gain a more detailed understanding of the types of threatened species that had the potential to occur on the subject site.

RESULTS

The following six vegetation communities were recorded during the current flora survey on the subject site:

- Blue Gum High Forest (BGHF; a Commonwealth and State listed Critically Endangered Ecological Community (CEEC));
- Blackbutt – Turpentine – Smooth Bark Apple Open Forest;
- Sydney Peppermint – Red Bloodwood Open Forest;

- Sydney Turpentine - Ironbark Forest (STIF; listed as a CEEC under Commonwealth legislation and an Endangered Ecological Community under State legislation);
- Riparian Vegetation; and
- Grassland with Scattered Trees.

In general, the vegetation of the subject site varies in condition and structure. Areas of dense forest exist that are too shady for weed invasion; while patches of open forest and woodland are also common. Where the native shrub layer and ground vegetation has been removed areas of lantana and exotic grasses are often present. Highly disturbed areas with high proportions of exotic weed invasion are present on much of the subject site and evidence of ongoing disturbance, such as slashing and the impacts of edge effects are clearly evident.

No threatened flora species as listed under the *Threatened Species Conservation Act 1995* (TSC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) have been detected on the subject site although sub-optimal habitat does occur for some threatened species, which are discussed in this report.

A wide range of fauna habitats occur and a number of fauna species were detected. The most frequently detected species include species that commonly occur in or adjacent to urban areas. Potential habitat for many threatened fauna species as listed under the TSC and EPBC Acts occurs across the subject site.

Threatened fauna species that were detected on the subject land during recent surveys include: the Powerful Owl (Vulnerable TSC Act), Grey-headed Flying-fox (Vulnerable TSC and EPBC Acts) and the Eastern False-Pipistrelle (Vulnerable TSC Act). A suspected nest tree for a pair of adult Powerful Owls with one juvenile was also located.

While not detected during recent surveys the subject site contains suitable habitat for a range of other threatened species including microchiropteran bats, Swift Parrot, Glossy Black Cockatoo and Gang-gang Cockatoo.

IMPACT ASSESSMENT

Approximately 5.771 ha of the 37.077 ha of the native vegetation on the subject site is proposed to be cleared for the development with a further 16.356 ha to be managed for asset protection zones (APZs) and 1.36 ha to be managed as bushfire fuel reduction zones. Asset protections zones and fuel reduction zones will be maintained around the proposed development with hollow-bearing trees being retained wherever possible to minimise impacts on fauna habitat. A summary of the management and structure of vegetation communities currently of the subject land is provided in Table S.1 below while a summary of the management and structure of vegetation communities under the proposed development is outlined in Table S.2.

Table S.1 CURRENT AREAS OF VEGETATION COMMUNITIES MANAGEMENT AND STRUCTURE

Vegetation Type	Relatively undisturbed community currently on Subject Land (ha)	APZs currently on Subject Land (ha)	Scattered Trees currently on Subject Land (ha)
Blue Gum High Forest	0.869	2.478	0.333[1]
Sydney Turpentine-Ironbark Forest	0.281	0.240	1.172
Blackbutt – Turpentine – Smooth-bark Apple Open Forest	24.131	-	0.711
Sydney Peppermint – Red Bloodwood Open Forest	3.785	-	-
Riparian Vegetation	3.077	-	-
Total	**32.143**	**2.718**	**2.216**

Notes: 1. This portion of the community does not meet the EPBC Act listing but does meet TSC Act listing

Table S.2 AREAS OF VEGETATION COMMUNITIES MANAGEMENT AND STUCTURE UNDER THE PROPOSED DEVELOPMENT

Vegetation Type	Vegetation to be retained (ha)		Vegetation to be cleared (ha)		Managed as APZs (ha)	Fuel Reduction Management (ha)
	Community	Scattered Trees	Community	Scattered Trees		
Blue Gum High Forest	0.052	0.116*	1.428	0.216	1.868	-
Sydney Turpentine-Ironbark Forest	-	0.402	0.015	0.770	0.506	-
Blackbutt – Turpentine – Smooth-bark Apple Open Forest	9.406	0.263	2.523	0.447	11.899	0.304
Sydney Peppermint – Red Bloodwood Open Forest	0.574	-	0.345	-	1.810	1.056
Riparian Vegetation	2.777	-	0.027	-	0.273	-
Total	**12.809**	**0.781**	**4.338**	**1.433**	**16.356**	**1.36**

*Notes: *Some scattered trees will be retained within APZs.*

Due to the impacts of the proposed development on EPBC-listed Blue Gum High Forest and the loss of other native vegetation the proposed action was determined a controlled action by the Department of the Environment, Water, Heritage and the Arts (DEWHA) in regards to the Blue Gum High Forest (BGHF), Grey-headed Flying-fox, Swift Parrot and other migratory bird species that have the potential to use the subject lands. In an effort to minimise the impacts on all ecological issues a site specific Biodiversity Management Plan (BMP) is recommended to be developed to ensure the quality of the BGHF, and other vegetation communities is maintained at a high level; including the endangered ecological community Sydney Turpentine-Ironbark Forest (STIF). The STIF located on the subject land is not considered to be the EEC under the EPBC Act due to its small size and poor quality; it is however considered the EEC under the TSC Act. This BMP will also allow for the creation of compensatory habitat for the threatened species mentioned above. If necessary, further mitigation options to account for the impacts on the BGHF and STIF EECs will be discussed with the relevant approval bodies.

To minimise any impacts on the nesting location of the Powerful Owls the concept design was altered to establish a 100 m buffer of native vegetation between any development and the nest tree, noting that there is currently existing residential development at this distance to the east of the nesting location. Advice provided by an ornithologist recommended: construction activities in the vicinity of the nest tree take place outside of the owls' breeding season; revegetation works include flora species that provide suitable foraging habitat for Powerful Owl prey species; and the provision of appropriate sized nest boxes at selected locations to provide alternative breeding locations if necessary. Monitoring of the breeding of the Powerful Owls and use of nest boxes was also recommended in the ornithologist's report.

MITIGATION MEASURES

In an effort to reduce the potential impacts of the development a number of mitigation measures have been implemented in the design process of the proposed development with more to be implemented upon approval of the development. To date, the concept plan for the site has undergone a number of iterations to reduce the potential impacts on CEECs, EECs and threatened species through the removal and relocation of proposed infrastructure.

Post development, all vegetation to be retained on the subject land will be zoned '2A Environmental Conservation' affording it the most stringent environmental protection apart from being incorporated into a National Park. These conservation lands will be managed under a Biodiversity Management Plan (BMP) to ensure the quality of the vegetation is improved or maintained through weed management and assisted rehabilitation of endangered communities. The BMP will also include a CEEC/EEC Monitoring Program to ensure that community composition does not change significantly during and post development. The BMP will incorporate a Powerful Owl Management Plan to assist in the management and monitoring of this TSC Act listed threatened species.

It is recommended that the areas of CEEC/EEC adjacent to development be fenced with aesthetic fencing to prevent trampling and weed dispersal due to increased traffic.

CONCLUSIONS AND RECOMMENDATIONS

The proposed redevelopment of Wahroonga Estate will impact upon the CEECs Blue Gum High Forest and Sydney Turpentine-Ironbark Forest. It will also clear some forest and woodland habitat for threatened fauna species including the Grey-headed Flying Fox and the Powerful Owl. However, a core of forest habitat will be retained along the Coups Creek and to the east of Fox Valley Road. Such forest habitat will retain the wildlife corridor function that currently exists along the creek corridor and will also continue to provide habitat for threatened species. If necessary, further mitigation options to account for the impacts on the BGHF and Sydney Turpentine-Ironbark Forest (STIF) EEC will be discussed with the relevant approval bodies.

All vegetation communities on the subject site can be enhanced through the implementation of a BMP. The BMP should provide for the control of weeds on the periphery of the developed areas, particularly within the EECs, and protect and enhance potential habitat for threatened species and their prey. Timing the construction phase of the project in areas adjacent to the Powerful Owl nest tree to avoid the breeding season and the provision of nest boxes will reduce impacts upon the Powerful Owls' breeding success. Monitoring the use of the nest tree and nest boxes during and after construction will provide valuable information on the impacts of development on this species.

Chapter 1

Introduction

1.1 Purpose

Cumberland Ecology Pty Ltd has been engaged to prepare a Flora and Fauna Assessment for the redevelopment of lands known as “Wahroonga Estate” (the subject land) and forming part of the Seventh Day Adventist Hospital situated at Fox Valley Road and the Comenarra Parkway, Wahroonga.

The objectives of this report are to:

- Describe and map the vegetation communities on the subject land;
- Describe fauna habitats and fauna usage of the subject land;
- Assess the likelihood of threatened species as listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) occurring on the subject land;
- Formally assess the impacts of the proposed development in terms of the Director General’s Requirements issued for the assessment of the project under Part 3A of the *Environmental Planning and Assessment Act 1979*.
- Assess the ecological constraints and opportunities for development on the subject land; and
- Where relevant, suggest mitigation measures to reduce the impacts of the proposed development on flora and fauna.

1.2 Site Description

Wahroonga Estate covers approximately 66ha and is located on the northern side of The Comenarra Parkway at the intersection with Fox Valley Road (Figure 1.1). Approximately 40% of the subject land supports urban bushland which is connected to Lane Cove National Park through recreation reserves and creek corridors to the southeast. The current land uses on the subject land include; the Sydney Adventist Hospital; Adventist

Church Regional Headquarters and administration offices; Seventh-day Adventist Churches; a primary school; commercial medical practices; Normanhurst Adventist Retirement Village and staff housing. A large portion of the subject land is currently undeveloped.

The subject land slopes away from Fox Valley Road, which intersects the site. The western side of the subject land has a westerly aspect and drains to Coups Creek. The area of the eastern side of the subject land has an easterly aspect and drains into Fox Valley Creek. Both creeks are tributaries of the Lane Cove River.

The site elevation varies between 130 and 170 metres Australian Height Datum (AHD) with slopes within the riparian corridors generally exceeding 18^{o}. Slopes outside of the riparian corridors are generally 0 – 10^{o}.

1.3 Proposed Development

The proposed concept plan calls for a comprehensive redevelopment of Wahroonga Estate including expansion and upgrading of the hospital as well as providing: new educational and community facilities; residential dwellings and a small retail/commercial centre as per the concept plan prepared for the subject site. The proposed site upgrade has been modified and designed to take into account significant vegetation; particularly Blue Gum High Forest (listed as a critically endangered ecological community under the TSC Act and the EPBC Act) and Sydney Turpentine – Ironbark Forest (listed as an endangered ecological community under the TSC Act and as a critically endangered ecological community under the EPBC Act). The proposed plan also allows for a significant buffer of native vegetation to surround a likely nesting location for Powerful Owls (*Ninox strenua*) listed as threatened under the TSC Act.

A Flora and Fauna Assessment has been prepared previously by Conacher Travers (Conacher Travers, 2004) for a different plan for the subject land. Cumberland Ecology has made extensive use of this existing ecological information in this report.

A number of buildings within the proposed development, including the retirement village, fall within APZs or have APZs passing between them. These structures were constructed prior to the relevant APZ bushfire legislation being introduced and are therefore approved in their current location (NSW Rural Fire Service, 2006). Both residential and Special Fire Protection Asset Protection Zones are considered necessary for the site as the site not only supports residential development but also the hospital and associated infrastructure.

The areas of thinned trees shown on the concept plan (refer to finalised EA), particularly to the west of the retirement village, the eastern side of Coups Creek and east of Fox Valley Road indicate areas to undergo management for APZs. The area to the south of retirement village is too steep to be managed as an APZ and will undergo fuel reduction management for bushfire protection. These processes are discussed in further detail in

Chapter 4 and exact management regimes will be outlined in the Fire Management Plan (FMP) to be prepared for the site.

1.4 Terminology

The following terminology is used throughout the report:

- Subject site is defined as the parcel of land on which development is proposed;
- Subject land refers to the total parcel of land owned by the Seventh Day Adventist Church, "Wahroonga Estate";
- Study area refers to the subject land and immediate surrounds that may be indirectly affected by the proposal;
- Locality refers to the land within a 5km radius of the subject site;
- TSC Act abbreviates the *Threatened Species Conservation Act 1995*;
- EPBC Act abbreviates the *Environment Protection and Biodiversity Conservation Act 1999*;
- EP&A Act abbreviates the *Environmental Planning and Assessment Act 1979*; and
- Threatened species refers to those flora and fauna species listed as vulnerable, endangered or critically endangered under the TSC Act or EPBC Act.

Coordinate System: UTM WGS 84 (Zone 56)

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Figure 1.1 **Subject Land**

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Chapter 2

Methodology

2.1 Literature Review and Database Analysis

A flora and fauna study of the subject land had previously been undertaken by Conacher Travers (Conacher Travers, 2004). Information on vegetation community mapping, and species recorded, particularly threatened species was extracted from the study. A summary of the methodology used by Conacher Travers is provided in Section 2.4 below.

The vegetation mapping of the Sydney 1:100,000 map sheet (Benson and Howell, 1994) was also used to determine the vegetation communities that occurred on the subject land and to standardise the vegetation community names that have been used in this report.

The Atlas of NSW Wildlife and the EPBC Act Protected Matters Search Tool were consulted for records of threatened flora and fauna species and endangered ecological communities listed under the TSC Act and EPBC Act respectively. The Atlas of NSW Wildlife search included all records within 10km and the EPBC Act Protected Matters search included all protected matters that may occur in a 10km radius.

2.2 Flora Survey

2.2.1 General Vegetation Survey

The vegetation of the subject land was surveyed in June 2008 following a general inspection in order to obtain an overview of the nature, distribution and variation of the vegetation within the study area.

The flora of the subject land was surveyed using quadrats located representatively throughout the subject land. Lists were made of species found when carrying out quadrat and random-meander surveys of the site. Specimens of plants not readily identified in the field were collected for later identification. Ten 20x20m quadrats were surveyed (Figure 2.1). The presence and cover abundance of each flora species in the quadrat was recorded according to the following rating, a modified Braun-Blanquet system:

- 1 = rare
- 2 = occasional
- 3 = common but less than 5% cover
- 4 = very common but less than 5% cover
- 5 = 5-25% cover
- 6 = 26-50% cover

Plant community structure, quadrat location and other details including slope, steepness and aspect of slope, and soil and rock details were recorded for most quadrats.

Species nomenclature accords with Harden (1994) (Harden, 1991, Harden, 1992, Harden, 1993), except for more recent revisions of: *Eucalyptus gummifera* to *Corymbia gummifera.*

Plant community units were generally classified according to structural details (Specht, 1970) and dominant canopy species. These were then compared to the community names used by Benson and Howell (Benson and Howell, 1994) and the names used by Conacher Travers (Conacher Travers, 2004).

2.2.2 Vegetation Condition Assessment

The condition of the vegetation on the subject lands was assessed by botanist David Thomas on 25th, 27th & 28th January 2009 following an initial site inspection and familiarisation. The condition of bushland remnants were mapped using targeted meander observations as well as the completion of 31 quadrats (5 m x 5 m) using survey pro-formas (Appendix F). The location of quadrat surveys was aimed at documenting the mapped condition effectively rather than providing a predictive model that would require an excessive number of quadrats to reflect the local variation.

The condition of the vegetation was mapped according to the weed infestation method described by Ku-ring-gai Council (Ku-ring-gai Municipal Council, 1995).

Weed Polygons were defined to provide a logical basis for the sequence of weed management using the following criteria:

- The type and density of weed infestation occurring;
- The potential for native plant regeneration from the soil seed bank (i.e. site resilience); and
- Weed codes - an estimate of the relative weed density within each stratum.

Vegetation quality definitions were modified from the Ku-ring-gai Council Guidelines (Ku-ring-gai Municipal Council, 1995). Vegetation quality was based on the stratum layer with the highest percentage cover of exotic weeds, where:

- Good quality vegetation was considered to be equivalent to vegetation falling into Weed Class 1. Where the stratum layer with the highest percentage cover of exotic weeds is less than 10%;
- Moderate quality vegetation was considered to be equivalent to vegetation falling into Weed Class 2 or 3. Where the stratum layer with the highest percentage cover of exotic weeds is between 11 and 60%;and
- Poor quality vegetation was considered to be equivalent to vegetation falling into Weed Class 4. Where the stratum layer with the highest percentage cover of exotic weeds is greater than 61%.

2.3 Fauna Surveys

The fauna survey work completed by Cumberland Ecology in June and August of 2008 updates the existing detailed fauna survey completed by Conacher Travers in November 2003. The results of the Conacher Travers survey work are incorporated into the Results section (Chapter 3) of this report. The Cumberland Ecology fauna surveys consisted of the diurnal and nocturnal survey methods outlined below.

2.3.1 Hair Funnel Survey

Faunatech hair funnels were placed in 3 transects of 20 funnels each, as shown in Figure 2.1. These funnels were set during 12th and 13th August 2008 with half the funnels placed on the ground and half on tree trunks, alternating throughout each transect. All funnels were collected on 19th August 2008. Hair funnels were baited with a mixture of peanut butter, oats, honey and diced bacon.

2.3.2 Spotlighting and call playback survey

Spotlighting was conducted on the nights of 11th March, 12th March, 12th August and 13th August 2008. The duration of surveys varied from 1hr 20min to 2hrs and incorporated call playback surveys. The routes traversed while spotlighting are shown in Figure 2.1.

During the survey period Powerful Owls were detected on the subject land. The presence of a recently fledged juvenile indicated that Powerful Owls were utilising the site for nesting. As Powerful Owls are known to be sensitive to disturbance during the nesting period, best practice dictated that call playback of owl or glider calls should not be conducted at the site during the survey period.

2.3.3 Tree hollow survey

A systematic search of the site was conducted to locate any hollow bearing trees not previously mapped by Conacher Travers. The following characteristics were noted for each tree:

- Tree species;
- Signs of use by fauna including scratch marks;
- Diameter at breast height;
- Number of hollows; and
- The presence of scats around the base of the tree.

2.3.4 Frog Survey

Frog surveys were carried out by Grant Webster at the site on the 11th and 12th of June 2008. Targeted searches were conducted for all threatened species recorded in the locality from the Atlas of NSW Wildlife, which includes; Giant Burrowing Frog, Green and Golden Bell Frog, Littlejohn's Tree Frog, Stuttering Frog, Southern Barred Frog and Red-crowned Toadlet. Heavy rain fell on the night of the 10th of June but the following three days were fine and sunny.

The site was traversed on foot during the day of the 11th of June and all freshwater habitats were recorded. Targeted searches were conducted for potential habitat of all threatened frogs known to occur in the wider locality. On the nights of the 11th and 12th of June the sites were revisited and all calling frogs were noted. At various locations across the site, the call of the Red-crowned Toadlet was imitated to try to elicit a response. Each freshwater site was then searched using head-lamps to locate sheltering frogs.

2.3.5 Bird survey

An aural and visual survey for diurnal birds was conducted on the 12th and 13th of August 2008 by searching all available habitat. Targeted surveys were conducted for Gang-gang Cockatoos, Swift Parrot, Glossy Black Cockatoo and Powerful Owl by Mr Carl Corden.

2.4 Conacher Travers Survey Methodology

Field surveys of the subject site were conducted by Conacher Travers on the 10, 18, 21 & 25 November 2003 and 13 April 2004. The flora surveys consisted of;

- Foot traverses within vegetated areas to identify the occurrence of flora species and the extent and location of vegetation communities present across the subject site;
- Ten (10) linear transects (100m long) were traversed on foot with observation and recording of all flora species observed within 2 metres of the transect being undertaken;
- Twelve (12) 20 x 20 metres (400m2) quadrats were sampled within the site recording the presence of all vascular plant taxa; and
- Any hollow bearing trees located within the area covered by the transects or quadrats were assessed for their habitat value during this survey. Any additional hollow bearing trees located during the survey that were not within these transects were also assessed.

Fauna surveys consisted of diurnal and nocturnal surveys as listed below:

- Nocturnal spotlighting;
- Bat echolocation call detection;
- Arboreal and terrestrial mammal trapping using Elliott Type A & B traps and cage traps;
- Arboreal and terrestrial mammal habitat searches;
- Habitat tree assessment;
- Amphibian searches;
- Reptile searches;
- Playback of recorded owl calls; and
- Diurnal and nocturnal bird surveys.

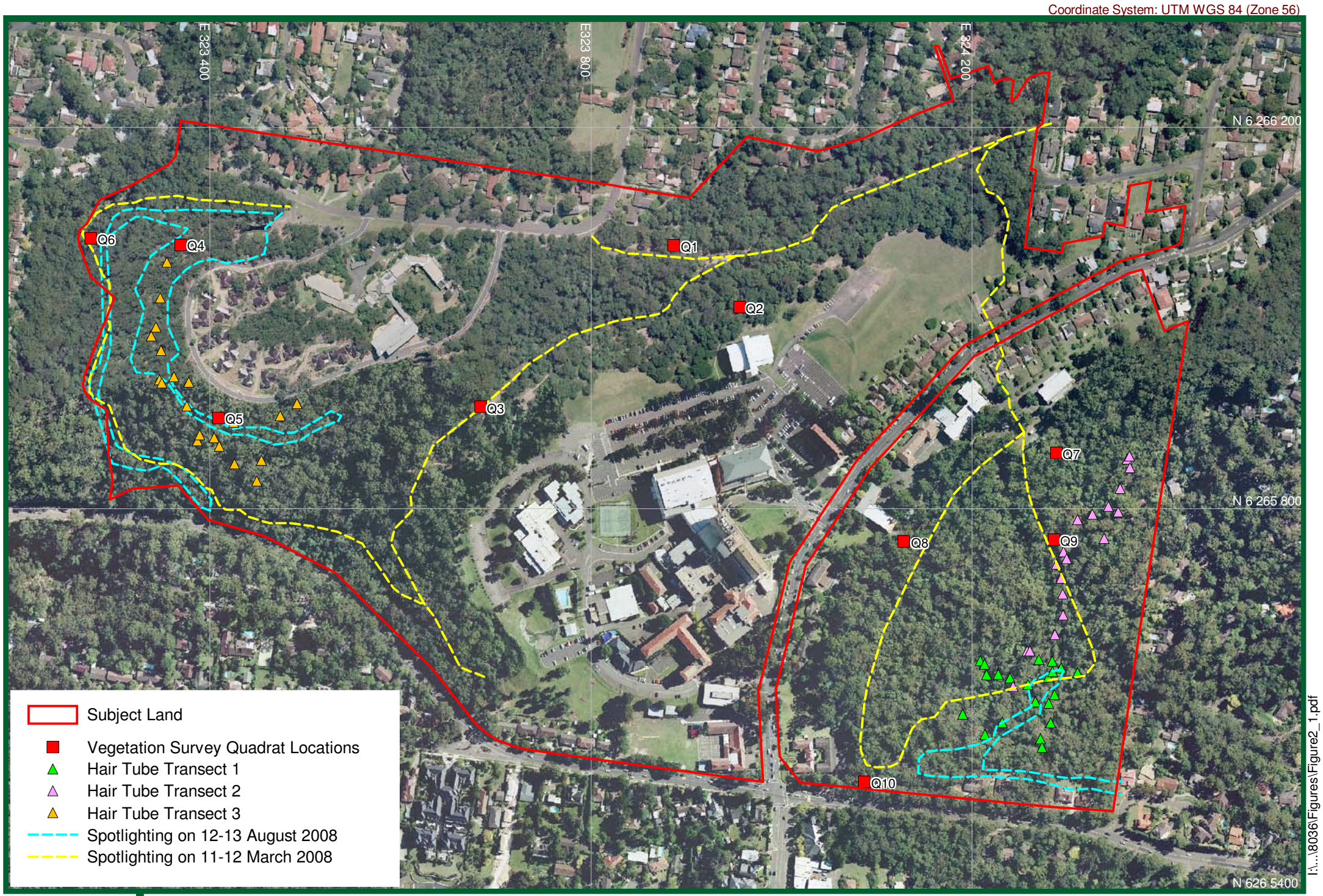

Figure 2.1 **Survey Effort Locations**

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Chapter 3

Results

3.1 Introduction

The vegetation of the subject site varies in condition from patches of open forest where the native shrub layer prevents the growth of weeds, to highly degraded areas where the understorey is dominated by exotic weeds. Much of the subject site contains evidence of disturbance from edge effects and slashing. A number of walking tracks are present throughout much of the vegetation. A full list of flora and fauna species identified on the subject site is provided in Appendix A and Appendix D respectively.

Much of the open forest vegetation provides a large number of tree hollows for birds and arboreal mammals while the denser riparian vegetation provides potential habitat for species that prefer to be beside water. Streams in the area flow through largely urbanised catchments; as such, the water quality in riparian areas is assumed to be quite degraded and consist of a high proportion of storm water runoff.

3.2 Vegetation Communities

The following vegetation communities were identified on the subject site:

- Blue Gum High Forest;
- Blackbutt - Turpentine - Smooth-barked Apple Open Forest;
- Sydney Peppermint - Red Bloodwood Open Forest;
- Sydney Turpentine - Ironbark Forest;
- Riparian Vegetation; and
- Cleared Land with Scattered Trees.

These communities are mapped in Figure 3.1 and described in further detail below.

The condition of the vegetation within these communities is mapped in Figure 3.2 and described in further detail below

Coordinate System: UTM WGS 84 (Zone 56)

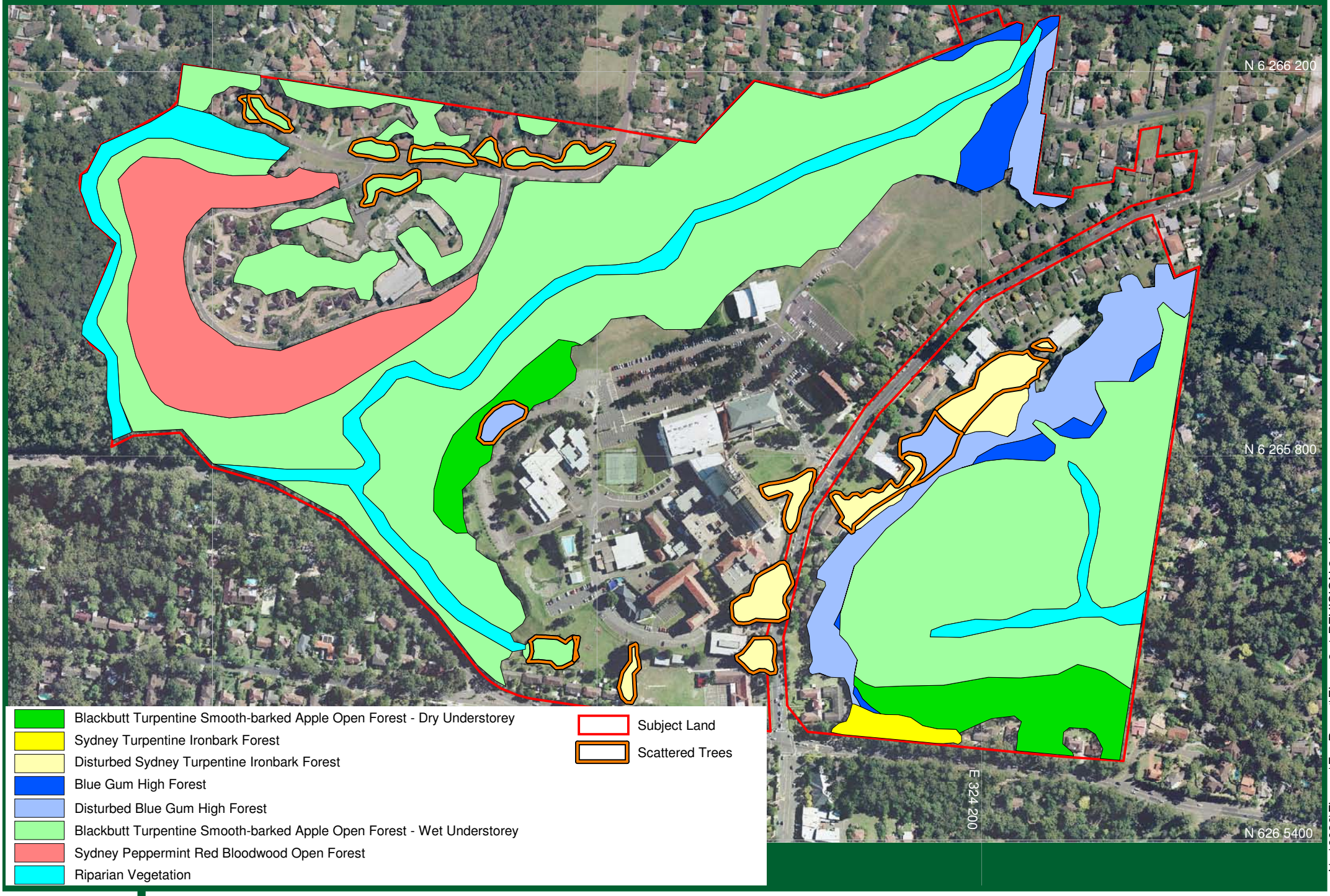

Figure 3.1 **Vegetation Communities on the Subject Land**

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Coordinate System: UTM WGS 84 (Zone 56)

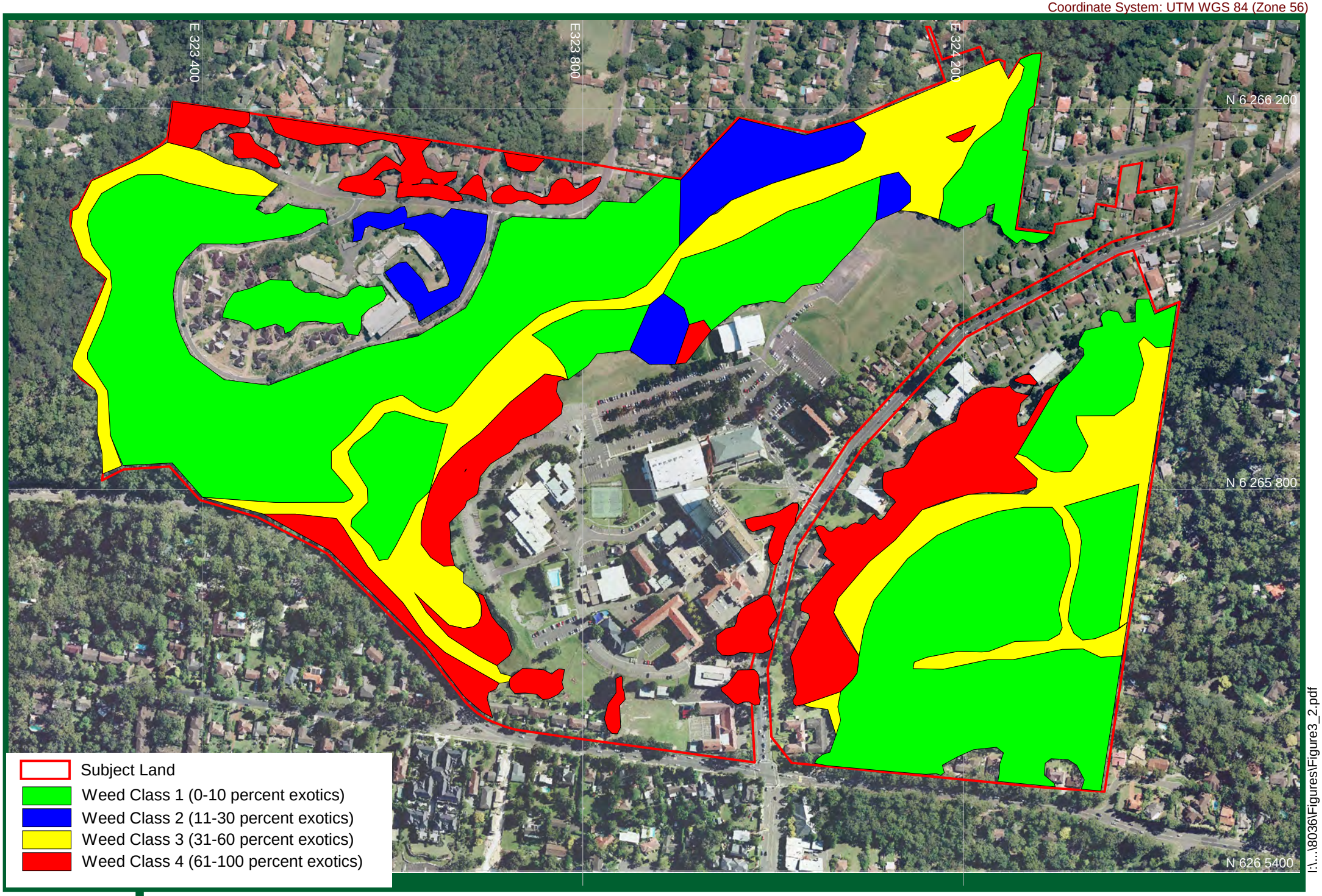

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Figure 3.2 **Condition of Vegetation on Subject Land**

3.2.1 Blue Gum High Forest

i. Conservation status

Blue Gum High Forest (BGHF) is listed as a Critically Endangered Ecological Community (CEEC) under the TSC Act and the EPBC Act (named *Blue Gum High Forest of the Sydney Basin Bioregion*).

All of the BGHF on the subject lands is considered to be the community as listed under the TSC Act with most of the community being dominated by exotics, with localised patches of native species. There are two small areas of BGHF on the subject land that are not considered to meet the requirements of the EPBC Act. One of these areas is a small patch of remnant scattered trees while the other is a small area of Blue Gum regrowth that has emerged from excavated fill material.

The small patch of BGHF on the eastern side of Fox Valley Road (Figure 3.1) is not considered to represent the ecological community as required under the EPBC Act due to its highly disturbed nature and small size. This area of BGHF contains no native shrubs with only a small percentage of native ground covers. This area is considered to be of low long-term management viability because it is an example of isolated trees characteristic of the community that have been incorporated in to an exotic lawn surrounded by disturbed/developed land. The crowns of these trees are connected to nearby bushland to the east; however the shrub layer is absent and the groundlayer has limited connectivity to this bushland due to exotic weed invasion. This group of scattered trees has an area of 0.15 ha. According to 'Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on amendments to the List of Ecological Communities under the EPBC Act on Blue Gum High Forest of the Sydney Basin Bioregion (BGHF)' (DEH, 2005a) such groups of scattered trees and any area of BGHF smaller than 1ha in size are not considered to represent the EPBC Act listed CEEC but are considered the CEEC under the TSC Act.

The area of BGHF regrowth on excavated fill material west of the hospital is 0.11 ha in area. This area is highly disturbed in nature and is a location for the regular dumping of vegetation waste. Weed invasion in the shrub and ground layer is high and the area is considered to be of low long term management viability. Due to the highly disturbed nature and small size of this area of BGHF it is not considered to represent the CEEC under the EPBC Act (DEH, 2005a) but is considered the CEEC under the TSC Act..

The other two areas of BGHF on the subject land occur in a corridor adjacent to the eastern side of Fox Valley Road and adjacent to the site boundary at the northern end of the Coups Creek corridor. Both of these areas are greater than one hectare in size and are directly connected to large areas of adjacent bushland. Therefore these areas of BGHF are considered to meet the listing requirements of the EPBC Act (DEH, 2005a).

ii. Other vegetation mapping

Blue Gum High Forest that has been mapped for this report is consistent with the NPWS mapping of a remnant of Map Unit 152 – Blue Gum High Forest (NSW NPWS, 2002), Map Unit 6b – Blue Gum High Forest (Benson and Howell, 1994) and the community Open Forest – *Eucalyptus saligna* mapped by Conacher Travers (Conacher Travers, 2004).

iii. Distribution on the subject land

This vegetation community occurs along the ridge tops and upper slopes and is associated with clay influenced soils. It primarily occurs in two areas; along the eastern side of Fox Valley Road and in the north-west corner of the subject site, west of Elizabeth Street and south of Ferndale Road. An area of scattered *Eucalyptus saligna* trees exist on excavated fill material to the west of the hospital.

iv. Community description

The canopy is dominated by *Eucalyptus saligna* (Sydney Blue Gum), *E, pilularis* (Blackbutt), *E. deanei* (Mountain Blue Gum) and *Syncarpia glomulifera* (Turpentine), with a height of 30m and projective foliage cover (PFC) of 30-50%. The shrub layer is dominated by *Pittosporum undulatum* (Sweet Pittosporum), *Breynia oblongifolia* (Coffee Bush), the exotic Large-leaved and Small-leaved Privet *(Ligustrum lucidum* and *L. sinense*), and *Notelaea longifolia* (Mock Olive). The shrub layer extends to 6m in height with a PFC of 5-90%. Common ground layer species are a mixture of exotic and native species including the exotic grasses *Bromus cartharticus* (Prairie Grass), *Erharta erecta* (Panic Veldtgrass) and *Briza maxima* (Quaking Grass), native grass *Microlaena stipoides* var *stipoides* (Weeping Meadow Grass), native herbs *Pratia purpurascens* (Whiteroot), *Sigesbeckia orientalis* (Indian Weed) and *Geranium homeanum* (Northern Cranesbill), and exotic herbs *Ageratina adenophora* (Crofton Weed) and *Tradescantia fluminensis* (Wandering Jew).The ground layer extends to 1.5m high with PFC of 75-95%.

v. Condition

a. General Condition

The condition of the vegetation within the BGHF community is generally poor; but varies, depending upon location and current vegetation management practices. In areas where management activities such as slashing for bushfire protection occurs weed invasion tends to be high and the shrub layer has been removed. In areas at greater distances from current developments disturbances from edge effects and weed invasion are less obvious, resulting in better quality vegetation.

The community contains a high level of exotic weeds particularly within the ground and shrub layers. Its proximity to the developed areas of the subject land has allowed for increased weed invasion. The following weeds are present: *Ligustrum sinense* (Small-

leaved Privet), *Ligustrum lucidum* (Large-leaved Privet), *Ageratina adenophora* (Crofton Weed), *Cinnamomum camphora* (Camphor Laurel), *Lantana camara* (Lantana), *Bromus cartharticus* (Prairie Grass), *Ehrharta erecta* (Panic Veldtgrass), *Briza maxima* (Quaking Grass) and *Tradescantia fluminensis* (Wandering Jew).

b. Condition of BGHF to the east of Fox Valley Road

East of Fox Valley Road, the main exotic species present in areas maintained by periodic slashing included: *Ehrharta erecta* (Veldt Grass), *Tradescantia albiflora* (Wandering Jew) and introduced Asteraceae. Other significant species were: *Sida rhombifolia*, *Rubus fruticosus* (Blackberry), *Pennisetum clandestinum* (Kikuyu) and *Delairea odorata* (Cape Ivy). These generally covered an estimated 99% of the projective foliage cover of the ground cover stratum in the eastern section of this community.

Exotics were generally dominant however there were some relatively large concentrations of indigenous species present. The few largely native ground cover patches typically contained: *Microlaena stipoides*, *Dichondra repens*, *Cyperus gracilis*, *Oplismenus aemulus*, *Lomandra longifolia*, *Poa affinis* and *Adiantum aethiopicum*,

Small trees and shrubs were generally absent. In locations where these occurred, juvenile *Ligustrum sinense* was the most common species. Native species were present where mowing had been discontinued or less frequent. The percentage of weed cover in these locations ranged from 5-60%. This was unlikely to result in development of a relatively natural small tree and shrub understorey as woody weeds such as *Ligustrum* spp. and *Lantana camara* would be expected to dominate, as has occurred in numerous locations below the margin of the slashed zone. Very small areas of BGHF, with a better quality understorey, occurred below the slashed zone of the upper slope.

Indigenous shrub species recorded included: *Notelaea longifolia*, *Breynia oblongifolia*, *Leucopogon juniperinus*, *Polyscias sambucifolius*, *Platylobium formosum*, *Pittosporum revolutum*, and *Ozothamnus diosmifolius*. The small tree stratum was largely absent but included: *Pittosporum undulatum* and occasional *Elaeocarpus reticulatus* and *Trochocarpa laurina*.

The canopy was similar to that in a natural forest (30-50% PFC) generally although more open locally. *Syncarpia glomulifera*, *Eucalyptus pilularis Eucalyptus saligna* and *Angophora costata* were the main species. Some non-local eucalypts had been planted in this zone.

A shrubby understorey had regrown downslope of the slashed vegetation zone, and was dominated by exotic species, especially *Lantana camara* (Lantana) at the upper margin. *Ligustrum sinense* (Small-leaved Privet) was the main species downslope of the *Lantana* band. In these locations exotic shrubs typically comprised 60-100% of the shrub stratum.

Owing to the general lack of indigenous species below the canopy and the anticipated nutrient enrichment of soil adjacent to the developed zone, it was concluded that the

eastern section of BGHF was not recoverable to a plant community that would be representative of the original community and viable as a native plant community.

Some of the northern section of this community, east of Fox Valley Road would be recoverable; however surrounding areas would probably remain as predominantly exotic, owing to their dominance by herbaceous environmental weeds that have repeatedly shown great resistance to control in most bush regeneration projects.

c. Condition of BGHF at the northern limit of Coups Creek

North of Fox Valley Road, the condition of BGHF was more variable but generally poor. The understorey adjacent to the existing residences had been cleared, probably as a fire hazard control measure, and almost totally replaced by exotic species in the three understorey strata.

Further away from the houses the understorey appears to have been cleared but later replaced with *Ligustrum* spp. and *Pittosporum undulatum*. The ground cover was sparse owing to the dense canopy and varied greatly but was generally dominated by exotics. The most common exotics were: *Ehrharta erecta*, *Tradescantia albiflora*, *Ligustrum sinense* seedlings, *Asparagus densiflorus* and *Hedera helix*. Recorded native species included: *Dichondra repens*, *Cyperus gracilis*, *Oplismenus imbecillis*, *Microlaena stipoides* and *Geranium homeanum*. The percentage of understorey covered by exotics was approximately 20-100% and 5-90% in the small tree and shrub strata, respectively.

The northern BGHF is very limited in area within the study area; however it extends further upstream and is part of a riparian corridor that impacts on Lane Cove National Park. Although the understorey of this forest is infested with mainly woody weeds, there would be potential to control these provided sufficient resources were available. The dense canopy currently limits the invasion of numerous herbaceous species that would make restoration much more difficult. Any weed control program should avoid overclearing to prevent this occurring. *Tradescantia albiflora* and *Ligustrum sinense* are probably the main species that need targeting initially.

Provided that appropriate strategies are used, part of the small northern section of this community (beyond the fire hazard control zone) could be restored to a condition more representative of BGHF. The section adjoining the houses is probably not feasible to restore as it would be retained as largely exotic ground cover in order to provide protection from bushfire.

d. Condition of BGHF to the west of the hospital

This area of BGHF exists on highly disturbed soil of excavated fill origin; as such the extent of exotic weed invasion is high. Exotics dominate the ground and shrub layers with percentage covers of approximately 80% and 65% respectively. The dominant weeds were *Asparagus densiflorus*, *Tradescantia albiflora* and *Ligustrum sinense*. Considering the general lack of indigenous species below the canopy, the small size of this area and the highly disturbed nature of the soil, it was concluded that this area of BGHF is not

recoverable to a plant community that would be representative of the original community and viable in the longer term.

Photograph 3.1 Blue Gum High Forest on the subject site.

3.2.2 Blackbutt – Turpentine – Smooth-barked Apple Open Forest

i. Conservation status

Sydney Sandstone Gully Forest is relatively well-represented throughout its distribution. Large tracts of this community are conserved within Ku-ring-gai Chase and Lane Cove National Parks.

ii. Other vegetation mapping

This community is consistent with the Tall open forest: *Eucalyptus pilularis – Syncarpia glomulifera* form of the Benson and Howell Map Unit 10ag – Sydney Sandstone Gully Forest (Benson and Howell, 1994). It has been mapped as Open Forest – *Eucalyptus pilularis/Syncarpia glomulifera/Angophora costata* by Conacher Travers (Conacher Travers, 2004).

This vegetation community most closely resembles Map-unit 10ag – Sydney Sandstone Gully Forest as described by Benson & Howell (1994).

iii. Distribution on the subject lands

The community can be divided into two distinct forms and as such has been mapped as Blackbutt, Turpentine, Smooth-bark Apple Open Forest (2a) - Wet Understorey form and Blackbutt, Turpentine, Smooth-bark Apple Open Forest (2b) - Dry Understorey form

The Open Forest (2a) - Wet Understorey form vegetation type is located on the mid and lower slopes and associated with sandstone substrate. A mesic shrub layer and high density of vine species dominate this community. The Open Forest (2b) – Dry Understorey form is located on the upper slopes of the sandstone substrate.

iv. Community description

The dominant trees present are *Eucalyptus pilularis* (Blackbutt), *Syncarpia glomulifera* (Turpentine), *Angophora costata* (Smooth-barked Apple), *Glochidion ferdinandi* (Cheese Tree), *Pittosporum undulatum* (Sweet Pittosporum) and *Allocasurina torulosa* (Forest Oak). Trees extend to 30m with a 50 – 65% PFC. The shrubs present include: *Pittosporum undulatum* (Sweet Pittosporum), *Ligustrum sinense* (Small-leaved Privet), *Leptospermum polygalifolium subsp. polygalifolium* (Lemon-scented Tea Tree), *Notelaea longifolia* (Mock Olive), *Allocasuarina torulosa* (Forest Oak) and *Glochidion ferdinandi* (Cheese Tree). Shrubs are present to 6m with a 35 – 40% PFC. The ground layer includes: *Entolasia marginata* (Bordered Panic), *Pseuderanthemum variabile* (Pastel Flower), *Blechnum cartilagineum* (Gristle Fern), *Calochlaena dubia* (Harsh Ground-fern), *Adiantum aethiopicum* (Common Maiden-hair Fern), *Dianella caerulea var. producta* (Blue Flax Lily) and *Oplismenus aemulus* (Basket Grass). The ground layer is present to 1.5m in height with a 60% PFC.

v. Condition

Most of this community southeast of Fox Valley Road was in excellent condition as much was unaffected by stormwater and other impacts. Exceptions included: lower gully zones and gully heads and some areas adjacent to residences. Some residents have been disposing of garden waste in the bushland, including environmental weeds such as *Tradescantia albiflora*. Some sections had been cleared for fire hazard and were being colonised by exotics and in part had been planted with exotic garden species.

A shrubby understorey had regrown downslope of the slashed vegetation zone and BGHF, and was dominated by exotic species, especially *Lantana camara* (Lantana) at the upper margin. *Ligustrum sinense* (Small-leaved Privet) was the main species downslope of the *Lantana* band. The width of *Lantana* understorey varied from approximately five to 15 metres. The *Ligustrum*-dominated understorey varied from a few metres width to over 50 metres down to the drainage lines. Generally the density of *Ligustrum* reduced further from the upper margin, indicating that it originated at the upper slope where soil nutrient levels were greatest. Despite this, the occurrence of seedlings of the exotic species indicated

that the condition of the lower slope should be anticipated to degenerate in the future unless suitable maintenance occurs.

Gully heads usually contained very high proportions of exotics. This appeared to be related to excess soil nutrient flows in stormwater from the upslope developed zone. Conversely, generally downslope of the BGHF, the ridges and their slopes tended to have low concentrations of exotics (generally estimated at less than 5%).

No exotic species were recorded in the canopy. In the gullies, exotics usually formed between 50 and 90% of the shrub and ground cover strata. Upper slopes and ridges generally contained only scattered individuals of introduced species. All these were environmental weeds and could be expected to greatly increase in concentration eventually if not managed appropriately owing to the suitable natural conditions of the site.

The much larger example of this community west of Fox Valley Road along the Coups Creek corridor is in variable condition, ranging from similar high densities and species of understorey exotics on some slopes and gullies, to very low proportions on the slopes, apart from margins of residential areas.

No exotics were recorded in the canopy. Exotic small tree, shrub and ground cover strata concentrations of exotics varied between nil and 100%. In good quality areas readings of less than 5% exotic species were obtained in the three lowest strata. The worst affected area was along the margin of Comenarra Parkway where exotics dominated all the understorey strata.

The recovery potential of the community east of Fox Valley Road is considered to be good. Most of the community is in excellent condition although individuals of some bird-spread environmental weeds are scattered through it. These could be expected to mature and reproduce eventually, spreading into new populations that would adversely affect the community. Occasional weed control in the currently excellent condition forest could be effective in maintaining its viability indefinitely.

The weed-infested slopes and margins appear to contain natural soil that is likely to be mildly affected by excess nutrients in stormwater runoff. In this condition it would still be feasible to implement effective weed control to restore the community to a more natural condition that is representative of the original forest. As with most bushland in the metropolitan area, weed control would need to be continued periodically once more stable native vegetation was established.

The community north of Fox Valley Road contained sections that would be feasible to regenerate and some in which this is unlikely to be achievable, given the probable limitation of resources that could be relied upon. It was considered that most of the east-west section of Coups creek forested zone could be restored. The section along Comenarra Parkway is probably beyond the limit of practical recoverability.

Photograph 3.2 **Blackbutt – Turpentine – Smooth-barked Apple Open Forest on the subject site.**

3.2.3 Sydney Peppermint – Red Bloodwood Open Forest

i. Conservation status

Sydney Sandstone Gully Forest is relatively well-represented throughout its distribution. Large tracts of this community are conserved within Ku-ring-gai Chase and Lane Cove National Parks.

ii. Other vegetation mapping

This community is consistent with the Open forest/woodland: *Eucalyptus piperita* – *Angophora costata* – *Eucalyptus gummifera* form of the Benson and Howell Map Unit 10ag – Sydney Sandstone Gully Forest (Benson and Howell, 1994). It has been mapped as Open Forest – *Eucalyptus pilularis/Syncarpia glomulifera/Angophora costata* by Conacher Travers (Conacher Travers, 2004).

iii. Distribution on the subject land

This community occurs in the western portion of the subject land to the south of the retirement village and in a small patch in the south eastern corner of the subject land. It is associated with upper slopes and ridges on sandstone substrate.

iv. Community description

The dominant trees are: *Eucalyptus piperita* (Sydney Peppermint), *Corymbia gummifera* (Red Bloodwood), *Angophora costata* (Smooth-barked Apple), *Syncarpia glomulifera* (Turpentine) and *Allocasuarina littoralis* (Black She-oak). The canopy reaches a height of 24 metres with 45-50% PFC.

The shrub layer consists of: *Dodonaea triquetra* (Hop Bush), *Leptospermum trinervium* (Flaky-barked Tea Tree), *Banksia spinulosa* (Hairpin Banksia), *Leptospermum polygalifolium subsp. polygalifolium* (Lemon-scented Tea Tree), *Persoonia linearis* (Narrow-leaved Geebung), *Dillwynia retorta subsp. retorta* (Eggs and Bacon), and *Platysace lanceolata* (Lance-leaf Platysace). Shrubs are present to 6 metres high with 50-55% PFC.

Ground layer species observed were: *Lomandra obliqua* (Twisted Mat Rush), *Xanthorrhoea arborea* (Broad-leaf grass tree), *Dianella caerulea var. producta* (Blue Flax Lily), *Entolasia marginata* (Bordered Panic), *Entolasia stricta* (Wiry Panic), *Imperata cylindrica var. major* (Blady Grass), *Lepidosperma laterale* (Variable Sword-sedge) and *Pteridium esculentum* (Bracken). The groundlayer reaches a height of 1.5 metres with 60% PFC.

v. Condition

This community was in excellent condition apart from occasional, very small localised sections near disturbed margins. Exotics were uncommon in all strata and were typically absent.

Typical canopy species were: *Eucalyptus piperita* (Sydney Peppermint), *Corymbia gummifera* (Red Bloodwood) and *Angophora costata*. *Eucalyptus pilularis* and *Syncarpia glomulifera* were occasionally present as individuals or in local patches.

Small trees were uncommon but included: *Banksia serrata*, *Pittosporum undulatum* and *Elaeocarpus reticulatus*. Shrubs formed the main understorey stratum. Common species were: *Dillwynia retorta*, *Acacia linifolia*, *Xanthorrhoea concava*, *Banksia spinulosa*, *Acacia terminalis* and *Persoonia levis*.

This community does not need restoration apart from removal of scattered individual weeds but may require maintenance weed control as thinning of the canopy and understorey may facilitate weed colonisation and spread.

Photograph 3.3 **Sydney Peppermint – Red Bloodwood Open Forest on the subject site.**

3.2.4 Sydney Turpentine-Ironbark Forest

i. Conservation status

Sydney Turpentine-Ironbark Forest (STIF) is listed as an Endangered Ecological Community under the TSC Act (named *Sydney Turpentine-Ironbark Forest*) and a Critically Endangered Ecological Community under the EPBC Act (named *Turpentine-Ironbark Forest in the Sydney Basin Bioregion*). All STIF on the subject land is considered to represent the community under the TSC Act, however none of this vegetation is considered to meet the listing requirements of the EPBC Act due to its small size and highly disturbed nature as outlined below..

Much of the STIF on the subject lands exists as small patches of highly disturbed remnants of the actual community with one area of relatively undisturbed STIF present on the western side of Fox Valley Road (Figure 3.1)The four small patches of STIF on the western side of Fox Valley Road and within the school grounds (Figure 3.1) are not considered to represent the ecological community as required under the EPBC Act due to their highly disturbed nature and their small size. All four of these areas of STIF contain no native shrubs with only a small percentage of native ground covers. These areas are considered to be of low long-term management viability because they are examples of isolated trees characteristic of the community that have been incorporated in to exotic lawns and garden beds. These areas are surrounded by disturbed/developed lands and are in no way interconnected to nearby bushland. These areas are considered to have

little to no recovery potential and therefore are not considered to fulfill the listing requirements for the community under the EPBC Act as stated within 'The Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on amendments to the List of Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on Turpentine-Ironbark Forest of the Sydney Basin Bioregion' (DEH, 2005b).

A small number of trees characteristic of the STIF community incorporated into landscaped lawns are present on the eastern side of Fox Valley Road. Similar to the trees on the western side of the road, these areas contain no native shrubs with few native ground covers present in very small percentages. The canopies of these trees are connected to adjacent bushland areas; however there is no connectivity at mid-storey or ground level. Therefore, as for the trees on the western side of Fox Valley Road, these trees are not considered to represent the listing requirements for the community under the EPBC Act due to the highly disturbed nature of these community remnants (DEH, 2005b).

Of the three areas of STIF on the eastern side of Fox Valley Road, the two northern most areas are considered to be of low long-term management viability, while the southern most is considered to be of moderate long-term management viability. The two northern most areas are presently in an area of a bushland fringe that undergoes regular slashing and management to create a 'defendable space' for bushfire protection. The shrublayer is absent due to regular management activities and the groundlayer is dominated by exotic species with intermittent occurrences of natives. The crowns of these areas are directly connected to the native bushland to the east; however the connectivity of the ground layer is limited due to the high proportion of exotic weed invasion in the area. Both of these areas are less than one hectare in size (0.21 ha in the north and 0.06 ha in the south). The Nationally Threatened Species and Ecological Communities Information Sheet on Turpentine - Ironbark Forest of the Sydney Basin Bioregion produced by the Department of the Environment and Heritage in September 2005 states "The listed ecological community includes patches with an intact vegetation structure, a tree canopy cover greater than 10%, and an area greater than one hectare" (DEH, 2005c). Based on these requirements these areas of STIF are not considered the CEEC due to the degraded nature of the ground and shrub layers and their area being less than 1 ha.

The area of STIF to the east of Fox Valley Road and adjacent to Comenarra Parkway is by far the best example of this community on the subject land. Native shrub and ground layers are present and the proportion of weed invasion is far lower than in other areas. The approximate area of this example of the CEEC is 0.28 ha. This area of STIF has good connectivity to the north and east with the bushland of the subject land but is bounded by Fox Valley Road to the west and Comenarra Parkway to the south. This area of vegetation is considered to be of moderate long term management viability. Despite the intact shrub and ground layers, low level of disturbance and low level of exotic weed invasion; this area of STIF does not meet the listing requirements of the EPBC Act because the area is less than one hectare in size (DEH, 2005b, DEH, 2005c).

ii. Other vegetation mapping

This vegetation community on subject site is considered to be consistent with Map Unit 15 – Turpentine Ironbark Forest as described by the National Parks and Wildlife Service (2002). It has been mapped as Open Forest – *Syncarpia glomulifera/Eucalyptus paniculata* by Conacher Travers (Conacher Travers, 2004).

iii. Distribution on the subject land

This vegetation community is found in close proximity to the Blue Gum High Forest on the eastern side of Fox Valley Road. Also, small groups of scattered trees characteristic of the community are present in a number of locations within the school and hospital grounds (Figure 3.1).

iv. Community Description

This community consisted of trees to 30 metres high with 65-70% PFC. The main tree species were *Syncarpia glomulifera* (Sydney Turpentine) and *Eucalyptus paniculata* (Grey Ironbark). Shrubs were sparse to absent with *Senna pendula var. glabrata* (Senna) and juveniles; and *Notelaea longifolia* (Mock Olive) present. Groundcovers were observed to 0.5 metres high with PFC of 70-80%. Species present included *Ehrharta erecta* (Panic Veldtgrass), *Commelina cyanea* (Scurvy Weed), *Paspalum dilatatum* (Paspalum), *Sida rhombifolia* (Paddy's Lucerne), *Trifolium repens* (White Clover) and *Cynodon dactylon* (Common Couch).

v. Condition

The condition of this community is generally poor with most areas consisting of remnant trees characteristic of the community that have been incorporated into lawns, landscaped gardens and fire protection zones. Exotic weed invasion in these areas is high with the dominant species being *Ehrharta erecta* (Panic Veldtgrass), *Paspalum dilatatum* (Paspalum), *Sida rhombifolia* (Paddy's Lucerne), *Trifolium repens* (White Clover) and. *Pennisetum clandestinum.* In certain areas exotic weeds dominated the ground cover up to 100%. Native ground covers, where present, typically contained: *Microlaena stipoides*, *Dichondra repens*, *Oplismenus aemulus*, *Poa affinis* and *Adiantum aethiopicum*. Shrubs were sparse to absent in these areas.

Due to the highly modified nature of this form of the community and high exotic weed invasion it was concluded that these sections of STIF are not recoverable to a plant community that would be representative of the original community or viable as a native plant community.

The small area of STIF located on the corner of Fox Valley Road and Comenarra Parkway is in far better condition than the other areas of this community. It contains a well developed shrub layer and a much higher proportion of native groundcovers (up to 65%).

Typical weeds include: *Ehrharta erecta*, *Tradescantia albiflora*, *Ligustrum sinense*, *Asparagus densiflorus* and *Hedera helix*. In this condition it is considered feasible to implement effective weed control to restore the community to a more natural condition that is somewhat representative of the original forest. The long-term viability of this community is questionable due to its small size.

3.2.5 Riparian Vegetation

i. Conservation status

Due to the proximity of this vegetation community to watercourses it is protected under the State's *Rivers and Foreshores Improvement Act 1948.*

ii. Other vegetation mapping

This community is consistent with the Closed forest: *Ceratopetalum apetalum – Tristaniopsis laurina* form of the Benson and Howell Map Unit 10ag – Sydney Sandstone Gully Forest (Benson and Howell, 1994) and with the Riparian Vegetation unit mapped by Conacher Travers (Conacher Travers, 2004). There are some broad transition zones and integration of species between this community and the Blackbutt –Turpentine Smooth-barked Apple Open Forest - Wet Understorey form.

iii. Distribution on the subject land

This community is associated with the drainage channels across the subject land.

iv. Community Description

Trees within this community form a canopy to 30 metres high with 65% PFC and consist of *Syncarpia glomulifera* (Turpentine), *Eucalyptus pilularis* (Blackbutt), *Ceratopetalum apetalum* (Coachwood), *Callicoma serratifolia* (Black Wattle), *Glochidion ferdinandi* (Cheese Tree), *Pittosporum undulatum* (Sweet Pittosporum) and *Acmena smithii* (Lilly Pilly).

The shrubs present are *Pittosporum undulatum* (Sweet Pittosporum), *Ligustrum sinense* (Small-leaved Privet), *Notelaea longifolia* (Mock Olive), *Ligustrum lucidum* (Large-leaved Privet), *Lomatia myricoides* (River Lomatia) and *Glochidion ferdinandi* (Cheese Tree). They exist to a height of 6 metres with 45-55% PFC.

The ground-layer is present to 1.5 metres high with 35-45% PFC. Species present include: *Entolasia marginata* (Bordered Panic), *Pseuderanthemum variabile* (Pastel Flower), *Ehrharta erecta* (Panic Veldtgrass), *Blechnum cartilagineum* (Gristle Fern), *Calochlaena dubia* (Harsh Ground-fern), *Tradescantia fluminensis* (Wandering Jew),

Adiantum aethiopicum (Common Maiden-hair Fern), *Dianella caerulea var. producta* (Blue Flax Lily) and *Oplismenus aemulus* (Basket Grass).

v. Condition

The riparian zones of most creeks in developed areas contain high proportions of exotic plant species. This principle also applied to riparian zones and gullies in the current study area where introduced species formed between 10 and 90% of the understorey strata. Exotics were generally absent from the canopy. Woody weeds dominated the Coups Creek southern tributary, especially on the eastern side that had been affected by runoff from Comenara Parkway. The western side was significantly less weedy owing to minimal nutrient impacts. Several sections of the riparian zone contained very few, or low proportions of exotics. The section along Coups Creel northern tributary was exceptional by being virtually weed-free for its length in the study area. Dense *Tradescantia albiflora* and other weeds were observed further upstream.

The nature of the vegetation in the riparian zones varied greatly, from disturbed herbaceous locations, to extensive open forest sections and localised closed forest. These conditions affected the ability of woody and most herbaceous weeds to colonise.

Owing to the long-term existing riparian impacts of the developed catchment, it would not be expected that restoration of the whole community would be achievable. Despite this assessment, some sections are in excellent condition and should be maintained or restored. In most other sections it would be possible to control weeds to obtain a community that is representative of the original vegetation. The worst sections (Coups Creek south tributary) would be a major challenge that would require long-term consistent management with sufficient provision of resources to outpace reinfestation or conversion to a herbaceous weedy understorey.

Photograph 3.4 Riparian vegetation on the subject site.

3.2.6 Cleared Land with Trees

i. Conservation status

This vegetation community does not fall under any conservation legislation.

ii. Other vegetation mapping

This vegetation community was mapped as cleared land by NPWS (2002) and as Cleared Land with Scattered Trees by Conacher Travers (Conacher Travers, 2004).

iii. Community description

This community is associated with developed areas of the site and occurs over large portions of the subject site. The entire community has been disturbed by previous land clearing and associated development. Ongoing disturbances are the result of high levels of exotic plantings, mowing and weed invasion. The level of exotic weed invasion is high throughout this community.

Trees, where present, exist to 25 metres in height, with a variable PFC of <5 to 15%. Species include: *Syncarpia glomulifera* (Turpentine), *Angophora costata* (Smooth-barked Apple), *Jacaranda mimosifolia* (Jacaranda) and *Eucalyptus sp.* (Planted Gum).

Shrubs include: *Pittosporum undulatum* (Sweet Pittosporum), *Nerium oleander* (Oleander Bush), *Grevillea sp.* (Grevillea) and *Callistemon sp.* (Bottlebrush); they reach 6 metres in height, with a variable <5 to 15% PFC.

The groundlayer reaches 1.5 metres high with variable 5 to 85% PFC. Common species are: *Pennisetum clandestinum* (Kikuyu), *Cynodon dactylon* (Common Couch), *Bromus cartharticus* (Prairie), *Ehrharta erecta* (Panic Veltdgrass), *Briza maxima* (Quaking Grass), *Trifolium repens* (White Clover), *Oxalis corniculata* (Yellow Wood Sorrel) and *Malva parviflora* (Small-flowered Mallow).

3.3 Rare or Threatened Plant Species

The full results of the flora quadrat survey can be found in Appendix A. No threatened flora species were recorded on the subject site. Table 3.1 analyses the likelihood of occurrence on the subject land for each threatened flora species recorded within the 10km radius.

Table 3.1 HABITAT REQUIREMENTS FOR THREATENED FLORA SPECIES KNOWN TO OCCUR WITHIN THE LOCALITY

Species	Legal Status	Habitat Requirements	Presence of Suitable Habitat in the Study Area and Likelihood of Occurrence
Acacia bynoeana	E1 (TSC Act); V (EPBC Act)	Occurs in heath or dry sclerophyll forest on sandy soils. Prefers open, sometimes slightly disturbed sites such as trail margins, etc.	No suitable habitat is present. Not observed during floristic survey.
Acacia gordonii	E1 (TSC and EPBC Acts)	Dry sclerophyll forest and heathlands amongst or within rock platforms on sandstone outcrops	No suitable habitat is present. Not observed during floristic survey.
Acacia pubescens	V (TSC and EPBC Acts)	Alluviums, shales and at the intergrade between shales of the Cumberland Plain and sandstones. The soils are characteristically gravely soils, often with ironstone.	No suitable habitat is present. Not observed during floristic survey.
Callistemon linearifolius	V (TSC Act)	Dry sclerophyll forest on the coast and adjacent ranges	Suitable habitat is present. Not observed during floristic survey.
Darwinia biflora	V (TSC and EPBC Acts)	Edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone	Suitable habitat is present. Not observed during floristic survey.
Darwinia peduncularis	V (TSC Act)	On or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone	Suitable habitat is present. Not observed during floristic survey.
Epacris purpurascens var. purpurascens	V (TSC Act)	A range of habitat types, most of which have a strong shale soil influence	Suitable habitat is present. Not observed during floristic survey.
Eucalyptus camfieldii	V (TSC and EPBC Acts)	Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath	Suitable habitat is present. Not observed during floristic survey.

Table 3.1 HABITAT REQUIREMENTS FOR THREATENED FLORA SPECIES KNOWN TO OCCUR WITHIN THE LOCALITY

Species	Legal Status	Habitat Requirements	Presence of Suitable Habitat in the Study Area and Likelihood of Occurrence
		mostly on exposed sandy ridges	
Grevillea caleyi	E1 (TSC and EPBC Acts)	Ridge tops between elevations of 170 to 240m asl, in association with laterite soils and a vegetation community of open forest, generally dominated by *Eucalyptus sieberi* and *Corymbia gummifera*	No suitable habitat is present. Not observed during floristic survey.
Haloragodendron lucasii	E1 (TSC and EPBC Acts)	Moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland	Suitable habitat is present. Not observed during floristic survey.
Hibbertia superans	E1 (TSC Act)	Sandstone ridge tops often near the shale/sandstone boundary.	No suitable habitat is present. Not observed during floristic survey.
Lasiopetalum joyceae	V (TSC and EPBC Acts)	In heath above sandstone.	No suitable habitat is present. Not observed during floristic survey.
Leptospermum deanei	V (TSC and EPBC Acts)	In woodland on lower hill slopes or near creeks. Sandy alluvial soil or sand over sandstone	Suitable habitat is present. Not observed during floristic survey.
Melaleuca deanei	V (TSC and EPBC Acts)	In heath on sandstone	No suitable habitat is present. Not observed during floristic survey.
Persoonia hirsuta	E1 (TSC and EPBC Acts)	Sandy soils in dry sclerophyll open forest, woodland and heath on sandstone	No suitable habitat is present. Not observed during floristic survey.
Persoonia mollis ssp. *maxima*	E1 (TSC and EPBC Acts)	Sheltered aspects of deep gullies or on the steep upper hillsides of narrow gullies on Hawkesbury Sandstone	Not likely to be present as outside the highly restricted range of this species. Not observed during floristic survey.
Pimelea curviflora	V (TSC and	Shaley/lateritic soils over sandstone and	Suitable habitat is present. Not observed during floristic

Table 3.1 HABITAT REQUIREMENTS FOR THREATENED FLORA SPECIES KNOWN TO OCCUR WITHIN THE LOCALITY

Species	Legal Status	Habitat Requirements	Presence of Suitable Habitat in the Study Area and Likelihood of Occurrence
var. *curviflora*	EPBC Acts)	shale/sandstone transition soils on ridge tops and upper slopes amongst woodlands	survey.
Syzygium paniculatum	V (TSC and EPBC Acts)	Grey soils over sandstone or gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities	Sub-optimal habitat is present. Not observed during floristic survey.
Tetratheca glandulosa	V (TSC and EPBC Acts)	Shale-sandstone transition habitat on ridge tops and upper-slope sandstone benches.	Suitable habitat is present. Not observed during floristic survey.

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Following detailed consideration of the site and species listed in Table 2.3 it is considered that there is sub optimal potential habitat on the subject site for the following species:

- *Callistemon linearifolius;*
- *Darwinia biflora;*
- *Darwinia peduncularis;*
- *Epacris purpurascens var. purpurascens;*
- *Eucalyptus camfieldii;*
- *Haloragodendron lucasii;*
- *Leptospermum deanei*
- *Pimelea curviflora* var. *curviflora;*
- *Syzygium paniculatum;* and
- *Tetratheca glandulosa.*

No threatened flora species as listed under the TSC Act or the EPBC Act were observed on site.

3.4 Fauna Habitats

A range of fauna habitats are present throughout the site and include:

- Fruit, nectar and seed producing trees and shrubs;
- Creek and drainage lines with associated aquatic habitats;
- Rocky overhangs, platforms with exfoliated rock and rock crevices;
- Moderately dense to dense understorey;
- Moderately dense to dense groundcover;
- Leaf litter and fallen logs;
- Hollow-bearing trees;
- Cleared mown areas and planted gardens;
- Buildings; and
- Refuse.

The subject site supports a wide variety of habitat types ranging from highly disturbed areas of low quality habitat to areas of relatively low disturbance with high quality habitat. The flower, nectar and seed producing tree and shrub species provide a seasonal foraging resource for a range of arboreal mammal and bird species.

The creek and drainage lines with their associated aquatic habitats provide habitat for a number of bird, mammal, reptile and amphibian species.

The cleared areas associated with the hospital provide habitat for mostly exotic bird and mammal species.

Sixty eight hollow-bearing trees were located by Cumberland Ecology within the subject site adding to the 111 hollow-bearing trees recorded by Conacher Travers (2004) giving a total of 179 hollow-bearing trees recorded for the site. The location of hollow-bearing trees are provided in Figure 3.2 with the details of the hollow trees provided in Appendix B Hollow-bearing trees provide important breeding and shelter habitat for hollow-dependent arboreal mammal, hollow-dependent birds and reptile species.

Coordinate System: UTM WGS 84 (Zone 56)

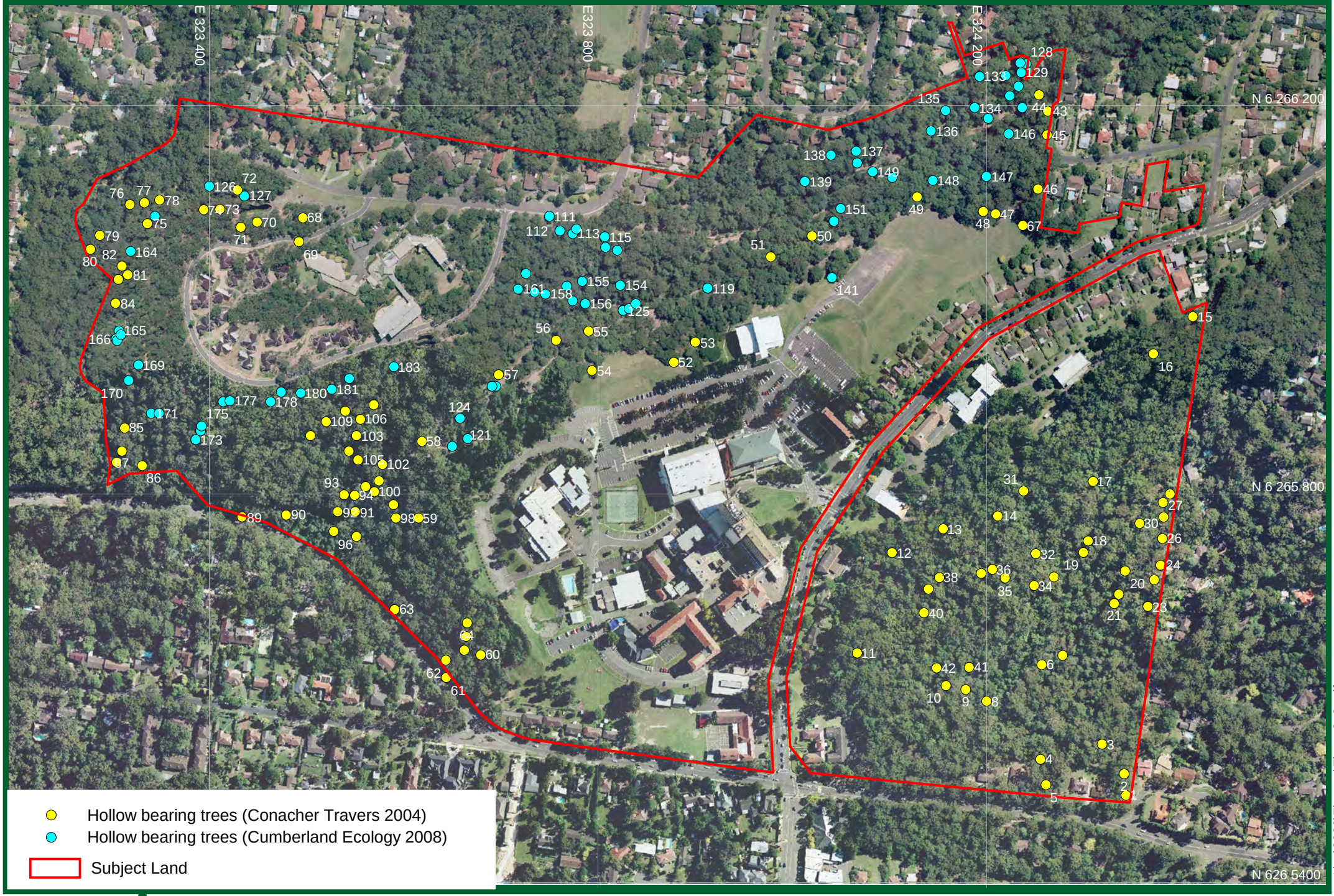


Figure 3.3 **Hollow-bearing Tree Assessment**

Cumberland Ecology

3.5 Threatened Fauna Species

A review of the Atlas of NSW Wildlife (DECC (NSW), 2008) database was carried out to determine if any threatened species had been recorded within 10km of the site and a threatened fauna species report generated. An EPBC Protected Matters search was conducted to provide a list of Commonwealth listed threatened fauna and fauna habitat that may occur in the locality of the subject site. Relevant reports from previous ecological studies of the area were also reviewed. A number of threatened species were identified as occurring or having the potential to occur in the area of the subject site; details of these fauna species are supplied in Table 3.2 below. Coastal and oceanic species identified in the desktop review were not included in the table due to a lack of suitable habitat within the subject site.

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
Giant Burrowing Frog	*Heleioporus australiacus*	E1 (TSC Act)	Found in heath, woodland and open forest with sandy soils. Generally lives in the heath or forest and will travel several hundred metres to creeks to breed. Burrows into deep litter or loose soil, emerging to feed or breed after rain.	No suitable habitat within the study area. Not recorded during fauna survey.
Green and Golden Bell Frog	*Litoria aurea*	V (TSC and EPBC Acts)	Marshes, dams, stream sides, particularly those containing bullrushes or spikerushes; unshaded water bodies free of Gambusia form optimum habitat; vegetation and/or rocks are needed for sheltering (NSW NPWS, 1999b)	Sub-optimal habitat within the study area. Not recorded during fauna survey.
Littlejohn's Tree Frog	*Litoria littlejohni*	V (TSC and EPBC Acts)	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops.	No suitable habitat within the study area. Not recorded during fauna survey.
Stuttering Frog	*Mixophyes balbus*	E(TSC Act) & V (EPBC)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	No suitable habitat within the study area. Not recorded during fauna survey.
Southern Barred frog	*Mixophyes iteratus*	E (TSC and EPBC Acts)	Southern Barred Frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m.	Sub-optimal habitat within the study area. Not recorded during targeted fauna survey.

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
Red-crowned Toadlet	*Pseudophryne australis*	V (TSC Act)	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter.	Sub-optimal habitat within the study area. Not recorded during targeted fauna survey.
Cotton Pygmy-Goose	*Nettapus coromandelianus*	E1 (TSC Act)	Prefers standing bodies of freshwater with floating and submerged aquatic vegetation. Roosts and nests in trees and hollows adjacent to water bodies	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Bush Stone-curlew	*Burhinus grallarius*	E1 (TSC Act)	Inhabits woodlands and open forests with a grassy groundlayer with fallen timber.	Sub-optimal habitat within the study area. Not recorded during targeted fauna survey.
Australasian Bittern	*Botaurus poiciloptilus*	V (TSC Act)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp.)* and spikerushes (*Eleoacharis spp*.). Hides during the day amongst dense reeds or rushes.	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Black Bittern	*Ixobrychus flavicollis*	V (TSC Act)	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	Sub-optimal habitat within the study area. Not recorded during targeted fauna survey.

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
Black-necked Stork	*Ephippiorhynchus asiaticus*	E1 (TSC Act)	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries.	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Superb Fruit-Dove	*Ptilinopus superbus*	V (TSC Act)	Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland on fruit-bearing trees.	Potential suitable forage habitat within the study area. Potential infrequent nomadic occurrence at the subject site. Not recorded during targeted fauna survey.
Osprey	*Pandion haliaetus*	V (TSC Act)	Favour coastal areas, especially the mouths of large rivers, lagoons and lakes.	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Grey Falcon	*Falco hypoleucos*	V (TSC Act)	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Regent Honeyeater	*Xanthomyza phrygia*	E1 (TSC & EPBC Acts)	Inhabits temperate woodlands and open forests, particularly Box-Ironbark Woodland and riparian forests of She-oak, with significantly large numbers of mature trees, high canopy cover and	Suitable habitat within the study area. Not recorded during targeted fauna survey.

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			abundance of mistletoe. Feeds mainly on nectar and fruit from eucalypts and mistletoes and occasionally on insects. Requires shrubby understorey for nesting material. Nomadic movement of the species may depend on flowering and other resource patterns.	
Pink Robin	*Petroica rodinogaster*	V (TSC Act)	The Pink Robin inhabits the dense shrub layer of damp or wet forests or rainforests moving to dense gully forest or cool-temperate rainforests during the breeding season which usually occurs from September to March. The Pink Robin is insectivorous and considered to be partly resident to partly migratory or dispersive in autumn to winter (Higgins and Peter, 2002).	Suitable habitat within the study area. Potential infrequent nomadic occurrence at the site Not recorded during targeted fauna survey.
Australian Painted Snipe	*Rostratula australis*	V (EPBC Act)	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Diamond Firetail	*Stagonopleura guttata*	V (TSC Act)	Occurs in grassy eucalypt woodlands, open forest, mallee, Natural Temperate Grassland and in secondary grassland derived from other communities and often in riparian areas or lightly wooded farmland. Feeds on the ground on grass	No suitable habitat within the study area. Not recorded during targeted fauna survey.

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			and herb seeds, leaves and insects.	
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V (TSC Act)	In summer, tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, at lower altitudes in drier, more open eucalypt forests and woodlands, and often in urban areas.	Suitable habitat. Not recorded during targeted fauna survey.
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V (TSC Act)	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur	Suitable habitat. Not recorded during targeted fauna survey.
Superb Parrot	*Polytelis swainsonii*	V (TSC & EPBC Acts)	River red gum and black box, yellow box, river oaks, mostly near rivers.	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Swift Parrot	*Lathamus discolor*	E1 (TSC and EPBC Acts)	Migrates between Tasmania and the mainland. Occurs where there are abundant eucalypt flowers or lerp infestations. Favours winter flowering eucalypt species including Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark and White Box	Suitable winter forage habitat within the study area. Not recorded during targeted fauna survey.
Turquoise Parrot	*Neophema pulchella*	V (TSC Act)	Lives on the edges of eucalypt woodland	No suitable habitat within the

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			adjoining clearings, timbered ridges and creeks in farmland	study area. Not recorded during targeted fauna survey.
Ground Parrot	*Pezoporus wallicus*	V (TSC Act)	Occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Barking Owl	*Ninox connivens*	V (TSC Act)	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. Nests in hollows of large, old eucalypts.	Suitable habitat within the study area. Not recorded during targeted fauna survey.
Powerful Owl	*Ninox strenua*	V (TSC Act)	The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. Nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old.	Suitable habitat within the study area. Recorded at the site by Conacher Travers (2004). Recorded breeding at the site during targeted fauna survey.
Grass Owl	*Tyto capensis*	V (TSC Act)	Found in areas of tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Masked Owl	*Tyto novaehollandiae*	V (TSC Act)	Lives in dry eucalypt forests and woodlands. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows for nesting.	Marginal habitat within the study area. Not recorded during targeted fauna survey.

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
Sooty Owl	*Tyto tenebricosa*	V (TSC Act)	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V (TSC Act)	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	Suitable habitat within the study area. Not recorded during targeted fauna survey.
Eastern Freetail-bat	*Mormopterus norfolkensis*	V (TSC Act)	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range	Suitable habitat within the study area. Not recorded during targeted fauna survey.
Grey-headed Flying-fox	*Pteropus poliocephalus*	V (TSC Act)	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Commonly found in gullies, close to water, in vegetation with a dense canopy	Suitable habitat within the study area. Recorded by Conacher Travers (2004) during targeted fauna survey.
Little Bent-wing Bat	*Miniopterus australis*	V (TSC Act)	Moist eucalypt forest, rainforest or dense coastal banksia scrub. Roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats	Suitable habitat within the study area. Not recorded during targeted fauna survey.
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	V (TSC Act)	Roosts mainly in caves but also in tunnels, mines or buildings. Non-breeding populations disperse within a 300 km range of maternity caves. Hunting	Suitable habitat within the study area. Not recorded during targeted fauna survey.

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			for moths and other insects takes place in forested areas above the canopy.	
Greater Long-eared Bat	*Nyctophilus timoriensis*	V (TSC Act)	Inhabits a variety of vegetation types, including mallee, bulloke *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland	No suitable habitat within the study area. Not recorded during targeted fauna survey.
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V (TSC Act)	Usually roosts in tree hollows and forages for beetles and other insects or microbats along creek and river corridors in open woodland habitat and dry open forests	Suitable habitat within the study area. Not recorded during targeted fauna survey.
Large-eared Pied bat	*Chalinolobus dwyeri*	V (TSC Act)	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin. Found in well-timbered areas containing gullies.	Suitable habitat within the study area. Not recorded during targeted fauna survey.
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V (TSC Act)	Occurs in moist habitat with trees over 20m in height, hunting insects above or just below the tree canopy. Roosts in eucalypt hollows, under bark and in buildings	Suitable habitat within the study area. Recorded by Conacher Travers (2004) during targeted fauna survey.
Spotted-tailed Quoll	*Dasyurus maculatus*	V (TSC Act)	Occurs in wide variety of habitats; rainforest, open	Sub-optimal habitat within the

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			forest, woodland, coastal heath and riparian forest. Uses hollows in trees, logs and rock crevasses as den sites. Species is nocturnal, carnivorous and has large territories (750-3000 ha) (DEC (NSW), 2005a)	study area. Not recorded during targeted fauna survey.
Brush-tailed Phascogale	*Phascogale tapoatafa*	V (TSC Act)	Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter	Sub-optimal habitat. Not recorded during targeted fauna survey.
Eastern Pygmy-possum	*Cercartetus nanus*	V (TSC Act)	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest	Sub-optimal habitat. Not recorded during targeted fauna survey.
Yellow-bellied Glider	*Petaurus australis*	V (TSC Act)	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils	Sub-optimal habitat. Not recorded during targeted fauna survey.
Squirrel Glider	*Petaurus norfolcensis*	V (TSC Act)	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas	Sub-optimal habitat. Not recorded during targeted fauna survey.
Rosenberg's Goanna	*Varanus rosenbergi*	V (TSC Act)	Hawkesbury sandstone outcrop specialist.	Sub-optimal habitat within the

Table 3.2 HABITAT REQUIREMENTS FOR THE TRHEATENED FAUNA SPECIES KNOWN TO OCCUR IN THE LOCALITY

Common Name	Scientific Name	Legal Status	Habitat Requirements	Presence of Suitable abitat in Study Area and Likelihood of Occurrence of Species
			Inhabits woodlands, dry open forests and heathland sheltering in burrows, hollow logs, rock crevices and outcrops. Requires terrestrial termite mounds for nesting.	study area. Not recorded during targeted fauna survey.
Broad-headed Snake	*Hoplocephalus bungaroides*	E1 (TSC Act) & V (EPBC Act)	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	Sub-optimal within the study area. Not recorded during targeted fauna survey.

3.6 Fauna Observed on the Subject Site

The fauna species recorded on the subject land in recent surveys are listed in Appendix D. Three (3) threatened species listed as vulnerable under the TSC Act were detected during the surveys of Cumberland Ecology and Conacher Travers. These species are the Powerful Owl (*Ninox strenua*), Grey-headed Flying-fox (*Pteropus poliocephalus*) which is also listed as Vulnerable under the EPBC Act, and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*). All other species, as listed in Appendix D, are considered relatively common in the local area.

Three other threatened species likely to occur on the subject site are the Glossy Black Cockatoo (*Calyptorhynchus lathami*), Gang-gang Cockatoo (*Callocephalon fimbriatum*) and Swift Parrot (*Lathamus discolour*). These species are also discussed in further detail below.

3.6.1 Details on the Threatened Fauna

*i. Powerful Owl (*Ninox strenua*)*

Powerful Owls were observed by Cumberland Ecology roosting and were considered likely to be nesting in the riparian vegetation in the south-east corner of the subject land on the 12th and 13th August 2008. Signs of significant whitewash and regurgitated pellets were detected in the area in which the owls were later observed. During spotlighting on the night of the 12th August a single juvenile Powerful Owl was observed. Upon return to the location next day the juvenile and two adults were seen roosting approximately 18m to 20m above the ground. Both roosting adults were holding remains of prey, in each case a Common Ringtail Possum.

The suspected nest tree, a large *Eucalyptus pilularis* (Blackbutt) approx 35m tall, 1.3m diameter at breast-height (dbh), contained a large basal hollow through the entire trunk to the top and a large living branch with right-angle hollow spout which could provide a potential nest site for Powerful Owls. This appeared to be the most likely potential nest site for Powerful Owls in the area, however, 2 or 3 large *Angophora costata* (Smooth-bark Apple) located at the edge of gully (but out of the denser riparian vegetation) provided suitable nesting hollows. All hollows in these alternative trees were considerably lower than the Blackbutt and there were no signs of whitewash around the base of these trees. Unlike the suspected nest tree, the hollow-bearing *Angophoras* at the subject site are located outside of the riparian vegetation where Powerful Owls were recorded roosting.

Habitat assessment at the roost sites indicate that the Powerful Owls have a preference for roosting in mid-canopy *Syncarpia glomulifera* (Turpentine) at approximately 20m to 25m with approximately 70% PFC.

Conacher Travers reported Powerful Owl responses to call playback on the subject land in November 2003 (Conacher Travers, 2004).

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

Conacher Travers observed large numbers of this species during evening surveys in November 2003 (Conacher Travers, 2004). The species was observed flying in to the site from the east and feeding on the nectar of the flowering eucalypt tree species within the subject site. Conacher Travers reported that the subject site provides suitable foraging habitat for this species, however, no "camps" were observed or are known to occur within the subject land.

No direct impact will occur on this species through the proposed development; however a reasonable amount of foraging habitat will be lost. However, large areas of equivalent or better foraging and nesting habitat exists for this species in nearby areas; therefore the impacts of the development upon this species are likely to be minimal.

*iii. Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)*

Conacher Travers detected this species via echolocation call recording during Anabat surveys conducted in November 2003 (Conacher Travers, 2004) within the vicinity of Coups Creek. Suitable foraging habitat is provided across the subject land with suitable roosting habitat available within the hollow-bearing trees throughout the subject land.

*iv. Glossy Black Cockatoo (*Calyptorhynchus lathami*)*

Suitable nesting and foraging habitat exist on the subject lands for this species. No signs of this species were recorded on the site during targeted surveys. Targeted survey methods used included visual searches for the species, listening for calls and searching for signs of foraging on *Allocasuarina torulosa* (Forest Oak) cones. *Allocasuarina torulosa* is a preferred foraging species for Glossy Black Cockatoos. They have a distinct method of chewing the cones and therefore chewed cones can be examined to indicate if the species uses the site. No evidence of this species using the site was uncovered using this method.

Large areas of equivalent or better foraging and nesting habitat exists for this species in nearby areas; therefore the impacts of the development upon this species are likely to be minimal.

*v. Swift Parrot (*Lathamus discolour*)*

Suitable foraging habitat exists for this species on the subject lands. Swift Parrots are seasonal migrants and nest in Tasmania, so the subject land is highly unlikely to provide breeding habitat for this species. In Sydney the species feeds on winter flowering

eucalypts and the sugary excretions of lerp (plant insect parasites (Family Psyllidae)) that inhabit *Eucalyptus* species*. Corymbia gummifera* (Red Bloodwood) flowers and lerp infested *Eucalyptus pilularis* (Blackbutt) provide suitable winter foraging habitat for Swift Parrots on the subject site. No Swift Parrots were identified on the subject lands during targeted surveys.

No direct impact will occur on this species through the proposed development, however a reasonable amount of winter foraging habitat will be lost. Extensive areas of suitable winter forageing habitat exists for this species in the locality and region.

*vi. Gang-gang Cockatoo (*Callocephalon fimbriatum*)*

The Gang-gang Cockatoo is listed as Vulnerable under the TSC Act and the population of Ku-ring-gai and Hornsby local government areas has been listed as an endangered population under Schedule 2 of the TSC Act. This species occurs in a variety of forest and woodland habitats and occasionally in more open areas in southeastern New South Wales (NSW Scientific Committee, 2001).

Suitable foraging and breeding habitat is present for this species within the subject land in particular within the catchment of Coups Creek. While not observed during the surveys of Cumberland Ecology or Conacher Travers this species has been observed foraging on the site by Dr David Robertson while employed by ERM in 2001 (ERM, 2001).

Chapter 4

Impact Assessment

4.1 Impacts on Native Vegetation

The major impact from the proposed development will be the clearing of vegetation. The 'Clearing of Native Vegetation' is listed as a Key Threatening Process (NSW Scientific Committee, 2004) and has been identified as a direct cause in the decrease in biodiversity. As a result of the proposed development the subject site will experience a reduction in the extent of native vegetation and increased fragmentation of vegetation. The quality of the remaining vegetation will be maintained through the implementation of a Biodiversity Management Plan (BMP) to minimise invasion by exotic invasive flora.

The current areas of each vegetation community their management type and structure are outlined in Table 4.1 while the areas of each community to be retained, cleared and to undergo bushfire management activities under the proposed development are summarised in Table 4.2 and mapped in Figure 4.1. Approximately 5.771 ha of native vegetation is proposed to be cleared with approximately 16.356 ha to undergo management for APZs. A further 1.36 ha of vegetation will undergo management for fuel reduction. This management involves either manual removal of visible ground surface fuels or periodic controlled burn-offs to minimise ground fuel loads. These figures include impacts on endangered and critically endangered ecological communities. Impacts on these communities are discussed in more detail below. Approximately 13.59 ha of native vegetation will be retained in its current form (12.809 ha community and 0.781 ha of scattered trees) as conservation lands and will undergo long-term management to improve or maintain its quality under the BMP to be prepared for the subject land.

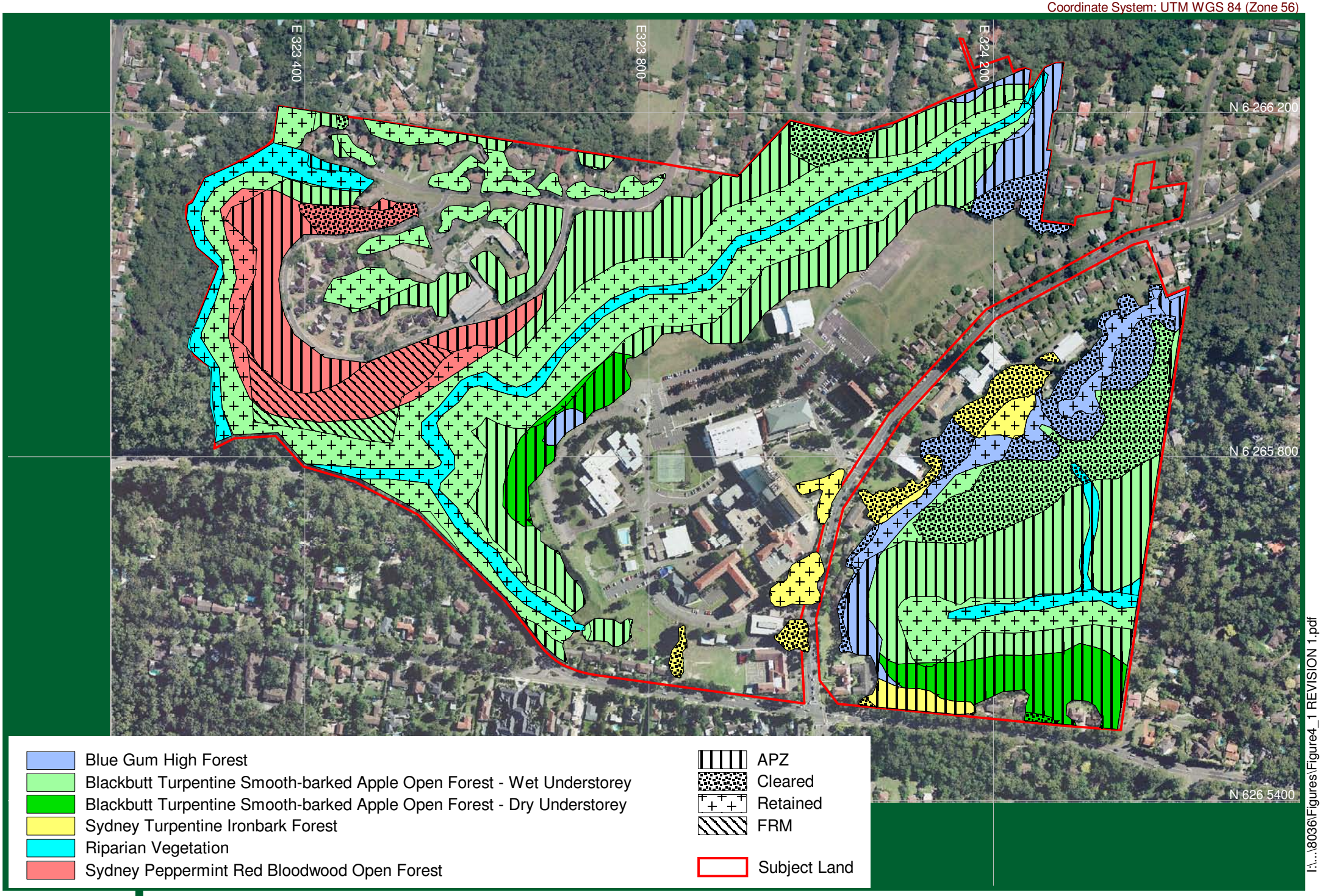


Figure 4.1 **Impacts of the proposed development on Native Vegetation**

Cumberland Ecology

Table 4.1 CURRENT AREAS OF VEGETATION COMMUNITIES MANAGEMENT AND STRUCTURE

Vegetation Type	Relatively undisturbed community currently on Subject Land (ha)	APZs currently on Subject Land (ha)	Scattered Trees currently on Subject Land (ha)
Blue Gum High Forest	0.869	2.478	0.333[1]
Sydney Turpentine-Ironbark Forest	0.281	0.240	1.172
Blackbutt – Turpentine – Smooth-bark Apple Open Forest	24.131	-	0.711
Sydney Peppermint – Red Bloodwood Open Forest	3.785	-	-
Riparian Vegetation	3.077	-	-
Total	**32.143**	**2.718**	**2.216**

Notes: 1. This portion of the community does not meet the EPBC Act listing but does meet TSC Act listing

Table 4.2 AREAS OF VEGETATION COMMUNITIES MANAGEMENT AND STUCTURE UNDER THE PROPOSED DEVELOPMENT

Vegetation Type	Vegetation to be retained (ha)		Vegetation to be cleared (ha)		Managed as APZs (ha)	Fuel Reduction Management (ha)
	Community	Scattered Trees	Community	Scattered Trees		
Blue Gum High Forest	0.052	0.116*	1.428	0.216	1.868	-
Sydney Turpentine-Ironbark Forest	-	0.402	0.015	0.770	0.506	-
Blackbutt – Turpentine – Smooth-bark Apple Open Forest	9.406	0.263	2.523	0.447	11.899	0.304
Sydney Peppermint – Red Bloodwood Open Forest	0.574	-	0.345	-	1.810	1.056
Riparian Vegetation	2.777	-	0.027	-	0.273	-
Total	**12.809**	**0.781**	**4.338**	**1.433**	**16.356**	**1.36**

*Notes: *Some scattered trees will be retained within APZs.*

4.2 Impacts on Endangered and Critically Endangered Ecological Communities listed under the TSC Act and the EPBC Act

4.2.1 Blue Gum High Forest of the Sydney Basin Bioregion

i. Introduction

Blue Gum High Forest of the Sydney Basin Bioregion (BGHF) is listed as a critically endangered ecological community (CEEC) under the EPBC Act and the TSC Act. All of the BGHF on the subject lands meets the listing requirements of the TSC Act; however the small area of Blue Gum regrowth to the west of the hospital does not meet the requirements of the EPBC Act due to its small size and lack of native understorey (DEH, 2005a). The areas of BGHF currently managed as APZs are degraded but are considered to constitute the EPBC Act community due to the under storey containing native species. For a more in depth discussion of the quality of this vegetation and justification of reasons why areas fail to meet EPBC Act listing requirements see Section 3.2.1 of this report. Of the 3.68 ha BGHF on the subject lands approximately0.869 ha is considered relatively undisturbed, 2.478 ha is currently managed for APZs and 0.333 ha consists of scattered trees.

The EPBC Act requires that Commonwealth approval be obtained for certain actions. The Act provides an assessment and approvals systems for actions that have a significant impact on matters of national environment significance (NES) which includes:

- Nationally listed threatened species and ecological communities.

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

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, the matter needs to be referred to the Department of the Environment, Water, Heritage and the Arts (DEWHA). The proposed development has been referred to DEWHA outlining all potential impacts of the development on the BGHF. The referral outlined the proposed development would:

- Reduce the extent of the BGHF through the clearing of vegetation;
- Fragment an area of BGHF through the construction of a road designed to access the proposed residential area;
- Cause adverse affects upon the habitat critical to the survival of the BGHF through the changes outlined below;

- Modify abiotic factors necessary for the BGHF's survival such as surface water drainage patterns and nutrient loads through the construction of 'hard-stand' areas as well as the installation of storm water drains and bio-retention swales;

- Possibly cause changes in species composition of the BGHF through under-storey management for asset protection zones (APZs); and

- Significantly increase in the edge to area ratio of the BGHF reducing the quality/ integrity of the BGHF through increased edge effects. Likely impacts include micro-climate changes (e.g. increased sunlight, air temperature and soil temperature); changes in flora and fauna species composition; increased use by pest animals; and increased weed invasion.

➢ Reduce the potential recovery / expansion of the BGHF.

In an official response to this referral DEWHA declared the proposed development as a controlled action indicating, in the department's opinion, a significant impact on BGHF is likely to occur as a result of the proposed development.

ii. Direct Impacts

The direct impacts upon the BGHF of the proposed development will take three forms; clearing, management as fuel reduction zones and fragmentation of the community. The areas of BGHF impacted by clearing and fuel reduction management are summarised in Table 4.3 below.

Table 4.3 IMPACTS OF THE PROPOSED DEVELOPMENT ON DIFFERENT FORMS OF THE BGHF ON THE SUBJECT LAND

Management Regime	Current Area (ha)	Area Post Development (ha)	Difference (ha)
Relatively Undisturbed	0.869	0.052	**-0.817**
APZ	2.478	1.868	**-0.610**
Scattered Trees[1]	0.333	0.116	**-0.217**
Total	**3.680**	**2.036**	**-1.644**

Notes: 1. This portion of the community does not meet the EPBC Act listing but does meet TSC Act listing

a. Clearing

Of the 3.680 ha of the TSC Act listed BGHF 3.347 ha constitutes the EPBC Act listed community and 2.487 ha is currently managed as APZs. Approximately 1.644 ha of the

TSC Act listed CEEC is proposed to be cleared which equates to 1.363 ha of the EPBC Act listed community. As described above, the impacts upon this CEEC have been considered a controlled action; however efforts have been made in the drafting of the concept plan to minimise clearing of the BGHF while providing the necessary housing and facilities for hospital staff and local residents. Mitigation measures to minimise potential ongoing impacts upon the BGHF are outlined in Chapter 5.

b. APZ Management

The area of BGHF of the subject land to be managed as APZs under the proposed development will reduce from 2.478 ha to 1.868 ha. APZs are required to reduce the potential impacts of possible bushfire events upon persons and property in the vicinity of these areas of BGHF. Ongoing management of APZs on the subject land will most likely take a combination of two forms: 1) manual removal of ground fuels with relocation and/or burning of loose fuels; 2) prescribed hazard reduction burning undertaken every 8-9 years. The exact regime of fuel management reduction is to be outlined in the Fire Management Plan that is to be prepared for the subject site. In some cases, such fire management can assist in the maintenance of the quality of vegetation through the removal of exotic weeds and activation of seeds within the soil seed-bank.

c. Fragmentation

The fragmentation of the BGHF results in reduced connectivity of the vegetation causing reduced seed dispersal potential and reduced recovery potential of the CEEC. Fragmentation of the CEEC also allows for the potential increase in indirect effects such as weed and pest invasion, trampling, dumping, changes in light regimes etc.

iii. Indirect impacts

The potential indirect impacts of the proposed development on BGHF on the subject lands are many. The more likely of these to occur are discussed below:

a. Hydrology

The construction of roads and buildings on the property is likely to have an impact on soils by increasing levels of nutrients via rainwater runoff that are greater than what would occur naturally. Whilst some nutrients are more readily dispersed through soil strata, phosphorus is largely retained and can be expected to favour growth of exotics in preference to most native species. Hydrological changes have occurred on and around the site in the past due to the previous development of the subject land. The significance of existing hydrological impact within the current area of BGHF has not been specifically determined or documented, however its impact on soil seems within the general limits of tolerance of numerous BGHF species including *Eucalyptus saligna* (Blue Gum).

As the existing and proposed development will occur upslope of both sections of the BGHF, the vegetation will continue to receive elevated nutrients in overland rainwater and subsurface flows. A *Flooding and Stormwater Master Plan* (Hyder Consulting Pty Ltd,

2008) has been prepared for the proposed development by Hyder Consulting Pty Ltd. This document details requirements for on-site retention, detention of stormwater, roof, surface drainage, subsoil drainage and stormwater quality control (in accordance with Ku-ring-gai Council's requirements) and outlines projected nutrient and pollutant loads expected in each of the sub-catchments on the subject land. These measures, together with the sediment and erosion control measures implemented during construction, will assist in the prevention of excess water reaching the BGHF.

Increased levels of runoff from stormwater could result in increased weed invasion through seed transferral within stormwater as well as increased nutrient levels. Weed dispersal will be limited by limiting stormwater runoff through measures outlined in the Hyder Consulting report (Hyder Consulting Pty Ltd, 2008). Weed levels within the retained vegetation, including EECs, will be managed and monitored as specified in the BMP to be prepared for the subject land.

b. Altered light regimes

The proposed development will alter the current light regime within the BGHF through either overshadowing from buildings or increased light from clearing. Both of these effects can result in a change in species composition within communities as light sensitive or light dependent species die out from over- or under-exposure. This results in more robust, opportunistic weedy species dominating the affected area. These issues will be managed and monitored as specified in the BMP to be prepared for the subject land.

c. Increased access

With the planned residential development and increased road access to areas adjacent to the BGHF it is likely that the CEEC will be subjected to increased human access potentially resulting in trampling under foot and the dumping of rubbish.

Increased accessibility to the BGHF will open the vegetation community up to pests and disease for both flora and fauna. Feral animals such as cats and foxes may be more likely to use the area thereby impacting upon native fauna and weeds will have more vectors (humans, animals, vehicles) for transfer into the area. Aesthetic fencing has been proposed to be erected around sensitive areas to minimise effects of increased access. Weeds and feral animals will be managed and monitored as specified in the BMP to be prepared for the subject land.

4.2.2 Sydney Turpentine-Ironbark Forest

i. Introduction

Sydney Turpentine-Ironbark Forest (STIF) is listed as an Endangered Ecological Community under the TSC Act and a Critically Endangered Ecological Community under the EPBC Act. All of the STIF on the subject site meets the listing requirements of the TSC Act; however none of this vegetation community falls under the listing requirements

of the EPBC Act due to the small size of the patches of this vegetation community and the poor quality of the ground and shrub layers in most of these patches (DEH, 2005b, DEH, 2005c). For a more in depth discussion of the quality of this vegetation and justification of reasons why it fails to meet EPBC Act listing requirements see Section 3.2.4 of this report.

ii. Direct and indirect impacts

All information regarding direct and indirect impacts on BGHF is relevant for STIF as the two communities are adjacent on the subject land and will undergo the same processes under the proposed development; however the area of this vegetation community to be effected by clearing and APZs differs. The areas of STIF impacted by clearing and fuel reduction management are summarised in Table 4.4 below.

Table 4.4 IMPACTS OF THE PROPOSED DEVELOPMENT ON DIFFERENT FORMS OF THE STIF ON THE SUBJECT LAND

Management Regime	Current Area (ha)	Area Post Development (ha)	Difference (ha)
Relatively Undisturbed	0.281	0.000	**-0.281**
APZ	0.240	0.506	**+0.266**
Scattered Trees	1.172	0.402	**-0.770**
Total	**1.693**	**0.908**	**-0.785**

a. Clearing

Of the approximately 1.693 ha of STIF identified on the subject site 0.281 ha of the community is relatively undisturbed, approximately 0.240 ha is managed as APZs and 1.172 ha is made up of scattered trees with little to no native understorey. Under the proposed development 0.785 ha of STIF will be cleared. While the development will impact upon the community by reducing the extent of the STIF community; given the poor quality of the vegetation and the scattered distribution of the small disjunct patches, the proposed development will not threaten the long-term survival of the community when considering the good quality STIF in nearby conservation reserves. The impacts of the development on STIF at a larger scale are considered below. Mitigation measures to offset the impacts on the STIF within the subject lands are outlined in Chapter 5.

b. APZ Management

Under the proposed development approximately 0.506 ha of the community will undergo management as APZs including all 0.281 ha of the relatively undisturbed vegetation to reduce the potential impacts of possible bushfire events. The exact regime of fuel management reduction is to be outlined in the site specific Fire Management Plan to be prepared for the site. In some cases, such fire management can assist in the

maintenance of the quality of vegetation through the removal of exotic weeds and activation of seeds within the soil seed-bank.

4.2.3 Significance of EECs at Larger Scales

i. Blue Gum High Forest

a. Introduction

Blue Gum High Forest is associated with soils derived from Wianamatta Shale, though may occur in adjacent areas that are underlain by Hawkesbury Sandstone. The community also occurs on soils associated with localised volcanic intrusions. Generally the BGHF occurs more than 100m above sea level, in places where rainfall is greater than 1050mm per annum. It may also be present in sheltered locations with lower rainfall. In drier areas approaching the shale-sandstone transition it may intergrade with the Sydney Turpentine Ironbark Forest which is also an Endangered Ecological Community (NSW Scientific Committee, 2007).

b. Significance at a Local Scale

Blue Gum High Forest has a very highly restricted geographic distribution, and is currently estimated to cover an extant area of less than 200 ha (Tozer, 2003). Formerly BGHF would have covered 25% of Ku-ring-gai LGA, however today only about 1.4% (23.4ha) exists within areas of council control. Another 50 ha of fragmented BGHF exists within the control of the adjacent Hornsby Council.

Blue Gum High Forest on the subject site covers an area of approximately 3.68 ha. The vegetation has been mapped by NPWS (NSW NPWS, 2002) and DECC (Tozer et al., 2006) as being part of a larger remnant, however much of this vegetation has been mapped as different communities or exists as isolated trees within gardens, and much is not likely to be comparable to BGHF. Blue Gum High Forest is highly fragmented throughout its extent, with the largest fragments being approximately 20ha in size.

Nearby fragments are located in Thornleigh Park, Pennant Hills Park, the extension of the Coups Creek vegetation corridor, Rofe Park, Turiban Reserve and Clive Evatt Reserve (NSW NPWS, 2002). All of these are council reserves or within the Lane Cove National Park and are thus afforded protection in the long-term. Maintenance of the condition of the vegetation within these reserves is dependent on council and government funding. Other vegetation mapped in the area is on private property and is likely to be in generally poor condition, and therefore is not protected in the long-term.

The condition of the vegetation is generally poor, with much weed infestation. The community has a long history of disturbance at the subject site. A wide variety of weeds are present, many of which are noxious. Weeds range from groundcover to shrubs and trees. These include species such as *Ehrharta erecta* (Veldt Grass), *Tradescantia albiflora* (Wandering Jew) *Ligustrum sinense* (Small-leaved Privet) and many others.

Vegetation condition assessments indicated that throughout the community most understorey strata contained very high proportions of introduced species (up to 100% cover in many places).

The current area of BGHF that is managed as APZs or exists as scattered trees is equivalent to 76% of this community on the subject land. The area of BGHF to be removed from the subject site represents approximately 45% of the community, however over 50% of this vegetation to be cleared currently exists as scattered trees or is managed as APZs. The proposed development accounts for the modification of a significant proportion of this community on the subject land, however, this area to be removed represents a much smaller percentage of the total area of BGHF in the wider study area (Figure 4.2) but few good quality reserves exist. By considering the size of the area of BGHF on the subject land and the critically endangered nature of this community the modification of this amount of CEEC is considered likely to constitute a significant impact within the local context of the community. However, the vegetation to be retained on the subject land is to be managed and monitored under the site's BMP and permanently conserved under environmental conservation rezoning.

c. Significance at a Regional Scale

Given the critically endangered status of the community at the State and Commonwealth level, any remaining patch of BGHF has some significance for long-term viability of the community as a whole. The vegetation on the subject site is in degraded and weed-infested condition, however some native understorey and groundcover vegetation does occur.

Blue Gum High Forest has a very highly restricted geographic distribution, and is currently estimated to cover an extant area of less than 200 ha (Tozer, 2003). Formerly BGHF would have covered 25% of the Ku-ring-gai LGA, however today only about 1.4% (23.4ha) exists within areas of council control. Another 50 ha of fragmented BGHF exists within the control of the adjacent Hornsby Council. This 200 ha exists of fragments of various sizes scattered throughout the region. Very little of the community is mapped as having a canopy cover of greater than 10% (NSW NPWS, 2002). Very little of the community has long-term protection as the majority of the community occurs on private land. The best condition examples of the community are conserved within the following reserves: Dalrymple-Hay Nature Reserve, Lane Cove National Park and Ku-ring-gai Chase National Park.

BGHF on the subject land forms a relatively large band in an area surrounded by small fragmented blocks of the community. As such, the vegetation of the subject site is important for the viability of the community as a whole as it acts as a sizeable source of genetic material for the community and facilitates genetic exchange between itself and smaller individual fragments. Despite the generally poor condition of the BGHF on the subject land and based alone on the relative size of the BGHF on the subject land in comparison to nearby smaller fragments, the BGHF on the subject lands is important at a regional scale as it adds value to local occurrences of the community and assists in the transfer of genetic material between other patches of BGHF. Therefore the loss of any of

this community on the subject site is considered likely to have a significant impact upon the community at a regional scale.

Coordinate System: UTM WGS 84 (Zone 56)

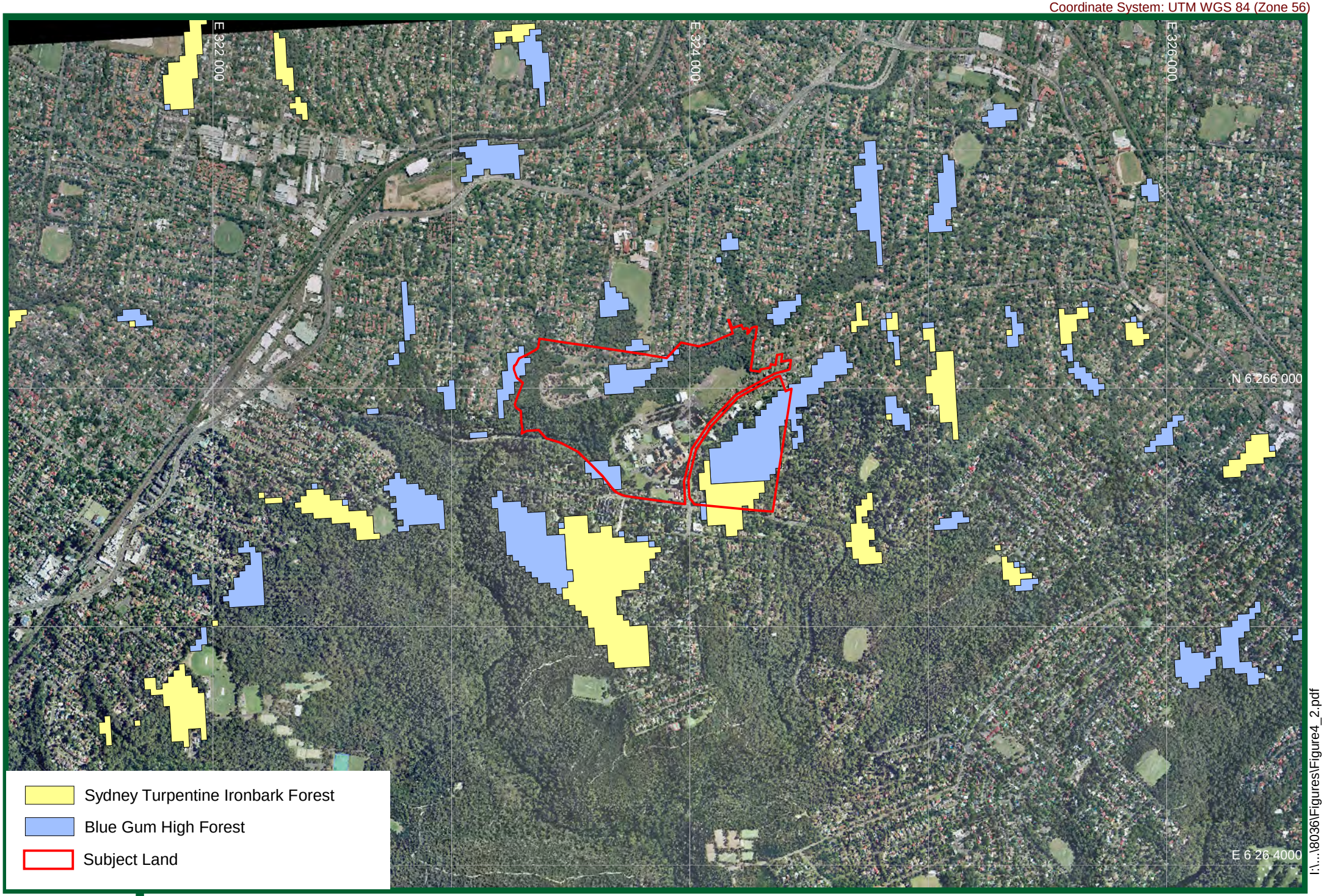


Figure 4.2 Blue Gum High Forest and Sydney Turpentine Ironbark Forest in the locality (Tozer et al (2006) Native vegetation of southeast NSW (SCIVI))

100 0 100 m

ii. Sydney Turpentine-Ironbark Forest

a. Introduction

Sydney Turpentine-Ironbark Forest typically occurs on soils derived from Wianamatta Shale, though may occur in adjacent areas that are underlain by Hawkesbury Sandstone. This vegetation community generally forms on plateaus and hillsides on the margins of shale capping over hillsides (DEC (NSW), 2005b) in moderately wet sites, with an annual rainfall of 800-1100 mm per year (DEH, 2005c). STIF often forms stands adjacent to the CEEC Blue Gum High Forest which tends to develop on shale rich soil and wetter locations.

b. Significance at Local Scale

STIF, like BGHF, has a very highly restricted geographic distribution, and is currently estimated to cover an extant area of just over 200 ha (Tozer, 2003). Less than 5% of the original forest is intact and retains the structural integrity of the vegetation. Existing remnants continue to be threatened by clearing and weed invasion.

STIF on the subject land occurs in scattered occurrences and covers an area of less than 1.7 ha. The vegetation has been mapped by NPWS (NSW NPWS, 2002) as a disturbed remnant of BGHF and Western Sandstone Gully Forest. The subject land's STIF is an example of the highly disturbed nature of the community which exists as small remnant fragments.

Nearby fragments are located in Thornleigh Park, Pennant Hills Park, Mitchell Crescent Reserve, Lewis Park and Eloper Bushland Reserve (NSW NPWS, 2002). All of these are council reserves or within the Lane Cove National Park and are thus afforded protection in the long-term. Maintenance of the condition of the vegetation within these reserves is dependent on council and government funding. Other vegetation mapped in the area is on private property and is likely to be in generally poor condition and not protected in the long-term.

The condition of this vegetation community on the subject land is generally highly degraded, with much weed infestation. The community has a long history of disturbance at the subject site. A wide variety of weeds are present, many of which are noxious. Weeds range from groundcover to shrubs and trees. The dominant weed species include: *Ehrharta erecta* (Panic Veldtgrass), *Paspalum dilatatum* (Paspalum), *Sida rhombifolia* (Paddy's Lucerne), *Trifolium repens* (White Clover) and *Pennisetum clandestinum* and many others. Within each of the quadrats surveyed, estimates were made of the percentages of exotic species in each of the four vegetation strata (canopy tree, small tree, shrub and ground cover). These indicated that throughout the community most understorey strata contained very high proportions of introduced species (up to 100% cover in many places).

STIF occurs on the subject land as a number of small fragmented blocks of the community; most of which are highly degraded. One of these patches contains a native ground and shrub layer and as such, this area is particularly important for the viability of these community layers as it acts as a source of genetic material and facilitates genetic exchange between itself and other fragments in the locality.

The current area of STIF that is managed as APZs or exists as scattered trees is equivalent to 82% of this community on the subject land. The area of STIF to be cleared from the subject site represents approximately 48% of the community however over 80% of this vegetation to be cleared currently exists as scattered trees or is managed as APZs. The proposed development accounts for the modification of a significant proportion of this community on the subject land, however, this area to be removed represents a much smaller percentage of the total area of BGHF in the wider study area (Figure 4.2) but, as for BGHF, few good quality reserves exist. Despite the poor quality and highly degraded nature of the STIF on the subject land; when considering the critically endangered nature of this community, it is considered the proposed development is likely to constitute a significant impact on this community at a local scale. However, the vegetation to be retained on the subject land is to be managed and monitored under the site's BMP and permanently conserved under environmental conservation rezoning.

c. Significance at a Regional Scale

Given the critically endangered status of the community at a Commonwealth level and the endangered status under State legislation, any remaining patch of STIF has some significance for the long-term viability of the community as a whole. The vegetation on the subject site is in a degraded and weed-infested condition, however in one location native understorey and groundcover vegetation dominates.

STIF has a very highly restricted geographic distribution, and is currently estimated to cover an extant area of a little over 200 ha (Tozer, 2003). This 200 ha exists of fragments of various sizes scattered throughout the region. Very little of the community is mapped as having a canopy cover of greater than 10% (NSW NPWS, 2002). Very little of the community has long-term protection as the majority of the community occurs on private land. The best condition examples of the community are conserved within the following reserves: Wallumatta Nature Reserve and Newington Nature Reserve.

Despite the generally poor condition and small area of the STIF on the subject land this vegetation is important at a regional scale as it adds value to local occurrences of the community and assists in the transfer of genetic material between patches of STIF. The loss of part of this community on the subject land is considered to have potential to have an impact upon the community at a regional scale.

4.3 Impacts on Flora Species Listed Under the TSC Act and the EPBC Act

While suitable habitat does occur for a number of threatened flora species on the subject land no State or Commonwealth listed threatened flora species have been recorded on or near the Subject Site in recent targeted surveys. Potential habitat for such species will be retained on the subject lands and managed according to the BMP.

4.4 Impacts on Fauna Species Listed Under the TSC Act and the EPBC Act

The major impact from the proposed development on the fauna species that use the site will be the clearing of vegetation resulting in habitat loss. The 'Clearing of Native Vegetation' is listed as a Key Threatening Process (NSW Scientific Committee, 2004) resulting in significant habitat loss for many species. The impact of clearing on the threatened fauna species that have been recorded or are likely to occur on the Subject Site is outlined below.

4.4.1 Forest Owls

Suitable habitat is present on the subject land for the following forest owls; Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*) and Sooty Owl (*Tyto tenebricosa*). Two adult Powerful Owls and one recently fledged juvenile were recorded in the forested area to the east of Fox Valley Road after the discovery of significant amounts of whitewash. A suspected nest tree with large hollows was located a short distance away from the roosting birds.

Powerful Owls are long lived birds that form monogamous partnerships and are known to use the same nesting site for many consecutive years. The species is sensitive to disturbance during nesting and will readily abandon the nest if disturbed (DEC (NSW), 2006). Due to the sensitivity of the species, ornithologist Dr Steven Debus was contracted to assist in the assessment of the potential impacts of the proposed development on the owls in their current breeding location. The full report can be found in Appendix E. In summary it considered that the owls may experience reduced breeding success or in a worst case abandon the nest site. However, based on the continued and possibly increasing presence of Powerful Owls in urban areas, and their response to disturbance, it is considered unlikely that the owls will abandon their home range completely. It is more likely that they would focus future breeding attempts in a more secluded location. Thus, the loss of a nest site need not mean the loss of a pair of owls from the local population, although their breeding productivity may be reduced (Debus 2008). It is expected then that the owls may be somewhat impacted by the development; however with appropriate mitigation measures and management strategies (Chapter 5) this impact will not be significant.

The proposed development has the potential impact upon the owls and without appropriate management the viability of the nesting site may be compromised. At present, the owls' nest tree is located within 100 m of residential development and associated infrastructure. Taking this into consideration the development has been designed to accommodate the Powerful Owls by creating a 100m buffer of native vegetation around the nesting location in order to minimise disturbance to the owls during nesting times. Therefore property development will not encroach any closer to the nesting location than it is at present, however APZs will be managed within this distance.

Research indicates that Powerful Owls and the other forest owls occupy very large home ranges (DEC (NSW), 2006). Given the large area of native forest surrounding the subject site, the clearing of some areas of native vegetation on the subject site will have minimal impact on foraging territories of the owls.

The site seems to be a potential 'source population' for the NSW Powerful Owl population at a local and regional scale. The proposed development has the potential to reduce breeding success for the species to some extent. It is likely however that if disrupted the owls will nest and breed again in a different location; again supplying juveniles to the region. Therefore, while the development may slightly reduce the breeding success of Powerful Owls in the short-term, it should have little to no impact in the long-term.

4.4.2 Swift Parrot (Lathamus discolor)

The Swift Parrot has not been recorded on the subject site however there are a number of records from the Ku-ring-gai LGA in 2002 (DECC (NSW), 2007). The Swift Parrot is listed as endangered under the EPBC and TSC Acts. During the winter migratory season the Swift Parrot flies north after breeding in Tasmania with most individuals migrating significantly further north than Sydney. The species forages in areas where eucalypts are flowering profusely or where there are abundant lerp infestations; feeding on the sugary secretions of the lerp. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta)*, Spotted Gum (*Corymbia maculata)*, Red Bloodwood (*Corymbia gummifera)*, Mugga Ironbark (*Eucalyptus sideroxylon)*, and White Box (*Eucalyptus albens)*. Commonly used lerp infested trees include Inland Grey Box (*Eucalyptus microcarpa)*, Coast Grey Box (*Eucalyptus moluccana)* and Blackbutt (*Eucalyptus pilularis)*. The subject land contains Red Bloodwood and Blackbutt and therefore provides some suitable foraging habitat for this species. The potential impact of the loss of foraging habitat was referred to DEWHA for this species; and the proposed development was considered a controlled action by DEWHA in consideration of the impacts on Swift Parrot.

The assessment of impact requirements for EPBC listed vulnerable species (DEH, 2006a) require certain criteria to be considered in the process of determining the significance of an impact caused by a proposed action. These criteria are assessed below for the Swift Parrots that have potential to use the site.

A significant impact on an EPBC listed endangered species is considered to have occurred if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population;
  - Expansive areas of suitable winter flowering trees and tree species suitable for lerp infestations are available to the Swift Parrot within nearby Lane Cove National Park and Ku-ring-gai Chase National Park. This vegetation is under conservation in these areas. Suitable feed trees are also present throughout Sydney in other National Parks, bushland reserves and privately owned land. The loss of the suitable foraging habitat on the subject site under the proposed development will not lead to a long-term decrease in the size of the Swift Parrot population because the amount of habitat loss caused by the proposal is minimal in consideration of areas surrounding the subject land.
- Reduce the area of occupancy of the species;
  - The proposed development will not reduce the area of occupancy of the species. The Swift Parrot is migratory and migrates north over the cooler months often well past the Sydney region. This being the case, the species potential area of occupancy includes the east coast of Australia as far north as the Queensland border.
- Fragment an existing population into two or more populations;
  - The proposed development will not fragment any Swift Parrot populations. The only impact of the development for this species is the loss of potential foraging habitat.
- Adversely affect habitat critical to the survival of a species;
  - The Swift Parrot will suffer the loss of some potential foraging habitat under the proposed development; however there are large areas of available foraging habitat for this species conserved within Sydney's National Parks as well as council reserves and privately held land. Therefore, the 22.21 ha of potential foraging habitat to be removed and modified is in no way critical to the survival of the species.
- Disrupt the breeding cycle of a population;
  - The species breeds in Tasmania. The proposed development will not affect the breeding cycle.
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
  - The Swift Parrot will suffer the loss of 5.31 ha and modification of 16.90 ha of potential foraging habitat under the proposed development. Habitat modified

for APZs and fuel management will contain appropriate feed trees for the Swift Parrot and therefore does not constitute an entire loss of this habitat. The species is known to forage over the entire Sydney region and NSW coast allowing and its mobility allows the species to access large tracts of native bushland in nearby National Parks containing suitable feed trees throughout. Suitable feed trees for the species are also present throughout the Sydney's urbanised areas. The proposed development will result in the removal and modification of available habitat to the species and the subject site will be revegetated to provide suitable feed trees under the site specific Biodiversity Management Plan (BMP). Given the amount of suitable foraging habitat available to the Swift Parrot the proposed development will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to an extent that the species is likely to decline.

- Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat;
  - The proposed development will not result in invasive species that are harmful to the Swift Parrot becoming established in the habitat on the subject land. Any invasive weeds that may result in the reduced success of feed tree species growth will be managed under the BMP to be prepared for the subject site.
- Introduce disease that may cause the species to decline; or
  - The proposed development will not cause the introduction of disease that may cause the species to decline.
- Interfere with the recovery of the species.
  - The removal and modification of 22.21 ha of suitable foraging habitat from the subject land will not interfere substantially with the recovery of the Swift Parrot because the alteration of this amount of habitat, in consideration of available suitable foraging habitat surrounding the subject lands, is not significant. The loss of this habitat will be mitigated through the planting of suitable feed trees for the Swift Parrot under the BMP to be prepared for the site.

In assessing the criteria above it can be considered there will be no significant impact on the Swift Parrot at a local or regional scale due to the alteration of foraging habitat on the subject site.

*4.4.3 Gang-gang Cockatoo (*Callocephalon fimbriatum*)*

Suitable foraging habitat and sub-optimal breeding habitat exists for this species on the subject land. The species has been recorded in the Ku-ring-gai LGA as recently as 2004 (DECC (NSW), 2007). The Ku-ring-gai population of Gang-gang Cockatoos is listed as Endangered under the TSC Act. The population is estimated to encompass about 18 to

40 breeding pairs. The population previously occurred over the Baulkham Hills, Cherrybrook and Dural areas, however, due to heavy development in these areas the species is now restricted to the Ku-ring-gai and Hornsby LGAs. The species is regionally important being the only breeding population in the Sydney metropolitan area. Gang-gang Cockatoos have a preference in the winter months for lower altitude habitats, including dry coastal eucalypt forest and Box - Ironbark assemblages. The Gang-gang Cockatoo will usually breed in tall sclerophyll forests with large hollows and a dense understorey; breeding occasionally occurs in coastal forests.

The proposed development will remove and alter an area of potential foraging habitat and possibly some suboptimal breeding hollows for this species. The habitat of the subject land is not considered to be significant to the viability of this species and large tracts of equivalent and better quality habitat are available in nearby Lane Cove and Ku-ring-gai Chase National Parks. The proposed development will not impact on this species at a local or regional scale as no individuals have been recently recorded using the subject site and because the extent of potential foraging habitat that occurs on the subject land is limited.

4.4.4 *Glossy Black Cockatoo (*Calyptorhynchus lathami)

Sub-optimal foraging and nesting habitat exists for this species on the subject land. The Glossy-Black Cockatoo inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*Allocasuarina torulosa*) or Drooping She-oak (*Allocasuarina verticillata*) occur. The species requires large tree hollows for nesting (NSW NPWS, 1999a) and has been recorded in the Ku-ring-gai LGA as recently as 2005 (DECC (NSW), 2007). The Glossy Black Cockatoo is listed as Vulnerable under the TSC Act.

The proposed development will remove and alter an area of potential foraging habitat and possibly some potential breeding hollows for this species. The habitat of the subject land is not considered to be significant to the viability of this species and large tracts of equivalent and better quality habitat are available in nearby Lane Cove and Ku-ring-gai Chase National Parks. The proposed development will not impact on this species at a local or regional scale as no individuals are known to use the subject site and because the extent of potential foraging habitat that occurs on the subject land is limited.

4.4.5 Other Threatened Birds

Sub-optimal or suitable foraging; and in some cases nesting habitat; exists on the subject land for the following bird species; all of which have been recorded on or within 10km of the site (NPWS; 2004); Bush Stone-curlew (*Burhinus grallarius),* Black Bittern (*Ixobrychus flavicollis)* and Regent Honeyeater (*Xanthomyza phrygia).* It is unlikely that these species make regular if any use of the subject land. However, in the case that the subject land was used by these species, the proposed development would not impact upon their long-

term viability because the subject land is contained within a wider area of native vegetation; and given the availability of large tracts of equivalent or better quality habitat within this wider area, the impacts of the development upon these species are likely to be minimal. Therefore the proposed development is not expected to impact on these species at a local or regional scale.

4.4.6 Arboreal Mammals

No threatened arboreal mammals have been recorded on the subject land, however, the site contains suitable potential habitat for; Squirrel Gliders (*Petaurus norfolcensis*), Yellow-bellied Gliders (*Petaurus australis*), Brush-tailed Phascogale (*Phascogale tapoatafa)* and Eastern Pygmy-possum (*Cercartetus nanus).* Based upon habitat assessments and consideration of recent records for these species (DECC (NSW), 2007) it is considered highly unlikely that these species utilise the subject land; however, if present the proposed development will impact upon them through the removal of some hollow-bearing trees. However, hollow-bearing trees will be retained in preference to non-hollow bearing trees and nest boxes will replace any hollows removed. Given the proximity and connectivity of the subject land to other areas of native vegetation and mobility of these species; the impact upon these arboreal mammals, if present, will be minimal. Therefore the proposed development is not expected to impact on these species at a local or regional scale.

4.4.7 Terrestrial Mammals

i. Spotted-tail Quoll

Sub-optimal habitat exists for the Spotted-tailed Quoll (*Dasyurus maculatus*). The species was recorded in the Ku-ring-gai LGA as recently as 2003 (DECC (NSW), 2007) however, these records are from areas much closer to Garigal and Ku-ring-gai National Parks which are much larger areas of bushland. The species was not detected in recent surveys and is considered very unlikely to occur on the subject land due to the small size of the bushland area on the subject land. If present the subject land would form a small part of a larger home range and therefore the species would not likely be impacted significantly by the development due to the ability of the species to move into an adjacent area of suitable habitat. It is considered that the proposed development will not impact on this species at a local or regional scale.

4.4.8 Bats

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

The Grey-headed Flying-fox (*Pteropus poliocephalus)* is listed as Vulnerable under the TSC Act and EPBC Act. The species inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated

areas. The subject site supports a number of species which are suitable feed trees for the Grey-headed Flying-fox. These include trees from the Fabaceae, Myrtaceae, Proteaceae, Sterculiaceae, Moraceae, Pittosporaceae and Lauraceae families. Whilst the subject land provides suitable foraging habitat for this species no camps were observed or are known to occur on it.

The Grey-headed Flying-fox roosts in colonies known as “camps”. Camps have a high site fidelity and the bats disperse between camps depending on the availability of food. In the Sydney area, there are three camps: Ku-ring-gai Flying-fox Reserve at Gordon adjacent to Garigal National Park, the Royal Botanic Gardens, and Cabramatta Creek Flying-fox Reserve at Cabramatta. The Gordon camp is within 6km of the subject land and there have been many sightings of the Grey-headed Flying-fox throughout the Ku-ring-gai LGA (DECC (NSW), 2007). The Kukundi Wildlife Shelter at Chatswood is adjacent to Lane Cove National Park is known to rehabilitate injured Grey-headed Flying-foxes and is likely to release animals that would join up with the Gordon colony. “Large numbers” of this species were observed visually on the subject site by Conacher Travers during their survey in 2004. No estimation of numbers was provided in the report, nor were details of numbers of the individuals feeding or flying over the site provided. The species was observed flying in to the site from the east and feeding on the nectar of the flowering eucalypt tree species within the subject land. The Grey-headed Flying-fox was not recorded by Cumberland Ecology during surveys in 2008.

Whilst the subject land provides suitable foraging habitat for this species no camps were observed or are known to occur on it. The Grey-headed Flying-foxes observed on the subject land by Conacher Travers are likely to have flown in from the Flying-fox Reserve at Gordon. Local populations do not exist as such due to the migration of individuals over large distances within their range in response to food availability. Flying-fox numbers vary greatly at camp sites throughout the year because the species is nomadic (Churchill, 1998).

The potential impact of the loss of foraging habitat was referred to DEWHA for this species; and the proposed development was considered a controlled action by DEWHA in consideration of the Grey-headed Flying-fox.

The assessment of impact requirements for EPBC Act-listed vulnerable species (DEH, 2006a) require certain criteria to be considered in the process of determining the significance of an impact caused by a proposed action. These criteria are assessed below for the Grey-headed Flying-fox that use the subject land.

A significant impact on an EPBC listed vulnerable species is considered to have occurred if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of the species;

    - The GHFF recorded on the subject site are most likely to have travelled from the Flying-fox camp at Gordon. This camp at Gordon forms one of three inhabited large permanent camps across Sydney; the others being in the

Royal Botanic Gardens and Cabramatta Creek. Flying-foxes are known to forage for food distances of up to 50 km, so it is possible that the bats originated from any of these colonies. However, given the proximity of the Gordon camp to the site it is most likely they originated from Gordon. In either case the Flying-foxes form part of an important population that is necessary for the species' long-term survival and recovery. The subject lands provide suitable foraging habitat for the species which will be reduced in size by 5.31 ha under the proposed development. 16.90 ha of vegetation will be modified for bushfire protection and therefore contain appropriate feed trees. The flying-fox reserve at Gordon and the subject lands are surrounded by large areas of bushland providing foraging habitat as well as large numbers of suitable remnant feed trees throughout private gardens. Therefore it is unlikely that the loss or modification of 22.21 ha vegetation on the subject lands will lead to a long-term decrease in the population size of the species.

- significantly reduce the area of occupancy of important populations of the species;

  - The removal of 5.31 ha and modification of 16.90 ha of suitable habitat for the species will not significantly reduce the area of occupancy of the Grey-headed Flying-fox. Habitat modified for APZs and fuel management will contain appropriate feed trees for the Grey-headed Flying-fox and therefore does not constitute an entire loss of this habitat. The species is known to forage over an area of up to 50km in an evening allowing the Gordon colony access to large tracts of native bushland in nearby National Parks including Garigal and Lane Cove National Parks, containing suitable feed trees throughout. Suitable feed trees for the species are also present throughout the adjacent urbanised areas. Therefore the proposed development should not result in a significant reduction in available habitat to the species, and hence will not significantly reduce the area of occupancy of important Grey-headed Flying-fox populations.

- fragment the existing important populations into two or more populations;

  - The species is highly mobile and known to forage large distances across urban areas. The proposed development, if completed, would not fragment any important populations of Grey-headed Flying-fox into two or more populations as the connectivity of habitat for this species would be maintained.

- adversely affect habitat critical to the survival of a species;

  - No known Grey-headed Flying-fox camps have been identified of the subject lands, therefore the proposed development will not impact on this type of habitat which is critical to the species.

The subject land provides a considerable area of habitat of suitable foraging habitat for the Grey-headed Flying-fox. The proposed development will result

in the removal of 5.31 ha and modification of 16.90 ha of potential habitat for the species. Habitat modified for fuel management will contain appropriate feed trees for the Grey-headed Flying-fox and therefore does not constitute an entire loss of this habitat for the species. The species is known to forage over an area of up to 50km in an evening allowing the Gordon colony access to large tracts of native bushland in nearby National Parks containing suitable feed trees throughout. Suitable feed trees for the species are also present throughout the adjacent urbanised areas. Therefore, the habitat to be removed on the subject lands is in no way critical to the survival of the Grey-headed Flying-fox.

- disrupt the breeding cycle of an important population;

  - There are no maternal camps for the Grey-headed Flying-fox known on the subject land. Therefore the proposed development will not disrupt the breeding cycle of an important population.

- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

  - The site provides a considerable area of habitat of suitable foraging habitat to the Grey-headed Flying-fox. The proposed development will result in the removal of 5.31 ha and modification of 16.90 ha of suitable habitat for the species. Habitat modified for fuel management will contain appropriate feed trees for the Grey-headed Flying-fox and therefore does not constitute an entire loss of this habitat. The species is known to forage over an area of up to 50km in an evening allowing the Gordon colony access to large tracts of native bushland in nearby National Parks containing suitable feed trees throughout. Suitable feed trees for the species are also present throughout the adjacent urbanised areas. The proposed development will result in the removal and modification of available habitat to the species and the subject site will be revegetated to provide suitable feed trees. Given the amount of adjacent habitat available to the Grey-headed Flying-fox, the proposed development will not, modify, destroy, remove or isolate or decrease the availability or quality of habitat to an extent that the species is likely to decline.

- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat; or

  - The proposed development will not result in invasive species that are harmful to the Grey-headed Flying-fox becoming established in the habitat on the subject land. Any invasive weeds that may result in the reduced success of feed tree species growth will be managed under the BMP to be prepared for the subject site.

- Interfere substantially with the recovery of the species.

- The removal and modification of 22.21 ha of suitable foraging habitat from the subject land will not interfere substantially with the recovery of the Grey-headed Flying-fox because the alteration of this amount of habitat is not significant in consideration of available suitable foraging habitat surrounding the subject lands. The loss of this habitat will be mitigated through the planting of suitable feed trees for the Grey-headed Flying-fox under the BMP to be prepared for the site.

In assessing the criteria above it can be considered there will be no significant impact on the Grey-headed Flying-fox at a local or regional scale due to the alteration of foraging habitat on the subject site.

ii. Microchiropteran Bats

a. Large-eared Pied-bat (*Chalinolobus dwyeri*)

This species is generally rare with scattered records in NSW. It is listed as Vulnerable under the TSC Act and EPBC Act. One record of the species exists in the Ku-ring-gai LGA from 1992 (DECC (NSW), 2008). It roosts in caves (near their entrances), crevices in cliffs and old mine workings. Found in well-timbered areas containing gullies, the species frequents low to mid-elevation dry open forest and woodland close to roosting sites. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years.

The site provides suitable diurnal roosting and sub-optimal maternal roost habitat within crevices and overhangs in sandstone outcropping. Suitable foraging habitat is present in the forested gullies across the subject land. The vast majority of roosting habitat and much of the best foraging habitat for this species on the subject land exists within the riparian corridors. This area of the subject land is protected under the *Water Management Act 2003*; therefore very few of the roosting locations will be affected by the development and the best quality areas of the foraging habitat will be retained.

An assessment of significance of impact of the proposed development for this EPBC Act-listed vulnerable species is provided below. There is considered to be no significant impact on this species because the proposed development will not:

- lead to a long-term decrease in the size of an important population of the species;

  - One single individual of this species has been recorded in the locality of the subject land and therefore it is unlikely the area supports a viable or important population of the species. The proposed development is not considered likelyto lead to a long-term decrease in population size because the best quality foraging and roosting habitat for the species will be retained on the subject land. The mobility of the species allows it to move to adjacent suitable habitat in Lane Cove National Park if required.

- significantly reduce the area of occupancy of important populations of the species;

  - The record of one individual of a species is not considered to be an important population; however the best available habitat for this species will be retained on the subject lands. Therefore the proposed development will not significantly reduce the area of occupancy for the species. The mobility of the species allows it to move to adjacent suitable habitat in Lane Cove National Park if required.

- fragment the existing important populations into two or more populations;

  - One record of the species is known for the Ku-ring-gai LGA. The proposed development will therefore not fragment a population of the species. The mobility of the Large-eared Pied-bat allows it to remain connected to any adjacent habitat or populations if the site is used by the species.

- adversely affect habitat critical to the survival of a species;

  - No known maternal cave roosts are known on the subject land for the species; therefore no habitat critical to the survival of the species will be affected. Large areas of suitable foraging and better roosting/breeding habitat are likely to be present in the adjacent Lane Cove National Park.

- disrupt the breeding cycle of an important population;

  - No known maternal cave roosts are known on the subject land for the species. Therefore the proposed development will not disrupt the breeding cycle of this species.

- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

  - The proposed development will, to some extent, modify and destroy some of the potential foraging and roosting habitat available to the species on the subject land. However the best quality foraging and roosting habitat available to this species will be conserved within the riparian corridors within the subject land. Therefore, if the species uses the subject site, the alteration of habitat under the proposed development will not lead to the decline of the species.

- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat; or

  - No known invasive species harmful to the Large-eared Pied-bat will become established on the subject land as a result of the proposed development.

- interfere substantially with the recovery of the species.

- The proposed development will reduce and modify the best available habitat for this species on the subject land however it will not interfere substantially with the recovery of the species

In assessing the criteria above it can be considered there will be no significant impact on the Large-eared Pied-bat at a local or regional scale due to the alteration of foraging habitat on the subject site.

b. Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) was recorded on the subject land in recent surveys (Conacher Travers 2004). The species is listed as vulnerable under the TSC Act and prefers moist habitats with trees greater than 20 m in height. Hollow-bearing trees are the most common roost sites for this species however it has also been recorded roosting in buildings and under bark.

The subject land provides suitable foraging and roosting habitat for this species which will be reduced in size under the proposed development. No other records exist for this species from the Ku-ring-gai LGA (DECC (NSW), 2008) so it is considered unlikely that there is a viable population of this species present in the locality of the subject site. The mobility of this species will allow it to forage and roost in areas of nearby suitable habitat in Lane Cove National Park. Therefore, the proposed development is not expected to cause a significant impact upon this species at a local or regional scale.

c. Other Microchiropteran Bats

Other threatened microbats that could potentially use the subject land for foraging and/or roosting include: the Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*); the Little Bent-wing Bat (*Miniopterus australis*); and the Eastern Free-tail Bat (*Mormopterus norfolkensis*). Small numbers of records (7, 2 and 1 respectively) for these species have been recorded within the Ku-ring-gai LGA (DECC (NSW), 2008) within the last ten years putting to question the long-term viability of the populations.

No habitat of great significance occurs on the subject land for any of these species. Equivalent or better roosting and foraging habitat occurs in the large areas of surrounding native vegetation, particularly Lane Cove National Park. Given the mobility of these species to move to these areas of nearby habitat the development is unlikely to cause any significant impact on these species at a local or regional scale.

4.4.9 Amphibians

The following threatened frogs have the potential to occur within the locality of the subject land: Giant Burrowing Frog (*Heleioporus australiacus),* Green and Golden Bell Frog (*Litoria aurea),* Littlejohn's Tree Frog (*Litoria littlejohni*), Stuttering Frog (*Mixophyes balbus*), Southern Barred frog (*Mixophyes iteratus)* and Red-crowned Toadlet (*Pseudophryne australis*). Species which potentially could exist within the sub-optimal habitat within the subject site include: Green and Golden Bell Frog (*Litoria aurea*) and

Red-crowned Toadlet (*Pseudophryne australis*). Development impacts upon these species, if present, are likely to be minimal given that all suitable habitat for these species is located in the moister gullies outside the development footprint.

Any potential impacts caused by pollutants and nutrients in increased run-off from larger hardstand areas are to be managed as per the Flooding and Stormwater Management Plan (Hyder Consulting Pty Ltd, 2008).

4.4.10 Reptiles

Sub-optimal habitat exists on the subject site for Rosenberg's Goanna (*Varanus rosenbergi*) and the Broad-headed Snake (*Hoplocephalus bungaroides*). Rosenberg's Goanna requires terrestrial termite mounds for nesting and these were not observed on the subject land while the Broad-headed Snake requires larger areas of native vegetation than the subject land offers for successful foraging. It is unlikely these species are present on the subject land and it does not offer significant habitat to these species. Therefore, the development is unlikely to cause significant impacts on these species.

4.5 Impacts on Migratory Birds Listed Under the EPBC Act

The EPBC Act protects all 'Matters of National Environmental Significance' which are considered necessary of protection. Included in the list of 'Matters of National Environmental Significance' are migratory species protected under international agreements. The subject land provides suitable habitat for a small number of these listed migratory species including: White-throated Needletail (*Hirundapus caudacutus*), Black-faced Monarch (*Monarcha melanopsis*), Satin Fly-Catcher (*Myiagra cyanoleuca*) and Rufous Fantail (*Rhipidura rufifrons*).

None of these listed migratory species have been identified on the subject site in recent surveys, in either the warmer or cooler months, however based on a review of available literature and assessment of the habitats within the subject land, the site was considered to potentially provide foraging and/or nesting habitat for the above migratory species.

The assessment criteria to determine if an action is considered to have a significant impact on these migratory species under the EPBC Act are considered below.

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

- Substantially modify, destroy or isolate an area of *important habitat* for a migratory species;

  - The subject land is not considered to constitute *important habitat*, as defined in the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines (DEH, 2006b), for any of these species because;

- it is believed not to support an ecologically significant proportion of the populations;
- it is believed not to form habitat of critical importance at particular life cycle stages;
- it does not form habitat at the limit of the species range; and
- it is not habitat in an area where the species are in significant decline.

- Result in an invasive species that is harmful to the migratory species becoming established in an area of *important habitat* for the migratory species;
  - Refer to response to of assessment of *important habitat* above.
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an *ecologically significant proportion of the population* of a migratory species.
  - The proposed development will not disrupt the lifecycle of an *ecologically significant proportion of the population* of these migratory species as the habitat lost due to the proposed development does not constitute habitat of significance to the species. If the habitat of the subject land is currently used by these species, their mobility will allow them to relocate to areas of suitable habitat in adjacent areas.

4.6 Impacts on Other Items Required by Director General's Requirements

4.6.1 Impacts of Edge Effects

The impacts of edge effects on vegetation are obvious throughout the subject land at present with weed invasion and signs of human disturbance common. There is potential for such disturbances and weed invasion to impact larger areas of the subject land under the proposed development which could degrade the quality of the vegetation further. Mitigation measures employed to ensure that these kinds of impacts do not occur following the proposed development include proposed aesthetic fencing around the EECs and further mitigation measures to be included in the site-specific Biodiversity Management Plan (BMP). Further details regarding the BMP are provided in Chapter 5 Mitigation Measures and Management Strategies.

4.6.2 Ecological Corridors

The subject land holds important ecological values due to the bushland providing ecological corridors to surrounding bushland (Figure 4.2). At present these corridors exist largely within the riparian areas and adjacent low-lying areas of the subject land.

Ecological corridors are important in the passage of fauna between locations ensuring the transfer of genetic diversity between populations. In the process, this fauna movement allows for the dispersal of flora propagules travelling with the fauna assisting in the long-term viability of flora species through wide dispersal. An assessment of impacts of the proposed development on each of the ecological corridors is provided below.

i. Coups Creek

The ecological corridor contained within Coups Creek will undergo a slight reduction in width and undergo APZ management processes under the current proposal; however the connectivity of the corridor with Lane Cove National Park via Thornleigh Park and Pennant Hills Park will be maintained. Despite ecological corridors being considered to be more effective, in terms of fauna movement, with increased width; the removal and management of the vegetation adjacent to the riparian corridor, which will particularly occur from the eastern side of the creek, will have no major impacts upon the passage of terrestrial and arboreal fauna to adjacent bushland areas because a corridor of at least 100m wide will be maintained; as required under the *Water Management Act 2003* and Ku-ring-gai Council's riparian corridor protection requirements (Ku-ring-gai Council, 2004).

The vegetation communities impacted by the development within the Coups Creek corridor are Blackbutt – Turpentine – Smooth-bark Apple Open Forest and a highly disturbed form of Blue Gum High Forest. Large areas of Blackbutt – Turpentine – Smooth-bark Apple Open Forest are conserved within nearby Lane Cove and Ku-ring-gai Chase National Parks; therefore, if reduced propagule transference did occur as result of the reduction in corridor width the long term viability of this vegetation community and the species within it would not be reduced.

Given the critically endangered status of the community, any remaining patch of BGHF has some significance for long-term viability of the community as a whole. The small area of scattered trees at this location on the subject site is regrowth from excavated fill material and the shrub and ground layers are weed-infested, however some native understorey vegetation does occur. The loss of some of these Blue Gum trees will reduce the available genetic material available further down the corridor; but will not play a significant role in threatening the long term viability of the community.

ii. Corridor on Western Side of the Subject Land

The riparian corridor adjacent to the western side of the subject land will also undergo a reduction in width in some areas due to a small amount of clearing for development with other areas to undergo under storey management for bushfire safety reasons. This clearing/management will have no major impacts on fauna passage through the subject land to surrounding bushland because a sizeable bushland corridor, suitable for fauna, will remain though this area.

The management of the under storey for bushfire protection purposes will have a greater impact on the flora in this corridor. The continual management of shrubs in this area will result in the reduced transfer potential of propagules and therefore reduced gene flow and population viability. This management of vegetation will mostly occur within the community Sydney Peppermint / Red Bloodwood Open Forest. Large areas of this vegetation community are conserved within nearby Lane Cove and Ku-ring-gai Chase National Parks; therefore if reduced propagule transferrance did occur as a result of the reduction in corridor width, the long term viability of the community and the species within it would not be reduced.

iii. Corridor to the East of Fox Valley Road

The current ecological corridor extending south east from Fox Valley Road towards Mitchell Crescent Reserve will undergo the greatest alteration due to the proposed development. The connection of the corridor with Mitchell Crescent Reserve will be maintained, however, the length and width of the corridor will be reduced due to the removal of vegetation adjacent to Fox Valley Road. Despite the vegetation loss this clearing should not greatly alter the current passage of fauna to and from this part of the subject land. The proposed clearing and development in the eastern precinct adjacent to Fox Valley Road will decrease the likelihood of terrestrial fauna attempting to cross into the eastern precinct from the Coups Creek corridor; however, this is unlikely at present given that fauna are required to cross the disturbed hospital grounds as well as Fox Valley Road. The bushland areas to the east of the subject land will remain connected to the Coups Creek catchment to arboreal birds and bats despite the larger disturbed area required to be crossed.

The vegetation communities impacted by the development within the corridor on the eastern side of Fox Valley Road are Blackbutt – Turpentine – Smooth-bark Apple Open Forest and Sydney Peppermint / Red Bloodwood Open Forest. Large areas of Blackbutt – Turpentine – Smooth-bark Apple Open Forest and Sydney Peppermint / Red Bloodwood Open Forest are conserved within nearby Lane Cove and Ku-ring-gai National Parks therefore if reduced propagule transferrance did occur as result of the clearing adjacent to the corridor, the long term viability of the community and the species within it would not be reduced.

4.6.3 Watercourses and Associated Riparian Vegetation

The water courses and associated riparian vegetation on the subject land will be unaffected by the proposed development as no aspect of the development will encroach within the DIPNR and Ku-ring-gai Council Core Riparian Zones and appropriate buffers (Ku-ring-gai Council, 2004). Impacts of pollution and runoff are mitigated in the sites Flooding and Stormwater Management Plan (Hyder Consulting Pty Ltd, 2008).

4.6.4 Existing Rock Outcrops

The geology of the subject land consists of Glenorie Shales within the higher grounds and Hawkesbury Sandstones within drainage lines (Chapman and Murphy, 1989). Based on field observations it appears the capping of shale is quite shallow and restricted to the higher elevated, less steep areas of the subject land. Sandstone rock outcropping is common along the steep slopes of the riparian areas and drainage lines across the subject land. Therefore, the vast majority of rock outcrops on the subject land will be unaffected by the proposed development because they will be conserved within the riparian areas of the subject land. Some of the rock outcrops which exist higher within the gullies may be impacted upon by construction / clearing activities south of the development to the east of Fox Valley Road and fuel management zones to the south of the retirement village in the western portion on the subject land.

The areas of rock outcropping affected by clearing for APZs/fuel reduction management will not be lost but habitat structure and diversity in these areas will be reduced. There is likely to be some loss of sandstone outcropping due to the residential development to the east of Fox Valley Road. However, by considering the extent of rock outcrop habitat across the subject lands the loss of this area of outcropping is not considered to be a significant loss of this habitat type on the subject land.

4.6.5 Lane Cove National Park

The proposed development will have no direct impacts upon Lane Cove National Park. Possible indirect effects of the proposed development on the National Park are associated with water run-off into the park.

The proposed development has potential to increase the sediment, pollutant and nutrient loads that reach the Lane Cove River via water run-off. The potential impacts of sediment will be mitigated through appropriate sediment and erosion control measures implemented during construction. A site specific document outlining these measures will be prepared closer to the date of construction.

Increased pollutant and nutrient loads from stormwater run-off, which could potentially reach Lane Cove National Park will be mitigated through measures set out in the subject land's Flooding and Stormwater Master Plan; these measures include rainwater tanks, gross pollutant traps, bioretention systems, ponds and other small scale stormwater management measures (Hyder Consulting Pty Ltd, 2008). As outlined in this specialist report, the pollutant reduction targets of the subject land are met; however a small portion of the subject land will continue to drain to the Lane Cove River, and hence Lane Cove National Park. This untreated portion of the site represents a very small fraction of the Lane Cove River catchment and therefore should not result in any major changes to the inflow of nutrients and pollutants into the National Park or the river itself.

Chapter 5

Mitigation Measures and Management Strategies

5.1 Introduction

Mitigation measures and management strategies to minimise the impacts of the development on threatened species, endangered ecological communities (EECs) and critically endangered ecological communities (CEECs) were adopted early within the concept design phase for the project. As each threatened species or EEC issue arose, careful consideration was given to the most appropriate action to be taken to minimise any impacts the development may have. For example the development has undergone a thorough design evolution process; the original preliminary concept plan, prior to the completion of the current ecological work, proposed to develop the entire area containing the EECs and CEECs. Upon advice to the proponent of the significance of these communities substantial amendments to the original concept plan were made. These changes included the provision of the dedicated conservation of all retained vegetation on the conservation lands. Despite these efforts in design evolution, impacts of the development are likely to occur. This chapter outlines further mitigative measures to be taken to address these impacts.

5.2 Native Vegetation

A substantial amount of the subject land's native vegetation will be impacted by clearing, APZs and fuel reduction management under the current proposal. The impact on this vegetation was attempted to be minimised from the earliest stages of the concept design by, wherever possible, attempting to restrict the development footprint to the currently cleared land. However, due to the complex network of stakeholders, and the limited amount of previously cleared space, further clearing was necessary to meet the development needs for the site. Wherever possible, attempts were made to avoid the planning of any development within areas containing EECs/CEECs during the concept design phase in an effort to minimise impacts on these vegetation communities. All retained vegetation on the subject site, will be declared a conservation area through rezoning as an area of environmental conservation and managed under a site specific Biodiversity Management Plan (BMP). The site specific Biodiversity Management Plan will be prepared by a suitably qualified person to help mitigate and minimise all potential impacts of the proposed development; such as impacts from edge effects and weed invasion, and to ensure that the condition of the vegetation on the subject land is maintained or, where possible, improved.

An area of 12.809 ha of unmodified vegetation, is to be retained on the subject lands under the current proposal. The retained vegetation will include the endangered ecological communities Blue Gum High Forest (0.89 ha) and Sydney Turpentine Ironbark Forest (0.64 ha). The vegetated areas to be retained on this state significant site listing will be rezoned to land retained for environmental conservation. All vegetation will be subject to management under a Biodiversity Management Plan to ensure the condition of the vegetation is at least maintained and where possible improved. The EECs will undergo regular monitoring and reporting as part of the BMP to ensure weed invasion does not occur and that species composition within each of the communities does not change outside that of an expected natural change. The management of the vegetation will continue in perpetuity; while the monitoring program will be conducted for a defined length of time to meet specific performance criteria.

The vegetation management of the conservation lands will initially be undertaken by the proponent, who proposes to own and manage the conservation lands. However the proponent is willing to negotiate the transfer of the conservation lands, to be secured within public ownership in perpetuity, with an appropriate government body as well as maintain the quality of the vegetation, in an agreed condition in an effort to assist offsetting the impacts of the development.

5.3 Fauna Habitats

The subject site contains various forms and quality of fauna habitats (Section 3.4). The destruction of hollow-bearing old growth trees is likely to cause the greatest loss of fauna habitat under the proposed development (Figure 3.3). Hollow-bearing trees provide important roosting habitat for arboreal mammals and microchiropteran bats as well as nesting habitat for many bird species. Hollow-bearing trees will be conserved on the subject site as a matter of priority to avoid destruction of this habitat resource. There will be no net loss of hollows under the proposed development with nest-boxes being installed at a ratio of 2 nest-boxes for each hollow-bearing tree required to be removed.

Some areas of rock outcropping will be destroyed or altered under the proposed development. Most of this outcropping will be impacted through the management of vegetation for bushfire fuel reduction. This will result in a loss of habitat structure and complexity adjacent to these outcropping areas. Large areas of outcropping are present in areas of the site to remain unaffected by the proposed development; therefore these impacts are not seen as significant for this habitat type.

5.4 Endangered and Critically Endangered Ecological Communities

5.4.1 Blue Gum High Forest (BGHF)

i. General Mitigation Measures

The site contains a large stand of variable quality (low – moderate) BGHF with a native shrub and ground layer. Much of the BGHF is currently undergoing management for bushfire risk reduction purposes, however regenerating native shrub and ground layers are identifiable despite weed invasion. All of the BGHF of the subject site is considered to constitute the CEEC under the TSC Act (NSW Scientific Committee, 2007) and the majority of this community on the subject site also is considered to constitute the CEEC as listed under the EPBC Act (DEH, 2005a). As such the proposed development has been referred to DEWHA and advice has been received that the project is likely to have a significant impact on the BGHF and is therefore considered a controlled action.

Wherever possible, attempts were made to avoid the planning of any development within areas containing BGHF during the concept design phase in an effort to minimise impacts on the EEC. All retained vegetation on the subject site, will be declared a conservation area through rezoning as an area of environmental conservation and managed under a site specific Biodiversity Management Plan (BMP) to ensure that the quality of the vegetation is maintained and, where possible, improved through assisted rehabilitation and weed management. If necessary, further mitigation measures are to be determined in consultation of the relevant government bodies.

ii. Mitigation of BGHF affected by APZs

A Bushfire Management Plan will be prepared for all bushfire protection issues of the subject land. It will be sympathetic to the ecological significance of the BGHF and attempt to manage bushfire protection issues and the subject land's fuel loads in an ecologically sustainable manner.

iii. Mitigation of Fragmentation

Fragmentation of the BGHF will occur in the large patch to the east of Fox Valley Road. A small road used to access the residential development in this eastern portion of the land is necessary; this road is proposed to cut through this area of BGHF. Mitigation of this fragmentation will take place, through the maintenance of crown connectivity across this road where possible. This will ensure the movement of birds and arboreal fauna between the two isolated patches and in doing so maintain the passage of genetic material between the two areas.

iv. Mitigation of Altered Hydrological Flows

Mitigation measures to prevent impacts of altered hydrological flows from the proposed development on the vegetation .have been covered in the Flooding and Stormwater Management Plan (Hyder Consulting Pty Ltd, 2008). Such measures include detention basins, gross pollutant traps and rain water tanks designed to reduce the volume of stormwater entering the vegetation and remove pollutants and nutrients. The BMP prepared for the site will manage and monitor any changes in community composition that potentially could arise from an alteration in hydrological flows.

v. Mitigation of Altered Light Regimes

Altered light regimes have the potential to alter the community composition through the loss of light-dependent and light-sensitive species. The overshadowing of species from buildings and the increased light penetration from clearing for the proposed development has the potential to alter the community composition within the BGHF. The BMP prepared for the site will manage and monitor any changes in community composition that potentially could arise from an alteration in light regimes. Plans of action will be prepared for situations where altered light regimes are suspected of impacting species composition.

vi. Mitigation of Increased Access

Increased access to the BGHF can result in the trampling of fragile groundcover species, increased weed invasion from vectors that previously could not enter the site, increased rubbish dumping as well as increased invasion by pests and disease. The proponent is proposing aesthetic fencing be placed around the EECs to deter entrance into these sensitive areas. This will minimise many of these potential impacts. The BMP prepared for the site will manage and monitor any changes in community composition that potentially could arise from increased access.

5.4.2 Sydney Turpentine-Ironbark Forest (STIF)

The majority of the mitigation measures described for BGHF above apply to the mitigation of the STIF on the subject land. The STIF on the subject land will not be fragmented by the proposed development and therefore mitigation measures relevant to fragmentation do not apply.

Much of the STIF of the subject site is in poor condition consisting of scattered trees with a mostly exotic ground layer and an absence of shrubs. A small area of good quality STIF, containing a native shrub and ground layer, is present in the south eastern portion of the subject site (Figure 3.1). All areas mapped as STIF in Figure 3.1 are considered to constitute the endangered ecological community (EEC) under the TSC Act (NSW Scientific Committee, 1998), however none of these areas constitute the critically endangered ecological community under the EPBC Act due to their small size and lack of

native understorey (DEH, 2005b). The development proposes to clear 0.78 ha of this vegetation type.

The majority of the good quality STIF in the south eastern portion of the site is to be conserved due to adjustments made in the concept design and planning process. These adjustments involved the relocation of the proposed development to avoid this community. This vegetation, as with all retained vegetation on the subject site, will be declared a conservation area through rezoning as an area of environmental conservation and managed under a site specific Biodiversity Management Plan (BMP) to ensure that the quality of the vegetation is maintained and, where possible, improved. However the proponent is willing to negotiate the transfer of the conservation lands, to be secured within public ownership in perpetuity, with an appropriate government body in an effort to assist offsetting the impacts of the development.

5.5 Threatened Fauna Species

A number of TSC Act and EPBC Act listed fauna threatened species are known to use or have potential to use the subject site (Table 3.2). A referral of a proposed action for the redevelopment of Wahroonga Estate was issued to DEWHA for review. Advice from DEWHA concluded that the proposed development was considered a controlled action with regards to the Grey-headed Flying-fox (*Pteropus poliocephalus)* and the Swift Parrot (*Lathamus discolor*). A suspected nesting location of the TSC Act listed Powerful Owl (*Ninox strenua*) was also located on the subject site. These threatened species will potentially be impacted by the proposed development. The information below provides mitigation measures and management strategies designed to minimise these impacts.

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

The Grey-headed Flying-fox has been recorded on the subject land (Conacher Travers, 2004) which provides suitable foraging habitat for the species. The site is not considered to constitute significant habitat for foraging or breeding to the species. No known significant roosting locations or 'camps' are present on the subject land and in consideration of available foraging habitat in the locality the subject land is not considered to be of any real significance.

The GHFF will, however suffer a loss and alteration of some potential foraging habitat on the subject land. Mitigative measures to be taken to mitigate impacts on this species include the planting of appropriate feed trees, particularly winter flowering species, throughout the subject lands landscaping works. The GHFF suffers potential food shortages during the colder months with the reduction in flowering trees. Appropriate feed trees that will be used in landscaping works include *Corymbia gummifera* (Red Bloodwood), *Corymbia maculata* (Spotted Gum), *Eucalyptus paniculata* (Grey Ironbark), *Acacia longifolia* (Sydney Golden Wattle) and *Syzygium paniculatum* (Lilly-pilly). Further appropriate feed species will be outlined in the land specific BMP.

5.5.2 Swift Parrot (*Lathamus discolor*)

While not recorded on the subject site, Swift Parrots have been recorded within the wider locality in recent years. The species breeds in Tasmania but migrates north over winter, foraging on flowering eucalypts and lerp secretions. The proposed development will result in the loss of a considerable area of potential foraging habitat. In an effort to mitigate against the impacts of lost foraging habitat, the planting of winter flowering feed trees for this species will be included in the landscaping of the developed lands. Such species include *Corymbia gummifera* (Red Bloodwood), *Corymbia maculata* (Spotted Gum) and *Eucalyptus paniculata* (Grey Ironbark). Other species potentially included in landscaping works include those that suffer form lerp infestation such as *Eucalyptus pilularis* (Blackbutt). Other feed trees considered appropriate for this species that could be planted on the subject land will be outlined in the site specific BMP.

5.5.3 Powerful Owl (*Ninox strenua*)

i. Mitigation Measures

A pair of Powerful Owl adults and a recently fledged juvenile were recorded roosting in the eastern precinct of the subject land. A suspected nest hollow in a large *Eucalyptus pilularis* was located a short distance from the roost site. Due to the potential significant nature of the nest site, ornithologist Dr Steven Debus was engaged to assist in determining the likelihood of impacts of the proposed development and appropriate mitigation measures to minimise these impacts.

The proposed concept design was adjusted to allow for a 100 m buffer of native vegetation between any development and the nest tree. This 100 m buffer is made up of approximately 50 m of untouched vegetation and approximately 50 m of vegetation to be managed for APZs. Development within this eastern precinct is not planned to take place for a number of years and hence the owls may no longer be using the site as a breeding location when construction is due to commence. If the owls are found to be using the site shortly prior to construction potential impacts could be further mitigated by undertaking the following:

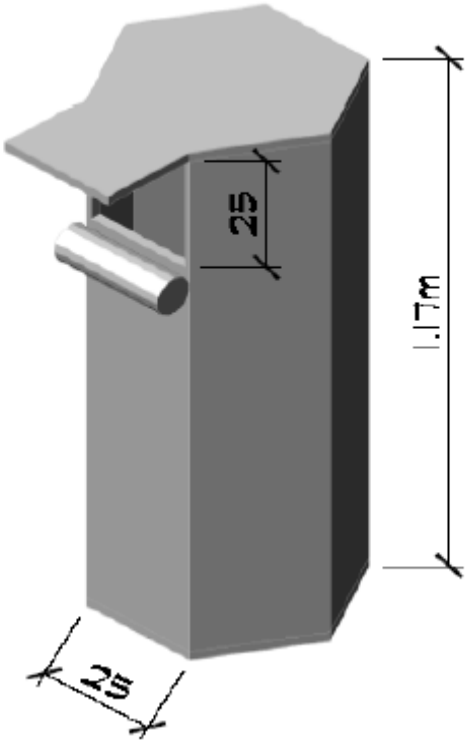
- scheduling development and asset-protection activities in the eastern precinct of the subject land to avoid the owls' breeding season (pre-laying to fledging, i.e. May to September);
- minimising disturbance within 100 m of the nest tree;
- providing suitable nest boxes farther down the gully from the current nest, and in the Coups Creek riparian corridor; and
- landscaping the development area with trees and shrubs suitable for the owl's prey species (especially the Common Ringtail Possum, which eats the leaves,

flowers and fruit of a variety of eucalypt and non-eucalypt native species as well as introduced plant species).

In a worst case scenario for the site the owls may choose to abandon their current nest location. The loss of this potential breeding location from the subject site may not necessarily result in the loss of a breeding pair of owls from the subject site, as these birds would most likely choose an alternative nest site in a more remote location of their home range if disturbance is too great (Debus, 2008). For this reason nest boxes, suitable for use by Powerful Owls, could be provided at nearby selected locations.

Nest boxes have previously been successful in providing nesting and roosting locations for Powerful Owls (McNabb 2007) (Photograph 5.1) and Masked Owls (Thompson 2006) (Photograph 5.2). The nest boxes described by Thompson for Masked Owls would be suitable for Powerful Owls with a slightly larger internal diameter (i.e. 70 cm) (Debus 2008).

Photograph 5.1 Powerful Owl Nest Box (dimensions 800 x 550 x550 mm) (McNabb, 2007)



Photograph 5.2 Masked Owl Nest Box with dimensions (Thompson, 2006)

ii. Monitoring

If the development is to proceed, it is recommended that a monitoring program be developed to monitor the Powerful Owls' response to the development and mitigation measures. Possible aims and objectives of the monitoring program include:

- determining whether the owls are still using the subject nest tree if and when the proposed development is about to proceed;
- determining how many other owl pairs occur in the Lane Cove Valley, and the locations of their nest and roost sites through literature and database research;
- documenting the owls' use of (or abandonment of) the current nest site and roost sites at Fox Valley as the development proceeds; and
- documenting the owls' use of, and breeding success in, nest boxes or alternative natural nest sites if the owls abandon the current nest tree.

This information provides an important insight into the effects of development upon the breeding behaviour of Powerful Owls in urban areas, potentially allowing the application of knowledge gained to similar situations in the future.

5.5.4 Other Threatened Birds

The subject land provides potential foraging and nesting habitat for the threatened birds Gang-gang Cockatoo (*Callocephalon fimbriatum)* and Glossy Black Cockatoo (*Calyptorhynchus lathami)*. Both species nest in large hollow bearing trees, which are found throughout the subject land. The loss of large hollows is suggested as being a limiting factor in successful breeding for a number of hollow nesting species. To mitigate against the loss of hollow-bearing trees throughout the subject land there is to be no net loss of hollows. Hollow-bearing trees will be selected for retention wherever possible over non-hollow-bearing trees and nest boxes will replace hollows at a ratio of two nest boxes per hollow-bearing tree lost. This provision of nest boxes should ensure that any of these threatened bird species retain sufficient nesting habitat on the subject land.

5.5.5 Microchiropteran Bats

The subject site provides habitat for the TSC Act-listed vulnerable bat Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and potential habitat for the threatened bats Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*), Little Bent-wing Bat (*Miniopterus australis*) and Eastern Free-tail Bat (*Mormopterus norfolkensis*). Retention of tree hollows and sandstone overhangs across the subject land will ensure that appropriate roosting habitat for these species is retained within the subject land. The provision of nest boxes at a ratio of two nest boxes to every tree hollow lost will ensure that roosting habitat for hollow roosting species will be retained on the subject land.

Chapter 6

Conclusions

6.1 Conclusions

The proposed redevelopment of Wahroonga Estate allows for the upgrading of the current hospital facilities, provision of new and upgrading existing educational facilities, as well as the provision of new commercial opportunities and residential dwellings to build on the present working/living community. The subject site contains a number of complex ecological issues including; the State and Commonwealth listed critically endangered ecological community Blue Gum High Forest, the state listed endangered ecological community Sydney Turpentine-Ironbark Forest, a suspected nesting location for Powerful Owls, foraging / roosting habitat for Eastern False Pipistrelle, foraging / nesting habitat for Gang-gang Cockatoos and suitable foraging habitat for Grey-headed Flying-fox. The site provides suitable foraging habitat for a number of threatened species not recorded on the subject site such as microchiropteran bats and other birds. No threatened flora species have been detected on the subject site.

Response to the referral of the proposed action submitted to DEWHA indicated that the redevelopment of the subject site was considered a controlled action in respect to the BGHF due to reduction in the extent, reduction in quality, reduction in the potential for recovery and fragmentation of the CEEC. Both the BGHF and STIF are to be managed under a site specific Biodiversity Management Plan (BMP) and appropriate offset and mitigation measures are to be determined in consultation with relevant authorities.

The referral response also indicated that the development was likely to cause a significant impact upon the Grey-headed Flying-fox (Vulnerable TSC and EPBC Acts) and the Swift Parrot (Endangered TSC and EPBC Acts) due to loss of foraging habitat. The impact upon these species is to be mitigated through the planting of suitable feed trees in site rehabilitation as managed under the BMP proposed for the subject land.

A core of forest habitat will be retained along the Coups Creek and to the east of Fox Valley Road. Such forest habitat will retain the wildlife corridor function that currently exists along the creek corridor and will also continue to provide habitat for threatened species.

Mitigation measures provided to minimise impacts on the Powerful Owls' (Vulnerable TSC Act) nesting site include: the retention of a 100m buffer around the nest tree; scheduling development and asset-protection activities in the eastern precinct to avoid the owls'

breeding season (pre-laying to fledging, i.e. May to September); provision of nest boxes at selected locations throughout Coups Creek and Lane Cove Valley; and the provision of suitable foraging vegetation for Powerful Owl prey species such as the Common Ring-tail Possum during post site rehabilitation. This will also be factored into the BMP for the site. With these measures in place the likelihood of retention of the Powerful Owls within the subject site and local area is greatly increased. Monitoring of the nest tree and nest boxes is recommended with development approval to determine the response of the owls to the impacts of the development.

The subject site provides foraging and roosting habitat for the TSC Act listed vulnerable species Eastern False Pipistrelle. Given that these species are highly mobile and no significant habitat occurs on the subject site the proposed development is unlikely to cause a significant impact on these species because other equivalent or higher quality habitat exists for this species in nearby areas. Nest boxes will be provided to replace removed tree hollows in an effort to ensure roosting habitat for the species is maintained on the subject land.

6.2 Key Recommendations

It is recommended that the following points be adopted into the Statement of Commitments.

6.2.1 Transfer of Conservation Lands

Under the proposed development the vegetation to remain on the subject land is to be rezoned E2 Environmental Conservation. This affords this vegetation the most stringent protection apart from being rezoned as land dedicated to a National Park. It is recommended that these conservation lands be transferred to another body such as local council or National Parks as a continuation of Lane Cove National Park to assist in offsetting potential impacts of the development.

6.2.2 Ecological Management

A Biodiversity Management Plan (BMP) will be prepared for the subject land. The BMP will be one all-inclusive document that handles the management of all ecological issues across the subject land. The BMP will include a Vegetation Management Plan and a Powerful Owl Management Plan. Each separate plan will be subject to separate approval and implementation as essential components of the project. Relevant components of the BMP will be implemented as necessary. Vegetation management will begin in relevant precincts following construction. EEC monitoring will commence prior to construction in areas containing EECs and Powerful Owl monitoring will begin prior to construction in areas adjacent to the nesting location.

i. Vegetation Management Plan (VMP)

The Vegetation Management Plan (VMP) will be prepared to assist the management of all vegetation on the site including endangered ecological communities (EECs) and weed control. It will also address the planned revegetation and landscaping works with consideration of provision of suitable habitat for the following threatened fauna species:

- Powerful Owl;
- Grey-headed Flying-fox; and
- Swift Parrot.

a. Vegetation Management

Vegetation management will involve the maintenance of all vegetation retained on the subject land, including EECs, during and after construction. The site will be landscaped to include known feed trees for threatened species and their prey and to provide additional habitat for the native fauna known to use habitat on the site. The vegetation and fauna habitat of the site will be improved or maintained through its implementation.

b. Weed Management

Information regarding weed management incorporated into the document will provide advice in the removal and/or control of weed species on the site and reduce potential for their spread into adjoining habitats. Protocols will be implemented to prevent the spread of weeds within the study area as a result of activities associated with the construction phase of the development. Weed management will comply with the NSW *Noxious Weeds Act 1993*.

c. EEC Monitoring

A monitoring program, with specific performance criteria, to determine the impacts of construction and the proposed development upon the EECs on the subject site will be implemented. If necessary mitigation measures will be undertaken for impacts associated with construction and the proposed development.

ii. Powerful Owl Management Plan (POMP)

The POMP will be prepared in an attempt to maintain the use of the site by Powerful Owls for breeding and foraging with consideration of the recommendations included in the Recovery Plan for Large Forest Owls (DEC 2006). The plan will require further survey for the species on the subject land and provide information on appropriate feed trees for preferred prey species of the Powerful Owl; the Common Ringtail Possum. Protocols for construction to minimise impacts on the owl's breeding will be outlined and locations for nest boxes will be identified to provide alternative nesting locations.

A monitoring program, with specific performance criteria, will be implemented to determine the response of the owls to construction and development as well as the response to the nest boxes.

6.2.3 Fencing

It is recommended that aesthetic fencing be placed around areas of BGHF and STIF that are likely to be impacted upon by the increased movement of people and vehicles. This will reduce the likelihood of impact though trampling of vegetation as well as transference of weed propagules into the vegetation. It could also potentially reduce the numbers of introduced species entering this vegetation; such as dogs, cats and foxes.

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Appendix A

LIST OF FLORA SPECIES IDENTIFIED ON THE SUBJECT LAND

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Trees												
Aceraceae	*Acer negundo**	Box Elder						1t	1t			
	*Archontophoenix cunninghamiana**	Bangalow Palm										
	Livistona australis	Cabbage Tree Palm										
Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda										
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak				2j	1t					
	Allocasuarina torulosa	Forest Oak		1t								
	Casuarina glauca	Swamp Oak										
Cunoniaceae	*Callicoma serratifolia*	Black Wattle			2t			3t				
	Ceratopetalum apetalum	Coachwood			2t			2t				
Cyatheaceae	*Cyathea australis*	Rough Tree-fern			1t			2t				
	Cyathea leichhardtiana	Prickly Treefern										
Eleocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash	3t	1t	1t	3t	1t	1j	2t		3t	
Euphorbiaceae	*Glochidion ferdinandii*	Cheese Tree			8t			1j	1j	1j		
Fabaceae	*Erythrina X sykesii**	Coral Tree							1j			
Lauraceae	*Cinnamomum camphora**	Camphor Laurel	1j		1t				2j			2j
Meliaceae	*Melia azedarach* var. *australasica*	White Cedar										
	Synoum glandulosum	Scentless Rosewood										
	*Toona ciliata**	Red Cedar	1j					1t				
Mimosaceae	*Acacia baileyana*	Cootamundra Wattle										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Acacia decurrens	Black Wattle										
	Acacia elata	Cedar Wattle						1t	1t		2t	
	Acacia irrorata subsp. *irrorata*	Green Wattle										
	Acacia mearnsii	Black Wattle										
	Acacia schinoides	-					2t					
Moraceae	*Ficus coronata*	Sandpaper Fig										
	Ficus superba	Fig Tree						2j				
	*Morus alba**	Mulberry										
Musaceae	*Musa acuminata**	Banana										
Myrtaceae	*Acmena smithii*	Lillypilly										
	Angophora costata	Smooth-barked Apple	2t	2t		1t		1t	2t		2t	
	Corymbia gummifera	Red Bloodwood				1t						
	Eucalyptus crebra	Narrow-leaved Ironbark										4t
	Eucalyptus paniculata subsp. *paniculata*	Grey Ironbark										
	Eucalyptus pilularis	Blackbutt						1t	1t		2t	
	Eucalyptus piperita subsp. *piperita*	Sydney Peppermint	1t	1t		6t		1t			1	
	Eucalyptus resinifera subsp. *resinifera*	Red Mahogany										
	Eucalyptus robusta	Swamp Mahogany										
	Eucalyptus saligna	Sydney Blue Gum							6t			2t
	Melaleuca quinquenervia	Broad-leaved Paperbark										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Syncarpia glomulifera	Turpentine	14t	5t		3t			5t	16t, 2j	2t	
Oleaceae	*Notelaea longifolia*	Mock Olive		1t	2t		1j	1	1j		3t	
	Notelaea ovata	Mock Olive										
	Olea europa subsp. *africana**	Common Olive										
Pinaceae	*Pinus radiata**	Radiata or Monterey Pine										
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	3t	2t		3t	1t	4t			2j	2t
Proteaceae	*Banksia serrata*	Old Man Banksia										
	*Macadamia sp**											
	Xylomelum pyriforme	Woody Pear				1t	1t					
Salicaceae	*Salix babylonica**	Weeping Willow										
Sapindaceae	*Diploglottis australis*	Native Tamarind										
	Guioa semiglauca	Guioa										
Simaroubaceae	*Ailanthus altissima**	Tree of Heaven										
Sterculiaceae	*Brachychiton acerifolius**	Illawarra Flame Tree										
Small Trees												
Mimosaceae	*Acacia maidenii*	Maiden's Wattle										
Shrubs												
Apiaceae	*Platysace lanceolata*	Lance-leaf Platysace										
	Platysace linearifolia	Narrow-leafed Platysace										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Xanthosia tridentata	Rock Xanthosia										
Araceae	*Philodendron* sp. (cultivar)*	-										
Araliaceae	*Astrotricha floccosa*	-	1									
	Astrotricha latifolia	Broad-leaf Star-hair										
	Polyscias sambucifolia	Elderberry Panax										
Asteliaceae	*Cordyline stricta*	Narrow-leaf Palm Lily			1					1		
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting					1	2				2
Caprifoliaceae	*Sambucus australasica*	Yellow Elderberry										
Celastraceae	*Maytenus silvestris*	-										
Cesalpinioideae	*Senna pendula* var. *glabrata**	-			2						2	
Cunoniaceae	*Ceratopetalum gummiferum*	Christmas Bush	4	2								
Epacridaceae	*Dracophyllum secundatum*	-										
	Epacris longiflora	Native Fuschia										
	Epacris pulchella	NSW Coral Heath					2					
	Leucopogon ericoides											
	Leucopogon juniperinus	Prickly Beard-heath		4				3			2	2
	Leucopogon lanceolatus	Lance-leaf Beard-heath										1
	Melichrus procumbens	Jam Tarts										
	Monotoca scoparia	Prickly Broom-heath				2	2					
	Trochocarpa laurina	Tree Heath										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Styphelia laeta subsp. *latifolia*	Five Corners					1					
	Styphelia longiflora	-					3					
	Woollsia pungens	-					3					
Euphorbiaceae	*Micrantheum ericoides*	-										
	Omalanthus populifolius	Bleeding Heart										
	Phyllanthus hirtellus	Thyme Spurge										
	*Ricinus communis**	Castor Oil Plant										
Fabaceae	*Bossiaea heterophylla*	Variable Bossiaea				2	3	2				
	Bossiaea obcordata	Spiny Bossiaea				2	2					
	Daviesia ulicifolia	Gorse Bitter Pea										
	Dillwynia floribunda var. *floribunda*	Parrot Pea										
	Dillwynia retorta var. *retorta*	Eggs and Bacon					1					
	*Genista monspessulana**	Montpellier Broom										
	Gompholobium grandiflorum	Golden Glory Pea					1					
	Gompholobium minus	Dwarf Wedge-pea										
	Hovea linearis	-										
	Indigofera australis	Native Indigo	1					1				
	Mirbelia rubiifolia	-										2
	Platylobium formosum subsp. *formosum*	Handsome Flat-pea					1					
	Pultenaea daphnoides	Large-leaf Bush Pea	1					1				

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Pultenaea stipularis	-	3									
	Pultenaea felxis	-					2					
Faboideae	*Phyllota phylicoides*	Heath Phyllota										
Lamiaceae	*Westringia fruiticosa*	Coast Westringia				2	2					
Malaceae	*Cotoneaster glaucophyllus**	Grey-leaved Cotoneaster		1								
	*Rhaphiolepis indica**	Indian Hawthorn										
Mimosaceae	*Acacia echinula*	Hooked Wattle										
	Acacia floribunda	Sally Wattle										
	Acacia linifolia	Flax Wattle					5	1			1	
	Acacia longifolia var. *longifolia*	Sydney Golden Wattle										
	Acacia myrtifolia	Red Stem Wattle										
	Acacia suaveolens	Sweet Scented Wattle										
	Acacia terminalis	Sunshine Wattle					3					
	Acacia ulicifolia	Prickly Moses		3		2						2
Myrsinaceae	*Rapanea variabilis*	Muttonwood						2			2	
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush										
	Kunzea ambigua	Tick Bush				3	4	2				
	Leptospermum arachnoides	-										
	Leptospermum polygalifolium	Lemon Scented Tea-tree										
	Leptospermum trinervium	Flaky-barked Tea-tree										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Melaleuca armillaris	Bracelet Honey Myrtle										
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant			2				2	2	3	
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet			2							
	*Ligustrum sinense**	Small-leaved Privet			1				1	2	2	
Phytolaccaceae	*Phytolacca octandra**	Inkweed										
Pittosporaceae	*Pittosporum revolutum*	Yellow Pittosporum										
Podocarpaceae	*Podocarpus elatus*	Plum Pine										
Polygalaceae	*Comesperma ericinum*	Matchheads										
Proteaceae	*Banksia ericifolia* var. *ericifolia*	Heath-leaved Banksia										
	Banksia spinulosa var. *spinulosa*	Hairpin Banksia				2	2					
	Grevillea buxifolia subsp. *buxifolia*	Grey Spider Flower				2						
	Grevillea linearifolia	White Spider Flower	2	1		1		2				
	Grevillea longifolia	Fern-leaved Spider Flower	1			1						
	Hakea dactyloides	Broad-leaved Hakea										
	Hakea sericea	Needlebush				3	2					
	Isopogon anemonifolius	Flat-leaved Drumsticks				2						
	Lambertia formosa	Mountain Devil					4					
	Lomatia silaifolia	Crinkle Bush				3	2					
	Persoonia laurina	Laurel Geebung										
	Persoonia linearis	Pine-leaved Geebung				2	2					

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Persoonia levis	Broad-leaved Geebung				2	1					
	Persoonia pinifolia	Pine-leaved Geebung										
	Petrophile pulchella	Conesticks										
Rubiaceae	*Opercularia aspera*	Common Stinkweed										
	Psychotria loniceroides	-										
Rutaceae	*Boronia ledifolia*	Sydney Boronia					1	1				
	Boronia parviflora	Swamp Boronia					2					
	Zieria pilosa	-	2	1								
	Zieria smithii	Sandfly Zieria	2	2				3				2
Santalaceae	*Leptomeria acida*	Native Currant										
	Exocarpos cupressiformis	Native Cherry					1					
Sapindaceae	*Dodonaea triquetra*	Hop Bush				2					3	1
Solanaceae	*Lycium ferocissimum**	African Boxthorn										
	*Solanum mauritianum**	Wild Tobacco							2			
Sterculiaceae	*Lasiopetalum ferrugineum* var. *ferrugineum*	Rusty Velvet-bush					3	1				
Theaceae	*Camellia japonica**	Camellia										
Theaceae	*Camellia sasanqua**	Camellia										
Verbenaceae	*Lantana camara**	Lantana		1						a	2	
	*Monstera deliciosa**	Fruit-salad Plant										2
	Nandina domestica 'Nana'*	Dwarf Sacred Bamboo										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Groundcovers												
Acanthaceae	*Brunoniella australis*	Blue Trumpet										
	Pseuderanthemum variabile	Pastel Flower										
	*Thunbergia alata**	Black-eyed Susan					2					
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair	3				2	2		1	4	
	Adiantum formosum	Giant Maidenhair										
Amaryllidaceae	*Crinum pedunculatum*	Swamp Lily										2
Anthericaceae	*Caesia parviflora* var. *parviflora*	Pale Grass Lily										
	Thysanotus tuberosus	Fringed Lily										
Apiaceae	*Centella asiatica*	Swamp Pennywort										
	Hydrocotyle laxiflora	Stinking Pennywort										
	Hydrocotyle peduncularis	Pennywort										
	Xanthosia pilosa	Woolly Xanthosia	2	2		2	2					
Araceae	*Gymnostachys anceps*	Settlers Flax			2							
Asparagaceae	*Asparagus densiflorus**	Asparagus Fern						3		2	2	2
	*Protasparagus plumosus**	Climbing Asparagus Fern										
	*Asphodelus fistulosus**	Onion Weed										
Aspleniaceae	*Asplenium australasicum*	Birds Nest Fern										
Asteraceae	*Actinotus minor*	Lesser Flannel Flower										
	*Ageratina adenophorum**	Crofton Weed			2			3				

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	*Ageratina riparia**	Mist Flower										
	*Bidens pilosa**	Cobbler's Pegs										
	Brachycome angustifolia	-										
	*Cirsium vulgare**	Spear Thistle										
	*Conyza albida**	Fleabane										
	*Erigeron karvinskianus**	Mexican Daisy										3
	Euchiton involucratus	Star Cudweed										
	*Gamochaeta americana**	Cudweed										
	*Gamochaeta spicata**	Cudweed										
	*Hypochaeris radicata**	Flatweed										
	*Senecio madagascariensis**	Fireweed										
	Sigesbeckia orientalis	Indian Weed								1		
	*Soliva pterosperma**	Bindii										
	*Sonchus oleraceus**	Common Sow-thistle			1						2	2
	*Taraxacum officinale**	Dandelion										
Blechnaceae	*Blechnum cartilagineum*	Gristle Fern			2							
	Blechnum nudum	-			1							
	Doodia aspera	Rasp Fern										
	Doodia caudata var. caudata											
Bromeliaceae	*Bromeliad* sp.*	-										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Campanulaceae	*Wahlenbergia gracilis*	Australian Bluebell										
Caryophyllaceae	*Stellaria media**	Common Chickweed										
Chenopodiaceae	*Einadia hastata*	Berry Saltbush										
Commelinaceae	*Commelina cyanea*	Scurvy Weed			3				4	4	4	
	*Tradescantia fluminensis**	Wandering Jew						4				
Convolvulaceae	*Dichondra repens*	Kidney Weed	2		2			3	3	3		
Cyperaceae	*Carex inversa*	Knob Sedge										
	Caustis pentandra	-										
	*Cyperus eragrostis**	Umbrella Sedge						2				
	Cyperus sanguinolentus	-										
	Gahnia melanocarpa	Black-fruit Saw-sedge										
	Gahnia sieberiana	Red-fruited Saw-sedge								2		
	Lepidosperma laterale	Variable Sword-sedge				3						
	Lepidosperma urophorum	-										
Davalliaceae	*Nephrolepis cordifolia**	Fish-bone Fern										
Dennstaedtiaceae	*Hypolepis muelleri*	Harsh Ground Fern	3									
	Pteridium esculentum	Bracken		5				5			2	
Dicksoniaceae	*Calochlaena dubia*	False Bracken			3			3		2	2	
Dilleniaceae	*Hibbertia aspera*	Rough Guinea Flower	2			1	2					2
	Hibbertia monogyna	-					2					

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Hibbertia diffusa	-		2								
	Hibbertia empetrifolia subsp. uncinata	-										
	Hibbertia fasciculata	-										
	Hibbertia linearis	-										
	Hibbertia obtusifolia	Grey Guinea Flower	2									
Euphorbiaceae	*Euphorbia peplus**	Spurge										
	Poranthera microphylla											
Fabaceae	*Medicago polymorpha**	Burr Medic										
	*Trifolium repens**	White Clover							3			2
Fumariaceae	*Fumaria muralis**	Wall Fumitory										
Geraniaceae	*Geranium homeanum*	Northern Cranesbill			3			3	3	2		
Gleicheniaceae	*Sticherus flabellatus*	Umbrella Fern										
Goodeniaceae	*Dampiera stricta*	Blue Dampiera										
	Goodenia bellidifolia	Daisy-leaved Goodenia										
	Goodenia hederacea subsp. *hederacea*	Ivy-leaved Goodenia										
	Goodenia heterophylla subsp. *heterophylla*	Variable Leaved Goodenia	1									
Haemodoraceae	*Haemodorum corymbosum*	Bloodroot										
	Haemodorum planifolium	Bloodroot										
Haloragaceae	*Gonocarpus teucroides*	Raspwort										
Iridaceae	*Crocosmia* X *crocosmiiflora**	Montbretia										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Patersonia glabrata	Leafy Purple-flag				1						
	Patersonia sericea	Wild Iris	1			2	2					
Juncaceae	*Juncus usitatus*	Common Rush										
Lindsaeaceae	*Lindsaea linearis*	Screw Fern			2			1				
	Lindsaea microphylla	Lacy Wedge-fern	2		1			2				
Liliaceae	*Agapanthus praecox**	Agapanthus										2
Lobeliaceae	*Lobelia alata*	-										
	Lobelia dentata	-										
	Pratia purpurascens	Whiteroot		2		1		3			2	
Lomandraceae	*Lomandra filiformis* subsp. *coriacea*	Wattle Mat-rush					3				2	
	Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush										
	Lomandra gracilis											
	Lomandra longifolia	Spiky-headed Mat-rush	6	6		3	2	2			3	2
	Lomandra multiflora	Many-flowered Mat-rush				2						
	Lomandra obliqua	Twisted Mat-rush				3	3					2
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne							3	2		
Onagraceae	*Epilobium hirtigerum*	Hairy Willow Herb										
Orchidaceae	*Acianthus fornicatus*	Pixie Caps	2							2		
	Cymbidium suave	Native Cymbidium										
	Calochilus robertsonii	Purplish Beard Orchid										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Cryptostylis subulata	Large Tongue Orchid										
	*Epidendrum ibaguense**	Crucifix Orchid										
	Pterostylis grandiflora	Cobra Greenhood										
	Pterostylis nutans	Nodding Greenhood	2									
	Pterostylis reflexa	Rusty Hood	1									
Oxalidaceae	*Oxalis corniculata**	Yellow Wood Sorrel										
	*Oxalis latifolia**	Pink Fishtail										
	Oxalis perrenans	-	2									
Phormiaceae	*Dianella caerulea* var. *assera*	Flax Lily		1	2	3	2	1	3	2	2	3
Phormiaceae	*Dianella prunina*	-				3	1	1				
Plantaginaceae	*Plantago lanceolata**	Ribwort			1							
Poaceae	*Aristida vagans*	Three-awn Speargrass										
	Austrostipa pubescens	Tall Speargrass						2				
	*Avena fatua**	Wild Oats										
	*Briza maxima**	Quaking Grass						1				
	*Briza minor**	Shivery Grass										
	*Bromus cartharticus**	Prairie Grass										
	*Chloris gayana**	Rhodes Grass						1				
	*Cortaderia selloana**	Pampas Grass										
	Cynodon dactylon	Common Couch										7

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Dichelachne micrantha	Short-hair Plume Grass						2				
	Echinopogon caespitosus var. *caespitosus*	Tufted Hedgehog Grass										
	Echinopogon ovatus	Forest Hedgehog Grass					2					
	*Ehrharta erecta**	Panic Veldtgrass						4	5	4		
	Entolasia marginata	Bordered Panic						2				
	Entolasia stricta	Wiry Panic										
	Eragrostis brownii	Brown's Lovegrass						1				
	*Eragrostis curvula**	African Lovegrass										
	Imperata cylindrica var. *major*	Blady Grass						2				
	*Lolium perrenne**	Perennial Ryegrass										
	Microlaena stipoides var. *stipoides*	Weeping Rice Grass										
	Oplismenus aemulus	Basket Grass	2				3	3	3			2
	Oplismenus imbecillis	-		3		2						
	Panicum simile	Two Colour Panic										
	*Paspalum dilatatum**	Paspalum										
	*Pennisetum clandestinum**	Kikuyu										
	Themeda australis	Kangaroo Grass										
Polygonaceae	*Persicaria decipiens*	Slender Knotweed								3		
	Persicaria hydropiper	Water Pepper										
	Rumex brownii	Swamp Dock										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	*Rumex crispus**	Curled Dock										
Polypodiaceae	*Platycerium bifurcatum* subsp. *bifurcatum*	Elkhorn										
Primulaceae	*Anagallis arvensis**	Scarlet Pimpernel										
Ranunculaceae	*Ranunculus repens**	Creeping Buttercup			1							
Rosaceae	*Duchesna indica**	Wild Strawberry										
Rubiaceae	*Galium aparine**	Cleavers										
Rubiaceae	*Pomax umbellata*	Pomax										
Rutaceae	*Leionema dentatum*											
Schizaeaceae	*Schizaea bifida*	Forked Comb-fern										
Scrophulariaceae	*Veronica plebia*	Creeping Speedwell										
Sinopteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	Poison Rock Fern										
Solanaceae	*Solanum aviculare*	Kangaroo Apple										
	*Solanum nigrum**	Black Nightshade							1			
	Solanum prinophyllum	Forest Nightshade								2	1	
	*Solanum pseudocapsicum**	-								2	1	
Stackhousiae	*Stackhousia viminea*	-										
Strelitzeaceae	*Strelitzea juncea**	Bird of Paradise										
Stylidiaceae	*Stylidium graminifolium*	Trigger Plant						2				
Thelypteridaceae	*Christella dentata*	-										
Thymelaeaceae	*Pimelea linifolia* subsp. *linifolia*	Slender Rice Flower					3					

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Typhaceae	*Typha orientalis*	Cumbungi										
Verbenaceae	*Verbena bonariensis**	Purpletop										
	*Verbena rigida**	Veined Verbena										
Violaceae	*Viola betonicifolia*	-										
	Viola hederacea	Ivy-leaved Violet										
Xanthorrhoaceae	*Xanthorrhoea arborea*	Broad-leaf Grass Tree	2				1					
	Xanthorrhoea media subsp. *media*	Forest Grass Tree				2	1					
Climbers												
Araliaceae	*Hedera helix**	English Ivy										
Asclepiadaceae	*Araujia hortorum**	Mothvine										
	Marsdenia suaveolens	Scented Marsdenia			2				2	1	2	2
	Tylophora barbata	Bearded Tylophora	1									
Bignoniaceae	*Pandorea pandorana*	Wonga Vine		1	1				1	1	2	
Caprifoliaceae	*Lonicera japonica**	Japanese Honeysuckle						2	1			
Convolvulaceae	*Ipomoea indica**	Coastal Morning Glory										
Dilleniaceae	*Hibbertia dentata*	Twining Guinea Flower			2							
Fabaceae	*Desmodium varians*	-							1			
	Glycine clandestina	Twining Glycine		3	1			3	1	2		2
	Glycine microphylla	-										
	Glycine tabacina	Twining Glycine										

Table A.1 FLORA SPECIES LOCATED ON THE SUBJECT LAND IN RECENT SURVEYS

Family	Common Name	Scientific Name	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	Hardenbergia violacea	False Sarsparilla		2								
	Kennedia rubicunda	Dusky Coral Pea									2	2
	Vicia sativa subsp. *sativa**	Common Vetch										
	*Wisteria sinensis**	Wisteria	2		2							
Lauraceae	*Cassytha glabella* forma *glabella*	Slender Devil's Twine										
	Cassytha pubescens	Common Devil's Twine	1			2	3					
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry									3	
	Geitonoplesium cymosum	Scrambling Lily										
Menispermiaceae	*Sarcopetalum harveyanum*	Pearl Vine										
	Stephania japonica var. *discolor*	Snake Vine										
Passifloraceae	*Passiflora edulis**	Common Passionfruit										
Pittosporaceae	*Billardiera scandens* var. *scandens*	Apple Dumplings										
Polygalaceae	*Comesperma volubile*	Love Creeper										
Ranunculaceae	*Clematis aristata*	Old Man's Beard										
Rubiaceae	*Morinda jasminoides*	-	3									
Rosaceae	*Rubus parvifolius*	Native Raspberry								2		
Smilacaceae	*Smilax australis*	Lawyer Vine	2	1	3	2				2	2	
	Smilax glyciphylla	Sarsaparilla	2		1				2			
Vitaceae	*Cissus antarctica*	Native Grape		1					3			
	Cissus hypoglauca	Water Vine		2					1	1	3	

Notes: Species not located in quadrat surveys were identified during random meander transects

Appendix B

CUMBERLAND ECOLOGY HOLLOW-BEARING TREE DATA

Table B.1 Data from hollow-bearing trees recorded by Cumberland Ecology on the Subject Site

Tree Number	Species (if alive)	Signs of Fauna Use	No. of Hollows
112	Dead		1
113	Dead	Termite Nest	1
114	Dead		1
115	Dead		2
116	Sydney Peppermint		1
117	Smooth Bark Apple		2
118	Dead		1
119	Dead		2
120	Smooth Bark Apple		1
121	Dead		2
122	Dead		2
123	Dead		1
124	Dead		2
125	Dead		2
126	Smooth Bark Apple		3
127	Smooth Bark Apple		2
128	Sydney Peppermint		1
129	Dead		1
130	Sydney Peppermint		1
131	Smooth Bark Apple		1
132	Dead		1
133	Dead		1
134	Sydney Peppermint		1
135	Smooth Bark Apple		1
136	Dead		2
137	Dead		2
138	Red Blood Wood		1
139	Dead		1
140	Dead		1
141	Blackbutt	Lorikeet Nesting	1
142	Smooth Bark Apple		1

Table B.1 Data from hollow-bearing trees recorded by Cumberland Ecology on the Subject Site

Tree Number	Species (if alive)	Signs of Fauna Use	No. of Hollows
143	Dead		1
144	Red Blood Wood		2
145	Dead		1
146	Dead		1
147	Blackbutt		2
148	Sydney Peppermint		2
149	Dead		1
150	Smooth Bark Apple		1
151	Blackbutt		1
152	Smooth Bark Apple		3
153	Dead		1
154	Smooth Bark Apple		2
155	Dead		1
156	Dead		2
157	Blackbutt		1
158	Smooth Bark Apple		3
159	Blackbutt		2
160	Smooth Bark Apple		3
161	Dead		1
162	Red Blood Wood		4
163	Dead	Lorikeet Nesting	1
164	Smooth Bark Apple		2
165	Sydney Peppermint		1
166	Smooth Bark Apple		3
167	Sydney Peppermint		3
168	Smooth Bark Apple		2
169	Turpentine		1
170	Sydney Peppermint		1
171	Sydney Peppermint		1
172	Sydney Peppermint		1
173	Dead		1
174	Blackbutt		3
175	Blackbutt		1
176	Blackbutt		1

Table B.1 Data from hollow-bearing trees recorded by Cumberland Ecology on the Subject Site

Tree Number	Species (if alive)	Signs of Fauna Use	No. of Hollows
177	Blackbutt		2
178	Sydney Peppermint		1
179	Sydney Peppermint		2

Appendix C

Results of Fauna Survey

Table C.1 RESULTS OF THE HAIR FUNNEL SURVEY

Date	Transect	Arboreal/ Terrestrial	Species Recorded
12/8/2008	1	Terrestrial	Black Rat (probable) (*Rattus rattus*)
12/8/2008	1	Arboreal	Possum Sp. (*Trichosurus sp.*)
12/8/2008	1	Arboreal	Possum Sp. (*Trichosurus sp.*)
12/8/2008	2	Arboreal	Brush-tail Possum (probable) (*Trichosurus vulpecula*)
12/8/2008	2	Terrestrial	Possum Sp. (*Trichosurus sp.*)
13/8/2008	3	Arboreal	Possum Sp. (*Trichosurus sp.*)
13/8/2008	3	Terrestrial	Possum Sp. (*Trichosurus sp.*)

Table C.2 RESULTS OF THE SPOTLIGHTING SURVEYS

Date	Start Time	End Time	Species Recorded
12/06/2008	1700	1900	Leaf Green Tree Frog
			Striped Marsh Frog
			Common Froglet
			Common Ring-tail Possum
13/06/2008	1700	1900	Leaf Green Tree Frog
			Common Froglet
			Brush-tail Possum
			Tawny Frogmouth
12/08/2008	1730	1850	Powerful Owl
13/08/2008	1730	1930	Common Ring-tail Possum
			Brush-tail Possum

Appendix D

Fauna Species Recorded in Recent Surveys

Table D.1 BIRD SPECIES LOCATED ON THE SUBJECT SITE IN RECENT SURVEYS

Common name	Scientific name
Masked Lapwing	*Vanellus miles*
Spotted Turtle-Dove	*Streptopelia chinensis*
Crested Pigeon	*Ocyphaps lophotes*
Sulphur-crested Cockatoo	*Cacatua galerita*
Long-billed Corella	*Cacatua tenuirostris*
Galah	*Cacatua roseicapilla*
Rainbow Lorikeet	*Trichoglossus haematodus*
Australian King-Parrot	*Afsterus scapularis*
Crimson Rosella	*Platycerous elegans*
Eastern Rosella	*Platycercus eximius*
Powerful Owl [TS]	*Ninox strenua*
Tawny Frogmouth	*Podargus strigoides*
Southern Boobook	*Ninox novaeseelandiae*
Common Koel	*Eudynamys scolopacea*
Dollarbird	*Eurystomus orientalis*
Laughing Kookaburra	*Dacelo novaeguineae*
White-throated Treecreeper	*Cormobates leucophaeus*
Olive-backed Oriole	*Oriolus sagittatus*
Noisy Miner	*Manorina melanocephala*
Red Wattlebird	*Anthochaera carunculata*
Little Wattlebird	*Anthochaera chrysoptera*
Lewin's Honeyeater	*Meliphaga lewinii*
White-eared Honeyeater	*Lichenostomus leucotis*
Scarlet Honeyeater	*Myzomela sanguinolenta*
Eastern Spinebill	*Acanthorhynchus tenuirostris*
Brown Thornbill	*Acanthiza pusilla*
Buff-rumped Thornbill	*Acanthiza reguloides*
Spotted Pardalote	*Pardalotus punctatus*
Eastern Yellow Robin	*Eopsaltria australis*
Grey Fantail	*Rhipidura fuliginosa*
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
White-browed Scrubwren	*Sericornis frontalis*
Welcome Swallow	*Hirundo neoxena*

Table D.1 BIRD SPECIES LOCATED ON THE SUBJECT SITE IN RECENT SURVEYS

Common name	Scientific name
Grey Butcherbird	*Cracticus torquatus*
Pied Currawong	*Strepera graculina*
Spangled Drongo	*Dicrurus bracteatus*
Australian Magpie	*Gymnorhina tibicen*
Australian Raven	*Corvus coronoides*
Satin Bowerbird	*Ptilonorhynchus violaceus*
Red-browed Finch	*Neochmia temporalis*
Superb Fairy-wren	*Malurus cyaneus*
Common Myna *	*Acridotheres tristis*
Common Starling *	*Sturnus vulgaris*
Red-whiskered Bulbul *	*Pycnonotus jocosus*

Notes: [TS] *indicates Threatened Species, * indicates Introduced Species.*

Table D.2 AMPHIBIAN AND REPTILE SPECIES LOCATED ON THE SUBJECT SITE IN RECENT SURVEYS

Common name	Scientific name
AMPHIBIANS	
Striped Marsh Frog	*Limnodynastes peronii*
Green Leaf Tree Frog	*Litoria phylochroa*
Common Eastern Froglet	*Crinia signifera*
REPTILES	
Garden Skink	*Lampropholis guichenoti*
Red-Bellied Black Snake	*Pseudechis porphyriacus*
Blue Tongue Lizard	*Tiliqua nigrolutea*
Eastern Water Dragon	*Physignathus lesueurii*
Eastern Water Skink	*Eulamprus quoyii*

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Table D.3 MAMMAL SPECIES LOCATED ON THE SUBJECT SITE IN RECENT SURVEYS

Common name	Scientific name
Gould's Wattled Bat	*Chalinolobus gouldii*
Eastern False Pipistrelle TS	*Falsistrellus tasmaniensis*
Grey-Headed Flying-fox TS	*Pteropus poliocephalus*
Cat *	*Felis cattus*
European Red Fox *	*Vulpes vulpes*
Brushtail Possum	*Trichosurus vulpecula*
Common Ringtail Possum	*Pseudocheirus peregrinus*
Brown Rat *	*Rattus norvegicus*
Black Rat*	*Rattus rattus*

*Note: * indicates Introduced Species.*

Appendix E

Ornithologist Report on Impacts of Proposed Development on Powerful Owls

POTENTIAL IMPACT OF THE WAHROONGA ESTATE REDEVELOPMENT PROPOSAL ON BREEDING POWERFUL OWLS AT FOX VALLEY, NSW

REPORT TO CUMBERLAND ECOLOGY

Stephen Debus PhD, Zoological Consultant, PO Box 1015, Armidale, NSW 2350

14 October 2008

Introduction and background

This case concerns a pair of Powerful Owls *Ninox strenua* that was discovered breeding in suburban bushland adjoining the Sydney Adventist Hospital at Fox Valley in the northern suburbs of Sydney. The owls apparently nested in a large hollow Blackbutt *Eucalyptus pilularis* in 2008, and a newly fledged juvenile was observed in August. The owl family also had many roost sites in the vicinity (Cumberland Ecology data, per N. Campbell).

The owls' suspected nest tree is in a bushland gully in a tributary of the upper Lane Cove River valley. Currently, the suspected nest tree is buffered from existing suburbia and hospital buildings by approximately 200 m on three sides, and 150 m to suburban houses in a 'bushland' setting (i.e. high tree cover) on the fourth side. The suspected nest tree appears to be the only suitable hollow tree in the relevant bushland gully of approximately 10 ha. However, the owls' nest gully is connected to extensive bushland in Pennant Hills Park and Lane Cove River National Park via a bushland corridor across a section of the Comenara Parkway, which is 200 m south of the nest tree.

The Powerful Owl is listed as a Vulnerable species under the NSW *Threatened Species Conservation Act* 1995, and current management requires a 200 m buffer or exclusion zone around nest sites and associated roost trees. However, this buffer zone is not based on empirical or experimental data, and was developed for harvesting protocols in state forests (e.g. Kavanagh 2000a), where logging with heavy machinery may potentially cause severe disturbance. Powerful Owls nest in urban bushland, and may tolerate moderate levels of passive human disturbance, although high levels of disturbance may cause breeding failure and relocation to a more secluded nest site (e.g. Webster *et al.* 1999; Cooke *et al.* 2002a). The Fox Valley pair currently nests within 150-200 m of existing suburbia.

Proposed development of the Wahroonga Estate would result in intrusion of residential development and associated infrastructure into the 100-200 m radius band around the nest tree in the north and north-west, and intrusion of the bushfire asset protection zone into the 50-100 m band in the north-west and south (per revised concept plan, August 2008). Asset protection will involve suppression of the ground and shrub layers, with retention of the tree canopy. If approved, the development may not proceed for up to 10 years (E. Howse pers. comm.).

Ecology and status of the Powerful Owl

The Powerful Owl requires large tree hollows for nesting, trees and large midstorey shrubs in sheltered gullies for roosting, and a large, well-vegetated foraging range that supports large populations of arboreal mammals for food (mainly possums, gliders and flying-foxes,

but increasingly the introduced Black Rat in urban sites) (e.g. Higgins 1999; Kavanagh 2002a,b; Menkhorst *et al.* 2005; Cooke *et al.* 2006; Hollands 2008). Nest-preparation and egg-laying (when the owls may be sensitive to disturbance) take place in late autumn and early winter (May-June), with nestlings in July and fledging from late August onwards (Higgins 1999). Nest trees may be used traditionally for many years, although where alternative sites are available the owls may switch hollows every few years (Higgins 1999; R. Cooke pers. comm.). Many of the owl's key prey species are also hollow-dependent, but in urban situations its major prey species (Common Brushtail Possums, Common Ringtail Possums and flying-foxes) are not (Cooke *et al.* 2002a,b). The owls may even roost in large trees in leafy suburban backyards (e.g. McNabb 2008). Owl home ranges in productive environments may be as little as 400-1000 ha (Higgins 1999), although home-range size in urban environments in unknown (Kavanagh 2004).

The Powerful Owl is well distributed throughout the Greater Sydney bushland, including urban bushland in the northern suburbs adjoining national parks (Kavanagh 2004). There is some evidence that the species is increasing in Sydney, with apparently new pairs becoming established in locations where they were formerly scarce or absent (or at least not breeding), including the Botanic Gardens near the city centre (e.g. Kavanagh 2004; McAllan & Larkins 2005). There may be several pairs in the Lane Cove Valley system, with at least the well-known Devlins Creek (Epping) pair (Kavanagh 2004) and the Fox Valley pair, with other records extending the length of the valley to its confluence with Sydney Harbour (Kavanagh 2004). There are also other pairs in nearby gully systems separated from the Lane Cove Valley by urbanised ridges, e.g. at North Rocks, West Pennant Hills, the Berowra Valley, Bobbin Head and Gordon (Kavanagh 2004).

The Powerful Owl is also believed to have increased in Brisbane (Pavey 1993) and Melbourne (Cooke & White 2006). With abundant prey in urban bushland and in leafy suburbs, the availability of nest sites may be a limiting factor for urban Powerful Owls (Cooke & White 2006; McNabb 2008). Powerful Owls forage in leafy suburbs (e.g. Cooke *et al.* 2002a, 2006).

Site inspection

The Fox Valley site was inspected on 1 October 2008, in company with Nathan Campbell (Cumberland Ecology), Wade Morris (Johnson Property Group) and Eric Howse (Australasian Conference Association) for orientation and background information. Aerial photographs of the subject site, at different scales, were also examined. The nest gully, nest tree and roosting areas were inspected (although no owls were encountered on the day), and the adjacent large protected gully (Coups Creek), where the owls have been detected previously by call playback, was also inspected. Coups Creek is about 1 km of

retained riparian corridor approximately 100 m wide on the Wahroonga Estate, to its confluence with a tributary of the Lane Cove River, but it contains no suitable hollows for Powerful Owl nests although there are many smaller hollow-bearing trees that could accommodate owl prey.

The owl's nest site is an old leaning tree with a completely rotten and hollow centre, on the side of the gully bottom. Thus, it may fall, or the owls may not be still using it, by the time development proceeds if there is up to a ten-year lag.

Potential impact of the proposal

Assuming that the nest tree is still being used if and when development proceeds, and depending on the degree of disturbance, the owls may experience reduced breeding success in their current nest site. The worst-case scenario is that the owls will abandon the nest site when development and asset-protection activities encroach towards the nest tree. Based on the continued and possibly increasing presence of Powerful Owls in urban areas, and their response to disturbance, it is considered unlikely that the owls will abandon their home range completely. It is more likely that they would focus future breeding attempts in a more secluded location, provided that there are alternative nest sites sufficiently far from neighbouring pairs in the Lane Cove Valley. Thus, the loss of a nest site need not mean the loss of a pair of owls from the local population, although their breeding productivity may be reduced.

Mitigation and monitoring

Potential impact of the development on the owls could be reduced by:

- scheduling development and asset-protection activities to avoid the owls' breeding season (prelaying to fledging, i.e. May to September);
- minimising disturbance within 100 m of the nest tree;
- providing suitable nest boxes farther down the gully from the current nest, and in the Coups Creek riparian corridor; and
- landscaping the development area with trees and shrubs suitable for the owl's prey species (especially the Common Ringtail Possum, which eats the leaves, flowers and fruit of a variety of eucalypt and non-eucalypt native species as well as introduced plant species).

Specific information on nest boxes used successfully by Powerful Owls is not yet available, but the general size and construction can be inferred from photographs in McNabb (2008). One box is approximately 70 cm square, of thick plywood, with an entrance hole near the top about 20 cm in diameter, with perches near the hole. The box is painted dull green, with strips of bark fixed to the outside walls, and is fixed to the trunk

of a tree by means of galvanised strapping. The design of nest boxes used by fledgling Masked Owls for roosting is described and illustrated by Thomson (2006): deeper (c. 1 m) than described by McNabb (2008), and with a hexagonal rather than square floor plan, giving an internal diameter of about 50 cm, and made of marine plywood. Such a design should prove suitable for Powerful Owls, perhaps with a slightly larger internal diameter (e.g. 70 cm), given that natural Powerful Owl nest hollows are up to a metre wide internally (Higgins 1999).

Information required for managing and monitoring the owls' response to development and mitigation measures includes:

- determining whether the owls are still using the subject nest tree if and when the proposed development is about to proceed;
- determining how many other owl pairs occur in the Lane Cove Valley, and the locations of their nest and roost sites;
- documenting the owls' use of (or abandonment of) the current nest site and roost sites at Fox Valley as the development proceeds; and
- documenting the owls' use of, and breeding success in, nest boxes or alternative natural nest sites if the owls abandon the current nest tree.

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Appendix F

Pro forma used for Vegetation Condition Assessment

Vegetation condition and Weed assessment *Pro forma*

Site: **Quadrat No.**

Date:

Vegetation Community:	**Quality:**	High	Mod.	Low
Photograph No.:	**Connectivity:**	Good	Mod.	Poor
Estimated Patch Size:	**Recovery Potential:**	Low	Mod.	High

Native Trees:

Crown Die-back Present:

Examples of dominants:

Comments:

Native Shrubs Present:

Examples of dominants:

Comments:

Native G'covers Present:

Examples of dominants:

Comments:

Weeds present in overstory	Weeds present in shrublayer	Weeds present in g'cover
% Weed cover in overstorey %	% Weed cover in shrublayer %	% Weed cover in groundlayer %

Notes: