

FLORA AND FAUNA ASSESSMENT

OF

**PART OF LOT 4 DP 771597
& PORTION 4
OFF LEO DRIVE,
NARRAWALLEE**

**DECEMBER 2006
(REF: 6266F)**

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EXECUTIVE SUMMARY

This Flora and Fauna Assessment Report has been prepared by *Conacher Travers Pty Ltd* to identify the flora and fauna characteristics of Lot 4, DP 771597, and Portion 4 off Leo Drive, Narawallee.

The document forms the basis of assessment required by Section 5A of the *Environmental Planning and Assessment Act* (1979). This assessment determines if future development of the site is likely to have a significant effect on threatened species, populations and/or endangered ecological communities.

In respect of matters required to be considered in the *Environmental Planning & Assessment Act* (1979) and relating to the species / provisions of the *Threatened Species Conservation Act* (1995), seven (7) threatened fauna species, no threatened flora species and one (1) threatened ecological communities were recorded within or in close proximity to the subject site.

These species included, Osprey (*Pandion haliaetus*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Masked Owl (*Tyto novaehollandiae*), Grey-headed Flying-fox (*Pteropus poliocephalus*), and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Swamp Sclerophyll Forest on Coastal Floodplains.

This project has undergone significant ecological surveys and assessment since early 2003, incorporating independent peer reviews initially by Bangalay Botanical Services and subsequently by David Robertson of Cumberland Ecology and Kevin Mills and Associates, on behalf of and in conjunction with, Department of Environment and Conservation (DEC) and Department of Natural Resources (DNR) (formerly the Department of Infrastructure Planning Natural Resources). This extensive consultation and independent review process has resulted in the completion of considerable additional survey effort and assessment to the acceptance of all previous consent authorities.

The cumulation of previous additional surveys and assessment have been prepared in the two addendum reports (Conacher Travers January 2004 and July 2004) attached as stand alone documents to this assessment. The results, methodology and assessment of these addendums, in combination with recent additional surveys and assessment have been incorporated within this report.

Following extensive survey of the site and significant peer review it is concluded that the proposed development will not cause a significant impact upon threatened species, populations and endangered ecological communities. Therefore a Species Impact Statement should not be required for the proposed development.

In respect of matters required to be considered in the *Environment Protection and Biodiversity Conservation Act* (1999) one (1) threatened fauna species, Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded. A referral to Department of the Environment & Heritage should not be required.

In respect of matters relative to the *Fisheries Management Act* 1994 there are no matters requiring further consideration.

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Licences –

National Parks and Wildlife Service

Individual staff members are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Section 120 & 131 of the *National Parks and Wildlife Act, 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: S10359 & S10618.

Department of Agriculture

The staff of *Conacher Travers* are licensed under an Animal Research Authority issued by the Department of Agriculture. This authority allows *Conacher Travers* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

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FLORA AND FAUNA ASSESSMENT OF PART OF LOT 4 DP 771597 & PORTION 4 OFF LEO DRIVE, NARRAWALLEE

SECTION 1.0 – INTRODUCTION

Conacher Travers Pty Ltd previously prepared a Flora and Fauna Assessment Report (*Conacher Travers* 2003) that identifies the flora and fauna characteristics of Part of Lot 4 DP 771597 and Portion 4 off Leo Drive, Narrawallee.

After extensive consultation and assessment of the proposed development by the former Department of Infrastructure, Planning and Natural Resources (DIPNR) in Mid 2003 and 2004 a number of additional flora and fauna survey works were required to be undertaken over the site. These additional requirements have been previously dealt within the Addendum Flora and Fauna Assessment Reports prepared in January 2004 and July 2004.

This current Flora and Fauna Assessment Report (*Conacher Travers* 2006) has been prepared to update the previous Flora and Fauna Assessment Report (*Conacher Travers* 2003) to address the current environmental legislation. The information collated in the Addendum Flora and Fauna Assessment Reports (*Conacher Travers* January 2004 and July 2004) has also been incorporated into this report.

Since our previous reports were prepared there have been minor amendments to the development design. The totality of these amendments have been considered in this report. Also the updating of this report required additional fauna survey works to ensure the veracity of our earlier works and an updated assessment in line with the revised relevant legislation.

Figure 1 provides an aerial appraisal of vegetation and landuses within and adjacent to the subject site.

1.1 Aims of the Assessment

The aims of the flora and fauna assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their condition in accordance with the guidelines adopted by Shoalhaven City Council;
- Carry out a fauna survey for the detection and assessment of fauna and their habitats in accordance with the guidelines adopted by Shoalhaven City Council;
- Complete target surveys for threatened species, populations and ecological communities; and
- Prepare a flora and fauna impact assessment in accordance with the requirements of the *Threatened Species Conservation (TSC) Act* (1995) and guidelines issued by the National Parks and Wildlife Service.

1.2 Information Collation

To achieve the above aims, *Conacher Travers Pty Ltd* carried out field surveys on

- 10, 11, 12, 13, 14, 15 September 2002
- 1, 2, 3, 4 December 2003
- 27, 28, 29 April 2004
- 4, 5, 6, 18, 19, 20, 21 May 2004 and
- 9, 10 December 2006.

A review of the relevant information pertinent to the subject site was undertaken prior to the initiation of field surveys as background to the study. Information sources reviewed include the following:

- Aerial photographs (scale 1:25000) and Topographical maps (scale 1:25000)
- Atlas of NSW Wildlife (DEC 2006) for the relevant 1:100,000 scale map sheet
- The schedules of the *Threatened Species Conservation Act* (1995)
- The schedules of the *Fisheries Management Act* (1994)
- Lists of threatened species and communities in the *Environment Protection and Biodiversity Conservation Act* (1999)
- Rare or Threatened Australian Plants (ROTAP)
- Previous reports and surveys within the local area

1.3 Statutory Requirements

1.3.1 State

Threatened Species Conservation Act (1995)

The specific requirements of the *Threatened Species Conservation (TSC) Act* (1995) must be addressed in the assessment of flora and fauna matters. This requires the consideration of potential impacts on threatened species, populations and ecological communities.

The factors to be taken into account in deciding whether there is a significant effect are set out in Section 5A of the *Environmental Planning & Assessment (EP&A) Act* (1979) and are based on a 7 part test of significance.

Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

Fisheries Management Act (1994)

The *Fisheries Management Act* (1994) provides a list of threatened aquatic species, which require consideration when addressing the potential impacts of a proposed development.

Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

1.3.2 National

The *Environment Protection and Biodiversity Conservation (EPBC) Act* (1999) requires that Commonwealth approval be obtained for certain actions. The Act provides an assessment and approvals system for actions that have a significant impact on matters of national environmental significance (NES). These may include:

- Wetlands protected by international treaty (the Ramsar Convention)
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species

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

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats, the matter needs to be referred to Department of the Environment & Heritage.

1.4 Development Proposal

It is proposed to subdivide the subject site for residential purposes. In addition to residential housing, roads and associated infrastructure, the proposal results in the creation of two public reserves with an approximate area of 2.32 hectares. These two areas will retain suitable habitat for local fauna species, particularly large forest owls and diurnal birds.

In addition a large public Reserve comprising approximately 65 hectares has been excised off the existing allotment. This large parcel of intact forest habitat will become public land managed by Council and provides a significant area of reserved habitat for local fauna species, particularly large forest owls and diurnal birds.

The proposal provides for a high level of water management to protect low lying areas to the west. These measures are identified by *J. Wyndham Prince Pty Ltd*.

Conacher Travers (2003) has also recommended appropriate bushfire protection measures for the proposal. The impacts of these measures, including Asset Protection Zones have been taken into consideration as part of the impact assessment within this report.

1.5 Site Description

Location

The subject site is situated on the western side of Leo Drive and to the north of Seaspray Street, Narrawallee. Approximate AMG coordinates of the study area are 269500E and 6088500N. The site is bounded by residential development to the east and south east, and by native vegetation to the north, west and south west. The site encompasses an area of approximately 30 hectares (ha).

Geology

The subject site is mapped by Sydney Basin 1:500,000 Geological Sheet as siltstone and silty sandstone (Psc) and gravel, sand, silt and clay (Qa) (Brunker, R.L. & Rose, G. 1967).

The soils within the site contained sandy loam and clay with fragments of siltstone.

Topography and Drainage

The study area is situated on low ridgeline aligned north to south forming a slope at the northern end. The western side of the ridgeline drains west north-west into a watercourse along the western side forming a narrow arm of Narrawallee Wetlands to the north. The eastern side of the ridgeline drains generally east and north east into residential development.

Gradients of the site are generally 10 to 25% with lower gradients along the ridge top. The elevation of the site is generally between 10 and 30 metres Australian Height Datum (AHD).

Vegetation

The site is naturally vegetated containing predominantly tall forest. The site is bound to the north and west by natural vegetation. Areas to the south and east contain residential development.

Conservation Reserves

The nearest conservation reserves are Narrawallee Creek Nature Reserve approximately 300 metres to the north and Morton National Park, approximately 13 km to the west.

Land Use

The study area landscape has been affected by the following impacts:

- **Clearing:** An area at the southern end of the site has been clear for excavations and small areas throughout the site have been cleared for vehicular tracks;
- **Bushfire:** There are no signs of recent bushfire;
- **Agriculture:** There is anecdotal evidence of past intensive grazing in the southern two thirds of the site but at the time of the survey that area was covered with natural vegetation and was not being used for any purpose;
- **Earthworks:** Excavations have been made in a small area in the southern part of the site;
- **Introduced weeds:** the subject site contains a moderate incursion of weeds predominantly along the southern and eastern boundaries adjoining residential development; and
- **Feral, Introduced and Domestic Fauna:** Native fauna within the subject site is likely to have been impacted upon by the predation of European Red Fox (*Vulpes vulpes*), Cats (*Felis catus*) and Dogs (*Canis familiaris*).

SECTION 2.0 - SURVEY TECHNIQUES

2.1 Flora Survey Techniques

- **Literature Review** - A review of available literature for the area was undertaken to obtain reference material and background information for this survey. These documents are listed in the Bibliography section of this report.
- **Database Searches** - The Atlas of NSW Wildlife (DEC 2006) threatened flora records for the Ulladulla 1:100,000 Scale Map Sheet and the EPBC Act database were analysed to provide a predictive list of threatened flora species that occur locally and could possibly occur throughout the habitats identified within the subject site.
- **Aerial Photograph Interpretation** - Aerial photographs at 1:25,000 scale were utilised to identify the extent of vegetation with respect to the site and surrounding areas.
- **General Flora Survey** - An initial flora survey using a systematic stratified sampling regime within each of the identified vegetation communities, incorporating the placement of 20x20 metre quadrats, was undertaken on September 14th & 15th 2002. The flora

survey targeted all vegetation communities present within the subject site. The locations of flora survey quadrats are shown in Figure 2. In addition, targeted threatened species searches were also conducted in potential habitat throughout the subject site.

- **Targeted Threatened Orchid Survey** - Detailed threatened orchid surveys targeting *Cryptostylis hunteriana* and *Genoplesium vernale* were conducted over the entire site on the 2nd and 3rd of December 2003. This date was selected as the most appropriate to cover both species at the same time. The surveys incorporated parallel traverses 10 metres apart over the entire subject site. Cropper (1993) has identified this method as ideal for targeted threatened species searches particularly cryptic orchids. Random Meander surveys were also carried out in the adjoining bushland areas.
- **Review of Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF) Boundary (Previously Sydney Coastal Estuary Swamp Forest Complex (SCESFC))**- An initial flora survey undertaken on 14th & 15th September 2002 identified within the study area a Fresh Treed Swampland vegetation community as commensurate with SSFCF (*Conacher Travers*, 2003). As the area was outside of the subject site, no comprehensive survey was undertaken (*Conacher Travers*, 2003). Subsequently, it was determined that there was insufficient room for an adequate buffer between this vegetation community and the boundary of the development area (*Conacher Travers*, 2004).

A more extensive investigation of this communities distribution was undertaken on 3rd December 2003 by *Conacher Travers* (2004) and *Kevin Mills & Associates* (2004). An additional review of both the *Conacher Travers* (January 2004) and *Kevin Mills & Associates* (2004) boundaries was completed on the May 5th and 6th 2004 (*Conacher Travers* July 2004). A detailed description of the methodology used to delineate this community is provided in Appendix 4 of the Addendum II (*Conacher Travers* July 2004).

- **Expert Advice** - At the time of the threatened orchid surveys, little was known about the species *Genoplesium vernale*, as it is a recently discovered species. *Conacher Travers* consulted with the botanist, Mark Clements of CSIRO, who is credited with discovering the species. *Conacher Travers* were advised that the timing of the survey in early December was appropriate for this species.
- **Accuracy of Identification** - Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation where relevant were made according to Specht et al. (1995).

2.2 FAUNA SURVEY TECHNIQUES

- **Literature Review** - A review of available literature for the area was undertaken to obtain reference material and background information for this survey. These documents are listed in the bibliography of this report.
- **Database Searches** - The Atlas of NSW Wildlife (DEC, 2006) Threatened Fauna records for the Ulladulla 1:100,000 Scale Map Sheets were analysed to provide a predictive list of fauna species that occur locally and could possibly occur throughout the habitats identified within the subject site.
- **Field Survey** - Survey dates, times, weather conditions and methods employed are shown in Appendix 2. The location of fauna survey is presented in Figure 3. Additional Field Survey targeting the threatened species Glossy Black-cockatoo, and

Powerful Owl were conducted by Conacher Travers Pty Ltd on April 27th, 28th, 29th and May 4th, 5th, 6th, 18th, 19th, 20th, and 21st 2004 and on December 9th and 10th 2006.

2.2.1 Diurnal Birds

Visual observation of birds was carried out during all visits to the site; between 2003 and 2006.

Opportunistic bird counts are also made while undertaking other survey work and during spotlight surveys of the site between 2003 and 2006.

2.2.1.1 December 2003 Surveys

Stands of *Allocasuarina* were identified and located within the subject site. Two (2) target diurnal surveys were conducted for Glossy Black-cockatoo (*Calyptorhynchus lathami*) within stands of *Allocasuarina*. The surveys were conducted on the mornings December 2nd and 4th 2003.

Searches of chewed cones (foraging evidence of Glossy Black-cockatoo) were conducted beneath stands of *Allocasuarina*. Glossy Black-cockatoo feeds almost exclusively on seeds of *Allocasuarina* (Higgins, 1999, pg 55).

Although the Glossy Black-cockatoo breeds during autumn and winter, habitat trees within the subject site were reassessed for the presence of nesting evidence and any utilisation was noted.

General diurnal bird censuses were undertaken throughout areas off-site to the west and north-west of the subject site. Suitable nesting hollows for Glossy Black-cockatoo were noted during hollow-bearing tree surveys off-site.

2.2.1.2 April & May 2004 Surveys

Searches for specimens and foraging evidence of Glossy Black-cockatoo were conducted along a series of parallel transects in conjunction with Powerful Owl roost searches. Surveys were conducted within both the subject site and the remaining study area (trade-off areas).

Stands of *Allocasuarina* sp. and foraging evidence (chewed cones) were located and mapped. The survey included an estimation of the age of any foraging evidence found.

Large sized hollow-bearing trees within the subject site and remaining study area considered to provide potential nesting habitat for Glossy Black-cockatoo were recorded.

A diurnal point census targeting Glossy Black-cockatoo was conducted within each area of *Allocasuarina* and adjacent to each large hollow-bearing tree recorded. The diurnal surveys for Glossy Black-cockatoo included visual and call identification.

The survey included a total of 33 transects from east to west, placed approximately 50m apart. These transects were traversed a total of four times during May 4th, 5th, 6th, 18th, 19th, 20th and 21st 2004. In addition, opportunistic observations of Glossy Black-cockatoos were made on April 28th and 29th 2004.

2.2.1.3 December 2006 Surveys

Visual observation of birds was carried out during visits to the site;

Opportunistic bird counts are also made while undertaking other survey work and during spotlight surveys of the site.

Stands of *Allocasuarina* sp. were searched for foraging evidence of the Glossy Black-cockatoo. Surveys that identified chewed *Allocasuarina* cones were mapped.

2.2.2 Nocturnal Birds

During the initial surveys (2002) the presence of Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Barking Owl (*Ninox connivens*) were targeted by broadcasting recorded calls through a 15 watt Toa 'Faunatech' amplifier and either by visual recognition or vocal identification. Calls were played for 5-minute periods at 5-minute intervals. This was followed with quiet listening and spotlighting.

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

2.2.2.1 December 2003 Surveys

The presence of Powerful Owl (*Ninox strenua*) was targeted by broadcasting recorded calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played for 3-minute periods at 3-minute intervals for 18 minutes. This was followed by 20 minutes of quiet listening and spotlighting.

Stagwatches were conducted for the known Powerful Owl nesting tree recorded by Gunninah (1999). This nest tree is located approximately 117m to the west of the subject site (see Figure 3, 4). Stagwatches were also conducted for five (5) additional hollow-bearing trees located within the subject site, which were considered to contain potential nesting habitat for Powerful Owl. This included hollow-bearing tree numbers HB5, HB8, HA5, HA6 and HB28 (see Figure 3, 4). These trees were also observed to assess the likelihood of utilisation by Powerful Owl. This included noting of any evidence of their presence such as white-wash and owl pellets beneath and within 50m of potential nesting trees.

Diurnal opportunistic observations of suitable roosting sites for Powerful Owl were conducted in areas of vegetation throughout the subject site and areas within the study area to the west, north-west and north. More specific observations were made in areas with canopies dominated by *Syncarpia glomulifera* (Turpentine), which provides suitable roosting habitat for Powerful Owl (Higgins, 1999).

2.2.2.2 April & May 2004 Surveys

Stagwatch surveys on selected large hollow bearing trees were conducted in the evening for approximately 15 minutes prior to and 30 minutes after sunset. Any owls observed leaving hollows were noted and identified.

Spotlighting for nocturnal fauna was carried out using a hand held lamp of 750,000 candlelight power (100W halogen globe). This technique involved walking amongst the woodland areas of the subject site so that a maximum number of trees could be observed.

Targeted owl surveys were conducted, paying particular attention to habitat suitable for Powerful Owl. Searches for specimens of roosting owls and diurnal owl roost sites were conducted along a series of parallel transects.

Searches were conducted along a total of 33 transects from east to west, placed

approximately 50m apart. These transects were traversed a total of four times during May 4th, 5th, 6th, 18th, 19th, 20th and 21st 2004. In addition, opportunistic observations of roosting owls and roost sites were made on April 28th and 29th 2004.

More concentrated surveys were conducted in the more suitable roosting habitats for Powerful Owl such as stands of *Syncarpia glomulifera* (Higgins, 1999). Searches for diurnal roost sites were conducted. These included looking for roosting owls, regurgitated owl pellets, whitewash and carcasses of prey.

Regurgitated owl pellets and/or carcasses were sent away to Barbara Triggs for identification and analysis to determine their source.

Large sized hollow trees within the development and trade-off areas considered to provide potential nesting habitat for Powerful Owl were mapped and observed for evidence of use. Searches for roosting owls and roost sites were conducted within a 50m radius from each potential nesting tree.

2.2.2.3 December 2006 Surveys

Stagwatch surveys were conducted on the known Powerful Owl nesting tree recorded by Gunninah (1999). selected large hollow bearing trees were conducted in the evening for approximately 15 minutes prior to and 45 minutes after sunset. Any owls observed leaving hollows were noted and identified. This tree was also assessed for indicative evidence of owl habituation such as white-wash and owl pellets.

During the initial surveys (Conacher Travers, 2002) the presence of Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Barking Owl (*Ninox connivens*) were targeted by broadcasting recorded calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played for 5-minute periods at 5-minute intervals. This was followed with quiet listening and spotlighting.

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

Spotlighting for nocturnal fauna was carried out using a hand held lamp of 750,000 candlelight power (100W halogen globe). This technique involved walking amongst the woodland areas of the subject site so that a maximum number of trees could be observed.

2.2.3 Arboreal and Terrestrial Mammals

2.2.3.1 December 2003 Surveys

Elliott type A and B traps were used for trapping arboreal and terrestrial mammals. Trapping consisted of a total of 240 Elliott trap nights including 120 arboreal trap nights and 120 terrestrial trap nights.

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

Terrestrial trap-lines of type A and B Elliott traps using 10-20 metre separations were placed along the same line as the arboreal traps in the most suitable terrestrial habitats.

The traps were baited with a mixture of rolled oats, honey and peanut butter.

Eight (8) trap-lines were set on the nights of September 10th, 11th and 12th, 2002. The location of the trap-lines is shown in Figure 3. Each trap-line consisted of 5 type A arboreal traps, 3 type B terrestrial traps and 2 type A terrestrial traps.

Cage trapping was conducted throughout the subject site. These were used to target two threatened species, Southern Brown Bandicoot (*Isodon obesulus*) and Spotted-tailed Quoll (*Dasyurus maculatus*). Fifteen (15) cage traps were set on the nights of September 10th, 11th and 12th, 2002. These were placed along animal tracks and in areas containing bandicoot diggings.

The presence of Yellow-bellied Glider (*Petaurus australis*) was targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played for 5-minute periods during each nocturnal survey, followed by 20 minutes of quiet listening and spotlighting.

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

- i. A search of the Atlas of NSW Wildlife database.
- ii. The site was surveyed on foot, with Koala food trees being inspected for signs of Koala usage. Trees were inspected and identified for the presence of Koalas, characteristic scratch and claw marks on the trunk and scats around the base of each tree. The proportion of trees showing signs of Koala use was calculated. Additionally the location and density of droppings if found were documented.
- iii. Koalas were also targeted during spotlight surveys.
- iv. Identification and an assessment of the density of tree species listed as Koala feed trees in State Environmental Planning Policy No. 44 - Koala Habitat Protection was undertaken across the site. An estimate of the percentage density of each tree species across the site was determined by averaging the percentage of stems counted.

2.2.3.2 April - May 2004

Assessment was made of 'found' scats, markings, diggings, runways and scratches during visits to the site. Habitat was also assessed to determine the likelihood of threatened native species of fauna occurring within the subject site.

Spotlighting for nocturnal mammalian fauna was carried out using a hand held lamp of 750,000 candlelight power (100W halogen globe). This technique involved walking amongst the woodland areas of the subject site so that a maximum number of trees could be observed.

2.2.3.3 December 2006 Surveys

Assessment was made of 'found' scats, markings, diggings, runways and scratches during visits to the site. Habitat was also assessed to determine the likelihood of threatened native species of fauna occurring within the subject site.

Spotlighting for nocturnal mammalian fauna was carried out using a hand held lamp of 750,000 candlelight power (100W halogen globe). This technique involved walking amongst the woodland areas of the subject site so that a maximum number of trees could be observed.

The subject area was assessed for activity by Koalas using the methods discussed in Section 2.2.3.1 above.

2.2.4 Bats

During initial surveys in 2002 micro-chiropteran bats were surveyed by echolocation using an Anabat Mk 2 detector in both fixed and mobile positions throughout the subject site. Mega-chiropteran bat species, such as Grey-headed Flying-fox (*Pteropus poliocephalus*), were surveyed by targeting flowering / fruiting trees during spotlighting activities.

2.2.4.1 December 2003 Surveys

Three (3) Harp traps were set along vehicular tracks throughout the subject site on the nights of December 1st, 2nd and 3rd 2003.

Micro-chiropteran bats were surveyed by echolocation using an Anabat Mk 2 detector in both fixed and mobile positions throughout the subject site. Two (2) Anabats were set on December 2nd and 3rd 2003.

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

2.2.4.2 April & May 2004 Surveys

Mega-chiropteran bat species, such as Grey-headed Flying-fox (*Pteropus poliocephalus*), were surveyed by targeting flowering / fruiting trees during spotlighting activities. Spotlighting surveys were conducted on April 27th, 28th, 29th and May 4th and 20th 2004.

2.2.4.3 December 2006 Surveys

Micro-chiropteran bats were surveyed by echolocation using an Anabat Mk 2 detector in fixed positions throughout the subject site. A total of three (3) Anabats Mk 2 detectors were set over the 9th and 10th December 2003.

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

2.2.5 Amphibians

Amphibians were surveyed by vocal call identification, by using a tape recorder to record male calls in suitable places and then comparing these to known calls. Amphibians were also surveyed by habitat searches.

Any amphibians found are visually identified and when required to be examined are handled with Latex gloves and kept moist until release.

The weather conditions prior to and during these surveys included, periods of heavy and light rainfall (refer to Appendix 2).

2.2.5.1 December 2003 & 2006 Surveys

The presence of Giant Burrowing Frog (*Heleioporus australiacus*) was targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played on the nights of December 1st and 2nd 2003 to the north and western areas within and in close proximity to the subject site. These calls were played at numerous points in transects within each area between short periods of quite listening.

Opportunistic surveys for amphibian species were conducted during both diurnal surveys and during spotlighting surveys. Spotlighting was conducted on the nights of December 1st, 2nd and 3rd 2003. This included general surveys such as vocal call identification, using a tape recorder to record male calls in suitable places and then comparing these to known calls.

The weather conditions prior to and during these surveys included, periods of heavy and light rainfall (refer to Appendix 2).

2.2.5.2 April & May 2004 Surveys

Opportunistic surveys for amphibian species were conducted during both diurnal surveys and during spotlighting surveys. Spotlighting surveys were conducted on April 27th, 28th and 29th and May 4th and 20th 2004.

This included general surveys such as vocal call identification, using a tape recorder to record male calls in suitable places and then comparing these to known calls.

The weather conditions prior to and during these surveys included, periods of heavy and light rainfall (refer to Appendix 2).

2.2.6 Reptiles

Searches for reptiles in likely localities such as under logs and in deep leaf litter were carried out during diurnal visits to the site. Spotlighting of terrestrial habitats suitable for reptiles occurred during nocturnal surveys. This methodology was used during all survey periods.

2.2.7 Hollow-bearing Trees

2.2.7.1 December 2003 Surveys

Hollow-bearing trees outside of the subject site were surveyed in 50 x 50m quadrats. Areas outside of the subject site include, the proposed residue lots, areas north of Narrawallee Creek and areas east of Leo Drive (see Figure 1).

The number of hollow-bearing trees and the type and size of hollows within each hollow-bearing tree were noted for each quadrat. Hollows were categorised into three diameter sizes including, small (<10cm), medium (10-30cm) and large (>30cm).

Twenty-eight (28) hollow-bearing tree quadrats were placed throughout proposed residue Lots, 2, 5, 7 and 8. Four (4) hollow-bearing tree quadrats were placed in forested areas to the north of the Narrawallee Creek estuary. Three (3) habitat tree quadrats were placed in vegetation to the east of Leo Drive. One (1) habitat tree quadrat was placed in a forested area to the north of Leo Drive and to the east of proposed residue lot 2.

Habitat trees within the subject site were assessed for the presence of nesting birds,

arboreal mammals and micro-chiropteran bat species and any utilisation was noted.

2.2.7.2 April & May 2004 Surveys

Surveys targeting large (>30cm) hollow-bearing trees considered to provide potential nesting habitat for Powerful Owl and Glossy Black-cockatoo were conducted in conjunction with the survey transects. A total of 33 transects from east to west were placed approximately 50m apart. These transects were traversed a total of four times during May 4th, 5th, 6th, 18th, 19th, 20th and 21st 2004.

SECTION 3.0 - SURVEY RESULTS

3.1 FLORA SURVEY RESULTS

A total of 144 species of plants was observed within the study area. Of these, 125 species were native plants and 19 species were exotic. The native species observed consisted of 8 trees, 48 shrubs, 15 vines, 45 herbs and 9 ferns. The plants observed are listed in Tables A1.1, A1.2 and A1.3 of Appendix 1.

Three vegetation communities were identified within the study area by *Kevin Mills & Associates Pty Ltd* during a survey in 1994. The same three vegetation communities were observed during the current survey although the boundaries of those communities were found to be in a different location. To eliminate confusion, the same titles are given to the vegetation communities as were given to them by Mills (1994).

- Blackbutt Tall Forest (Dense Understorey);
- Fresh Treed Swampland; and
- Blackbutt Tall Forest (Open Understorey).

3.2 FAUNA SURVEY RESULTS

Conacher Travers identified 90 fauna species within the study area during surveys in 2002, 2003, 2004 and 2006. This consisted of 61 species of birds, 18 species of mammals, 5 species of reptile and 5 species of amphibian.

Fauna surveys within the subject site conducted by *Kevin Mills and Associates* in 1994 identified 39 species. This consisted of 33 species of birds, 4 species of mammals, no species of reptiles and 2 species of amphibians.

A collaboration of *Kevin Mills* and *Conacher Travers* records identified a total of 93 fauna species within the study area. This consisted of 63 species of birds, 19 species of mammals, 5 species of reptiles and 5 species of amphibians.

Seven (7) Threatened Species were identified within study area and subject site during surveys. These include Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Sooty Owl (*Tyto tenebricosa*), Osprey (*Pandion haliaetus*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).

Species recorded throughout the duration of the fauna survey are listed in Table A1.4 of Appendix 1.

SECTION 4.0 - ECOLOGICAL ASSESSMENT

4.1 Previous Surveys Reviewed

Preliminary Flora and Fauna Assessment Land at Narrawallee Shoalhaven, Kevin Mills & Associates Pty Ltd (April 1994)

This assessment concluded that no rare or threatened plant species were found in or near the study area and none are likely to occur. The swampland on the flats to the northwest of the study area adjoining SEPP 14 wetlands are of regional significance. No threatened fauna species were observed within the study area.

Flora and Fauna Assessment Report for Proposed Tourist Park Development Lot 2 DP 115688 15 Ocean Street Mollymook, May 2002 (Conacher Travers)

No threatened flora species were recorded within the subject site. One (1) endangered ecological community, Sydney Coastal Estuary Swamp Forest Complex was observed within the subject site. One (1) threatened fauna species, Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) was recorded within the subject site. The White-bellied Sea Eagle (*Haliaeetus leucogaster*) which is covered by migratory and marine provisions of the EPBC Act, 1999, was recorded.

Flora and Fauna Assessment Report for Part of Lot 4 DP 771597 and Portion 4 off Leo Drive, Narrawallee, March 2003 (Conacher Travers)

This report is the original assessment of the current subject site. Two (2) threatened species were observed within the subject site, the Powerful Owl (*Ninox strenua*) and the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*). An example of the threatened ecological community Sydney Coastal Estuary Swamp Forest Complex was observed within the study area but west of the subject site.

Addendum I Flora and Fauna Assessment Report for Part of Lot 4 DP 771597 and Portion 4 off Leo Drive, Narrawallee, January 2004 (Conacher Travers)

This is a supporting document to the Flora and Fauna Report prepared by *Conacher Travers* in 2003. This report was prepared to detail the observations of surveys conducted in request for addition works by the consent authorities.

Addendum Flora and Fauna Assessment Report for Part of Lot 4 DP 771597 and Portion 4 off Leo Drive, Narrawallee, July 2004 (Conacher Travers)

This is a supporting document to the Flora and Fauna Report prepared by *Conacher Travers* in 2003. This report was prepared to detail the observations of surveys conducted in request for addition works to the January 2004 Addendum report. The additional survey was requested by the Department of Infrastructure, Planning and Natural Resources (DIPNR) in relation to the proposal at the time.

Five (5) threatened species were identified during these surveys. These include Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Glossy-black Cockatoo (*Calyptorhynchus lathami*), Osprey (*Pandion haliaetus*) and the Grey-headed Flying-fox (*Pteropus poliocephalus*). The threatened ecological community Sydney Coastal Estuary Swamp Forest Complex, (now Swamp Sclerophyll Forest on Coastal Floodplains) boundary was reviewed and considered to be positioned in a similar position indicated in the original Flora & Fauna Assessment Report.

Powerful Owl 'Eight Part Test' Assessment, Part Lot 122 D.P. 579649 Yarrawonga Drive, Mollymook November 2002. Conacher Travers (2002b)

This previous report is located approximately 1.5km to the south of the current subject site.

This report concluded that the distance between the proposed subdivision and the nesting tree is considered likely to be sufficient in relation to buffer width, particularly as it is greater than that previously recommended by NPWS. It was considered that the proposed subdivision is unlikely to result in a significant impact on the nesting tree as a viable nesting location.

Flora and Fauna Assessment Proposed Residential Subdivision Yarrawonga Drive, Mollymook City of Shoalhaven, May 2002 Kevin Mills & Associates Pty Limited

This report was prepared over the same area as covered by the current report. It focused on the likely impact upon the Powerful Owl as a result of the proposed 15 lot subdivision. Points raised within the report included:

- The subdivision is well clear of the nest tree and the separation distance is greater than what was recommended by the National Parks and Wildlife Service in the Director-General's Concurrence Report in 1999;
- The forest on this site is not roosting habitat for Powerful Owls; there are no dense stands of Turpentines, their preferred roost tree species, and owls have never been found roosting on the site;
- The owls forage over a large home territory that takes in the residential areas and fragmented forest in the Mollymook area, so the loss of this relatively small area is not likely to place them at risk of extinction;
- The development of the subdivision will involve clearing of an additional 1.03ha of Blackbutt Forest. This 1.03ha constitutes only a very small proportion of the foraging habitat within the Powerful Owl's home territory, which includes most of the forest around Mollymook. The SIS surveys demonstrated that the Powerful Owl's arboreal prey (i.e. possums and gliders) are abundant in the forests around Milton-Ulladulla, including fragmented areas of forest.

The report concluded that the proposed subdivision in Yarrawonga Drive is not likely to have a significant effect on Powerful Owl's and that a SIS is not required.

Ecological Review Draft Milton-Ulladulla Local Environmental Plan City of Shoalhaven. Kevin Mills & Associates Pty Ltd, May 2002

This report refers to the Powerful Owl habitat at Narrawallee. According to this report the NPWS makes comment on the value of Blackbutt Tall Forest and the Powerful Owl nest tree at Narrawallee and the need to protect it and the surrounding habitat. This report reiterates the distance of the nest tree from the 2(c) zone to justify development of this area. The report states that the tree is at least 80m from the edge of this zone and that this is consistent with advice given by the NPWS in their concurrence report on a residential development at Garside Road, Mollymook, where a distance of 75m was considered adequate from that nest tree.

This report states that most of the Glossy Black-cockatoo habitat in the LEP area is zoned Environmental Protection.

Flora and Fauna Assessment of Lot 385 D.P. 45117, Matron Porter Drive, Narrawallee, New South Wales. Development Opportunities and Constraints Study. March 2002. Lesryk Environmental Consultants March 2002

This previous survey site is located approximately 800m to the south of the current subject site.

Grey-headed Flying-fox, Yellow-bellied Sheath-tail-bat, Eastern False Pipistrelle, Common Bentwing-bat,

This survey recorded four (4) threatened species, Grey-headed Flying-fox (*Pteropus poliocephalus*), Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*), Common Bentwing-bat (*Miniopterus schreibersii*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).

Proposed Rezoning at Seaspray Street, Narrawallee Lot 29 D.P. 874275 – Response to Issues April 2000. Gunninah Environmental Consultants

This previous report is for land located adjacent to the south of the current subject site.

This report prepared a table of relevant planning and conservation issues relating to the proposed rezoning of this site (Table 1 of Gunninah report). The proposed measures for Powerful Owl included:

- A minimum of 100m buffer zone around the identified nest tree;
- A boundary fence of the site would be constructed to limit access to the nest tree; and
- Potential habitat and foraging resources will be maintained within the Environmental Protection Zone.

The outcome of these measures was to provide approximately 140m of protection between the nest tree and the subdivision.

Part Lot 28 D.P. 871790 Seaspray Street, Narrawallee, Proposed Rezoning and Residential Development, Supplementary Flora & Fauna Issues, December 1999. Gunninah Environmental Consultants

These subsequent investigations have indicated that the Powerful Owl nest tree is located approximately 100m to the north of the subject site. According to this report the NPWS have indicated that a 100m buffer around the nest tree is adequate, both to separate the tree and development activities, and to minimise the likelihood of disturbance to breeding owls. This report concluded that the subsequent development of the site is not regarded as likely to impose a significant effect on the Powerful Owl or on any other threatened species, populations or ecological communities, or their habitats.

Part Lot 28 D.P. 871790 Seaspray Street, Narrawallee, Proposed Rezoning and Residential Development, Flora and Fauna Issues, July 1999. Gunninah Environmental Consultants

This previous survey relates to land adjoining the current subject site to the south.

This report concluded that no threatened species are considered likely to be dependant solely or particularly on the site for their survival in the locality. They also found that it was unlikely that the proposed development will impose a significant impact upon Powerful Owl, as the Powerful Owl is tolerant of some habitat modification and disturbance, the species is wide-ranging and highly mobile and this species occupies a large home range of which the site only comprises a small proportion.

*Powerful Owl (*Ninox strenua*) & Glossy Black-cockatoo (*Calyptorhynchus lathami*) Nesting Assessment, Part Lot 28, D.P. 871790 Seaspray Street, Narrawallee City of Shoalhaven, David Coombes, October 1998*

This previous survey is located adjacent to the south of the current subject site.

No Powerful Owls were recorded during the assessment. Ten well used diurnal roost sites for Powerful Owl were located within and close to the study area. All of the roost sites were in Turpentine (*Syncarpia glomulifera*). Several potential nest trees, *Eucalyptus pilularis* (Blackbutt) were found within and near the study area.

No Glossy Black-cockatoos were recorded during the assessment. A small number of chewed She-oak cones were found in the south-west corner of the subject site. A number of potential nesting trees were observed within the study area.

Flora and Fauna Study Part Lot 28 D.P. 871790 Seaspray Street, Narrawallee, City of Shoalhaven. Kevin Mills & Associates Pty Ltd, April 1998

This previous report was located immediately adjacent to the southern side of the current subject site.

One (1) threatened fauna species, Powerful Owl (*Ninox strenua*) was recorded within the study area. The Powerful Owl was heard calling in southern part of the study area.

In addition to Powerful Owl, another eight (8) threatened species were considered likely to occur within the Narrawallee area. These species include, Green and Golden Bell Frog, Regent Honeyeater, Southern Brown Bandicoot, Giant Burrowing Frog, Glossy Black-cockatoo, Swift Parrot, Squirrel Glider and Common Bentwing-bat. Four (4) additional micro-chiropteran bat species are not known to occur in the local area but are considered to have potential habitat within the site. These species include, Eastern Freetail-bat, Eastern False Pipistrelle, Yellow-bellied Sheath-tail-bat and Greater Broad-nosed Bat.

According to Mills (1998) this area contains several large eucalypts providing potential nesting habitat for a variety of arboreal mammals. According to Mills (1998) the Powerful Owl is expected to occur wherever there is well developed forest.

4.2 Vegetation Communities

Three vegetation communities were identified within the study area through aerial photographic interpretations and extensive ground truthing:

- Blackbutt Tall Forest (Dense Understorey)
- Fresh Treed Swampland
- Blackbutt Tall Forest (Open Understorey)

As stated above, the same titles for the vegetation communities that were used by Mills (1994) have been adopted by this report. The current survey however, redefines the boundaries as shown by Mills (1994). It is considered that the vegetation was originally uniform but that the vegetation in Community 1 has been heavily logged or cleared in the early 1900s and the present vegetation is a serial stage in the regeneration of the original vegetation which was probably similar to that in Vegetation Community 3.

Vegetation Community 1 – Blackbutt Tall Forest (Dense Understorey):

Occurrence - This vegetation community occurs over the majority of the relevant section of Portion 4.

Structure - Tall Open Forest with a canopy cover of approximately 50% and height of approximately 25-30 metres. The understorey consists of a dense shrublayer to 8 metres high and a moderate to sparse groundcover of herbs, ferns and grasses.

Disturbances - This vegetation community appears to be regrowth from a past history of intensive logging or clearing. The only recent disturbances are vehicular trails and clearing in close proximity to existing residential development. It has a generally low incidence of weeds except for in the immediate vicinity of residential areas.

Common Species

Trees: *Corymbia gummifera* (Red Bloodwood), *Eucalyptus pilularis* (Blackbutt) and *Syncarpia glomulifera* (Turpentine).

Shrubs: *Gompholobium latifolium* (Golden Glory Pea), *Hakea salicifolia* (Willow Hakea), *Persoonia mollis*, *Platylobium formosum* (Handsome Flat-pea) and *Pultenaea flexilis*.

Groundcovers: *Entolasia stricta* (Wiry Panic), *Lepidosperma filiforme* (Common Rapier Sedge) and *Lomandra longifolia* (Spiky-headed Mat-rush).

Vegetation Community 2 – Fresh Treed Swampland:

Occurrence - This vegetation community occurs along the ephemeral watercourse to the west of the subject site.

Structure - Open Forest / Woodland with a canopy cover of approximately 30-50% and height of approximately 20-30 metres. This vegetation community is extremely variable and varies from similar to Vegetation Community 1 with the addition of some moisture loving species to semi-permanent lagoons with woodland structure trees. The understorey consists of a sparse to dense shrublayer to 5 metres high and a sparse to dense groundcover of herbs and ferns.

Disturbances - This vegetation community is relatively undisturbed.

Common Species

Trees: *Casuarina glauca* (Swamp Oak), *Corymbia gummifera* (Red Bloodwood), *Eucalyptus longifolia* (Woollybutt), *Eucalyptus pilularis* (Blackbutt), *Eucalyptus robusta* (Swamp Mahogany) and *Syncarpia glomulifera* (Turpentine).

Shrubs: *Callicoma serratifolia* (Black Wattle), *Glochidion ferdinandi* (Cheese Tree) and *Melaleuca ericifolia*.

Groundcovers: *Baloskian tertraphyllum* (Tassel-rush), *Blechnum indicum* (Swamp Water-fern), *Calochlaena dubia* (Common Ground Fern), *Gleichenia dicarpa* (Pouched Coral Fern), *Gahnia clarkei* (Saw Sedge), *Gonocarpus teucroides* (Raspwort) and *Lepidosperma filiforme* (Common Rapier Sedge).

Vegetation Community 3 – Blackbutt Tall Forest (Open Understorey):

Occurrence - This vegetation community occurs over the majority of the relevant section of Lot 4.

Structure - Tall Open Forest with a canopy cover of approximately 40% and height of approximately 25-30 metres. The understorey consists of a moderate to dense shrublayer to 6 metres high and a moderate to sparse groundcover of herbs, ferns and grasses.

Disturbances - This vegetation community appears to be relatively undisturbed except for vehicular trails and clearing in close proximity to existing residential development. It has a generally low incidence of weeds except for in the immediate vicinity of residential areas.

Common Species

Trees: *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus pilularis* (Blackbutt).

Shrubs: *Acacia longifolia* (Sydney Golden Wattle), *Allocasuarina littoralis* (Black She-oak) and *Dodonaea triquetra* (Hop Bush).

Groundcovers: *Dichondra repens* (Kidney Weed), *Eragrostis brownei* (Brown's Lovegrass), *Macrozamia communis* (Burrawang), *Pteridium esculentum* (Bracken Fern) and *Themeda australis* (Kangaroo Grass).

4.3 Vegetation Connectivity

The subject site is bound to the south and east by residential development, to the north by natural bushland adjoining Narrawallee Creek and to the west and southwest by natural bushland adjoining cleared agricultural land.

The subject site forms part of a vegetation corridor from Narrawallee Creek in the north to Mollmook Golf Course in the south. Removal of vegetation from the subject site is likely to substantially reduce the width of this corridor within the vicinity of the subject site by approximately 300 metres.

However, the existing corridor is approximately 700 metres in width and the majority of the residual 400 metres of corridor is to be dedicated as Open Space, down to Narrawallee Creek to the north east. This means that connectivity for flora and fauna within the locality will be guaranteed. As such it is considered unlikely that the proposed development will result in a significant impact upon connectivity within the local area for flora and fauna, particularly as no connectivity currently exists to the east.

4.4 Flora Species

The plants observed are listed in Tables A1.1 and A1.2 of Appendix 1. The quadrat results are listed in Table A1.3 of Appendix 1. Methodology utilised throughout the duration of flora surveys is presented in Section 2.1.

No threatened species were observed during the survey.

A sample of the Endangered Ecological Community Swamp Sclerophyll forest on Coastal Floodplains was observed in the western edge of the study area and will be discussed further in Section 4.7 below.

No ROTAP species were observed during the survey.

4.5 Regional Significance

The presence of *Swamp Sclerophyll forest on Coastal Floodplains (SSFCF)* within the study area is considered to be regionally significant. While that community does not occur within the subject site, it is downstream from the subject site. The potential for this area to be impacted by runoff/stormwater has been considered by J. Wyndham Prince Pty Ltd.

The vegetation within the subject site consists entirely of forms of Blackbutt forest. The Blackbutt forests within the study area have been stated by *Kevin Mills & Associates* (1994) as common and widespread in the region and not of special conservation significance. Observations by *Conacher Travers* also indicate that Blackbutt forest is common and widespread in the locality of the survey.

4.6 Threatened Flora

Two threatened flora species protected by State and National legislation have been identified as having the potential to occur within the subject site and one additional species *Melaleuca biconvexa* has potential to occur in close vicinity to the subject site. These species are identified in the sub-section below.

4.6.1 State Legislative Matters

TSC Act (1995) - A search of the Atlas of NSW Wildlife (NPWS 2006) database indicated that very few species have been recorded on the Ulladulla map sheet and so for the purpose of this survey, all species recorded on that map have been considered. Eleven (11) threatened species have been recorded on the Ulladulla map sheet and are listed in Table A1.3 (Appendix 1). In addition, consent authorities identified the species *Genoplesium vernale* and *Melaleuca biconvexa* as having potential habitat within or in close vicinity to the subject site.

Of the thirteen threatened flora species, two species *Cryptostylis hunteriana* and *Genoplesium vernale* have the potential to occur within the subject site and one species *Melaleuca biconvexa* has potential to occur in close vicinity to the subject site.

Cryptostylis hunteriana – A rare, saprophytic orchid which occurs in coastal NSW, south from Gibraltar Range and extends onto the Northern Tablelands. Bishop (1996) states “Favours swamp fringes in Victoria, while in NSW it occupies habitats ranging from scrubby swamp fringes to steep bare hillsides in tall Eucalypt forest”. It is also considered to occur in association with the very common *Cryptostylis subulata* and *Cryptostylis erecta*.

No specimens of *Cryptostylis subulata* were observed and only small numbers of *Cryptostylis erecta* were observed in the northern part of the subject site. As *Cryptostylis hunteriana* is a saprophyte, it can only be observed while flowering. However, no specimens were observed during this species flowering period despite detailed targeted surveys.

Genoplesium vernale – Is a rare terrestrial orchid restricted to a small geographic range between Mogo and Ulladulla in dry sclerophyll forests. This species was targeted during surveys, however, no specimens were observed during this species flowering period.

4.6.2 National Legislative Matters

Environment Protection and Biodiversity Conservation Act (1999)

A review of the schedules of the *EPBC Act* (1999) identified the presence of twenty (20) threatened species located within the region. These include *Irenepharsus trypherus*, *Callitris oblonga* subsp. *corangensis*, *Budawangia gnidioides*, *Pultenaea baeuerlenii*, *Eucalyptus langleyi*, *Eucalyptus macarthurii*, *Eucalyptus sturgissiana*, *Leptospermum thompsonii*, *Melaleuca biconvexa*, *Caladenia tessellata*, *Cryptostylis hunteriana*, *Genoplesium superbum*, *Genoplesium vernale*, *Plinthanthesis rodwayi*, *Grevillea renwickiana*, *Baloskion longipes*, *Galium australe*, *Boronia deanei*, *Thesium australe*, *Solanum celatum*. Of these, only *Cryptostylis hunteriana*, *Melaleuca biconvexa* and *Genoplesium vernale* are considered to have potential habitat within the site. A referral to Environment Australia is not required for the proposal.

4.7 Endangered Ecological Communities

During the previous survey it was noted that the vegetation referred to as Fresh Treed Swampland in the original report was commensurate with the endangered ecological community *Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF)*. As it was outside of the subject site, no specific definition of community boundaries was undertaken, other than to ensure that it was outside of the subject site.

SWAMP SCLEROPHYLL FOREST ON COASTAL FLOODPLAINS (SSFCF)

General Description:

A variable complex of vegetation structures, ranging from forests to scrub to reedland. This complex includes species such as *Eucalyptus robusta* and *E. botryoides*, *Livistona australis*, *Melaleuca* sp. and *Phragmites australis*. This complex includes vegetation described previously as Coastal Swamp Forest Complex (Benson & Howell, 1994) and is part of the Alluvial Forest described by Chafer (1997).

Habitat Requirements:

- Geology / Soils: waterlogged estuarine alluvial soils.
- Topography: Low lying estuarine areas with periodically poor drainage.
- Characteristic Canopy Species: Variable, includes species such as *Eucalyptus robusta*, *E. botryoides*, *Livistona australis* and *Melaleuca* sp.

Conservation Status and Distribution:

Occurs from the Lake Macquarie Local Government area in the north to the Shoalhaven Local Government Area in the south. Small areas are known to be reserved in the Cockle Bay Nature Reserve, Garigal and Royal National Parks.

Key Threatening Processes:

Waste filling, clearing associated with urban development, urban and agricultural runoff, weed invasion, grazing and trampling.

Occurrence in Subject Site:

The habitat requirements and species that characterise this community are present in the alluvial soils along the western boundary of the study area. This community does not occur within the subject site, although does occur within the study area.

A more extensive investigation of this extent of this community was then undertaken on 3rd December 2003 (*Conacher Travers*, 2004). It was assessed that not all of the Fresh Treed Swampland vegetation community was commensurate with SSFCF (*Conacher Travers*, 2004). The eastern boundary of the SSFCF was marked by *Conacher Travers* and located by land surveyors.

Conacher Travers conducted an additional review of the SSFCF boundary on the May 5th and 6th 2004 using methodology outlined in Appendix 4. The review indicated that the original location of the SCESFC was generally correct.

The boundary of SSFCF was also determined by *Kevin Mills & Associates*. The estimation of the community edge was similar to *Conacher Travers* in the north and south, however in the central section KMA established the boundary to be between 8 and 15 metres closer to the proposed development than the boundary determined by *Conacher Travers*. The proposed development layout has been adjusted to provide a buffer distance from the most conservative boundary determination of the *Swamp Sclerophyll Forest on Coastal Floodplains* community as determined by *Kevin Mills & Associates*.

4.8 Fauna Species

Conacher Travers identified 90 fauna species within the subject site and adjacent lands during surveys in 2002, 2003, 2004 and 2006. This consisted of 61 species of bird, 18 species of mammals, 5 species of reptile and 6 species of amphibian.

Fauna surveys within the subject site conducted by *Kevin Mills and Associates* in 1994 identified 39 species. This consisted of 33 species of birds, 4 species of mammals, no species of reptiles and 2 species of amphibians.

A collaboration of *Kevin Mills* and *Conacher Travers* records identified a total of 93 fauna species within the study area. This consisted of 63 species of birds, 19 species of mammals, 5 species of reptile and 5 species of amphibians. Species recorded throughout the duration of the fauna survey are listed in Table A1.4 of Appendix 1.

Seven (7) Threatened Species were identified within study area and subject site during surveys. These include Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebriscosa*), Masked Owl (*Tyto novaehollandiae*), Osprey (*Pandion haliaetus*), Grey-headed Flying-fox (*Pteropus poliocephalus*), and the Eastern False Pipistrelle (*Falsistrellus tasmaniensis*). The locations of threatened species are presented in Figure 3.

Conacher Travers recorded sixty one (61) birds within the subject site and adjoining lands. This included Six (6) threatened species, Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebriscosa*), Masked Owl (*Tyto novaehollandiae*), Osprey (*Pandion haliaetus*), Glossy-black Cockatoo (*Callocephalon fimbriatum*), Gang-gang Cockatoo (*Callocephalon fimbriatum*). All other species are considered to be common within the local area. Including those identified during surveys, Thirteen (13) threatened bird species are considered to have potential to utilise the subject site.

The Powerful Owl (*Ninox strenua*) was observed south of the subject site during surveys in 2002 and 2003. This species was again observed calling some distance south of the subject site during surveys in 2004. *Gunninah* (1999) identified a nest site for this species located approximately 150m west of the subject site. *Conacher Travers* did not identify or reveal evidence of the Powerful Owl utilising this tree during stag-watch and diurnal surveys in 2002, 2003, 2004 and more recently in 2006. Additional stagwatch surveys (Tree 12C) in December 2006 by *Conacher Travers* did not identify any owl species utilising this tree. A White-bellied Sea Eagle was observed roosting in this tree during the day and a small amount of white-wash and fish remains were observed at its base. No Owl pellets were identified near tree 12C in December 2006 surveys.

Intensive transects of study area in 2004 identified four roost sites that contained owl pellets outside the subject site boundary. Six (6) possible owl roost sites were identified within the subject site however none of these contained owl pellets (Figure 4).

During stagwatches conducted on May 4th and 20th 2004 a Sooty Owl was observed emerging from the large broken trunk hollow in hollow Tree number 12C (known Powerful Owl nest tree: (Figure 3 & 4). Stagwatch surveys by *Conacher Travers* in 2006 did not identify any owl species utilising tree 12C (known Powerful Owl nest tree).

One individual Masked Owl was observed flying into the survey station and responding to Owl call playback surveys on the 10th December 2006. This species was recorded approximately 50m west of the Tree 12 (known Powerful Owl nest tree). Owl call playback surveys within the subject site on the previous night at a similar time did not identify this species. No roost or nest sites were identified within the subject site or study area during surveys.

No specimens of Glossy Black-cockatoo were heard or observed during extensive survey in April and May 2004. There was also no evidence of tree hollow utilisation nesting recorded throughout the study area. Recent foraging evidence of Glossy Black-cockatoo was observed within the subject site on May 5th, and near the southern boundary of the study area on April 28th 2004. The location of foraging evidence of Glossy Black-cockatoo is presented in Figure 3.

A single Osprey was observed feeding on a fish while roosting in a stag (hollow tree number HB18) in the centre of the subject site at approximately 12 noon May 19th 2004. Cuttlefish remains were found at the base of the stag. Cuttlefish or other fish remains were also found under two other stags within close proximity to HB18.

The Gang-gang Cockatoo was observed in low numbers foraging on Eucalyptus seed within the subject site and study area. There was also no evidence of tree hollow utilisation nesting recorded throughout the study area.

Conacher Travers have identified eighteen (18) species of mammal utilising the subject site and study area. This included one (1) threatened mega-chiropteran bat species, Grey-headed Flying-fox (*Pteropus poliocephalus*). Thirteen (13) threatened mammal species, including Grey-headed Flying-fox are considered to have potential to utilise the subject site.

The Grey-headed Flying-fox was spotlighted on the nights of December 1st and 2nd, 2003. These individuals were observed foraging in flowering trees along the main track within the subject site. No Grey-headed Flying-fox camps were observed within or in close proximity to the study area. This species was not observed during additional Targeted fauna surveys in 2006.

Five (5) common species of reptile were recorded within the subject site and study area. No threatened species of reptile are considered to have potential to utilise the subject site.

Five (5) common amphibian species recorded within the watercourse and moist areas of the subject site and study area. Two (2) threatened species of amphibian are considered to have potential to utilise the study area and one (1) is considered to have potential to utilise the subject site.

4.9 Habitat Types

A range of fauna habitats is present throughout the subject site and study area includes:

- Vegetated areas of Open Forest dominated by the September to March flowering *Eucalyptus pilularis* (Blackbutt)
- Moderate to dense shrublayer
- Moderate density ground cover
- Nectar producing plants, principally *Banksia* and *Acacia*
- Sap flows, particularly Red Bloodwood trees
- Tree hollows
- Fallen timber and hollow logs
- Ephemeral swampy areas
- Ephemeral drainage line
- Loose soil suitable for burrowing
- Scattered surface rocks and
- Areas of sparse and dense litter layer.

4.10 Habitat

The two (2) vegetation communities present within the subject site provide a diverse array of habitat. The habitat attributes of each vegetation community are described below.

The Blackbutt Open Forest (with dense understorey) vegetation community occurs in the southern section of the subject site. This vegetation community is dominated by September to March flowering *Eucalyptus pilularis* (Blackbutt). This species and other flowering trees provide suitable foraging habitat for birds, bats and arboreal mammals. Fifty-three (53) hollow bearing trees were observed within this community. These provide suitable nesting and roosting habitat for birds, bats and arboreal mammals. A dense understorey provides protective and foraging habitat for a variety of terrestrial and semi-arboreal species. The ephemeral swampy area provides suitable foraging, shelter and breeding habitat for bird, small mammal, reptile and amphibian species. A moderate density groundcover of herbs and grasses, surface rocks and tree litter provides suitable habitat for reptiles and amphibians.

The Blackbutt Open Forest (with sparse understorey) vegetation community occurs in the northern section of the subject site. This vegetation community is dominated by September to March flowering *Eucalyptus pilularis* (Blackbutt). This species and other flowering trees provide suitable foraging habitat for birds, bats and arboreal mammals. Twenty-three (23) hollow bearing trees were observed within this community. These provide suitable nesting and roosting habitat for birds, bats and arboreal mammals. A sparse understorey provides some protective and foraging habitat for a variety of terrestrial and semi-arboreal species. A moderate density groundcover of herbs and grasses, surface rocks and tree litter provides suitable habitat for reptiles and amphibians.

4.11 Threatened Fauna

4.11.1 State Legislative Matters

TSC Act (1995) - A search of the Atlas of NSW Wildlife (DEC, 2006) database for threatened species resulted in twenty one (21) threatened species having been recorded within a 10 km radius of the subject site. Coastal and oceanic threatened species found within 10 km have not been assessed in this report. Eight (8) threatened species, Barking Owl (*Ninox connivens*), Eastern Pygmy Possum (Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Freetail-bat (*Mormopterus norfolkensis*), Little Bentwing-bat (*Miniopterus australis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Squirrel Glider (*Petaurus norfolcensis*), Eastern Pygmy Possum (*Cercartetus nanus*) and Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*) were not found within 10km by the Atlas of NSW Wildlife database, but are considered to have the potential to inhabit the subject site. These species has been included in the list of threatened species to be considered in the eight-part test. Table A1.6 of Appendix 1 identifies whether the subject site provides potential habitat for these species.

One Koala food tree species (*Eucalyptus robusta*) listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection, was observed outside of the subject site. No Koala food tree species were observed within the subject site. As such this was less than the 15% indicated by SEPP 44 for classification as Potential Koala Habitat.

No Koalas were observed during the fauna survey and there was no evidence of previous Koala habitation in the area. A search of the Atlas of NSW Wildlife (NPWS, 2002) database found 1 records of Koala habitation within a 10 km radius from the study area. The record was approximately 10 km to the north in 1999.

A habitat assessment of the vegetation communities present within the study area, combined with knowledge on the location of local threatened species populations, yielded the identification of potential habitat for the following threatened species within the proposed development area:

Species	Nesting/Den	Foraging	Roosting	Breeding
Giant Burrowing Frog		✓		✓
Stuttering Frog		✓		✓
Australasian Bittern	✓	✓	✓	✓
Square-tailed Kite	✓	✓	✓	✓
Osprey	✓		✓	✓
Superb Fruit-dove	✓	✓	✓	✓
Glossy Black-cockatoo	✓	✓	✓	✓
Gang-gang Cockatoo	✓	✓	✓	✓
Swift Parrot		✓		
Regent Honeyeater		✓		
Masked Owl	✓	✓	✓	✓
Sooty Owl	✓	✓	✓	✓
Barking Owl	✓	✓	✓	✓
Powerful Owl	✓	✓	✓	✓
Pink Robin		✓		
Southern Brown Bandicoot		✓		✓
Long-nosed Potoroo		✓		✓
Spotted-Tailed Quoll	✓	✓		
Squirrel Glider	✓	✓		✓
Yellow-bellied Glider	✓	✓		✓
Eastern Pygmy Possum	✓	✓		✓
Grey-headed Flying-fox		✓		
Yellow-bellied Sheath-tail-bat		✓	✓	✓

Species	Nesting/Den	Foraging	Roosting	Breeding
Eastern Bentwing-bat		✓		
Little Bentwing-bat		✓		
Greater Broad-nosed bat		✓	✓	✓
Eastern False Pipistrelle		✓	✓	✓
Eastern Freetail-bat		✓	✓	✓
Large-eared Pied Bat		✓		

A detailed assessment in accordance with Section 5A of the *EP&A Act* (1979) will be completed for these species in Section 5 of this report.

Fisheries Management Act (1994) – A review of the *Fisheries Management Act* (1994) did not identify the presence of any threatened aquatic species within a 10km radius of the study area.

4.11.2 National Legislative Matters

EPBC Act (1999) – A review of the schedules of the *EPBC Act* (1999) identified the presence of fifteen (15) threatened species within a 10km radius of the subject site. These species have been listed in Table A1.5 (Appendix 1) and those with potential to utilise the subject site will be considered in the seven-part test within Section 5. A referral to Department of Environment and Heritage is not required.

SECTION 5.0 - 7 PART TEST OF SIGNIFICANCE (SECTION 5A EPA ACT 1979)

Council is required to consider the impact upon threatened species from any development or activity via the process of an 7 part test of significance. The significance of the assessment is then used to determine the need for a more detailed Species Impact Statement (SIS).

The following 7 part test of significance relies on the ecological assessment provided in Sections 3 & 4 above and should be read as such. It is considered that the subject site provides potential habitat for the following threatened species and will be assessed accordingly in the following seven-part test:

- *Cryptostylis hunteriana*
- *Genoplesium vernale*
- *Melaleuca biconvexa*
- *Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF)*
- Giant Burrowing Frog
- Stuttering Frog
- Australasian Bittern
- Square-tailed Kite
- Osprey
- Superb Fruit-dove
- Glossy Black-cockatoo
- Gang-gang Cockatoo
- Swift Parrot
- Regent Honeyeater
- Masked Owl
- Powerful Owl
- Sooty Owl
- Barking Owl
- Pink Robin
- Southern Brown Bandicoot
- Long-nosed Potoroo
- Spotted-tailed Quoll
- Yellow-bellied Glider
- Squirrel Glider
- Eastern Pygmy Possum
- Grey-headed Flying-fox
- Yellow-bellied Sheath-tail-bat
- Eastern Bentwing-bat
- Little Bentwing-bat
- Eastern Freetail-bat
- Greater Broad-nosed Bat
- Eastern False Pipistrelle
- Large-eared Pied Bat

The '7 part test of significance' is as follows.

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

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

Cryptostylis hunteriana

Cryptostylis hunteriana is a saprophytic orchid that grows in swamp heath on sandy soils from the Gibraltar Range to Eden. Throughout the duration of the flora survey of the subject site it was identified that the open forest vegetation community provides potential habitat for this species. During the survey of the subject site, no specimens of *Cryptostylis hunteriana* were observed. Despite the presence of potential habitat for *Cryptostylis hunteriana* within the subject site, it is considered that the future development of the site is unlikely to disrupt the habitat of a local viable population of this species such that it is likely to be placed at risk of extinction.

Genoplesium vernale

Is a terrestrial orchid restricted to a small geographic range between Mogo and Ulladulla in dry sclerophyll forests. Throughout the duration of the flora survey of the subject site it was identified that the open forest vegetation community provides potential habitat for this species. During the survey of the subject site, no specimens of *Genoplesium vernale* were observed. Despite the presence of potential habitat for *Genoplesium vernale* within the subject site, it is considered that the future development of the site is unlikely to disrupt the habitat of a local viable population of this species such that it is likely to be placed at risk of extinction.

Melaleuca biconvexa

Melaleuca biconvexa is an erect shrub or small tree to 10 metres high. It occurs in dense stands along perennial watercourses which pass through, or rise in, Terrigal Formation geology and as dense stands or scattered specimens in wetlands on flood plains and along streams. Throughout the duration of the flora survey of the subject site and study area it was identified that the Fresh Treed Swampland vegetation community provide marginal habitat for this species. During the survey of the subject site, no specimens of *Melaleuca biconvexa* were observed within the site. Despite the presence of marginal habitat for *Melaleuca biconvexa* within the subject site, it is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Giant Burrowing Frog

The Giant Burrowing Frog occurs in disjunct populations from Olney State Forest to the Victorian Highlands. It occurs in semi permanent to ephemeral sand or rock based streams, and infrequently occurs in semi-permanent to permanent fire dams and artificial drainage ditches / culverts on roadsides (Ehmann, 1997). It is strongly associated with the upper drainage lines and ridgetops of Hawkesbury Sandstone and occurs in a variety of habitats. This species has been seen emerging from burrows on ridgetops several hundred metres from available water. This species has also been found in deeper rainforest gullies of Sydney sandstone. It is considered that the subject site provides potential foraging habitat for this species. Despite the presence of potential foraging habitat for the Giant Burrowing Frog within the subject site, this species was not observed during the fauna survey. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Stuttering Frog

The Stuttering Frog is a terrestrial inhabitant of rainforest, antarctic beach forest and wet sclerophyll forest, feeding on insects and smaller frogs (Cogger, 2000). It is considered that the study area provides potential foraging habitat for this species within the ephemeral creek lines present. Despite the presence of potential foraging habitat for the Stuttering Frog, this species was not recorded during the fauna survey. The proposed development will not remove habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Australasian Bittern

The Australasian Bittern inhabits shallow freshwater or brackish wetlands with tall dense beds of reeds, sedges or rush species and swamp edges. It is considered that the study area provides marginal potential foraging habitat for the Australasian Bittern within the northern part of the subject site. Despite the presence of marginal potential foraging habitat for this species, this species was not observed during the fauna survey. The proposed development will not remove habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Square-tailed Kite

The Square-tailed Kite moves low over the canopy of woodland, exploiting ecotones while hunting. It is known to favour *Angophora floribunda* and *Angophora subvelutina* woodland in association with box / ironbark eucalypt species along moist valleys on the coast of NSW. There is usually profuse blossom associated with this type of vegetation, which provides an abundance of nesting birds on which the kite typically preys. It is considered that the subject site and study area provides potential foraging habitat for this species. Despite the presence of potential habitat, this species was not recorded during the fauna survey. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Osprey

The Osprey is generally found in association with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). These habitat locations usually have a sufficient supply of fish for food and possible nesting sites (Clancy 1991). Nests are generally located within 1km of feeding habitat. Osprey maintain feeding and breeding territories of between 5 and 20km of coastline, patrolling their territories either singly or in dispersed pairs (SFNSW 1995).

The Osprey feed primarily on fish such as Sea Mullet, Garfish, Flat-tail Mullet and other fatty fish, occasionally taking sea snakes (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995), crabs, birds, reptiles and mammals (Olsen 1995). The Osprey hunts by hovering 15-30m above the waters surface, plunging into the water to catch their prey and then returning to a perch or roost to feed (Schodde and Tidemann 1986; Clancy 1991).

Osprey breed from August through to November (Schodde and Tidemann 1986). Osprey may nest on the ground on sea cliffs or in trees (Olsen 1995). Osprey generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995). Nests are large and built of sticks, roughly lined with grass and seaweed (Schodde and Tidemann 1986). No Osprey nests have been observed within the subject site or the remainder of the study area.

A single Osprey was observed feeding on a fish while roosting in a stag (hollow tree number

HB18) in the centre of the subject site at approximately 12 noon May 19th 2004. Cuttlefish remains were found at the base of the stag. Cuttlefish or other fish remains were also found under two other stags within close proximity to HB18. This indicates that this area is likely to be a regularly used roosting area for the Osprey. The closest likely foraging resource for this species is situated approximately 800m to the north-west within the estuary.

It is considered that the Osprey is utilising the subject site for roosting only. The Osprey is likely to have selected the subject site for this purpose because of its height and outlook relative to surrounding lands, the estuary to the north and the ocean to the east. The selection of roosting sites is considered to be opportunistic and tolerant to human activity. The Osprey is known to rest in dead trees and artificial structures, e.g. lighthouses, boat masts, jetty's, electrical pylons and radio transmitting towers (Marchant & Higgins, 1993, pg229). It is considered that given the removal of these roosting trees this species is likely to utilise other similar topography and vegetation outside of the subject site.

It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Superb Fruit-dove

The Superb Fruit-dove inhabits rainforests and their fringes, as well as mangroves and wooded stream margins (Pizzey and Knight, 1997). Habitat within and near rainforests includes scrub, lantana thickets, isolated figs, pittosporums, lilly pillies, and blackberries (Pizzey and Knight, 1997). The Superb Fruit-dove feeds primarily on the fruit of rainforest trees and moist vegetation (State Forests of NSW, 1995). It is considered that the subject site provides potential nesting and foraging habitat for this species. Despite the presence of potential nesting and foraging habitat for the Superb Fruit-dove, this species was not observed during the fauna survey. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Glossy Black-cockatoo

The Glossy Black-cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of casuarinas (SFNSW 1995a). The breeding season of the Glossy Black-cockatoos is between March and August (Higgins, 1999, pg61). The Glossy Black-cockatoo lives in permanent groups of up to 10 individuals (SFNSW 1995b), roosting communally at night and travelling at dawn to groves of seeding Casuarina trees to feed for the day. Foraging within Casuarinas tends to be concentrated on trees with greater crops of cones (Clout 1989).

This species has a bill structure and highly specialised feeding techniques developed for feeding almost exclusively on Casuarinas with large cones such as the *Allocasurina littoralis*, *A. stricta* and *A. torulosa* (Lindsey 1992; SFNSW 1995a). It apparently does not feed on *Casuarina glauca* (UBBS, 1997). This species is also known to feed on insects and the seeds of eucalypts, angophoras, hakeas, acacias and sunflowers (Blakers *et al.* 1984; Lindsey 1992). Once food resources are exhausted in one area the birds move to another.

No specimens of Glossy Black-cockatoo were observed during surveys.

General survey for large hollow-bearing trees observed twenty-four (24) large hollow-bearing trees within the subject site and forty-one (41) large hollow-bearing trees within the

trade-off area. A comparison of large hollow-bearing trees within the subject site compared to the trade-off area can be made using the density of large hollow-bearing trees per hectare. The subject site contains 1.1 large hollow-bearing trees / ha (see Table A3.1). The remainder of the study area contains 0.5 large hollow-bearing trees / ha (see Table A3.3). The subject site therefore contains a higher density of large hollow-bearing trees. However no specimens of this species were observed during target surveys at each located large hollow-bearing tree within the study area despite the timing of these survey within the breeding season of March to August.

Mapping of *Allocasuarina* stands within the subject site and the remaining study area were conducted (see Section 2.2.1.2). The area of clumped *Allocasuarina* within the subject site is approximately 1.016ha. The area of clumped *Allocasuarina* within the remaining study area (trade off areas) is approximately 2.607ha. As a percentage of the study area *Allocasuarina* within the subject site forms approximately 0.98%. As a percentage of the study area *Allocasuarina* within the trade-off area forms approximately 2.5%. Therefore *Allocasuarina* within the trade-off area forms a greater percentage of the study area.

No specimens of this species were observed during target survey conducted within each located area of *Allocasuarina*. However, recent foraging evidence of Glossy Black-cockatoo was observed within the subject site on May 5th in the same location as those found in December 2003. Evidence was also found near the southern boundary of the study area on April 28th 2004. The location of foraging evidence of Glossy Black-cockatoo is presented in Figure 3.

A search of Atlas of NSW Wildlife (NPWS June 5th, 2004) records for the Ulladulla 1:100,000 Scale Map Sheet found twenty-one (21) records of Glossy Black-cockatoo within 20km from the subject site. Two (2) records are located within or in close proximity to the study area. The most recent record within 10km is in September 2002 approximately 6.5km to the south of the subject site.

According to Mills (2002) most of the Glossy Black-cockatoo habitat in the LEP area is zoned Environmental Protection (Mills, 2002, pg10). Given the extent of potential foraging habitat for Glossy Black-cockatoo outside of the subject site and the lack of breeding evidence within the subject site, it is considered that removal of patches of *Allocasuarina* from within the subject site are unlikely to disrupt the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Gang-gang Cockatoo

The Gang-gang Cockatoo is associated with a variety of woodland and forest habitats, and occasionally more open areas in south-eastern New South Wales and Victoria (NSW Scientific Committee, 2001). This species has been observed in eucalypt forests and exotic trees (Morris 1997), and is known to feed on the seeds of native shrubs and trees, in addition to some exotic species such as the Hawthorn and Cupressus species (Schodde & Tideman 1976). The subject site and study area provide suitable foraging and nesting habitat for this species. This species has been regularly observed within the subject site and within the local area. No roost sites were identified within the subject site. The local area contains extensive areas of suitable habitat for the Gang-gang Cockatoo. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Swift Parrot

The Swift Parrot inhabits eucalypt forests and woodlands foraging on winter flowering eucalypts including the local Mugga Ironbark. It is considered that the subject site provides potential foraging habitat for this species. Despite the presence of potential foraging habitat for the Swift Parrot, this species was not observed during the fauna survey. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Regent Honeyeater

The Regent Honeyeater inhabits temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. This species is often observed foraging on winter flowering eucalypts throughout western Sydney. It is considered that the subject site provides potential foraging habitat for this species. Despite the presence of potential foraging habitat for the Regent Honeyeater, this species was not observed during the fauna survey. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Barking Owl

The Barking Owl utilises eucalypt forests, woodlands and adjacent cleared areas for foraging and large hollows for nesting and breeding (Schodde & Tiedemann, 1986). Potential nesting and foraging habitat for this species occurs throughout the subject site. Despite the presence of potential nesting and foraging habitat for the Barking Owl, this species was not observed during the fauna survey. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Masked Owl

The Masked Owl utilises eucalypt forests, woodlands and adjacent cleared areas for foraging and large hollows for nesting and breeding (Schodde & Tiedemann 1986). The subject site contains suitable roosting, nesting and foraging habitat for this species. The Masked Owl was recorded within the study area approximately 50m west of habitat tree 12c (known Powerful Owl nest site). Despite extensive surveys no Masked Owl roost or nest sites have been identified within the subject site. There is extensive areas of suitable habitat within the local area for this species. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Powerful Owl

On December 1st, 2003 an individual Powerful Owl was heard calling at approximately 20.40 in response to call playback from within close proximity to the known nest tree. This individual was then later spotlighted approximately 100m to the north of the known nesting tree. The Powerful Owl was also heard calling to the south of the subject site on the night of September 11th, 2002 (*Conacher Travers*, 2002).

A total of fifteen (15) possible owl roost sites were recorded within the subject site and the trade-off areas during the survey (see Figure 3 and 4). Of these fifteen roosts, four (4) had regurgitated pellets, two (2) had numerous plucked Pied Currawong feathers and one (1) had the remains of a *Rattus* sp. The remaining eight (8) roost sites contained whitewash only.

Given the records of both Powerful Owl and Sooty Owl within the study area, it is considered

that roost sites may be from either of these species.

During spotlighting survey at 6pm on April 27th 2004 a Powerful Owl was heard calling repeatedly in the western side of the study area, approximately 350m from the subject site. The Owl was again heard calling within the same area at 6.10pm the following night of April 28th. No roosting Powerful Owls were observed during extensive survey throughout the study area. It is considered the Powerful Owl utilises the study area for foraging and occasionally for roosting.

The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Sooty Owl

The Sooty Owl is generally associated with tall, dense, wet closed and open forests (Schodde and Tidemann 1986). According to Higgins (1999, pg891) this species mostly occurs in moist gullies and on the slopes of valleys. This species rarely occurs on ridges (Higgins, 1999, pg891).

The Sooty Owl is a solitary, sedentary and nocturnal species, preying on a wide range of prey including rodents, *Antechinus* spp, Common Ringtail Possums (*Pseudocheirus peregrinus*), Sugar Gliders (*Petaurus breviceps*), Yellow-bellied Gliders (*Petaurus australis*), rabbits (*Oryctolagus cuniculus*), bandicoots and birds (Kavanagh 1993). It would appear that the Sooty Owl relies on high prey density and diversity (Kavanagh 1993).

The Sooty Owl requires old mature trees with very large hollows for breeding. Available evidence indicates narrow habitat requirements for nesting, with very large hollows (40 to 50cm deep and a 40 to 60cm diameter) being essential for nesting (Hyem 1979). The home range of the Sooty Owl has been estimated to be between 200 and 800 hectares (Debus 1994, Schodde and Mason 1980, Schodde and Tidemann 1986).

During stagwatches conducted on May 4th and 20th 2004 a Sooty Owl was observed emerging from the large broken trunk hollow in hollow tree number 12C (the known Powerful Owl nest tree: see Figure 3 and 4). The breeding season for Sooty Owl is generally known to be from January to June (Higgins, 1999, pg898). Although it is possible that the Sooty Owl is utilising this tree for breeding, this species may also utilise large hollows for roosting (Higgins, 1999, pg891). The utilisation of this tree by Sooty Owl is unknown. The buffer requirements from a nesting Sooty Owl is considered to be similar to that for Powerful Owl. Therefore, it is considered that the distance of this nesting tree from the proposed development has been sufficiently justified by previous discussions for Powerful Owl.

A total of sixty-five (65) hollow-bearing trees containing large hollows were observed within the study area. This included twenty-four (24) within the subject site, and forty-one (41) throughout the remainder of the study area (trade off areas). Based on the nesting hollow requirements for Sooty Owl it is considered unlikely that any hollows within the subject site provide suitable nesting habitat for this species.

Turpentine trees are considered to provide suitable roosting habitat for most owl species including Sooty Owl (Higgins, 1999, pg891) due to their dense foliage. Ten (10) of the fifteen (15) roost sites were found beneath Turpentine trees. The remaining five (5) roost sites were found beneath *Corymbia gummifera* and *Eucalyptus pilularis*. Three (3) of these roost sites contained white-wash. It is considered that these roost sites are unlikely to be evidence of owl roosts.

It is considered that roost sites beneath Turpentine trees are more likely to be from owl species including Sooty Owl. Nine (9) of these roost sites are present within the trade-off areas. Therefore it is considered that the trade-off areas are likely to provide more significant areas

of roosting habitat for owls.

The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Pink Robin

The Pink Robin inhabits dense fern gullies and open forest in the south east of the state. Males remain in breeding areas for most of the year but sometimes wander into drier forest in the country and suburban areas (Trounson & Trounson, 1998). Occasionally vagrants travel as far north as Sydney during the winter months. It is considered that the subject site provides marginal foraging habitat for this species. Despite the presence of potential foraging habitat for the Pink Robin, this species was not observed during the fauna survey. The proposed development will retain marginal habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Southern Brown Bandicoot

The Southern Brown Bandicoot has been detected in a range of habitats including open forest, woodland, heaths, agricultural land and urban areas, preferring areas with thick ground cover which provide protection from predators (Braithwaite 1988). It nests in shallow depressions in the ground which are covered by grass, litter and other plant material. The chamber within the nest is lined with grass or leaves and has no permanent entry or exit point, the animal using any point to emerge (Braithwaite 1988). Males have a home range of between 5-20 hectares which is larger than the home range of females which is between 1.8-3.3 hectares (Braithwaite 1988). Within an animals home range several nests may be used. It is considered that the subject site provides potential nesting and foraging habitat for the Southern Brown Bandicoot. Despite the presence of potential nesting and foraging habitat for the Southern Brown Bandicoot, this species was not observed during the fauna survey. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Long-nosed Potoroo

The Long-nosed Potoroo has a scattered distribution along the coast of NSW. It is generally restricted to areas with an annual rainfall greater than 760 millimetres (Strahan, 1998). The habitat requirements of this species are generally coastal heath and dry and wet sclerophyll forest with a relatively thick ground cover and light sandy soil (Strahan, 1998). This species forages by digging holes in soft soil in search of roots, tubers, fungi, insects, insect larvae and other soft bodied animals in the soil (Strahan, 1998). It is considered that the subject site provides potential foraging habitat for this species. Despite the presence of potential foraging habitat for the Long-nosed Potoroo, this species was not observed during the fauna survey. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Spotted-tailed Quoll

The Spotted-tailed Quoll inhabits a number of habitats including dry to moist open forests or closed forests containing rock caves, hollow logs or trees for shelter / breeding. It is considered that the subject site provides potential foraging habitat for this species within the woodland vegetation community. Despite the presence of potential foraging habitat for the Spotted-tailed Quoll, this species was not observed during the fauna survey. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Yellow-bellied Glider

The Yellow-bellied Glider utilises tall mature eucalypt forests which contain high nectar producing species and hollow bearing trees (Russell, 1984). It is considered that the subject site provides potential foraging habitat for this species. Despite the presence of potential habitat, this species was not recorded nor was foraging evidence observed during extensive fauna survey. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Squirrel Glider

The Squirrel Glider inhabits mixed aged stands of eucalypt forest & woodlands including gum barked and high nectar producing species with hollow bearing trees. According to Quin (1995) the home-ranges of Squirrel Gliders have been estimated at between 0.65 and 8.55 ha, the movement of males being greater than that of females (NPWS, 1995). Nightly movements are estimated at between 300 and 500 m (NPWS, 1995). Quin (1995) found that the home-range of a family group is likely to vary according to habitat quality and availability of resources (NPWS 1995). The Squirrel Glider is a hollow-dependant species. It is considered that the subject site provides potential nesting and foraging habitat. Despite the presence of potential nesting and foraging habitat for the Squirrel Glider, this species was not observed during extensive fauna survey. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Eastern Pygmy Possum

The Eastern Pygmy Possum is found from rainforest through sclerophyll forest to tree heath. This species nests preferably in tree hollows as well as spherical nests, of about 6 centimetres in diameter. It is considered that the subject site provides potential nesting and foraging habitat for this species. Despite the presence of potential habitat, this species was not recorded during extensive fauna survey. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey-headed Flying-fox

The Grey-headed Flying-fox is found in a variety of habitats including rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated areas (Churchill, 1998).

Grey-headed Flying Foxes congregate in large camps of up to 200,000 individuals, depending on availability of surrounding blossoming plants, from early until late summer (Churchill, 1998). Camps are commonly formed in gullies, typically not far from water and in vegetation with a dense canopy. Roost sites are an important resource where mating, birth and rearing of young occurs as well as providing refuge (Strahan, 1995).

These bats eat the fruit or blossoms of more than 80 species of plants. Their major food source is eucalypt blossom and native fruits from a variety of tree species. Native figs (*Ficus* spp) account for a large percentage of the fruit eaten. They are also known to eat rain orchids of cultivated fruit. The Grey-headed Flying-fox has a nightly feeding range of 20 to 50km from their camp (Churchill, 1998).

The Grey-headed Flying Fox was spotlighted on the nights of December 1st and 2nd, 2003. These individuals were observed foraging in flowering trees along the main track within the subject site (see Figure 3 and 4). No Grey-headed Flying-fox camps were observed within or in close proximity to the study area. It is considered that the subject site does not provide a significant area of foraging habitat for this species.

The proposed development will retain suitable foraging habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Yellow-bellied Sheath-tail Bat

The Yellow-bellied Sheath-tail-bat inhabits rainforests, sclerophyll forests and woodlands. This species has been noted to forage and breed throughout these habitats where suitable tree hollows are available for roosting. It is considered that the subject site provides potential roosting and foraging habitat for this species. Despite the presence of potential roosting and foraging habitat for the Yellow-bellied Sheath-tail Bat, this species was not recorded during extensive fauna survey. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Little Bentwing-bat

The Little Bentwing-bat forages below the canopy within open forests and woodlands, feeding on small insects. This species roosts in caves, tunnels and occasionally old buildings. It is considered that the subject site provides potential foraging habitat for this species. The subject site does not provide suitable breeding habitat for the Little Bentwing-bat. Despite the presence of potential habitat, this species was not recorded during extensive fauna survey. The proposed development will retain suitable foraging habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Eastern Bentwing-bat

The Eastern Bentwing-bat inhabits areas where there are caves, old mines, old buildings, stormwater drains for shelter and well-timbered areas for foraging. It is considered that the subject site provides potential foraging habitat for this species. The subject site does not provide suitable breeding habitat for the Eastern Bentwing-bat. Despite the presence of potential habitat, this species was not recorded during extensive fauna survey. The proposed development will retain suitable foraging habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Eastern Freetail-bat

The Eastern Freetail-bat inhabits open forests and woodlands foraging above the canopy and along the edge of forests. This species is known to roost in tree hollows, under bark and buildings. It is considered that the subject site provides potential roosting and foraging habitat for this species. Despite the presence of potential roosting and foraging habitat for the Eastern Freetail-bat, this species was not recorded during extensive fauna survey. The

proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Eastern False Pipistrelle

The Eastern False Pipistrelle has been recorded roosting in caves, old buildings and tree hollows. This species forages throughout woodlands and open forest. This species was recorded foraging along the main vehicular track through the centre of the subject site. The local area contains extensive areas of habitat suitable for this species. It is considered that the subject site provides potential roosting habitat for this species in tree hollows observed throughout the subject site.

Seventy-six (76) hollow bearing trees were observed throughout the subject site. Similar suitable foraging and nesting habitat for this species is present throughout adjoining bushland areas, including within the proposed Open Space reserve adjoining the subject site to the west.

It has been recommended within this report that habitat trees be retained where feasible. Where this is not considered to be feasible it has been recommended that hollow bearing trees be inspected prior to and during removal in order to ensure that species such as the Eastern False Pipistrelle are not harmed. Where species such as the Eastern False Pipistrelle are located it is recommended that work be halted and the consultant confer with Council as to further requirements for the species.

The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Greater Broad-nosed Bat

The Greater Broad-nosed Bat inhabits areas containing moist river & creek systems especially tree-lined creeks for foraging and breeding. It is considered that the subject site provides potential roosting and foraging habitat for this species. Despite the presence of potential roosting and foraging habitat for the Greater Broad-nosed Bat within the subject site, this species was not recorded during extensive fauna survey. The proposed development will retain suitable habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Large-eared Pied Bat

The Large-eared Pied Bat has a restricted distribution from south central Queensland to central and northern NSW and is localised and uncommon throughout its range occurring in Rainforest, wet sclerophyll forest to dry sclerophyll forest and woodland habitats (State Forests of NSW, 1997). It is considered that the subject site provides potential roosting and foraging habitat for this species. Despite the presence of potential foraging habitat for the Large-eared Pied Bat within the subject site, this species was not recorded during extensive fauna survey. The proposed development will retain suitable foraging habitat for this species. It is considered that the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

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

There are no locally occurring endangered populations with potential habitat within the subject site.

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

- i. *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or***
- ii. *Is likely to substantially and adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction,***

- 1.)** The proposed action will not result in the direct loss of any of the EEC, Swamp sclerophyll forest on Coastal Floodplains (SSFCF) within the subject site.

The proposed development layout has been adjusted to provide a buffer distance from the SSFCF boundary. The adjustment of the proposal includes movement of part of the western boundary to the east to decrease the potential impact of the proposal on the SSFCF. Detailed land survey of the SSFCF boundary has identified the nearest point of this community to the subject site as approximately 30m, while the distance between the SSFCF boundary and the current proposed development is approximately 50 metres. The proposed fire trail will be contained within the subject site and therefore be situated at least 20 metres from the SSFCF boundary. Drainage contours and sediment control structures included within the fire trail design are to be provided to prevent any adverse affects on the SSFCF community. SSFCF has also been identified as occupying portions of the locally conserved SEPP 14 wetlands. At a regional level no accurate mapping has been completed to determine the extent of SCESFC. It is considered that this community is common on alluvial flats adjoining estuaries along the NSW coast and throughout the Shoalhaven LGA.

It is therefore considered that the proposed action is not likely to have an adverse effect on the local extent of the SSFCF such that its local occurrence is likely to be placed at risk of extinction.

- 2.)** The proposed action will not result in the direct loss of any of the EEC, Swamp sclerophyll forest on Coastal Floodplains (SSFCF) within the subject site.

The proposed development layout has been adjusted to provide an adequate natural buffer from the SSFCF boundary. In addition, the sites stormwater design is likely to include drainage contours and sediment control structures within the fire trail design to be provide additional mitigating measures form any adverse affects on the SSFCF community. SSFCF has also been identified as occupying portions of the locally conserved SEPP 14 wetlands.

It is therefore considered that the proposed action is not likely to substantially and adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction.

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

- i. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- ii. Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- iii. The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality**

It is considered that the proposal will not remove or modify a significant area of habitat for *Cryptostylis hunteriana*, *Genoplesium vernale*, *Melaleuca biconvexa*, Swamp Sclerophyll forest on Coastal Floodplains, Giant Burrowing Frog, Stuttering Frog, Australasian Bittern, Square-tailed Kite, Osprey, Superb Fruit-dove, Glossy Black-cockatoo, Gang-gang Cockatoo, Swift Parrot, Regent Honeyeater, Masked Owl, Powerful Owl, Sooty Owl, Barking Owl, Pink Robin, Southern Brown Bandicoot, Long-nosed Potoroo, Spotted-tailed Quoll, Yellow-bellied Glider, Squirrel Glider, Eastern Pygmy Possum, Grey-headed Flying-fox, Yellow-bellied Sheath-tail-bat, Eastern Bentwing-bat, Little Bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat, Greater Broad-nosed Bat, Large-eared Pied Bat and Yellow-bellied Sheath-tail-bat within the local area or region.

- i.) The subject site has an area of 17.5 ha, and is connected to over 300 ha (approx). The proposed development is likely to remove or modify approximately on 15.18 ha of potential habitat for the aforementioned species.
- ii.) The subject site is bound to the south and east by residential development, to the north by natural bushland adjoining Narrawallee Creek and to the west and south-west by natural bushland adjoining cleared agricultural land.

The subject site forms part of a local vegetation corridor from Narrawallee Creek in the north to Mollymook Golf Course in the south. The conservation of the trade-off areas is considered to be sufficient to maintain this vegetation corridor. The remaining corridor is considered to be sufficient to maintain the ecological requirements of the locally occurring threatened species.

It is considered that known habitat for a threatened species, population or ecological community within the local area is unlikely to become fragmented or isolated from other areas of habitat as a result of the proposed action.

- iii.) In regards to threatened flora species the local area contains large areas of similar condition vegetation communities, of which, large areas are securely reserved in the local conservation network. Given the presence of these additional large areas of potential habitat within the locality and the absence of any of these species from the subject site despite detailed targeted surveys, it is considered that the habitat to be impacted by the proposal is unlikely to be important to the long-term survival of these species in the locality.

In regards to the endangered ecological community, SSFCF it is considered that given the provision of the natural buffer and additional stormwater design features providing additional mitigating measures, the proposal is unlikely to result in the removal, modification, fragmentation or isolation of the endangered ecological community, SSFCF in the locality.

In regards to threatened fauna species the local area contains large areas of similar vegetation communities which provide a generally superior level of fauna habitats by way of tree hollows

fallen logs etc. The removal of vegetation from the subject site is unlikely to create an important impact on the long-term survival of threatened fauna in the locality and is not considered to be significant.

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

The site has not been identified as critical habitat within the provisions of the *TSC Act* (1995). Therefore this matter does not require any further consideration.

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

There are current or draft recovery plans for the following threatened species with potential habitat within the subject site: *Genoplesium vernale*, Barking Owl, The Large Forest Owls, and Yellow-bellied Glider.

Genoplesium vernale

The subject site provides only marginal potential habitat for this species. There are no known local occurrences of this species within 20km of the subject site. While the subject site will result in the loss of a relatively small amount of potential habitat for this species within the locality. The proposed development is considered generally consistent with the objectives or actions of the Recovery Plan.

Barking Owl and Large Forests Owls

The proposed development is considered generally consistent with the objectives or actions of the Barking Owl and Large Forest Owls Recovery Plans. However these plans emphasise the need for protection of suitable habitat for these species. The proposed action will retain suitable foraging and shelter habitat for large forest owls.

Yellow-bellied Glider

The proposed development is considered generally consistent with the objectives or actions of the Yellow-bellied Glider Recovery Plan. However these plans emphasise the need for protection of suitable habitat for these species. Despite suitable habitat extensive surveys did not reveal this highly vocal species.

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

The proposal is likely to include clearing of native vegetation and removal of dead wood. "Clearing of native vegetation" and "Removal of dead wood and dead trees" are listed as Key Threatening Processes under the *TSC Act* (1995) and as such the proposal is of a class of development or activity that is recognised as a threatening process.

The proposed development may alter impacts on adjoining lands by increasing the numbers of domestic Cat ownership. 'Predation by Feral Cat (*Felis catus*)' is listed as Key Threatening Processes under the *TSC Act* (1995) and as such the action proposed may increase the impact of this threatening process.

SECTION 6.0 - CONCLUSION

Conacher Travers has undertaken an ecological survey and assessment of an area that is

proposed to be developed for residential purposes.

In respect of matters required to be considered in the *Environmental Planning & Assessment Act* (1979) and relating to the species / provisions of the *Threatened Species Conservation Act* (1995), seven (7) threatened fauna species, no threatened flora species and one (1) threatened ecological communities were recorded within or in close proximity to the subject site.

These species included, Osprey (*Pandion haliaetus*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*), Masked Owl (*Tyto novaehollandiae*), Grey-headed Flying-fox (*Pteropus poliocephalus*), and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Swamp Sclerophyll Forest on Coastal Floodplains.

Following extensive survey, ecological assessment and peer review between the years 2003-2006 it is concluded that the proposed development will not cause a significant impact upon threatened species, populations and endangered ecological communities. Therefore a Species Impact Statement should not be required for the proposed development.

Extensive surveys by *Conacher Travers* did not identify Powerful Owl utilising Tree 12C. This tree was identified as a Powerful Owl nest site by Gunninah (1999). During stagwatch surveys on 4th and 20th May 2004 *Conacher Travers* identified a Sooty Owl exiting a large hollow in tree 12C.

Additional stagwatch surveys (Tree 12C) in December 2006 by *Conacher Travers* did not identify any owl species utilising this tree. A White-bellied Sea Eagle was observed roosting in this tree during the day and a small amount of white-wash and fish remains were observed at its base. No Owl pellets were identified near tree 12C in December 2006 surveys. Tree 12C is located approximately 150 metres to the west of the subject site.

This area will be protected within the proposed Open Space reserve, which is a total of 82ha in size. Recommendations are also provided below in regard to habitat tree retention / inspection measures for both of these species.

All of the threatened fauna species identified within the study area are highly mobile species. It is considered that the subject site makes up a small portion of their foraging home range and that these species do not forage within the subject site exclusively. No breeding sites have been identified within the subject site for these threatened species. No known breeding sites will be removed as a result of the proposed action.

In respect of habitat trees, where feasible, habitat trees should be retained. Where this is not feasible, the habitat tree should be inspected prior to removal to ensure that the tree is not currently in use by fauna. Whereby fauna is located, Council is to be contacted by the consultant to discuss appropriate action.

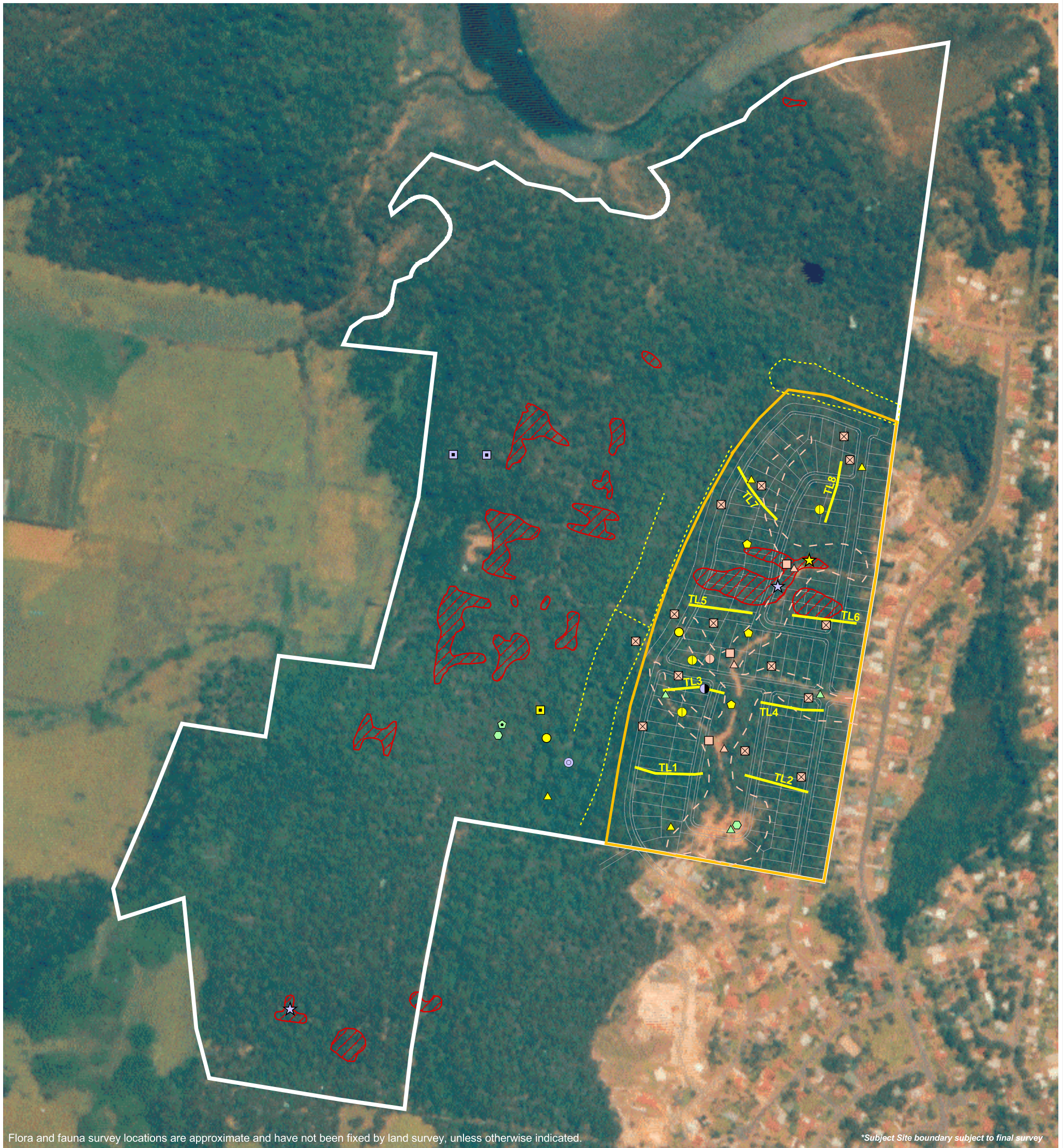
The local area contain extensive areas of similar or higher quality habitat for these species. It is concluded that the proposed development is unlikely to result in a significant impact upon threatened species, populations and endangered ecological communities. Therefore, a Species Impact Statement should not be required for the proposed development.

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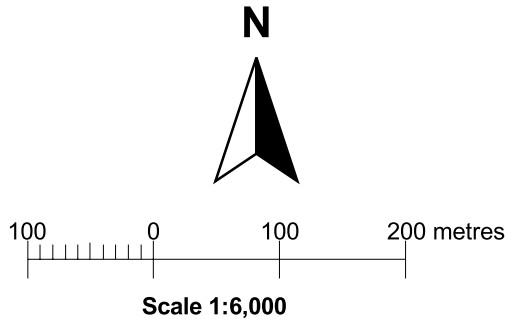


Flora and fauna survey locations are approximate and have not been fixed by land survey, unless otherwise indicated.

*Subject Site boundary subject to final survey

Legend

- | | | |
|--|--|--|
| Study Area Boundary | Eastern False Pipistrelle (2002) | Glossy Black Cockatoo foraging evidence (2004) |
| *Subject Site Boundary | Nocturnal Call Playback (2003) | Powerful Owl (2004) |
| Allocasuarina (Potential foraging for Glossy Black Cockatoo) | Anabat Station (2003) | Sooty Owl (2004) |
| 100m Elliott Trapline (2002) | Harp Trap (2003) | Osprey (2004) (observed feeding) |
| Spotlight/Mobile Anabat Transect (2002) | Spotlight/Giant Burrowing Frog Call Playback & Habitat Search (2003) | Owl Call Playback (2006) |
| Anabat Station (2002) | Chewed Cones (2003) (Glossy Black Cockatoo Foraging) | Anabat Station (2006) |
| Cage Trap (2002) | Powerful Owl (2003) | Masked Owl (2006) |
| Harp Trap (2002) | Grey-headed Flying Fox (2003) | |



Original plan produced in A3 colour



Bushfire & Environmental Consultants

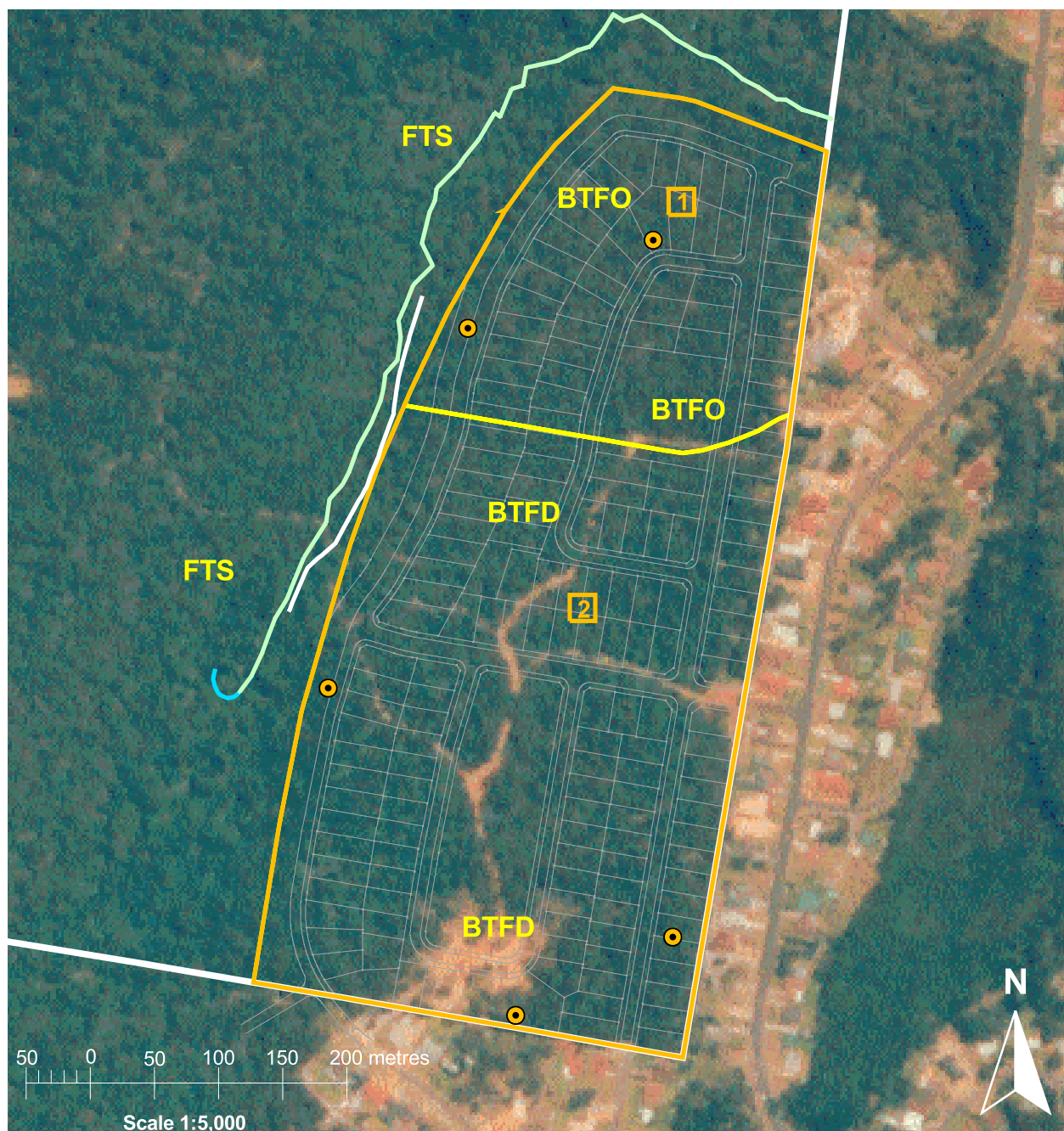
40 The Avenue, Mt. Penang Parklands,
Central Coast Highway, Kariong NSW 2250
Ph (02) 4340 0677 Fax (02) 4340 2367

e-mail: ecology@conachertravers.com.au

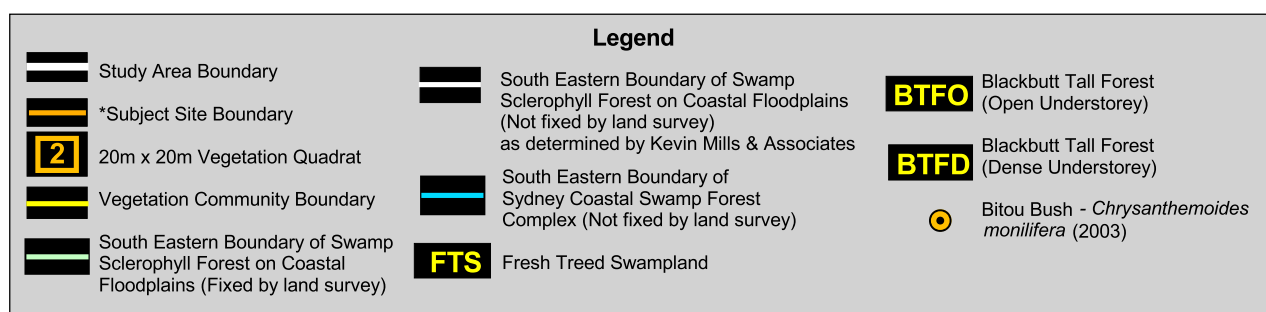
Figure 3 - Fauna Survey & Threatened Species Locations Leo Drive - Narrawallee

Ver.F3
12/12/06
Ref.No.6266

Source: DLWC 1:25,000 Aerial Photograph, Ulladulla 1:50,000 NSW4533 (M2243) Run 5, Frame 187 dated 20/12/00



Flora and fauna survey locations are approximate and have not been fixed by land survey.



*Subject Site boundary subject to final survey

Original plan produced in A4 colour

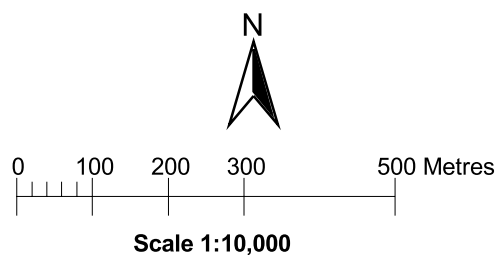
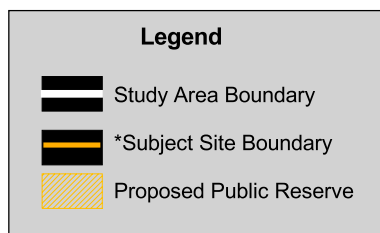
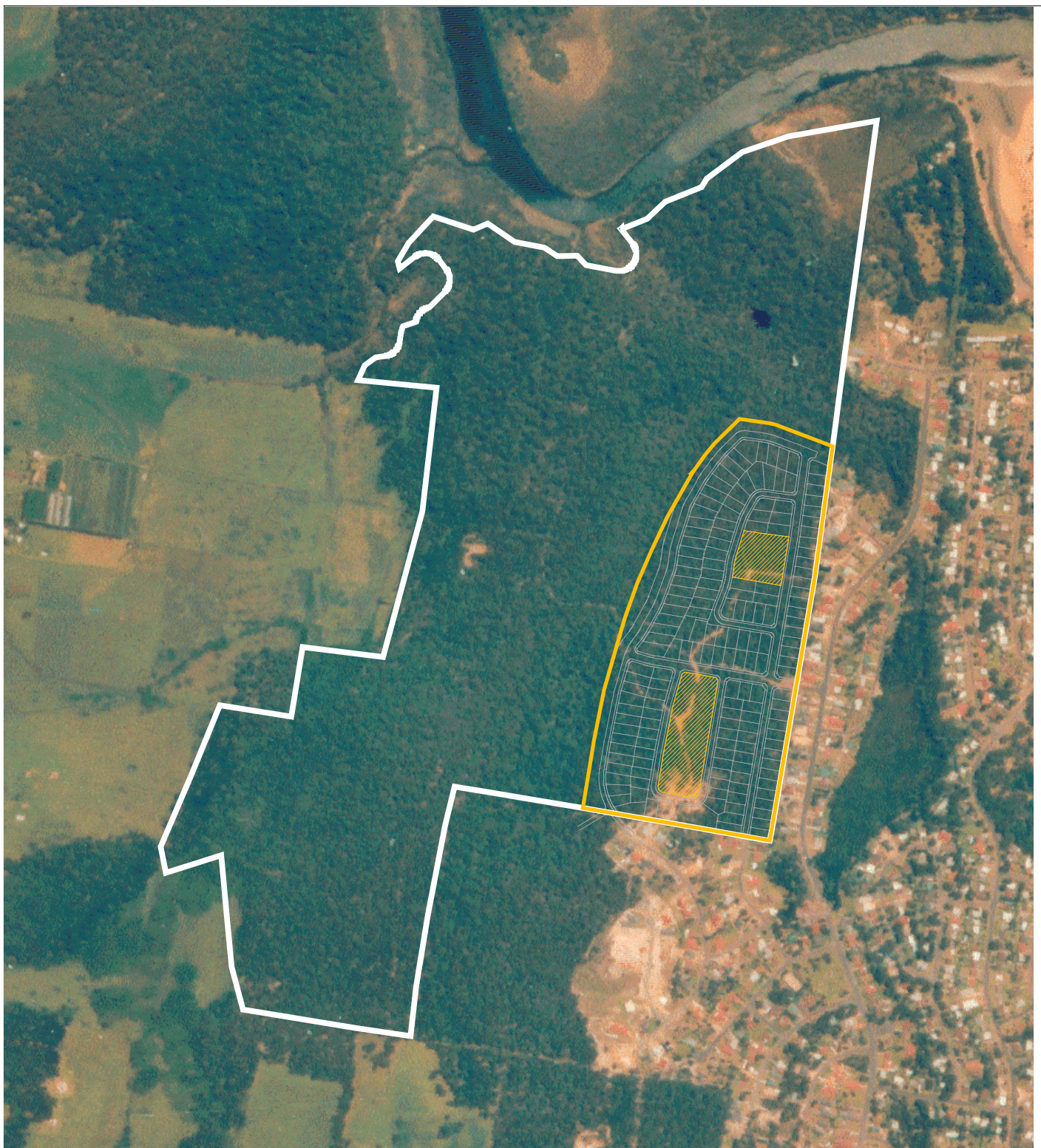


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Figure 2 - Vegetation Communities & Survey Locations Leo Drive - Narrawallee

Ver F2
12/12/06
Ref.No.6266

Source: DLWC 1:25,000 Aerial Photograph,
 Ulladulla 1:50,000 NSW4533 (M2243) Run 5, Frame 187 dated 20/12/00



*Subject Site boundary subject to final survey
Original plan produced in A4 colour

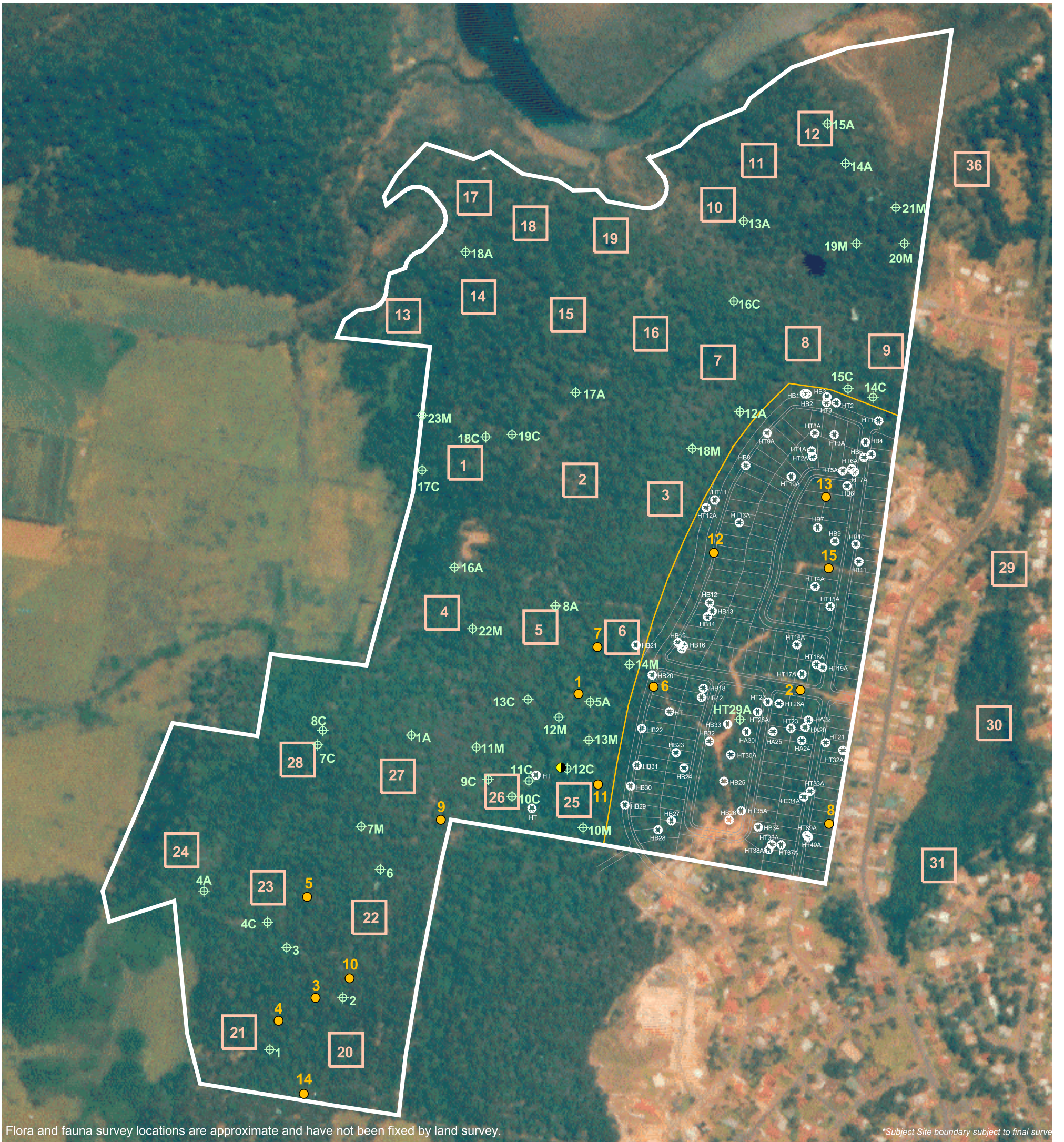


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**Figure 1 -
Subject Site and Study Area
Leo Drive - Narrawallee**

Ver: F1 A4P
12/12/06
Ref: No. 6266

Source: DLWC 1:25,000 Aerial Photograph,
Ulladulla 1:50,000 NSW4533 (M2243) Run 5, Frame 187 dated 20/12/00



Legend

- | | | | |
|--|---|--|---|
| | Study Area Boundary | | Large sized Hollow Bearing Tree
(not fixed by land survey) |
| | *Subject Site Boundary | | Hollow Bearing Tree (fixed by land survey) |
| | Possible Owl Roost Site | | Hollow Bearing Tree Quadrat Boundary (2003) |
| | Owl Nest Site (Gunninah 1999)
(Large sized Hollow Bearing Tree #12C) | | |

N

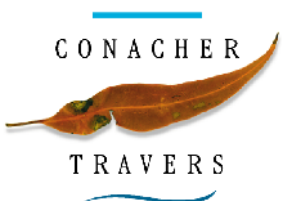


100 0 100 200 metres

Scale 1:6,000

Original plan produced in A3 colour

Figure 4 -
Habitat Trees & Owl Roost Sites
Leo Drive - Narrawallee



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Ver.F4
12/12/06
Ref.No.6266

Source: DLWC 1:25,000 Aerial Photograph, Ulladulla 1:50,000 NSW4533 (M2243) Run 5, Frame 187 dated 20/12/00

APPENDIX 1

FLORA AND FAUNA SPECIES LISTS

Table A1.1 - Native Flora Observations for the study area

Scientific Name	Common Name	Community
Trees		
<i>Angophora floribunda</i>	Rough-barked Apple	2 3
<i>Casuarina glauca</i>	Swamp Oak	2
<i>Corymbia gummifera</i>	Red Bloodwood	1 2 3
<i>Eucalyptus longifolia</i>	Woollybutt	2
<i>Eucalyptus pilularis</i>	Blackbutt	1 2 3
<i>Eucalyptus robusta</i>	Swamp Mahogany	2
<i>Livistona australis</i>	Cabbage Tree Palm	2
<i>Syncarpia glomulifera</i>	Turpentine	1 2 3
Shrubs		
<i>Acacia longifolia</i>	Sydney Golden Wattle	1 2 3
<i>Acacia mearnsii</i>	Black Wattle	1 3
<i>Acacia myrtifolia</i>	Red-stem Wattle	1 3
<i>Acacia suaveolens</i>	Sweet Scented Wattle	1 3
<i>Acacia terminalis</i>	Sunshine Wattle	1
<i>Allocasuarina littoralis</i>	Black She-oak	1 3
<i>Aotus ericoides</i>	-	3
<i>Banksia integrifolia</i>	Honeysuckle	1
<i>Banksia serrata</i>	Old Man Banksia	1 3
<i>Banksia spinulosa</i>	Hairpin Banksia	1 3
<i>Bossiaea obcordata</i>	Spiny Bossiaea	1
<i>Breynia oblongifolia</i>	Breynia	1 3
<i>Callicoma serratifolia</i>	Black Wattle	1 2
<i>Cassinia quinquefaria</i>	-	1
<i>Dodonaea triquetra</i>	Hop Bush	1 3
<i>Glochidion ferdinandi</i>	Cheese Tree	1 2
<i>Gompholobium latifolium</i>	Golden Glory Pea	1 3
<i>Goodenia ovata</i>	Hop Goodenia	2
<i>Hakea salicifolia</i>	Willow Hakea	1
<i>Hibbertia aspera</i>	-	1 2 3
<i>Hibbertia obtusifolia</i>	-	1 3
<i>Kunzea ambigua</i>	Tick Bush	1 2 3
<i>Leptospermum continentale</i>	-	1 Q2
<i>Leptospermum juniperinum</i>	Prickly Tea-tree	2 3
<i>Leucopogon lanceolatus</i>	Lance-leaf Beard-heath	1 3
<i>Melaleuca armillaris</i> cultivar	-	1
<i>Melaleuca ericifolia</i>	-	2
<i>Melaleuca hypericifolia</i>	-	1
<i>Melaleuca linariifolia</i>	Snow in Summer	2
<i>Monotoca elliptica</i>	Tree Broom-heath	3
<i>Omphacomeria acerba</i>	Leafless Soubush	1 3
<i>Ozothamnus diosmifolius</i>	Ball Everlasting	2
<i>Persoonia linearis</i>	Narrow-leaved Geebung	3
<i>Persoonia mollis</i>	-	1 2 3
<i>Petrophile pedunculata</i>	Conesticks	1
<i>Phyllanthus hirtellus</i>	Thyme Spurge	1 3
<i>Pimelea linifolia</i>	Slender Rice Flower	1 3
<i>Pittosporum revolutum</i>	Yellow Pittosporum	3
<i>Pittosporum undulatum</i>	Sweet Pittosporum	1
<i>Platylobium formosum</i>	Handsome Flat-pea	1

Table A1.1 - Native Flora Observations for the study area (Cont.)

Scientific Name	Common Name	Community
Shrubs (Cont.)		
<i>Platysace lanceolata</i>	Lance-leaf Platysace	1 3
<i>Podolobium ilicifolium</i>	Native Holly	1 3
<i>Pultenaea daphnoides</i>	Large-leaf Bush Pea	1
<i>Pultenaea flexilis</i>	-	1 2
<i>Pultenaea retusa</i>	-	1 3
<i>Ricinocarpus pinifolius</i>	Wedding Bush	3
<i>Wilkiea huegeliana</i>	Wilkiea	1 3
<i>Zieria smithii</i>	Sandfly Zieria	1 2 3
Vines		
<i>Baloskian tetraphyllum</i>	Tassel-rush	2 3
<i>Billardiera scandens</i>	Apple Dumplings	1 3 2
<i>Cassytha pubescens</i>	Devil's Twine	2 3
<i>Cissus hypoglauca</i>	Water Vine	3
<i>Clematis aristata</i>	Clematis	3
<i>Eustrephus latifolius</i>	Wombat Berry	1
<i>Glycine clandestina</i>	Twining Glycine	1 2 3
<i>Gleichenia dicarpa</i>	Pouched Coral Fern	1 2
<i>Glycine clandestina</i>	Twining Glycine	1 2 3
<i>Hardenbergia violacea</i>	False Sarsparilla	1 3
<i>Hibbertia dentata</i>	Twining Guinea Flower	1
<i>Hibbertia scandens</i>	Climbing Guinea Flower	1 2 3
<i>Kennedia rubicunda</i>	Dusky Coral Pea	1 2
<i>Marsdenia suaveolens</i>	Scented Marsdenia	1 3
<i>Parsonsia straminea</i>	Common Silkpod	2
<i>Smilax glyciphylla</i>	Sarsparilla	1 2
Herbs		
<i>Acianthus fornicatus</i>	Pixie Caps	3
<i>Amperea xiphoclada</i>	Broom Spurge	3
<i>Anisopogon avenaceus</i>	Oat Spear Grass	1
<i>Burchardia umbellata</i>	Milkmaids	1
<i>Caladenia carnea</i>	Pink Finger Orchid	1 3
<i>Capillipedium parviflorum</i>	Scented-top Grass	1
<i>Cryptostylis erecta</i>	Bonnet Orchid	3
<i>Cymbidium suave</i>	Native Cymbidium	3
<i>Cynodon dactylon</i>	Common Couch	1
<i>Desmodium variens</i>	Slender Tick-trefoil	3
<i>Dianella caerulea</i>	Flax Lily	1 2 3
<i>Dichondra repens</i>	Kidney Weed	3
<i>Drosera auriculata</i>	Sundew	1 3
<i>Echinopogon caespitosus</i>	Tufted Hedgehog Grass	3
<i>Entolasia marginata</i>	Bordered Panic	1 3
<i>Entolasia stricta</i>	Wiry Panic	1 2
<i>Eragrostis brownii</i>	Brown's Lovegrass	1 3
<i>Gahnia clarkei</i>	Saw Sedge	2
<i>Gahnia sieberiana</i>	Red-fruited Saw-sedge	1 3
<i>Gonocarpus teucroides</i>	Raspwort	1 2 3
<i>Hybanthus vernonii</i>	Slipper Violet	1 3
<i>Hydrocotyle peduncularis</i>	Pennywort	2
<i>Imperata cylindrica</i>	Blady Grass	1 3
<i>Juncus usitatus</i>	Common Rush	2

Table A1.1 - Native Flora Observations for the study area (Cont.)

Scientific Name	Common Name	Community
Herbs (Cont.)		
<i>Lagenifera gracilis</i>	-	1 3
<i>Lepidosperma filiforme</i>	Common Rapier Sedge	1 2
<i>Lomandra longifolia</i>	Spiky-headed Mat-rush	1 3
<i>Lomandra multiflora</i>	Many-flowered Mat-rush	1 3
<i>Lomandra obliqua</i>	Twisted Mat-rush	3
<i>Macrozamia communis</i>	Burrawang	3
<i>Panicum simile</i>	Two Colour Panic	1 3
<i>Patersonia sericea</i>	Wild Iris	1
<i>Poranthera ericifolia</i>	Heath-leaved Poranthera	1
<i>Pratia purpurascens</i>	Whiteroot	2 3
<i>Pseudoraphis paradoxa</i>	Slender Mudgrass	2
<i>Schoenus melanostachys</i>	Black Bog-rush	1
<i>Sowerbaea juncea</i>	Vanilla Lily	1 3
<i>Stackhousia monogyna</i>	Creamy Candles	1
<i>Tetradlea thymifolia</i>	Black-eyed Susan	1
<i>Thelymitra ixioides</i>	Spotted Sun Orchid	1
<i>Themeda australis</i>	Kangaroo Grass	1 3
<i>Trachymene incisa</i>	-	1 3
<i>Villarsia exaltata</i>	Yellow Marsh Flower	2
<i>Xanthorrhoea resinifera</i>	-	1 3
Ferns		
<i>Adiantum aethiopicum</i>	Common Maidenhair	1
<i>Blechnum camfieldii</i>	-	2
<i>Blechnum cartilagineum</i>	Gristle Fern	3
<i>Blechnum indicum</i>	Swamp Water-fern	2
<i>Calochlaena dubia</i>	Common Ground Fern	1 2 3
<i>Gleichenia dicarpa</i>	Pouched Coral Fern	1 2
<i>Lindsaea linearis</i>	Screw Fern	1 3
<i>Pteridium esculentum</i>	Bracken Fern	1 3
<i>Selaginella uliginosa</i>	Swamp Selaginella	3

Table A1.2 - Exotic Flora Observations for the study area

Scientific Name	Common Name	Community
<i>Andropogon virginicus</i>	Whisky Grass	1
<i>Bidens pilosa</i>	Cobblers Pegs	1
<i>Briza maxima</i>	Quaking Grass	1
<i>Chrysanthemoides monilifera</i>	Bitou Bush	1
<i>Cirsium vulgare</i>	Spear Thistle	1
<i>Conyza albida</i>	Tall Fleabane	1
<i>Holcus lanatus</i>	Yorkshire Fog	1
<i>Hydrocotyle bonariensis</i>	Pennywort	1
<i>Hypochaeris glabra</i>	-	1
<i>Hypochaeris radicata</i>	Flatweed	1 2
<i>Lilium formosanum</i>	-	1
<i>Osteospermum ecklonis</i>	-	1
<i>Paspalum urvillei</i>	Vasey Grass	1
<i>Pennisetum clandestinum</i>	Kikuyu	1
<i>Plantago lanceolata</i>	Ribwort	1
<i>Senna pendula</i>	Cassia	1

Table A1.2 - Exotic Flora Observations for the study area (Cont.)

Scientific Name	Common Name	Community
<i>Stellaria media</i>	Chickweed	1
<i>Stenotaphrum secundatum</i>	Buffalo Grass	1
<i>Trifolium repens</i>	White Clover	1

Table A1.3 - Quadrat Observations for the subject site

C – denotes common

O – denotes occasional

R – denotes rare

A number indicates the number of specimens more than 3 metres high

Scientific Name	Common Name	Quadrat	
		1	2
<i>Acacia longifolia</i>	Sydney Golden Wattle	O	O
<i>Acacia mearnsii</i>	Black Wattle	O	
<i>Acacia myrtifolia</i>	Red-stem Wattle	O	O
<i>Acacia suaveolens</i>	Sweet Scented Wattle	O	O
<i>Acacia terminalis</i>	Sunshine Wattle	O	O
<i>Acianthus fornicatus</i>	Pixie Caps	O	
<i>Allocasuarina littoralis</i>	Black She-oak		R
<i>Angophora floribunda</i>	Rough-barked Apple	1	
<i>Banksia integrifolia</i>	Honeysuckle		R
<i>Banksia serrata</i>	Old Man Banksia		O
<i>Banksia spinulosa</i>	Hairpin Banksia	O	O
<i>Billardiera scandens</i>	Apple Dumplings		O
<i>Breynia oblongifolia</i>	Breynia	O	
<i>Burchardia umbellata</i>	Milkmaids		O
<i>Cassinia quinquefaria</i>	-		O
<i>Cassytha pubescens</i>	Devil's Twine	O	
<i>Clematis aristata</i>	Clematis	O	
<i>Corymbia gummifera</i>	Red Bloodwood	7	17
<i>Cymbidium suave</i>	Native Cymbidium	R	
<i>Desmodium varians</i>	Slender Tick-trefoil	O	
<i>Dianella caerulea</i>	Flax Lily	O	O
<i>Dichondra repens</i>	Kidney Weed	O	
<i>Dodonaea triquetra</i>	Hop Bush	C	R
<i>Drosera auriculata</i>	Sundew (glabrous)		O
<i>Echinopogon caespitosus</i>	Tufted Hedgehog Grass	O	
<i>Entolasia marginata</i>	Bordered Panic	O	O
<i>Entolasia stricta</i>	Wiry Panic	O	
<i>Eragrostis brownii</i>	Brown's Lovegrass	O	
<i>Eucalyptus pilularis</i>	Blackbutt	4	7
<i>Eustrephus latifolius</i>	Wombat Berry	O	
<i>Glochidion ferdinandi</i>	Cheese Tree		O
<i>Glycine clandestina</i>	Twining Glycine	O	
<i>Gompholobium latifolium</i>	Golden Glory Pea		C
<i>Hakea salicifolia</i>	Willow Hakea		C
<i>Hardenbergia violacea</i>	False Sarsparilla	O	O
<i>Hibbertia aspera</i>	-	O	O
<i>Hibbertia obtusifolia</i>	-	R	R

Table A1.3 - Quadrat Observations for the subject site (Cont.)

C – denotes common

O – denotes occasional

R – denotes rare

A number indicates the number of specimens more than 3 metres high

Scientific Name	Common Name	Quadrat	
<i>Hibbertia scandens</i>	Climbing Guinea Flower	O	
<i>Imperata cylindrica</i>	Blady Grass	O	O
<i>Lagenifera gracilis</i>	-	O	O
<i>Lepidosperma filiforme</i>	-		C
<i>Leptospermum continentale</i>	-		R
<i>Leucopogon lanceolatus</i>	Lance-leaf Beard-heath	O	
<i>Lomandra longifolia</i>	Spiky-headed Mat-rush	O	O
<i>Lomandra multiflora</i>	Many-flowered Mat-rush	O	
<i>Lomandra obliqua</i>	Twisted Mat-rush	O	
<i>Macrozamia communis</i>	Burrawang	O	
<i>Marsdenia suaveolens</i>	Scented Marsdenia		O
<i>Monotoca elliptica</i>	Tree Broom-heath	R	
<i>Omphacomeria acerba</i>	Leafless Soubush	O	
<i>Panicum simile</i>	Two Colour Panic	O	O
<i>Persoonia linearis</i>	Narrow-leaved Geebung	R	
<i>Persoonia mollis</i>	-	O	C
<i>Phyllanthus hirtellus</i>	Thyme Spurge	O	O
<i>Pimelea linifolia</i>	Slender Rice Flower	O	
<i>Platysace lanceolata</i>	Lance-leaf Platysace	R	O
<i>Podolobium ilicifolium</i>	Native Holly	O	
<i>Pteridium esculentum</i>	Bracken Fern	O	O
<i>Pultenaea daphnoides</i>	Large-leaf Bush Pea		R
<i>Pultenaea flexilis</i>	-		O
<i>Pultenaea retusa</i>	-	O	
<i>Smilax glycyphylla</i>	Sarsparilla		O
<i>Syncarpia glomulifera</i>	Turpentine		2
<i>Themeda australis</i>	Kangaroo Grass	C	
<i>Trachymene incisa</i>	-	O	O
<i>Wilkiea huegeliana</i>	Wilkiea	O	O
<i>Xanthorrhoea resinifera</i>	-	R	O
<i>Zieria smithii</i>	Sandfly Zieria		R

Table A1.4 - Threatened Flora

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
<i>Baloskian longipes</i>	Dioecious perennial herb. Grows in swamps or depressions in sandy alluvium in Cyde Mtn district. Southern Tablelands.	Unknown	No suitable habitat present. Not recorded during survey.	V	-
<i>Boronia deanei</i>	Erect shrub 0.2 to 1.5m high. Grows in wet heath; rare from Lithgow district to Nalbaugh NP near the Victorian border. Central tablelands. Southern Tablelands.	Kanangra Boyd N.P. (pop unknown), Buddaroo N.P. (pop unknown), Morton N.P. (pop unknown), Nalbaugh N.P. (pop unknown).	No suitable habitat present. Not recorded during survey.	V	V
<i>Budawangia gnidioides</i>	Rhizomatous shrub. Grown in skeletal soil in sandstone crevices or on sandy ledges beneath cliffs on the margins of open forest and heathland. Restricted to northern Bundaawang Ra. And adjacent plateau escarpments. South Coast. Southern Tablelands.	Morton N.P. (pop unknown),	No suitable habitat present. Not recorded during survey.	V	V
<i>Callitris oblonga</i> ssp. <i>corangensis</i>	Small tree or shrub to 5m high. Dark green foliage. Grows in sand near banks of streams, in scrub and open forest, scattered along the eastern side of the tablelands. Rare in NSW. Northern Tablelands. Southern Tablelands. Tas.	Guy Fawkes River N.P. (<1000 plants), Werrikimbe N.P. (>1000 plants), Morton N.P. (<1000 plants).	No suitable habitat present. Not recorded during survey.	V	V
<i>Cryptostylis hunteriana</i>	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S-south of Eden.	Gibraltar Range NP, Ku-ring-gai Chase NP, Ben Boyd NP	Marginal habitat present. Not recorded during survey.	V	V

Table A1.4 - Threatened Flora (Cont.)

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
<i>Eucalyptus langleyi</i>	Mallee to 6m high. Smooth bark, grey, green or pink, shedding in ribbons. Restricted and localised, in mallee scrubland on poorly drained shallow sand on sandstone. Confined to Nowra district. Central Coast. South Coast.	No known records from conservation reserves.	No suitable habitat present. Not recorded during survey.	V	V
<i>Eucalyptus sturgissiana</i>	Mallee to 5m high. Bar smooth, grey or grey-brown, shedding in short or long ribbons. Restricted and uncommon, usually an emergent in low scrub heath on shallow sandy swampy soils. Ettrema district. South Coast. Southern Tablelands.	Morton N.P. (>1000 plants)	No suitable habitat present. Not recorded during survey.	V	-
<i>Genoplesium vernale</i>	Saprophytic orchid. Grows in heath understoreys of Stringybark/Spotted Gum forests on sandy soils. Distribution limits; generally restricted to the East Lynne locality to west of Ulladulla.	Budawang NP, Morton NP, Murramang NP	Marginal habitat present. Not recorded during survey.	V	V
<i>Irenepharsus trypherus</i>	Annual herb to 1m high. Not common, grows in gullies on the coast and escarpment between Wollongong and the Shoalhaven. Central Coast. South Coast.	Budderoo N.P. (<1000 plants).	No suitable habitat present. Not recorded during survey.	E	E
<i>Melaleuca biconvexa</i>	Tall shrub. Grows in wetlands adjoining perennial streams and on the banks of those streams, generally within the geological series known as the Terrigal Formation. Distribution limits N – Port Macquarie S – Jervis Bay.	Bouddi NP, Wyrribalong NP	Marginal habitat present adjoining the site. Not recorded during survey.	V	V
<i>Plinthanthesis rodwayi</i>	Caespitose perennial to 0.7m high. Grows in montane woodland. Flowers in spring-summer. Southern	Budawang N.P. (<1000 plants).	No suitable habitat present. Not recorded	V	V

	Tablelands.		during survey.		
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Table A1.4 - Threatened Flora (Cont.)

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
<i>Pultenaea baeuerlenii</i>	Erect shrub. Grows in swamp heath on sandstone. Confined to the Budawang Ranges. Southern Tablelands.	Budawang N.P. (<1000 plants), Morton N.P. (<1000 plants).	No suitable habitat present. Not recorded during survey.	V	V
<i>Thesium australe</i>	Erect herb to 0.4 m high. Root parasite. Grassland or woodland often damp. Distribution limits N - Tweed Heads S - south of Eden.	Bullen Range NR, Kosciuszko NP, Namadgi NP, Crowdy Bay NP, Hat Head NP, Kattang NR	No suitable habitat present. Not recorded during survey.	V	V

Table A1.5 - Threatened Fauna

Common Name Scientific Name	Preferred Habitat	Comments	TSC Act or FM Act	EPBC Act
Giant Burrowing Frog <i>Heleioporus australiacus</i>	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. Distribution Limit- N-Near Singleton. S-South of Eden	Potential habitat present within the subject site. Not observed during surveys.	V	V
Green and Golden Bell Frog <i>Litoria aurea</i>	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. Distribution Limit – N-Byron Bay. S-South of Eden	No potential habitat present.	E1	V
Littlejohn's Tree Frog* <i>Litoria littlejohni</i>	Wet or dry sclerophyll forest associated with sandstone outcrops, at altitudes of 280-1000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. Distribution, south coast of NSW.	No potential habitat present.	V	V
Stuttering Frog* <i>Mixophyes balbus</i>	Terrestrial inhabitant of rainforest and wet sclerophyll forests. Distribution Limit – N-Near Tenterfield. S-South of Bombala.	Sub-optimal habitat present within the subject site. Not observed during surveys.	V	V

Table A1.5 - Threatened Fauna (Cont.)

Common Name Scientific Name	Preferred Habitat	Comments	TSC Act or FM Act	EPBC Act
Square-tailed Kite <i>Lophoictinia isura</i>	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. Distribution Limit – N-Goondiwindi. S-South of Eden.	Potential habitat present within the subject site. Not observed during surveys.	V	-
Osprey <i>Pandion haliaetus</i>	Utilises waterbodies including coastal waters, inlets, lakes, estuaries and offshore islands with a dead tree for perching and feeding. Distribution Limit – N-Tweed Heads. S-South of Eden.	Observed within subject site during surveys.	V	-
Little Tern <i>Sterna albifrons</i>	An almost exclusively coastal species inhabiting open beaches, sheltered inlets, estuaries and occasionally lakes. Distribution Limit- N-North of Tweed Heads. S-South of Eden.	No potential habitat present	E1	-
Hooded Plover <i>Thinornis rubricollis</i>	Inhabits ocean beaches and coastal lakes. Forages on exposed flat sandy expanses on annelids, gastropods and crustaceans. Distribution Limit – N-Jervis Bay. S-Eden	No potential habitat present		
Sooty Oystercatcher <i>Haematopus fuliginosus</i>	Exclusively coastal in distribution foraging along rocky coastlines and estuaries. Distribution Limit- N-Tweed Heads S-South of Eden.	No potential habitat present	V	-
Pied Oystercatcher <i>Haematopus longirostris</i>	Inhabits coastal beaches and estuarine flats. Distribution Limit N-Tweed Heads S-South of Eden.	No potential habitat present	V	-
Australasian Bittern <i>Botaurus poiciloptilus</i>	Inhabits shallow freshwater or brackish wetlands with tall dense beds of reeds, sedges or rush species and swamp edges. Distribution Limit – N-North of Lismore. S- Eden.	Potential habitat present within the subject site. Not observed during surveys.	V	-

Table A1.5 - Threatened Fauna (Cont.)

Common Name Scientific Name	Preferred Habitat	Comments	TSC Act or FM Act	EPBC Act
Painted Snipe* <i>Rostratula benghalensis</i>	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. Distribution Limit- N-Tweed Heads S-South of Eden	No potential habitat present	E	V
Superb Fruit-dove <i>Ptilinopus superb</i>	Rainforests, adjacent mangroves, eucalypt forests, scrubland with native fruits. Distribution Limit – N-Border Ranges National Park. S-Bateman's Bay.	Potential habitat present within the subject site. Not observed during surveys.	V	-
Glossy Black-Cockatoo <i>Calyptorhynchus lathami</i>	Open forests with <i>Allocasuarina</i> species and hollows for nesting. Distribution Limit – N-Tweed Heads. S-South of Eden.	Foraging evidence was recorded within the subject site during surveys.	V	-
Gang-Gang Cockatoo <i>Callocephalon fimbriatum</i>	Prefers wetter forests and woodlands from sea level to > 2000m on Divide, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. Distribution Limit –mid north coast of NSW to western Victoria	Potential habitat present within the subject site. Not observed during surveys.	V	-
Swift Parrot* <i>Lathamus discolor</i>	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. Distribution Limit – N-Border Ranges National Park. S-South of Eden.	Potential foraging habitat present within the subject site. Not observed during surveys.	E1	E
Regent Honeyeater <i>Xanthomyza phrygia</i>	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. Distribution Limit – N-Urbanville. S-Eden	Potential foraging habitat present within the subject site. Not observed during surveys.	E	E
Pink Robin <i>Petroica rodinogaster</i>	Found in dense gullies, rainforests and open forests, dispersing into drier more open habitats in winter. Distribution Limit – N-Sydney. S-South of Eden	Potential habitat present within the subject site. Not observed during surveys.	V	-

Table A1.5 - Threatened Fauna (Cont.)

Common Name Scientific Name	Preferred Habitat	Comments	TSC Act or FM Act	EPBC Act
Barking Owl <i>Ninox connivens</i>	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. Distribution Limits- N-Border Ranges National Park S-Eden	Potential habitat present within the subject site. Not observed during surveys.	V	-
Powerful Owl <i>Ninox strenua</i>	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. Distribution Limits – N-Border Ranges National Park. S-Eden	Observed within the study area during surveys.	V	-
Masked Owl <i>Tyto novaehollandiae</i>	Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. Distribution Limit – N-Border Ranges National Park. S-Eden	Potential habitat present within the subject site. Not observed during surveys.	V	-
Sooty Owl <i>Tyto tenebricosa</i>	Tall, dense, wet forests containing trees with very large hollows. Distribution Limit – N-Border Ranges National Park. S-South of Eden	Observed within study area during surveys.	V	-
Brown Treecreeper <i>Climacteris picumnus subsp. victoriae</i>	Utilises Eucalypt woodlands/forests throughout eastern Australia. Distribution Limit- N-Border Ranges National Park S-Eden	No potential habitat present	V	-
Spotted-tailed Quoll* <i>Dasyurus maculatus</i>	Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit- N-Mt Warning National Park S-South of Eden.	Potential habitat present. Not observed within subject site during surveys.	V	V
Southern Brown Bandicoot* <i>Isodon obesulus</i>	Utilises a range of habitats containing thick ground cover - open forest, woodland, heath, cleared land, urbanised areas and regenerating bushland. Distribution Limit - N-Kempsey. S-South of Eden.	Potential habitat present. Not observed within subject site during surveys.	E1	E
Long-nosed Potoroo <i>Potorous tridactylus</i>	Coastal heath and dry and wet sclerophyll forests. Distribution Limit - N-Mt Warning National Park. S-South of Eden.	Potential habitat present within the subject site. Not observed during surveys.	V	V

Table A1.5 - Threatened Fauna (Cont.)

Common Name Scientific Name	Preferred Habitat	Comments	TSC Act or FM Act	EPBC Act
Brush-tailed Rock-wallaby * <i>Petrogale penicillata</i>	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. Distribution Limit - N-North of Tenterfield. S-Bombala.	No potential habitat present.	V	V
Squirrel Glider <i>Petaurus norfolcensis</i>	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. Distribution Limit - N- Tweed Heads S-Albury	Potential habitat present with the subject site. Not observed during surveys.	V	-
Yellow-bellied Glider <i>Petaurus australis</i>	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-South of Eden.	Potential habitat present with the subject site. Not observed during surveys.	V	-
Eastern Pygmy Possum <i>Cercartetus nanus</i>	Inhabits a variety of environments, both coastal and higher elevations south of Newcastle and at higher elevations north of Newcastle	Potential habitat present with the subject site. Not observed during surveys.	V	-
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	Occurs primarily along the eastern coastal plains of NSW. It is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, Melaleuca swamps and Banksia woodlands (NPWS, 2000).	Observed foraging within the subject site. No roosting habitat present within the subject site.	V	V
Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i>	Rainforests, sclerophyll forests and woodlands. Distribution Limit - N-North of Walgett. S-Sydney	Potential foraging and roosting habitat present with the subject site. Not observed during surveys.	V	-

Table A1.5 - Threatened Fauna (Cont.)

Common Name Scientific Name	Preferred Habitat	Comments	TSC Act or FM Act	EPBC Act
Eastern Bentwing-bat <i>Miniopterus schreibersii oceanensis</i>	Prefers areas where there are caves, old mines, old buildings, stormwater drains & well timbered areas. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Potential foraging habitat present with the subject site. Not observed during surveys.	V	-
Little Bentwing-bat <i>Miniopterus australis</i>	Roosts in caves, old buildings and tree hollows in the higher rainfall forests along the south coast of Australia. Distribution Limit - N-Border Ranges National Park. S-Sydney.	Potential foraging habitat present with the subject site. Not observed during surveys.	V	-
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	Inhabits areas containing moist river & creek systems especially tree lined creeks. Distribution Limit - N-Border Ranges National Park. S-Pambula.	Potential foraging and roosting habitat present with the subject site. Not observed during surveys.	V	-
Eastern Freetail-bat <i>Mormopterus norfolkensis</i>	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. Distribution Limit - N-Woodenbong. S-Pambula.	Potential foraging and roosting habitat present with the subject site. Not observed during surveys.	V	-
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit- N-Border Ranges National Park S-Pambula	Recorded foraging within the subject site during Anabat surveys. Potential roosting habitat present with the subject site.	V	-

Table A1.5 - Threatened Fauna (Cont.)

Common Name Scientific Name	Preferred Habitat	Comments	TSC Act or FM Act	EPBC Act
Large-eared Pied Bat* <i>Chalinolobus dwyeri</i>	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. Distribution Limit - N-Border Ranges Nation Park. S-Wollongong.	Potential foraging habitat present with the subject site. Not observed during surveys.	V	V
* - Denotes species listed in EPBC Act search, but not recorded within 10 km of the subject site on the Atlas of NSW Wildlife database				

Table A1.6 - Fauna Observations for the Study Area

Common name	Scientific name	Previous Surveys	Conacher Travers 2002	Conacher Travers 2003	Conacher Travers 2004	Conacher Travers 2006
Birds						
Australian King Parrot	<i>Alisterus scapularis</i>	PR	O C	O	O	O C
Australian Magpie	<i>Gymnorhina tibicen</i>	PR	O		O C	O C
Australian Magpie-Lark	<i>Grallina cyanoleuca</i>	PR	O			
Australian Raven	<i>Corvus coronoides</i>	PR	O	O	O C	O C
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	PR				O C
Brown Gerygone	<i>Gerygone mouki</i>	PR				
Brown Thornbill	<i>Acanthiza pusilla</i>	PR		O C	O	O C
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>			C		C
Common Bronzewing	<i>Phaps chalcoptera</i>			O		
Common Koel	<i>Eudynamys scolopacea</i>			C		C
Common Myna	<i>Acridotheres tristis</i>				O	
Common Starling *	<i>Sturnus vulgaris</i>		O C			
Crested Pigeon	<i>Ocyphaps lophotes</i>		O C		O	O C
Crested Shrike-tit	<i>Falcunculus frontatus</i>	PR			O	
Crimson Rosella	<i>Platyercus elegans</i>	PR	O C	O C	O C	O C
Dollarbird	<i>Eurystomus orientalis</i>					O C
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	PR	O	O	O	O C
Eastern Whipbird	<i>Psophodes olivaceus</i>	PR	C	C	O C	O C
Eastern Yellow Robin	<i>Eopsaltria australis</i>		O	O	O	O C
Fan-tailed Cuckoo	<i>Cuculus flabelliformis</i>			C	O C	
Galah	<i>Cacatua roseicapilla</i>	PR	O C		O C	O C
Gang -gang Cockatoo ^{TS}	<i>Callocephalon fimbriatum</i>			O C	O C	
Golden Whistler	<i>Pachycephala pectoralis</i>	PR	O C		O C	O C
Grey Butcherbird	<i>Cracticus torquatus</i>	PR			C	
Grey Fantail	<i>Rhipidura fuliginosa</i>		O		O C	O C
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	PR	O C	O	O C	O C
House Sparrow*	<i>Passer domesticus</i>		O			
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	PR	O C	O C	O C	O C
Lewin's Honey-eater	<i>Meliphaga lewinii</i>	PR		C	C	O C
Masked Owl ^{TS}	<i>Tyto novaehollandiae</i>					Sp, C
Mistletoe Bird	<i>Dicaeum hirundinaceum</i>	PR				
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	PR	O	O	O	
Noisy Friarbird	<i>Philemon corniculatus</i>	PR		C		
Noisy Miner	<i>Manorina melanocephala</i>		C			O C
Osprey ^{TS}	<i>Pandion haliaetus</i>				O	
Pied Currawong	<i>Strepera graculina</i>	PR	C		C Sc	O C
Powerful Owl ^{TS}	<i>Ninox strenua</i>		O C	O C	C	
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	PR	O C	O C	O C	O C
Red Wattle Bird	<i>Anthochaera carunculata</i>	PR	O C	O C	O C	O C
Red-browed Finch	<i>Neochmia temporalis</i>	PR	O C	O	O	
Rufous Fantail	<i>Rhipidura rufifrons</i>			O C		
Rufous Whistler	<i>Pachycephala rufiventris</i>			C		O C
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>			O		O C
Silvereye	<i>Zosterops lateralis</i>	PR	O			
Sooty Owl ^{TS}	<i>Tyto tenebricosa</i>				St, Sp, C	
Southern Boobook	<i>Ninox novaeseelandiae</i>					C
Spotted Pardalote	<i>Pardalotus punctatus</i>	PR	O			
Spotted Turtle-dove *	<i>Streptopelia chinensis</i>	PR	O	O	O	O
Striated Thornbill	<i>Acanthiza lineata</i>	PR	O			
Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	PR	O C	C	O C	O C
Superb Fairy-wren	<i>Malurus cyaneus</i>		O			O C
Tawny Frogmouth	<i>Podargus strigoides</i>					O
Veriegated Fairy-wren	<i>Malurus lamberti</i>			O		
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>					O
White-browed Scrubwren	<i>Sericornis frontalis</i>	PR	O	O	O	O C
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>			O		

Table A1.6 - Fauna Observations for the Study Area (Cont.)

Common name	Scientific name	Previous Surveys	Conacher Travers 2002	Conacher Travers 2003	Conacher Travers 2004	Conacher Travers 2006
Birds						
White-headed Pigeon	<i>Columba leucomela</i>		O		O C	O
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	PR	O C	O C	O C	O C
White-faced Heron	<i>Egretta novaehollandiae</i>				O	
Willie Wagtail	<i>Rhipidura leucophrys</i>				O C	
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	PR	O	C	O C	O C
Yellow-tailed Black-cockatoo	<i>Calyptorhynchus funereus</i>	PR	C			
Yellow Thornbill	<i>Acanthiza nana</i>			O		
Mammals						
Brown Antechinus	<i>Antechinus stuartii</i>		E			
Bush Rat	<i>Rattus fuscipes</i>	PR	E CT			
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	PR				
Common Brushtail Possum	<i>Trichosurus vulpecula</i>		Sc	Sp	Sp	Sp
Sugar Glider	<i>Petaurus breviceps</i>					Sp, St
Long-nosed Bandicoot	<i>Parameles nasuta</i>		CT			
Swamp Wallaby	<i>Wallabia bicolor</i>	PR				
Grey-Headed Flying-fox ^{TS}	<i>Pteropus poliocephalus</i>			Sp Sc C	Sp	
Goulds Wattled Bat	<i>Chalinolobus gouldi</i>			A		A
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		A H			A
Eastern False Pipistrelle ^{TS}	<i>Falsistrellus tasmaniensis</i>		A			
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>		A H			
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>		A	A		
Large Forest Bat	<i>Vespadelus darlingtoni</i>			A		
Southern Forest Bat	<i>Vespadelus regulus</i>		A H	A		A
Little Forest Bat	<i>Vespadelus vulturnus</i>					A
Black Rat *	<i>Rattus rattus</i>		E			
European Red Fox *	<i>Vulpes vulpes</i>	PR				
Dog *	<i>Canis familiaris</i>		Sc	Sc		
Reptiles						
Diamond Python	<i>Morelia spilota</i>				O	
Eastern Blue Tongue	<i>Tiliqua scincoides</i>			O		
Eastern Water Skink	<i>Eulamprus quoyii</i>		O	O		O
Garden Skink	<i>Lampropholis guichenoti</i>			O		O
Red-Bellied Black Snake	<i>Pseudechis porphyriacus</i>		O			O
Amphibians						
Common Eastern Froglet	<i>Crinia signifera</i>	PR	C	C	C	C
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>			Sp C		
Striped Marsh Frog	<i>Limnodynastes peronii</i>	PR		C		
Bleating Tree Frog	<i>Litoria dentata</i>			C		
Smooth Toadlet	<i>Uperoleia laevigata</i>		C			C
Dwarf Tree Frog	<i>Litoria fallax</i>					C
Note: * indicates introduced species ^{TS} indicates vulnerable species						
A	-	Anabat II	C	-	Call Identification	
O	-	Observation	P	-	Call Playback Response	
E	-	Elliott Trap	S	-	Habitat Search	
CT	-	Cage Trap	H	-	Harp Trap	
Sp	-	Spotlight	Sc	-	Scat, Track or Sign Identification	
St	-	Stagwatch	Pr1	-	Kevin Mills & Assoc. (April, 1994)	

APPENDIX 2

FAUNA SURVEY DETAILS

APPENDIX 2.1 - FAUNA SURVEY DETAILS

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time (24hr)
Diurnal Birds	10/09/02 11/09/02 12/09/02 13/10/02	3/8 cloud, 6 - 11 kph SE, temp 17°C 0/8 cloud, 11 – 19 kph S, temp 14°C 0/8 cloud, no wind, temp 17°C 0/8 cloud, no wind, temp 17°C	Diurnal Opportunistic Diurnal Opportunistic Diurnal Opportunistic Diurnal Opportunistic	1 hrs 15mins 13.45 - 15.00 1hr 09.25 – 10.25 1 hr 09.20 – 10.20 2 hrs 08.30 – 10.30
Nocturnal Birds	11/09/02 12/09/02	2/8 cloud, no wind, temp 13°C 0/8 cloud, no wind, temp 13°C	Owl call playback Owl call playback	1 hr 30 mins 19.00 – 20.30 1 hr 30 mins 18.00 – 19.30
Arboreal Mammals	11/09/02 11/09/02 12/09/02 12/09/02 13/10/02	0/8 cloud, 11 – 19 kph S, temp 14°C 2/8 cloud, no wind, temp 12°C 0/8 cloud, no wind, temp 17°C 0/8 cloud, no wind, temp 13°C 0/8 cloud, no wind, temp 17°C	Elliott trapping Spotlighting Elliott trapping Spotlighting Elliott trapping	40 trap nights 2 hrs 18.30 – 20.30 40 trap nights 1 hr 18.30 – 19.30 40 trap nights
Terrestrial Mammals	11/09/02 11/09/02 12/09/02 12/09/02 13/10/02	0/8 cloud, 11 – 19 kph S, temp 14°C 2/8 cloud, no wind, temp 12°C 0/8 cloud, no wind, temp 17°C 0/8 cloud, no wind, temp 13°C 0/8 cloud, no wind, temp 17°C	Trapping Spotlighting Trapping Spotlighting Trapping	24 B, 16A trap nights + 15 cagetraps nights 2 hrs 18.30 – 20.30 24 B, 16A trap nights + 15 cagetraps nights 1 hr 18.30 – 19.30 24 B, 16A trap nights + 8 cage trap nights
Bats	11/09/02 11/09/02 11/09/02 12/09/02 12/09/02 12/09/02	0/8 cloud, 1/8 moon, 0-6 kph SE, temp 12°C 0/8 cloud, 1/8 moon, 0-6 kph SE, temp 12°C 2/8 cloud, 1/8 moon, no wind, temp 12°C 0/8 cloud, 1/3 moon, 6-11kph SE wind 0/8 cloud, 1/3 moon, 6-11kph SE wind 0/8 cloud, no wind, temp 13°C	Anabat II - Stationary Anabat II - Mobile Harp Trapping Anabat II - Stationary Anabat II - Mobile Harp Trapping	2 hrs 18.00 - 20.00 1hr 19.00 - 20.00 1 Harp trap night 2 hrs 17.45 - 19.50 2 hrs 17.40 - 19.50 1 Harp trap night
Reptiles	11/09/02 11/09/02 12/09/02 12/09/02	0/8 cloud, 11 – 17kph SE, temp 20°C 2/8 cloud, no wind, temp 12°C 0/8 cloud, 0 – 6kph NE, temp 19°C 0/8 cloud, no wind, temp 13°C	Habitat search Spotlighting Habitat search Spotlighting	2 hrs 30 mins 12.30 - 15.00 1 hr 18.30 – 19.30 3 hrs 30 mins 11.30 - 15.00 30 mins 22.00 – 22.30
Amphibians	11/09/02 11/09/02 12/09/02 12/09/02 12/09/02	0/8 cloud, 11 – 17kph SE, temp 20°C 2/8 cloud, no wind, temp 12°C 0/8 cloud, 0 – 6kph NE, temp 19°C 0/8 cloud, no wind, temp 13°C 0/8 cloud, no wind, temp 13°C	Habitat search Spotlighting Habitat search Spotlighting Call Playback - Giant Burrowing Frog	2 hrs 30 mins 12.30 - 15.00 1 hr 18.30 – 19.30 3 hrs 30 mins 11.30 - 15.00 1 hr 18.30 - 19.30 0.5 hr 20.00 - 20.30

APPENDIX 2.2 - FAUNA SURVEY DETAILS FOR DECEMBER 2003

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time (24hr)
Diurnal Birds	01/12/03 02/12/03 02/12/03 03/12/03 03/12/03 04/12/03 04/12/03	8/8 light cloud, no wind, temp 21°C, light rain 8/8 cloud, no wind, temp 20°C, light patchy rain 8/8 cloud, no wind, temp 20°C, light patchy rain 8/8 cloud, no wind, temp 17°C, light to mod. rain 8/8 cloud, no wind, temp 25°C, light patchy rain 0/8 cloud, no wind, temp 18°C 0/8 cloud, no wind, temp 20°C	Diurnal Opportunistic Diurnal Opportunistic Target Glossy Black Cockatoo Census Diurnal Opportunistic Diurnal Opportunistic Target Glossy Black Cockatoo Census Diurnal Opportunistic	2hrs 30mins 14.30-17.00 7hr 15 mins 09.00-17.15 45 mins 09.45-10.30 4 hrs 30 mins 09.00-13.30 1hr 45 mins 15.30-17.15 40 mins 08.20-09.00 1 hr 45 mins 09.00-10.45
Nocturnal Birds	01/12/03 02/12/03 02/12/03 03/12/03	8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 17°C, no rain 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17°C, light rain	Owl call playback Stagwatching Owl call playback Stagwatching	20 mins 20.40-21.00 1hr 20 mins 08.00-08.50 (40 mins x 2 persons) 30 mins 21.00-21.30 50 mins 20.00-20.50 (50 mins x 2 persons)
Arboreal Mammals	01/12/03 02/12/03 02/12/03 03/12/03 03/12/03	8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17°C, light rain 8/8 cloud, no wind, temp 17°C, light patchy rain	Spotlighting Stagwatching Spotlighting Stagwatching Spotlighting	1hr 30 mins 20.30-22.00 1hr 20 mins 08.00-08.50 (40 mins x 2 persons) 3 hrs 19.45-22.45 50 mins 20.00-20.50 (50 mins x 2 persons) 20.00-21.15 1hr 15 mins
Terrestrial Mammals	01/12/03 02/12/03 03/12/03	8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17°C, light patchy rain	Spotlighting Spotlighting Spotlighting	1hr 30 mins 20.30-22.00 (90 mins x 2 persons) 3 hrs 19.45-22.45 (180 mins x 2 persons) 1hr 15 mins 20.00-21.15 (75 mins x 2 persons)
Bats	01/12/03 02/12/03 02/12/03 03/12/03 03/12/03	8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 20°C, light rain 8/8 cloud, no wind, temp 17°C, light patchy rain	Harp Trapping AnabatII Harp Trapping AnabatII Harp Trapping	3 Harp trap nights 4 person hrs 20.00-22.00 3 Harp trap nights 2 person hrs 20.00-21.00 3 Harp trap nights

APPENDIX 2.2 - FAUNA SURVEY DETAILS FOR DECEMBER 2003 (Cont.)				
Reptiles	01/12/03 02/12/03 02/12/03 03/12/03 03/12/03 04/12/03	8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 18-25°C, scattered showers 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17-26°C, light to mod. rain 8/8 cloud, no wind, temp 17°C, light patchy rain 0/8 cloud, no wind, temp 20°C	Spotlighting Habitat search Spotlighting Habitat search Spotlighting Habitat search	1hr 30 mins 20.30-22.00 (90 mins x 2 persons) 7 hrs 09.00-17.00 3 hrs 19.45-22.45 (180 mins x 2 persons) 4 hrs 10.00-16.00 1hr 15 mins 20.00-21.15 (75 mins x 2 persons) 1hr 25 mins 09.30-10.55
Amphibians	01/12/03 01/12/03 02/12/03 02/12/03 02/12/03 03/12/03 03/12/03 04/12/03	8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 18-25°C, scattered showers 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17-26°C, light to mod. rain 8/8 cloud, no wind, temp 17°C, light patchy rain 0/8 cloud, no wind, temp 20°C	Call playback for Giant Burrowing Frog Spotlighting + call detection Habitat search Call playback for Giant Burrowing Frog Spotlighting + call detection Habitat search Spotlighting + call detection Habitat search	1 hrs 21.00-22.00 1hr 30 mins 20.30-22.00 (90 mins x 2 persons) 7 hrs 09.00-17.00 45 mins 22.00-22.45 3 hrs 19.45-22.45 (180 mins x 2 persons) 4 hrs 10.00-16.00 1hr 15 mins 20.00-21.15 (75 mins x 2 persons) 1hr 25 mins 09.30-10.55

APPENDIX 2.3 - FAUNA SURVEY DETAILS FOR APRIL – MAY 2004 AND DECEMBER 2006

Fauna Group	Date	Weather Conditions	Survey Method	Person Hours / Time (24hr)
Diurnal Birds	28/04/04	0-8/8 cloud, no wind, temp 17-22°C	Glossy Black-cockatoo target survey	15 hrs 08.00-16.00
	28/04/04	0/8 cloud, no wind, temp 17°C	Glossy Black-cockatoo survey + point census survey at hollow trees	1 hr 30 mins 16.15-17.10
	29/04/04	0-7/8 cloud, no wind, temp 12-20°C	Glossy Black-cockatoo target survey	16 hrs 40 mins 07.10-16.00
	04/05/04	0/8 cloud, 0-10 kph W, temp 17-21°C	Glossy Black-cockatoo survey + point census survey at hollow trees	15 hrs 40 mins 13.05-17.00
	05/05/04	0-8/8 cloud, no wind, temp 17°C	Glossy Black-cockatoo survey + point census survey at hollow trees	31 hrs 40 mins 08.00-16.25
	06/05/04	0/8 cloud, no wind, temp 11-18°C	Glossy Black-cockatoo survey + point census survey at hollow trees	20 hrs 07.10-12.10
	18/05/04	1-7/8 cloud, no wind, temp 19-21°C	Glossy Black-cockatoo target survey	14 hrs 13.00-16.30
	19/05/04	0/8 cloud, no wind, temp 17-21°C	Glossy Black-cockatoo target survey	31 hrs 07.30-15.45
	20/05/04	0/8 cloud, 0-5 kph S, temp 18-22°C	Glossy Black-cockatoo target survey	30 hrs 07.45-15.45
	21/05/04	0/8 cloud, no wind, temp 18-19°C	Glossy Black-cockatoo target survey	5 hrs 08.00-09.15
	9/10/06	0/8 cloud, 5-10kph NW, temp 26°C	Opportunistic Observation	1 hr 18.30-19.30
	10/12/06	0/8 cloud, 0-5kph NE, temp 27°C	Bird Census, Opportunistic Observation	2hrs 30min 17.00-19.30
	11/12/06	0/8 cloud, no wind, temp 27°C	Bird Census, Opportunistic Observation	30mins 08.00-08.30
Nocturnal Birds	28/04/04	0-8/8 cloud, no wind, temp 17-22°C	Powerful Owl diurnal roost search	15 hrs 08.00-16.00
	28/04/04	0/8 cloud, no wind, temp 17°C	Powerful Owl target survey at hollow trees	1 hr 30 mins 16.15-17.10
	29/04/04	0-7/8 cloud, no wind, temp 12-20°C	Powerful Owl diurnal roost search	16 hrs 40 mins 07.10-16.00
	27/04/04	2/8 cloud, no wind, temp 18°C	Stagwatching, Spotlighting + call detection	2 hrs 40 mins 17.40-19.00
	28/04/04	0/8 cloud, no wind, temp 16°C	Stagwatching, Spotlighting + call detection	1 hr 40 mins 17.40-18.30
	29/04/04	5/8 cloud, no wind, temp 16°C	Stagwatching, Spotlighting + call detection	1 hr 50 mins 17.35-18.30
	04/05/04	0/8 cloud, 0-10 kph W, temp 17-21°C	Powerful Owl diurnal roost search + target survey at hollow trees	15 hrs 40 mins 13.05-17.00
	05/05/04	0-8/8 cloud, no wind, temp 17°C	Powerful Owl diurnal roost search + target survey at hollow trees	31 hrs 40 mins 08.00-16.25
	06/05/04	0/8 cloud, no wind, temp 11-18°C	Powerful Owl diurnal roost search + target survey at hollow trees	20 hrs 07.10-12.10
	04/05/04	0/8 cloud, 5-10 kph W, temp 16°C	Stagwatching, Spotlighting + call detection	3 hrs 20 mins 17.30-18.20
	20/05/04	0/8 cloud, 0-5 kph S, temp 16°C	Stagwatching, Spotlighting + call detection	5 hrs 17.15-18.20
	18/05/04	1-7/8 cloud, no wind, temp 19-21°C	Powerful Owl diurnal roost search	14 hrs 13.00-16.30
	19/05/04	0/8 cloud, no wind, temp 17-21°C	Powerful Owl diurnal roost search	31 hrs 07.30-15.45
	20/05/04	0/8 cloud, 0-5 kph S, temp 18-22°C	Powerful Owl diurnal roost search	30 hrs 07.45-15.45
	21/05/04	0/8 cloud, no wind, temp 18-19°C	Powerful Owl diurnal roost search	5 hrs 08.00-09.15
	9/10/06	4/8 cloud, 0-5 kph NW, temp 23°C	Stagwatch – Powerful Owl nest tree	45min 19.45-20.45
Arboreal Mammals	9/12/06	4/8 cloud, 0-5 kph NW, temp 23°C	Stagwatching, Spotlighting , call playback surveys	1hr 45min 19.45-21.30
	10/12/06	0/8 cloud, 0-5 kph NE, temp 24°C	Stagwatching, Spotlighting , call playback surveys	1hr 45min 19.45-21.30

APPENDIX 2.3 - FAUNA SURVEY DETAILS FOR APRIL – MAY 2004 AND DECEMBER 2006 (Cont.)				
Fauna Group	Date	Weather Conditions	Survey Method	Person Hours / Time (24hr)
Terrestrial Mammals	9/12/06	4/8 cloud, 0-5 kph NW, temp 23°C	Spotlighting Surveys	1hr 20.30-21.30
	10/12/06	0/8 cloud, 0-5kph NE, temp 27°C	Habitat searches, Scat & Track Surveys, Opportunistic Surveys	2hrs 30min 17.00-19.30
	10/12/06	0/8 cloud, 0-5 kph NE, temp 24°C	Spotlighting Surveys	1hr 20.30-21.30
Bats	9/12/06	4/8 cloud, 0-5 kph NW, temp 23°C	Anabat II Survey	1hr 30min 20.00-21.30
	10/12/06	0/8 cloud, 0-5 kph NE, temp 24°C	Anabat II x 2 Surveys	1hr 30min 20.00-21.30
Reptiles	9/10/06	0/8 cloud, 5-10kph NW, temp 26°C	Habitat searches, Opportunistic Surveys	1 hr 18.30-19.30
	9/12/06	4/8 cloud, 0-5 kph NW, temp 23°C	Spotlighting Surveys	1hr 20.30-21.30
	10/12/06	0/8 cloud, 0-5kph NE, temp 27°C	Habitat searches, Opportunistic Surveys	2hrs 30min 17.00-19.30
	10/12/06	0/8 cloud, 0-5 kph NE, temp 24°C	Spotlighting Surveys	1hr 20.30-21.30
	11/12/06	0/8 cloud, no wind, temp 27°C	Habitat searches, Opportunistic Surveys	30mins 08.00-08.30
Amphibians	9/10/06	0/8 cloud, 5-10kph NW, temp 26°C	Habitat searches, Opportunistic Surveys	1 hr 18.30-19.30
	9/12/06	4/8 cloud, 0-5 kph NW, temp 23°C	Spotlighting Surveys, Call Detection	1hr 20.30-21.30
	10/12/06	0/8 cloud, 0-5kph NE, temp 27°C	Habitat searches, Opportunistic Surveys	2hrs 30min 17.00-19.30
	10/12/06	0/8 cloud, 0-5 kph NE, temp 24°C	Spotlighting Surveys, Call Detection	1hr 20.30-21.30
	11/12/06	0/8 cloud, no wind, temp 27°C	Habitat searches, Opportunistic Surveys	30mins 08.00-08.30

APPENDIX 3

HOLLOW-BEARING TREE DATA

Table A3.1 – Hollow-bearing Tree Data for the Subject Site

No. of hollow-bearing trees	78
No. of Large hollow-bearing Trees	24
No. of large hollows	34
No. of medium hollows	86
No. of small hollows	69
Total no. of hollows	189
Area of subject site (ha)	21.9
Density of hollows (hollows/ ha)	8.63
No. of large hollows / ha	1.55
No. of Large hollow-bearing Tree / ha	1.1
No. of medium hollow / ha	3.93
No. of small hollows / ha	3.15

Table A3.2 – Hollow Calculation for Study Area & Surrounds

	Large	Medium	Small
Total no. of hollows	10	72	99
Average no. of hollows / quadrat	0.28	2	2.75
Average no. of hollows / ha	1.2	8	11.2

Table A3.4 – Hollow-bearing Tree Data for the Trade-off Areas (Area within Study Area, Outside of Subject site) (note: based on April – May 2004 transect surveys)

	Large
Total no. of hollow-bearing trees	41
Size of Trade-off Area (ha)	82
No. of hollow-bearing trees / ha	0.5

Table A3.3 – Hollow-bearing Tree Quadrat Data for Study Area & Surrounds

Quadrat Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	East of site				north of estuary			
No. of Habitat Trees	4	3	6	1	2	1	4	2	5	3	3	4	0	2	2	1	2	4	3	3	2	2	1	1	4	3	1	1	2	1	0	6	7	6	3	5
Density of Habitat Trees (Habitat Trees / ha)	16	12	24	4	8	4	16	8	20	12	12	16	0	8	8	4	8	16	12	12	8	8	4	4	16	12	4	4	8	4	0	24	28	24	12	20
No. of Small Hollows	6	3	4	7	2	1	3	3	5	1	3	5	0	2	3	1	2	3	2	1	2	0	1	1	6	1	1	2	1	1	0	2	4	6	8	6
No. of Medium Hollows	1	0	2	2	0	1	4	4	3	3	1	0	0	0	4	0	0	1	1	3	0	1	0	0	3	1	0	0	0	0	0	10	10	4	6	7
No. of Large Hollows	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2	0	1
Total no. of hollows	7	3	7	9	3	2	7	7	9	5	4	5	0	2	7	1	2	5	3	4	2	2	1	1	9	3	1	2	1	1	0	12	14	12	14	14
Density of Hollows (Hollows / ha)	28	12	28	36	12	8	28	28	36	20	16	20	0	8	28	4	8	20	12	16	8	8	4	4	36	12	4	8	4	4	0	48	56	48	56	56

APPENDIX 4

INITIAL RESPONSE TO DIPNR (2003)

APPENDIX 5

**REVIEW OF FLORA AND FAUNA BY
KEVIN MILLS AND ASSOCIATES (2004)**

**REVIEW OF FLORA AND FAUNA ASSESSMENTS
LOT 4 DP 771597 AND PORTION 4
LEO DRIVE, NARRAWALLEE
CITY OF SHOALHAVEN**

a report prepared by

KEVIN MILLS & ASSOCIATES
ECOLOGICAL AND ENVIRONMENTAL CONSULTANTS

April 2004
04/16

REVIEW OF FLORA AND FAUNA ASSESSMENTS
LOT 4 DP 771597 AND PORTION 4
LEO DRIVE, NARRAWALLEE
CITY OF SHOALHAVEN

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April 2004
04/16

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1 INTRODUCTION

Kevin Mills & Associates were engaged by Hazcorp Pty Limited to review the following documents relating to a proposed residential subdivision on land at Leo Drive, Narrawallee in the City of Shoalhaven.

The land is known as Lot 4 DP 771597 and Portion 4, Leo Drive; the extent of the land is shown on the figures in the following reports by Conacher Travers.

- Conacher Travers (2003). Flora and Fauna Assessment, Part of Lot 4 DP 771597 & Portion 4 off Leo Drive, Narrawallee, March.
- Conacher Travers (2003). Bushfire Protection Assessment for The Proposed Subdivision and Residential Development of Leo Drive, Narrawallee, March.
- Conacher Travers (2003). Letter to Department of Infrastructure, Planning and Natural Resources dated 25 September.
- Conacher Travers (2004). Addendum, Flora and Fauna Assessment Report, Part of Lot 4 DP 771597 & Portion 4 off Leo Drive, Narrawallee, January.
- Department of Infrastructure, Planning and Natural Resources (2004). Letter to Hazcorp regarding Flora and Fauna Assessment, Proposed 200 Lot Subdivision, off Leo Drive, Narrawallee dated 27 February.
- Law, Bradley S. (2003). Monitoring the Powerful Owl *Ninox strenua* at Maisie Williams Drive, Mollymook, 2002 – Year 3.
- Law, Bradley S. (2004). Monitoring the Powerful Owl *Ninox strenua* at Maisie Williams Drive, Mollymook, 2003 – Year 4.

The purpose of this report is to set out our findings after reviewing the above reports in terms of their adequacy in describing and assessing the flora and fauna of the subject land at Narrawallee. In particular, attention is given to assessing the validity of the conclusions reached regarding the known and likely presence of threatened species and communities, as listed in the schedules to the NSW *Threatened Species Conservation Act 1995*.

Inspections of the site were made in March and April 2004 specifically to undertake this review. The consultants were already familiar with the site, having visited it on previous occasions while carrying out other investigations.

The proposed development involves the residential subdivision of about 30 hectares of land immediately to the west of the existing residential area of Narrawallee. A total of 200 lots are proposed. The site is mostly covered in natural forest that is a part of a much larger area of forest extending to the south, west and north. The adjoining forest on the remainder of the Hazcorp land will be set aside as a public reserve, possibly ultimately to be added to the nearby Narrawallee Creek Nature Reserve. The features of the site and the proposed residential subdivision are shown on a photo-map at Figure 1 in the original flora and fauna report and Figures 1 and 2 in the addendum report by Conacher Travers (2003, 2004).

The "subject land" as recognised in this report refers to the "study area" as shown on Figure 1 in the original flora and fauna report.

2 GENERAL CONTENT OF THE REPORTS

The flora and fauna report prepared by Conacher Travers in March 2003 documented their field surveys carried out in mid-September 2002. The report provides a fairly comprehensive description of the subject site, its character and the biota that they found there. This report is referred to here as the "original flora and fauna report".

The above report was supplemented by an addendum report prepared by Conacher Travers in January 2004. This report documented the results of additional targeted field surveys and assessments undertaken in December 2003. This additional survey work was carried out in response to a request from the Department of Infrastructure, Planning and Natural Resources (DIPNR) for more information on certain species of plant and animal.

Sections of the above reports describe the site, the vegetation on the site and the habitats found there; lists of the plant and animal species found on the subject site, and in the case of fauna on nearby sites, are also provided. Some survey work undertaken as part of the additional work documented in the addendum report includes sites off the subject land. Particular attention is given to those species, etc. that are listed under the *Threatened Species Conservation Act 1995*, and their potential to occur on the subject land. In general, standard survey and assessment methods have been used to identify, describe and assess the biota of the subject land.

Conacher Travers have also responded to requests from DIPNR for additional information in a letter report dated 25 September 2003.

The vegetation and flora of the subject land, including threatened species and communities, are described in Sections 4.2, 4.6 and 4.7 of the original flora and fauna report, while additional information is provided in Section 4 of the addendum report.

Fauna, including threatened animal species, are discussed in Sections 4.8 to 4.11 of the original Conacher Travers (2003) report and in Section 4.2 of the addendum report; the fauna survey methods are set out Section 2.2 in both reports.

We do not propose to repeat all of the information on the flora and fauna of the site contained in the reports by Conacher Travers. Our aim in the next section is to identify the key flora and fauna issues present on the subject site and to assess the adequacy of the reports in addressing these issues.

3 IDENTIFYING THE KEY ISSUES

The purpose of this section is to draw out those flora and fauna issues that are significant in terms of the site and the proposed subdivision. The following section assesses the adequacy of the available reports in addressing these issues.

3.1 THE FOREST AS HABITAT

The flora and fauna report describes the site, its vegetation and habitat characteristics at various places in the report. The report also lists the species of plants and animals located during their surveys, as well as listing those species of animal recorded in other studies nearby. These lists are provided in the Appendix to the report. The addendum report also provided the flora and fauna lists as an appendix, with a few additions.

Descriptions of the vegetation communities occurring on the land are provided in Section 4.2 in the original report and their distribution on the land, along with other relevant flora and fauna information, is shown on a colour photo-map at Figure 1. Additional information on tree hollow distribution on and off the development site is provided in the addendum report; see Figure 1, Sections 2.2.6 and 3.2.5, and Appendix 3.

The species lists provided in the appendices to the reports give an idea of the diversity of the plants and vertebrate animals occurring in the forest on the site. The lists contain 125 native plants and 71 native vertebrate animal species recorded on the site. These figures are clearly under-estimates and based on a limited amount of time on the site. However, this is consistent with our understating of these forest types in the region; that is, they are species rich, particularly in terms of mammals.

The species lists appear to be fairly comprehensive, although the plant list was found to be somewhat deficient. A casual walk for ten minutes along one of the tracks found an additional 20 species that were not listed on their plant list. This is probably not that important, but it perhaps does bring into question the familiarity with the flora of the region to those undertaking the survey. As noted elsewhere, we have identified at least a few species misidentifications. Two plant species that appear on the list are very rare on the south coast and if present on the subject land would be significant, although they are not listed as threatened. These are *Wilkiea huegeliana* and *Blechnum camfieldii*. We believe that both identifications are almost certainly misidentifications.

The proposed development will result in the clearing of about 30 hectares of high quality forest. The reports by Conacher Travers (2003, 2004) did not attempt to place this into a wider context nor consider the cumulative loss of forest in the locality and region. Admittedly, this is a difficult assessment to make, although the work that we have carried out for Shoalhaven City Council for the Milton-Ulladulla LEP, including vegetation mapping and calculations of the areas of the different forest types, provides a basis upon which the loss of vegetation types can be assessed, at least in the Milton-Ulladulla region.

It is also unfortunate that the reports did not provide information and maps of the forest adjoining the subject land to the west. There is some information but not enough to show the reader what type of habitats, including threatened species habitats, are present. This would have been useful in assessing the habitats present on the subject land.

3.2 THREATENED PLANT SPECIES

The flora and fauna assessment report prepared by Conacher Travers (2003) stated in Section 4.6 that "one threatened flora species protected by State and National legislation have [sic] been identified as having the potential to occur within the subject site." This species, subsequently identified as the Leafless Tongue Orchid *Cryptostylis hunteriana*, was culled from a list of 11 such species listed for the Ulladulla 1:100,000 map sheet in the NSW wildlife Atlas; this is explained in their Section 4.6.1. No other species were dealt with in detail, although all species are listed in Table A1.4 at Appendix 1.

The later addendum flora and fauna report by Conacher Travers (2004), in response to matters raised by DIPNR, again discussed the threatened plant species listed for the above 1:100,000 map sheet; see Section 4.1.5. Note that the Ulladulla 100,000 map sheet extends onto the tablelands, so the Wildlife Atlas list includes high altitude species that do not occur anywhere near Narrawallee. The exclusion of these species from detailed discussion is an appropriate technique to use. The original report discussed each of these species in Table A1.4 (not A1.3 as stated in Section 4.6.1). These additional species are also discussed in the addendum report at Section 4.1.2 and Section 4.1.5.

The probability of each species occurring on the subject land is adequately dealt with in the addendum report; none of the species are likely to occur there as they are either high altitude species or the habitat on the subject land is not suitable.

Two orchid species are dealt with especially and in more detail in the addendum report, these are the Leafless Tongue Orchid *Cryptostylis hunteriana* and the East Lynne Midge Orchid *Corunastylis vernalis* (syn. *Genoplesium vernale*); see Section 4.1.1. The report notes that contact with the expert on the latter species indicates that this orchid occurs in habitat in the East Lynne area (about 35 kilometres to the south of Narrawallee) that does not occur on the subject land. It appears that the probability of this orchid occurring at Narrawallee is very slim.

Conacher Travers undertook surveys on the subject land on 2 and 3 December 2003 using numerous traverses at 10 metre spacings in an attempt to locate the above two orchids. This is a standard method that is acceptable to the NPWS and that we have used several times looking for ground orchids.

A few points need to be made about the survey for *Cryptostylis hunteriana*:

- The orchid did flower during the 2003/2004 season, but only a few flowering plants appeared at some of the known sites (K. Mills, pers. obs.).
- The species has been found growing in forest environments to the north of Conjola Lake, along old logging tracks etc, but always on sites without dense shrubs or ground cover (K. Mills, pers. obs.). There is thus some suitable habitat on the subject land.
- Swansea, a site stated as having flowering orchids at the time of their survey, is a long way north of Narrawallee and the orchids in the Shoalhaven are likely to flower later.
- The earliest we have found this orchid flowering in the region is 28 November; most plants flower later and without flowers or leaves the species is very difficult to locate.
- *Cryptostylis hunteriana* is noted as flowering between December and February, although in the Shoalhaven we have found it flowering from the last week in November to mid March. Plants start flowering at the bottom of the spike with the flowers progressively opening up along the spike as the season progresses; this explains the long flowering period.

The letter from DIPNR dated 27 February 2004 requested further consideration of other threatened species noted by them as also listed on the Ulladulla 1:100,000 map sheet; these species are *Grevillea renwickiana*, *Leptospermum thompsonii* and *Melaleuca biconvexa*. The first two species are high altitude species, the former being found on the western margins of Morton National Park, many kilometres inland of Narrawallee and in completely different habitat. The *Leptospermum* is found in the Clyde Mountain area

and other high country in the vicinity, such as in Morton National Park. Again, this is many kilometres inland from Narrawallee. Neither species could possibly be expected to occur on the subject land, and their exclusion from consideration in the reports by Conacher Travers is understandable.

The tree paperbark *Melaleuca biconvexa* occurs around the western margins of Jervis Bay, with its southern limit at about Wandandian (K. Mills pers. obs.). This is one species that probably should have been considered in the flora and fauna report, as suitable habitat exists along the bottom of the creek valley on the subject land.

Melaleuca biconvexa occurs on poorly drained creek flats in the Vincentia - St Georges Basin area, where it is sometimes locally common. We have not found it south of about Wandandian (near the highway), although we have undertaken numerous searches between that location and the Ulladulla area. Inexperienced observers could mistake it for another species of tree paperbark, as this threatened tree has a very restricted distribution and is generally unknown to most workers.

Perusal of the plant list in the original flora and fauna report (Appendix 1, Table A1.1) found that four species of *Melaleuca* are listed; namely *M. armillaris*, *M. linariifolia*, *M. ericifolia* and *M. hypericifolia*. The two last named species are shrubs with distinctive habit and leaves, and could not be confused with *M. biconvexa*. *M. linariifolia* and *M. biconvexa*, both trees, have quite distinct leaves and could not really be confused. *M. armillaris* almost certainly does not occur on the subject land, it is either very rare in the Shoalhaven or, more likely, is absent from this region altogether. It may be a misidentification for a large specimen of *M. ericifolia*.

The habitat that could conceivably support *M. biconvexa* is along the creek, which is outside the proposed development area. *M. biconvexa* would almost certainly not occur in the denser forest on the adjacent upland.

3.3 THREATENED ANIMAL SPECIES

Threatened animal species are discussed in Section 4.11 of the original flora and fauna report as well as Table A1.4 in Appendix 1, and in Sections 3.2 and 4.2 of the addendum report. The first report lists a total of 25 threatened fauna species, not 22 as stated in the first paragraph under Section 4.11.1. These species, listed in a table on page 14 and 15 of the addendum report, were mostly obtained from the NSW Wildlife Atlas as having been recorded within 10 kilometres of the subject land. This list forms the basis of their threatened fauna species assessment, including the eight part test, which is subsequently set out in Section 5 of the original report, starting at page 17.

We concur that the above list of species includes those species that could reasonable be expected to occur at Narrawallee and that the list is exhaustive in terms of those species that require discussion in regard to the subject land.

Two threatened bat species were recorded during the Conacher Travers surveys: the Grey-headed Flying-fox, seen and heard during the December 2003 surveys, and the Eastern False Pipistrelle, recorded using ANABAT echo-location recording equipment in September 2002.

The report speculates that the Powerful Owl and the Glossy Black-Cockatoo utilise the forest on the subject land. In assessing the Powerful Owl, the reports document a survey of the tree hollows on and around the subject land and targeted surveys for this owl. The original report states that a Powerful Owl was heard calling on 1 December 2003 in response to a call playback session at the known nest tree and that an owl was subsequently spotlighted about 100m north of this nest tree; see location on Figure 1 in addendum

report. The addendum report states that an owl "was heard calling to the south of the subject site on the night of 11 September 2002"; no accurate location or distance was provided.

The known nest tree is shown on Figure 1 in the addendum report (labelled "nocturnal call playback (2003)"). Using the map scale on Figure 1, this tree is located about 117 metres west of the proposed development (i.e. "subject site" in their Figure 1). The original report stated at page 19 that this nest tree is "located approximately 150 metres to the west of the subject site"; this appears to be an over-estimate.

The area of Black She-oak that the Glossy Black-Cockatoo is most likely to use is shown on Figure 1 in the addendum report as red hatching. Our field inspection found the delineation of these trees to be fairly accurate, noting that there is also a scattering of casuarinas elsewhere on the site.

We concur in general with the conclusions reached in assessing each of the threatened species dealt with in the eight-part test. We have only a few concerns and these are discussed below in Section 4.2.

3.4 ENDANGERED ECOLOGICAL COMMUNITY

Presence of the Community

The endangered ecological community known as Sydney Coastal Estuary Swamp Forest Complex was identified in the addendum report as occurring along the creek valley in the lowest, western part of the subject land. A surveyed boundary of the community is shown on the photo-map at Figure 1 in the addendum report. This forest was identified in the original flora and fauna report as Fresh Treed Swampland, the report stating that "this community does not occur within the subject site [development area], although does occur within the study area" (page 11). The community was subsequently dealt with in more detail in the addendum report.

We have provided a description of the community at Appendix 1 that contains the Final Determination for the above community made by the NSW Scientific Committee (2000). The swamp forest community on the western part of the subject land is at the upper limit of the community, it is totally a freshwater environment and well away from the estuary. The forest to the north of the development area is closer to the estuary and is somewhat different in its species composition. The species present in each case clearly indicate that the forest is part of the endangered ecological community complex as envisaged by the NSW Scientific Committee.

The addendum report describes the method of delineating the endangered community in the vicinity of the Narrawallee land, in the following way (see Section 4.1.7 page 12).

"During the inspection of the community, the line of demarcation between the hillside and estuarine alluvium over most of the area was almost impossible to determine visually, due to the dense understorey and very low gradients along the foot of the hillside. It was noted that two of the most common shrubs were *Melaleuca ericifolia* and *Pultenaea flexilis* [should be *Pultenaea blakelyi*]. *Melaleuca ericifolia* has a particular affinity for the types of soil which support SCESFC, while *Pultenaea flexilis* has an equally strong aversion to those soils. It was noted that although both species were very common, there was almost no overlapping of the species and that where the overlapping did occur, it was only by a few metres."

and

"The line of demarcation between those species was adopted as the boundary of SCESFC."

The presence and absence of certain species is an accepted method of defining the boundary of an ecological community; in general we agree with this approach. However, delineating the boundary by using just two plant species may not be adequate to pick subtleties in the boundary. Having viewed a small part of the flagged surveyed edge during our site inspection, it seems that the method used has picked up the edge of the community as we would have defined it, accepting that no two people will mark the boundary in

exactly the same location. However, further checking of the boundary is, we believe, required to ensure that the boundary upon which the impact assessment and the setback distances are based, is accurate.

We concur that the bulk of the forest on the subject land, Blackbutt - Red Bloodwood - Turpentine Tall Forest, is not an endangered ecological community. This is the dominant forest type in the Milton-Ulladulla district.

Development Setback Distances

The addendum report states "the nearest point of this community [Sydney Coastal Estuary Swamp Forest Complex] to the subject site [development area] boundary as [sic] approximately 20m, while the distance between the SCESFC boundary and the current development is approximately 50 metres. The proposed fire trail will be contained within the subject site and therefore be situated at least 20 metres from the SCESFC boundary. Drainage contours and sediment control structures included within the fire trails [sic] design are provided to prevent any adverse affects on the SCESFC community." (see Section 4.1.7, pages 12 -13).

Why the fire trail and drainage works are not considered to be part of the development is unclear, as they clearly are development. This means that the minimum distance between the development and the endangered community boundary is "approximately 20m"; this has apparently not been determined by survey. Our measurements of the setback distances, based on the photo-map at Figure 1 in the addendum report, range from less than 20 metres to 50 metres.

Impact on the Community

The report focuses on erosion and sediment impacts on the community and does not mention any other likely impacts of having an extra 200 houses as close as 20 metres from the retained forest. Some impacts are mentioned in the report but there is one section that discusses in detail the impact of the development, the amelioration measures proposed or the management requirements of the retained forest. In the latter matter, the management of the edge of the forest (i.e. the buffer area) is a critical issue.

4 ADDRESSING THE KEY ISSUES

The key issues distilled from the discussion in Section 3, above, are dealt with in detail below. A summary of the additional field surveys and assessments that we believe are required is provided in Section 5.

4.1 THREATENED PLANTS

Cryptostylis hunteriana

Having made the points in Section 3 that may give the impression of casting doubt on the timing of the surveys, we believe that the likelihood of actually finding *Cryptostylis hunteriana* on the subject land at Narrawallee to be fairly small. We base this belief on the amount of suitable habitat available on the subject land; such habitat is restricted to a few locations along the existing bush tracks where shrub cover is low. All of our observations of this species in the Shoalhaven region indicate that it is very unlikely to occur on sites that have a moderate to dense shrub layer. We accept that the species probably does not occur on the site.

Melaleuca biconvexa

It seems unlikely that this tree is present in the swamp community along the creek, and even less likely that it is present on the adjacent upland development site. However, it would be worthwhile keeping a lookout for it during the boundary checking envisaged below in Section 4.3.

4.2 THREATENED ANIMALS

Powerful Owl

Although we note that the nest tree at Narrawallee is over 100 metres from the edge of the development and that this is greater than the distance NPWS have stated as an appropriate set back from the Mollymook nest tree, we believe that further discussion of the potential for another 200 houses to impact on the Powerful Owl should be undertaken.

The original report provides a few recommendations to address the potential presence of the Powerful Owl on the development site; these are hidden away in the eight-part test section of the report. The report does not have a section containing recommendations or a separate section dealing with the actual impact of the development, other than the eight-part test.

Glossy Black-Cockatoo

Although it is unlikely that the stands of Black She-oak on the development site are of critical importance to the local Glossy Black-Cockatoos, and that most of this habitat in the district is within conservation reserves, it would complete the assessment if we knew how much similar habitat was available on the land to be reserved to the west of the development site.

4.3 ENDANGERED COMMUNITIES

Extent of Sydney Coastal Estuary Swamp Forest Complex

We are not convinced that the method used to delineate the boundary of this community is accurate. Further checking of the boundary is, we believe, required to ensure that the boundary upon which the impact assessment and the setback distances are based, is accurate. The boundary may turn out to be the same, but at least it would have been confirmed by two independent biologists, providing a firmer basis upon which to make assessments.

Development Setbacks

Once the above boundary has been surveyed, an assessment should be undertaken of the location of the proposed development in terms of the edge of the community. This assessment should look specifically at the setback distance, taking into account local topography, the nature and location of the drainage control works and the measures to be employed to avoid and minimise the short term and long term potential to impact upon the endangered community. A proposed setback distance of about 20 metres is, by today's standards, quite narrow and this should specifically be investigated.

Other Potential Impacts

As noted above in Section 3.4, the Conacher Travers reports focus on potential erosion and sediment impacts on the endangered community. Such impacts require an engineering solution and it is beyond our brief or expertise to comment on such matters. However, there are various other potential impacts that should be considered in terms of the adequacy of the proposed setback distances. These may be able to be satisfactorily addressed through urban design and management, but given the significance of the forest adjacent to the development site, careful consideration should be given to the matter. We believe that the following matters should be considered.

- impact during the development and construction period when it is most likely that significant impacts can occur;
- management of the edge of the retained forest; e.g. should it be fenced and what type of fence should be used;
- explore imaginative ways of addressing the usual impacts on adjacent bushland that accompany residential development.
- the eventual ownership of the retained forest should be explored; and
- an interim bushland management plan should be prepared, this would also deal with the clearing of the development area and the retention of trees there.

Impact of the Development

As noted above, there is no detailed assessment or discussion of the overall impact of the proposed subdivision. Similarly, there is no description of the forest area to be dedicated as public reserve. This should have been done not only because it is a very positive aspect of the proposal, but also because it places the loss of the forest on the development site in a better context.

Management of the Retained Forest

We have noted above that there is no discussion of the appropriate management regime for the retained forest (i.e. public reserve). Although the preparation of a Bushland Plan of Management could be a condition of consent, some discussion of management needs would have been useful, particularly the management of the edge of the retained forest during the construction period.

4.4 OTHER MATTERS

Cumulative Loss of Forest Habitat

Although we appreciate that assessing cumulative impact is difficult, this should at least be attempted. Data are available on the area of the vegetation communities in the Milton-Ulladulla LEP area, and the percentages that are reserved or zone for conservation. This would place the forest to be cleared in a better context.

5 SUMMARY OF RECOMMENDED ADDITIONAL WORK

The following is a summary of the additional survey and assessment work that we believe would provide a complete and thorough assessment of the proposed subdivision at Leo Drive, Narrawallee.

- (i) The boundary of the endangered ecological community Sydney Coastal Estuary Swamp Forest Complex should be checked by a botanist. Where this differs from the boundary tagged and surveyed by Conacher Travers it should be re-surveyed and a new map prepared.
- (ii) Careful consideration should be given to the distances between the developed area (i.e. the stormwater swale) and the swamp forest community, as mapped in the above process. This buffer or setback distance should be assessed in terms of the potential to impact on the community, not only regarding stormwater, but all other impacts that are likely to accompany the residential development.
- (iii) There is a need to compile a report chapter describing the impact of the proposed subdivision; this should discuss all potential impacts associated with the development. Part of this chapter should place the loss of the forest into a regional and local context. The chapter should also address all of the ameliorative measures proposed to protect the environment, including subdivision design and management actions.
- (iv) The character and significant features of the forest to be retained and dedicated to the public should be described; this will place the loss of the forest on the development site into a wider context. This is particularly important for assessing the loss of the forest and significant features (e.g. Glossy Black-Cockatoo foraging area) on the development site.
- (v) Some consideration should be given to the management of the forest to be retained (i.e. the public reserve), particularly the forest edge during the construction phase. The preparation of a Bushland Plan of Management should be a condition of consent, but is probably not warranted at this stage.
- (iv) There is no need for further surveys for threatened plant species, although attention should be given to the tree paperbarks during the marking of the swamp forest boundary, as *Melaleuca biconvexa* could conceivably occur in the area.
- (iv) Further consideration of the potential to impact on the Powerful Owl should be made. For example, the presence and abundance of prey in the forest on the development site.
- (v) Further consideration of the potential to impact on the Glossy Black-Cockatoo needs to be undertaken. This entails quantifying the area of foraging habitat on the site and in nearby areas and investigating possible use of hollow-bearing trees on the site for nesting.
- (vi) The addendum report hints at a large amount of data on the forest on the development site and the forest to be retained, gathered from survey plots. Only the hollow-bearing tree data is used in the report. More should be made of this data, particularly in characterising the forest to be retained.
- (vii) Once the above information has been gathered, a fresh "eight-part test" should be prepared, incorporating the relevant new detailed information, particularly on the Powerful Owl, Glossy Black-Cockatoo and the Sydney Coastal Estuary Swamp Forest Complex.

6 REFERENCES

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NSW Scientific Committee
Final Determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list the Sydney Coastal Estuary Swamp Forest Complex in the Sydney Basin Bioregion as an ENDANGERED ECOLOGICAL COMMUNITY on Part 3 of Schedule 1 of the Act. The listing of Endangered Ecological Communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. The Sydney Coastal Estuary Swamp Forest Complex is the name given to the plant community characterised by the assemblage of species listed in paragraph 3 that is a mosaic of vegetation types occurring on waterlogged estuarine alluvial soils and strongly influenced by periodically poor drainage conditions. All sites are within the Sydney Basin Bioregion.
2. Sydney Coastal Estuary Swamp Forest Complex includes vegetation described as Coastal Swamp Forest Complex (Map unit 27a) in Benson & Howell (1994), and referred to in Adam & Stricker (1993) and Smith & Smith (1997). Sydney Coastal Estuary Swamp Forest Complex is part of the alluvial forest of Chafer (1997).
3. Sydney Coastal Estuary Swamp Forest Complex is characterised by the following assemblage of plant species

Acacia longifolia
Blechnum camfieldii
Calochlaena dubia
Casuarina glauca
Dodonaea triquetra
Eucalyptus robusta
Gahnia sieberiana
Hydrocotyle peduncularis
Imperata cylindrica
Livistona australis
Melaleuca ericifolia
Melaleuca styphelioides
Phragmites australis
Triglochin procera
Villarsia exaltata
Baumea juncea
Blechnum indicum
Carex appressa
Darwinia procera
Eucalyptus botryoides
Gahnia clarkei
Glochidion ferdinandi
Hypolepis muelleri
Isachne globosa
Melaleuca biconvexa
Melaleuca linariifolia
Persicaria strigosa
Pteridium esculentum

Typha orientalis
Viola hederacea

4. The total species list of the flora and fauna of the community is considerably larger than that given in 3 (above), with many species present in only one or two sites or in very small quantity. In any particular site not all of the assemblage listed above may be present. At any one time, propagules and seeds of some species may only be present in the soil seed bank with no above-ground individuals present. Invertebrate species may be restricted to sediments or canopy trees and shrubs for example. The species composition of the site will be influenced by the size of the site and by its recent disturbance history. The number of species and the above-ground composition of species will change with time since fire, and may also change in response to changes in fire frequency. The community includes animals and invertebrates many of which are poorly known.
5. Sydney Coastal Estuary Swamp Forest Complex is a mosaic ranging from forest to scrub to reedland and includes open-forest with *Eucalyptus robusta* and *Eucalyptus botryoides*, woodland with *Livistona australis*, scrub with *Melaleuca* species including *Melaleuca linariifolia*, *Melaleuca styphelioides* and *Melaleuca ericifolia*, herbland with waterferns and reedland with *Phragmites australis*. *Casuarina glauca* may occur as a component of this community [but pure *Casuarina glauca* forests are a separate community, as are mangroves and saltmarsh].
6. Sydney Coastal Estuary Swamp Forest Complex occurs on waterlogged estuarine alluvial soils strongly influenced by periodically poor drainage conditions such as soils of the Cockle Bay, Tacoma Swamp and Warriewood Soil Landscapes (Chapman & Murphy 1989, Murphy 1993). It may grade into Sydney Coastal Riverflat Forest which generally occurs on higher land or away from the estuary. It may grade into *Casuarina glauca*, *Juncus* saltmarsh and mangrove communities in areas subject to regular tidal inundation. It differs from Sydney Coastal Freshwater Swamp in having a more silty site and higher nutrients, and generally less open standing water.
7. Sydney Coastal Estuary Swamp Forest Complex is or has been known to occur in the local government areas of Lake Macquarie, Wyong, Gosford, Baulkham Hills, Pittwater, Warringah, Liverpool, Rockdale, Sutherland, Wollongong, Shellharbour and Kiama, but may occur elsewhere in the Sydney Basin Bioregion.
8. Sydney Coastal Estuary Swamp Forest Complex has been reported from Swansea, Porters Creek Wetland, Wyong River floodplains, Lisarow wetlands, Erina Creek, Bensville, Middle and Deep Creeks and Narrabeen Lagoon, Dee Why Lagoon, Voyager Point, Leo Smith Reserve Ramsgate, Kurnell, Bundeena and Mill Creek, Bellambi Lagoon, Fairy Creek, Wollongurrie Swamps (Duck Creek), Dunmore Wetlands (Shellharbour) and Minnamurra Wetlands (Kiama) but may occur elsewhere.
9. Disturbed remnants are still considered to form part of the community described under this determination where the natural soil and associated seedbank is partially intact. At some sites changes to hydrology or drainage might be required to assist regeneration.
10. Sydney Coastal Estuary Swamp Forest Complex has been extensively cleared and filled for recreational purposes - playing fields, car parks and roads. Remnants are threatened with waste filling, clearing associated with urban development, urban runoff associated with proximity to urban and agricultural areas, weed invasion including *Ludwigia peruviana*, *Ipomoea cairica* and *Anredera cordifolia*, and by grazing and trampling, including by deer.
11. Small areas of the Sydney Coastal Estuary Swamp Forest Complex has been reported from Cockle Bay Nature Reserve, and Garigal and Royal National Parks.

12. Plant species of conservation significance reported for Sydney Coastal Estuary Swamp Forest Complex include *Melaleuca biconvexa* and *Darwinia procera*. As a winter flowering plant *Eucalyptus robusta* is particularly important to fauna. Animals of conservation significance include Australasian Bittern, *Botaurus poiciloptilus* and Large Footed Myotis, *Myotis adversus*.
13. In view of the small size of existing remnants, and the threat of further disturbance and degradation, the Scientific Committee is of the opinion that the Sydney Coastal Estuary Swamp Forest Complex in the Sydney Basin Bioregion is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

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APPENDIX 6

ADDENDUM FLORA AND FAUNA ASSESSMENT REPORT (CONACHER TRAVERS, JANUARY 2004)

ADDENDUM
FLORA AND FAUNA ASSESSMENT REPORT

**PART OF LOT 4 DP 771597
& PORTION 4
OFF LEO DRIVE,
NARRAWALLEE**

**JANUARY 2004
(REF: 2308)**

ADDENDUM
FLORA AND FAUNA ASSESSMENT REPORT

**PART OF LOT 4 DP 771597
& PORTION 4
OFF LEO DRIVE,
NARRAWALLEE**

JANUARY 2004

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National Parks and Wildlife Service

Individual staff members are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Section 120 & 131 of the *National Parks and Wildlife Act, 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: S10359 & S10618.

Department of Agriculture

The staff of *Conacher Travers* are licensed under an Animal Research Authority issued by the Department of Agriculture. This authority allows *Conacher Travers* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

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SECTION 1

INTRODUCTION

Conacher Travers Pty Ltd prepared a Flora and Fauna Assessment Report (March 2003) that identified the flora and fauna characteristics of Part of Lot 4 DP 771597 and Portion 4 off Leo Drive, Narrawallee. An assessment of the proposed development by the Department of Planning and Natural Resources (DIPNR) in Mid 2003 who required additional survey works to be undertaken over the site. As a result further survey was carried out on (1st to the 4th of December 2003). This addendum report has been prepared to assess the results of the further survey and to address the issues that have been raised by the consent authority. This addendum report is to be read in conjunction with the original Flora and Fauna Assessment Report (March 2003).

1.1 PREVIOUS SURVEYS

Powerful Owl 'Eight Part Test' Assessment, Part Lot 122 D.P. 579649 Yarrawonga Drive, Mollymook November 2002. Conacher Travers (2002b).

This previous report is located approximately 1.5km to the south of the current subject site.

This report concluded that the distance between the proposed subdivision and the nesting tree is considered likely to be sufficient in relation to buffer width, particularly as it is greater than that previously recommended by NPWS. It was considered that the proposed subdivision is unlikely to result in a significant impact on the nesting tree as a viable nesting location.

Flora and Fauna Assessment Proposed Residential Subdivision Yarrawonga Drive, Mollymook City of Shoalhaven, May 2002 Kevin Mills & Associates Pty Limited.

This report was prepared over the same area as covered by the current report. It focused on the likely impact upon the Powerful Owl as a result of the proposed 15 lot subdivision. Points raised within the report included:

- The subdivision is well clear of the nest tree and the separation distance is greater than what was recommended by the National Parks and Wildlife Service in the Director-General's Concurrence Report in 1999;
- The forest on this site is not roosting habitat for Powerful Owls; there are no dense stands of Turpentines, their preferred roost tree species, and owls have never been found roosting on the site;
- The owls forage over a large home territory that takes in the residential areas and fragmented forest in the Mollymook area, so the loss of this relatively small area is not likely to place them at risk of extinction;
- The development of the subdivision will involve clearing of an additional 1.03ha of Blackbutt Forest. This 1.03ha constitutes only a very small proportion of the foraging habitat within the Powerful Owls' home territory, which includes most of the forest around Mollymook. The SIS surveys demonstrated that the Powerful Owls' arboreal prey (i.e. possums and gliders) are abundant in the forests around Milton-Ulladulla, including fragmented areas of forest.

The report concluded that the proposed subdivision in Yarrawonga Drive is not likely to have a significant effect on Powerful Owls and that a SIS is not required.

Ecological Review Draft Milton-Ulladulla Local Environmental Plan City of Shoalhaven. Kevin Mills & Associates Pty Ltd, May 2002.

This report refers to the Powerful Owl habitat at Narrawallee. According to this report the NPWS makes comment on the value of Blackbutt Tall Forest and the Powerful Owl nest tree at Narrawallee and the need to protect it and the surrounding habitat. This report reiterates the distance of the nest tree from the 2(c) zone to justify development of this area. The report states that the tree is at least 80m from the edge of this zone and that this is consistent with advice given by the NPWS in their concurrence report on a residential development at Garside Road, Mollymook, where a distance of 75m was considered adequate from that nest tree.

This report states that most of the Glossy Black-cockatoo habitat in the LEP area is zoned Environmental Protection.

Flora and Fauna Assessment of Lot 385 D.P. 45117, Matron Porter Drive, Narrawallee, New South Wales. Development Opportunities and Constraints Study. March 2002. Lesryk Environmental Consultants March 2002.

This previous survey site is located approximately 800m to the south of the current subject site.

Grey-headed Flying-fox, Yellow-bellied Sheath-tail-bat, Eastern False Pipistrelle, Common Bentwing-bat,

This survey recorded four (4) threatened species, Grey-headed Flying-fox (*Pteropus poliocephalus*), Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*), Common Bentwing-bat (*Miniopterus schreibersii*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).

Proposed Rezoning at Seaspray Street, Narrawallee Lot 29 D.P. 874275 – Response to Issues April 2000. Gunninah Environmental Consultants

This previous report is for land located adjacent to the south of the current subject site.

This report prepared a table of relevant planning and conservation issues relating to the proposed rezoning of this site (Table 1 of Gunninah report). The proposed measures for Powerful Owl included:

- A minimum of 100m buffer zone around the identified nest tree;
- A boundary fence of the site would be constructed to limit access to the nest tree; and
- Potential habitat and foraging resources will be maintained within the Environmental Protection Zone.

The outcome of these measures was to provide approximately 140m of protection between the nest tree and the subdivision.

Part Lot 28 D.P. 871790 Seaspray Street, Narrawallee, Proposed Rezoning and Residential Development, Supplementary Flora & Fauna Issues, December 1999. Gunninah Environmental Consultants.

These subsequent investigations have indicated that the Powerful Owl nest tree is located approximately 100m to the north of the subject site. According to this report the NPWS have indicated that a 100m buffer around the nest tree is adequate, both to separate the tree and development activities, and to minimise the likelihood of disturbance to breeding owls. This report concluded that the subsequent development of the site is not regarded as likely to

impose a significant effect on the Powerful Owl or on any other threatened species, populations or ecological communities, or their habitats.

Part Lot 28 D.P. 871790 Seaspray Street, Narrawallee. Proposed Rezoning and Residential Development. Flora and Fauna Issues, July 1999. Gunninah Environmental Consultants.

This previous survey relates to land adjoining the current subject site to the south.

This report concluded that no threatened species are considered likely to be dependant solely or particularly on the site for their survival in the locality. They also found that it was unlikely that the proposed development will impose a significant impact upon Powerful Owl, as the Powerful Owl is tolerant of some habitat modification and disturbance, the species is wide-ranging and highly mobile and this species occupies a large home range of which the site only comprises a small proportion.

Powerful Owl (*Ninox strenua*) & Glossy Black-cockatoo (*Calyptorhynchus lathami*) Nesting Assessment, Part Lot 28, D.P. 871790 Seaspray Street, Narrawallee City of Shoalhaven, David Coombes, October 1998.

This previous survey is located adjacent to the south of the current subject site.

No Powerful Owls were recorded during the assessment. Ten well used diurnal roost sites for Powerful Owl were located within and close to the study area. All of the roost sites were in Turpentine (*Syncarpia glomulifera*). Several potential nest trees, *Eucalyptus pilularis* (Blackbutt) were found within and near the study area.

No Glossy Black-cockatoos were recorded during the assessment. A small number of chewed She-oak cones were found in the south-west corner of the subject site. A number of potential nesting trees were observed within the study area.

Flora and Fauna Study Part Lot 28 D.P. 871790 Seaspray Street, Narrawallee, City of Shoalhaven. Kevin Mills & Associates Pty Ltd, April 1998.

This previous report was located immediately adjacent to the southern side of the current subject site.

One (1) threatened fauna species, Powerful Owl (*Ninox strenua*) was recorded within the study area. The Powerful Owl was heard calling in southern part of the study area.

In addition to Powerful Owl another eight (8) threatened species were considered likely to occur within the Narrawallee area. These species include, Green and Golden Bell Frog, Regent Honeyeater, Southern Brown Bandicoot, Giant Burrowing Frog, Glossy Black-cockatoo, Swift Parrot, Squirrel Glider and Common Bentwing-bat. Four (4) additional micro-chiropteran bat species are not known to occur in the local area but are considered to have potential habitat within the site. These species include, Eastern Freetail-bat, Eastern False Pipistrelle, Yellow-bellied Sheathtail-bat and Greater Broad-nosed Bat.

According to Mills (1998) this area contains several large eucalypts providing potential nesting habitat for a variety of arboreal mammals. According to Mills (1998) the Powerful Owl is expected to occur wherever there is well developed forest.

SECTION 2

METHODOLOGY

2.1 VEGETATION SURVEY METHODOLOGY

- **Literature Review** - A review of available literature for the area was undertaken to obtain reference material and background information for this survey. These documents are listed in the Bibliography section of this report. In addition to the literature review, orchid experts Mark Clements of CSIRO and Dr Peter Weston of Royal Botanic Gardens, Sydney, were contacted for advice on the threatened orchid *Genoplesium vernale*.
- **Database Searches** - The Atlas of NSW Wildlife (NPWS 2003) threatened flora records for the Ulladulla 1:100,000 Scale Map Sheet (updated in December 2003) and the EPBC Act database were analysed to provide a predictive list of any additional threatened flora species not targeted within the initial flora surveys that could possibly occur throughout the habitats identified within the subject site.
- **Aerial Photograph Interpretation** - Aerial photographs at 1:25,000 scale were utilised to identify the extent of vegetation with respect to the site and surrounding areas.
- **Field Survey** - A flora survey using parallel traverses 10 metres apart was conducted over the entire site on the 2nd and 3rd of December 2003. Cropper (1993) has identified this method as ideal for targeted threatened species searches particularly cryptic orchids. This survey methodology has been utilised regularly by *Conacher Travers Pty Ltd* to target and locate *Cryptostylis hunteriana* previously. Detailed foot traverses were also conducted along the transition zone of Sydney Coastal Estuary Swamp Forest and the Tall Forest Communities. Random Meander surveys were also carried out in the adjoining bushland areas.

2.2 FAUNA SURVEY TECHNIQUES

- **Literature Review** - A review of available literature for the area was undertaken to obtain reference material and background information for this survey. These documents are listed in the bibliography of this report.
- **Database Searches** - The Atlas of NSW Wildlife (NPWS December 1st, 2003) Threatened Fauna records for the Ulladulla 1:100,000 Scale Map Sheets were analysed to provide a predictive list of fauna species that occur locally and could possibly occur throughout the habitats identified within the subject site.
- **Field Survey** - Survey dates, times, weather conditions and methods employed are shown in Appendix 2. The location of fauna survey is presented in Figure 1.

2.2.1 Diurnal Birds

Glossy Black-cockatoo feeds almost exclusively on seeds of *Allocasuarina* (Higgins, 1999, pg 55). Stands of *Allocasuarina* were identified and located within the subject site. Two (2) target diurnal surveys were conducted for Glossy Black-cockatoo (*Calyptrorhynchus lathami*) within stands of *Allocasuarina*. The surveys were conducted on the mornings December 2nd and 4th, 2003.

Searches of chewed cones (foraging evidence of Glossy Black-cockatoo) were conducted beneath stands of *A. littoralis*.

General diurnal bird censuses were undertaken throughout areas off-site to the west and north-west of the subject site. Suitable nesting hollows for Glossy Black-cockatoo were noted during hollow-bearing tree surveys off-site.

Opportunistic observation of birds was carried out during all surveys.

Although the Glossy Black-cockatoo breeds during autumn and winter, habitat trees within the subject site were reassessed for the presence of nesting evidence and any utilisation was noted.

2.2.2 Nocturnal Birds

The presence of Powerful Owl (*Ninox strenua*) was targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played for 3-minute periods at 3-minute intervals for 18 minutes. This was followed by 20 minutes of quiet listening and spotlighting.

Stagwatches were conducted for the known Powerful Owl recorded by (Gunninah, 1999). This nest tree is located approximately 117m to the west of the subject site (refer to Figure 1). Stagwatches were also conducted for five (5) additional hollow-bearing trees located within the subject site, which were considered to contain potential nesting habitat for Powerful Owl. This included hollow-bearing tree numbers HB5, HB8, HA5, HA6 and HB28 (refer to Figure 1). These trees were also observed to assess the likelihood of utilisation by Powerful Owl. This included noting of any evidence of their presence such as white-wash and owl pellets beneath the potential nesting trees.

Diurnal opportunistic observations of suitable roosting sites for Powerful Owl were conducted in areas of vegetation throughout the subject site and areas within the study area to the west, north-west and north. More specific observations were made in areas with canopies dominated by *Syncarpia glomulifera* (Turpentine), which provides suitable roosting habitat for Powerful Owl (Higgins, 1999).

2.2.3 Arboreal and Terrestrial Mammals

Assessments of 'found' scats, markings, diggings, runways and scratches were conducted during visits to the site.

Spotlighting for nocturnal mammalian fauna was carried out using a hand held lamp of 50W. This technique involved walking throughout the subject site so that a maximum number of trees could be observed.

2.2.4 Bats

Three (3) Harp traps were set along vehicular tracks throughout the subject site on the nights of December 1st, 2nd and 3rd, 2003.

Micro-chiropteran bats were surveyed by echolocation using an Anabat Mk 2 detector in both fixed and mobile positions throughout the subject site. Two (2) Anabats were set on December 2nd and 3rd, 2003.

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

2.2.5 Amphibians

The presence of Giant Burrowing Frog (*Heleioporus australiacus*) was targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played on the nights of December 1st and 2nd, 2003 to the north and western areas within and in close proximity to the subject site. These calls were played at numerous points in transects within each area between short periods of quite listening.

Opportunistic surveys for amphibian species were conducted during both diurnal surveys and during spotlighting surveys. Spotlighting was conducted on the nights of December 1st, 2nd and 3rd, 2003. This included general surveys such as vocal call identification, using a tape recorder to record male calls in suitable places and then comparing these to known calls.

The weather conditions prior to and during these surveys included, periods of heavy and light rainfall (refer to Appendix 2).

2.2.6 Hollow-bearing Trees

Hollow-bearing trees outside of the subject site were surveyed in 50 x 50m quadrats. Areas outside of the subject site include, the proposed residue lots, areas north of Narrawallee Creek and areas east of Leo Drive (refer to Figure 2).

The number of hollow-bearing trees and the type and size of hollows within each hollow-bearing tree were noted for each quadrat. Hollows were categorised into three diameter sizes including, small (<10cm), medium (10-30cm) and large (>30cm).

Twenty-eight (28) hollow-bearing tree quadrats were placed throughout proposed residue lots, 2, 5, 7 and 8. Four (4) hollow-bearing tree quadrats were placed in forested areas to the north of the Narrawallee Creek estuary. Three (3) habitat tree quadrats were placed in vegetation to the east of Leo Drive. One (1) habitat tree quadrat was placed in a forested area to the north of Leo Drive and to the east of proposed residue lot 2.

Habitat trees within the subject site were assessed for the presence of nesting birds, arboreal mammals and micro-chiropteran bat species and any utilisation was noted.

SECTION 3

RESULTS

3.1 FLORA SURVEY RESULTS

No threatened flora species were observed within the subject site during detailed systematic surveys.

3.2 FAUNA SURVEY RESULTS

3.2.1 Powerful Owl

On December 1st, 2003 an individual Powerful Owl was heard calling at approximately 20.40 in response to call playback from the known nesting tree. This individual was then later spotlighted approximately 100m to the north of the known nesting tree. Call playback for Powerful Owl was conducted on December 2nd, 2003 from the centre of the subject site. No response was heard and no individuals were spotlighted.

No specimens of Powerful Owl were observed during stagwatches of the known Powerful Owl nesting tree.

No specimens of Powerful Owl were observed or recorded during stagwatching of the five (5) hollow-bearing trees within the subject site which are considered to contain potential nesting habitat for this Powerful Owl. No evidence was found to suggest that Powerful Owl is utilising these hollow-bearing trees.

3.2.2 Glossy Black-cockatoo

Target surveys for Glossy Black-cockatoo were conducted within the located stand of *Allocasuarina* on the mornings of December 2nd and 4th, 2003. No Glossy Black-cockatoo's were heard or observed within these locations. Chewed *Allocasuarina* cones (foraging evidence of Glossy Black-cockatoo) were found in two locations within the stand of *Allocasuarina* (refer to Figure 1 for locations).

Several bird censuses were conducted throughout the proposed residue lots on December 1st, 2nd, 3rd and 4th, 2003 (refer Appendix 2 - Fauna Survey Details). No Glossy Black-cockatoo's were heard or observed during these surveys.

The results of hollow-bearing tree surveys found thirty-four (34) large hollows within the subject site. None of these were found to contain evidence of nesting by the Glossy Black-cockatoo. The results of hollow-bearing tree quadrats in areas outside of the subject site found that there were 1.2 large hollows per hectare.

3.2.3 Micro-chiropteran Bats

Four (4) species of bats were recorded within the subject site during the current December 2003 survey. These species included Gould's Wattled Bat (*Chalinolobus gouldii*), Eastern Broad-nosed Bat (*Scotorepens orion*), Large Forest Bat (*Vespadelus darlingtoni*) and Eastern Forest Bat (*Vespadelus pumulus*).

Five (5) species of bats were recorded within the subject site during the September 2002 survey. These species included Chocolate Wattled Bat (*Chalinolobus morio*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Broad-nosed Bat (*Scotorepens sp 1*) and Southern Forest Bat (*Vespadelus regulus*).

Therefore a total of nine (9) species of bats have been recorded within the subject site.

3.2.4 Giant Burrowing Frog

Calls were played on the nights of December 1st and 2nd, 2003 to the north and western areas within and in close proximity to the subject site. These calls were played at numerous points in transects within each area between short periods of quite listening. No specimens of Giant Burrowing Frog were heard or observed.

3.2.5 Hollow-bearing Trees

The hollow-bearing tree survey categorised the hollows into small, medium and large sizes. Hollow densities for within and outside of the subject site can therefore be obtained for each hollow size to allow analysis of the variety of roosting and nesting habitat present. These results of hollow-bearing tree densities have been obtained from data shown in Appendix 2. The results are summarised in the Table 1.

Table 1 - Hollow Densities Within and Outside of Subject Site

Hollow Densities (hollows / ha)	Within Subject Site	Outside of Subject Site
All Sized Hollows	8.6	20.1
Large Hollows	1.6	1.2
Medium Hollows	3.9	8
Small Hollows	3.2	11.2

A total of seventy-eight (78) hollow-bearing trees have been recorded within the subject site. These hollow-bearing trees contained 34 large, 86 medium and 69 small hollows providing a total of 189 hollows within the subject site (refer to Appendix 2).

The area of the subject site is approximately 21.9 ha. Therefore the density of hollows within the subject site is approximately 8.6 hollows/ ha (refer to Table 1).

The density of hollows outside of the subject site has been calculated from representative hollow-bearing tree quadrats. Areas outside of the subject site include, the proposed residue lots, areas north of Narrawallee Creek and areas east of Leo Drive (refer to Figure 2). The average density of hollows from quadrats outside of the subject site is approximately 20.1 hollows/ ha (refer to Table 1).

SECTION 4

DISCUSSION

4.1 VEGETATION DISCUSSION

4.1.1 Undertake surveys for *Cryptostylis hunteriana* and *Genoplesium vernale* on the site, within areas of suitable habitat.

Detailed surveys for *Cryptostylis hunteriana* and *Genoplesium vernale* were undertaken on 2nd and 3rd December 2003. This date was selected as the most appropriate to cover both species at the same time.

Although the flowering period of *Cryptostylis hunteriana* is stated in Flora of NSW as December to February, most observations along the NSW coast appear to be late November to early January and known specimens near Swansea were in flower at the time of the survey.

Little is known about *Genoplesium vernale*, as it is a recently discovered species. Information which we have been able to obtain from botanists who are familiar with the species is that it flowers from late November to early December. As it is a very diminutive species, it was felt that fruiting bodies after flowering would be easier to observe than buds prior to flowering and so a survey towards the end of its flowering period would be more appropriate.

Contact was made with Mark Clements of CSIRO, who is credited with discovering the species who advised that the survey for this species was carried out at an appropriate time. He stated that his discovery was at East Lynne, approximately 40 km to the south west of the subject site and although several new populations have been discovered, as far as he is aware, they are all in the vicinity of East Lynne. He also stated that the species is now known as *Corunastylis vernalis*, although the database for the Royal Botanic Gardens shows it as *Genoplesium vernale*. As the purpose of this report is related to its status as a threatened species, *Genoplesium vernale*, as shown in Schedule 2 of the TSC Act 1995, has been adopted for this report.

The populations that Mark Clements is aware of are in Stringybark forests, which occur as small sockets in an area dominated by Spotted Gum forest. Within the stringybark forests, there are small, heathy gaps and it is in those gaps that the species has been observed. No similar vegetation occurs within, or adjacent to, the subject site.

The whole of the subject site was covered by parallel traverses 10 metres apart. During that survey no specimens of *Cryptostylis hunteriana* or *Genoplesium vernale* were observed. During the two days, random meander traverses were also carried out in surrounding bushland, targeting both of those species. No specimens of *Cryptostylis hunteriana* or *Genoplesium vernale* were observed during those traverses.

4.1.2 Undertake surveys for other threatened species identified on the Environment Australia database for the area

Other species listed on the EPBC database were: *Boronia deanei*, *Budawangia gnidioides*, *Callitris oblonga* ssp. *corangensis*, *Eucalyptus langleyi*, *Irenepharsus typhurus*, *Pultenaea baeuerlenii* and *Thesium australe*.

Boronia deanei is confined to higher altitude wetlands and is not recorded by Flora of NSW as occurring in any of the coastal botanical subdivisions.

Budawangia gnidioides is a small shrub which is confined to skeletal soil in sandstone crevices in the northern Budawang Range and adjacent escarpments.

Callitris oblonga ssp. *corangensis* is confined to sandy creek banks on the Corang Range, near Nerriga.

Eucalyptus langleyi is a mallee confined to the plateau area to the west and south west of Nowra. Populations known to *Conacher Travers* are in shallow, lateritic soil, in vegetation communities devoid of trees.

Irenepharsus typherus is a herb to 1 metre which is confined to gullies on the coast and escarpment between Wollongong and the Shoalhaven River.

Pultenaea baeuerlenii is a shrub, which is confined to areas of swamp heath on sandstone, in the Budawang Range.

Thesium australe is a root parasite in grassland or woodland. Although widespread, it is very rare and is not shown in Flora of NSW as occurring within the South Coast botanical subdivision.

It is considered that the species listed above are unlikely to occur on the subject site for one or more of the following reasons; many of the specific habitat requirements for these species do not occur within the subject site; the subject sites location is not considered to occur within the species known regional distribution and finally none of these species were recorded during detailed additional survey of the site.

4.1.3 Supply further documentation that will detail mitigative and/or ameliorative measures to prevent significant effects upon areas of Sydney Coastal Estuary Swamp Forest Complex which may arise from the proposed development;

Conacher Travers provided detailed advice to the client at the development design stage to ensure that a suitable buffer was provided to the Sydney Coastal Estuary Swamp Forest Complex that would mitigate any increase in sedimentation or stormwater runoff.

A buffer of over 50 metres (including biofiltration trench) has been provided. The biofiltration trench provides for filtration of sediment and nutrients from stormwater created by the proposed development. Furthermore the implementation of sediment control structures, and appropriate drainage design during the construction phase and combined with the high permeability of the soils between the subject site and the SCESFC boundary will ensure that the natural drainage to the SCESFC is maintained. The proposed stormwater drainage system has been designed so that there is no concentration of stormwater flows into this community.

4.1.4 Locate hollow-bearing trees on the site using a registered surveyor;

The locations of hollow bearing trees on the site have been identified by registered surveyor and are shown in figure 1.

4.1.5 Provide additional information on threatened species based on an up-to-date NP&WS Atlas database search;

A database search, dated 1st December 2003, showed records of the following species within the Ulladulla 1:100,000 sheet:

Baloskian longipes is a sedge which grows in swamps or depressions in sandy alluvium, in the Clyde Mountain district. It is not shown in Flora of NSW as occurring in the South Coast botanical subdivision.

Boronia deanei (Discussed in EPBC section above)

Budawangia gnidioides (Discussed in EPBC section above)

Callitris oblonga ssp. *corangensis* (Discussed in EPBC section above)

Cryptostylis hunteriana (Discussed in EPBC section above)

Eucalyptus langleyi (Discussed in EPBC section above)

Eucalyptus sturgissiana is a mallee restricted to low shrub heath on shallow, sandy soils in the Ettrema district, north of Nerriga.

Irenepharsus trypherus (Discussed in EPBC section above)

Plinthanthesis rodwayi is a grass species which grows in montane woodland in the Southern Tablelands botanical subdivision.

Pultenaea baeuerlenii (Discussed in EPBC section above)

Thesium australe (Discussed in EPBC section above)

It is considered that the species listed above are unlikely to occur on the subject site for one or more of the following reasons; many of the specific habitat requirements for these species do not occur within the subject site; the subject sites location is not considered to occur within the species known regional distribution and finally none of these species were recorded during detailed additional survey of the site.

4.1.6 Provide further details of the precise location of SEPP 14 wetland N0. 287. This information should describe its relationship to the site, and the potential for the proposed development to create adverse impacts upon the wetland need to be provided.

The location of the SEPP 14 wetland is indicated in figure 1. This wetland appears to be the salt marsh section of the extensive swamp forest area between the subject site and Narrawallee Creek.

SEPP 14 wetland 287 is located approximately 500 metres from the northern side of the subject site. Stormwater runoff from the subject site runs into a depression between Blake Street and Macleay Street, which drains directly into Narrawallee creek. The SEPP 14 wetland 287 is located on the opposite side of Macleay Street and is separated from the subject site by elevated land and will thus not be impacted by the proposed development.

4.1.7 Additional documentation and mapping to be supplied for the Sydney Coastal Estuary Swamp Forest Complex, to clarify where this Endangered Ecological Community occurs with respect to the area proposed to be developed. This documentation should also examine the likely impacts of the development on this Endangered Ecological Community, including any arising from any bushfire management strategies, a proposed “Fire Trail” within or very near to the “Environment Protection” area, and should substantiate the claim that a 20m buffer between the development and this Endangered Ecological Community is sufficient;

During the previous survey it was noted that the vegetation referred to as Fresh Treed Swampland in the original report was commensurate with the endangered ecological community Sydney Coastal Estuarine Swamp Forest Complex (SCESFC). As it was outside of the subject site, no specific definition of community boundaries was undertaken, other than to ensure that it was outside of the subject site.

A more extensive investigation was undertaken during the December 2003 survey, when it was assessed that not all of the Fresh Treed Swampland vegetation community was commensurate with SCEFC.

SCEFC is confined to estuarine alluvium, whereas the Fresh Treed Swampland extends upslope in some areas where the colluvial soil is poorly drained or subject to seepage from the hillside. Fresh Treed Swampland also follows the creek line, as a narrow belt, above where it levels out onto the estuarine alluvium.

During the inspection of the community, the line of demarcation between the hillside and estuarine alluvium over most of the area was almost impossible to determine visually, due to the dense understorey and very low gradients along the foot of the hillside. It was noted that two of the most common shrubs were *Melaleuca ericifolia* and *Pultenaea flexilis*. *Melaleuca ericifolia* has a particular affinity for the types of soil which support SCEFC, while *Pultenaea flexilis* has an equally strong aversion to those soils. It was noted that although both species were very common, there was almost no overlapping of the species and that where the overlapping did occur, it was only by a few metres.

The line of demarcation between those species was adopted as the boundary of SCESFC. This boundary was tagged so that surveyors could accurately locate it. Towards the eastern end of the site, those two species lost their prominence, but by that stage, the base of the hillside was clearly visible in most areas and where it was not obvious, the SCESFC boundary was adopted as being immediately downslope from any Blackbutts or Bloodwoods.

The clearing of native vegetation within the asset protection zones surrounding the proposed development, combined with an increase in overland flow and storm water runoff resulting from the proposed development has the potential to increase soil erosion on the lower western slopes surrounding the SCESFC community.

Any increase in soil erosion will subsequently lead to an increase in sedimentation of the SCESFC community. These impacts can be mitigated through the proposed placement of sediment control and stormwater dispersion structures within the proposed developments design. Furthermore the retention of groundcovers within the asset protection zones will significantly reduce the potential erosion of the lower slopes.

Detailed land survey of the SCESFC boundary depicted in Figure 1, has identified the nearest point of this community to the subject site boundary as approximately 20m, while the distance between the SCESFC boundary and the current proposed development is

approximately 50 metres. The proposed fire trail will be contained within the subject site and therefore be situated at least 20 metres from the SCESFC boundary. Drainage contours and sediment control structures included within the fire trails design are provided to prevent any adverse affects on the SCESFC community.

4.1.8 A flora and fauna assessment should assess the likely impacts arising from a proposed development or action; Bitou Bush *Chrysanthemoides monilifera* subsp. *rotundata* is stated to occur on the subject site, is listed as a Noxious Weeds species and “Invasion of Native Plant Communities by *Chrysanthemoides monilifera*” is listed as a Key Threatening Process under the TSC Act 1995. Actions to prevent the spread of this species from its current location(s) to other sites must be detailed.

Chrysanthemoides monilifera (Bittou Bush) has been observed on the subject during detailed flora survey. The locations of this species are limited to 5 isolated patches (as indicated in figure 1) within the subject site. It is likely that the *Chrysanthemoides monilifera* will be removed during the construction phase of the proposed development. Therefore the proposed development is unlikely to result in the spread of this species from its current locations to other sites.

4.2 FAUNA DISCUSSION

4.2.1 Powerful Owl

The Powerful Owl is well documented resident of local area of Narrawallee. A search of the Atlas of NSW Wildlife (NPWS December 1st, 2003) found twenty-eight (28) records of Powerful Owl within 10km. Five (5) of these records occur within 6km to the subject site. The closest record is within approximately 100m to the west of the subject site in August 1999.

The most recent record is in September 2002 within 1km to the south of the subject site. Several previous surveys in Narrawallee have recorded this species and a known nesting tree has been located (refer to Section 1.1 – Previous Surveys). This known nesting tree has been fixed by land survey and is located 117m to the west of the western boundary of the subject site.

On December 1st, 2003 an individual Powerful Owl was heard calling at approximately 20.40 in response to call playback from within close proximity to the known nest tree. This individual was then later spotlighted approximately 100m to the north of the known nesting tree. The Powerful Owl was also heard calling to the south of the subject site on the night of September 11th, 2002 (Conacher Travers, 2002).

Records of Powerful Owl in the local area as well as the location of a known nest tree within close proximity to the subject site requires the following issues to be addressed:

- The distance of the known nesting tree from the proposed development and whether or not this distance provides a sufficient buffer for this species;
- Potential nesting trees within the subject site and whether or not these trees are utilised or are likely to be used in the future by this species;
- Roosting habitat throughout the study area and whether or not areas within the subject site provide suitable roosting habitat for this species; and
- The abundance of foraging resources and whether or not the subject site provides a significant area for foraging, including consideration for the abundance of prey resources within the subject site relative to other foraging areas within the Powerful Owls home range.

- **The distance of the known nesting tree from the proposed development and whether or not this distance provides a sufficient buffer for this species;**

Two (2) known nesting trees for Powerful Owl are located within close proximity to the subject site. One nesting tree is located at Yarrawonga Drive, Mollmook approximately 1.5km to the south of the subject site (Conacher Travers, 2002b).

A known Powerful Owl nesting tree is located approximately 117m (fixed by land survey) to the west of the western boundary of the subject site (refer to Figure 1.). Cooke *et al.* (2002) found that Powerful Owls breed successfully in some urban areas, but are limited in the amount of human disturbance they can tolerate near their nesting hollow.

According to a report by Gunninah (1999) for a development at a site adjacent to the south of the subject site, the NPWS have indicated that a 100m buffer around the nest tree is adequate, both to separate the tree and development activities, and to minimise the likelihood of disturbance to breeding owls.

In a concurrence report on the residential development at the Mollmook site, NPWS advised that 75m was an adequate distance from that tree (Mills, 2002). The current proposal will therefore allow a buffer of at approximately 45m in addition to that considered adequate for nesting tree at Mollmook.

It is considered that the direct impact of development of the subject site, 117m to the east of the nesting tree is unlikely to significantly impact this nesting tree as a viable nesting location for Powerful Owl.

- **Potential nesting trees within the subject site and whether or not these trees are utilised or are likely to be used in the future by this species;**

The Powerful Owl nests in the cavity of a large hollow tree. Large trees with hollows at least 0.5m deep are required for shelter and breeding (Schodde *et al.* 1980; SWC Consultancy 1993). The cavity is prepared by the male which is carpeted with dead leaves and wood debris (Lindsey 1992). Breeding occurs from May through to October (Higgins, 1999).

Five (5) hollow-bearing trees containing large hollows are considered to provide marginal potential nesting habitat for Powerful Owl. These trees were stag-watched and observed to assess the likelihood of utilisation by Powerful Owl. No fauna species were observed or recorded during stag-watching activities. Due to the breeding season of May to October, it is unlikely that the owls would be observed using the nest or roosting in close proximity to the nest (Higgins, 1999).

No evidence of utilisation of Powerful Owl was observed on or around hollows or on the ground around the base of these trees. Given the general characteristics of the hollows relative to those known to be utilised by Powerful Owl it is considered that none of the large hollows present within the subject site provide ideal nesting habitat for this species.

Potential nesting hollows for Powerful Owl are present throughout the study area and surrounds. The density of large hollows outside of the subject site is 1.2 hollows / ha (refer to Table 1). This is compared to 1.6 large hollows / ha within the subject site (refer Table 1). These results show that large hollows which form potential nesting habitat for Powerful Owl are present in a relatively even density throughout the subject site, study area and surrounds.

Therefore, given the presence of potential nesting trees throughout and that the potential nesting trees within the subject site are considered to be of low suitability and / or current unutilised for nesting of Powerful Owl, the proposed development is unlikely to removed nesting trees for this species.

- **Roosting habitat throughout the study area and whether or not areas within the subject site provide suitable roosting habitat for this species; and**

Mated pairs of Powerful Owl roost together or separately, maintaining several roost sites throughout their territory which are used in rotation (Lindsey 1992), shifting with the availability of prey. The Powerful Owl mostly roosts in closed forest, including rainforest or wet sclerophyll forest (Higgins, 1999, pg 819).

The Powerful Owl is known to roost in trees in the canopy or sub-canopy, either on bare horizontal branch or among foliage in several species of tree including, *Syncarpia glomulifera* (Turpentine) and *Melaleuca* (Paperbark) (Higgins, 1999, pg 819). In a site adjoining the study area to the south it was found that all of the Powerful Owl roosting trees were Turpentine (Coombes, 1998).

Turpentine are present in varying amounts throughout the subject site. General observations indicate that densities of Turpentine are relatively equal throughout the subject site and study area. It is considered that potential roosting areas are present throughout both the subject site and the study area. No evidence of roosting was found within the subject site.

During the nesting period, the male usually roosts in trees near the nest-tree, sometimes favouring one site, often within 50m of the nest (Higgins, 1999, pg824). The known nesting tree has been located approximately 117m to the west of the western boundary of the subject site. According to the 50m roosting buffer in Higgins (1999), the proposal will allow a buffer of 67m from likely roosting areas during the breeding season. It is considered that the proposal is unlikely to significantly impact upon areas of roosting habitat during the nesting period.

The subject site and study area together form an area of approximately 104 ha (total area), including 21.9 ha within the subject site and 82 ha within the study area. The subject site therefore forms 21% of the total area. The area of potential roosting habitat within the subject site is not considered to provide a significant area of roosting habitat relative to the study area.

- **The abundance of foraging resources and whether or not the subject site provides a significant area for foraging, including consideration for the abundance of prey resources within the subject site relative to other foraging areas within the Powerful Owls home range.**

The species is a nocturnal and solitary carnivore that specialises in hunting arboreal prey of moderate to large size. It preys on birds, small mammals, invertebrates and arboreal mammals, including the Common Ringtail Possum (*Pseudocheirus peregrinus*), the Greater Glider (*Petauroides volans*) and Gliders (*Petaurus* sp.) (Seebeck 1976; Lavazanian *et al.* 1994; Pavey *et al.* 1994).

Powerful Owl is also known to forage on some terrestrial mammals such as *Antechinus* species and *Rattus* species (Higgins, 1999, pg 821-823). Despite this range of prey species any one pair of Powerful Owls tend to specialise, taking only one or two prey types. The Powerful Owl also tends to concentrate foraging activities within a small pocket of their

overall territory and switch to adjacent areas after prey numbers have been substantially reduced (Kavanagh, 1988).

A search of Atlas of NSW Wildlife (NPWS December 1st, 2003) records for the Ulladulla 1:100,000 Scale Map Sheet found records of a variety of potential prey species for Powerful Owl within 10km from the subject site. These species include, Common Ringtail Possum (*Pseudocheirus peregrinus*), Common Brushtail Possum (*Trichosurus vulpecular*), Sugar Glider (*Petaurus breviceps*), Bush Rat (*Rattus fuscipes*), Swamp Rat (*Rattus lutreolus*), Yellow-footed Antechinus (*Antechinus flavipes*), Brown Antechinus (*Antechinus stuartii*) and Dusky Antechinus (*Antechinus swainsonii*).

Five (5) potential prey species were recorded by surveys in the subject site (Conacher Travers, 2000a; Conacher Travers 2000b; Mills, 1994). These species include Brown Antechinus, Bush Rat, Common Ringtail Possum, Common Brushtail Possum and Grey-headed Flying-fox.

The main prey of the Powerful Owl are hollow dependant arboreal marsupials (Soderquist et al., 2002). The amount of hollows and large old trees may be surrogate measures for the densities of arboreal mammals that are the preferred prey of Powerful Owls (Soderquist et al., 2002). In studies of Box-Ironbark forest of Victoria it was found that owl territories had significantly more hollows and large old trees than surrounding forest (Soderquist et al., 2002). The density of hollows within the subject site is approximately 8.6 hollows / ha (refer to Table 1). This is compared to approximately 20.1 hollows / ha within the study area and surrounds (refer to Table 1). These results show that the potential foraging resources for Powerful Owl are likely to be significantly higher in the study area and surrounds.

Estimates of the home range of this species vary greatly but territories are thought to be a minimum of 800 hectares (Kavanagh, 1988) and up to 1500 ha (Higgins, 1999, pg824). The home ranges of Powerful Owl have been estimated to be as little as 400-600ha in productive habitat containing high densities of prey, however this can be as little as 300ha where there is a very dense understorey (Higgins, 1999, pg 824).

Soderquist et al (2002) showed that larger home ranges resulted from low prey densities in Box-Ironbark forest. The total area of the study area and subject site is approximately 104 ha. The area of the subject site is approximately 21.9 ha, which forms approximately 21% of the total area (area of subject site and study area).

The significance of the subject site and study area may vary depending on their quality of foraging habitat for Powerful Owl. From home range and prey densities referenced above the total area (including the study area and subject site) may form as much as 25% of a home range containing high prey densities or as little as 7% of a home range contain low prey densities. Given the area of the subject site relative to the home range of Powerful Owl, it is considered that the subject site is unlikely to form a significant area of foraging habitat for the Powerful Owl.

4.2.2 Glossy Black-cockatoo

The Glossy Black-cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of casuarinas (SFNSW 1995a). The breeding season of the Glossy Black-cockatoos is between March and August (Higgins, 1999, pg61). The Glossy Black-cockatoo lives in permanent groups of up to 10 individuals (SFNSW 1995b), roosting communally at night and travelling at dawn to groves of seeding Casuarina trees to feed for the day. Foraging within Casuarinas tends to be concentrated on trees with greater crops of cones (Clout 1989).

This species has a bill structure and highly specialised feeding techniques developed for feeding almost exclusively on Casuarinas with large cones such as the *Allocasuarina littoralis*, *A. stricta* and *A. torulosa* (Lindsey 1992; SFNSW 1995a). It apparently does not feed on *Casuarina glauca* (UBBS, 1997). This species is also known to feed on insects and the seeds of eucalypts, angophoras, hakeas, acacias and sunflowers (Blakers *et al.* 1984; Lindsey 1992). Once food resources are exhausted in one area the birds move to another.

Evidence of foraging including, chewed *Allocasuarina* cones were found in two locations within the stand of *Allocasuarina* (refer to Figure 1 for locations). It is considered that the subject site provides suitable foraging habitat for this species within areas of *Allocasuarina* (refer to Figure 1.) No Glossy Black-cockatoo's were heard or observed within the subject site or study area.

A search of Atlas of NSW Wildlife (NPWS December 1st, 2003) records for the Ulladulla 1:100,000 Scale Map Sheet found thirty-six (36) records of Glossy Black-cockatoo within 10km from the subject site. The closest record was approximately 0.45km to the south-west of the subject site in March 2001. The most recent record within 10km was in September 2002 approximately 7.4km to the south of the subject site.

The total area of the study area and subject site is approximately 104 ha. The area of the subject site is approximately 21.9 ha, which forms approximately 21% of the total area (area of subject site and study area). The areas of *Allocasuarina* form approximately 1 ha or approximately 4.7% of the subject site.

Blackbutt forest throughout the study area, especially along the ridge to the west of the subject site contains an abundance of *Allocasuarina*. It is considered that the area of foraging habitat for Glossy Black-cockatoo within the subject site is unlikely to form a significant area foraging habitat for this species compared to that present the study area and the local area.

According to Mills (2002) most of the Glossy Black-cockatoo habitat in the LEP area is zoned Environmental Protection (Mills, 2002, pg10). Given the extent of potential foraging habitat for Glossy Black-cockatoo outside of the subject site, it is considered that removal of patches of *Allocasuarina* from within the subject site are unlikely to disrupt the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

The Glossy Black-cockatoo nests in large trees with large hollows (dead and alive) (SFNSW 1995a). The results of hollow-bearing tree surveys found thirty-four (34) large hollows within the subject site. This forms approximately 1.6 large hollows / ha within the subject site. No Glossy Black-cockatoo's were observed to be nesting within the subject site.

None of the large hollows were found to contain evidence of nesting by the Glossy Black-cockatoo. The results of hollow-bearing tree quadrats in areas outside of the subject site found that there were approximately 1.2 large hollows per hectare (refer to Table 1).

Therefore the density of large hollows varies by only 0.4 hollow / ha between the subject site and the study area. It is considered that large hollows which form potential nesting habitat for Glossy Black-cockatoo are present in a relatively even density throughout the subject site, study area and surrounds. It is also considered that the subject site forms a relatively small area compared to the study area as the subject site forms only approximately 21% of the total area (area of subject site and study area).

Given that no Glossy Black-cockatoo's were observed to be using nests within the subject site and the size of the subject site relative to the study area, it is considered that the proposal is unlikely to removed a significant area of suitable nesting trees for this species.

4.2.3 Micro-chiropteran Bats

Comments from DIPNR suggested that further survey effort for micro-chiropteran bat species be required to be conducted during warmer months. Additional survey was conducted in December 2003. This survey recorded four (4) additional species including Gould's Wattled Bat (*Chalinolobus gouldii*), Eastern Broad-nosed Bat (*Scotorepens orion*), Large Forest Bat (*Vespadelus darlingtoni*) and Eastern Forest Bat (*Vespadelus pumilis*). The seasonal variation in the species present within the subject site indicates that this survey was sufficient to satisfy the requirements of DIPNR.

LesryK Environmental Consultants 2002 recorded three (3) threatened micro-chiropteran bat species, Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Common Bentwing-bat (*Miniopterus schreibersii*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) within 1km of the current subject site.

Several species of forest bats roost in hollow branches, tree trunks or under bark (Churchill, 1998, pg 8). The roosting habitat present within the subject site and the study area can be determined by analysing the results of tree hollow surveys in Table 1.

4.2.3.1 Yellow-bellied Sheathtail-bat

The Yellow-bellied Sheathtail Bat inhabits open country, mallee, eucalypt forests, rainforests, heathland and waterbodies (Richards 1988, SFNSW 1995). It is usually solitary or found in groups of less than 10 individuals. The Yellow-bellied Sheathtail Bat roosts in tree hollows and has been found inhabiting the abandoned nests of Sugar Gliders (Richards 1988). This species has been noted to forage and breed throughout these habitats where suitable tree hollows are available for roosting.

The majority of records for southern Australia are from mid to late summer which suggests that the Yellow-bellied Sheathtail Bat migrates from northern to southern Australia during that time of the year (SFNSW 1995). However, this speculation is not supported by studies of seasonal fat deposition in this species (Chimimba and Kitchener 1987).

The total area of the study area and subject site is approximately 104 ha. The area of the subject site is approximately 21.9 ha, which forms approximately 21% of the total area (area of subject site and study area). According to tree hollow surveys, the subject site provides approximately 8.6 hollows / ha compared to approximately 20.1 hollows / ha within the study area and surrounds (Table 1). These results show that the areas outside of the subject site provide greater area for foraging and a greater density of potential roosting habitat for this species.

It is considered that the subject site and study area provide potential roosting and foraging habitat for this species. Despite the presence of potential roosting and foraging habitat, this species was not recorded during the fauna survey. Given the relative small size of the subject site compared to the study area and the greater density of roosting habitat within the study area, it is considered that the proposal is unlikely to disrupt the life cycle of the Yellow-bellied Sheathtail-bat such that a viable local population is likely to be placed at risk of extinction.

4.2.3.2 Common Bentwing-bat

The Common Bentwing-bat occupies a range of habitats, mainly near the coast and utilises caves, old mines, stormwater channels, under bridges and occasionally buildings for shelter (NSW CRA & RFA Steering Committee 2000; Dwyer 1988). This species has a complex

social structure, which requires a range of roost sites for different functions, eg maternity, wintering and acclimatisation (NSW CRA & RFA Steering Committee 2000).

This species is considered to utilise very large foraging areas, with edges perhaps preferred, ie ecotones between forest & cleared land (NSW CRA & RFA Steering Committee 2000). The Common Bent-wing Bat is typically found in well-timbered areas where it forages above and below the tree canopy on small insects (Dwyer 1988). This species will travel large distances between roost sites according to seasonal and local needs.

Breeding of the Common Bent-wing Bat is confined to areas where there are caves with suitable temperature, humidity and physical dimensions (Dwyer 1988; Reardon and Flavel 1987). This species has also been found to frequently share roosting and nursery caves with colonies of the Little Bent-wing Bat (*Miniopterus australis*) (Dwyer 1988).

It is considered that the subject site provides potential foraging habitat for this species. Despite the presence of potential foraging habitat, this species was not recorded during the fauna survey. No caves were observed within or in close proximity to the subject site. The total area of the study area and subject site is approximately 104 ha. The area of the subject site is approximately 21.9 ha, which forms approximately 21% of the total area (area of subject site and study area).

The areas outside of the subject site provide greater area of potential foraging habitat and therefore the subject site is unlikely to provide a significant area of foraging habitat for this species. Given absence of roosting caves and the extent suitable foraging habitat in study area, it is considered that the proposal is unlikely to disrupt the life cycle of the Common Bentwing-bat such that a viable local population is likely to be placed at risk of extinction.

4.2.3.3 Eastern False Pipistrelle

The Eastern False Pipistrelle inhabits warm- to cool-temperate moist and dry open forests (Strahan 1988). Little is known about the biology of this species although it has been recorded in logged and unlogged areas (QEM 1994), preferring open areas for foraging (O'Neill and Taylor 1986).

The Eastern False Pipistrelle roosts mainly in tree hollows, occasionally utilising caves and abandoned buildings (Parnaby 1992; Phillips *et al.* 1985). This species has been observed roosting in the hollows of Mountain Gums (*E. dalrympleana*) 20m from the ground and the hollows of Brown Barrel (*E. fastigata*) located some 10m from the ground (AMBS 1995).

The total area of the study area and subject site is approximately 104 ha. The area of the subject site is approximately 21.9 ha, which forms approximately 21% of the total area (area of subject site and study area). According to tree hollow surveys, the subject site provides approximately 8.6 hollows / ha compared to approximately 20.1 hollows / ha within the study area and surrounds (Table 1). These results show that the areas outside of the subject site provide greater area for foraging and a greater density of potential roosting habitat for this species.

It is considered that the subject site and study area provide potential roosting and foraging habitat for this species. Despite the presence of potential roosting and foraging habitat, this species was not recorded during the fauna survey. Given the relative small size of the subject site compared to the study area and the greater density of roosting habitat within the study area, it is considered that the proposal is unlikely to disrupt the life cycle of the Eastern False Pipistrelle such that a viable local population is likely to be placed at risk of extinction.

4.2.4 Giant Burrowing Frog

The Giant Burrowing Frog is usually only found around sandstone plateaux (Hoser 1989), mostly associated with hanging sandstone shelves and the upper laterals. The Giant Burrowing Frog is associated with semi-permanent to ephemeral sand or rock based streams (Hoser, 1989). The soil must be soft and sandy so that burrows can be constructed (Environment Australia 2001).

The Giant Burrowing Frog is considered to forage widely, up to several hundred metres away from breeding sites in woodlands, wet heath, dry and wet sclerophyll forest. The Giant Burrowing Frog is capable of dispersing long distances through intact native vegetation (Environment Australia 2001). This species is distributed from Olney State Forest, extending along the coast and ranges into the highlands of Victoria.

The Giant Burrowing Frog breeds from late summer to autumn (NSW NPWS, 2000).

It is considered that the subject site provides potential burrowing and foraging habitat for this species. It is considered that wetland areas offsite to the north and west may provide potential breeding habitat for this species.

The subject site is mapped by Sydney Basin 1:500,000 Geological Sheet as siltstone and silty sandstone (Psc) and gravel, sand, silt and clay (Qa) (Brunker, R.L. & Rose, G. 1967). The soils within the site contained sandy loam and clay with fragments of siltstone. It is considered that the geology and soils present provide potential habitat for Giant Burrowing Frog.

The closest records of Giant Burrowing Frog include, 5.5km to the south and 6.4km to the south in 1997 (Atlas of NSW Wildlife NPWS 2003). Therefore records of this species are present in the local area, however there are no known records within close proximity to the subject site.

Additional target surveys for this species were conducted on December 1st and 2nd, 2003. The weather during the week of the survey included periods of heavy downpours and scattered showers. This weather was considered to be suitable as this species is known to be active during periods of heavy rain during summer.

Although the subject site and adjoining areas are considered to provide suitable habitat, no specimens of Giant Burrowing Frog were heard of or observed during the survey. Given the extent nature and locality of the proposal and the absence of this species during suitable survey times, it is considered that the proposal is unlikely to disrupt the life cycle of the Giant Burrowing Frog such that a viable local population is likely to be placed at risk of extinction.

SECTION 5

CONCLUSION

This addendum report has been prepared to assess the results of the additional survey and to address the issues that have been raised by the consent authority. Given the results of the additional survey and discussion of these issues, it is considered that the addendum report supports the conclusions of the Flora and Fauna Assessment Report (March, 2003).

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APPENDIX 1
FAUNA SPECIES LISTS

Table A1.1 - Fauna Observations for the subject site and local area

Common name	Scientific name	Previous Surveys	Conacher Travers 2002	Conacher Travers 2003
Birds				
Australian King Parrot	<i>Alisterus scapularis</i>	Pr1 Pr2	O C	O
Australian Magpie	<i>Gymnorhina tibicen</i>	Pr1 Pr2	O	
Australian Magpie-Lark	<i>Grallina cyanoleuca</i>	Pr1 Pr2	O	
Australian Raven	<i>Corvus coronoides</i>	Pr1 Pr2	O	O
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Pr1		
Brown Gerygone	<i>Gerygone mouki</i>	Pr1 Pr2		
Brown Thornbill	<i>Acanthiza pusilla</i>	Pr1 Pr2		O C
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>			C
Common Bronzewing	<i>Phaps chalcoptera</i>			O
Common Koel	<i>Eudynamis scolopacea</i>			C
Common Starling *	<i>Sturnus vulgaris</i>		O C	
Crested Pigeon	<i>Ocyphaps lophotes</i>		O C	
Crested Shrike-tit	<i>Falcunculus frontatus</i>	Pr1		
Crimson Rosella	<i>Platycerus elegans</i>	Pr1 Pr2	O C	O C
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	Pr1 Pr2	O	O
Eastern Whipbird	<i>Psophodes olivaceus</i>	Pr1 Pr2	C	C
Eastern Yellow Robin	<i>Eopsaltria australis</i>	Pr2	O	O
Fan-tailed Cuckoo	<i>Cuculus flabelliformis</i>			C
Galah	<i>Cacatua roseicapilla</i>	Pr1 Pr2	O C	
Gang -gang Cockatoo	<i>Callocephalon fimbriatum</i>			O c
Golden Whistler	<i>Pachycephala pectoralis</i>	Pr1	O C	
Grey Butcherbird	<i>Cracticus torquatus</i>	Pr1 Pr2		
Grey Fantail	<i>Rhipidura fuliginosa</i>	Pr2	O	
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	Pr1 Pr2	O C	O
House Sparrow*	<i>Passer domesticus</i>		O	
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Pr1 Pr2	O C	O C
Lewin's Honey-eater	<i>Meliphaga lewinii</i>	Pr1		C
Mistletoe Bird	<i>Dicaeum hirundinaceum</i>	Pr1		
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	Pr1 Pr2	O	O
Noisy Friarbird	<i>Philemon corniculatus</i>	Pr1		C
Noisy Miner	<i>Manorina melanocephala</i>		C	
Pied Currawong	<i>Strepera graculina</i>	Pr1 Pr2	C	
Powerful Owl ^v	<i>Ninox strenua</i>		O C	O C
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	Pr1 Pr2	O C	O C
Red Wattle Bird	<i>Anthochaera carunculata</i>	Pr1 Pr2	O C	O C
Red-browed Finch	<i>Neochmia temporalis</i>	Pr1 Pr2	O C	O
Rufous Fantail	<i>Rhipidura rufifrons</i>			O C
Rufous Whistler	<i>Pachycephala rufiventris</i>			C
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>			O
Silvereye	<i>Zosterops lateralis</i>	Pr1 Pr2	O	
Spotted Pardalote	<i>Pardalotus punctatus</i>	Pr1	O	
Spotted Turtle-dove *	<i>Streptopelia chinensis</i>	Pr1	O	O
Striated Thornbill	<i>Acanthiza lineata</i>	Pr1	O	
Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	Pr1 Pr2	O C	C
Superb Fairy-wren	<i>Malurus cyaneus</i>	Pr2	O	
Veriegated Fairy-wren	<i>Malurus lamberti</i>			O
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>			O
White-browed Scrubwren	<i>Sericornis frontalis</i>	Pr1	O	O
White-headed Pigeon	<i>Columba leucomela</i>		O	

Table A1.1 - Fauna Observations for the subject site and local area (Cont.)

Common name	Scientific name	Previous Surveys	Conacher Travers 2002	Conacher Travers 2003
Birds (Cont.)				
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	Pr1 Pr2	O C	O C
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	Pr1 Pr2	O	C
Yellow-tailed Black-cockatoo	<i>Calyptorhynchus funereus</i>	Pr1	C	
Yellow Thornbill	<i>Acanthiza nana</i>			O
Mammals				
Brown Antechinus	<i>Antechinus stuartii</i>		E	
Bush Rat	<i>Rattus fuscipes</i>	Pr1	E CT	
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	Pr1		
Common Brushtail Possum	<i>Trichosurus vulpecula</i>		Sc	Sp
Grey-Headed Flying-fox ^v	<i>Pteropus poliocephalus</i>			Sp Sc C
Long-nosed Bandicoot	<i>Parameles nasuta</i>		CT	
Swamp Wallaby	<i>Wallabia bicolor</i>	Pr1		
Goulds Wattled Bat	<i>Chalinolobus gouldi</i>			A
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		A H	
Eastern False Pipistrelle ^v	<i>Falsistrellus tasmaniensis</i>	Pr2	A	
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>		A H	
Broad-nosed Bat	<i>Scotorepens sp.1</i>		A	
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>			A
Large Forest Bat	<i>Vespadelus darlingtoni</i>			A
Eastern Forest Bat	<i>Vespadelus pumilus</i>			A
Southern Forest Bat	<i>Vespadelus regulus</i>		A H	A
Black Rat *	<i>Rattus rattus</i>		E	
European Red Fox *	<i>Vulpes vulpes</i>	Pr1		
Dog *	<i>Canis familiaris</i>		Sc	Sc
Reptiles				
Eastern Blue Tongue	<i>Tiliqua scincoides</i>			O
Eastern Water Skink	<i>Eulamprus quoyii</i>		O	O
Garden Skink	<i>Lampropholis guichenoti</i>			O
Red-Bellied Black Snake	<i>Pseudechis porphyriacus</i>		O	
Amphibians				
Common Eastern Froglet	<i>Crinia signifera</i>	Pr1	C	C
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>			Sp C
Striped Marsh Frog	<i>Limnodynastes peronii</i>	Pr1		C
Bleating Tree Frog	<i>Litoria dentata</i>			C
Smooth Toadlet	<i>Uperoleia laevisgata</i>		C	
Note: * indicates introduced species ^v indicates vulnerable species				
A	- Anabat II	C	- Call Identification	
O	- Observation	P	- Call Playback Response	
E	- Elliott Trap	S	- Habitat Search	
CT	- Cage Trap	H	- Harp Trap	
Sp	- Spotlight	Sc	- Scat, Track or Sign Identification	
Pr1	- Kevin Mills & Assoc. (April, 1994)			

APPENDIX 2

FAUNA SURVEY DETAILS

APPENDIX 2 - FAUNA SURVEY DETAILS				
Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort / Time (24hr)
Diurnal Birds	01/12/03	8/8 light cloud, no wind, temp 21°C, light rain	Diurnal Opportunistic	2hrs 30mins 14.30-17.00
	02/12/03	8/8 cloud, no wind, temp 20°C, light patchy rain	Diurnal Opportunistic	7hr 15 mins 09.00-17.15
	02/12/03	8/8 cloud, no wind, temp 20°C, light patchy rain	Target Glossy Black Cockatoo	45 mins 09.45-10.30
	03/12/03	8/8 cloud, no wind, temp 17°C, light to mod. rain	Census	4 hrs 30 mins 09.00-13.30
	03/12/03	8/8 cloud, no wind, temp 25°C, light patchy rain	Diurnal Opportunistic	1hr 45 mins 15.30-17.15
	04/12/03	0/8 cloud, no wind, temp 18°C	Diurnal Opportunistic	40 mins 08.20-09.00
	04/12/03	0/8 cloud, no wind, temp 20°C	Target Glossy Black Cockatoo Census Diurnal Opportunistic	1 hr 45 mins 09.00-10.45
Nocturnal Birds	01/12/03	8/8 cloud, no wind, temp 22°C, light rain	Owl call playback	20 mins 20.40-21.00
	02/12/03	8/8 cloud, no wind, temp 17°C, no rain	Stagwatching	1hr 20 mins 08.00-08.50 (40 mins x 2 persons)
	02/12/03	8/8 cloud, no wind, temp 17°C	Owl call playback	30 mins 21.00-21.30
	03/12/03	8/8 cloud, no wind, temp 17°C, light rain	Stagwatching	50 mins 20.00-20.50 (50 mins x 2 persons)
Arboreal Mammals	01/12/03	8/8 cloud, no wind, temp 22°C, light rain	Spotlighting	1hr 30 mins 20.30-22.00
	02/12/03	8/8 cloud, no wind, temp 17°C	Stagwatching	1hr 20 mins 08.00-08.50 (40 mins x 2 persons)
	02/12/03	8/8 cloud, no wind, temp 17°C	Spotlighting	3 hrs 19.45-22.45
	03/12/03	8/8 cloud, no wind, temp 17°C, light rain	Stagwatching	50 mins 20.00-20.50 (50 mins x 2 persons)
	03/12/03	8/8 cloud, no wind, temp 17°C, light patchy rain	Spotlighting	20.00-21.15 1hr 15 mins
Terrestrial Mammals	01/12/03	8/8 cloud, no wind, temp 22°C, light rain	Spotlighting	1hr 30 mins 20.30-22.00 (90 mins x 2 persons)
	02/12/03	8/8 cloud, no wind, temp 17°C	Spotlighting	3 hrs 19.45-22.45 (180 mins x 2 persons)
	03/12/03	8/8 cloud, no wind, temp 17°C, light patchy rain	Spotlighting	1hr 15 mins 20.00-21.15 (75 mins x 2 persons)
Bats	01/12/03	8/8 cloud, no wind, temp 22°C, light rain	Harp Trapping	3 Harp trap nights
	02/12/03	8/8 cloud, no wind, temp 17°C	AnabatII	4 person hrs 20.00-22.00
	02/12/03	8/8 cloud, no wind, temp 17°C	Harp Trapping	3 Harp trap nights
	03/12/03	8/8 cloud, no wind, temp 20°C, light rain	AnabatII	2 person hrs 20.00-21.00
	03/12/03	8/8 cloud, no wind, temp 17°C, light patchy rain	Harp Trapping	3 Harp trap nights

APPENDIX 2 - FAUNA SURVEY DETAILS (Cont.)				
Reptiles	01/12/03 02/12/03 02/12/03 03/12/03 03/12/03 04/12/03	8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 18-25°C, scattered showers 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17-26°C, light to mod. rain 8/8 cloud, no wind, temp 17°C, light patchy rain 0/8 cloud, no wind, temp 20°C	Spotlighting Habitat search Spotlighting Habitat search Spotlighting Habitat search	1hr 30 mins 20.30-22.00 (90 mins x 2 persons) 7 hrs 09.00-17.00 3 hrs 19.45-22.45 (180 mins x 2 persons) 4 hrs 10.00-16.00 1hr 15 mins 20.00-21.15 (75 mins x 2 persons) 1hr 25 mins 09.30-10.55
Amphibians	01/12/03 01/12/03 02/12/03 02/12/03 03/12/03 03/12/03 04/12/03	8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 22°C, light rain 8/8 cloud, no wind, temp 18-25°C, scattered showers 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17°C 8/8 cloud, no wind, temp 17-26°C, light to mod. rain 8/8 cloud, no wind, temp 17°C, light patchy rain 0/8 cloud, no wind, temp 20°C	Call playback for Giant Burrowing Frog Spotlighting + call detection Habitat search Call playback for Giant Burrowing Frog Spotlighting + call detection Habitat search Spotlighting + call detection Habitat search	1 hrs 21.00-22.00 1hr 30 mins 20.30-22.00 (90 mins x 2 persons) 7 hrs 09.00-17.00 45 mins 22.00-22.45 3 hrs 19.45-22.45 (180 mins x 2 persons) 4 hrs 10.00-16.00 1hr 15 mins 20.00-21.15 (75 mins x 2 persons) 1hr 25 mins 09.30-10.55

APPENDIX 3
HOLLOW-BEARING TREE DATA

Table A3.1 – Hollow-bearing Tree Data for the Subject Site

No. of hollow-bearing trees	78
No. of large hollows	34
No. of medium hollows	86
No. of small hollows	69
Total no. of hollows	189
Area of subject site (ha)	21.9
Density of hollows (hollows/ha)	8.63
No. of large hollows / ha	1.55
No. of medium hollow / ha	3.93
No. of small hollows / ha	3.15

Table A3.2 – Hollow Calculation for Study Area & Surrounds

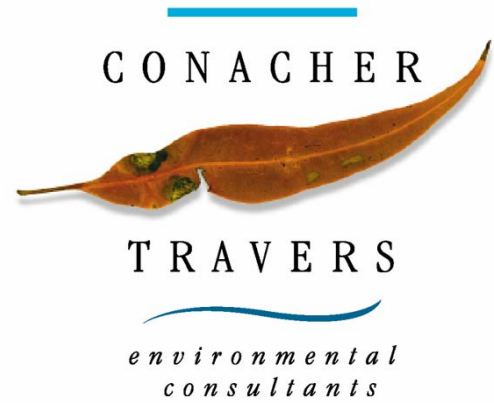
	Large	Medium	Small
Total no. of hollows	10	72	99
Average no. of hollows / quadrat	0.28	2	2.75
Average no. of hollows / ha	1.2	8	11.2

Table A3.3 – Hollow-bearing Tree Quadrat Data for Study Area & Surrounds

Quadrat Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	East of site				north of estuary			
No. of Habitat Trees	4	3	6	1	2	1	4	2	5	3	3	4	0	2	2	1	2	4	3	3	2	2	1	1	4	3	1	1	2	1	0	6	7	6	3	5
Density of Habitat Trees (Habitat Trees / ha)	16	12	24	4	8	4	16	8	20	12	12	16	0	8	8	4	8	16	12	12	8	8	4	4	16	12	4	4	8	4	0	24	28	24	12	20
No. of Small Hollows	6	3	4	7	2	1	3	3	5	1	3	5	0	2	3	1	2	3	2	1	2	0	1	1	6	1	1	2	1	1	0	2	4	6	8	6
No. of Medium Hollows	1	0	2	2	0	1	4	4	3	3	1	0	0	0	4	0	0	1	1	3	0	1	0	0	3	1	0	0	0	0	0	10	10	4	6	7
No. of Large Hollows	0	0	1	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2	0	1
Total no. of hollows	7	3	7	9	3	2	7	7	9	5	4	5	0	2	7	1	2	5	3	4	2	2	1	1	9	3	1	2	1	1	0	12	14	12	14	14
Density of Hollows (Hollows / ha)	28	12	28	36	12	8	28	28	36	20	16	20	0	8	28	4	8	20	12	16	8	8	4	4	36	12	4	8	4	4	0	48	56	48	56	56

APPENDIX 7

ADDENDUM FLORA AND FAUNA ASSESSMENT REPORT (CONACHER TRAVERS, JULY 2004)



FLORA AND FAUNA ASSESSMENT REPORT

**PART OF LOT 4 DP 771597
& PORTION 4
OFF LEO DRIVE,
NARRAWALLEE**

**JULY 2004
(REF: 2308)**

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FLORA AND FAUNA ASSESSMENT REPORT

**PART OF LOT 4 DP 771597
& PORTION 4
OFF LEO DRIVE,
NARRAWALLEE**

JULY 2004

Conacher Travers

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2308	June 2004	Final	July 2004	NE	JT

EXECUTIVE SUMMARY

This report has been prepared to assess the results of the additional survey in December 2003 and April – May 2004, and to address the issues that have been raised by the consent authority. Given the results of the additional survey and discussion of these issues, it is considered that the addendum report supports the conclusions of the Flora and Fauna Assessment Report (March, 2003).

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Licences –

National Parks and Wildlife Service

Individual staff members are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Section 120 & 131 of the *National Parks and Wildlife Act, 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: S10359 & S10618.

Department of Agriculture

The staff of *Conacher Travers* are licensed under an Animal Research Authority issued by the Department of Agriculture. This authority allows *Conacher Travers* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

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SECTION 1

INTRODUCTION

Conacher Travers Pty Ltd prepared a Flora and Fauna Assessment Report (March 2003) that identified the flora and fauna characteristics of Part of Lot 4 DP 771597 and Portion 4 off Leo Drive, Narrawallee. An assessment of the proposed development by the Department of Infrastructure, Planning and Natural Resources (DIPNR) in Mid 2003 required additional survey works to be undertaken over the site. As a result further surveys were carried out in December 2003. An Addendum Flora and Fauna Assessment Report was prepared by Conacher Travers in January 2004.

After ongoing consideration of the proposed development and the addendum report, DIPNR required further survey works to be undertaken in April – May 2004.

The proposed development layout has been adjusted to provide a buffer distance from the Sydney Coastal Estuary Swamp Forest Complex boundary. The adjustment of the proposal includes movement of part of the western boundary to the east to decrease the potential impact of the proposal on the SCESFC.

This addendum report has been prepared to assess the results of the further survey and to address the additional issues that have been raised by the consent authority. This addendum report is to be read in conjunction with the Addendum Flora and Fauna Report dated January 2004 and the original Flora and Fauna Assessment Report dated March 2003.

For the purpose of discussion within this report areas of the site will be referred to as follows:

- The 'subject site' is the area of the proposed development (see Figures);
- The 'study area' consists of the subject site and land to the west, north-west and north of the subject site (see Figure 2); and
- The 'trade-off area' consists of areas within the study area but outside of the subject site.

The aims of this report are defined as follows:

- In relation to the Endangered Ecological Community (EEC) Sydney Coastal Estuary Swamp Forest Complex (SCESFC), to provide a check of the EEC boundary;
- In relation to Powerful Owl, to determine the area and location of potential nesting and roosting habitat and the extent of foraging resources throughout the study area;
- In relation to Glossy Black-cockatoo, to determine the area and location of potential nesting and foraging habitat throughout the study area;
- Assess the potential for *Melaleuca biconvexa* to occur within the study area;
- Provide an assessment for additional threatened species recorded;
- Determine the overall likely impact of the proposed development on the recorded threatened species and the EEC within the study area and in a regional context; and
- Provide ameliorative measures to minimise the impact of the proposal on threatened species and the EEC.

1.1 PREVIOUS SURVEYS

Kevin Mills & Associates (2004). *Final Report – Review of the Boundary of the Sydney Coastal Estuary Swamp Forest Complex, Endangered Ecological Community Leo Drive, Narrawallee, City of Shoalhaven*, KMA May 2004

The purpose of this report is to document the results of a review of the Conacher Travers surveyed boundary of the community by ground truthing. The estimation of the community edge is similar to Conacher Travers in the north and south, however in the central section KMA established the boundary to be between 8 and 15 metres closer to the proposed development than the boundary determined by Conacher Travers.

The boundary of SCESFC for both KMA and Conacher Travers is shown in Figure 1.

SECTION 2

METHODOLOGY

2.0 SURVEY METHODOLOGY

An on-site meeting was held on 16th March 2004. Attendees of the meeting included representation from NSW National Parks and Wildlife Service, Department of Infrastructure, Planning and Natural Resources, Conacher Travers, Kevin Mills, David Robertson and Peter Lean. This meeting was held to discuss requirements for additional survey and assessment required to provide a more complete appraisal of ecological issues for the proposed development at Leo Drive Narrawallee.

Kevin Mills and Associates provided a summary of recommended additional work to provide a more complete assessment of the proposed subdivision at Leo Drive, Narrawallee. In summary, these recommendations included;

1. *The boundary of the EEC should be checked by a botanist and then re-surveyed followed by the preparation of a new map.*
2. *Further consideration should be given to the distances between the EEC community and the developed area (i.e. the stormwater swale) and its potential to impact on the community.*
3. *The addition of a report chapter addressing all potential impact associated with the development, including the loss of the EEC in a regional and local context.*
4. *To place the loss of the development site into a wider context, a description of the forest (public reserve) to be retained and dedicated to the public should be included.*
5. *The management of the conservation reserve should be considered, especially throughout the construction phase.*
6. *Further survey effort for threatened plant species is not warranted, although the potential of *Melaleuca biconvexa* should be noted.*
7. *The potential impact of the development on the presence/abundance of prey utilized by the Powerful Owl needs to be considered further.*
8. *The potential impact of the development on Glossy Black Cockatoo habitat needs to be considered further.*
9. *More use of the large amount of data gathered from survey plots on the forest on the development site and the forest to be retained as public reserve should be made.*
10. *Once the above data has been gathered a revised 8 part test should be prepared, concentrating on The Powerful Owl, Glossy Black Cockatoo and The Sydney Coastal Estuary Swamp Forest Complex.*

2.1 VEGETATION SURVEY METHODOLOGY

2.1.1 Literature Review - A review of available literature for the area was undertaken to obtain reference material and background information for this survey. These documents are listed in the Bibliography section of this report.

2.1.2 Database Searches - The Atlas of NSW Wildlife (NPWS 2003) threatened flora records for the Ulladulla 1:100,000 Scale Map Sheet (updated in June 15th, 2004) and the EPBC Act database were analysed to provide a predictive list of any additional threatened flora species not targeted within the initial flora surveys that could possibly occur throughout the habitats identified within the subject site.

2.1.3 Aerial Photograph Interpretation - Aerial photographs at 1:25,000 scale were utilised to identify the extent of vegetation with respect to the site and surrounding areas.

2.1.4 Sydney Coastal Estuary Swamp Forest Complex (SCESFC) Boundary

Conacher Travers utilised two methods to determine the SCESFC boundary for the purpose of an internal review. The methodology is shown in Appendix 4.

A review of the Conacher Travers SCESFC boundary was conducted by Kevin Mills & Associates (see Section 1.1).

2.2 FAUNA SURVEY TECHNIQUES

- **Literature Review** - A review of available literature for the area was undertaken to obtain reference material and background information for this survey. These documents are listed in the bibliography of this report.
- **Database Searches** - The Atlas of NSW Wildlife (NPWS June 15th, 2004) Threatened Fauna records for the Ulladulla 1:100,000 Scale Map Sheets were analysed to provide a predictive list of fauna species that occur locally and could possibly occur throughout the habitats identified within the subject site.
- **Field Survey** - Survey dates, times, weather conditions and methods employed are shown in Appendix 2. The location of fauna survey is presented in Figure 1. Field Survey targeting the threatened species Glossy Black-cockatoo and Powerful Owl were conducted by Conacher Travers on April 27th, 28th, 29th and May 4th, 5th, 6th, 18th, 19th, 20th, and 21st 2004. A total of 180.5 person hours of diurnal surveys targeting both Glossy Black-cockatoo and Powerful Owl were conducted within the study area. A total of 14.5 hours of nocturnal surveys targeting Powerful Owl were conducted within the study area.

2.2.1 Diurnal Birds

Glossy Black-cockatoo feeds almost exclusively on seeds of *Allocasuarina* (Higgins, 1999, pg 55). Searches for specimens and foraging evidence of Glossy Black-cockatoo were conducted along a series of parallel transects in conjunction with Powerful Owl roost searches. Surveys were conducted within both the subject site and the trade-off area.

Stands of *Allocasuarina* sp. and foraging evidence (chewed cones) were located and mapped. The survey included an estimation of the age of any foraging evidence found.

Large sized hollow-bearing trees within the subject site and the trade-off area considered to provide potential nesting habitat for Glossy Black-cockatoo were recorded.

A diurnal point census targeting Glossy Black-cockatoo was conducted within each area of *Allocasuarina* and adjacent to each large hollow-bearing tree recorded. The diurnal surveys for Glossy Black-cockatoo included visual and call identification.

The survey included a total of 33 transects from east to west, placed approximately 50m apart. These transects were traversed a total of four times including twice during May 4th, 5th, 6th and twice during May 18th, 19th, 20th and 21st 2004. Transect surveys were conducted using 3 or 4 field surveyors on each day. In addition, opportunistic observations of Glossy Black-cockatoos were made on April 28th, and 29th 2004.

2.2.2 Nocturnal Birds

Stag-watch surveys were conducted on selected large hollow bearing trees to target Powerful Owl. These surveys were conducted in evenings for approximately 15 minutes prior to and 30 minutes after sunset. Any fauna observed leaving hollows were noted and identified.

Spotlighting for nocturnal fauna was carried out using a hand held lamp of 750,000 candlelight power (100W halogen globe). These surveys were done in conjunction with stagwatch surveys and involved walking amongst the woodland areas so that a maximum number of trees could be observed.

Stag-watching and spotlighting surveys were conducted on the nights of April 27th, 28th and 29th and May 4th and 20th, 2004.

Searches for specimens of roosting owls and diurnal owl roost sites were conducted along a series of parallel transects, paying particular attention to the habitat requirements of Powerful Owl.

A total of 33 transects from east to west, placed approximately 50m apart. These transects were traversed a total of four times over the days of May 4th, 5th, 6th, 18th, 19th, 20th and 21st 2004. This survey was done using 3 or 4 field surveyors on each day. In addition, opportunistic observations of roosting owls and roost sites were made on April 28th, and 29th 2004.

Concentrated surveys were conducted in the suitable roosting habitats for Powerful Owl such as stands of *Syncarpia glomulifera* (Higgins, 1999). Searches for diurnal roost sites were conducted. These included looking for roosting owls, regurgitated owl pellets, whitewash and carcasses of prey.

Regurgitated owl pellets and/or carcasses were sent away to Barbara Triggs for identification and analysis to determine their source.

Habitat trees containing large sized hollows within the development and trade-off areas considered to provide potential nesting habitat for Powerful Owl were mapped and observed for evidence of use. Searches for roosting owls and roost sites were conducted within a 50m radius from each potential nesting tree.

2.2.3 Arboreal and Terrestrial Mammals

Assessments of 'found' scats, markings, diggings, runways and scratches were conducted during visits to the site.

Spotlighting for nocturnal mammalian fauna was carried out using a hand held lamp of 50W. This technique involved walking throughout the vegetation so that a maximum number of trees could be observed. Spotlighting surveys were conducted on April 27th, 28th and 29th and May 4th and 20th, 2004.

2.2.4 Bats

Mega-chiropteran bat species, such as Grey-headed Flying-fox (*Pteropus poliocephalus*), were surveyed by targeting flowering / fruiting trees during spotlighting activities. Spotlighting surveys were conducted on April 27th, 28th and 29th and May 4th and 20th, 2004.

2.2.5 Amphibians

Opportunistic surveys for amphibian species were conducted during both diurnal surveys and during spotlighting surveys. Spotlighting surveys were conducted on April 27th, 28th and 29th and May 4th and 20th, 2004.

This included general surveys such as vocal call identification, using a tape recorder to record male calls in suitable places and then comparing these to known calls.

2.2.6 Hollow-bearing Trees

Surveys targeting large (>30cm) hollow-bearing trees considered to provide potential nesting habitat for Powerful Owl and Glossy Black-cockatoo were conducted in conjunction with the survey transects. A total of 33 transects from east to west were placed approximately 50m apart. These transects were traversed a total of four times during May 4th, 5th, 6th, 18th, 19th, 20th and 21st 2004.

SECTION 3

RESULTS

3.1 FLORA SURVEY RESULTS

An initial flora survey was undertaken on 14th & 15th September 2002 in which an area, labelled Fresh Treed Swampland in a previous report, was considered to be commensurate with Sydney Coastal Estuarine Swamp Forest Complex (SCESFC) (Conacher Travers, 2003). As the area was outside of the subject site, no comprehensive survey was undertaken (Conacher Travers, 2003).

Subsequent to that survey, it was determined that there was insufficient room for a buffer area to be established between that area and the boundary of the development area (Conacher Travers, 2004). A more extensive investigation was then undertaken on 3rd December 2003 (Conacher Travers, 2004). It was assessed that not all of the Fresh Treed Swampland vegetation community was commensurate with SCESFC (Conacher Travers, 2004). The eastern boundary of the SCESFC was marked by Conacher Travers and located by land surveyors.

Conacher Travers conducted a review of the SCESFC boundary on the May 5th and 6th 2004 using methodology outlined in Appendix 4. The review indicated that the original location of the SCESFC was correct. The location of this boundary is presented in Figure 1.

The boundary of SCESFC was also determined by Kevin Mills & Associates (see Section 1.1 & Figure 1). The estimation of the community edge was similar to Conacher Travers in the north and south, however in the central section KMA established the boundary to be between 8 and 15 metres closer to the proposed development than the boundary determined by Conacher Travers (see Figure 1). The subdivision has been adjusted to conform to the eastern most SCESFC boundary defined by KMA.

Despite the presence of potential habitat, no specimens of this *Melaleuca biconvexa* were observed within the study area. It is considered that Narrawallee is outside of the area of occurrence for *Melaleuca biconvexa*. This species is discussed further in Section 4.1.3.

3.2 FAUNA SURVEY RESULTS

Several fauna surveys have been conducted within the subject site and the broader study area. Fauna observations of the subject site and surrounds are presented in Table A1.5.

Fauna surveys conducted in April – May 2004 recorded a total of thirty-nine (39) fauna species within the subject site and broader study area. These included thirty-five (35) species of birds, two (2) species of mammals, one (1) species of reptile and one (1) species of amphibian. Five (5) threatened fauna species, Glossy Black-cockatoo (*Calyptorhynchus lathami*), Osprey (*Pandion haliaetus*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) were recorded during this fauna survey.

A compilation of the current and previously conducted fauna surveys provides a total of eighty-eight (88) fauna species recorded within the study area and surrounds. These species included fifty-nine (59) species of bird, nineteen (19) species of mammal, five (5) species of reptiles and five (5) species of amphibians. Six (6) threatened fauna species have been recorded during the surveys. These species include, Eastern False Pipistrelle (*Falsistrellus*

tasmaniensis), Glossy Black-cockatoo (*Calyptorhynchus lathami*), Osprey (*Pandion haliaetus*), Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebriscosa*) and Grey-headed Flying-fox (*Pteropus poliocephalus*). The locations of threatened species are presented in Figures 1 and 2.

3.2.1 Powerful Owl

A total of fifteen (15) possible owl roost sites were recorded within the subject site and the trade-off areas during the survey. The roost search results are presented in Table 1. The locations of roost sites are presented in Figure 2.

Table 1 – Details of Roost Site Locations

Site Number	Species of Roost Tree	Location	Level of White-wash	Other Signs
R1	<i>Syncarpia glomulifera</i>	Trade-off area	Moderate	Remains of <i>Rattus sp.</i>
R2	<i>Corymbia gummifera</i>	Subject site	Low	Plucked Pied Currawong feathers
R3	<i>Syncarpia glomulifera</i>	Trade-off area	Moderate	-
R4	<i>Syncarpia glomulifera</i>	Trade-off area	Moderate	1 pellet containing bird remains (Pied Currawong)
R5	<i>Syncarpia glomulifera</i>	Trade-off area	Low	-
R6	<i>Corymbia gummifera</i>	Subject site	Moderate	1 Corvid pellet
R7	<i>Syncarpia glomulifera</i>	Trade-off area	Low	Numerous plucked grey feathers
R8	<i>Syncarpia glomulifera</i>	Subject site	Low	1 Corvid pellet
R9	<i>Syncarpia glomulifera</i>	Trade-off area	Low	1 medium sized pellet with bird remains (Pied Currawong)
R10	<i>Syncarpia glomulifera</i>	Trade-off area	Moderate	1 pellet containing regurgitated bird feathers (Pied Currawong)
R11	<i>Syncarpia glomulifera</i>	Trade-off area	Moderate	1 old decayed pellet containing fur from <i>Rattus rattus</i>
R12	<i>Eucalyptus pilularis</i>	Subject site	Moderate	-
R13	<i>Eucalyptus pilularis</i>	Subject site	Moderate	-
R14	<i>Syncarpia glomulifera</i>	Trade-off area	Moderate	-
R15	<i>Eucalyptus pilularis</i>	Subject site	Low	-

The results of the roost site surveys, found four (4) regurgitated pellets identified by Barbara Triggs (2004) as owl pellets. These include R4, R9, R10 and R11. Ten (10) roost sites were located beneath *Syncarpia glomulifera* (Turpentine). Nine (9) of these were located outside of the subject site within the trade-off areas.

During spotlighting survey at 6pm on April 27th 2004 a Powerful Owl was heard calling repeatedly in the western portion of the study area, approximately 350m from the subject site. The Owl was again heard calling within the same area the night after at 6.10pm April 28th. No roosting Powerful Owls were observed during extensive survey throughout the study area.

3.2.2 Glossy Black-cockatoo

No specimens of Glossy Black-cockatoo were heard or observed during extensive survey in April and May 2004. There was also no evidence of tree hollow utilisation nesting recorded throughout the study area. Recent foraging evidence of Glossy Black-cockatoo was observed within the subject site on May 5th, and near the southern boundary of the study area on April 28th 2004. The location of foraging evidence of Glossy Black-cockatoo is presented in Figure 2.

A total of sixty-five (65) large hollow-bearing trees were observed within the study area. This included twenty-four (24) within the subject site, and forty-one (41) throughout the trade-off area.

Mapping of *Allocasuarina* stands within the subject site and the remaining study area were conducted (see Section 2.2.1). The area of *Allocasuarina* within the subject site is approximately 1.016ha. The area of *Allocasuarina* within the trade-off area is approximately 2.607ha.

The study area forms approximately 103.9 ha.

As a percentage of the study area *Allocasuarina* within the subject site forms approximately 0.98%. As a percentage of the study area *Allocasuarina* within the trade-off area forms approximately 2.5%.

3.2.3 Sooty Owl

During stagwatches conducted on May 4th and 20th 2004 a Sooty Owl was observed emerging from the large broken trunk hollow in hollow tree number 12C (the known Powerful Owl nest tree: see Figure 1 & 2).

3.2.4 Osprey

A single Osprey was observed feeding on a fish while roosting in a stag (hollow tree number HB18) in the centre of the subject site at approximately 12am May 19th 2004. Cuttlefish remains were found at the base of the stag. Cuttlefish or other fish remains were also found under two other stags within close proximity to HB18.

3.2.5 Grey-headed Flying-fox

The Grey-headed Flying Fox was spotlighted on the nights of December 1st and 2nd, 2003. These individuals were observed foraging in flowering trees along the main track within the subject site. No Grey-headed Flying-fox camps were observed within or in close proximity to the study area.

3.2.6 Hollow-bearing Trees

Hollow-bearing tree surveys consisting of detailed transects were conducted in April – May 2004 to concentrate on the trade-off areas. A total of forty-one (41) hollow-bearing trees containing large hollows were found throughout trade-off area. Twenty-four (24) hollow-bearing trees containing large hollows were found within the subject site (Conacher Travers, 2004) forming a total of sixty-five (65) hollow-bearing trees containing large hollows within the study area.

SECTION 4

DISCUSSION

4.1 VEGETATION DISCUSSION

4.1.1 Clarification of SCESFC Boundary

During the previous survey it was noted that the vegetation referred to as Fresh Treed Swampland in the original report (Conacher Travers, 2003) was commensurate with the endangered ecological community Sydney Coastal Estuarine Swamp Forest Complex (SCESFC). As it was outside of the subject site, no specific definition of community boundaries was undertaken, other than to ensure that it was outside of the subject site.

A more extensive investigation was undertaken during the December 2003 survey, when it was assessed that not all of the Fresh Treed Swampland vegetation community was commensurate with SCESFC (Conacher Travers, 2004).

SCESFC is confined to estuarine alluvium, whereas the Fresh Treed Swampland extends upslope in some areas where the colluvial soil is poorly drained or subject to seepage from the hillside. Fresh Treed Swampland also follows the creek line, as a narrow belt, above where it levels out onto the estuarine alluvium.

During the inspection of the community, the line of demarcation between the hillside and estuarine alluvium over most of the area was almost impossible to determine visually, due to the dense understorey and very low gradients along the foot of the hillside. It was noted that two of the most common shrubs were *Melaleuca ericifolia* and *Pultenaea flexilis*. *Melaleuca ericifolia* has a particular affinity for the types of soil which support SCESFC, while *Pultenaea flexilis* has an equally strong aversion to those soils. It was noted that although both species were very common, there was almost no overlapping of the species and that where the overlapping did occur, it was only by a few metres.

The line of demarcation between those species was adopted as the boundary of SCESFC. This boundary was tagged so that surveyors could accurately locate it. Towards the eastern end of the site, those two species lost their prominence, but by that stage, the base of the hillside was clearly visible in most areas and where it was not obvious, the SCESFC boundary was adopted as being immediately downslope from any Blackbutts or Bloodwoods.

Conacher Travers conducted a second survey on the May 5th and 6th 2004 using different species to locate the boundary of the SCESFC. This survey was conducted for the purpose of an internal review. It was found that original location of the SCESFC was correct.

The boundary of SCESFC was also determined by Kevin Mills & Associates (see Section 1.1 & Figure 1). The estimation of the community edge was similar to Conacher Travers in the north and south. In the central section of the boundary, KMA established the boundary to be between 8 and 15 metres closer to the proposed development than the boundary determined by Conacher Travers (see Figure 1). The subdivision has been adjusted to conform to the eastern most SCESFC boundary defined by KMA.

The location of this boundary is presented in Figure 1.

The proposed development layout has been adjusted to provide a buffer distance from the Sydney Coastal Estuary Swamp Forest Complex boundary. The adjustment of the proposal includes movement of part of the western boundary to the east to decrease the potential impact of the proposal on the SCESFC.

Detailed land survey of the SCESFC boundary depicted in Figure 3, has identified the nearest point of this community to the subject site boundary as approximately 30m, while the distance between the SCESFC boundary and the current proposed development is approximately 50 metres. The proposed fire trail will be contained within the subject site and therefore be situated at least 20 metres from the SCESFC boundary. Drainage contours and sediment control structures included within the fire trail design are to be provided to prevent any adverse affects on the SCESFC community.

4.1.2 Sydney Coastal Estuary Swamp Forest Complex (SCESFC) 8-part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

This part does not apply to ecological communities.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

This part does not apply to ecological communities.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The Sydney Coastal Estuary Swamp Forest Complex (SCESFC) is listed as an Endangered Ecological Community in the Sydney Basin Bioregion. SCESFC occurs on waterlogged estuarine alluvial soils in low lying estuarine areas with periodically poor drainage. The characteristic canopy species of this community are variable, including species such as *Eucalyptus robusta*, *E. botryoides*, *Livistona australis* and *Melaleuca sp.*

SCESFC is known to occur in local government areas of Lake Macquarie, Wyong, Gosford, Baulkham Hills, Pittwater, Warringah, Liverpool, Rockdale, Sutherland, Wollongong, Shellharbour and Kiama, but may also occur elsewhere in the Sydney Basin Bioregion (NSW Scientific Committee, 2000).

Known locations of SCESFC include, Swansea, Porters Creek Wetland, Wyong River floodplains, Lisarow wetlands, Erina Creek, Bensville, Middle and Deep Creeks and Narrabeen Lagoon, Dee Why Lagoon, Voyager Point, Leo Smith Reserve Ramsgate, Kurnell, Bundeena and Mill Creek, Bellambi Lagoon, Fairy Creek, Wollingurrie Swamps (Duck Creek), Dunmore Wetlands (Shellharbour LGA) and Minnamurra Wetlands (Kiama LGA) (NSW Scientific Committee, 2000).

Small areas are known to be reserved in the Cockle Bay Nature Reserve, Garigal National Park and Royal National Park.

At a regional level no accurate mapping has been completed to determine the extent of SCESFC. It is considered that this community is common on alluvial flats adjoining estuaries along the NSW coast. Also it is considered that SCESFC is present throughout the Shoalhaven LGA.

All areas of SCESFC observed within the study area are outside of the subject site. The proposal also includes a buffer zone of greater than 30 metres between the development and the SCESFC. It is considered that the proposal will not remove or modify a significant area of habitat for SCESFC within the local area or region.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

With regard to SCESFC, all of the observed areas were outside of the subject site and a buffer zone is proposed to be established between the SCESFC and any development.

It is considered that known habitat for this ecological community within the local area and region is unlikely to become isolated from currently interconnecting or proximate areas of habitat as a result of the proposal.

(e) Whether critical habitat will be affected.

The site has not been identified as critical habitat within the provisions of the *TSC Act* (1995).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Limited surveys have been undertaken to establish the extent of this vegetation community beyond the Newcastle / Wollongong area and thus it is not possible to establish the extent to which this ecological community is conserved outside of that area.

On the basis of available information, it is considered that this ecological community is not adequately represented within secure conservation reserves.

(g) Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process

The SCESFC is not included within the proposed development area and thus this part requires no further attention.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

SCESFC is not considered to be approaching the natural limits of its distribution within the Narrawallee local area.

4.1.3 Assessment of *Melaleuca biconvexa*

Melaleuca biconvexa is a paperbark shrub, which occurs principally between Broken Bay and Morisset, although disjunct populations have been observed as far afield as Port Macquarie and Jervis Bay.

On the Central Coast, *Melaleuca biconvexa* often occurs in dense thickets, along the banks of perennial streams which rise in, or pass through, Terrigal Formation geology. This species also occurs in wetlands on flood plains associated with these perennial streams. This species occurs on sheltered hillsides and along ephemeral drainage lines within Terrigal Formation geology.

The records of *Melaleuca biconvexa* from Jervis Bay are from similar habitat to the Sydney Coastal Estuary Swamp Forest Complex at Narrawallee. Despite the presence of potential habitat, no specimens of this *Melaleuca biconvexa* were observed within the study area. It is considered that Narrawallee is outside of the area of occurrence for *Melaleuca biconvexa*.

4.2 FAUNA DISCUSSION

The following fauna discussion consists of a detailed assessment of Powerful Owl to address specific issues raised by the consent authority. This is followed by a revised 8-part test of Powerful Owl, Glossy Black-cockatoo and Grey-headed Flying-fox, and a new 8-part test for Sooty Owl and Osprey.

4.2.1 Powerful Owl

A total of fifteen (15) possible owl roost sites were recorded within the subject site and the trade-off areas during the survey (see Figure 2). Of these fifteen roosts, four (4) had regurgitated pellets, two (2) had numerous plucked Pied Currawong feathers and one (1) had the remains of a *Rattus* species. The remaining eight (8) roost sites contained whitewash only.

Given the records of both Powerful Owl and Sooty Owl within the study area, it is considered that roost sites may be from either of these species.

The three (3) roost sites containing Pied Currawong kills were observed within the subject site.

During spotlighting survey at 6pm on April 27th 2004 a Powerful Owl was heard calling repeatedly in the western side of the study area, approximately 350m from the subject site. The Powerful Owl was again heard calling within the same area at 6.10pm the following night of April 28th. No roosting Powerful Owls were observed during extensive survey throughout the study area. It is considered the Powerful Owl utilises the study area for foraging and occasionally for roosting.

The following points taken from the Addendum Report (Conacher Travers, 2004) are considered relevant to address the aims of this report in regards to Powerful Owl. The discussion beneath each of these points has been updated to include the most current information from the surveys in May and April 2004.

4.2.1.1 Potential nesting trees within the subject site and the trade-off area and whether or not these trees are utilised or are likely to be used in the future by this species;

The Powerful Owl nests in the cavity of a large hollow tree. Large trees with hollows at least 0.5m deep are required for shelter and breeding (Schodde *et al.* 1980; SWC Consultancy 1993). The cavity is prepared by the male which is carpeted with dead leaves and wood debris (Lindsey 1992). Breeding occurs from May through to October (Higgins, 1999).

A total of sixty-five (65) hollow-bearing trees containing large hollows were observed within the study area. This included twenty-four (24) within the subject site, and forty-one (41) throughout the remainder of the study area (trade off areas).

From the twenty-four (24) hollow-bearing trees containing large hollows within the subject site only five (5) of these are considered to provide potential nesting habitat for Powerful Owl (Conacher Travers, 2004). The selection of these five hollows is based on knowledge of hollow characteristics for Powerful Owl. However it is considered that none of these hollows provide ideal nesting habitat for Powerful Owl. Considerations for hollow selection include primarily the hollow type as well as the size, age and height of tree, height of hollow and entry size, internal size and depth of hollow. According to Higgins (1999) the Powerful Owl nests in hollows in large old trees, usually in living *Eucalyptus*, however rarely in dead stags, stumps or broken-off trunks.

Survey transects conducted in April and May 2004 observed forty-one (41) large hollow-bearing trees within the trade-off area. A comparison of large hollow-bearing trees within the subject site compared to the trade-off area can be made using the density of large hollow-bearing tree per hectare. The subject site contains 1.1 large hollow-bearing trees / ha (see Table A3.1). The trade-off area contains 0.5 large hollow-bearing trees / ha (see Table A3.3). The subject site therefore contains a higher density of large hollow-bearing trees.

Survey transects were conducted throughout entire the study area during April – May 2004 (prior to the winter breeding season) to observe possible roosting Powerful Owls. During the nesting period, the male usually roosts in trees near the nest-tree, sometimes favouring one site, often within 50m of the nest (Higgins, 1999, pg824). Powerful Owls are also known to roost in close proximity to the nest site prior to the breeding season.

An observation of a roosting Powerful Owl would therefore indicate that a nesting tree was in close proximity to that location. However no roosting individuals of this species were observed within the subject site or the trade-off area. It is unlikely that large hollow-bearing trees within the subject site or the trade-off study area are being utilised.

Given that the subject site contains a higher density of large hollow-bearing trees, it could be considered that the subject site has a greater potential per unit area to provide potential nesting habitat for this species. However based on more detailed analysis of large hollow-bearing trees within the subject site, it is considered that only five (5) of the large hollow-bearing trees within the subject site provide potential nesting habitat for this species.

No roosting owls were found within the subject site during the period prior to the nesting season. Therefore, it is considered unlikely that large hollow-bearing trees within the subject site were being utilised.

The proposed development is unlikely to remove nesting trees for this species.

4.2.1.2 Roosting habitat throughout the study area and whether or not areas within the subject site provide suitable roosting habitat for this species; and

Mated pairs of Powerful Owl roost together or separately, maintaining several roost sites throughout their territory which are used in rotation (Lindsey 1992), shifting with the availability of prey. The Powerful Owl mostly roosts in closed forest, including rainforest or wet sclerophyll forest (Higgins, 1999, pg 819).

The Powerful Owl is known to roost in the canopy or sub-canopy of trees, either on bare horizontal branch or among foliage in several species. These species include, *Syncarpia glomulifera* (Turpentine) and *Melaleuca* (Paperbark) (Higgins, 1999, pg 819). In a site

adjoining the study area to the south it was found that all of the Powerful Owl roosting trees were Turpentine (Coombes, 1998).

Surveys transects were conducted throughout the entire study area during April – May 2004 (prior to the winter breeding season) to observe possible roosting Powerful Owls. During the nesting period, the male usually roosts in trees near the nest-tree, sometimes favouring one site, often within 50m of the nest (Higgins, 1999, pg824). Powerful Owls are also known to roost in close proximity to the nest site prior to the breeding season.

An observation of a roosting Powerful Owl would therefore indicate that a nesting tree was in close proximity to that location. However no roosting individuals of this species were observed within the subject site or the trade-off area.

The results of the roost site surveys, found four (4) regurgitated pellets identified by Barbara Triggs (2004) as Owl pellets. These include R4, R9, R10 and R11 (refer to Table 1 in Section 3.2.1). Ten (10) roost sites were located beneath *Syncarpia glomulifera* (Turpentine). Nine (9) of these were located outside of the subject site within the trade-off areas.

Turpentine is considered to provide suitable roosting habitat for Powerful Owl as well as most owl species due to their dense foliage and often horizontal branches. Ten (10) of the fifteen (15) roost sites were found beneath Turpentine. The remaining five (5) roost sites were found beneath *Corymbia gummifera* and *Eucalyptus pilularis*. Three (3) of these roost sites contained white-wash. Areas of white-wash which do not contain owl pellets may be due to roosting sites of diurnal bird species. It is considered that these roost sites are unlikely to be evidence of owl roosts.

It is considered that roost sites beneath Turpentine are more likely to be from owl species including Powerful Owl. Nine (9) of these roost sites are present within the trade-off areas (see Figure 2). Therefore it is considered that the trade-off areas are likely to provide more significant areas of roosting habitat for owls.

The known nesting tree has been located approximately 117m to the west of the western boundary of the subject site. According to the 50m roosting buffer in Higgins (1999), the proposal will allow a buffer of 67m from likely roosting areas during the breeding season. It is considered that the proposal is unlikely to significantly impact upon areas of roosting habitat for the known nesting tree during the nesting period.

4.2.1.3 The abundance of foraging resources and whether or not the subject site provides a significant area for foraging, including consideration for the abundance of prey resources within the subject site relative to other foraging areas within the Powerful Owls home range.

The species is a nocturnal and solitary carnivore that specialises in hunting arboreal prey of moderate to large size. It preys on birds, small mammals, invertebrates and arboreal mammals, including the Common Ringtail Possum (*Pseudocheirus peregrinus*), the Greater Glider (*Petauroides volans*) and Gliders (*Petaurus* sp.) (Seebeck 1976; Lavazanian *et al.* 1994; Pavey *et al.* 1994).

Powerful Owl is also known to forage on some terrestrial mammals such as *Antechinus* species and *Rattus* species (Higgins, 1999, pg 821-823). Despite this range of prey species any one pair of Powerful Owls tend to specialise, taking only one or two prey types. The Powerful Owl also tends to concentrate foraging activities within a small pocket of their overall territory and switch to adjacent areas after prey numbers have been substantially reduced (Kavanagh, 1988).

A search of Atlas of NSW Wildlife (NPWS June 15th, 2004) records for the Ulladulla 1:100,000 Scale Map Sheet found records of a variety of potential prey species for Powerful Owl within 10km from the subject site. These species include, Common Ringtail Possum (*Pseudocheirus peregrinus*), Common Brushtail Possum (*Trichosurus vulpecular*), Sugar Glider (*Petaurus breviceps*), Bush Rat (*Rattus fuscipes*), Swamp Rat (*Rattus lutreolus*), Yellow-footed Antechinus (*Antechinus flavipes*), Brown Antechinus (*Antechinus stuartii*) and Dusky Antechinus (*Antechinus swainsonii*).

Five (5) potential prey species were recorded by surveys in the subject site (Conacher Travers, 2000a; Conacher Travers 2000b; Mills, 1994). These species include Brown Antechinus, Bush Rat, Common Ringtail Possum, Common Brushtail Possum and Grey-headed Flying-fox.

The main prey of the Powerful Owl are hollow dependant arboreal marsupials (Soderquist et al., 2002). The number of hollows and large old trees may be a surrogate measures for the densities of arboreal mammals which are preferred prey of Powerful Owls (Soderquist et al., 2002). In studies of Box-Ironbark forest of Victoria it was found that owl territories had significantly more hollows and large old trees than surrounding forest (Soderquist et al., 2002). The density of hollows within the subject site is approximately 8.6 hollows / ha (refer to Table A3.1). This is compared to approximately 20.1 hollows / ha within the trade-off area (Conacher Travers, 2004). These results show that the potential foraging resources for Powerful Owl are likely to be significantly higher in the trade-off area and surrounds.

Estimates of the home range of this species vary greatly but territories are thought to be a minimum of 800 hectares (Kavanagh, 1988) and up to 1500 ha (Higgins, 1999, pg824). The home ranges of Powerful Owl have been estimated to be as little as 400-600ha in productive habitat containing high densities of prey (Higgins, 1999, pg 824).

Soderquist et al (2002) showed that larger home ranges resulted from low prey densities in Box-Ironbark forest. The total area of the study area is approximately 104 ha. The area of the subject site is approximately 21.9 ha, which forms approximately 21% of the study area.

The significance of the subject site and trade-off area may vary depending on their quality of foraging habitat for Powerful Owl. Based on home range and prey densities referenced above the total area (area of the study area) may form as much as 13% of a home range containing high prey densities or as little as 7% of a home range contain low prey densities. This calculation is based on the area of the study area and not just the subject site. Given the area of the subject site relative to the possible home range of Powerful Owl, it is considered that the subject site is unlikely to form a significant area of foraging habitat for the Powerful Owl.

4.2.1.4 Powerful Owl – Revised 8-part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

On December 1st, 2003 an individual Powerful Owl was heard calling at approximately 20.40 in response to call playback from within close proximity to the known nest tree. This individual was then later spotlighted approximately 100m to the north of the known nesting tree. The Powerful Owl was also heard calling to the south of the subject site on the night of September 11th, 2002 (Conacher Travers, 2002).

A total of fifteen (15) possible owl roost sites were recorded within the subject site and the trade-off areas during the survey (see Figure 3). Of these fifteen roosts, four (4) had regurgitated pellets, two (2) had numerous plucked Pied Currawong feathers and one (1) had the remains of a *Rattus* sp. The remaining eight (8) roost sites contained whitewash only.

Given the records of both Powerful Owl and Sooty Owl within the study area, it is considered that roost sites may be from either of these species.

During spotlighting survey at 6pm on April 27th 2004 a Powerful Owl was heard calling repeatedly in the western side of the study area, approximately 350m from the subject site. The Owl was again heard calling within the same area at 6.10pm the following night of April 28th. No roosting Powerful Owls were observed during extensive survey throughout the study area. It is considered the Powerful Owl utilises the study area for foraging and occasionally for roosting.

Based on the above information (see Section 4.2.1 above) it is considered that the proposal is unlikely to disrupt the life cycle of the Powerful Owl such that a viable local population of this species is likely to be placed at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

No endangered populations of Powerful Owl are listed within the TSC Act (1995). This matter does not require any further consideration.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The Powerful Owl is well documented resident of local area of Narrawallee. A search of the Atlas of NSW Wildlife (NPWS June 15th, 2004) found seven (7) records of Powerful Owl within 20km of the subject site. These records include, 1 within the study area, 1 adjacent to the south along Matron Porter Drive, 1 to the south along Mollymook Creek, 1 in Ulladulla, 1 at the northern end of Burrill Lake and 2 to the south-west of the subject site along Kingiman Road within the Croobyar State Forest.

The two (2) records within and in close proximity to the study area were in 1999 and 2002.

Powerful Owl is known to occur within fifteen (15) conservation reserves throughout the Sydney Basin Bio-region: Berowra Valley Regional Park, Blue Mountains NP, Bouddi NP, Brisbane Water NP, Cattai NP, Dharug NP, Garigal NP, Heathcote NP, Ku-ring-gai Chase NP, Marramarra NP, Nattai NP, Royal NP, Seven Mile Beach NP, Wollemi NP and Yengo NP (NPWS, 1997; NPWS, 2004).

Several habitat attributes were identified within the study area including:

- Vegetated areas of Open Forest dominated by the September to March flowering *Eucalyptus pilularis* (Blackbutt);
- Vegetated areas containing *Syncarpia glomulifera* (Turpentine), which provides suitable roosting habitat for Powerful Owl;
- Tree hollows ranging from small (<10cm) to large (>30cm) diameter, which provides suitable nesting habitat for Powerful Owl and its prey species;
- Moderate to dense shrublayer;
- Moderate density ground cover;

- Nectar producing plants, principally *Banksia* and *Acacia*;
- Sap flows, particularly Red Bloodwood trees;
- Fallen timber and hollow logs;
- Loose soil suitable for burrowing;
- Scattered surface rocks;
- Areas of sparse and dense litter layer;

Habitats within the region that are similar to those identified within the subject site, which contain potential habitat for Powerful Owl are likely to be widespread in forested coastal areas in the south-eastern section of the Sydney Basin Bioregion.

It is considered that the proposal will not remove or modify a significant area of habitat for Powerful Owl within the local area or region.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The subject site is bound to the south and east by residential development, to the north by natural bushland adjoining Narrawallee Creek and to the west and south-west by natural bushland adjoining cleared agricultural land.

The subject site forms part of a local vegetation corridor from Narrawallee Creek in the north to Mollymook Golf Course in the south. The conservation of the trade-off areas is considered to be sufficient to maintain this vegetation corridor. The remaining corridor is considered to be sufficient to maintain the ecological requirements of the Powerful Owl in the local area.

It is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated from currently interconnecting or proximate areas of habitat as a result of the proposal.

(e) Whether critical habitat will be affected.

The site has not been identified as critical habitat within the provisions of the *TSC Act* (1995).

(g) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Powerful Owl is known to occur within fifteen (15) conservation reserves throughout the Sydney Basin Bio-region: Berowra Valley Regional Park, Blue Mountains NP, Bouddi NP, Brisbane Water NP, Cattai NP, Dharug NP, Garigal NP, Heathcote NP, Ku-ring-gai Chase NP, Marramarra NP, Nattai NP, Royal NP, Seven Mile Beach NP, Wollemi NP and Yengo NP (NPWS, 1997; NPWS, 2004).

While the Powerful Owl is represented in secure conservation reserves as indicated above, on the basis of available information, it is considered that this species is not adequately represented within secure conservation reserves.

(g) Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process

The proposal is likely to include clearing of native vegetation, removal of dead wood and dead trees and removal of bushrock. "Clearing of native vegetation", "Removal of dead wood and dead trees" and "Bush Removal" are listed as a Key Threatening Processes.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

According to Bennet *et.al.* (2003) the Powerful Owl is not considered to be approaching the natural limits of its distribution within the Narrawallee local area.

4.2.2 Glossy Black-cockatoo Revised 8-part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Glossy Black-cockatoo inhabits mountain forests, coastal woodland, open forest and trees bordering watercourses where there are substantial stands of casuarinas (SFNSW 1995a). The breeding season of the Glossy Black-cockatoos is between March and August (Higgins, 1999, pg61). The Glossy Black-cockatoo lives in permanent groups of up to 10 individuals (SFNSW 1995b), roosting communally at night and travelling at dawn to groves of seeding Casuarina trees to feed for the day. Foraging within Casuarinas tends to be concentrated on trees with greater crops of cones (Clout 1989).

This species has a bill structure and highly specialised feeding techniques developed for feeding almost exclusively on Casuarinas with large cones such as the *Allocasuarina littoralis*, *A. stricta* and *A. torulosa* (Lindsey 1992; SFNSW 1995a). It apparently does not feed on *Casuarina glauca* (UBBS, 1997). This species is also known to feed on insects and the seeds of eucalypts, angophoras, hakeas, acacias and sunflowers (Blakers *et al.* 1984; Lindsey 1992). Once food resources are exhausted in one area the birds move to another.

No specimens of Glossy Black-cockatoo were observed during surveys.

General survey for large hollow-bearing trees observed twenty-four (24) large hollow-bearing trees within the subject site and forty-one (41) large hollow-bearing trees within the trade-off area. A comparison of large hollow-bearing trees within the subject site compared to the trade-off area can be made using the density of large hollow-bearing trees per hectare. The subject site contains 1.1 large hollow-bearing trees / ha (see Table A3.1). The remainder of the study area contains 0.5 large hollow-bearing trees / ha (see Table A3.3). The subject site therefore contains a higher density of large hollow-bearing trees. However no specimens of this species were observed during target surveys at each located large hollow-bearing tree within the study area despite the timing of these survey within the breeding season of March to August.

Mapping of *Allocasuarina* stands within the subject site and the remaining study area were conducted (see Section 2.2.1.2). The area of clumped *Allocasuarina* within the subject site is approximately 1.016ha. The area of clumped *Allocasuarina* within the remaining study area (trade off areas) is approximately 2.607ha. As a percentage of the study area *Allocasuarina* within the subject site forms approximately 0.98%. As a percentage of the study area *Allocasuarina* within the trade-off area forms approximately 2.5%. Therefore *Allocasuarina* within the trade-off area forms a greater percentage of the study area.

No specimens of this species were observed during target survey conducted within each located area of *Allocasuarina*. However, recent foraging evidence of Glossy Black-cockatoo was observed within the subject site on May 5th in the same location as those found in December 2003. Evidence was also found near the southern boundary of the study area on April 28th 2004. The location of foraging evidence of Glossy Black-cockatoo is presented in Figure 2.

A search of Atlas of NSW Wildlife (NPWS June 5th, 2004) records for the Ulladulla 1:100,000 Scale Map Sheet found twenty-one (21) records of Glossy Black-cockatoo within 20km from the subject site. Two (2) records are located within or in close proximity to the study area. The most recent record within 10km is in September 2002 approximately 6.5km to the south of the subject site.

According to Mills (2002) most of the Glossy Black-cockatoo habitat in the LEP area is zoned Environmental Protection (Mills, 2002, pg10). Given the extent of potential foraging habitat for Glossy Black-cockatoo outside of the subject site and the lack of breeding evidence within the subject site, it is considered that removal of patches of *Allocasuarina* from within the subject site are unlikely to disrupt the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

It is considered that the proposal is unlikely to disrupt the life cycle of this species such that a viable local population of this species is likely to be placed at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

No endangered populations of Glossy Black-cockatoo are listed within the TSC Act (1995) for the Narrawallee area. This matter does not require any further consideration.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

A search of Atlas of NSW Wildlife (NPWS June 5th, 2004) records for the Ulladulla 1:100,000 Scale Map Sheet found twenty-one (21) records of Glossy Black-cockatoo within 20km from the subject site. Two (2) records are located within or in close proximity to the study area. The most recent record within 10km is in September 2002 approximately 6.5km to the south of the subject site.

The local records of Glossy Black-cockatoo within 20km to the subject site include, 2 within or in close proximity to the study area, 2 near Warden Head Ulladulla, 13 between Burrill Lake and Ulladulla, 3 to the north of Tabourie Lake within the Woodburn State Forest and 1 near Pigeon House Fire Trail and Doctors Creek within Morton National Park (NSW NPWS, 2004).

Glossy Black-cockatoo is known to occur within thirteen (13) conservation reserves throughout the Sydney Basin Bio-region including: Bouddi NP, Parr SRA, Blue Mountains NP, Brisbane Water NP, Cattai NP, Dharug NP, Ku-ring-gai Chase NP, Murrumbidgee NP, Marramarr NP, Nattai NP, Wollemi NP, Yengo NP and Morton National Park (NPWS, 1997; NPWS, 2004).

Several habitat attributes were identified within the study area including:

- Vegetated areas of Open Forest dominated by the September to March flowering *Eucalyptus pilularis* (Blackbutt);
- Open Forest containing *Allocasuarina littoralis*, which provides suitable foraging habitat for Glossy Black-cockatoo;
- Tree hollows including large hollows (>30cm) diameter, which provide potential nesting habitat for Glossy Black-cockatoo;
- Moderate to dense shrublayer;
- Moderate density ground cover;
- Nectar producing plants, principally *Banksia* and *Acacia*;

- Sap flows, particularly Red Bloodwood trees;
- Fallen timber and hollow logs;
- Loose soil suitable for burrowing;
- Scattered surface rocks;
- Areas of sparse and dense litter layer;

Habitats within the region that are similar to those identified within the study area, which contain potential habitat for Glossy Black-cockatoo, are likely to be widespread in forested coastal areas in the south-eastern section of the Sydney Basin Bioregion.

It is considered that the proposal will not remove or modify a significant area of habitat for Glossy Black-cockatoo within the local area or region.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The subject site is bound to the south and east by residential development, to the north by natural bushland adjoining Narrawallee Creek and to the west and south-west by natural bushland adjoining cleared agricultural land.

The subject site forms part of a local vegetation corridor from Narrawallee Creek in the north to Mollymook Golf Course in the south. The conservation of the trade-off areas is considered to be sufficient to maintain this vegetation corridor. The remaining corridor is considered to be sufficient to maintain the ecological requirements of the Glossy Black-cockatoo in the local area.

It is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated from currently interconnecting or proximate areas of habitat as a result of the proposal.

(e) Whether critical habitat will be affected.

The site has not been identified as critical habitat within the provisions of the *TSC Act* (1995).

(h) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Glossy Black-cockatoo is known to occur within twelve (12) conservation reserves throughout the Sydney Basin Bio-region including: Bouddi NP, Parr SRA, Blue Mountains NP, Brisbane Water NP, Cattai NP, Dharug NP, Ku-ring-gai Chase NP, Murramarang NP, Marramarra NP, Nattai NP, Wollemi NP and Yengo NP (NPWS, 1997; NPWS, 2004).

While the Glossy Black-cockatoo is represented in secure conservation reserves as indicated above, on the basis of available information, it is considered that this species is not adequately represented within secure conservation reserves.

(g) Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process

The proposal is likely to include clearing of native vegetation, removal of dead wood and dead trees and removal of bushrock. "Clearing of native vegetation", "Removal of dead wood and dead trees" and "Bush Removal" are listed as a Key Threatening Processes.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

The known foraging resource for Glossy Black-cockatoo, *Allocasuarina littoralis* is distributed from Queensland to Victoria and Tasmania (Harden, 1993).

According to Barret *et.al.* (2003) the Glossy Black-cockatoo is not considered to be approaching the natural limits of its distribution within the Narrawallee local area.

4.2.3 Grey-headed Flying-fox 8-part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Grey-headed Flying-fox is found in a variety of habitats including rainforest, mangroves, paperbark swamps, wet and dry sclerophyll forests and cultivated areas (Churchill, 1998).

Grey-headed Flying Foxes congregate in large camps of up to 200,000 individuals, depending on availability of surrounding blossoming plants, from early until late summer (Churchill, 1998). Camps are commonly formed in gullies, typically not far from water and in vegetation with a dense canopy. Roost sites are an important resource where mating, birth and rearing of young occurs as well as providing refuge (Strahan, 1995).

These bats eat the fruit or blossoms of more than 80 species of plants. Their major food source is eucalypt blossom and native fruits from a variety of tree species. Native figs (*Ficus* spp) account for a large percentage of the fruit eaten. They are also known to raid orchards of cultivated fruit. The Grey-headed Flying-fox has a nightly feeding range of 20 to 50km from their camp (Churchill, 1998).

The Grey-headed Flying Fox was spotlighted on the nights of December 1st and 2nd, 2003. These individuals were observed foraging in flowering trees along the main track within the subject site (see Figure 1). No Grey-headed Flying-fox camps were observed within or in close proximity to the study area. It is considered that the subject site does not provide a significant area of foraging habitat for this species.

It is considered that the proposal is unlikely to disrupt the life cycle of this species such that a viable local population of this species is likely to be placed at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

No endangered populations of Grey-headed Flying-fox are listed within the TSC Act (1995). This matter does not require any further consideration.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

A search of Atlas of NSW Wildlife (NPWS June 5th, 2004) records for the Ulladulla 1:100,000 Scale Map Sheet found four (4) records of Grey-headed Flying-fox within 20km from the subject site. These records include, 2 at the northern end of Burrill Creek near Stoney Creek, 1 near Romney Park to the west of Ulladulla and 1 near Mimosa Park to the south-west of Ulladulla.

Grey-headed Flying-fox is known to occur within seven (7) conservation reserves throughout the Sydney Basin Bio-region. These include: Blue Mountains NP, Brisbane Water NP, Dharug NP, Ku-ring-gai Chase NP, Munmorah SRA, Royal NP and Wyrabalong NP (NPWS, 2004).

Several habitat attributes were identified within the subject site including:

- Vegetated areas of Open Forest dominated by the September to March flowering *Eucalyptus pilularis* (Blackbutt);
- Moderate to dense shrublayer;
- Moderate density ground cover;
- Nectar producing plants, principally *Banksia* and *Acacia*;
- Sap flows, particularly Red Bloodwood trees;
- Tree hollows;
- Fallen timber and hollow logs;
- Loose soil suitable for burrowing;
- Scattered surface rocks;
- Areas of sparse and dense litter layer;

Habitats within the region that are similar to those identified within the subject site, which contain potential habitat for Grey-headed Flying-fox are likely to be widespread in forested coastal areas in the south eastern section of the Sydney Basin Bioregion.

It is considered that the proposal will not remove or modify a significant area of habitat for Grey-headed Flying-fox within the local area or region.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The subject site is bound to the south and east by residential development, to the north by natural bushland adjoining Narrawallee Creek and to the west and south-west by natural bushland adjoining cleared agricultural land.

The Grey-headed Flying-fox is a highly mobile species which travel long distances each night from camps to suitable foraging resources.

The subject site forms part of a local vegetation corridor from Narrawallee Creek in the north to Mollymook Golf Course in the south. The conservation of the trade-off areas is considered to be sufficient to maintain this vegetation corridor.

It is considered that known habitat for Grey-headed Flying-fox within the local area and region is unlikely to become isolated from currently interconnecting or proximate areas of habitat as a result of the proposal.

(e) Whether critical habitat will be affected.

The site has not been identified as critical habitat within the provisions of the *TSC Act* (1995).

(i) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Grey-headed Flying-fox is known to occur within seven (7) conservation reserves throughout the Sydney Basin Bio-region. These include: Blue Mountains NP, Brisbane Water NP, Dharug NP, Ku-ring-gai Chase NP, Munmorah SRA, Royal NP and Wyrabalong NP (NPWS, 2004).

While Grey-headed Flying-fox is represented in secure conservation reserves as indicated above. On the basis of available information, it is considered that this species is not adequately represented within secure conservation reserves.

(g) Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process

The proposal is likely to include clearing of native vegetation, removal of dead wood and dead trees and removal of bushrock. "Clearing of native vegetation", "Removal of dead wood and dead trees" and "Bush Removal" are listed as a Key Threatening Processes.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

The Grey-headed Flying-fox occurs along the coast from Rockhampton (Qld) to Melbourne (Vic) (Strahan, 1995).

The Grey-headed Flying-fox is not considered to be approaching the natural limits of its distribution within the Narrawallee local area.

4.2.4 Sooty Owl 8-part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Sooty Owl is generally associated with tall, dense, wet closed and open forests (Schodde and Tidemann 1986). According to Higgins (1999, pg891) this species mostly occurs in moist gullies and on the slopes of valleys. This species rarely occurs on ridges (Higgins, 1999, pg891).

The Sooty Owl is a solitary, sedentary and nocturnal species, preying on a wide range of prey including rodents, *Antechinus* spp, Common Ringtail Possums (*Pseudocheirus peregrinus*), Sugar Gliders (*Petaurus breviceps*), Yellow-bellied Gliders (*Petaurus australis*), rabbits (*Oryctolagus cuniculus*), bandicoots and birds (Kavanagh 1993). It would appear that the Sooty Owl relies on high prey density and diversity (Kavanagh 1993).

The Sooty Owl requires old mature trees with very large hollows for breeding. Available evidence indicates narrow habitat requirements for nesting, with very large hollows (40 to 50cm deep and a 40 to 60cm diameter) being essential for nesting (Hyem 1979). The home range of the Sooty Owl has been estimated to be between 200 and 800 hectares (Debus 1994, Schodde and Mason 1980, Schodde and Tidemann 1986).

During stagwatches conducted on May 4th and 20th 2004 a Sooty Owl was observed emerging from the large broken trunk hollow in hollow tree number 12C (the known Powerful Owl nest tree: see Figure 1). The breeding season for Sooty Owl is generally known to be from January to June (Higgins, 1999, pg898). Although it is possible that the Sooty Owl is

utilising this tree for breeding, this species may also utilise large hollows for roosting (Higgins, 1999, pg891). The utilisation of this tree by Sooty Owl is unknown. The buffer requirements from a nesting Sooty Owl is considered to be similar to that for Powerful Owl. Therefore, it is considered that the distance of this nesting tree from the proposed development has been sufficiently justified by previous discussions for Powerful Owl.

A total of sixty-five (65) hollow-bearing trees containing large hollows were observed within the study area. This included twenty-four (24) within the subject site, and forty-one (41) throughout the remainder of the study area (trade off areas). Based on the nesting hollow requirements for Sooty Owl it is considered unlikely that any hollows within the subject site provide suitable nesting habitat for this species.

Turpentine trees are considered to provide suitable roosting habitat for most owl species including Sooty Owl (Higgins, 1999, pg891) due to their dense foliage. Ten (10) of the fifteen (15) roost sites were found beneath Turpentine trees. The remaining five (5) roost sites were found beneath *Corymbia gummifera* and *Eucalyptus pilularis*. Three (3) of these roost sites contained white-wash. It is considered that these roost sites are unlikely to be evidence of owl roosts.

It is considered that roost sites beneath Turpentine trees are more likely to be from owl species including Sooty Owl. Nine (9) of these roost sites are present within the trade-off areas. Therefore it is considered that the trade-off areas are likely to provide more significant areas of roosting habitat for owls.

It is considered that the proposal is unlikely to disrupt the life cycle of this species such that a viable local population of this species is likely to be placed at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

No endangered populations of Sooty Owl are listed within the TSC Act (1995). This matter does not require any further consideration.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

A search of Atlas of NSW Wildlife (NPWS June 5th, 2004) records for the Ulladulla 1:100,000 Scale Map Sheet found two (2) records of Sooty Owl within 20km from the subject site. These 2 records are near the intersection of Kingiman Road and Woodstock Creek Road within the Croobyar State Forest to the south-west of the subject site.

Sooty Owl is known to occur within seven (7) conservation reserves throughout the Sydney Basin Bio-region including: Blue Mountains NP, Bouddi NP, Brisbane Water NP, Dharug NP, Murramarang NP, Nattai NP and Royal NP, (NPWS, 1997; NPWS, 2004).

Several habitat attributes were identified within the subject site including:

- Vegetated areas of Open Forest dominated by the September to March flowering *Eucalyptus pilularis* (Blackbutt);
- Large hollows (>30cm) which provide suitable nesting and roosting habitat for Sooty Owl;
- Moderate to dense shrublayer;
- Moderate density ground cover;

- Nectar producing plants, principally *Banksia* and *Acacia*;
- Sap flows, particularly Red Bloodwood trees;
- Tree hollows;
- Fallen timber and hollow logs;
- Loose soil suitable for burrowing;
- Scattered surface rocks;
- Areas of sparse and dense litter layer;

Habitats within the region that are similar to those identified within the subject site, which contain potential habitat for Sooty Owl are likely to be widespread in forested coastal areas in the south-eastern section of the Sydney Basin Bioregion.

It is considered that the proposal will not remove or modify a significant area of habitat for Sooty Owl within the local area or region.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The subject site is bound to the south and east by residential development, to the north by natural bushland adjoining Narrawallee Creek and to the west and south-west by natural bushland adjoining cleared agricultural land.

The subject site forms part of a local vegetation corridor from Narrawallee Creek in the north to Mollymook Golf Course in the south. The conservation of the trade-off areas is considered to be sufficient to maintain this vegetation corridor. The remaining corridor is considered to be sufficient to maintain the ecological requirements of the Sooty Owl in the local area.

It is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated from currently interconnecting or proximate areas of habitat as a result of the proposal.

(e) Whether critical habitat will be affected.

The site has not been identified as critical habitat within the provisions of the *TSC Act* (1995).

(j) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Sooty Owl is known to occur within seven (7) conservation reserves throughout the Sydney Basin Bio-region including: Blue Mountains NP, Bouddi NP, Brisbane Water NP, Dharug NP, Murramarang NP, Nattai NP and Royal NP, (NPWS, 1997; NPWS, 2004).

While the Sooty Owl is represented in secure conservation reserves as indicated above, on the basis of available information, it is considered that this species is not adequately represented within secure conservation reserves.

(g) Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process

The proposal is likely to include clearing of native vegetation, removal of dead wood and dead trees and removal of bushrock. "Clearing of native vegetation", "Removal of dead wood and dead trees" and "Bush Removal" are listed as a Key Threatening Processes.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

According to Barret *et.al.* (2003) the Sooty Owl is not considered to be approaching the natural limits of its distribution within the Narrawallee local area.

4.2.5 Osprey 8-part Test

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Osprey is generally found in association with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995). These habitat locations usually have a sufficient supply of fish for food and possible nesting sites (Clancy 1991). Nests are generally located within 1km of feeding habitat. Osprey maintain feeding and breeding territories of between 5 and 20km of coastline, patrolling their territories either singly or in dispersed pairs (SFNSW 1995).

The Osprey feed primarily on fish such as Sea Mullet, Garfish, Flat-tail Mullet and other fatty fish, occasionally taking sea snakes (Schodde and Tidemann 1986; Clancy 1991; Olsen 1995), crabs, birds, reptiles and mammals (Olsen 1995). The Osprey hunts by hovering 15-30m above the waters surface, plunging into the water to catch their prey and then returning to a perch or roost to feed (Schodde and Tidemann 1986; Clancy 1991).

Osprey breed from August through to November (Schodde and Tidemann 1986). Osprey may nest on the ground on sea cliffs or in trees (Olsen 1995). Osprey generally prefer emergent trees, often dead or partly dead with a broken off crown (Olsen 1995). Nests are large and built of sticks, roughly lined with grass and seaweed (Schodde and Tidemann 1986). No Osprey nests have been observed within the subject site or the remainder of the study area.

A single Osprey was observed feeding on a fish while roosting in a stag (hollow tree number HB18) in the centre of the subject site at approximately 12am May 19th 2004. Cuttlefish remains were found at the base of the stag. Cuttlefish or other fish remains were also found under two other stags within close proximity to HB18. This indicates that this area is likely to be a regularly used roosting area for the Osprey. The closest likely foraging resource for this species is situated approximately 800m to the north-west within the estuary.

It is considered that the Osprey is utilising the subject site for roosting only. The Osprey is likely to have selected the subject site for this purpose because of its height and outlook relative to surrounding lands, the estuary to the north and the ocean to the east. The selection of roosting sites is considered to be opportunistic and tolerant to human activity. The Osprey is known to rest in dead trees and artificial structures, e.g. lighthouses, boat masts, jetty's, electrical pylons and radio transmitting towers (Marchant & Higgins, 1993, pg229). It is considered that given the removal of these roosting trees this species is likely to utilise other similar topography and vegetation outside of the subject site.

It is considered that the proposal is unlikely to disrupt the life cycle of this species such that a viable local population of this species is likely to be placed at risk of extinction.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

No endangered populations of Osprey are listed within the TSC Act (1995). This matter does not require any further consideration.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

A search of Atlas of NSW Wildlife (NPWS June 5th, 2004) records for the Ulladulla 1:100,000 Scale Map Sheet found two (2) records of Osprey within 20km from the subject site. These records include, 1 at Narrawallee Beach and 1 at Burrill Beach.

Osprey is not known to occur within any conservation reserves throughout the Sydney Basin Bio-region (NPWS, 2004).

Several habitat attributes were identified within the subject site including:

- Vegetated areas of Open Forest dominated by the September to March flowering *Eucalyptus pilularis* (Blackbutt);
- Moderate to dense shrublayer;
- Moderate density ground cover;
- Nectar producing plants, principally *Banksia* and *Acacia*;
- Sap flows, particularly Red Bloodwood trees;
- Tree hollows;
- Fallen timber and hollow logs;
- Loose soil suitable for burrowing;
- Scattered surface rocks;
- Areas of sparse and dense litter layer;

Habitats within the region that are similar to those identified within the subject site, which contain potential habitat for Osprey are likely to be widespread in forested coastal areas in the south-eastern section of the Sydney Basin Bioregion.

It is considered that the proposal will not remove or modify a significant area of habitat for Osprey within the local area or region.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The subject site is bound to the south and east by residential development, to the north by natural bushland adjoining Narrawallee Creek and to the west and south-west by natural bushland adjoining cleared agricultural land.

The subject site forms part of a local vegetation corridor from Narrawallee Creek in the north to Mollymook Golf Course in the south. The conservation of the trade-off areas is considered to be sufficient to maintain this vegetation corridor. The remaining corridor is considered to be sufficient to maintain the ecological requirements of the Osprey in the local area.

It is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated from currently interconnecting or proximate areas of habitat as a result of the proposal.

(e) Whether critical habitat will be affected.

The site has not been identified as critical habitat within the provisions of the *TSC Act* (1995).

(k) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Osprey is not known to occur within any conservation reserves throughout the Sydney Basin Bio-region (NPWS, 2004).

It is considered that this species is not adequately represented within secure conservation reserves.

(g) Whether the development or activity proposed is a class of development or activity that is recognised as a threatening process

The proposal is likely to include clearing of native vegetation, removal of dead wood and dead trees and removal of bushrock. "Clearing of native vegetation", "Removal of dead wood and dead trees" and "Bush Removal" are listed as a Key Threatening Processes.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

According to Barret *et.al.* (2003) Narrawallee is located outside (to the south) of the known breeding distribution of Osprey. However Barret *et.al.* (2003) also shows that the distribution of Osprey is located as far south as Victoria.

The Osprey is not considered to be approaching the natural limits of its distribution within the Narrawallee local area.

SECTION 5

CONCLUSIONS AND AMELIORATIVE MEASURES

5.1 POTENTIAL ECOLOGICAL IMPACTS OF THE PROPOSED DEVELOPMENT AND ASSOCIATED AMELIORATIVE MEASURES

5.1.1 Sydney Coastal Estuary Swamp Forest Complex (SCESFC)

The clearing of native vegetation within the asset protection zones surrounding the proposed development, combined with an increase in overland flow and storm water runoff resulting from the proposed development has the potential to increase soil erosion on the lower western slopes surrounding the SCESFC community.

Any increase in soil erosion will subsequently lead to an increase in sedimentation of the SCESFC community. These impacts can be mitigated through the placement of sediment control and stormwater dispersion structures within the proposed developments design. Furthermore the retention of groundcovers within the asset protection zones will significantly reduce or even eliminate the potential erosion of the lower slopes.

The proposed development layout has been adjusted to provide a buffer distance from the Sydney Coastal Estuary Swamp Forest Complex boundary. The adjustment of the proposal includes movement of part of the western boundary to the east to decrease the potential impact of the proposal on the SCESFC.

The proposed fire trail which will be contained within the subject site is situated greater than 30 metres from the SCESFC boundary. Drainage contours and sediment control structures included within the fire trails design are to be provided to prevent any adverse affects on the SCESFC community.

Conacher Travers provided detailed advice to the client at the development design stage to ensure that a suitable buffer was provided to the Sydney Coastal Estuary Swamp Forest Complex that would mitigate any increase in sedimentation or stormwater runoff.

Due to a re-design of the development layout it is now planned to provide a buffer of over 50 metres (including biofiltration trench). The biofiltration trench provides for filtration of sediment and nutrients from stormwater created by the proposed development. Furthermore the implementation of sediment control structures, and appropriate drainage design during the construction phase, combined with the high permeability of the soils between the subject site and the SCESFC boundary will replicate the natural drainage to the SCESFC. The proposed stormwater drainage system has been designed so that there is no concentration of stormwater flows into this community.

5.1.2 SEPP 14 Wetland

This wetland appears to be the salt marsh section of the extensive swamp forest area between the subject site and Narrawallee Creek.

SEPP 14 wetland 287 is located approximately 500 metres from the northern side of the subject site. Stormwater runoff from the subject site runs into a depression between Blake Street and Macleay Street, which drains directly into Narrawallee creek. The SEPP 14 wetland 287 is located on the opposite side of Macleay Street and is separated from the subject site by elevated land and will thus not be impacted by the proposed development.

5.1.3 Threatened Fauna Species

The threatened fauna species, Powerful Owl, Glossy Black-cockatoo, Grey-headed Flying-fox, Sooty Owl and Osprey have been recorded within the study area. It is considered that the proposal is unlikely to disrupt the life cycle of these species such that a viable local populations of these species are likely to be placed at risk of extinction. In order to minimise any potential impacts of the proposal, Conacher Travers has recommended some ameliorative measures for each of the threatened species.

- Any felling of hollow bearing trees should be supervised by a qualified fauna ecologist. These trees should be felled in sections of approximately one metre length. Hollow sections should be inspected before and after felling to determine if fauna are present within the hollow. Any fauna found should be carefully removed by an experienced and licensed fauna ecologist and relocated to adjoining habitat areas;
- All hollows removed from trees during clearing should be salvaged and re-erected in remaining trees at a height above four metres by an experienced arborist; and
- Consideration should be paid to providing species-specific nest boxes within appropriate retained habitat.

Where machinery is required to fell hollow trees, the blade or bucket of the machinery should be tapped against the base of the tree to disturb any fauna present. The tree should then be felled as gently as possible.

It is recommended that nest-boxes be placed throughout the trade-off area to compensate for hollow-bearing trees lost within the subject site. Nest-boxes should include large (>30cm) nesting hollows suitable for Powerful Owl, Sooty Owl and Glossy Black-cockatoo. Nest-boxes should also include medium (10-30cm) and small (<10cm) nesting hollows suitable for prey species of particularly the Powerful Owl such as Common Ringtail Possum (*Pseudocheirus peregrinus*), Common Brushtail Possum (*Trichosurus vulpecular*) and Sugar Glider (*Petaurus breviceps*).

It is recommended that landscaping throughout the proposed development utilise only local endemic flora species. This will provide suitable foraging habitat for Grey-headed Flying-fox and prey species of the Powerful Owl.

5.2 CONCLUSIONS

The boundary of the Sydney Coastal Estuary Swamp Forest Complex has been checked by an internal review and a more detailed analysis of methodology utilised (see Section 4.1.1 & Appendix 4). It was found that the original boundary of SCESFC was correct.

The boundary of SCESFC determined by Kevin Mills & Associates estimated the community edge to be similar to Conacher Travers in the north and south, however closer to the proposed development in the central section of the boundary (see Figure 1). The subdivision has been adjusted to conform to the eastern most SCESFC boundary defined by KMA.

The records of *Melaleuca biconvexa* from Jervis Bay are from similar habitat to the Sydney Coastal Estuary Swamp Forest Complex at Narrawallee. Despite the presence of potential habitat, no specimens of this *Melaleuca biconvexa* were observed within the study area. It is considered that Narrawallee is outside of the area of occurrence for *Melaleuca biconvexa*.

In relation to Powerful Owl, large hollow-bearing trees which provide potential nesting habitat were observed throughout the study area within both subject site and trade-off area. It is considered that none of the large hollow-bearing trees within the subject site provide ideal nesting habitat for the Powerful Owl. Diurnal surveys for roosting birds resulted in no

specimens being observed, which provided no further data on location of nesting trees throughout the study area.

Surveys and assessment has been conducted to determine the area and location of roosting habitat for Powerful Owl. Given that nine (9) out of ten Turpentine roosts (considered to be owl roosts) were found within the trade-off areas, it is considered that the most suitable roosting areas are likely to be within the trade-off area.

In relation to Glossy Black-cockatoo, based on mapping of *Allocasuarina*, it is considered that the trade-off area provides a greater area of foraging habitat. The subject site provides a greater density of large hollow-bearing trees within potential nesting habitat for Glossy Black-cockatoo. However forty-two (42) large hollow-bearing were observed within the trade-off area compared to only twenty-four (24) within the subject site.

An assessment of the regional impact of the proposed development on the SCESFC and the threatened species was provided in part (c) of each eight-part test.

Given the distance of the SCESFC in relation to the proposal, the recommended ameliorative measures (see Section 5.1) and the likely extent of suitable habitat for this community (see Section 4.2.2 part (c)), it is considered that the proposal will not remove or modify a significant area of habitat for SCESFC within the local area or region.

Given the extent of suitable habitat and records for the threatened species (see part (c) of eight-part tests), Powerful Owl, Glossy Black-cockatoo, Grey-headed Flying-fox, Sooty Owl and Osprey, it is considered that the proposal will not remove or modify a significant area of habitat for these species within the local area or region.

This addendum report has been prepared to assess the results of the additional survey in December 2003 and April – May 2004, and to address the issues that have been raised by the consent authority. Given the results of the additional survey and discussion of these issues, it is considered that the addendum report supports the conclusions of the Flora and Fauna Assessment Report (March, 2003).

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APPENDIX 1
FAUNA SPECIES LISTS

Table A1.5 - Fauna Observations for the subject site and local area

Common name	Scientific name	Previous Surveys	Conacher Travers 2002	Conacher Travers 2003	Conacher Travers 2004
Birds					
Australian King Parrot	<i>Alisterus scapularis</i>	PR	O C	O	O
Australian Magpie	<i>Gymnorhina tibicen</i>	PR	O		O C
Australian Magpie-Lark	<i>Grallina cyanoleuca</i>	PR	O		
Australian Raven	<i>Corvus coronoides</i>	PR	O	O	O C
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	PR			
Brown Gerygone	<i>Gerygone mouki</i>	PR			
Brown Thornbill	<i>Acanthiza pusilla</i>	PR		O C	O
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>			C	
Common Bronzewing	<i>Phaps chalcoptera</i>			O	
Common Koel	<i>Eudynamys scolopacea</i>			C	
Common Myna	<i>Acridotheres tristis</i>				O
Common Starling *	<i>Sturnus vulgaris</i>		O C		
Crested Pigeon	<i>Ocyphaps lophotes</i>		O C		O
Crested Shrike-tit	<i>Falcunculus frontatus</i>	PR			O
Crimson Rosella	<i>Platycerus elegans</i>	PR	O C	O C	O C
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	PR	O	O	O
Eastern Whipbird	<i>Psophodes olivaceus</i>	PR	C	C	O C
Eastern Yellow Robin	<i>Eopsaltria australis</i>		O	O	O
Fan-tailed Cuckoo	<i>Cuculus flabelliformis</i>			C	O C
Galah	<i>Cacatua roseicapilla</i>	PR	O C		
Gang -gang Cockatoo	<i>Callocephalon fimbriatum</i>			O C	O C
Glossy Black-cockatoo ^v	<i>Calyptorhynchus lathami</i>			Sc	Sc
Golden Whistler	<i>Pachycephala pectoralis</i>	PR	O C		O C
Grey Butcherbird	<i>Cracticus torquatus</i>	PR			C
Grey Fantail	<i>Rhipidura fuliginosa</i>		O		O C
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	PR	O C	O	O C
House Sparrow *	<i>Passer domesticus</i>		O		
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	PR	O C	O C	O C
Lewin's Honey-eater	<i>Meliphaga lewinii</i>	PR		C	C
Mistletoe Bird	<i>Dicaeum hirundinaceum</i>	PR			
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	PR	O	O	O
Noisy Friarbird	<i>Philemon corniculatus</i>	PR		C	
Noisy Miner	<i>Manorina melanocephala</i>		C		
Osprey	<i>Pandion haliaetus</i>				O
Pied Currawong	<i>Strepera graculina</i>	PR	C		C Sc
Powerful Owl ^v	<i>Ninox strenua</i>		O C	O C	C
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>	PR	O C	O C	O C
Red Wattle Bird	<i>Anthochaera carunculata</i>	PR	O C	O C	O C
Red-browed Finch	<i>Neochmia temporalis</i>	PR	O C	O	O
Rufous Fantail	<i>Rhipidura rufifrons</i>			O C	
Rufous Whistler	<i>Pachycephala rufiventris</i>			C	
Scarlet Honeyeater	<i>Myzomela sanguinolenta</i>			O	
Silvereye	<i>Zosterops lateralis</i>	PR	O		
Sooty Owl	<i>Tyto tenebricosa</i>				Sp
Spotted Pardalote	<i>Pardalotus punctatus</i>	PR	O		
Spotted Turtle-dove *	<i>Streptopelia chinensis</i>	PR	O	O	O
Striated Thornbill	<i>Acanthiza lineata</i>	PR	O		
Sulphur Crested Cockatoo	<i>Cacatua galerita</i>	PR	O C	C	O C
Superb Fairy-wren	<i>Malurus cyaneus</i>		O		
Veriegated Fairy-wren	<i>Malurus lamberti</i>			O	
White-cheeked Honeyeater	<i>Phylidonyris nigra</i>			O	
White-browed Scrubwren	<i>Sericornis frontalis</i>	PR	O	O	O
White-headed Pigeon	<i>Columba leucomela</i>		O		O C
White-throated Treecreeper	<i>Cormobates leucophaeus</i>	PR	O C	O C	O C
White-faced Heron	<i>Egretta novaehollandiae</i>				O
Willie Wagtail	<i>Rhipidura leucophrys</i>				O C
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>	PR	O	C	O C

Table A1.5 - Fauna Observations for the subject site and local area (Cont.)

Common name	Scientific name	Previous Surveys	Conacher Travers 2002	Conacher Travers 2003	Conacher Travers 2004
Yellow-tailed Black-cockatoo	<i>Calyptorhynchus funereus</i>	PR	C		
Yellow Thornbill	<i>Acanthiza nana</i>			O	
Mammals					
Brown Antechinus	<i>Antechinus stuartii</i>		E		
Bush Rat	<i>Rattus fuscipes</i>	PR	E CT		
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	PR			
Common Brushtail Possum	<i>Trichosurus vulpecula</i>		Sc	Sp	Sp
Grey-Headed Flying-fox ^v	<i>Pteropus poliocephalus</i>			Sp Sc C	Sp
Long-nosed Bandicoot	<i>Parameles nasuta</i>		CT		
Swamp Wallaby	<i>Wallabia bicolor</i>	PR			
Goulds Wattled Bat	<i>Chalinolobus gouldi</i>			A	
Chocolate Wattled Bat	<i>Chalinolobus morio</i>		A H		
Eastern False Pipistrelle ^v	<i>Falsistrellus tasmaniensis</i>		A		
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>		A H		
Broad-nosed Bat	<i>Scotorepens sp.1</i>		A		
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>			A	
Large Forest Bat	<i>Vespadelus darlingtoni</i>			A	
Eastern Forest Bat	<i>Vespadelus pumilus</i>			A	
Southern Forest Bat	<i>Vespadelus regulus</i>		A H	A	
Black Rat *	<i>Rattus rattus</i>		E		
European Red Fox *	<i>Vulpes vulpes</i>	PR			
Dog *	<i>Canis familiaris</i>		Sc	Sc	
Reptiles					
Diamond Python	<i>Morelia spilota</i>				O
Eastern Blue Tongue	<i>Tiliqua scincoides</i>			O	
Eastern Water Skink	<i>Eulamprus quoyii</i>		O	O	
Garden Skink	<i>Lampropholis guichenoti</i>			O	
Red-Bellied Black Snake	<i>Pseudechis porphyriacus</i>		O		
Amphibians					
Common Eastern Froglet	<i>Crinia signifera</i>	PR	C	C	C
Eastern Banjo Frog	<i>Limnodynastes dumerilii</i>			Sp C	
Striped Marsh Frog	<i>Limnodynastes peronii</i>	PR		C	
Bleating Tree Frog	<i>Litoria dentata</i>			C	
Smooth Toadlet	<i>Uperoleia laevigata</i>		C		
Note: * indicates introduced species ^v indicates vulnerable species					
A	-	Anabat II	C	-	Call Identification
O	-	Observation	P	-	Call Playback Response
E	-	Elliott Trap	S	-	Habitat Search
CT	-	Cage Trap	H	-	Harp Trap
Sp	-	Spotlight	Sc	-	Scat, Track or Sign Identification
PR	-	Kevin Mills & Assoc. (April, 1994)			

APPENDIX 2
FAUNA SURVEY DETAILS

APPENDIX 2.2 - FAUNA SURVEY DETAILS FOR APRIL – MAY 2004				
Fauna Group	Date	Weather Conditions	Survey Method	Person Hours / Time (24hr)
Diurnal Birds	28/04/04	0-8/8 cloud, no wind, temp 17-22°C	Glossy Black-cockatoo target survey	15 hrs 08.00-16.00
	28/04/04	0/8 cloud, no wind, temp 17°C	Glossy Black-cockatoo survey + point census survey at hollow trees	1 hr 30 mins 16.15-17.10
	29/04/04	0-7/8 cloud, no wind, temp 12-20°C	Glossy Black-cockatoo target survey	16 hrs 40 mins 07.10-16.00
	04/05/04	0/8 cloud, 0-10 kph W, temp 17-21°C	Glossy Black-cockatoo survey + point census survey at hollow trees	15 hrs 40 mins 13.05-17.00
	05/05/04	0-8/8 cloud, no wind, temp 17°C	Glossy Black-cockatoo survey + point census survey at hollow trees	31 hrs 40 mins 08.00-16.25
	06/05/04	0/8 cloud, no wind, temp 11-18°C	Glossy Black-cockatoo survey + point census survey at hollow trees	20 hrs 07.10-12.10
	18/05/04	1-7/8 cloud, no wind, temp 19-21°C	Glossy Black-cockatoo target survey	14 hrs 13.00-16.30
	19/05/04	0/8 cloud, no wind, temp 17-21°C	Glossy Black-cockatoo target survey	31 hrs 07.30-15.45
	20/05/04	0/8 cloud, 0-5 kph S, temp 18-22°C	Glossy Black-cockatoo target survey	30 hrs 07.45-15.45
	21/05/04	0/8 cloud, no wind, temp 18-19°C	Glossy Black-cockatoo target survey	5 hrs 08.00-09.15
Nocturnal Birds	28/04/04	0-8/8 cloud, no wind, temp 17-22°C	Powerful Owl diurnal roost search	15 hrs 08.00-16.00
	28/04/04	0/8 cloud, no wind, temp 17°C	Powerful Owl target survey at hollow trees	1 hr 30 mins 16.15-17.10
	29/04/04	0-7/8 cloud, no wind, temp 12-20°C	Powerful Owl diurnal roost search	16 hrs 40 mins 07.10-16.00
	27/04/04	2/8 cloud, no wind, temp 18°C	Stagwatching, Spotlighting + call detection	2 hrs 40 mins 17.40-19.00
	28/04/04	0/8 cloud, no wind, temp 16°C	Stagwatching, Spotlighting + call detection	1 hr 40 mins 17.40-18.30
	29/04/04	5/8 cloud, no wind, temp 16°C	Stagwatching, Spotlighting + call detection	1 hr 50 mins 17.35-18.30
	04/05/04	0/8 cloud, 0-10 kph W, temp 17-21°C	Powerful Owl diurnal roost search + target survey at hollow trees	15 hrs 40 mins 13.05-17.00
	05/05/04	0-8/8 cloud, no wind, temp 17°C	Powerful Owl diurnal roost search + target survey at hollow trees	31 hrs 40 mins 08.00-16.25
	06/05/04	0/8 cloud, no wind, temp 11-18°C	Powerful Owl diurnal roost search + target survey at hollow trees	20 hrs 07.10-12.10
	04/05/04	0/8 cloud, 5-10 kph W, temp 16°C	Stagwatching, Spotlighting + call detection	3 hrs 20 mins 17.30-18.20
	20/05/04	0/8 cloud, 0-5 kph S, temp 16°C	Stagwatching, Spotlighting + call detection	5 hrs 17.15-18.20
	18/05/04	1-7/8 cloud, no wind, temp 19-21°C	Powerful Owl diurnal roost search	14 hrs 13.00-16.30
	19/05/04	0/8 cloud, no wind, temp 17-21°C	Powerful Owl diurnal roost search	31 hrs 07.30-15.45
	20/05/04	0/8 cloud, 0-5 kph S, temp 18-22°C	Powerful Owl diurnal roost search	30 hrs 07.45-15.45
	21/05/04	0/8 cloud, no wind, temp 18-19°C	Powerful Owl diurnal roost search	5 hrs 08.00-09.15

APPENDIX 3
HOLLOW-BEARING TREE DATA

Table A3.1 – Hollow-bearing Tree Data for the Subject Site

No. of hollow-bearing trees	78
No. of Large hollow-bearing Trees	24
No. of large hollows	34
No. of medium hollows	86
No. of small hollows	69
Total no. of hollows	189
Area of subject site (ha)	21.9
Density of hollows (hollows/ ha)	8.63
No. of large hollows / ha	1.55
No. of Large hollow-bearing Tree / ha	1.1
No. of medium hollow / ha	3.93
No. of small hollows / ha	3.15

Table A3.2 – Hollow-bearing Tree Data for the Trade-off Areas (Area within Study Area, Outside of Subject site) (note: based on April – May 2004 transect surveys)

	Large
Total no. of hollow-bearing trees	41
Size of Trade-off Area (ha)	82
No. of hollow-bearing trees / ha	0.5

APPENDIX 4

SYDNEY COASTAL ESTUARY SWAMP FOREST COMPLEX BOUNDARY REVIEW METHODOLOGY

Flora Survey Methodology used for Initial Review of SCESFC Boundary

Conacher Travers conducted an additional independent assessment of the SCESFC boundary on the 5th and 6th of May 2004. In determining the SCESFC boundary the following methodology was used to delineate between the Tall Blackbutt Forest (*Eucalyptus pilularis*) and the SCESFC Communities. These criteria are listed below:

- The line of demarcation between the hillside and estuarine alluvium. (This method was not precise enough to be used alone due to the dense understorey vegetation); and
- A number of common indicator species for both SCESFC and the Tall Blackbutt Forest were identified. The grouped species were then broken down into species specifically restricted to the respective communities and species found within a transition zone between the communities.

Indicator species were taken from each of the groundcover, shrub and canopy layers to provide a more holistic view of the vegetation communities.

Understorey species were particularly used as they provided a strong indication of the moist or waterlogged soils diagnostic to the SCESFC community. Considering the recent lack of rainfall the occurrence of SCESFC understorey species was expected to be representative of the minimum community size.

Positive indicator species to determine the SCESFC boundary included *Eucalyptus longifolia*, *Melaleuca ericifolia*, *Baloskian tetraphyllum*, *Goodenia ovata* and *Gahnia clarkei*.

Some of those species are not listed as characteristic of SCESFC, but were used as possible indicators of the extent of the estuarine alluvium on the site where disagreement had occurred. While *Melaleuca linariifolia* and *Eucalyptus robusta* were predominantly found within the SCESFC community they were also found to incur into the Tall Blackbutt Forest. These two species were therefore not used to delineate the boundary.

Positive indicator species for the Tall Blackbutt Forest included *Syncarpia glomulifera*, *Eucalyptus pilularis*, *Entolasia marginata* and *Persoonia linearis*. These species were considered to be largely absent from the SCESFC community while *Pultenaea blakelyi*, *Acacia longifolia*, *Pteridium esculentum* extended into the SCESFC.

Flora Survey Methodology used for Final Review of SCESFC Boundary

The flora survey methodology used for the final review and determination of the SCESFC boundary was as follows.

The Final Determination for SCESFC describes this community as occurring on estuarine alluvial soils (Scientific Committee, 2000). Fresh Treed Swampland extends upslope in some areas where the colluvial soil is poorly drained or subject to seepage from the hillside. Fresh Treed Swampland also follows the creek line, as a narrow belt, above where it levels out onto the estuarine alluvium.

During the inspection of the community, the line of demarcation between the colluvial, hillside alluvium and estuarine alluvium over most of the area was almost impossible to determine visually, due to the dense understorey and very low

gradients along the foot of the hillside. It was noted that two of the most common shrubs were *Melaleuca ericifolia* and *Pultenaea blakelyi*.

Melaleuca ericifolia has a particular affinity for the types of soil which support SCESFC, while *Pultenaea blakelyi* has an equally strong aversion to those soils. It was noted that although both species were very common, there was almost no overlapping of the species and that where the overlapping did occur, it was only by a few metres. These two species were nominated as the determining species for the SCESFC boundary. The line of demarcation between those species was adopted as the boundary of SCESFC.

Towards the eastern end of the line, these two species lost their prominence, however the hillside was clearly visible in most parts of this area and where it was not obvious, the SCESFC boundary was then adopted as being immediately downslope from any Blackbutts or Bloodwoods.