Flora and Fauna Assessment

Lot 1 DP 1021332 & Part Lot 458 DP 1063107
George Evans Road, Mundamia

Prepared for
Shoalhaven City Council

28 March 2013

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PREPARED FOR	**Shoalhaven City Council**
PROJECT NO	**09SGBECO-0063**
DATE	**28 March 2013**

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1 Introduction

This report has been prepared by Eco Logical Australia (ELA) at the request of Watkinson Apperley on behalf of Shoalhaven City Council, to assess the proposed subdivision of Lot 1 DP 1021332 and Part Lot 458 DP 1063107 George Evans Road, Mundamia (hereafter referred to as the subject site, shown in Figure 1).

The subject site is part of the Nowra Bomaderry Structure Plan New Living Area 5: Mundamia. As part of the process to investigate the appropriate extent of the proposed Mundamia new living area, BES (2004a, 2004b) undertook extensive flora and fauna surveys of the Mundamia area to identify ecological attributes and areas of high conservation value. This information allowed Council to amend the boundaries of the Mundamia new living area so that the highest conservation values would be excluded from future development areas.

The subject site is currently zoned 1(d) General Rural under the Shoalhaven Local Environmental Plan 1985, but will be zoned R1 General Residential under the Shoalhaven Draft Local Environment Plan 2009 and assessed under the latter plan.

This report provides the findings of a review of the relevant literature, database interrogation, and field survey results. Furthermore, the report addresses relevant statutory considerations associated with the proposal. The aim of this investigation was to assess the ecological impacts of the proposal on flora, fauna and habitats within the study area.

The objectives of this investigation were:

- to identify and describe the flora species and vegetation communities present in the study area and their conservation significance;
- to identify and describe the fauna habitats present in the study area and their condition;
- to identify the fauna species which are present or likely to occur in the study area, and their conservation significance;
- to assess the impacts of the proposal on vegetation, fauna, habitats, and other environmental features as necessary; and
- to make recommendations regarding any environmental management and impact mitigation/amelioration measures, which can be implemented to limit the effects of the proposal on vegetation, fauna, habitats, and other environmental features as necessary.

1.1 PROJECT DESCRIPTION

The development proposal involves a residential subdivision comprising a range of residential housing lots, roads, shopping centre and public open space. Preliminary subdivision plans are shown in Figure 2. The proposal is likely to involve the removal of all native vegetation and habitats from the subject site. Asset protection zones will be contained within the subdivision and surrounding road easements. Primary access will be provided via the upgrading and realignment of George Evans Road however the access beyond the subject site will be assessed separately and is not considered part of the proposal for the purposes of this report.

1.1.1 Direct and Indirect Impacts

The following direct impacts on flora and fauna are anticipated from the proposal:

a) Clearing of native vegetation for the development footprint;

b) Removal of fauna habitats and connectivity through the area;

c) Compaction and covering of the soil within areas to be concreted and/or bitumen sealed; and

d) Death or injury to native and introduced flora and fauna inhabiting the areas to be cleared or modified for the proposal.

The following indirect impacts on flora and fauna are anticipated from the proposal:

a) Changes to drainage characteristics from the concentration and redirection of stormwater and possible changes to groundwater flows;

b) Weed invasion into areas of native vegetation adjoining the proposal;

c) Increased noise, lighting and vehicle movements;

d) Increased activity by humans and domestic animals in areas of native vegetation to be retained; and

e) Increased potential for erosion and discharges of sediments into downstream habitats during construction of the proposal.

1.2 SUBJECT SITE, STUDY AREA AND LOCALITY

The subject site for the purposes of this report comprises all of Lot 1 and part of Lot 458 (approximately 12.5 ha in size) which will be directly affected by the proposed development. The study area for the purposes of this report includes the subject site and extends to areas immediately beyond Lot 1, as shown in Figure 1. The need to undertake flora and fauna surveys over a larger area was negated by the extensive flora and fauna studies previously completed on surrounding lands by BES (2004a, 2004b).

The study area is generally bounded by George Evans Road and native vegetation to the west; native vegetation and Jonsson Road to the north; cleared rural land to the east and native vegetation to the south. The study area occupies a broad ridgetop position at an altitude of approximately 60 m Australian Height Datum (AHD). The area is generally flat, apart from substantial excavations made for quarrying and drainage channels, which would appear to direct most surface water to the north. The study area appears to be underlain by Nowra Sandstone and the soil material is generally sandy. The study area does not contain any exposed rock, although surrounding areas contain substantial sandstone sheets, outcrops and cliffs.

Most of the study area has been severely disturbed as part of a large quarry that extended further to the south and west. Within the study area, only the north eastern section contains relatively intact native vegetation. Much of the remainder of the study area is regenerating to some degree with typical colonising native species and some weeds. Large areas of exposed soil are present towards the centre of Lot 1, along with numerous vehicle tracks. Two power line easements with associated clearing also occur within the study area. Surrounding disturbances include unsealed roads to the north and west, and cleared agricultural land to the east.

The locality for the purposes of this report is the area within 10 km of the study area.

Figure 1: Location

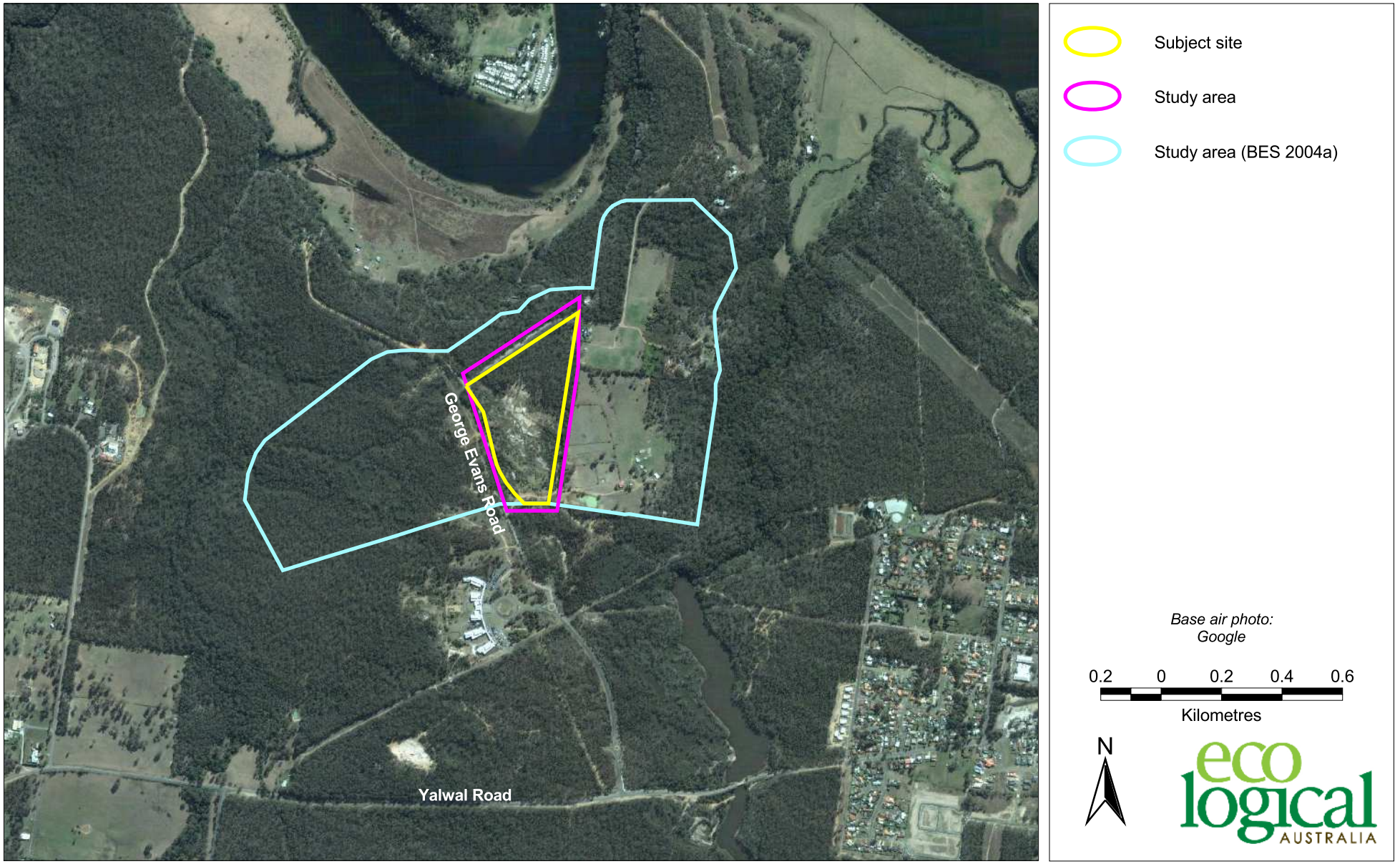
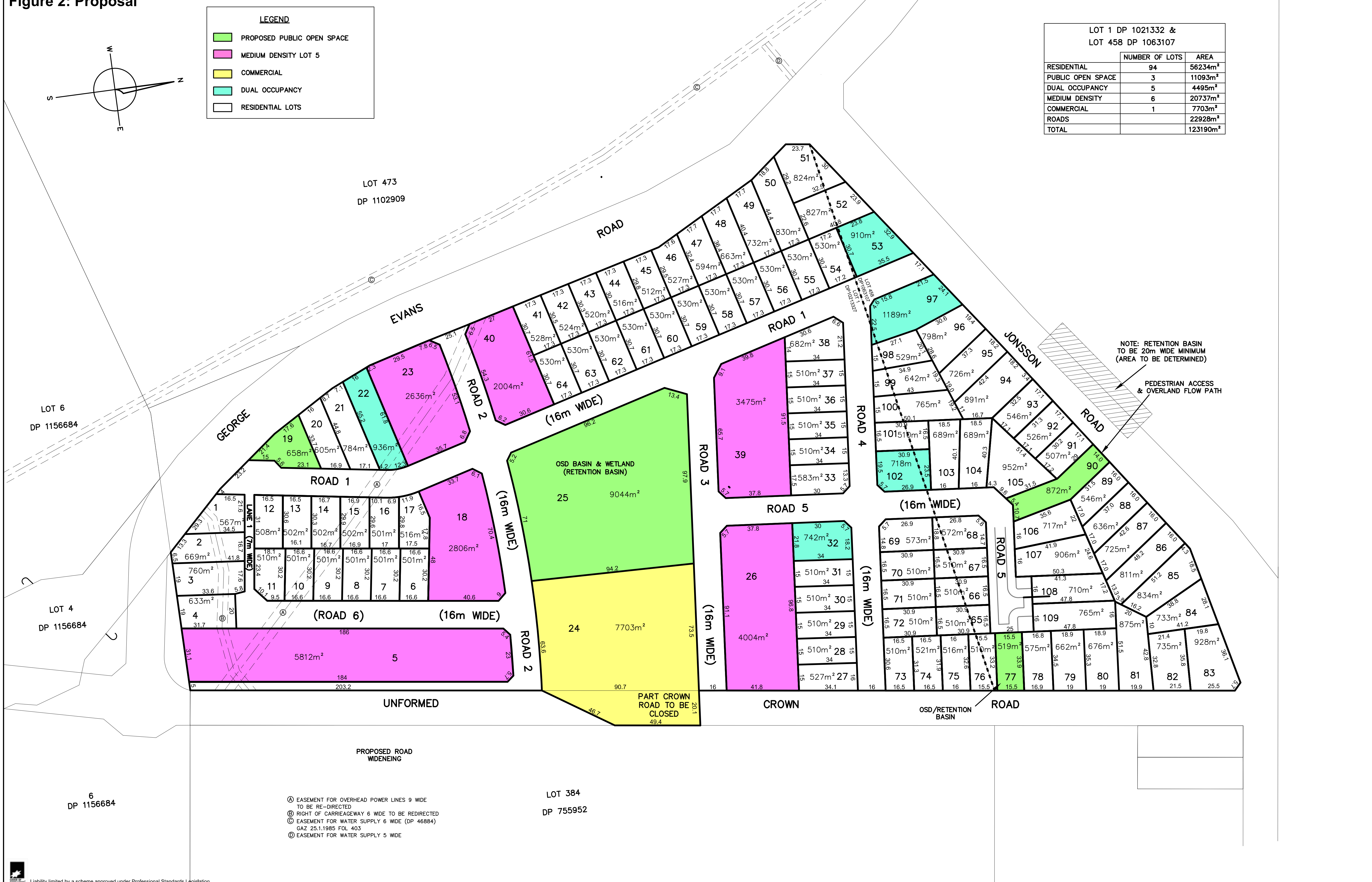


Figure 2: Proposal



LOT 1 DP 1021332 & LOT 458 DP 1063107	NUMBER OF LOTS	AREA
RESIDENTIAL	94	56234m²
PUBLIC OPEN SPACE	3	11093m²
DUAL OCCUPANCY	5	4495m²
MEDIUM DENSITY	6	20737m²
COMMERCIAL	1	7703m²
ROADS		22928m²
TOTAL		123190m²

Ⓐ EASEMENT FOR OVERHEAD POWER LINES 9 WIDE TO BE RE-DIRECTED
Ⓑ RIGHT OF CARRIAGEWAY 6 WIDE TO BE REDIRECTED
Ⓒ EASEMENT FOR WATER SUPPLY 6 WIDE (DP 46884) GAZ 25.1.1985 FOL 403
Ⓓ EASEMENT FOR WATER SUPPLY 5 WIDE

SCALE 1:1000 @ A1 1:2000 @ A3

DATUM AHD

SURVEY 0 | DESIGN AR | DRAWN MN | CHECKED AR | APPROV'D

AMENDMENTS	BY	DATE
O – ORIGINAL ISSUE	AR	25/10/12
A – AMENDMENTS TO ORIGINAL ISSUE	AR	13/11/12
B – AMENDMENTS TO ORIGINAL ISSUE	AR	26/11/12
C – EASEMENTS ADDED	AR	28/11/12
D – STAGING ADDED	AR	30/11/12
F – FINAL PLAN	AR	05/12/12

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SKETCH PLAN SHOWING PROPOSED LOT LAYOUT OVER LOT 1 DP 1021332 & PART LOT 458 DP 1063107
GEORGE EVANS ROAD, MUNDAMIA
FOR: SHOALHAVEN CITY COUNCIL

A1 SHEET 1 OF 2 SHEETS
REF. No. 102166
PLAN No. 12/98

2 Methods

The flora and fauna survey methods used in this study were targeted to detect threatened species in the study area rather than general surveys, due to the comprehensive flora and fauna surveys previously undertaken in the study area and surrounds as part of the Mundamia urban expansion area assessment. Previous studies completed in the area by BES (2004a, 2004b) are outlined below and survey efforts summarised in Appendix A. Flora and fauna surveys conducted in and around the study area by BES (2004a) and ELA are shown in Figure 3.

2.1 DATABASE AND LITERATURE REVIEW

A review of relevant information was undertaken prior to the commencement of field studies. Databases and other sources were interrogated to generate a list of species that have been recorded within 10 km of the study area and included:

The NSW National Parks and Wildlife Service Wildlife Atlas – last searched on 31 March 2010

The EPBC Act Protected Matters Search Tool – last searched on the 31 March 2010

Data gathered during all field studies and the literature review was analysed and interpreted in accordance with the provisions of legislation and planning controls pertaining to flora and fauna. Threatened and migratory species, threatened populations and Endangered Ecological Communities (EECs) that have been recorded, or have the potential to occur within the locality have been assessed for their likelihood to inhabit the study area (Appendix B). All listed species and EECs considered likely to occur within the subject site, or to be affected by the proposal, require consideration pursuant to Section 5A of the (EPA Act) and under the EPBC Act.

Previous studies

Extensive flora and fauna surveys have been undertaken in the Mundamia urban expansion investigation area by BES (2004a, 2004b), which incorporates the current study area. Previous surveys in the current study area have included general vegetation surveys, targeted flora surveys for threatened and otherwise significant species, intensive habitat surveys (for hollow-bearing trees and feed-trees), nesting assessments for the Powerful Owl and Glossy Black-cockatoo, mammal and reptile trapping, hair tube surveys, stagwatching, spotlighting, call playback and AnaBat echolocation recording surveys. Previous BES flora and fauna survey efforts for the Mundamia urban expansion investigation area appear in Appendix A.

2.2 TARGETED FLORA SURVEYS

Terrestrial Orchid Surveys

Parallel transect surveys for the threatened Leafless Tongue Orchid *Cryptostylis hunteriana* and Bauer's Midge Orchid *Genoplesium baueri* were undertaken in December 2009 and February 2010 respectively. Surveys were undertaken following confirmation of flowering at known populations in the general area. The surveys involved searching for the species along parallel transects 5-10 metres apart throughout suitable habitat in the study area, supplemented by random meander searches of poorer quality habitat within the study area.

Searches for the Spring Tiny Orchid *Pterostylis vernalis* (Flat Rock Creek) were undertaken on 17 June 2012, following confirmation of leaf rosettes appearing at nearby populations. Targeted searches of potentially suitable habitat (moss or shallow soil under patches of White Kunzea *Kunzea ambigua*) were undertaken within the subject site, although most of the potential habitat for this species had been derived from regrowth after quarrying operations.

Flora Survey Effort

The flora survey effort entailed a total of 22 person-hours as detailed in Table 1.

Table 1: Targeted flora survey effort

DATE	METHOD	EFFORT	TARGET SPECIES
15 December 2009	Transect searches	10 person hours	*Cryptostylis hunteriana*
5 February 2010	Transect searches	4 person hours	*Genoplesium baueri*
8 February 2010	Transect searches	4 person hours	*Genoplesium baueri*
12 June 2012	Targeted searches	4 person hours	*Pterostylis vernalis*

2.3 TARGETED FAUNA SURVEYS

Diurnal Fauna and Habitat Surveys

Specific bird, reptile and amphibian searches were conducted across the study area involving both visual and aural detection of species. Diurnal mammal searches were conducted in areas of potential habitat across the study area, with emphasis on searches for scats, tracks, burrows, diggings and scratchings.

Specific searches were conducted for habitats or resources of relevance for those threatened fauna species known from the general region, or species, which might be anticipated to occur given the vegetation communities and habitats present. Any opportunistic detection of threatened fauna during the survey period was noted.

Gang-gang Cockatoo and Turquoise Parrot Nesting Assessment

During November and December 2009, nesting assessments for the Gang-gang Cockatoo and Turquoise Parrot were undertaken on two occasions in the late afternoon. Areas containing hollow-bearing trees (potential nest trees) were monitored for the presence of the Gang-gang Cockatoo and Turquoise Parrot in the 1.5 hours prior to sunset when the birds are likely to be detected returning to a nesting hollow. The study area was also monitored for these species during other surveys.

Nocturnal Stagwatching, Spotlighting and Call Playback Surveys

Nocturnal surveys were undertaken in November and December 2009 and February 2010, consisting of stagwatching and listening for vocalisations of nocturnal animals at dusk, call playback and spotlighting.

Suitable trees with hollows in the study area were watched at dusk for a period of 1 hour to observe any utilisation by nocturnal birds and mammals, which generally emerge from hollows at or just after dusk. Identification of species was aided by the use of spotlights and binoculars where necessary, as well as listening for characteristic vocalisations of some species. The Yellow-bellied Glider, Squirrel Glider, Eastern Pygmy-possum and Masked Owl were particularly targeted by dusk stagwatching surveys.

Following stagwatching, call playback techniques were used to survey for the Koala, Yellow-bellied Glider, Squirrel Glider, Bush Stone Curlew, Masked Owl and Powerful Owl. Pre-recorded digital calls were broadcast from a 15W Toa megaphone for a period of 2.5 to 5 minutes each, followed by a listening period of 10 minutes. Listening for vocalisations continued during the subsequent spotlighting surveys, for a further one hour.

Spotlighting transects were undertaken throughout the study area with a Narva Colt 55 W hand-held spotlight to observe nocturnal mammals, birds and amphibians. Spotlighting surveys concentrated on better quality habitat for threatened fauna species, and particularly targeted the Yellow-bellied Glider, Squirrel Glider and Eastern Pygmy-possum.

Nocturnal AnaBat Echolocation Surveys

Microchiropteran echolocation recording was used to target ‘micro-bats’ in the study area and was used in conjunction with stagwatching surveys in an attempt to identify any tree hollow roosting sites. Titley ANABAT II bat detectors linked to Titley Z-Caim digital data recorders were used at stationary points in the study area to record microchiropteran bat echolocation calls on three occasions during November and December 2009 and February 2010. In November, one detector was activated from approximately sunset for a further two and a half hours, whereas the detector was left out overnight in December and February. In February, two AnaBat units were used at different locations in the study area. Echolocation calls recorded were analysed by Lesryk Environmental Consultants.

Trapping Surveys

Trapping surveys targeting the Eastern Pygmy-possum and White-footed Dunnart were undertaken over four consecutive nights during December 2009. Fifty A-type Elliott traps were used to gain a trapping effort of 200 trap-nights. Traps were placed on the ground at approximately 15 m intervals along several transects that targeted better quality habitats for target species. Where possible, traps were placed close to resources for target species, such as nectar producing plants, hollow-bearing trees and logs. All traps were baited with a mixture of peanut butter, honey and rolled oats and were checked each morning soon after sunrise. Captured animals were identified and then released at the trap site.

Remote Camera Surveys

Over twelve days in March 2010, two infrared motion activated cameras and bait stations were set in the study area to target Rosenberg's Monitor, Spotted-tailed Quoll, Long-nosed Potoroo and Southern Brown Bandicoot (Figure 3). The cameras were attached to tree trunks about 80 cm from the ground, and provided night and day surveillance of fauna visiting the bait stations. Bait stations were fixed to the ground and one contained raw chicken pieces and one contained a standard bait mix of peanut butter and rolled oats.

Survey Conditions

Fauna survey conditions throughout the study period are detailed in Table 2 below.

Table 2: Fauna survey conditions

DATE	SURVEY TYPE	TEMP	WIND	CLOUD	MOON	RAIN
25 November 2009	Nocturnal	20°C	0	0	¼	0
15 December 2009	Nocturnal	24°C - 19°C	1	0	¼	0
9 February 2010	Nocturnal	22°C	0	3/5	0/4	0
15-18 December 2009	Trapping	16°C – 32°C	0-2	N/A	¼	0-2
19- 31 March 2010	Remote camera	16°C – 27°C	0-2	N/A	2/4	0

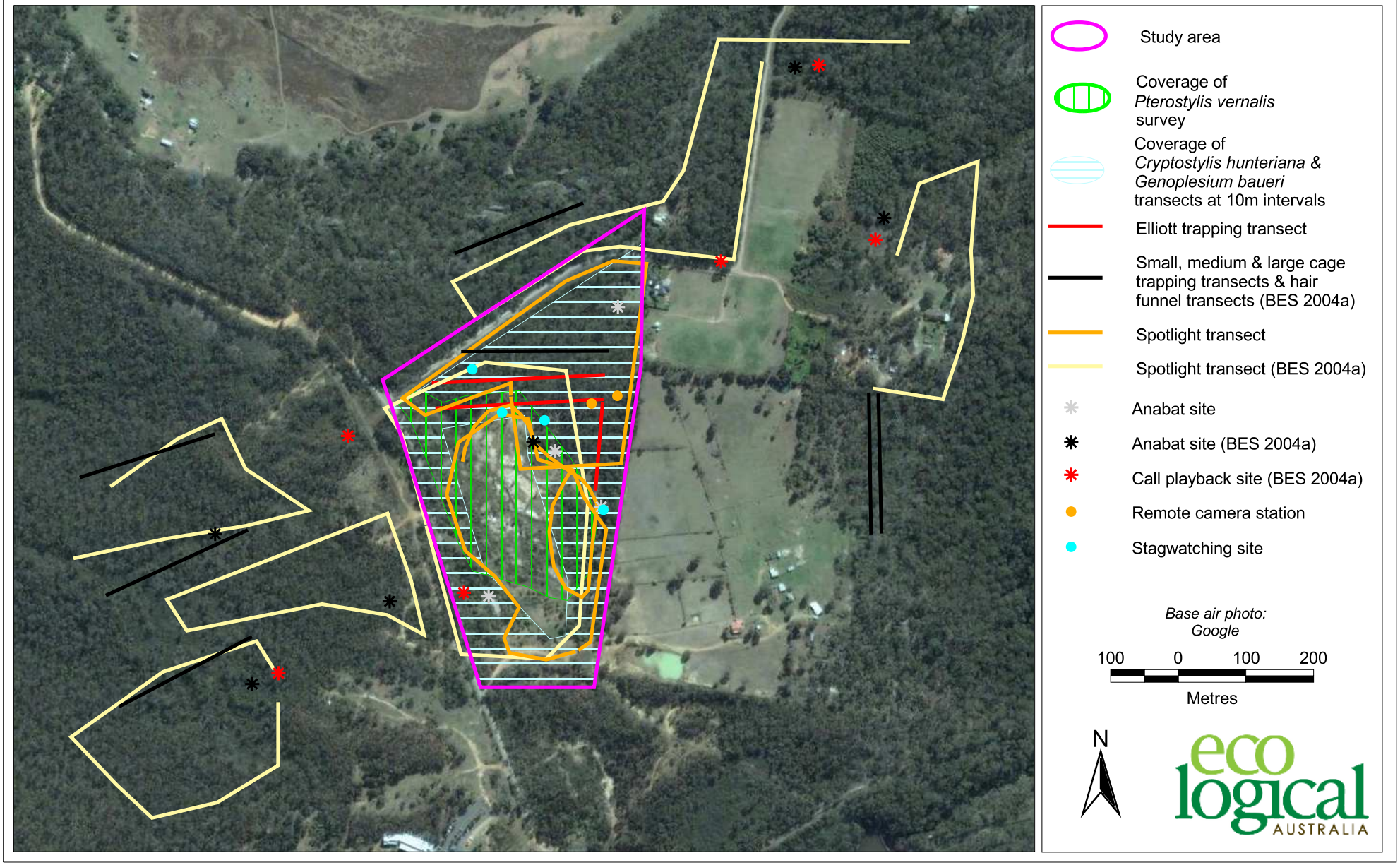
Survey Effort

The fauna survey effort employed a total of 14 person-hours, 200 Elliott trap-nights, 24 remote camera days/nights, and three nights (approximately 32.5 hours) of Anabat echolocation recording, as documented in Table 3.

Table 3: Fauna survey effort employed over the study area

DATE	METHOD	EFFORT	TARGET SPECIES
25 November 2009	Nesting assessment	1.5 person hours	Gang-Gang Cockatoo
	Stagwatch	1 person hour	Nocturnal mammals and birds
	Spotlight	1 person hour	Nocturnal mammals, birds, amphibians
	Anabat	2.5 hours	Microchiropterans
	Call Playback	0.5 person hours	Yellow-Bellied Glider, Squirrel Glider, Koala, Bush Stone Curlew, Powerful Owl, Masked Owl
15 December 2009	Nesting assessment	3 person hours	Gang-Gang Cockatoo
	Stagwatch	2 person hours	Nocturnal mammals and birds
	Spotlight	2 person hours	Nocturnal mammals, birds, amphibians
	Anabat	Overnight	Microchiropterans
	Call Playback	1 person hour	Yellow-Bellied Glider, Squirrel Glider, Koala, Bush Stone Curlew, Powerful Owl, Masked Owl
9 February 2010	Stagwatch	1 person hour	Nocturnal mammals and birds
	Call Playback	0.5 person hours	Yellow-Bellied Glider, Bush Stone Curlew
	Spotlight	0.5 person hours	Nocturnal mammals, birds, amphibians
	Anabat (x 2)	Overnight	Microchiropterans
15-18 December 2009	Elliott Trapping (type A)	200 trap-nights	Eastern Pygmy-possum, White-footed Dunnart
19- 31 March 2010	Remote camera station (x2)	24 camera days/nights	Rosenberg's Goanna, Spotted Tailed Quoll

Figure 3: Flora and fauna surveys



3 Results

3.1 DATABASE AND LITERATURE REVIEW

Appendix B provides a list of threatened species that have been recorded from data base searches within a 10 km radius of the study area. In Appendix B, the habitat characteristics of these species have been evaluated to determine their likelihood to occur within the study area. Those species identified from field surveys or considered likely to occur require further assessment according to Section 5A of the EPA Act.

3.2 FLORA

The wider Mundamia urban release area contains four native vegetation communities: Scribbly Gum – Bloodwood Woodland; Grey Gum – Stringybark Forest/Woodland; Kunzea Shrubland/Heathland; and Paperbark Closed Forest (BES 2004a). The majority of the study area has been severely disturbed by the quarry operations and comprises regenerating vegetation, however the less disturbed areas in the north and north east contain the Scribbly Gum – Bloodwood Woodland community as described below (Figure 4).

3.2.1 Vegetation Communities

Scribbly Gum - Bloodwood Woodland

This community is dominated by Red Bloodwood *Corymbia gummifera* and Hard-leaved Scribbly Gum *Eucalyptus sclerophylla*, but also includes Grey Gum *Eucalyptus punctata*, Silvertop Ash *Eucalyptus sieberi* and White Stringybark *Eucalyptus globoidea* to a height of 12-15 m with foliage projective cover of approximately 20% (BES 2004a).

The understorey is generally dominated by heathy shrubs such as Bushy Needlebush *Hakea sericea*, Mountain Devil *Lambertia formosa*, Swamp Banksia *Banksia paludosa*, Hairpin Banksia *Banksia spinulosa*, and Conesticks *Petrophile pedunculata* to a height of 2.5 m with foliage projective cover of approximately 20-40 %. The understorey also typically includes species such as Broad-leaved Hakea Hakea dactyloides, NSW Coral Heath *Epacris pulchella*, Spiny Bossiaea *Bossiaea obcordata*, Bearded Heath *Leucopogon ericoides*, Round-leaf Tea-tree *Leptospermum rotundifolium*, Yellow Tea-tree *Leptospermum polygalifolium*, Flaky-barked Tea-tree *Leptospermum trinervium*, Native Currant *Leptomeria acida*, Prickly Moses *Acacia ulicifolia*, Sunshine Wattle *Acacia terminalis* and *Acacia obtusifolia* (BES 2004a).

The groundcover includes a diverse range of shrubs, herbs, grasses and sedges including Curly Sedge *Caustis flexuosa*, Silky Purple Flag *Patersonia sericea*, Fish Bones *Lomandra obliqua*, Leafy Purple Flag *Patersonia glabrata*, Common Bracken *Pteridium esculentum*, Soft Twig-rush *Baumea rubiginosa*, Pomax *Pomax umbellata*, Variable Sword-sedge *Lepidosperma laterale*, Wiry Panic *Entolasia stricta* and Scale-rush *Lepyrodia scariosa* to a height of around 0.5 m with foliage projective cover of approximately 20% (BES 2004a).

3.2.2 Flora Species

A total of 269 flora species were recorded in the Mundamia urban release area by BES (2004a), and this list appears in Appendix C. These species include the endangered Nowra Heath Myrtle *Triplarina nowraensis* and the critically endangered Spring Tiny Greenhood *Pterostylis vernalis.* These threatened

species were not recorded within the current study area, and suitable habitat for these species does not occur within the current study area.

No threatened flora species were recorded in the current study area by BES (2004a) or during recent targeted surveys by ELA. One non-threatened but nationally significant plant, the Nowra Tea-tree *Leptospermum sejunctum*, is known from the north of the subject site from a few individuals (BES 2004a, Figure 5. Several other non-threatened but uncommon species were recorded by BES (2004a): *Acacia hispidula*, *Acacia subtilinervis* and the Jervis Bay Tea-tree *Leptospermum epacridoideum*. These species are associated with heathland or shubland and shallow soils. They were not recorded in the current study area and suitable habitat is not present. Flora species of conservation significance are shown in Figure 5.

3.3 FAUNA

A total of 98 fauna species were recorded in the Mundamia urban release area by BES (2004a), and this list appears in Appendix D. Threatened species recorded by BES (2004a) include the Yellow-bellied Glider, Glossy Black-cockatoo, Powerful Owl, Square-tailed Kite, Eastern Bentwing Bat and Grey-headed Flying-fox. Of these, the threatened Yellow-bellied Glider, Glossy Black-cockatoo and Eastern Bentwing Bat were recorded within the current study area during previous surveys.

In the current study, targeted surveys for threatened fauna recorded the Glossy Black-cockatoo and Yellow-bellied Sheathtail Bat from within the study area. The threatened Eastern Bentwing Bat, Greater Broadnosed Bat, Large-eared Pied Bat and Little Bentwing Bat were recorded in the study area via echolocation calls with a 'probable' level of confidence. The threatened Yellow-bellied Glider was recorded offsite, to the north of Jonsson Road. None of these species were recorded in the study area on a regular basis and none were recorded using tree hollows in the study area. All studies to date indicate that threatened fauna recorded in or near the study area use the habitats there only for occasional foraging.

Fauna species recorded during targeted fauna surveys for the current assessment by ELA are listed below in Table 4. Further opportunistic fauna sightings were not recorded (given the extent of previous fauna work) unless the species was threatened, otherwise noteworthy or not previously recorded by BES (2004a). The locations of fauna species of conservation significance (excluding bats) are shown in Figure 6.

Table 4: Fauna species recorded during targeted surveys for this study (*denotes introduced species, bold denotes threatened species)

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
Mammals	Agile Antechinus	*Antechinus agilis*	Trapping
	Chocolate Wattled Bat	*Chalinolobus morio*	Anabat (Confident identification)
	Eastern Bentwing Bat	***Miniopterus (schreibersii) orianae oceansis***	Anabat (Probable identification)
	Eastern Freetail Bat	*Mormopterus ridei*	Anabat (Confident identification)
	Eastern Grey Kangaroo	*Macropus giganteus*	Camera station
	Eastern Horseshoe Bat	*Rhinolophus megaphyllus*	Anabat (Confident identification)
	Gould's Wattled Bat	*Chalinolobus gouldii*	Anabat (Confident identification)
	Greater Broadnosed Bat	***Scoteanax rueppellii***	Anabat (Probable identification)
	Large-eared Pied Bat	***Chalinolobus dwyeri***	Anabat (Probable identification)
	Little Bentwing Bat	***Miniopterus australis***	Anabat (Probable identification)
	Little Forest Bat	*Vespadelus vulturnus*	Anabat (Confident identification)
	Longeared Bat	*Nyctophilus sp.*	Anabat (Confident identification)
	Red Fox *	*Vulpes vulpes* *	Camera station
	Swamp Wallaby	*Wallabia bicolor*	Camera station
	White-striped Freetail Bat	*Austronomus australis*	Anabat (Confident identification)
	Yellow-bellied Glider	***Petaurus australis***	Call playback (offsite)
	Yellow-bellied Sheathtail Bat	***Saccolaimus flaviventris***	Anabat (Confident identification)
Reptiles	Eastern Blue Tongue Lizard	*Tiliqua scincoides*	Opportunistic (observed)
	Lace Monitor	*Varanus varius*	Camera station
Birds	Common Koel	*Eudynamys scolopacea*	Opportunistic
	Glossy Black-cockatoo	***Calyptorhynchus lathami***	Feeding sign
	Indian Peafowl *	*Pavo cristatus* *	Opportunistic
	Pallid Cuckoo	*Cuculus pallidus*	Opportunistic

3.4 HABITAT

Most habitat in the study area has been heavily disturbed, with its value to fauna substantially reduced. Only the Scribbly Gum – Bloodwood Woodland in the north of the study area contains relatively intact fauna habitats, although this area has been fragmented and isolated from surrounding habitats by previous rural and infrastructure clearing

Trees in the study area provide foraging resources for a range of native fauna species, particularly birds, arboreal mammals and bats. A few Red Bloodwood and Grey Gum trees showed signs of sap feeding by the common Sugar Glider, although no trees in the study area were found to have been incised by the Yellow-bellied Glider. In the understorey, Banksia and other high nectar-producing species may also provide a food resource for smaller birds and mammals. Grasses in the study area provide grazing resources for herbivores such as the Eastern Grey Kangaroo and Swamp Wallaby, as well as some seeds for granivorous species such as finches. Black She-oak trees in the study area provide a foraging resource for the threatened Glossy Black-cockatoo, with 11 feed-trees recorded by BES (2004a) and ELA surveys (Figure 4).

A key shelter resource for fauna in the study area is tree hollows, which occur in relatively small trees and are generally restricted to the less disturbed areas in the north east. Thirty eight trees with hollows were recorded in the study area (BES 2004a, Figure 4). The tree canopy in the north and north east would also provide a sheltering resource for a range of common birds. The understorey vegetation, fallen branches and leaf litter in the northern parts of the study area is dense enough to provide shelter for some terrestrial fauna.

No rock habitats occur in the study area, which limits the potential use of the study area by some reptile species. Very few terrestrial termite mounds, which provide potential breeding sites for the Lace Monitor and Rosenberg's Goanna, were recorded in the study area. Ephemeral water habitats occur in the lower sections of the quarry and drainage channels, and provide some breeding habitat for common amphibians following rainfall.

Some habitat connectivity exists to the north, west and south of the study area, although this is dissected by roads and electricity easements, and limited in quality by the previous quarry disturbances and regenerating vegetation. Connectivity would also be provided through the study area in a north-south direction, mainly for more mobile fauna.

Figure 4: Vegetation and hollow-bearing trees

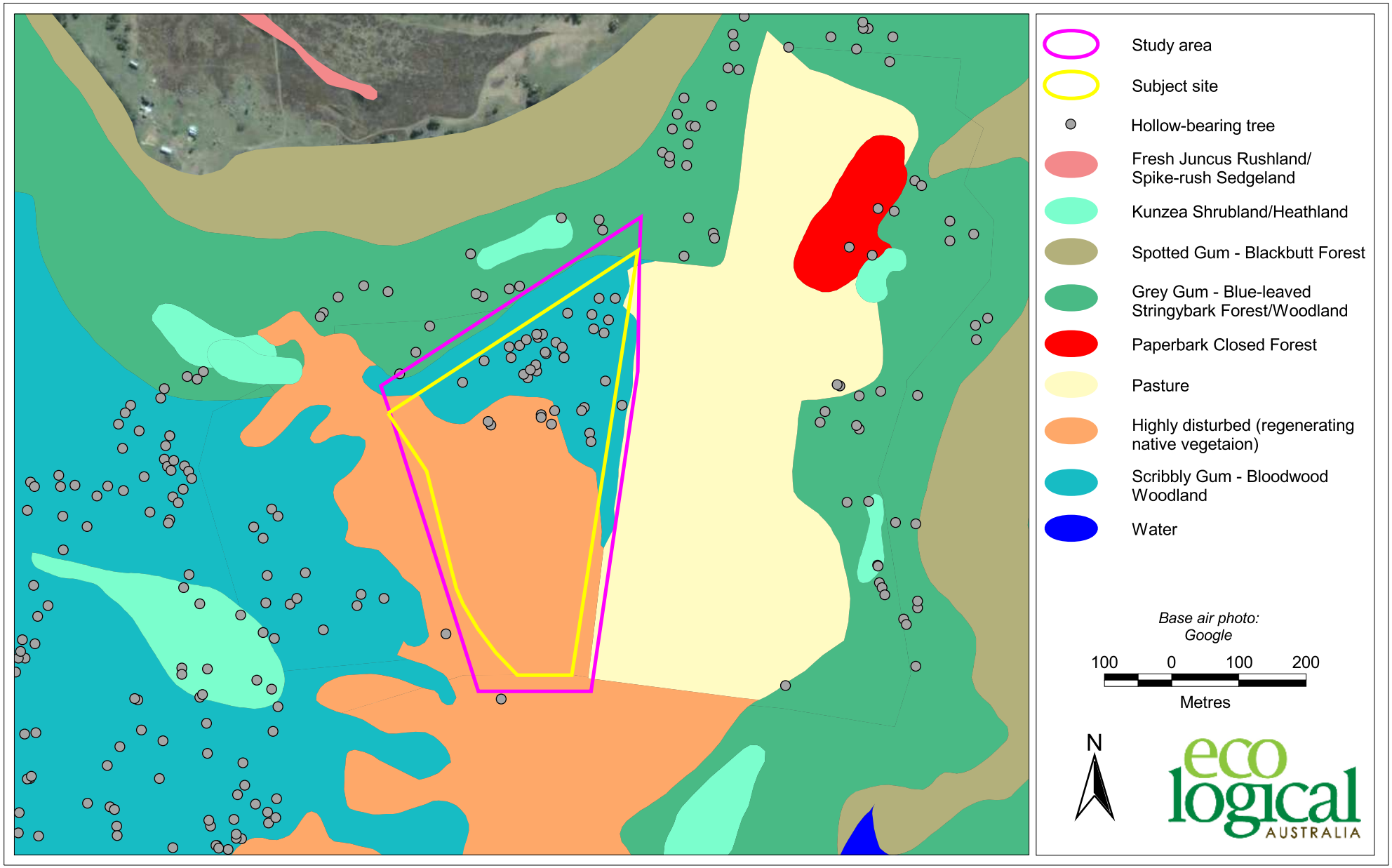


Figure 5: Flora species of conservation significance

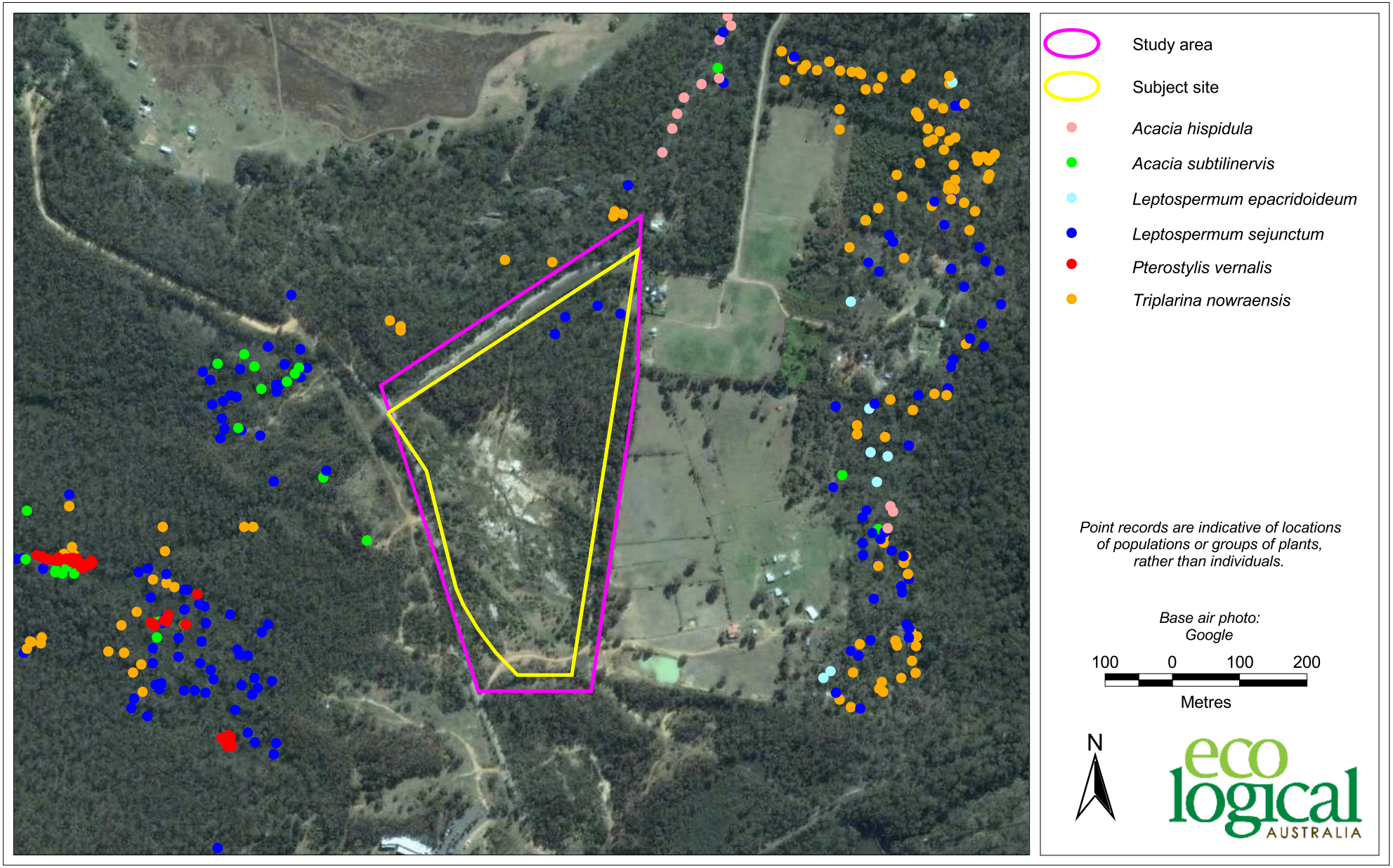
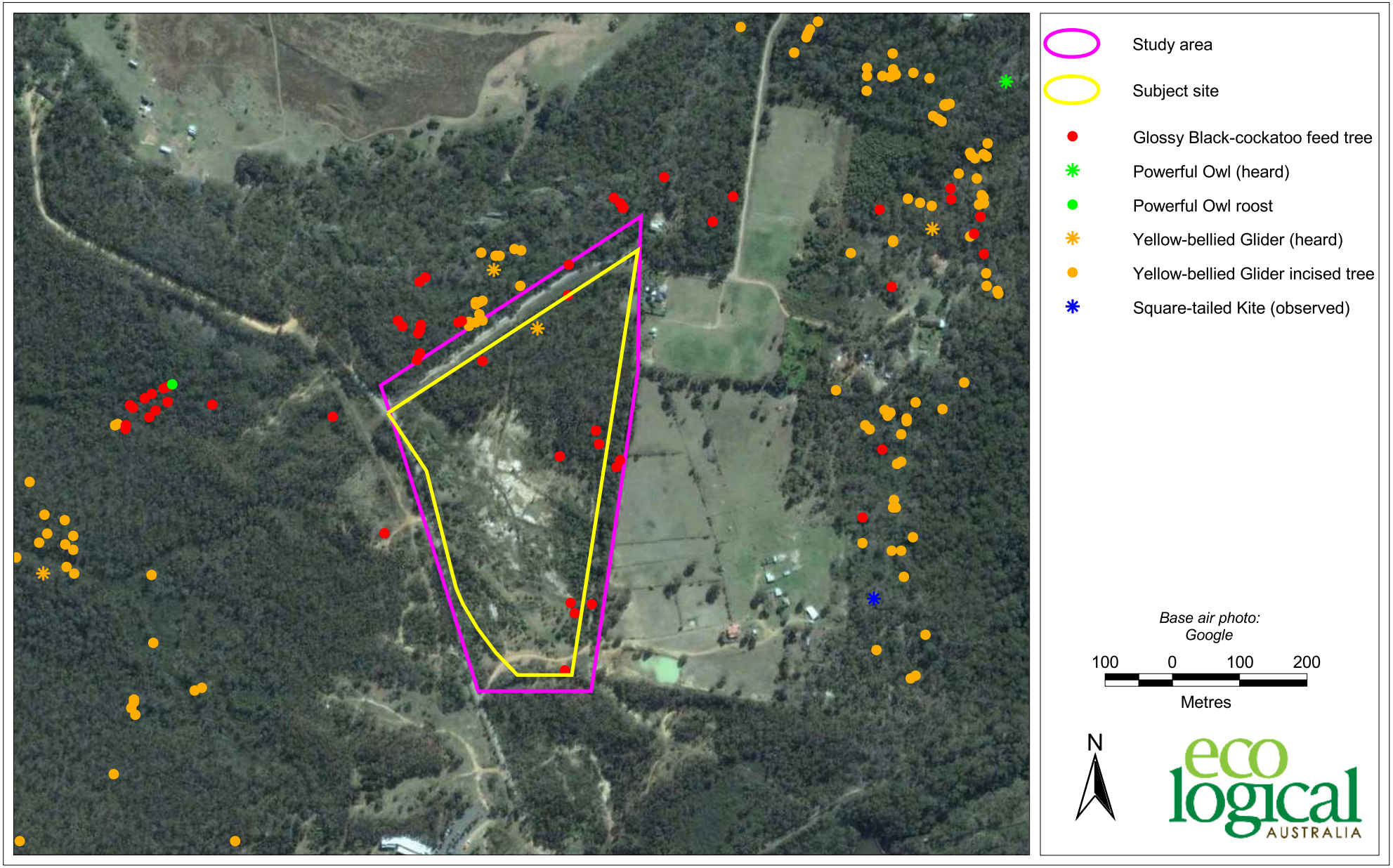


Figure 6: Fauna species of conservation significance (excluding bats)



4 Impact Assessment

4.1 VEGETATION COMMUNITIES

The proposal as assessed in this report will result in the removal of approximately 4.3 ha of Scribbly Gum – Bloodwood Woodland and 8.1 ha of regenerating native vegetation in poor condition from historic quarrying and clearing activities. The affected area of Scribbly Gum – Bloodwood Woodland is relatively intact, but has been degraded to some extent by previous landuse in the area. The area has been separated and isolated from adjoining vegetation by clearing for agriculture, roads, power easements and quarrying operations. The Scribbly Gum – Bloodwood Woodland is relatively widespread in the Shoalhaven, with an estimated 11,218 ha, the majority of which is protected in reserves or by other land zoning. The loss of 4.3 ha of Scribbly Gum – Bloodwood Woodland in this context is relatively minor and acceptable.

The vegetation communities in and around the study area do not comprise any endangered ecological communities listed on the TSC Act or EPBC Act.

4.2 FAUNA HABITATS AND CONNECTIVITY

The majority of the subject site contains heavily disturbed and modified fauna habitats as a result of quarrying operations and associated clearing. These heavily disturbed habitats to be removed include young regenerating native vegetation, shallow ephemeral ponds, areas of exotic grasses and several Glossy Black-cockatoo feed trees. Approximately 10 Glossy Black-cockatoo feed trees likely to be removed by the proposal. This feeding resource is known to be relatively widespread in surrounding areas, with 53 feed trees recorded by BES (2004a, Figure 6).

The north eastern portion of the subject site contains more intact and less disturbed fauna habitats within the Scribbly Gum-Bloodwood Woodland. These habitats to be removed include a variety of widespread and common foraging and sheltering resources, a few terrestrial termitaria and 38 moderately-sized hollow-bearing trees. While hollow-bearing trees are an important sheltering and/or breeding resource for a range of fauna, no species of conservation significance were recorded using this resource in the study area, and none are considered likely to on a regular basis. Hollow-bearing trees are relatively widespread in surrounding areas, with BES (2004a) recording 274 trees with hollows in the wider Mundamia study area (Figure 4).

The fauna habitats to be removed for the proposal are all relatively widespread in surrounding areas and while utilised by a moderate range of species, do not appear to provide important resources for fauna of conservation significance.

The proposal will result in some loss of habitat connectivity through the general area for fauna, mainly along a north-south axis for more mobile species which are able to traverse the heavily disturbed habitats in the south the subject site. However, the degraded subject site has already lost most of its habitat connectivity values and does not provide an important habitat link or corridor through the area.

4.3 REGIONALLY SIGNIFICANT SPECIES

Several regionally significant flora species are know from the wider Mundamia area, although only one species, Nowra Tea-tree *Leptospermum sejunctum,* was recorded in the study area. Only four individuals of *L. sejunctum* were recorded in the study area during targeted surveys by BES (2004a) and all are likely to be removed by the proposal. The study area does not provide optimal or important habitat for this species. The species was found to be fairly widespread in the wider Mundamia area by BES (2004a), with a further 150 locations recorded (Figure 5). The loss of around four *L. sejunctum* individuals is considered to be negligible.

4.4 THREATENED AND MIGRATORY SPECIES

As a result of database searches, literature review and field studies, the following species in Table 5 (from Appendix A) were considered likely to occur in the subject site and/or could be affected by the proposal. The potential impact of the proposal on these species has been assessed under relevant State and Federal legislation (Appendix E)

Table 5: Threatened and migratory species with the potential to occur in the study area or to be affected by the proposal

Scientific Name	Common Name	TSC Act	EPBC Act	Occurrence
Triplarina nowraensis	Nowra Heath Myrtle	E	E	Nearby
Pterostylis vernalis *Pterostylis* sp. Flat Rock Creek	Spring Tiny Greenhood	CE	CE	Nearby
Calyptorhynchus lathami	Glossy-black Cockatoo	V	—	Known
Callocephalon fimbriatum	Gang-gang Cockatoo	V	—	Potential
Ninox strenua	Powerful Owl	V	—	Potential
Lophoictinia isura	Square-tailed Kite	V	—	Potential
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	—	Potential
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	—	Potential
Mormopterus norfolkensis	East Coast Freetail Bat	V	—	Potential
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Potential
Scoteanax rueppellii	Greater Broad-nosed Bat	V	—	Potential
Petaurus australis	Yellow-bellied Glider	V	—	Potential
Varanus rosenbergi	Rosenberg's Goanna	V	—	Potential

4.5 SEPP 44 KOALA HABITAT ASSESSMENT

Grey Gum *Eucalyptus punctata,* occurs on the site and is listed as a Koala feed tree species on Schedule 2 of SEPP 44. However, the species does not comprise 15% or more of the canopy and as such, the study area does not qualify as Potential Koala Habitat. No further provisions of SEPP 44 apply, and the proposal does not require a management plan for Koala habitat.

4.6 CONCLUSION OF SEVEN-PART TEST

An assessment of significance under Section 5A of the EPA Act was undertaken on those species with potential to occur on the site or otherwise be affected by the proposal (Appendix E). The outcome of this assessment was that the development is unlikely to significantly impact those threatened fauna species assessed. Provided that effective measures to mitigate and manage indirect impacts to nearby *Pterostylis vernalis* and *Triplarina nowraensis* habitat are implemented as part of the proposal, it is unlikely that the development would significantly impact threatened flora species.

The proposal is concentrated on an area substantially degraded by previous quarrying activities that generally provides poor or marginal habitats for flora and fauna species. The removal of vegetation from the subject site will not substantially affect habitat connectivity in the area nor increase fragmentation given the disturbances within and surrounding the site. The extent of habitat or vegetation to be removed is considered a minor impact in the context of the available resources in the locality.

No endangered populations or ecological communities occur in or near the study area.

Further recommendations have been provided in Section 5 to ameliorate the potential impacts of the proposal.

4.7 CONCLUSION OF EPBC ASSESSMENT

An assessment of significance under the EPBC Act was undertaken on those species likely to occur on the site or with the potential to be indirectly affected by the proposal (Appendix E). The study area provides only marginal foraging habitat for threatened fauna and listed migratory species. However, an unmitigated development has the potential to result in indirect impacts to the critically endangered *Pterostylis vernalis*, and to a lesser extent the endangered *Triplarina nowraensis,* that may be considered 'significant' according to the criteria in the EPBC Act assessment

The provision of mitigation measures to replicate the hydrological flows beyond the site, together with monitoring and management of other indirect impacts, should be able to adequately control impacts to these species and their habitats.

While impacts are likely to be controllable, referral to the Commonwealth under the EPBC Act is recommended.

5 Recommendations

To further ameliorate the potential impacts of the proposal and ensure the best possible environmental outcomes, the following recommendations for impact mitigation and amelioration should be required as modifications to the proposal and/or imposed as conditions of consent.

1. The potential for the proposal to adversely affect hydrological regimes and water quality for adjacent habitats of conservation significance should be controlled by the implementation of recharge areas to replicate water flows to adjoining areas (i.e. Martens 2012) along with strategies to maintain water quality.

2. The proposal also has the potential to indirectly degrade surrounding habitats in other ways, such as trampling, dumping of rubbish and garden waste, weed invasion, off-road vehicle use, increased fire frequency and increased predation of native fauna by pet cats and dogs. Surrounding areas contain habitat for several species of conservation significance and increased protection of these areas is necessary. Strategies and actions should be detailed in a management plan for the site and surrounding areas, in consultation with relevant landowners and government departments. The management plan should address issues including access to surrounding habitats, fire management, weed control, drainage and erosion control, long-term monitoring and public education.

3. Consideration should be given to more formal protection of adjacent land containing species and habitats of conservation significance, such as conservation agreements, protective land zoning and/or transfer to the DECCW reserve system.

4. Sediment and erosion controls should be employed prior to any work commencing on the land and maintained on a regular basis for as long as necessary.

5. If possible, cone-bearing Black She-oak trees should be retained and/or planted for landscaping as foraging resources for the threatened Glossy Black-cockatoo.

6. If possible, other native trees and shrubs should be retained in appropriate locations within the subdivision.

7. Locally occurring plant species (such as those listed in Appendix C) should be considered for landscaping purposes.

8. Invasive plant species are not be used for landscaping purposes.

9. A worker induction program should be implemented to prevent damage to adjoining habitats to be retained.

10. Pre-clearing surveys should be employed prior to the removal of hollow-bearing trees.

11. Protocols for removing hollow-bearing trees should include tree felling at least one day after clearing of other vegetation and lowering of hollow sections to the ground to allow inspection by ecologist or wildlife handler.

12. A land purchaser's kit should be produced, which contains simple and clear guidelines for land owners on environmental responsibilities and actions to avoid impacts on surrounding habitats.

6 Conclusion

This report assesses the potential impacts on threatened and migratory species, endangered populations and ecological communities of the proposal to subdivide Lot 1 DP 1021332 and part Lot 458 DP 1063107 George Evans Road, Mundamia, as part of a new residential living area.

Following the application of the Section 5A of the EPA Act and in accordance with relevant assessment guidelines, it is concluded that the proposal is unlikely to have a significant effect on threatened species, endangered populations, ecological communities, or their habitats, provided that effective measures are undertaken to control, monitor and manage indirect impacts of the proposal on nearby habitats of conservation value.

Following consideration of the administrative guidelines for determining significance under the EPBC Act it is concluded that an unmitigated proposal could potentially have a significant impact on the Spring Tiny Orchid *Pterostylis vernalis* and the Nowra Heath Myrtle *Triplarina nowraensis*, and a referral to the Commonwealth Environment Minister is recommended.

A number of preliminary impact mitigation and amelioration strategies have been recommended for the proposal and these are set out in the previous section. These strategies mitigate the effects of the proposal on threatened species, endangered populations, ecological communities, or their habitats and minimise the impacts of the proposal on the flora and fauna values of the study area and surrounds.

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Appendix A: Previous flora and fauna survey effort

Previous flora survey effort – Mundamia urban expansion investigation area (BES 2004a, 2004b)

DATE	METHOD	EFFORT	TARGET SPECIES
26 February 2004	General vegetation surveys	3 person hours	All flora species
2 March 2004	Targeted grid searches	23.5 person hours	*Acacia hispidula, A. subtilinervis, Eucalyptus langleyi, E. sturgissiana, Leptospermum epacridoideim, L. sejunctum, Triplarina nowraensis*
18 March 2004	General vegetation surveys	4 person hour	All flora species
19 March 2004	Targeted grid searches	52 person hours	*Acacia hispidula, A. subtilinervis, Eucalyptus langleyi, E. sturgissiana, Leptospermum epacridoideim, L. sejunctum, Triplarina nowraensis*
27 April 2004	Targeted grid searches	15 person hours	*Genoplesium baueri*
22 June 2004	Targeted transects (beyond study area)	4 person hours	*Triplarina nowraensis*
8 October 2004	Targeted search	6 person hours	*Pterostylis vernalis (now Pterostylis* sp. Flat Rock Creek)
TOTAL FLORA SURVEY EFFORT		**107.5 person hours**	

Previous fauna survey effort – Mundamia urban expansion investigation area (BES 2004a)

DATE	METHOD	EFFORT	TARGET SPECIES
26 February 2004	Diurnal habitat search	3 person-hours	All species
	Nocturnal spotlighting	2 person-hours	Mammals, birds and frogs
	Nocturnal call playback	2.25 person-hours	Squirrel Glider Yellow-bellied Glider, Powerful Owl, Barking Owl, Sooty Owl, Masked Owl, Bush Stone-curlew and Giant Burrowing Frog

DATE	METHOD	EFFORT	TARGET SPECIES
26 February 2004	Nocturnal ANABAT	3 person-hours	Microchiropteran bats
26-29 February 2004	Terrestrial Elliott trapping (type A)	250 trap-nights	Terrestrial mammals including White-footed Dunnart, Eastern Pygmy-possum
	Terrestrial small cage trapping	100 trap-nights	Terrestrial mammals including Southern Brown Bandicoot, Long-nosed Potoroo
	Terrestrial large cage trapping	16 trap-nights	Spotted-tailed Quoll, Rosenberg's Goanna
26 February – 18 March	Arboreal hair-funnels	550 hair funnel-nights	Arboreal mammals including Pygmy Possum, Squirrel Glider
2 March 2004	Diurnal habitat search	23.5 person-hours	All species
	Nocturnal spotlighting	2 person-hour	Mammals, birds and frogs
	Nocturnal call playback	2 person-hours	Squirrel Glider Yellow-bellied Glider, Powerful Owl, Barking Owl, Sooty Owl, Masked Owl, Bush Stone-curlew and Giant Burrowing Frog
	Nocturnal ANABAT	2.25 person-hours	Microchiropteran bats
18 March 2004	Diurnal habitat search	4 person-hours	All species
	Nocturnal spotlighting	2 person-hours	Mammals, birds and frogs
	Nocturnal call playback	1.7 person-hour	Squirrel Glider Yellow-bellied Glider, Powerful Owl, Barking Owl, Sooty Owl, Masked Owl, Bush Stone-curlew and Giant Burrowing Frog
	Nocturnal ANABAT	2.5 person-hours	Microchiropteran bats
19 March 2004	Diurnal habitat search	52 person-hours	All species
10 & 22 June 2004	Nesting Assessments	11.5 person hours	Large Forest Owls, Glossy Black-Cockatoo
TOTAL FAUNA SURVEY EFFORT		**113.7 PERSON-HOURS, 550 Hair funnel trap nights, 250 Elliott trap nights, 100 small cage trap nights, 16 large cage trap nights**	

Appendix B: Likelihood of Occurrence

Summary of initial assessment to determine the likelihood of occurrence of threatened species, populations and communities and migratory species in the proposal site.

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

“yes” = the species was or has been observed on the site

“likely” = a medium to high probability that a species uses the site

“potential” = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur

“unlikely” = a very low to low probability that a species uses the site

“no” = habitat on site and in the vicinity is unsuitable for the species.

CE – Critically Endangered

E = Endangered

E2 = Endangered Population

V = Vulnerable

M = Migratory

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Acacia bynoeana	Bynoe's Wattle	E	V	The species is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra (DECC 2007). It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (DECC 2007). The species seems to prefer open and sometimes slightly disturbed sites (DECC 2007). Characteristic overstorey species include: *Corymbia gummifera*, *Eucalyptus haemastoma*, *E. gummifera, E. parramattensis*, *E. sclerophylla*, *Banksia serrata* and *Angophora bakeri*. Shrubs often associated with the species include *B. spinulosa*, *B. serrata, A. oxycedrus*, *A. myrtifolia* and *Kunzea* spp. (Winning 1992; James 1997). It flowers from September to March and fruits mature in November.	Unlikely Not recorded during surveys, not known from nearby, most of site extensively disturbed
Acacia pubescens		V	V	Associated with on Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest. Clay soils, often with ironstone gravel (NPWS 1997, Benson and McDougall 1996).	No
Apatophyllum constablei			E	Occurs in dry sclerophyll forest on slopes with a north to north-westerly aspect. It typically grows near cliffs (i.e. near the base or just above). The soils at sites are sandy and skeletal, mostly on Narrabeen sandstone. Found in association with *Eucalyptus piperita, E. punctata, E. sparsifolia, Banksia serrata, Acacia linifolia, Cleistochloa rigida, Lomandra obliqua*.	No
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	It is known from a range of vegetation communities including swamp-heath and woodland (DECC 2007). The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); where it appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*) (DECC 2007). Bell (2001) has identified Coastal Plains Scribbly Gum Woodland and Coastal Plains Smoothed-barked Apple Woodland as potential habitat on the Central Coast. Flowers between November and February, although may not flower regularly (DECC 2007; Bell 2001).	Unlikely No recorded during targeted surveys

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Cynanchum elegans		E	E	Climber or twiner with a variable form (DECC 2007). It occurs in dry rainforest gullies, scrub and scree slopes (NPWS 1997). It prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest. However has been found in littoral rainforest; *Leptospermum laevigatum – Banksia integrifolia* subsp *integrifolia* coastal scrub; *Eucalyptus tereticornis* aligned open forest/ woodland; *E. maculata* aligned open forest/woodland; and *Melaleuca armillaris* scrub to open scrub (DECC 2007). Flowers between August and May, peaking in November (DECC 2007). Seeds are unlikely to persist in the seedbank (DECC 2007).	No
Eucalyptus langleyi	Albatross Mallee	V	V	Poor sandy sites west and south west of Nowra (Brooker and Kleinig 1999); mallee shrubland on poorly drained shallow sand on sandstone (Harden 1994).	No Not recorded during targeted surveys
Eucalyptus sturgissiana	Ettrema Mallee	V	-	Restricted to sandstone plateaus west and south west of Nowra, with a few small patches near the coast (Brooker and Kleinig 1999); Emergent in low shrub heath on sandy swampy soils (Harden 1994).	No Not recorded during targeted surveys
Genoplesium baueri	Bauer's Midge Orchid	E	-	The species has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Grows in sparse sclerophyll forest and moss gardens over sandstone. Flowers Dec to Mar.	Unlikely Not recorded during targeted surveys

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Grevillea parviflora subsp. parviflora	Small Flower Grevillea	V	V	Occurs on sandy clay loam soils, often with lateritic ironstone gravels (DECC 2007). Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones. Soil landscapes include Lucas Heights and Berkshire Park (DECC 2007). Often occurs in open, slightly disturbed sites such as along tracks. Flowering has been recorded between July to December as well as April-May (DECC 2007).	Unlikely
Melaleuca biconvexa	Biconvex Paperbark	V	V	Associated with damp habitats, such as Coastal Narrabeen Moist Forest, Riparian Melaleuca Swamp Woodland (LMCC 2001). This species may occur in dense stands forming a narrow strip adjacent to watercourses, in association with other *Melaleuca* species or as an understorey species in wet forest (NSW Scientific Committee 1998). Flowering occurs over just 3-4 weeks in September and October (DECC 2007).	No
Melaleuca deanei	Deane's Paperbark	V	V	Found in heath on sandstone (DECC 2007), and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (Benson and McDougall 1998).	No
Pterostylis gibbosa	Illawarra Greenhood	E	E	Associated with seasonally hard setting clay soils with approximately 1000mm of rainfall (NPWS 1997). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum *Eucalyptus tereticornis*, Woollybutt *E. longifolia* and White Feather Honey-myrtle *Melaleuca decora*. Near Nowra, the species grows in an open forest of Spotted Gum *Corymbia maculata*, Forest Red Gum and Grey Ironbark *E. paniculata*. The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter and flowers in spring.	No
Pterostylis pulchella	Waterfall Greenhood	V	V	Grows on escarpments close to waterfalls and on moist, sheltered ridges; chiefly from Blue Mtns to Fitzroy Falls.	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pterostylis vernalis *Pterostylis* sp. Flat Rock Creek	Spring Tiny Greenhood	CE	CE	The Spring Tiny Greenhood is known from five populations in heath and heathy forests in the Nowra district. One population is in a national park, one is on land zoned for urban development and the other three are on uncommitted crown land. The species is most commonly found in open sites in shallow sandy soil and moss gardens around the margins of sandstone sheets with associated dwarf heaths and sedges. (Jones, pers. comm., 2006; ERIN, 2009). Largest known population occurs approximately 300m west of the subject site.	No occurrence within subject site, but potential for indirect impacts
Rhizanthella slateri	Eastern Australian Underground Orchid	V	V	An Underground Orchid with a whitish, fleshy underground stem to 15 cm long and 15 mm diameter (DECC 2005). Occurs from south-east Queensland to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore usually located only when the soil is disturbed. Flowers October to November (DECC 2005).	Unlikely
Solanum celatum	Solanum celatum	E	-	Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Majority of records are prior to 1960 and the majority of populations are likely to have been lost to clearing. Grows in rainforest clearings, or in wet sclerophyll forests.	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Syzygium paniculatum	Magenta Lillypilly	E	V	This species occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities (Payne 1997). In the Ourimbah Creek valley, *S. paniculatum* occurs within gallery rainforest with *Alphitonia excelsa, Acmena smithii, Cryptocarya glaucescens, Toona ciliata, Syzygium oleosum* with emergent *Eucalyptus saligna*. At Wyrrabalong NP, *S. paniculatum* occurs in littoral rainforest as a co-dominant *with Ficus fraseri, Syzygium oleosum, Acmena smithii, Cassine australe*, and *Endiandra sieberi*. Payne (1991) reports that the species appears absent from Terrigal formation shales, on which the gully rainforests occur. *S. paniculatum* is summer flowering (November-February), with the fruits maturing in May (DECC 2007).	No
Thelymitra sp. Kangaloon	Kangaloon Sun-orchid	CE	CE	The Kangaloon Sun-orchid occurs in NSW and is known from three locations near Robertson in the Southern Highlands. This species occurs within the Southern Rivers Natural Resource Management Region. The species has an estimated extent of occurrence of 300 km². The Kangaloon Sun-orchid has an estimated area of occupancy of 10 km². The three localities are Butler's Swamp (0.125 km²), Stockyard Swamp (once known as Molly Morgan Swamp) (7 km²) and Wildes Meadow Swamp (3 km²), and are all located above what is known as the Kangaloon Aquifer	No
Thesium australe	Austral Toadflax	V	V	Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (*Themeda australis)* (DECC 2007). Flowers in spring–summer. Widespread but rare. NSW subdivisions: NC, CC, SC, NT, ST, NWS, CWS. Other Australian states: Qld, Tas.	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Triplarina nowraensis	Nowra Heath Myrtle	E	E	There are five known populations of Nowra Heath Myrtle. Three of these form a cluster to the immediate west of Nowra. A fourth, much smaller population is found 18km south-west of Nowra in the Boolijong Creek Valley. The fifth population is located north of the Shoalhaven River on the plateau above Bundanon. Nowra Heath Myrtle occurs on poorly drained, gently sloping sandstone shelves or along creek lines underlain by Nowra Sandstone. The sites are often either treeless or have a very open tree canopy due to the impeded drainage.	No habitat within subject site, but potential for indirect impacts
Zieria baeuerlenii	Bomadary Zieria	E	E	The species occurs in only one location north-west of Nowra. The population occurs in a total of 43 colonies in six discrete clusters. These clusters are confined within a 0.5 km x 1.0 km area of the bushland, and are found on both sides of Bomaderry Creek. Bomaderry Zieria occurs on skeletal sandy loam overlaying sandstone, on a rocky plateau amongst sandstone boulders in either shrubby open forest, shrubby woodland or closed scrub.	No
Zieria tuberculata	Warty Zieria	V		The species grows in shrub communities on monzonite rock outcrops, fringed by temperate rainforest or eucalypt open forest. The species occasionally extends into the eucalypt forest understorey (Briggs & Leigh 1990; Armstrong 2002). Associated heath species include Kunzea ambigua, Acacia mearnsii, Beyeria lasiocarpa, Ficus rubiginosa, Prostanthera nivea, Dodonaea viscosa, Notelaea venosa, Plectranthus parviflorus, Dendrobium speciosum and Coprosma sp. (Briggs & Leigh 1990). Thought to be now restricted to the central Tilba area on the south coast.	No
Disclaimer: Data extracted from the Atlas of NSW Wildlife and EPBC Act Protected Matters Report are only indicative and cannot be considered a comprehensive inventory.					

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
FROGS					
Heleioporus australiacus	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	No
Litoria aurea	Green and Golden Bell Frog	E	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2007). Fast flowing streams are not utilised for breeding purposes by this species (Mahony 1999). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DECC 2007). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (Gambusia holbrooki) (DECC 2007).	No
Litoria littlejohni	Heath Frog	V	V	It appears to be restricted to sandstone woodland and heath communities at mid to high altitude (NSW Scientific Committee 2000). It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer (NSW Scientific Committee 2000).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Mixophyes balbus	Stuttering Frog	E	V	A variety of forest habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest (DECC 2007) that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997). Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans (Ehmann 1997) or still water environments (NSW Scientific Committee 2002).	No
REPTILES					
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (DECC 2007). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998b). Some of the canopy tree species found to regularly co-occur at known sites include *Corymbia eximia, C. gummifera, Eucalyptus sieberi, E. punctata* and *E. piperita* (DECC 2007).	No
Varanus rosenbergi	Rosenberg's Goanna	V		Associated with Sydney sandstone woodland and heath land. Rocks, hollow logs and burrows are utilised for shelter (Environment Australia 2000). Terrestrial termitaria are required for reproduction (King and Green 1999). Few records in the locality, although one record from the west Nowra area, with more records further to the south west.	Potential Not recorded during surveys

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
DIURNAL BIRDS					
Anthochaera phrygia *Formerly Xanthomyza phrygia*	Regent Honeyeater	E	E, M	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (*Casuarina cunninghamiana*) (Garnett 1993). Areas containing Swamp Mahogany (*Eucalyptus robusta)* in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	Unlikely
Botaurus poiciloptilus	Australasian Bittern	V	—	Terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993). Reedbeds, swamps, streams, estuaries (Simpson & Day 1999).	No
Burhinus grallarius	Bush Stone-curlew	E	—	Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (Pittwater Council 2000; Marchant & Higgins 1993). Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Environment Australia 2000; Marchant & Higgins 1993). Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed to lightly disturbed. There are few records of the species in the locality, although one record from south west of Nowra. Possibly a non-permanent inhabitant in the locality.	Unlikely Not recorded during surveys, marginal habitat , no recent records
Callocephalon fimbriatum	Gang-gang Cockatoo	V	—	During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004).	Potential Occasional foraging habitat only

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	—	Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils (Environment Australia 2000; NPWS 1997; DECC 2007). Intact drier forest types with less rugged landscapes are preferred (DECC 2007). Nests in large trees with large hollows (Environment Australia 2000).	Yes Known to forage in study area
Circus assimilis	Spotted Harrier	V		The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania (Barrett *et al.* 2003). The Spotted Harrier occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (*e.g.* chenopods) (Marchant and Higgins 1993; Aumann 2001a). It is found mostly commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (DECC 2009).	No
Daphoenositta chrysoptera	Varied Sittella	V		The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west (Higgins and Peter 2002; Barrett *et al.* 2003). It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland (DECC 2009).	Unlikely
Dasyornis brachypterus	Eastern Bristlebird	E	E	Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone. Age of habitat since fires (fire-age) is of paramount importance to this species; Illawarra and southern populations reach maximum densities in habitat that has not been burnt for at least 15 years; however, in the northern NSW population a lack of fire in grassy forest may be detrimental as grassy tussock nesting habitat becomes unsuitable after long periods without fire; northern NSW birds are usually found in habitats burnt five to 10 years previously.	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Glossopsitta pusilla	Little Lorikeet	V	—	In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box (*Eucalyptus albens*) and Yellow Box (*E. melliodora*) are particularly important food sources for pollen and nectar respectively.	Unlikely
Hieraaetus morphnoides	Little Eagle	V	—	The Little Eagle is distributed throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment (Marchant and Higgins 1993). The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used (Marchant and Higgins 1993; Aumann 2001a). For nest sites it requires a tall living tree within a remnant patch (DECC 2009).	No
Ixobrychus flavicollis	Black Bittern	V	—	Occurs in both terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation (DECC 2007). In areas with permanent water it may occur in flooded grassland, forest, woodland, rainforest and mangroves (DECC 2007)	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Lathamus discolor	Swift Parrot	E	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986; Forshaw and Cooper 1981). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*) (DECC 2007).	Unlikely
Limosa limosa	Black-tailed Godwit	V	M	Mainly coastal, usually sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats (DEH 2005a). Often found inland in small numbers (i*bid*). Breeds in Iceland, Nth Atlantic, Europe, Russian and China (*ibid*). Primarily found along the coast on sandspits, lagoons and mudflats (DECC 2007). The species has also been found to occur inland on mudflats or shallow receding waters of portions of large muddy swamps or lakes (Pizzey and Knight 1997; Higgins & Davies 1996).	No
Lophoictinia isura	Square-tailed Kite	V	—	In coastal areas associated tropical and temperate forests and woodlands on fertile soils with an abundance of passerine birds (Marchant & Higgins 1993, DECC 2007). May be recorded inland along timbered watercourses (DECC 2007). In NSW it is commonly associated with ridge or gully forests dominated by Woollybutt (*Eucalyptus longiflora*), Spotted Gum (*Corymbia. maculata*), or Peppermint Gum (*E. elata, E. smithii*) (DECC 2007).	Potential Occasional foraging habitat only

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Neophema chrysogaster	Orange-bellied Parrot	E	E, M	Breeds only in coastal south-west Tasmania and spends the winter in coastal Victoria and South Australia. It nests in hollows in eucalypt trees which grow adjacent to its feeding plains. In early October the birds arrive in the south west and depart after the breeding season usually in March and April. It feeds on the seeds of several sedges and heath plants, including buttongrass. Its main food preferences are found in sedgelands which have not been burned for between 3-15 years. Also included in the diet are seeds of three Boronia species and the everlasting daisy *Helichrysum pumilum*. After breeding, migrating birds move gradually northwards up the west coast, through the Hunter Group and King Island in Bass Strait and on to the mainland. On the journey the birds usually feed on beach-front vegetation including salt tolerant species such as sea rocket *Cakile maritima*. They also eat various coastal native and introduced grasses.	No
Neophema pulchella	Turquoise Parrot	V	—	Steep rocky ridges and gullies, rolling hills, valleys and river flats and the plains of the Great Dividing Range compromise the topography inhabited by this species (Marchant & Higgins 1993). Spends much of the time on the ground foraging on seed and grasses (DECC 2007). It is associated with coastal scrubland, open forest and timbered grassland, especially low shrub ecotones between dry hardwood forests and grasslands with high proportion of native grasses and forbs (Environment Australia 2000).	Unlikely Not recorded during surveys, marginal habitat

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Petroica boodang	Scarlet Robin	V		The Scarlet Robin is found in south-eastern Australia (extreme south-east Queensland to Tasmania, western Victoria and south-east South Australia) and south-west Western Australia. In NSW it occupies open forests and woodlands from the coast to the inland slopes (Higgins and Peter 2002). Some dispersing birds may appear in autumn or winter on the eastern fringe of the inland plains. The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees (Higgins and Peter 2002; Debus 2006a,b)	Unlikely
Petroica phoenicea	Flame Robin	V		The Flame Robin is found in south-eastern Australia (Queensland border to Tasmania, western Victoria and south-east South Australia). In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains (Higgins and Peter 2002).	Unlikely
Petroica rodinogaster	Pink Robin	V		The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. Breeds between October and January and can produce two clutches in a season.	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Rostratula benghalensis australis	Painted Snipe (Australian subspecies)	E	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (*ibid.*). Breeding is often in response to local conditions; generally occurs from September to December (DECC 2007). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007). Feeds on worms, molluscs, insects and some plant-matter (*ibid.*).	No
Stictonetta naevosa	Freckled Duck	V	—	Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters (DECC 2007).	No
Thinornis rubricollis	Hooded Plover	E		In south-eastern Australia this species uses long stretches of sandy shore, backed by tussock and creeper-covered dunes with nearby inland lakes (DECC 2007). Preferred habitat is beaches with a wide wash zone with seaweed mounds for feeding (Murlis 1989).	No
NOCTURNAL BIRDS					
Ninox connivens	Barking Owl	V	—	Associated with a variety of habitats such as savanna woodland, open eucalypt forests, wetland and riverine forest. The habitat is typically dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (DECC 2007). It usually roosts in dense foliage in large trees such as River She-oak (*Allocasuarina cunninghamiana*), other *Casuarina* and *Allocasuarina*, *Eucalypts*, *Angophora*, *Acacia* and rainforest species from streamside gallery forests (NPWS 2003). It usually nests near watercourses or wetlands (NPWS 2003) in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).	Unlikely Not recorded during surveys, marginal habitat
Ninox strenua	Powerful Owl	V	—	Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus & Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000).	Potential

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Tyto novaehollandiae	Masked Owl	V	—	Associated with forest with sparse, open, understorey, typically dry sclerophyll forest and woodland (DECC 2007) and especially the ecotone between wet and dry forest, and non forest habitat (Environment Australia 2000). Known to utilise forest margins and isolated stands of trees within agricultural land (Hyem 1979) and heavily disturbed forest where its prey of small and medium sized mammals can be readily obtained (Kavanagh & Peake 1993).	Unlikely Not recorded during surveys, marginal habitat
Tyto tenebricosa	Sooty Owl	V	—	Sooty Owls are associated with tall wet old growth forest on fertile soil with a dense understorey and emergent tall Eucalyptus species (Environment Australia 2000, Debus 1994). Pairs roost in the daytime amongst dense vegetation, in tree hollows and sometimes in caves. The Sooty Owl is typically associated with an abundant and diverse supply of prey items and a selection of large tree hollows (Debus 1994, Garnett 1993, Hyem 1979).	No
MAMMALS (EXCLUDING BATS)					
Cercartetus nanus	Eastern Pygmy-possum	V	—	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy-Possums feed mostly on the pollen and nectar from *Banksias*, *Eucalypts* and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of *Banksia* sp. and *Leptospermum* sp. are an important habitat feature (DECC 2007). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old bird nests and in the branch forks of tea-trees (Turner & Ward 1995).	Unlikely Not recorded during targeted surveys
Dasyurus maculatus *Dasyurus maculatus maculatus*	Spotted-tailed Quoll Spotted-tailed Quoll (SE Mainland Population)	V —	— E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007j), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Dasyurus viverrinus	Eastern Quoll	E	V	Associated with a variety of habitats, including dry sclerophyll forest, shrub, heath land, riparian forests and agricultural areas. Requires features such as hollow logs and rock piles for shelter (NPWS 1999).	No
Isoodon obesulus	Southern Brown Bandicoot	E	E	This species is associated with heath, coastal scrub, heathy forests (Menkhorst & Knight 2004), shrubland and woodland on well drained soils. This species is thought to display a preference for newly regenerating heathland and other areas prone to fire (Menkhorst & Seebeck 1990).	Unlikely
Macropus parma	Parma Wallaby	V	—	Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest (DECC 2007).	No
Petaurus australis	Yellow-bellied Glider	V	—	This species is restricted to tall mature forests, preferring productive tall open sclerophyll forests with a mosaic of tree species including some that flower in winter (Environment Australia 2000, Braithwaite 1984, Davey 1984, Kavanagh 1984; DECC 2007). Large hollows within mature trees are required for shelter, nesting and breeding (Henry and Craig 1984; DECC 2007).	Yes
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Strahan 1995).	No
Phascolarctos cinereus	Koala	V	—	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable *Eucalypt* food trees. Some preferred Eucalyptus species are: *Eucalyptus tereticornis*, *E. punctata, E. cypellocarpa, E. viminalis*	Unlikely Not recorded during targeted surveys, marginal habitat
Potorous tridactylus *Potorous tridactylus tridactylus*	Long-nosed Potoroo Long-nosed Potoroo (SE Mainland Population)	V —	— V	Associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2004).	Unlikely Not recorded during targeted surveys

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pseudomys fumeus	Konoom, Smoky Mouse	E	E	The Smoky Mouse is currently limited to a small number of sites in western, southern and eastern Victoria, south-east NSW and the ACT. The Smoky Mouse appears to prefer heath habitat on ridge tops and slopes in sclerophyll forest, heathland and open-forest from the coast (in Victoria) to sub-alpine regions of up to 1800 metres, but sometimes occurs in ferny gullies. (DECC 2005)	No
Sminthopsis leucopus	White-footed Dunnart	V	—	The White-footed Dunnart occurs in Tasmania and along the Victorian and southern NSW coast. The Shoalhaven area is the species' northern-most limit. The White-footed Dunnart is found in a range of different habitats across its distribution, including coastal dune vegetation, coastal forest, tussock grassland and sedgeland, heathland, woodland and forest. In NSW, the species seems to favour vegetation communities with an open understorey structure. Mating occurs in late July and August. Breeding populations have been recorded in logged forest shortly after disturbance, but these usually do not persist as regeneration proceeds and a dense ground cover of vegetation establishes. The White-footed Dunnart is an opportunistic carnivore that feeds on a variety of ground-dwelling invertebrates and, occasionally, small lizards. They shelter in bark nests in hollows under standing or fallen timber, burrows in the ground, piles of logging debris, large grass clumps such as provided by Grass Trees *Xanthorrhoea sp.* and Macrozamias and rock crevices.	Unlikely Not recorded during targeted surveys
MAMMALS (BATS)					
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; DECC 2007). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007).	Potential

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	—	Prefers moist habitats with trees taller than 20m (DECC 2007). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (DECC 2007).	Potential
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	—	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (AMBS 1995, Dwyer 1995, Dwyer 1981). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1995).	Potential
Mormopterus norfolkensis	East Coast Freetail Bat	V	—	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Allison & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia 2000; Allison & Hoye 1998).	Potential
Myotis macropus	Southern Myotis	V	—	Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water. The bat forages over streams and pools catching insects and small fish by raking their feet across the water surface (Churchill 1998; DECC 2009). When roosting it is most commonly associated with caves, however, this species has been observed to roost in tree hollows, amongst vegetation, under bridges, in mines, tunnels and stormwater drains (DECC 2009). The species apparently has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used (Richards 1998).	Unlikely

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	Potential
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	—	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998), open country, mallee, rainforests, heathland and waterbodies (SFNSW 1995). Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock (Environment Australia 2000) and in abandoned sugar glider nests (Churchill 1998). The Yellow-bellied Sheathtail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (Environment Australia 2000).	Potential
Scoteanax rueppellii	Greater Broad-nosed Bat	V	—	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). Within denser vegetation types use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1998).	Potential
MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT					
Haliaeetus leucogaster	White-bellied Sea-Eagle	—	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	No
Hirundapus caudacutus	White-throated Needletail	—	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Merops ornatus	Rainbow Bee-eater	—	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May (Pizzey and Doyle 1988). Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (*ibid*). Nest is a chamber a the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (*ibid*).	Unlikely
Monarcha melanopsis	Black-faced Monarch	—	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	No
Myiagra cyanoleuca	Satin Flycatcher	—	M	Associated with drier eucalypt forests, absent from rainforests (Blakers et al. 1984), open forests, often at height (Simpson & Day 1999).	Unlikely
Rhipidura rufifrons	Rufous Fantail	—	M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	No
Xanthomyza phrygia (Anthochaera phrygia)	Regent Honeyeater	E	E, M	SEE DIURNAL BIRDS ABOVE	Unlikely
Disclaimer: Data extracted from the Atlas of NSW Wildlife and DEW Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species', 'Migratory wetland species', and 'listed marine species' listed on the EPBC Act (and listed on the DEW protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine and wetland habitats.					

Appendix C: Previous Flora List

Flora species recorded in the Mundamia urban expansion investigation area (BES 2004a, 2004b)

SCIENTIFIC NAME	COMMON NAME
*Acacia baileyana**	Cootamundra Wattle*
Acacia binervata	Two-veined Hickory
Acacia elongata	Slender Wattle
Acacia falcata	Sickle Wattle
Acacia hispidula	A wattle
Acacia implexa	Hickory
Acacia irrorata	Green Wattle
Acacia longifolia	Sydney Golden Wattle
Acacia mearnsii	Black Wattle
Acacia myrtifolia	Myrtles Wattle
Acacia obtusifolia	A wattle
Acacia parramattensis	Parramatta Green Wattle
Acacia stricta	Straight Wattle
Acacia suaveolens	Sweet Wattle
Acacia subtilinervis	A wattle
Acacia terminalis	Sunshine Wattle
Acacia ulicifolia	Prickly Moses
Actinotus helianthi	Flannel Flower
Adiantum aethiopicum	Common Maidenhair Fern
*Ageratina adenophora**	Crofton Weed*
Allocasuarina distyla	Scrub She-oak
Allocasuarina littoralis	Black She-oak
*Amaranthus viridis**	Green Amaranth*
*Anagalis arvensis **	Scarlet Pimpernel *
Angophora hispida	Dwarf Apple
Anisopogon avenaceus	Oat Spear Grass
Aotus ericoides	Aotus
*Araujia sericifera**	Moth Plant*
Aristida sp.	A Three-awned Spear-grass
Aristida vagans	Three-awned Spear-grass
Asplenium flabellifolium	Necklace Fern
Austrodanthonia tenuior	A wallaby grass

SCIENTIFIC NAME	COMMON NAME
Backhousia myrtifolia	Grey Myrtle
Baeckea brevifolia	Short-leaved Heath-myrtle
Baeckea diosmifolia	A heath-myrtle
Banksia paludosa	Swamp Banksia
Banksia spinulosa	Hair-pin Banksia
Banksia serrata	Saw Banksia
Baumea rubiginosa	Soft Twig-rush
*Bidens pilosa**	Cobbler's pegs*
Billardiera scandens	Apple Berry
Bossiaea ensata	A bossiaea
Bossiaea heterophylla	Variable Bossiaea
Bossiaea obcordata	Spiny Bossiaea
Bossiaea scolopendria	A bossiaea
Brachycome spathulata	A daisy
*Briza maxima**	Quaking Grass*
*Bromus catharticus**	Prairie grass*
Brunoniella australis	Blue Trumpet
Brunoniella pumilio	Dwarf Trumpet
Bursaria spinosa	Boxthorn
Caesia parviflora var. *parviflora*	Pale Grass-lily
Callistemon rigidis	Stiff Bottlebrush
*Callitris sp.**	Cypress Pine*
Calochlaena dubia	Soft Bracken
Calytrix tetragona	Fringe-myrtle
Cassytha glabella	Slender Devil's Twine
Cassytha pubescens	Common Devil's Twine
Caustis flexuosa	Curly Sedge
*Centaurium tenuiflorum**	-
Centella asiatica	Indian Pennywort
Ceratopetalum gummiferum	NSW Christmas Bush
Cheilanthes sieberi	Mulga Fern
*Chenopodium album**	Fat Hen*
Chloanthes stoechadis	Common Chloanthes
*Chlorophytum comosum**	Spider Plant*
*Cinnamomum camphora**	Camphor Laurel*
*Cirsium vulgare**	Spear Thistle*
Clematis aristata	Old Man's Beard
Comesperma ericinum	Matchheads

SCIENTIFIC NAME	COMMON NAME
Comesperma volubile	Love Creeper
Commelina cyanea	Scurvy Weed
Conospermum longifolium	Long-leaf Coneseed
*Conyza sp.**	A fleabane*
Correa reflexa var. *reflexa*	Common Correa
*Cortaderia selloana**	Pampas Grass*
Corymbia gummifera	Red Bloodwood
Corymbia maculata	Spotted Gum
*Crassula multicava**	A stonecrop*
Crassula sieberiana	Austral Stonecrop
Crowea exalata	-
Cryptostylis subulata.	Large Tongue Orchid
Cyathea australis	Rough Tree Fern
Cymbidium suave	Snake Flower
Cymbopogon refractus	Barbed-wire Grass
Cyperus polystachyos	A sedge
Davallia pyxidata	Hares Foot Fern
Daviesia ulicifolia	Gorse Bitter Pea
Dendrobium speciosum	Rock Orchid
Deyeuxia quadriseta	Reed Bent Grass
Dianella caerula	Paroo Lily
Dianella caerula var. producta	Paroo Lily
Dichondra repens	Kidney Weed
Digitaria sp.	A fingergrass
Dillwynia ramosissima	Bushy Parrot-pea
Dillwynia retorta ssp. *Retorta*	Eggs and Bacon
Dillwynia rudis	Eggs and Bacon
Dillwynia sp. 'trichopoda'	Eggs and Bacon
Dodonaea triquetra	Common Hop Bush
Drosera peltata	Pale Sundew
Echinopogon caespitosus	Tufted Hedgehog Grass
*Ehrharta erecta**	Panic Veldt Grass*
Elaeocarpus reticulatus	Blueberry Ash
Eleocharis sp.	A spike-rush
Entolasia marginata	Bordered Panic
Entolasia stricta	Wiry Panic
Epacris microphylla	Coral Heath
Epacris pulchella	NSW Coral Heath

SCIENTIFIC NAME	COMMON NAME
Eragrostis brownii	Brown's Love Grass
Eucalyptus agglomerata	Blue-leaved Stringybark
Eucalyptus globoidea	White Stringybark
Eucalyptus imitans	A Stringybark
Eucalyptus pilularis	Blackbutt
Eucalyptus punctata	Grey Gum
Eucalyptus sclerophylla	Hard-leaved Scribbly Gum
Eucalyptus sieberi	Silvertop Ash
Euchiton involucratus	Cudweed
Eustrephus latifolius	Wombat Berry
Exocarpos strictus	Pale Ballart
Ficus rubiginosa	Port Jackson Fig
Fimbristylis dichotoma	A sedge
Gahnia aspera	A saw-sedge
Gahnia clarkei	Tall Saw-sedge
Gahnia radula	A saw-sedge
Gleichenia dicarpa	Pouched Coral-fern
Glochidion ferdinandi	Cheese Tree
Glycine clandestina	Love Creeper
Gompholobium grandiflorum	A wedge-pea
Gompholobium pinnatum	A wedge-pea
Gonocarpus tetragynus	Poverty Raspwort
Gonocarpus teucrioides	Germander Raspwort
Goodenia hederacea var. *hederacea*	Violet-leaved Goodenia
Goodenia heterophylla ssp. *eglandulosa*	A Goodenia
Goodenia paniculata	Swamp Goodenia
Haemodorum corymbosum	Blood Root
Hakea dactyloides	Broad-leaved Hakea
Hakea salicifolia	Willow-leaved Hakea
Hakea sericea	Bushy Needlebush
Hakea teretifolia	Dagger Hakea
Hardenbergia violacea	Twining Pea
Helichrysum collinum	A Paper-daisy
Hibbertia monogyna	Leafy Guinea Flower
Hibbertia obtusifolia	Grey Guinea-flower
Hibbertia sp. Aff. *Riparia*	A guinea-flower
Hovea linearis	Narrow-leaf Hovea
Hydrocotyle peduncularis	A pennywort

SCIENTIFIC NAME	COMMON NAME
Hypericum gramineum	Small St John's Wort
Hypochaeris radicata *	Flatweed *
Hypoxis hygrometrica	Golden Star
Imperata cylindrica	Blady Grass
Isopogon anemonifolius	Drumsticks
Isopogon anethifolius	Narrow-leaf Drumsticks
Kunzea ambigua	White Kunzea
Lambertia formosa	Mountain Devil
*Lantana camara**	Lantana*
Lasiopetalum ferrugineum var. *ferrugineum*	Rusty Petals
Laxmannia gracilis	Slender Wire-lily
Lepidosperma concavuum	A sword-sedge
Lepidosperma laterale	Variable Sword-sedge
Lepidosperma sp.	A rapier-sedge
Leptocarpus tenax	A twine rush
Leptomeria acida	Native Currant
Leptospermum continentale	A tea-tree
Leptospermum epacridoideum	Jervis Bay Tea-tree
Leptospremum morrisonii	A tea-tree
Leptospermum parvifolium	Slender Tea-tree
Leptospermum polygalifolium	Yellow Tea-tree
Leptospermum rotundifolium	Round-leaf Tea-tree
Leptospermum sejunctum	Nowra Tea-tree
Leptospermum trinervium	Flaky-barked Tea-tree
Lepyrodia scariosa	Scale-rush
Leucopogon ericoides	Bearded Heath
Leucopogon juniperinus	Juniper Beard-heath
Leucopogon lanceolatus	Lance-leaf Beard-heath
Leucopogon microphyllus	Small-leaved White-beard
Leucopogon virgatus	A beard-heath
Lindsaea linearis	Screw Fern
Lindsaea microphylla	Lacy Wedge-fern
Lissanthe strigose ssp. *strigosa*	Peach Heath
Lobelia alata	A lobelia
Lomandra confertifolia ssp. *Rubiginosa*	A mat-rush
Lomandra glauca	Pale Mat-rush
Lomandra longifolia	Spiny-headed Mat-rush
Lomandra multiflora	Many-flowered Mat-rush

SCIENTIFIC NAME	COMMON NAME
Lomandra obliqua	Fish Bones
Lomatia ilicifolia	Holly-leaved Lomatia
Lycopodium deuterodensum	Bushy Clubmoss
Macrozamia communis	Burrawang
Melaleuca hypericifolia	A paperbark
Melaleuca thymifolia	Thyme Honey-myrtle
Melaleuca linariifolia	Snow-in-Summer
Melia azedarach	White Cedar
Micromyrtus ciliata	Fringed Heath-myrtle
Mirbelia rubiifolia	-
Microlaena stipoides	Weeping Meadow Grass
Mitrasacme polymorpha	Mitre Weed
Monotoca scoparia	Prickly Broom-heath
Morinda jasminoides	Jasmine Morinda
Notelaea venosa	Mock Olive
Opercularia aspera	Common Stinkweed
Oplismenus aemulus	Basket Grass
Ozothamnus diosmifolium	Everlasting
Pellaea falcata ssp. *falcata*	Sickle Fern
Panicum sp.	A grass
Parsonsia straminea	Common Silkpod
Paspalum dilatatum *	Paspalum *
*Paspalum urvillei**	Vasey Grass*
Passiflora herbertiana ssp. *herbertiana*	A passion flower
Patersonia sericea	Silky Purple Flag
Patersonia glabrata	Leafy Purple Flag
Pennisetum clandestinum *	Kikuyu *
Persoonia levis	Broad-leaved Geebung
Persoonia linearis	Narrow-leaf Geebung
Persoonia mollis	Soft Geebung
Petrophile pedunculata	Conesticks
Petrophile pulchella	Conesticks
Philotheca scabra ssp. *scabra*	A wax-flower
Phyllanthus hirtellus	Thyme Spurge
Phyllota phyllicoides	Common Phyllota
Phytolacca octandra *	Inkweed *
Pimelea linifolia	Slender Rice-flower
Pittosporum revolutum	Rough-fruit Pittosporum

SCIENTIFIC NAME	COMMON NAME
Pittosporum undulatum	Sweet Pittosporum
Platysace lanceolata	Native Parsnip
Platysace linearifolia	Narrow-leaf Platysace
Platylobium formosum	Handsome Flat-pea
Plectranthus graveolens	Netted Cockspur Flower
Pomaderris discolor	A pomaderris
Pomaderris intermedia	A pomaderris
Pomax umbellata	Pomax
Pratia purpurascens	Whiteroot
Prostanthera incana	Velvet Mint-Bush
Pteridium esculentum	Common Bracken
*Pterostylis vernalis (*syn sp. Flat Rock Creek)	Spring Tiny Greenhood
Ptilothrix deusta	A sedge
Pultenaea daphnoides	Large-leaf Bush-pea
Pultenaea elliptica	A bush-pea
Pultenaea retusa	A bush-pea
Pyrrhosia rupestris	Rock Felt Fern
Scaevola ramosissima	Snake-flower
Schoenus imberbis	Beardless Bog-rush
Selaginella uliginosa	Swamp Selaginella
Senecio hispidulus var. *hispidulus*	A groundsel
Senecio linearifolius	Fireweed Groundsel
*Senecio madagascariensis**	Fireweed*
Senna odorata	Southern Cassia
*Setaria geniculata**	Slender Pigeon Grass*
Sigesbeckia orientalis ssp. *orientalis*	Indian-weed
Smilax glyciphylla	Native Sarsaparilla
*Solanum nigrum**	Blackberry Nightshade*
Solanum pungetium	Eastern Nightshade
Spiranthes australis	Austral Ladies Tresses
Stylidium graminifolium	Trigger Plant
Stylidium laricifolium	Giant Trigger Plant
Syncarpia glomulifera	Turpentine
*Taraxacum officinale **	Dandelion *
Telopea speciosissima	Waratah
Themeda australis	Kangaroo Grass
*Thunbergia alata**	Black-eyed Susan*
Thysanotus tuberosus	Fringe Lily

SCIENTIFIC NAME	COMMON NAME
Triplarina nowraensis	Nowra Heath Myrtle
Verbena sp *	A purpletop *
Veronica plebeia	Creeping Speedwell
Viminaria juncea	Golden Spray
Wahlenbergia gracilis	Native Bluebell
Xanthorrhoea resinosa ssp. *Resinosa*	A grass tree
Xanthosia tridentata	Rock Xanthosia
Zieria laevigata ssp. *laevigata*	A zieria
Zieria pilosa	Hairy Zieria
Zieria smithii	Sandfly Zieria

Appendix D: Previous Fauna List

Fauna species recorded in the Mundamia urban expansion investigation area (BES 2004a)

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
Mammals	Agile Antechinus	*Antechinus agilis*	Hair analysis
	Broad-nosed Bat sp.	*Scotorepens sp.*	ANABAT
	Brown Hare*	*Lepus capensis*	Direct observation
	Cat*	*Felis catus*	Direct observation
	Common Brushtail Possum	*Trichosurus vulpecula.*	Hair analysis
	Common Ringtail Possum	*Pseudocheirus peregrinus*	Direct observation
	Chocolate Wattled Bat	*Chalinolobus morio*	ANABAT
	Dog*	*Canis familiaris*	Direct observation
	Domestic Cattle*	*Bos taurus*	Direct observation
	Eastern Bentwing Bat	*Miniopterus schreibersii*	ANABAT
	Eastern Broad-nosed Bat	*Scotorepens orion*	ANABAT
	Eastern Grey Kangaroo	*Macropus giganteus*	Direct observation
	Eastern Horseshoe Bat	*Rhinolophus megaphyllus*	ANABAT
	European Rabbit*	*Oryctolagus cuniculus*	Fox Scat analysis
	Gould's Wattled Bat	*Chalinolobus gouldii*	ANABAT
	Grey-headed Flying-fox	*Pteropus poliocephalus*	Direct observation
	Horse*	*Equus caballus*	Direct observation
	Large Forest Bat	*Vespadelus darlingtoni*	ANABAT
	Little Forest Bat	*Vespadelus vulturnus*	ANABAT
	Long-eared Bat sp.	*Nyctophilus sp.*	ANABAT
	Long-nosed Bandicoot	*Perameles nasuta*	Fox & Dog Scat anaylsis
	Red Fox*	*Vulpes vulpes*	Direct observation
	Sugar Glider	*Petaurus breviceps*	Direct observation
	Swamp Rat	*Rattus lutreolus*	Hair analysis
	Swamp Wallaby	*Wallabia bicolor*	Scat
	White-striped Freetail Bat	*Tadarida australis*	ANABAT
	Yellow-bellied Glider	*Petaurus australis*	Call recognition / Feeding sign
Birds	Australian Magpie	*Gymnorhina tibicen*	Direct observation
	Australian Magpie-lark	*Grallina cyanoleuca*	Direct observation
	Australian Owlet Nightjar	*Aegotheles cristatus*	Call recognition
	Australian Raven	*Corvus coronoides*	Direct observation

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
Birds (cont'd)	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	Direct observation
	Brown Thornbill	*Acanthiza pusilla*	Direct observation
	Common Bronzewing	*Phaps chalcoptera*	Direct observation
	Crimson Rosella	*Platycercus elegans*	Direct observation
	Dollarbird	*Eurystomus orientalis*	Call recognition
	Double-barred Finch	*Taeniopygia bichenovii*	Direct observation
	Dusky Woodswallow	*Artamus caynopterus*	Direct observation
	Eastern Rosella	*Platycercus eximius*	Direct observation
	Eastern Spinebill	*Acanthorhynchus tenuirostris*	Direct observation
	Eastern Whipbird	*Psophodes olivaceus*	Call recognition
	Galah	*Cacatua roseicapilla*	Direct observation
	Gang-gang Cockatoo	*Callocephalon fimbriatum*	Direct observation
	Glossy Black-cockatoo	*Calyptorhynchus lathami*	Feeding signs / call
	Grey Butcherbird	*Cracticus torquatus*	Direct observation
	Grey Fantail	*Rhipidura fuliginosa*	Direct observation
	Grey Shrike-thrush	*Colluricincla harmonica*	Direct observation
	Laughing Kookaburra	*Dacelo novaeguineae*	Direct observation
	Leaden Flycatcher	*Myiagra rubecula*	Direct observation
	Lewin's Honeyeater	*Meliphaga lewinii*	Call recognition
	Little Lorikeet	*Glossopsitta pusilla*	Call recognition
	Masked Lapwing	*Vanellus miles*	Direct observation
	Musk Lorikeet	*Glossopsitta concinna*	Direct observation
	New Holland Honeyeater	*Phylidonyris novaehollandiae*	Direct observation
	Noisy Friarbird	*Philemon corniculatus*	Direct observation
	Peaceful Dove	*Geopelia striata*	Direct observation
	Powerful Owl	*Ninox strenua*	Call recognition / Roost
	Rainbow Lorikeet	*Trichoglossus haemotodus*	Direct observation
	Red Wattlebird	*Anthochaera lunulata*	Direct observation
	Red-browed Finch	*Neochmia temporalis*	Direct observation
	Rock Warbler	*Origma solitaria*	Direct observation
	Rufous Fantail	*Rhipidura rufifrons*	Direct observation
	Rufous Whistler	*Pachycephala rufiventris*	Direct observation
	Sacred Kingfisher	*Todiramphus sanctus*	Direct observation
	Satin Bowerbird	*Ptilonorhynchus violaceus*	Direct observation
	Scarlet Honeyeater	*Myzomela sanguinolenta*	Call recognition
	Southern Boobook Owl	*Ninox novaeseelandiae*	Direct observation
	Spotted Pardalote	*Paradeletus punctatus*	Call recognition
	Square-tailed Kite	*Lophoictinia isura*	Direct observation

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
Birds (cont'd)	Striated Pardalote	*Pardalotus striatus*	Call recognition
	Striated Thornbill	*Acanthiza lineata*	Direct observation
	Sulphur-crested Cockatoo	*Cacatua galerita*	Direct observation
	Superb Fairy Wren	*Malurus cayneus*	Direct observation
	Superb Lyrebird	*Menura alberti*	Digging sign / Call recognition
	Tree Martin	*Ceropis nigricans*	Direct observation
	Variegated Fairy-Wren	*Malurus assimilis*	Direct observation
	White-throated Nightjar	*Eurostopodus mysticlais*	Call recognition
	White-eared Honeyeater	*Lichensotomus ieucotis*	Direct observation
	White-naped Honeyeater	*Melithreptus brevirostris*	Direct observation
	White-throated Treecreeper	*Cormobates leucophrys*	Direct observation
	Willie Wagtail	*Rhipidura leucophrys*	Direct observation
	Wood Duck	*Chenonetta jubata*	Direct observation
	Yellow-faced Honeyeater	*Lichenostomus chycops*	Direst observation
	Yellow-tailed Black Cockatoo	*Calyptorhynchus funereus*	Direct observation
	Yellow-tufted Honeyeater	*Lichenodtomus melanops*	Direct observation
Reptiles	Copper-tailed Skink	*Ctenotus teaniolatus*	Direct observation
	Garden Sun-skink	*Lampropholis delicata*	Direct observation
	Grass Sun-skink	*Lampropholis guichenoti*	Direct observation
	Jacky Lizard	*Amphibolurus muricatus*	Direct observation
	Lace Monitor	*Varanus varius*	Direct observation
	Red-bellied Black Snake	*Pseudechis porphyriacus*	Direct observation
Amphibians	Bleating Tree Frog	*Litoria dentata*	Call recognition
	Common Eastern Froglet	*Crinia signifiera*	Call recognition
	Haswell's Froglet	*Paracrinia haswelli*	Call recognition
	Peron's Tree Frog	*Litoria peronii*	Call recognition
	Striped Marsh Frog	*Limnodynastes peronii*	Call recognition
	Tyler's Toadlet	*Uperoleia tyleri*	Call recognition
	Whistling Tree Frog	*Litoria verreauxii verreauxii*	Call recognition

Appendix E: Assessment of Significance

EP&A ACT ASSESSMENT OF SIGNIFICANCE (7-PART TEST)

The Assessment of Significance (7-part test) is applied to species, populations and ecological communities listed on Schedules 1, 1A and 2 of the TSC Act and Schedules 4, 4A and 5 of the Fisheries Management Act. The assessment sets out 7 factors, which when considered, allow proponents to undertake a qualitative analysis of the likely impacts of an action and to determine whether further assessment is required via a Species Impact Statement (SIS). All factors must be considered and an overall conclusion made based on all factors in combination. An SIS is required if, through application of the 7-part test, an action is considered likely to have a significant impact on a threatened species, population or ecological community.

Threatened species, populations and ecological communities which may be directly or indirectly affected by the current proposal include:

- *Pterostylis vernalis* (Spring Tiny Orchid)
- *Triplarina nowraensis* (Nowra Heath Myrtle)
- Yellow-bellied Glider *(Petaurus australis)*
- Glossy-black Cockatoo (*Calyptorhynchus lathami*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Powerful Owl (*Ninox strenua*)
- Square-tailed Kite (*lophoictinia isura*)
- Grey-headed flying-fox (Pteropus poliocephalus)
- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Little Bentwing Bat (*Miniopterus australis*)
- East Coast Freetail Bat *(Mormopterus norfolkensis)*
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Greater Broadnosed Bat (*Scoteanax rueppellii*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Rosenberg's Goanna (*Varanus rosenbergi)*

***Pterostylis vernalis* (Spring Tiny Orchid)**

The Spring Tiny Greenhood is known from five populations in heath and heathy forests in the Nowra district. Specific habitat is associated open sites on shallow sandy soil and moss gardens around the margins of sandstone sheets and Kunzea Shrubland. One population is in a national park, one is on land zoned for urban development and the other three are on uncommitted crown land. One of the largest known populations occurs approximately 300m west of the subject site.

***Triplarina nowraensis* (Nowra Heath Myrtle)**

There are five known populations of Nowra Heath Myrtle. Three of these form a cluster to the immediate west of Nowra. A fourth, much smaller population is found 18km south-west of Nowra in the Boolijong Creek Valley. The fifth population is located north of the Shoalhaven River on the plateau above Bundanon. Nowra Heath Myrtle occurs on poorly drained, gently sloping sandstone shelves or along creek lines underlain by Nowra Sandstone. The sites are often either treeless or have a very open tree canopy due to the impeded drainage or shallow soils.

Yellow-bellied Glider *(Petaurus australis)*

The Yellow-bellied Glider lives in family groups of up to about 6 individuals, occupying large permanent home ranges in coastal forest. The species has specific resource requirements of suitable sized tree hollows, winter flowering *Eucalypts* to provide nectar, pollen, sap and trees with loose, shedding bark for foraging a range of insect prey. Additionally, honeydew, manna and occasionally *Acacia* gum are used. The species glides between trees rarely coming to the ground, and will occupy large home ranges of 20 to 85 ha, which comprises of a number of den trees.

Glossy Black-cockatoo *(Calyptorhynchus lathami)*

The Glossy-black cockatoo is associated with a variety of forest types containing *Allocasuarina* species, usually reflecting the poor nutrient status of underlying soils. Intact drier forest types with less rugged landscapes are preferred. The species forages primarily on the fruit of selected mature *Allocasuarina* species. The Glossy-black cockatoo nests in large trees and requires large hollows for breeding.

Gang-gang Cockatoo (*Callocephalon fimbriatum*)

The Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee.

In summer, the Gang-gang often occupies tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, individuals may move to lower altitudes in drier more open eucalypt forests and woodlands, and can also often be found in urban areas. However, the species is known to occur in coastal environments throughout the year, breeding in spring and summer. The species favours old growth attributes for nesting and is dependent on tree hollows in relative large trees. The seeds of *Eucalypts* and *Acacias* comprise much of the Gang-gang cockatoo's diet, which also includes introduced seed-bearing shrubs and trees.

Powerful Owl (*Ninox strenua)*

The Powerful Owl occurs at low densities in coastal and tableland forest and woodland. It requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense canopied trees. The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. As most prey species require hollows and a shrub layer, these are important habitat components for the owl. The Powerful Owl occupies large, permanent home ranges (400 – 1450 ha) supporting large trees with hollows for nesting.

Square-tailed Kite (*Lophoictinia isura)*

The Square-tailed Kite is a seasonal, breeding migrant in the Shoalhaven, arriving in Spring and leaving in Autumn. It breeds in mature live trees, often near water and hunts for prey over vast areas of forested lands. The species is a specialist hunter of passerines and insects, picking most prey items from the outer foliage of the canopy. It routinely hunts in the mornings, afternoons and evenings. In the Shoalhaven, the breeding season occurs between August and November with nests built in forks or along large horizontal limbs of mature trees. Nests may be re-used over subsequent years.

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

The Grey-headed Flying fox is a nectarivore and frugivore, reliant on seasonably reliable and continuous nectar. Nectar and pollen from the flowers of Eucalypts (genera *Eucalyptus, Corymbia* and *Angophora*), *Melaleucas* and *Banksias* and primarily rainforest fruits are the primary food for the species (Duncan et al. 1999).

The Grey-headed Flying-fox, particularly lactating females, has been recorded feeding on introduced flowers and fruits (eg orchards), which has been attributed to poor production of native forage resources. The Grey-headed Flying-fox is a nomadic species, following fruiting seasons, with only a small portion being sedentary. The Grey-headed Flying fox has been reported migrating hundreds of kilometres.

During nocturnal activities, the grey headed flying fox travels long distances (i.e. generally within 20 km but sometimes 50 km) between roosts and foraging areas. Roost selection in the Grey-headed Flying-fox is poorly understood, though they mostly occur proximate to a watercourse with the dominant vegetation usually being rainforest, wet sclerophyll, *Melaleucas*, *Casuarinas* or mangroves.

Microchiropterans

- **Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)**
- **Little Bentwing Bat (*Miniopterus australis*)**
- **East Coast Freetail Bat *(Mormopterus norfolkensis)***
- **Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)**
- **Greater Broadnosed Bat (*Scoteanax rueppellii*)**
- **Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)**

- **Large-eared Pied Bat (*Chalinolobus dwyeri*)**

These bat species are assessed collectively for the purposes of this report, as their broad habitat requirements are similar. All forage for invertebrates in and around forested areas, including disturbed sites. Apart from the Eastern Bentwing Bat, Little Bentwing Bat and Large-eared Pied Bat, which roost primarily in caves, the other bats primarily roost in tree hollows.

Rosenberg's Goanna (*Varanus rosenbergi)*

The Rosenberg's Goanna (also known as the Heath Monitor) occupies large home ranges in woodland, heath and open forest communities and forages on a range of smaller fauna and carrion. Rocks, hollow logs and burrows are utilised for shelter and terrestrial termitaria are required for reproduction. There are few records in the locality, although one is from the West Nowra area. Most records in the Shoalhaven are in woodland and heath habitats further to the south west.

Part 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

***Pterostylis vernalis* (Spring Tiny Orchid)**

Pterostylis vernalis does not occur within the subject site, but its proximity to the site and potentially sensitive habitat makes it susceptible to indirect impacts from the development. The species is known to occur within 300 m to the west and south east of the site. Potentially suitable habitat (Kunzea Shrubland) also occurs within similar distances to the north and north-west of the site. These areas have not been comprehensively surveyed for the species, so the full extent of its occurrence in the Mundamia area is not known. Populations of the species are small and appear restricted to preferred microhabitats, which are often associated with Kunzea Shrubland fringes.

There is potential for the species to be indirectly affected by the proposal by polluted stormwater runoff, changes to groundwater quality or flow regimes, weed invasion, altered fire regimes and other disturbances resulting from the establishment of a new residential area. While there are inherent risks to populations of the species posed by the development, there are also reasonably sized buffers of native vegetation between the development and orchid habitat, and the potential for indirect impacts to be effectively managed and controlled.

The proposal needs to be designed to minimise adverse hydrological impacts to surrounding habitats and incorporate measures to protect nearby habitats of conservation significance from the indirect impacts of a new residential centre.

Provided that the development can incorporate effective strategies to manage the range of indirect impacts likely to be associated with it, the proposal is unlikely to have an adverse effect on the life cycle of this species, such that a viable local population would be placed at the risk of extinction.

***Triplarina nowraensis* (Nowra Heath Myrtle)**

Triparina nowraensis has not been recorded from the current study area (despite targeted surveys by BES (2004a)), and no suitable occurs there. It has, however, been recorded in substantial numbers around the periphery of the Mundamia urban land release area (BES 2004a). The species is known to occur approximately 50 m from the northern boundary of the subject site, and about 250 m to the west of the site.

The proposal will have no direct impact on the species and will generally maintain substantial vegetated buffers (>50 m) to known occurrences. However, there is potential for the species to be indirectly affected by the proposal by polluted stormwater runoff, changes to groundwater quality or flow regimes, weed invasion, altered fire regimes and other disturbances resulting from an increased human population. The proposal needs to be designed to minimise adverse hydrological impacts to surrounding habitats and incorporate measures to protect nearby habitats of conservation significance from the indirect affects of a new residential centre.

With the above measures, and considering the relatively large numbers of plants that would constitute the viable local population of the Mundamia study area, the proposal is unlikely to have an adverse effect on the life cycle of this species, such that a viable local population would be placed at the risk of extinction.

Yellow-bellied Glider

The north of the study area provides some foraging resources for the Yellow-bellied Glider, and possible denning resources in larger hollow-bearing trees. The species is known to occur in the Mundamia area, with BES (2004a) recording 98 incised feed trees, mainly around the periphery of the Mundamia urban release area. No incised feed trees were located within the current study area by BES or ELA. On one occasion, BES (2004a) heard one Yellow-bellied Glider from the northern edge of the current study area, close to Jonsson Road, which indicates the species may use the more intact northern parts of the study area for at least foraging. The Yellow-bellied Glider was not recorded in the study area during targeted surveys by ELA, but was heard calling to the north of Jonsson Road.

Surveys suggest that the study area may be used by the Yellow-bellied Glider on occasions for foraging, but does not represent good quality habitat. Of the 39 hollow-bearing trees recorded in the study area, only a very low number would be potentially suitable for use by the glider, and no evidence of den tree use has been recorded in the study area. The heavily disturbed subject site contains only marginal habitat for the species and it is unlikely to use the site given the much higher quality habitat in the area.

The proposal is not expected to remove anything but marginal or unsuitable habitat for the Yellow-bellied Glider and the species is known to persist in close proximity to residential areas. 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 would be placed at the risk of extinction.

Glossy Black-cockatoo

The study area provides foraging habitat for the Glossy Black-cockatoo, with 12 feed-trees (Black She-oaks) showing evidence of feeding by the species (BES 2004a). Recent feeding evidence was noted under a few of the feed-trees during ELA fieldwork. Black She-oaks are scattered through the study area and surrounding landscape. BES (2004a) recorded a total of 53 Glossy Black-cockatoo feed-trees in the Mundmaia urban land release area.

Few of the hollow-bearing trees in the study area would be suitable as nest sites for the species, and none are considered high quality or likely nesting resources. Targeted nesting assessments by BES (2004a) found no evidence of Glossy Black-cockatoo nesting in the current study area or the surrounding Mundamia urban land release area. The species is not expected to use the study area for nesting.

The proposal is likely to remove approximately 10 Glossy Black-cockatoo feed-trees, along with scattered Black She-Oak trees within the development footprint and 11 hollow-bearing trees that are very unlikely nesting resources for the species. Given the very large home range of the species, its high mobility and extent of suitable and better quality habitat in the surrounding landscape, the proposal is unlikely to have an adverse effect on the life cycle of this species such that a viable local population would be placed at the risk of extinction.

Gang-gang Cockatoo

The study area provides potential foraging habitat for the Gang-gang Cockatoo through the seeds of eucalypt and large wattles. A few of the hollow-bearing trees may provide potential, although unlikely, nesting resources. The species is known from the general area, but prefers taller forest habitats. The Gang-gang Cockatoo has not been recorded in the current study area by BES (2004a) or during recent nesting assessments by ELA. While the species could forage in the study area on occasions, the habitats there are of lower quality or marginal for this species.

The proposal would remove a relatively small area of marginal foraging habitat and a few tree hollows that provide very unlikely nesting resources for the species. It is unlikely that the proposal will have an adverse effect on the life cycle of this species such that a viable local population of the species would be placed at the risk of extinction.

Powerful Owl

The study area contains some low quality foraging habitat for the Powerful Owl, but no suitable roosting or breeding habitat. While the species is known from the Mundamia area, it has never been recorded from the current study area and is unlikely to occur there apart from possibly using the site for occasional foraging as part of a much larger home range.

The proposal would remove around one hectare of relatively low quality potential foraging habitat and is very unlikely to have an adverse effect on the life cycle of this species such that a viable local population of the species would be placed at the risk of extinction.

Square-tailed Kite

The study area contains potential foraging habitat for the Square-tailed Kite, mainly in the north where vegetation is relatively intact, but no potential nesting habitat. The species was observed foraging in the Mundamia area by BES (2004a), but has not been recorded in the current study area. As the generalised foraging habitat is common and widespread in the locality and the species forages over a very large area, the proposal will not have an adverse effect on the life cycle of this species such that a viable local population of the species would be placed at the risk of extinction.

Microchiropterans

The study area provides some potential foraging habitat for a range of threatened insectivorous bat species, including the Eastern Bent-wing Bat, Little Bentwing Bat, East Coast Freetail Bat, Eastern False Pipistrelle and Greater Broadnosed Bat, Yellow-bellied Sheathtail-bat and Large-eared Pied Bat. All of these species could forage in and around the site from time to time. The subject site does not provide optimal foraging habitat due to the extent of previous disturbances within and around the site Some of the 39 hollow-bearing trees in the study area could provide roosting resources for hollow-dependant species, although no evidence of bat roosting was found during targeted stagwatching and echolocation recording surveys by BES (2004a) or ELA.

The proposal would remove sub-optimal to marginal foraging resources for these species and up to 39 trees containing hollows. Given the apparent infrequent use of the study area by these species, the sub-optimal to marginal foraging and roosting habitat within the subject site, the extent of higher quality resources in the surrounding area, the mobility and large home range of these species, the impacts of the proposal on these species is expected to be minor or negligible.

The proposal is unlikely to have an adverse effect on the life cycle of these bat species (i.e. impacts on breeding habitat) such that a viable local population would be placed at the risk of extinction.

Grey-headed Flying-fox

The study area provides suitable foraging habitat for the species in the larger eucalypt trees and banksias, although this habitat is far from optimal given its structure, species composition and disturbance history. The study area contains no suitably roosting resources. The species is known from the area and occurs throughout the region. It has not been recorded in the study area by BES (2004a) or during recent surveys by ELA, suggesting that there are no important foraging resources in the study area.

The species may pass through the study area and forage there on occasions, although the removal of a relatively small area of marginal foraging habitat is considered a negligible impact to this species. The proposal is very unlikely to have an adverse effect on the life cycle of the Grey-headed Flying-fox such that a viable local population of the species would be placed at the risk of extinction.

Rosenberg's Goanna (Heath Monitor)

The study area provides relatively low quality habitat for Rosenberg's Goanna, given the previous disturbances, lack of sheltering resources and obvious foraging opportunities. Very few terrestrial termite mounds (termitaria), which provide potential breeding resources, were observed in the study area, and were generally located in the north beyond the subject site.

The species is not known from the Mundamia urban land release area, although it has been recorded in the vicinity to the south west. Targeted trapping, remote camera and opportunistic surveys in the Mundamia area by BES (2004a) and ELA have failed to record the species, but regularly recorded the Lace Monitor, on several occasions within the current study area.

While Rosenberg's Goanna could conceivably occur in the study area, it is unlikely to do so on a regular basis given the lower habitat quality and lack of sightings in surrounding areas. The study area does not provide an obvious corridor or habitat linkage and few termitaria would be removed by the proposal. The species has some potential to be indirectly affected by the proposal, for example by an increase in

vehicle numbers that could lead to an increase in road kills. However, surveys results, records of the species in the locality, the relatively poor quality of habitat in the study area and the distribution of better quality habitat in surrounding areas suggests that road kills and other indirect impacts are unlikely to substantially affect the species.

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

Part 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 listed in *Schedule 1 - Part 2* of the *Threatened Species Conservation Act 1995*, are found in or near the study area.

Part c)

In the case of an 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 of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

No endangered ecological communities were identified in the study area or are likely to be affected by the proposal.

Part d)

In relation to the habitat of a threatened species, population 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.*

(i) The proposal will remove or modify approximately 4.27 ha of Scribbly Gum – Bloodwood Woodland and 8.09 ha of severely disturbed regenerating woodland, including 38 hollow-bearing trees and 10 Glossy Black-cockatoo feed trees. It is possible that nearby habitat of *Triplarina nowraensis* and *Pterostylis vernalis* could be indirectly affected by surface runoff, changed groundwater conditions, weeds and/or increased human disturbance.

(ii) The study area is already fragmented from other habitats by roads, power easements and past clearing. The proposal will result in some further reduction of connectivity through the general area although much of the subject site and surrounding areas have already been subjected to extensive clearing and other disturbances. The proposal will not isolate any areas of habitat.

(iii) Due to previous disturbances, reduced habitat quality and the relatively small area of habitat to be removed, the subject site is unlikely to provide important habitat for any species considered in this assessment. For threatened fauna,, the subject site appears to constitute at best occasional foraging or sheltering habitat, both of which are widespread in surrounding areas. The proposal will not affect habitat important for the long-term survival of any threatened fauna species in the locality. The likely extent of indirect impacts on habitat for *Triplarina nowraenis* and *Pterostylis vernalis* is less clear, but given that these species have very restricted distributions and are known from a low number of sites, all habitat where they occur in substantial numbers may be important for their survival in the locality. However, effectively mitigating adverse indirect impacts to these species is considered achievable.

Part e)

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

No areas listed as critical habitat under the TSC Act occur in the study area, therefore the action proposed will not adversely affect critical habitat.

Part f)

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

Recovery plans have been produced for the Yellow-bellied Glider (NPWS 2003a), Powerful Owl (DEC 2006a), Large-eared Pied Bat (DERM 2011) and *Triplarina nowraensis* (OEH 2011). A draft recovery plan has been prepared for the Grey-headed Flying-fox (DECCW 2009)

Recovery plans have not been formulated for other species considered, however, DECCW have detailed a number of priority actions to help recover these species.

The above recovery plans and priority actions have been reviewed. The proposal is considered consistent with objectives and actions for threatened fauna species, as it will involve the removal of generally marginal foraging and sheltering habitat from an area which is been subject to substantial disturbances.. Previous flora and fauna surveys have identified the proposal area as one of the least valuable areas to threatened species in the wider Mundamia area.

For the threatened flora species *Triplarina nowraensis*, the proposal will be consistent with the recovery plan provided that measures are taken to effectively mitigate indirect impacts, including changes to groundwater and surface water quality and quantity, weed invasion, increased fire frequencies and direct human disturbance.

Part 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 will remove around 4.3 ha of Scribbly Gum – Bloodwood Woodland and up to 8.1 ha of highly disturbed regenerating (predominantly native) vegetation, which constitutes the Key Threatening

Process '*Clearing of native vegetation'*. The native vegetation to be removed is among the most disturbed in the Mundamia area. Previous quarrying operations have severely limited the regeneration potential of the subject site. The contribution to this key threatening process is relatively minor considering the large extent of Scribbly Gum - Bloodwood Woodland in the area and the poor condition of much of the vegetation to be removed.

The proposal will also result in the removal of some dead wood and 38 hollow-bearing trees, which is consistent with the Key Threatening Process: '*Removal of dead wood and dead trees'* and '*Loss of hollow-bearing trees'.* The hollow-bearing trees to be removed are smaller woodland trees of relatively low quality compared to those in the surrounding landscape, and occur within and adjacent to heavily disturbed areas. No fauna species of conservation significance were recorded using these trees or are expected to regularly use the hollow-bearing trees to be removed. A further 216 hollow-bearing trees were recorded in the surrounding area (BES 2004a).

The proposal could result in the introduction of invasive grasses and subsequent spread of these grasses into nearby native vegetation, constituting the Key Threatening Process: '*Invasion of native plant communities by exotic perennial grasses'.* However, restrictions on planting of exotic grasses and the ongoing monitoring and management of weeds in areas of native vegetation adjoining the proposal, as recommended in Section 5, is expected to effectively mitigate this key threatening process.

Conclusion

The proposal is located in and adjacent to areas of severe historic disturbances, which limit the value of the subject site for threatened flora and flora species. The direct impacts of the proposal on threatened species are minimal. No endangered populations or ecological communities occur in or near the study area. However, beyond the subject site are species and habitats of considerable conservation value, primarily for the threatened plants *Triplarina nowraensis* and *Pterostylis vernalis,* which are susceptible to indirect impacts from the proposal. These indirect impacts need to be addressed and controlled, with additional protection given to nearby areas containing these species or suitable habitat for these species. Provided that measures to mitigate and manage the indirect impacts of the proposal are applied, as recommended in Section 5, it is unlikely that the proposal will result in significant impacts to any threatened species.

On the basis of the above, a Species Impact Statement is therefore not required for the proposal.

EPBC ACT SIGNIFICANT IMPACT CRITERIA ON COMMONWEALTH THREATENED AND MIGRATORY SPECIES

The EPBC Act Administrative Guidelines on Significance set out **'Significant Impact Criteria'** that are to be used to assist in determining whether a proposed action is likely to have a significant impact on matters of national environmental significance. Matters listed under the EPBC Act as being of national environmental significance include:

- Listed threatened species and ecological communities
- Listed migratory species
- Wetlands of International Importance
- The Commonwealth marine environment
- World Heritage properties
- National Heritage places
- Nuclear actions
- Great Barrier Reef

Specific **'Significant Impact Criteria'** are provided for each matter of national environmental significance except for threatened species and ecological communities in which case separate criteria are provided for species listed as endangered and vulnerable under the EPBC Act.

Threatened and migratory species listed under the EPBC Act with potential to occur within the study area or otherwise be affected by the proposal are given in Appendix B of the Report. The relevant Significant Impact Criteria have been applied to these threatened and migratory species to determine the significance of impact of the project.

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
(a) any environmental impact on a World Heritage Property;	No
(b) any environmental impact on Wetlands of International Importance;	The proposal will not affect any part of a RAMSAR wetland.
(c) any impact on Commonwealth Listed Critically Endangered or Endangered Species;	Yes. Two Commonwealth listed plants *Triplarina nowraensis* and *Pterostylis vernalis (P.* sp. Flat Rock Creek) have the potential to be indirectly affected by the proposal. An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will: • lead to a long-term decrease in the size of a population: - Possibly, if the subdivision results in the reduced quality or other adverse changes to groundwater flows or stormwater runoff. However, the implementation of adequate mitigation measures and monitoring should be able to avoid adverse indirect impacts.

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
	• reduce the area of occupancy of the species: - The action will not directly affect the habitat of these species, so will not reduce the area of occupancy. • fragment an existing population into two or more populations: - The action will not fragment populations of either species. • adversely affect habitat critical to the survival of a species - Possibly – for *Pterostylis,* if groundwater quality or hydrological regimes are adversely changed. However, the implementation of adequate mitigation measures and monitoring should be able to avoid adverse indirect impacts. • disrupt the breeding cycle of a population: - Possibly, *Pterostylis* and *Triplarina* seedlings may be adversely affected by increased nutrient levels and other hydrological changes. • modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline: - Possibly, if groundwater quality or hydrological regimes are adversely changed and effective measures are not implemented to protect against edge effects and an increased human population. However, the implementation of adequate mitigation measures and monitoring should be able to avoid adverse indirect impacts. • result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat: - Unlikely, provided that surface runoff and introduced plant species resulting from the proposal can be adequately controlled. • introduce disease that may cause the species to decline: - Unlikely • interfere with the recovery of the species: - Possibly, if indirect impacts degrade habitat or reduce population sizes.
(d) any impact on Commonwealth Listed vulnerable Species;	Yes. Two Commonwealth listed vulnerable species have the potential occur in the study area: • Grey-headed Flying-Fox (*Pteropus poliocephalus*) • Large-eared Pied Bat (*Chalinolobus dwyeri)* The study area contains potential foraging habitat for these species and the proposal will remove a relatively small amount of already disturbed habitat. The impacts to these species caused by the proposal are minimal and these species are not expected to be adversely affected by the proposal.
(e) any environmental impact on Commonwealth Listed Migratory Species;	No. Commonwealth Listed Migratory Species are not expected to occur within the study area or be adversely affected by the proposal.
(f) does any part of the Proposal involve a Nuclear Action;	No. The project does not include a Nuclear Action.
(g) any environmental impact on a Commonwealth Marine Area;	No. There are no Commonwealth Marine Areas within the study area.

MATTERS TO BE ADDRESSED	IMPACT (COMMONWEALTH LEGISLATION)
(h) In addition, any direct or indirect impact on Commonwealth lands	No. The project does not directly or indirectly affect Commonwealth land.

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