Environmental

Services

Flora and Fauna Assessment

Proposed Mixed Use, Residential, Commercial & Recreational Development (Stages 2, 3 and 5)
Lot 1 DP 1045990 Princes Hwy
Dolphin Point
Shoalhaven

October 2006

Our Reference: 04670 & 6185

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Lot 1 DP 1045990 Princes Highway

Dolphin Point

City of Shoalhaven

Prepared October 2006

for

Elderslie Property Investments Pty Ltd

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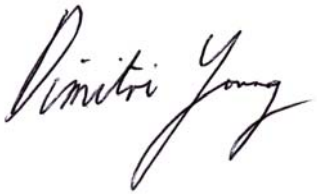
Approved by	 Dimitri Young **Manager** **Environmental Services Division**
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EXECUTIVE SUMMARY

This report has identified and described the biological environment of Lot 1 DP 1045990 Princes Highway, Dolphin Point (Stages 2, 3 and 5). The report has assessed the potential impacts on flora and fauna, including threatened and migratory species, endangered populations and threatened communities, or their habitats, of the proposal to undertake a residential subdivision on the property. It has focused on the areas identified as Stages 2 and 3 and given preliminary consideration to Stage 5, which is only in the conceptual planning phase at present.

The development application will be assessed pursuant to Part 3A of the *NSW Environmental Planning and Assessment Act 1979* (*EP&A Act*) and will be determined by the Minister for Planning, so the Director General's Environmental Assessment Requirements pertaining to flora and waterways were considered in preparing this report.

The existing environment was described in detail from a literature review and from data gathered during fieldwork between September 2005 and August 2006. Flora and fauna surveys resulted in the detection of 92 flora species and 51 fauna species. Two vegetation communities, Introduced Grassland, and Paperbark Shrubland dominate areas identified as Stages 2 and 3 with small areas of Bangalay Swamp Forest, Kunzea Shrubland and Spotted Gum-Blackbutt Forest occurring in the east and north-east of the Stage 2 and 3 areas. The vegetation in the Stage 5 area comprises a mosaic of Swamp Oak Forest, Bangalay Swamp Forest, Paperbark Shrubland and Coastal Saltmarsh in low-lying areas with open forests dominated by Spotted Gum, Blackbutt and Bangalay at higher elevations.

Surveys targeting threatened species resulted in the detection of one threatened species, the Glossy Black-cockatoo listed as Vulnerable on the schedules of the *NSW Threatened Species Conservation Act 1995.* In addition, the Paperbark Shrubland and Bangalay Swamp Forest within the areas identified as Stages 2 and 3 were determined to comprise the endangered ecological community *Swamp sclerophyll forest on the coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* as listed on the *NSW Threatened Species Conservation Act 1995.* No other threatened species, endangered populations or threatened ecological communities listed on the *NSW Threatened Species Conservation Act 1995*, the *NSW Fisheries Management Act 1994*, or the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* were recorded within the areas identified as Stages 2 and 3 during the survey period.

The proposal will involve the clearing or disturbance of approximately 0.92 ha of heavily disturbed native vegetation and the proposal includes a range of measures to mitigate impacts on flora and fauna.

An assessment pursuant to *NSW State Environmental Planning Policy No 44 – Koala Habitat Protection* was carried out, which concluded that the study area did not contain potential or core Koala habitat and that a Plan of Management for Koala habitat was not required.

The impacts of the proposal on threatened species, endangered populations, threatened ecological communities, and migratory species listed on the *Commonwealth Environment Protection & Biodiversity Conservation Act 1999* were assessed under the administrative guidelines produced by Environment Australia. This assessment concluded that there would not be a significant impact on matters of national environmental significance resulting from the proposal, and that a referral to the Commonwealth Environment Minister is not required

The key biodiversity conservation issue associated with the proposal was identified as the endangered ecological community *Swamp sclerophyll forest on the coastal floodplains of the North Coast, Sydney Basin and South East Corner bioregions* and appropriate impact mitigation and offsets for this community are recommended to be incorporated into the proposal.

The extent, magnitude and significance of the impacts of the proposal on threatened species, populations and ecological communities listed on the *TSC Act* and *FM Act* were assessed in accordance with the Draft Guidelines for Threatened Species Assessment (Department of Environment and Conservation, Department of Planning, 2005) in the context of the proposed impact mitigation measures and offsets and it was concluded that the proposal:

- will maintain or improve biodiversity values;
- is unlikely to reduce the long-term viability of local populations of threatened species, populations or ecological communities;
- is unlikely to accelerate the extinction of threatened species, populations or ecological communities; and
- will not affect critical habitat.

1. INTRODUCTION

1.1 Background

This report has been prepared by Bushfire and Environmental Services (BES) at the request of Rygate and West on behalf of Elderslie Property Investments Pty Ltd, in support of Major Project Application (MP 05_0016) for a Mixed-use Residential, Commercial and Recreational Development at Lot 1 DP 1045990 Princess Highway, Dolphin Point, hereafter referred to as Lot 1, to assess the impacts of the development on flora, fauna and habitats. The application will be determined by the Department of Planning (DOP) pursuant to Part 3A of the *Environmental Planning and Assessment Act 1979 (EP&A Act)*.

Lot 1 comprises approximately 28 ha of freehold land located to the west of the village of Dolphin Point, about 4 km south of Ulladulla (Figure 1, Appendix A). It adjoins Barnunj State Conservation Area in the west and south, freehold land zoned for residential uses in the east, and the Princes Highway and Dolphin Point Road in the north.

Lot 1 has been a rural holding with a history of agricultural uses and is generally undulating with pockets of remnant vegetation along some of the existing drainage lines. It has moderate grades and generally drains to an existing dam located centrally and thence to Burrill Lake.

The proposed development of Lot 1 has been divided into three stages with Stage 1 now completed. The subject of this report, Stages 2 and 3, comprise an area of approximately 15 ha and 5 ha respectively, located in the south and west of the holding. Stage 5 in the north-east is given preliminary consideration in this report as the planning for this part of the land is only within a conceptual stage at this point in time.

This report is the outcome of flora and fauna survey work and desktop analyses undertaken by BES during September and October 2005, and March and August 2006.

1.2 The Proposal

1.2.1 Description

Stage 2 of the proposal involves the subdivision of the southern section of Lot 1 to create 135 residential allotments and the provision of associated infrastructure including roads, drainage, landscaping and services, as shown in Figure 2 (Appendix A). Stage 3 in the west will require a rezoning of the land by Shoalhaven City Council before the DOP can give further consideration to the subdivision of the land, which is anticipated to yield 25 residential allotments.

Stage 5 of the proposal involves the provision of recreational structures in the north-east of Lot 1 and the potential future development of parts of the land for more intensive uses generally in accordance with the Urban Design Review prepared by Urbis JHD (2006).

Construction of the proposal will involve the clearing of some remnant vegetation on Lot 1, particularly in the east of the Stage 2 area and the south of the Stage 3 area, and the excavation of the land for the construction of roads, drainage and connection of services. Sewer connection to Stage 2 is proposed from the north through the Stage 5 area adjacent to an existing water quality control pond to minimise removal of native vegetation.

According to Patterson Britten (2006) the proposal has incorporated the principles of Water Sensitive Urban Design (WSUD) and Ecologically Sustainable Development (ESD) in response to the requirements of Shoalhaven City Council and the Department of Natural Resources regarding best management practice for stormwater management.

The development has therefore been designed with a water management strategy that incorporates stormwater detention (to reduce localised peak runoff flow rates), on-site retention/reuse (to reduce runoff volumes) and pollutant removal devices (to reduce pollutant load export).

Stormwater flows will be returned to the watercourse in the west and to the floodplain vegetation in the east via a stormwater drainage system designed to mimic current flow rates, frequencies and volumes. The proposal will improve water quality for flows leaving the site via the pollutant removal devices, which will reduce the pollutant loads resulting from current agricultural uses.

1.2.2 Direct and Indirect Impacts

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

a) Removal of some existing native vegetation for roads and lots in the east and for roads and creek crossings in the west;

b) Excavation of earth material associated with the construction of creek crossings in the west, and roads, drainage and service connections throughout the remainder of the subdivision;

c) Compaction and covering of the soil within all areas to be bitumen sealed and in the locations where drainage and services will be buried; and

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

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

a) Changes to the hydrology of downstream vegetation and habitats arising from the concentration and redirection of stormwater flows;

b) Increased potential for discharges of sediments into downstream vegetation and habitats during construction of the subdivision;

c) Increased potential for discharges of nutrients into downstream vegetation and habitats arising from future residential uses in the subdivision;

d) Increased potential for disturbances to the adjoining conservation reserve arising from the intensification of land uses associated with the subdivision, including unauthorised vehicular access and the dumping of waste; and

e) Increased potential for predation of native fauna in the adjoining conservation reserve arising from the keeping of domestic pets by future residents of the subdivision.

1.3 Study Area and Locality

The study area for the purposes of this report comprises the parts of Lot 1 identified as Stages 2 and 3 as shown in Figure 2 (Appendix A).

Stage 5 was not investigated in detail for the purposes of this report, but vegetation community mapping was undertaken there.

The study area is bounded by Barnunj State Conservation Area in the south and west, freehold land zoned for residential purposes in the east, an existing residential subdivision in the north-west, and Stage 5 in the north and north-east.

The locality for the purposes of this report is defined as the land within an area of 10 km x 10 km centred on the study area.

1.4 Aim and Objectives

The aim of this investigation was to assess the ecological impacts of the proposal on the flora, fauna and habitats of the study area, with particular attention to species and communities of conservation significance.

The objectives of this investigation were:

a) to identify and describe the flora species and vegetation communities present in the study area and their conservation importance;

b) to identify and describe the fauna habitats present in the study area and their condition;

c) to identify the fauna species which are present or likely to occur in the study area and their conservation importance;

d) to evaluate and assess the magnitude, extent and significance of the impacts associated with the proposal in the context of the conservation importance of the flora, fauna, habitats and other environmental features to be affected;

e) to describe and justify measures to avoid, mitigate and/or offset any adverse effects of the proposal on flora, fauna, habitats and other environmental features of conservation importance;

f) to demonstrate and justify how the proposal meets the key thresholds identified in the Draft Guidelines For Threatened Species Assessment (Department of Environment and Conservation - Department of Primary Industries, 2005);

g) to address the Environmental Assessment Requirements of the Director-General of the DOP regarding flora and fauna issues; and

h) to make recommendations regarding any environmental management, offset and impact mitigation/amelioration measures, which can be implemented to limit the impacts of the proposal on vegetation, fauna, habitats, and other environmental features as necessary.

1.5 Environmental Assessment Requirements

A Major Project Application (05_0016) has been lodged with the DOP for a Concept Plan for Stages 2, 3 and 5 and a concurrent Project Application for Stages 2 and 3, and various issues pertaining to flora and fauna have been raised in correspondence from the department dated 7 July 2006, which sets out the Director General's Environmental Assessment Requirements pursuant to Section 75F(2) of the *EP&A Act*.

Consequently, the following flora and fauna issues raised by the DOP will be addressed by this report:

a) Impacts on Waterways and Estuary Management
   - Provision of native vegetation riparian zones adjacent to watercourses or wetlands (and) development of management strategies and actions……to protect the Dolphin Point wetland and maintenance (sic) of vegetative buffers and sensitive habitats.

b) Impacts on Threatened Species and Corridors
   - Provide a Flora and Fauna study to address the indirect impacts of the development on threatened species and their habitats, such as the threatened orchid (*Cryptostylis hunteriana*).

1.6 Certification

The contents of this report are certified by Dimitri Young, Manager – Environmental Services Division of BES, to comply with the *Draft Guidelines for Threatened Species Assessment* (Department of Environment and Conservation - Department of Primary Industries 2005) and with the *Draft Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities* (Department of Environment and Conservation 2004).

2. METHODOLOGY

2.1 Review of Existing Data

A review of relevant existing data was undertaken prior to the commencement of field studies, which involved:

a) reviewing available literature including relevant flora and fauna studies, legislation, environmental planning instruments, topographic maps, and aerial photographs of the subject site and study area;

b) searching the Atlas of NSW Wildlife for threatened flora and threatened fauna species recorded in the locality; and

c) searching the Commonwealth Environment Protection & Biodiversity Conservation Act Protected Matters Search Tool for matters of national environmental significance recorded in the locality.

The data gathered during the field inspection and from the review of literature were analysed and interpreted in accordance with the provisions of legislation and planning controls pertaining to flora and fauna.

2.2 Flora Survey Methods

A detailed botanical survey was conducted by BES in the study area on 7 September and 7 October 2005 in the locations shown in Figure 2 (Appendix A). Preliminary botanical investigations were undertaken in the Stage 5 area on 1 August 2006.

Community Identification and Floristic Audit

The Random Meander technique documented by Cropper (1993) was used across the study area, to document the flora species present, including those of conservation significance, and the location and extent of vegetation communities.

Vegetation survey sheets were completed for each native vegetation community within the parts of the study area identified as Stages 2 and 3. The vegetation was surveyed at all levels present: the canopy (trees), middle canopy (trees), understorey (shrubs), and groundcover plants (plants less then one metre in height). An abundance score was assigned to each species recorded. Dominant species and the projected foliage cover of each stratum were recorded at locations that typified the vegetation communities. A general description of the vegetation was then prepared based on structural characteristics and dominant canopy species in accordance with Walker and Hopkins (1990) and Specht (1970). These techniques were used to classify and name the vegetation communities in the study area and immediate surrounds.

Random meander was used across the Stage 5 area to provide an indicative map of vegetation communities. Detailed floristic data were not collected for this part of Lot 1.

The vegetation communities identified in the study area and the Stage 5 area were compared with the Final Determinations of the NSW Scientific Committee to ascertain whether the communities comprised listed threatened ecological communities.

Limitations

The floristic audit undertaken recorded as many species as possible and provides a comprehensive but not definitive species list. More species would probably be recorded during a longer survey over various seasons.

Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to assess the impacts of the proposal on the flora species and vegetation communities found within the study area.

Nomenclature

Most of the plant species names in this report are the current names published in the Flora of NSW (Harden 1990-2000). The taxonomic names have been supplemented with common names obtained from various sources. The scientific and conservation significance of individual plant species was established with reference to Briggs and Leigh (1996) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* in the national context, and to the *NSW Threatened Species Conservation Act 1995* in the state context.

Flora Survey Effort

The flora survey effort employed a total of 8.34 person-hours as documented in Table 1.

Table 1: Flora survey effort employed over the study area and surrounds

DATE	METHOD	EFFORT	TARGET SPECIES
7 September 2005	Random meander	1.67 person-hours	All flora species
7 October 2005	Vegetation plots and mapping	5 person-hours	All flora species
1 August 2006	Random meander and mapping	1.67 person-hours	All flora species
TOTAL FLORA SURVEY EFFORT		**8.34 PERSON-HOURS**	

2.3 Fauna Survey Methods

Detailed field investigations for fauna were conducted by BES in the study area on 7 September and 7 October 2005, and 21 and 29 March 2006 in the locations shown in Figure 2 (Appendix A). Preliminary fauna investigations were undertaken in the Stage 5 area on 1 August 2006.

Opportunistic Diurnal Surveys

Opportunistic fauna surveys involved observations of animal activity, habitat surveys and searches for indirect evidence of fauna.

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 bird, reptile and amphibian searches were conducted across the study area involving both visual and aural detection of species. Searches for feeding evidence were also conducted for various bird species including the Glossy Black-cockatoo.

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. Opportunistic records of all fauna species observed were maintained throughout the survey period, and an inventory was compiled of all species recorded during the current investigations.

Habitat Analysis

A description of the fauna habitats in the study area was prepared because the type of habitat in an area influences which animals occur there, as well as diversity and abundance. This habitat assessment also has an important role in predicting threatened fauna likely to occur in an area. The information collected included the type of vegetation present, the presence/absence of rock outcrops, tree hollows, dams, ponds, streams, foraging substrates and other features likely to attract threatened fauna. The study area was traversed along a number of transects to identify habitat components, which were recorded and described.

Targeted Amphibian Surveys

Targeted nocturnal surveys for the Green and Golden Bell Frog and Giant Burrowing Frog were undertaken on 21 and 29 March 2006 at each of the four dams in the study area. Surveys at each dam involved listening for calls for 10 minutes, followed by the playing of calls through a Toa megaphone connected to a Sony Walkman CD player for five minutes, and then a further listening period of 10 minutes. This was followed by spotlighting of the edges of each dam and emergent vegetation for a further 15 minutes to assist with searching for frogs. All calls heard during the survey were identified to species level.

Targeted ANABAT and Stag-watching Surveys

Targeted ANABAT and stag-watching surveys for threatened hollow-dependent microchiropteran bats were undertaken on 21 and 29 March 2006. Surveys targeted a single stag (dead tree) with small visible hollows adjacent to the southern boundary of the study area, commencing one half hour before dusk and continuing for one hour after dusk. An observer positioned to silhouette visible hollow entrances against the western sky watched the hollows with the aid of binoculars and a spotlight whilst pointing an ANABAT II echolocation detector connected to a Sony Walkman Cassette Recorder at the stag. The spotlight was turned on intermittently and not directed at the hollows, but just to one side of the stag to provide indirect illumination for observations. Fauna species exiting the hollows were identified either by direct observation or by analysis of echolocation calls. Calls were analysed by Mr. Adam Fawcett, Regional Ecologist for State Forests of NSW.

A second tree with one small visible hollow adjacent to the eastern boundary of the study area was not targeted for stag-watching as the hollow was inhabited by bees.

Limitations

The results of fauna surveys can be optimised by conducting investigations over a long period to compensate for the effects of unfavourable weather, seasonal changes and climatic variation. In general, the longer the survey the more species will be recorded. Results can also be improved by using a wide range of techniques, since some species are more likely to be recorded by a particular method. Such techniques include scat analysis, spotlighting, small-cage trapping, pitfall trapping, hair tubing and harp trapping. However, surveys are subject to constraints that determine the amount of time allocated, the methods used and the timing of the work. Thus, the results should be viewed in the light of these limitations. The fauna recorded in current survey work are a guide to the native fauna present, but are by no means a definitive list of the species occurring in the study area. Nevertheless, the techniques used in this investigation are considered adequate to gather the data necessary to assess the impacts of the proposal on the fauna species and habitats found in the study area.

Nomenclature

The nomenclature in this report is based on the Mammals of Australia (Strahan 1995), and Australian Bats (Churchill 1998), The Taxonomy and Species of Birds of Australia and its Territories (Christidis & Boles 1994) and Reptiles and Amphibians of Australia (Cogger 1996).

Survey Effort

The fauna survey effort employed a total of 20.01 person-hours as documented in Table 2.

Table 2: Fauna survey effort employed over the study area and surrounds

DATE	METHOD	EFFORT	TARGET SPECIES
7 September 2005	Opportunistic diurnal observations and habitat searches	1.67 person-hours	All species
7 October 2005	Opportunistic diurnal observations and habitat searches	5 person-hours	All species
21 March 2006	Call playback and spotlighting	2.5 person-hours	Green and Golden Bell Frog
	Stag-watching	1.5 person-hours	Hollow-dependent fauna
	ANABAT echolocation call recording	1.5 person-hours	Microchiropteran bats
29 March 2006	Call playback and spotlighting	2.5 person-hours	Green and Golden Bell Frog
	Stag-watching	1.5 person-hours	Hollow-dependent fauna
29 March 2006	ANABAT echolocation call recording	2.17 person-hours	Microchiropteran bats
1 August 2006	Opportunistic diurnal observations	1.67 person-hours	All species
TOTAL FAUNA SURVEY EFFORT		**20.01 PERSON HOURS**	

Survey Weather Conditions

Weather conditions throughout the survey period are detailed in Table 3.

Table 3: Fauna survey conditions

DATE	TEMPERATURE	WIND	CLOUD	RAIN	MOON
7 September 2005	14 ^{0}C	Calm	0/8	-	-
7 October 2005	16 ^{0}C	Calm	2/8	-	-
21 March 2006	20 ^{0}C	Light SE	5/8	Occasional drizzle	-
29 March 2006	22 ^{0}C	Light NE	1/8	Heavy on previous day	-
1 August 2006	17 ^{0}C	Calm	0/8	-	--

3. THE EXISTING ENVIRONMENT

3.1 Topography, Geology, and Soils

The study area lies at an altitude of approximately 0-20 m Australian Height Datum and comprises four landform elements:

- Landform 1 - a flat crest along the southern boundary comprising cleared grazing land with occasional remnant trees;
- Landform 2 - gently sloping low hills with a north-east aspect across the majority of the southern and western sections comprising cleared grazing land with occasional remnant trees;
- Landform 3 - two vegetated creeks in the east and west and two cleared overland flow paths in the central parts, draining to a small partly vegetated coastal floodplain in the centre and north-east; and
- Landform 4 – a low-lying floodplain associated with Burrill Lake in the north-east comprising a mosaic of floodplain vegetation communities amongst introduced pasture, which extends into the Stage 5 area.

The Ulladulla 1:250,000 Geological Series Sheet (S1 56-13) indicates that the substrate of Landforms 1 and 2 is of Permian age and comprises conglomerate, sandstone and silty sandstone of the Conjola Formation in the Shoalhaven Group. Soils appear to be sandy loams in these parts of the study area. Landforms 3 and 4 comprise areas of Quaternary alluvium gravel and swamp deposits associated with the lower parts of the drainage lines and floodplain.

3.2 Disturbances

The study area has undergone severe disturbances from agricultural uses over many years. It has been cleared and sown with pasture grasses and four farm dams have been constructed in associated with the creeks and overland flow paths. Two dams occur in the creek in the west with one dam in the overland flow path in the north-west and another adjacent to the creek in the east. A larger dam in the centre of Lot 1 (Stage 5) accepts water from the creek in the west, the overland flow path in the north-west and the existing Stage 1 subdivision to the north.

As a result, the vegetation within the study area is highly disturbed and comprises predominantly exotic pasture species with a few wattle trees and occasional eucalypts. The largest areas of remnant native vegetation occur in association with the creeks in the west and east and the floodplain in the north-east.

3.3 Flora

The study area generally supports two vegetation communities, Introduced Grassland, and Paperbark Shrubland, which are described in detail within this section. Very small areas of Bangalay Swamp Forest, Kunzea Shrubland and Spotted Gum-Blackbutt Forest occur in the east and north-east and these are briefly described below.

Bangalay Swamp Forest occurs as a very small vegetation unit adjacent to the eastern boundary of Stage 2 within the creek corridor. This vegetation is dominated by Bangalay *Eucalyptus botryoides* in the canopy. There is an understorey comprised of Tantoon *Leptospermum polygalifolium* with a few Snow-in-Summer *Melaleuca linariifolia* and Swamp Paperbark *Melaleuca ericifolia*.

A small rise in the north-east of the Stage 2 area comprises a small unit of Kunzea Shrubland dominated by White Kunzea *Kunzea ambigua* adjacent to the eastern boundary.

A small area of Spotted Gum-Blackbutt Forest occurs further to the north-east. This is an open forest dominated by Spotted Gum *Corymbia maculata* and Blackbutt *Eucalyptus pilularis* with White Kunzea *Kunzea ambigua* dominating the understorey.

Within proposed Stage 5 there is a mosaic of vegetation communities associated with coastal floodplains in low-lying areas including Swamp Oak Forest, Bangalay Swamp Forest, Paperbark Shrubland and Coastal Saltmarsh. At higher elevations open forests dominated by Spotted Gum, Blackbutt and Bangalay occur generally on the eastern and western margins of the floodplain.

The locations of vegetation communities are shown in Figure 3 (Appendix A).

3.3.1 Introduced Grassland

This community occurs across the majority of the study area generally within Landforms 1 and 2. The community comprises predominantly exotic grasses, weeds and herbs with occasional remnant trees along the boundaries such as Bangalay *Eucalyptus botryoides*, Sydney Peppermint *Eucalyptus piperita*, Blackbutt *Eucalyptus pilularis*, Blue Gum-Bangalay Hybrid Eucalyptus *saligna x botryoides*, White Stringybark *Eucalyptus globoidea* and Black She-oak *Allocasuarina littoralis*.

Characteristic species include exotic grasses and weedy herbs such as Kikuyu *Pennisetum clandestinum*, Parramatta Grass *Sporobolus sp.*, Paspalum *Paspalum dilatatum,* Buffalo Grass *Stenotaphrum secundatum*, Whiskey Grass *Andropogon virginicus*, Yorkshire Fog *Holcus lanatus*, Sweet Vernal Grass *Anthoxanthum odoratum*, Clover *Trifolium sp*., Fireweed *Senecio madagascariensis*, Scarlet Pimpernel *Anagalis arvensis*, Scotch Thistle *Cirsium vulgare*, Dandelion *Taraxacum officinale*, Catsear *Hypochaeris radicata,* Lambs Tongue *Plantago lanceolatus* and Blackberry *Rubus fruticosus* complex.

3.3.2 Paperbark Shrubland

This community occurs generally in Landforms 3 and 4 in association with the creeks in the west and east and with parts of the floodplain. Parts of the community have been disturbed by the construction of farm access tracks and farm dams, rough grazing, slashing and clearing. Disturbed areas are in various stages of regeneration. Occasional Bangalay trees occur in the community, which is characterised by a dense mid-canopy and shrub layer where it is intact, and these are most prevalent in the drainage line adjacent to the eastern boundary.

Due to disturbances, the community was mapped according to its condition. Map units identified as Paperbark Shrubland are in relatively good condition with few obvious disturbances except along their margins. Areas mapped as Disturbed Paperbark Shrubland have been extensively disturbed by grazing, clearing, weed invasion and the construction of dams. Map units identified as Regrowth Paperbark Shrubland have been slashed and comprise regenerating individuals generally less than 1m in height.

The dominant mid-canopy and understorey species is Swamp Paperbark *Melaleuca ericifolia* to a height of 5-8 m with projective foliage cover (PFC) of 90% in the mid-canopy and to a height of 2 m with PFC of 30% in the understorey.

Characteristic groundcover species include Couch *Cynodon dactylon*, Tall Saw-sedge *Gahnia clarkei*, the rush *Juncus usitatus*, Shining Pennywort *Hydrocotyle peduncularis* and Whiteroot *Pratia purpurascens*. A range of exotics also dominate the groundcover Buffalo Grass *Stenotaphrum secundatum*, Yorkshire Fog *Holcus lanatus*, Sweet Vernal Grass *Anthoxanthum odoratum* and Catsear *Hypochaeris radicata.*

A number of dams occur in association with this community and contain aquatic species such as Woolly Frogmouth *Philydrum lanuginosum*, Water Ribbons *Triglochin microtuberosum*, Tall Spike-rush *Eleocharis sphacelata* and Creeping Buttercup *Ranunculus repens*.

Two small low-lying areas in Stage 5 are dominated by Swamp Weed *Selliera radicans*, which is characteristic of Coastal Saltmarsh vegetation.

3.3.3 Flora Species

A total of 92 flora species were recorded in the study area during the flora survey, comprising 68 native species and 24 introduced species, and these are listed in Table 3 below. No threatened flora species were recorded during the survey period.

Table 4: Flora species recorded in the study area (* denotes introduced species or planting)

SCIENTIFIC NAME	COMMON NAME
Acacia elongata	Swamp Wattle
Acacia longifolia	Sydney Golden Wattle
Acacia mearnsii	Black Wattle
Allocasuarina littoralis	Black She-oak
*Anagalis arvensis**	Scarlet Pimpernel
*Andropogon virginicus**	Whisky Grass*
Anisopogon avenaceus	Oat Speargrass
*Anthoxanthum odoratum**	Sweet Vernal Grass*
Aristida vagans	Three-awn Spear-grass
Baumea teretifolia	A sedge
Breynia oblongifolia	Coffee Bush
Brunoniella pumilio	Dwarf Blue Trumpet
Callicoma serratifolia	Callicoma
Calochlaena dubia	Rainbow Fern
Centella asiatica	Indian Pennywort
*Cirsium vulgare**	Spear Thistle
Convolvulus erubescens	Blushing Bindweed
*Conyza sp.**	A fleabane*
Corymbia maculata	Spotted Gum
Cymbidium suave	Snake Orchid
Cynodon dactylon	Couch
Cyperus polystachyos	A sedge
*Cyperus congesta**	A sedge*
Desmodium varians	Variable Tick-trefoil
Dichondra repens	Kidney Weed
*Eleocharis minuta**	A spike-rush*
Eleocharis sphacelata	Tall Spike-rush
Entolasia marginata	Bordered Panic
Entolasia stricta	Wiry Panic
Eucalyptus botryoides	Bangalay
Eucalyptus globoidea	White Stringybark
Eucalyptus pilularis	Blackbutt

SCIENTIFIC NAME	COMMON NAME
Eucalyptus piperita	Sydney Peppermint
Eucalyptus saligna/botryoides	Blue Gum/Bangalay Hybrid
Exocarpos cupressiformis	Native Cherry
Gahnia clarkei	Tall Saw-sedge
Gahnia sieberana	Red-fruited Saw-sedge
Gleichenia dicarpa	Pouched Coral Fern
Glycine clandestina	Love Creeper
Goodenia paniculata	Swamp Goodenia
Hibbertia aspera	Rough Guinea-flower
Hibbertia scandens	Trailing Guinea-flower
*Holcus lanatus**	Yorkshire Fog*
Hydrocotyle laxiflora	Stinking Pennywort
Hydrocotyle peduncularis	Shining Pennywort
Hypericum gramineum	Small St John's Wort
*Hypochaeris radicata**	Flatweed*
Imperata cylindrica	Blady Grass
*Juncus acutus**	A rush
Juncus sp.	A rush
Juncus usitatus	Common Rush
Kennedia rubicunda	Dusky Coral Pea
Kunzea ambigua	White Kunzea
Lepidosperma filiforme	Common Rapier-sedge
Leptospermum polygalifolium	Tantoon
Leucopogon juniperinus	Bearded Heath
Lomandra longifolia	Spiny-headed Mat-rush
Ludwigia peploides	Water Primrose
Melaleuca ericifolia	Swamp Paperbark
Melaleuca linariifolia	Snow-in-Summer
Melaleuca thymifolia	A paperbark
Notelaea longifolia	Mock Olive
Oplismenus aemulus	Basket Grass
Ozothamnus diosmifolius	Everlasting
*Pennisetum clandestinum**	Kikuyu*

SCIENTIFIC NAME	COMMON NAME
Philydrum lanuginosum	Woolly Frogmouth
Pittosporum undulatum	Sweet Pittosporum
*Plantago lanceolata**	Lamb's Tongue*
Pratia purpurascens	Whiteroot
Pteridium esculentum	Common Bracken
Pultenaea retusa	A bush-pea
Ranunculus inundatus	River Buttercup
*Ranunculus repens**	Creeping Buttercup*
*Rubus discolor**	Blackberry*
*Salvinia molesta**	Salvinia*
Selliera radicans	Swamp Weed
*Senecio madagascariensis**	Fireweed*
*Setaria sp.**	A pigeon grass*
*Sonchus sp.**	A sowthistle*
*Sporobolus sp.**	A Parramatta Grass*
*Stenotaphrum secundatum**	Buffalo Grass*
Stephania japonica	Snake Vine
Syncarpia glomulifera	Turpentine
*Taraxacum officinale**	Dandelion*
Themeda australis	Kangaroo Grass
*Trifolium dubium**	Yellow Suckling Clover
*Trifolium sp.**	A clover
Triglochin microtuberosum	Water Ribbons
*Verbena sp.**	Purpletop*
Viola hederacea	Native Violet
Wahlenbergia communis	Native Bluebell
Zieria smithii	Sandfly Zieria

3.4. Fauna

3.4.1 Fauna Habitats

The fauna habitats present in the study area are those generally associated with introduced grasslands with occasional remnant trees, and Paperbark Shrublands containing farm dams.

The introduced grasslands may provide occasional foraging habitat for common native birds, which are likely to forage on insects and other invertebrates, common reptiles and amphibians that would occur there. Granivores such as native parrots may also forage in the study area on occasion. The grasslands also provide foraging habitat for exotic herbivores, such as horses, which occur within the study area. Native herbivores such as the Eastern Grey Kangaroo were also observed exploiting these resources. Some terrestrial native birds may nest among the pasture grasses, but overall these habitats provide very limited shelter for native fauna. Two Black She-oak trees adjacent to the eastern boundary of the study area were utilised by the Glossy Black-cockatoo for seed resources. These are outliers of an extensive seed source for the species present on the adjoining forested lands.

Given the limited cover resulting from an almost total absence of canopy or understorey strata, and the absence of fallen logs, water or rock habitats, the study area would not provide shelter, nesting or breeding habitat for any terrestrial mammals or other native fauna apart from invertebrates, common reptiles and amphibians, and common birds such as the Masked Lapwing *Vanellus miles*, which was observed there during the survey period.

The two hollow-bearing trees in the study area were not inhabited by hollow-dependent fauna during the survey period. The hollows in these trees were small and unlikely to be utilised due to their size and exposed landscape position. Targeted stagwatching and ANABAT surveys failed to record any evidence of native fauna in these hollows.

The Paperbark Shrubland and associated dams and watercourses in the study area provide nectar resources for birds and insects. Microchiropteran bats may forage on insects attracted to flowering shrubs and birds of prey may predate upon small nectarivorous birds. Common amphibians inhabit the farm dams associated with the Paperbark Shrubland and would disperse along the riparian corridors. Water fowl inhabit the large water quality control pond to the north of the study area and occasionally the farm dams along the watercourses.

Habitat interconnections generally occur along the two vegetated watercourses, which flow into the study area from the adjoining conservation reserves. The connectivity is broken in the north and north-east for many terrestrial fauna by disturbances associated with past agricultural uses but avifauna and frogs could access floodplain resources beyond these disruptions.

3.4.2 Fauna Species

Fauna surveys during the survey period resulted in the detection of 51 faunal species inhabiting the study area comprising one introduced species and 50 native species. A total of seven mammals, 38 birds and six amphibians were recorded and these are listed in Table 4.

Table 5: Fauna species identified during this study (*denotes introduced species

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
Mammals	Eastern Grey Kangaroo	*Macropus giganteus*	Direct observation
	Gould's Wattled Bat	*Chalinolobus gouldii*	ANABAT recording
	Horse*	*Eqqus eqqus**	Direct observation
	Long-nosed Bandicoot	*Perameles nasuta*	Direct observation
	Sugar Glider	*Petaurus breviceps*	Call identification
	Swamp Wallaby	*Wallabia bicolor*	Direct observation
	Unidentified Forest Bat	*Nyctophilus sp.*	ANABAT recording
Birds	Australian Magpie	*Gymnorhina tibicen*	Call recognition
	Australian Pipit	*Anthus novaeseelandiae*	Direct observation
	Australian Raven	*Corvus coronoides*	Call recognition
	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	Direct observation
	Channel-billed Cuckoo	*Scythrops novaehollandiae*	Call recognition
	Chestnut Teal	*Anas castanea*	Direct observation
	Common Bronzewing	*Phaps chalcoptera*	Call recognition
	Common Koel	*Eudynamys scolopacea*	Call recognition
	Crested Pigeon	*Ocyphaps lophotes*	Direct observation
	Crimson Rosella	*Platycercus elegans*	Call recognition
	Dollarbird	*Eurystomas orientalis*	Call recognition
	Eastern Rosella	*Platycercus eximius*	Call recognition
	Eastern Spinebill	*Acanthorhynchus tenuirostris*	Call recognition
	Eastern Whipbird	*Psophodes olivaceus*	Call recognition
	Fan-tailed Cuckoo	*Cacomantis flabelliformis*	Call recognition
	Galah	*Cacatua roseicapilla*	Direct observation
	Glossy Black-cockatoo	*Calyptorhynchus lathami*	Call recognition
	Great Egret	*Egreta alba*	Direct observation
	Grey Butcherbird	*Cracticus torquatus*	Call recognition
	Grey Fantail	*Rhipidura fuliginosa*	Call recognition
	Laughing Kookaburra	*Dacelo novaehollandiae*	Call recognition

CATEGORY	COMMON NAME	SCIENTIFIC NAME	DETECTION METHOD
	Little Black Cormorant	*Phalacrocorax sulcirostris*	Direct observation
	Magpie-lark	*Grallina cyanoleuca*	Call recognition
	Masked Lapwing	*Vanellus miles*	Direct observation
	Noisy Friarbird	*Philemon corniculatus*	Call recognition
	Olive-backed Oriole	*Oriolus sagittatus*	Call recognition
	Pacific Black Duck	*Anas superciliosa*	Direct observation
	Pallid Cuckoo	*Cuculus pallidus*	Call recognition
	Pied Cormorant	*Phalacrocorax varius*	Direct observation
	Pied Currawong	*Strepera graculina*	Call recognition
	Rainbow Lorikeet	*Trichoglossus haematodus*	Direct observation
	Red Wattlebird	*Anthochaera lunulata*	Direct observation
	Royal Spoonbill	*Platalea regia*	Direct observation
	Sacred Ibis	*Threskiornis molucca*	Direct observation
	Spotted Pardalote	*Pardalotus punctatus*	Call recognition
	Swamp Hen	*Porphyrio porphyrio*	Direct observation
	White-bellied Sea-eagle	*Haliaeetus leucogaster*	Direct observation
	Willie Wagtail	*Rhipidura leucophrys*	Direct observation
Amphibians	Bleating Tree Frog	*Litoria dentata*	Call recognition
	Common Eastern Froglet	*Crinia signifera*	Call recognition
	Haswell's Froglet	*Paracrinia haswelli*	Call recognition
	Peron's Tree Frog	*Litoria peronii*	Call recognition
	Striped Marsh Frog	*Limnodynastes peronii*	Call recognition
	Verreaux's Tree Frog	*Litoria verreauxii*	Call recognition

4. CONSERVATION SIGNIFICANCE

The *NSW Threatened Species Conservation Act 1995* (*TSC Act*) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) provide for the listing of threatened flora and fauna species, endangered populations and threatened ecological communities.

The *EPBC Act* also provides for the listing of migratory species. The *NSW Fisheries Management Act 1994* (*FM Act*) provides for the listing of threatened fish species and marine vegetation, endangered populations and threatened ecological communities.

The *TSC Act* classifies threatened flora and fauna species as Endangered (Schedule 1, Part 1), Vulnerable (Schedule 2), or Presumed Extinct (Schedule 1, Part 4). Records of these species may be obtained by searching the Atlas of NSW Wildlife.

The *EPBC Act* classifies threatened flora and fauna species as Extinct, Critically Endangered, Endangered or Vulnerable. An indication of the threatened and migratory species likely to be encountered in a locality may be obtained by using the *EBPC Act* Protected Matters Search Tool.

Both of these databases were searched on 5 October 2006 for records of threatened flora, threatened fauna and migratory species within an area of 10 km x 10 km centred on the subject site.

The *FM Act* classifies threatened fish and marine vegetation as Endangered, Vulnerable, or Presumed Extinct. An indication of the species likely to be encountered in a locality may be obtained by reviewing the recommendations for threatened species listed on the schedules of the *FM Act*.

An indication of the endangered populations and threatened ecological communities likely to be encountered in the locality can be obtained by reviewing the Final Determinations of the NSW Scientific Committee, NSW Fisheries Scientific Committee and the schedules of the TSC Act, FM Act and EPBC Act.

4.1 Threatened Flora

The outcomes of database searches for threatened flora were reviewed to yield the list of species shown in Table 6 below, with the status of each species listed as endangered (E) or vulnerable (V).

The potential for each of these species to occur in the study area and the importance of the habitats are discussed in Table 6 and a decision made regarding the need for further assessment in this report.

Table 6: Threatened flora species recorded or likely to occur in the locality

THREATENED FLORA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITATS TO BE AFFECTED BY THE PROPOSAL	FURTHER ASSESSMENT REQUIRED IN THIS REPORT
	TSC Act	EPBC Act		
Caladenia tessellata Thick-lipped Spider Orchid	E	V	This terrestrial orchid occurs in coastal heath, heathy woodland and coastal forests. It appears to favour areas with a shrubby understorey and is suppressed in the absence of fire. Suitable substrate includes clay loam or sandy soils. The species would have been detectable during surveys undertaken within the study area as it is known to flower between September and November. The closest known occurrence was approximately 3 km north within an area of Bangalay open forest adjacent to a creek and behind a coastal dune system. This species has poorly understood habitat requirements and it may occur in any remnant vegetation along the coastal strip (M. Duncan pers comm.). The study area contains very small areas of highly disturbed remnant vegetation, but there is no heath, heathy woodland or coastal forest. Most of the study area is covered with pasture grasses. The species was not recorded during the survey period and is highly unlikely to occur there.	No
Cryptostylis hunteriana Leafless Tongue Orchid	V	V	This terrestrial orchid is known from swamp-heath and open forest on sandy soils in coastal districts. The species is known from a population a few kilometres to the south-west and from a population about 200 m to the east and south-east of the study area. Two of these populations occur in Scribbly Gum Woodland and the third occurs in sedgeland. The study area contains highly disturbed habitats which are not suitable for this species. It is highly unlikely to occur there. Indirect impacts on this species are possible even though it occurs in densely vegetated areas to the east and south where access is difficult.	Yes
Thesium australe Austral Toad-flax	V	V	This species is associated with native grasslands and is a hemi-parasite of Kangaroo Grass which occurs in very low densities within the study area. Kangaroo Grass occurs in a few locations associated with the creek in the west of the study area. The species was not detected within the study area despite searches of clumps of Kangaroo Grass and it is considered highly unlikely that it species would occur there.	No

Note: Habitat requirements for flora species in Table 6 have been sourced from: Fairley (2004), Harden (2000), NPWS (2000),), PlantNET accessed 2006 and the NPWS Atlas of NSW Wildlife accessed 2006.

No threatened flora species were recorded in the study area during the survey period and none are expected to occur in the habitats found there. The proposal may result in indirect impacts on a known population of the Leafless Tongue Orchid in the adjoining conservation reserve. The indirect impacts of the proposal on this species will be assessed in subsequent sections of this report.

4.2 Threatened Fauna

The outcomes of database searches for threatened fauna and the recommendations for threatened species listed on the schedules of the *FM Act* were reviewed to yield the list of species shown in Table 7 below, with the status of each species listed as endangered (E) or vulnerable (V).

The potential for each of these fauna species to occur in the subject site and the importance of the habitats to be affected by the proposal are discussed in Table 7 and a decision made regarding the need for further assessment in this report. Marine species and shorebirds have been omitted as they would not occur in the study area.

Table 7: Threatened fauna species recorded or likely to occur in the locality

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITATS TO BE AFFECTED BY THE PROPOSAL	FURTHER ASSESSMENT REQUIRED IN THIS REPORT
	TSC Act	EPBC Act		
Mammals				
Eastern Cave Bat *Vespadelus troughtoni*	V	-	This bat uses caves as roosting sites and forests for foraging. The study area does not contain caves or forests and the species is highly unlikely to occur there. It was not recorded during targeted bat surveys.	No
Eastern Freetail Bat *Mormopterus norfolkensis*	V	-	This bat roosts in tree hollows and forages in forests. The species may occasionally forage for insects in the study area but it was not recorded utilising the two trees with hollows found there This suggests that the species would be unlikely to rely on the habitats found there. It was not recorded during targeted bat surveys.	No
Greater Broad-nosed Bat *Scoteanax rueppellii*	V	-	This bat roosts in tree hollows and forages in forests. The species may occasionally forage for insects in the study area but it was not recorded utilising the two trees with hollows found there. This suggests that the species would be unlikely to rely on the habitats found there. It was not recorded during targeted bat surveys.	No
Grey-headed Flying-fox *Pteropus poliocephalus*	V	V	The species roosts in permanent camps and forages for nectar in flowering trees and shrubs over vast areas. There are no camps in the study area and very limited foraging resources. The species is unlikely to occur in the study area regularly or be dependent upon it.	No

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITATS TO BE AFFECTED BY THE PROPOSAL	FURTHER ASSESSMENT REQUIRED IN THIS REPORT
	TSC Act	EPBC Act		
Large-footed Myotis *Myotis adversus*	V	-	This bat roosts in caves and tree hollows near watercourses, and forages over rivers and streams. The species may hunt for prey over the open water habitats in the study area. Breeding habitat does not occur there as the two trees with hollows were not inhabited by bats during the survey period. Large areas of open water habitats in the north will not be affected. The species was not detected in the study area despite the use of targeted survey techniques. It is not expected to inhabit the study area regularly.	No
Birds				
Glossy Black-cockatoo *Calyptorhynchus lathami*	V	-	This species occurs in forests and woodlands where She-oak feeding resources are prevalent and large tree hollows exist for breeding. The study area does support a very limited area of foraging resources but there is no breeding habitat for the species. It is extremely unlikely that the species would occur in the study area regularly although it was recorded feeding along the eastern boundary.	Yes
Ground Parrot *Pezoporus wallicus*	V	_	This species is usually associated with heathland and sedgeland vegetation, which does not occur in the study area. It is considered extremely unlikely to occur in the study area.	No
Masked Owl *Tyto novaehollandiae*	V	-	This species may forage from time to time on terrestrial mammals that may occur in the study area. However the study area provides an insignificant amount of foraging habitat relative to the large home range of this species, and the potential foraging habitat in the locality. The study area does not support any roosting or breeding habitat for the species.	No
Powerful Owl *Ninox strenua*	V	-	The study area does not provide any roosting, breeding or foraging habitat for the species, which preys predominantly on arboreal mammals. It is unlikely that the species would occur within the study area.	No
Osprey *Pandion haliaetus*	V	-	This species builds nests in large dead trees close to water and hunts for fish in wetlands and the ocean. No nests were detected in the study area, where trees are too small and too far from water to be selected by the species. The species is unlikely to occur in the study area and it was not detected during surveying.	No

THREATENED FAUNA SPECIES	STATUS		POTENTIAL TO OCCUR IN THE STUDY AREA AND IMPORTANCE OF HABITATS TO BE AFFECTED BY THE PROPOSAL	FURTHER ASSESSMENT REQUIRED IN THIS REPORT
	TSC Act	EPBC Act		
Regent Honeyeater *Xanthomyza phrygia*	E	E	This migrant to the region forages in winter-flowering trees such as Spotted Gum, Woollybutt, and Swamp Mahogany. Winter-flowering trees Spotted Gum trees occur within the study area but they are not abundant. The species may forage there from time to time but the foraging resources there are insignificant relative to those available elsewhere in the locality and Shoalhaven local government area.	No
Amphibians				
Giant Burrowing Frog *Heleioporus australiacus*	V	V	The creeks and dams in the study area do not contain habitat suitable for this species. It is usually recorded in close proximity to watercourses underlain by sandstone. The creeks and the vegetation do not have the characteristic vegetation and banks selected by the species. These watercourses have been disturbed by past agricultural activities rendering the habitats unsuitable for the species, which is usually recorded in relatively undisturbed environments. Targeted call playback surveys did not elicit responses and the species was not recorded in the study area.	No
Green and Golden Bell Frog *Litoria aurea*	E	V	This species prefers permanent, unshaded water bodies containing emergent vegetation such as Cumbungi. Such habitats do occur in the study area but the species was not recorded there despite targeted surveys under appropriate seasonal conditions.	No

Note: Habitat requirements for fauna species in Table 7 have been sourced from Commonwealth DEH (1999), Commonwealth DEH (2001), NSW NPWS (2001), NSW NPWS (2002b), www.threatenedspecies.environment.nsw.gov.au (accessed 2006) and Schodde & Tidemann (1997).

A small amount of suitable foraging habitat is available within the study area for the Glossy Black-cockatoo. The effects of the proposal on this threatened fauna species will be assessed in subsequent sections of this report.

4.3 Migratory Species

The outcome of the database search for migratory species is shown in Table 8 below. The potential for each of these species to occur in the study area and the importance of the habitats to be affected by the proposal are discussed in Table 8 and a decision made regarding the need for further assessment in this report.

Species encountered only in marine and wetland environments have been omitted as these habitats do not occur in the study area.

Table 8: Migratory species recorded or likely to occur in the locality

SPECIES	POTENTIAL TO OCCUR IN THE SUBJECT SITE AND IMPORTANCE OF HABITATS TO BE AFFECTED BY THE PROPOSAL	FURTHER ASSESSMENT REQUIRED IN THIS REPORT
Black-faced Monarch *Monarcha melanopsis*	This migratory species is known to breed in damp forest types and forage in rainforest and eucalypt forest. There is no foraging habitat within the study area and the species would not occur there.	No
Regent Honeyeater *Xanthomyza phrygia*	This migrant to the region forages in winter-flowering eucalypts and nectar producing trees and shrubs. There very little suitable habitat for the species within the study area and it is extremely unlikely that it would occur there.	No
Rufous Fantail *Rhipidura rufifrons*	This migratory species is known to utilise dense understorey in damp forests or beside rivers. There is no foraging habitat within the study area and the species would not occur there.	No
Satin Flycatcher *Myiagra cyanoleuca*	This migratory species inhabits lowland eucalypt forests. It is known to nest in dense gully vegetation. There is no foraging habitat within the study area and the species would not occur there.	No
White-throated Needletail *Hirundapus caudacutus*	This migratory species is associated with hillsides and is thought to spend all of its time in the air whilst in Australia. The study area is not on a prominent hillside and the species would not occur there.	No

Note: Habitat requirements for migratory species in Table 8 have been sourced from Schodde & Tidemann (1997).

No migratory species were recorded in the study area during the survey period and none are expected to occur there. The White-bellied Sea-eagle was recorded flying over the study area, but the species would not utilise the habitat there. No further consideration is given to migratory species in this report.

4.4 Endangered Populations

The *TSC Act* provides for the listing of endangered populations on Schedule 1, Part 2. There are no endangered populations listed on the schedules of the *TSC Act* found in the Shoalhaven local government area. No further consideration is given to endangered populations in this report.

4.5 Threatened Ecological Communities

The *TSC Act* and *EPBC Act* provide for the listing of threatened ecological communities. None of the threatened ecological communities listed by the *EPBC Act* occur in the study area. Two communities in the study area, Paperbark Shrubland and Bangalay Swamp Forest appear to have affinities with endangered ecological communities listed by the *TSC Act*. The characteristics of these communities are discussed below in the context of the Final Determinations of the NSW Scientific Committee.

The Paperbark Shrubland and Bangalay Swamp Forest identified in this report show floristic and structural affinities with the endangered ecological community *Swamp sclerophyll forest on the coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* (NSW Scientific Committee 2004) hereafter referred to as *Swamp sclerophyll forest*.

These communities resemble the structural and floristic description of the *Swamp sclerophyll forest* (NSW Scientific Committee 2005) because:

- Both communities occur on a coastal floodplain and within drainage lines associated with coastal floodplains on alluvial substrates primarily below 20 m elevation.
- There is a canopy dominated by Bangalay in the Bangalay Swamp Forest;
- Shrubs such as Yellow Tea-tree and Swamp Paperbark occur in the Bangalay Swamp Forest;
- The Paperbark Shrubland is dominated by Swamp Paperbark; and
- There is a groundcover dominated by sedges, ferns, forbs and grasses such as Tall Saw-sedge, Shining Pennywort and Whiteroot in the Paperbark Shrubland and Bangalay Swamp Forest.

Given the characteristics of the Paperbark Shrubland and Bangalay Swamp Forest within the study area they are considered to be representative of the *Swamp sclerophyll forest*

The *Swamp sclerophyll forest* extends into the Stage 5 area where it is associated with other floodplain vegetation. The Coastal Saltmarsh vegetation in the Stage 5 area is a form of *Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions* endangered ecological community, whilst the Swamp Oak Forest is a form of the *Swamp oak floodplain forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions* endangered ecological community.

The locations of endangered ecological communities in the study area and in the Stage 5 area are shown in Figure 4 (Appendix A). The condition of each community was not taken into account with respect to the vegetation mapping shown in Figure 4.

5. EVALUATION OF IMPACTS

5.1 Impacts on Flora

5.1.1 Vegetation Community Impacts

The proposal will involve the removal or modification of up to approximately 1 ha of disturbed native vegetation comprising approximately 0.27 ha of Disturbed Paperbark Shrubland, 0.69 ha of Regrowth Paperbark Shrubland and 0.04 ha of Bangalay Swamp Forest.

Vegetation communities in the Shoalhaven local government area (LGA) have been mapped and their extent calculated (Kevin Mills & Associates 1999). Kevin Mills & Associates (1999) indicates that Paperbark Shrubland is well-represented in lands managed for conservation purposes with approximately 80% of the mapped 1256 ha of the community within the Shoalhaven occurring in National Parks estate, protective zonings, or lands managed by the Commonwealth for conservation purposes. Clearing of 0.27 ha of Disturbed Paperbark Shrubland and 0.69 ha of Regrowth Paperbark Shrubland is considered an acceptable impact in terms of the extant area of this vegetation community within the Shoalhaven LGA and the locality.

Clearing of 0.04 ha of disturbed Bangalay Swamp Forest is considered an acceptable impact in terms of the extant area of this vegetation community within the locality. Conacher Travers (2003) recorded 72 ha of Bangalay Swamp Forest in two polygons comprising 58 ha to the west of the Narrawallee urban area and to the south of Narrawallee Inlet, with a further 14 ha to the south of Mollymook Hilltop Golf Course along Blackwater Creek. The clearing of 0.04 ha of highly disturbed Bangalay Swamp Forest equates to less than 0.04% of the extant Bangalay Swamp Forest in the locality.

The proposal may impose indirect impacts on native vegetation in the adjacent Barnunj State Conservation Area resulting from unauthorised access into these vegetated lands by vehicles. The proposal will provide appropriate vehicle-proof fencing of the western and southern boundaries of Stages 2 and 3 to control vehicle access. The design has already incorporated a perimeter road to avoid building blocks adjoining the State Conservation Area, thereby reducing the potential for incursions by neighbours into this vegetation. Weed invasion is not considered to be a major indirect impact as the existing state of Stages 2 and 3 has already provided conditions conducive to weeds, which have not invaded densely vegetate areas adjoining Lot 1. The provision of restrictions on the use of noxious and/or invasive weed species in landscaping for the proposal will further ameliorate indirect impacts on adjoining vegetation in the conservation reserve.

In summary, the proposal will not impose significant impacts on vegetation communities.

5.1.2 Threatened Flora Species Impacts

The proposal will not impact on threatened flora species. No threatened flora species were recorded in the study area during the survey period and none are expected to occur there. However, the study area lies near a population of the Leafless Tongue-orchid *Cryptostylis hunteriana.*

With respect to the Leafless Tongue-orchid *Cryptostylis hunteriana*, the species is known from a population approximately 200m to the east and 200m to the south-east of the study area. Individuals occurring to the east of the study area are on private freehold land, whilst the remainder of the population in the south-east lies within Barnunj State Conservation Area.

The proposal may impose indirect impacts on the adjacent population of the species resulting from unauthorised access into these vegetated lands by vehicles. The population is at sufficient distances from the proposal to be unaffected by weed invasion. The proposal will provide appropriate vehicle-proof fencing of the western and southern boundaries of Stages 2 and 3 to control vehicle access. The design has already incorporated a perimeter road to avoid building blocks adjoining the State Conservation Area, thereby reducing the potential for incursions by neighbours into this vegetation.

In summary, the proposal will not impose significant impacts on threatened flora species.

5.1.3 Regionally Significant Flora Species Impacts

The proposal will not impact on regionally significant flora species as identified by Kevin Mills and Associates (1996). No regionally significant flora species were recorded in the study area during the survey period and none are expected to occur there. The proposal will not impose significant impacts on regionally significant flora species.

5.2 Impacts on Fauna

5.2.1 Fauna Habitat Impacts

The fauna habitats to be removed or modified for the proposal consist of very limited foraging resources within disturbed shrublands, limited potential roosting resources in two trees with hollows, and aquatic foraging, breeding and sheltering resources in three farm dams.

The foraging resources to be removed would not be relied upon exclusively by any populations of fauna species and are likely to be used only occasionally by highly mobile fauna such as birds. The two trees with hollows to be removed were not inhabited by any faunal species during the survey period and are unlikely to provide key resources for hollow-dependent fauna. The hollows are too small to be used by large birds or arboreal mammals and represent relatively low quality resources for hollow-dependent species.

The three farm dams to be removed provide habitat for amphibians and limited resources for water fowl. The dams were inhabited by common amphibians and water fowl during the survey period, but the loss of these resources is unlikely to significantly impact local populations of these common species.

The proposal may impose indirect impacts on fauna habitats in the adjoining conservation reserve resulting from predation by domestic pets, particularly cats. The proposal will include measures to control domestic pets by requiring that they be kept wholly within the dwelling curtilage at all times.

In summary, the proposal will not impose significant impacts on fauna habitats, given the context of the study area, the conservation value of the habitats found there and the presence of similar habitats of superior quality on adjacent and nearby lands with high conservation value. Strategies to mitigate the impacts on fauna habitats in the study area are discussed in a subsequent section of this report.

5.2.2 Threatened Fauna Species Impacts

The Glossy Black-cockatoo was recorded in the study area during the survey period from feeding evidence underneath two Black She-oak trees in the east of the study area. No other threatened fauna species were recorded in the study area during the survey period despite targeted surveys under appropriate seasonal conditions and none are expected to occur there.

The study area provides very limited Black She-oak foraging resources for this species with a few trees occurring adjacent to the eastern boundary of the study area. There are no breeding resources for the species in the study area as the two trees with hollows do not have hollows large enough for this species. Extensive areas of Black She-oak occur on adjoining lands with large numbers of known feed trees recorded in these areas. The loss of two known feed trees would be highly unlikely to have any quantifiable impacts on the local population of the species in the context of its home range, mobility, and the available foraging resources on the extensive vegetated lands in the locality, particularly in Meroo National Park and Barnunj State Conservation Area.

These conservation reserves contain large areas of high quality forests and woodlands providing extensive stands of Black She-oak for the Glossy Black-cockatoo. According to Graham-Higgs (2002), Black She-oak occurs as a dominant species in the sub-canopy of 1,121 ha of forest ecosystems in Meroo National Park and Barnunj State Conservation Area. Black She-oak also occurs occasionally in the sub-canopy of a further 1,067 ha of forest ecosystems in these conservation reserves (Graham-Higgs 2002).

In this context, the loss of known foraging resources for the Glossy Black-cockatoo in the study area is unlikely to reduce the long-term viability of the local population or accelerate the

extinction of the species and the impacts of the proposal on this species are not considered significant. Nevertheless, the proposal will incorporate the preferential use of Black She-oak in landscaping to provide future foraging resources for the species.

In summary, the proposal will not impose significant impacts on threatened fauna species.

5.3 Impacts on Endangered Ecological Communities

The study area supports approximately 0.73 ha of Disturbed Paperbark Shrubland, 0.79 ha of Regrowth Paperbark Shrubland and 0.1 ha of partly disturbed Bangalay Swamp Forest. These vegetation communities are all forms of the endangered ecological community *Swamp sclerophyll forest* (SSF) listed on the *TSC Act*. The community occurs within the drainage lines in the east and west and on the floodplain in the north-east, comprising 1.62 ha of SSF in the study area.

All of the SSF in the study area has been disturbed by past and ongoing agricultural activities, with the Disturbed Paperbark Shrubland and Bangalay Swamp Forest showing evidence of weed invasion, grazing, clearing for vehicle tracks, clearing for fencing, and excavation for dams, and the Regrowth Paperbark Shrubland showing evidence of slashing resulting in Swamp Paperbark individuals with heights of less than 1 m.

The proposal will result in the removal of approximately 1 ha of SSF, comprising 0.81 ha of SSF in the study area for roads, drainage structures and residential lots, and 0.19 ha of SSF in the Stage 5 area for roads and drainage structures. The remaining SSF in the west of the study area will be fragmented by roads, whilst that remaining in the east will be contiguous with SSF occurring in the Stage 5 area and in vegetated freehold land to the east.

According to the NSW Scientific Committee Final Determination (NSW Scientific Committee 2004) there was considered to be less than 1000 ha of remnant SSF in the Sydney/South Coast region in the 1990s. The final determination suggests that the SSF includes the Northern Coastal Lowlands Swamp Forest of Thomas *et al.* (2000), which is estimated to currently occupy 459 ha or approximately 98.7% of the original extent of the community within the southern tablelands and south coast region, with approximately 14 % of the extant community in conservation reserves. The Northern Coastal Lowlands Swamp Forest is described as being characterised by a canopy of Swamp Mahogany and does not mention Bangalay specifically as a canopy species.

Evidence suggests that the forms of SSF found in the study area occur elsewhere in the locality (Young 2003, Young 2006). This would suggest that the distribution of the extant area of SSF in the region as stated by the NSW Scientific Committee (2004) may have been substantially underestimated. Much larger occurrences of SSF occur elsewhere in the Shoalhaven particularly in the Jervis Bay area in association with Currambene Creek, Black Swamp, Moona Moona Creek, Carama Creek and Coonemia Creek which is the largest tributary of Lake

Wollumboola. Some of these occurrences include contiguous areas of more than 250 ha (KMA 1999).

In this context, the 1.62 ha of SSF within the study area is a small occurrence of the community with limited importance at a regional level.

The SSF within the study area retains connectivity with other endangered ecological communities to the west on the adjoining conservation reserve, to the north-east through the Stage 5 area and to the east on adjoining freehold land, although this connectivity has been fragmented to the north and north-east by agricultural activities and urban development. In this context the SSF does not provide significant habitat connectivity.

The SSF within the study area provides limited foraging resources for a range of non-threatened fauna in the canopy, mid-canopy and shrub strata, but no nesting, breeding or roosting habitat in for hollow-dependent fauna. Some of these resources will be retained within the proposal, although connectivity will be disrupted, particularly for less mobile fauna that are not capable of flying. This impact is considered acceptable in the context of the extensive areas of similar resources available elsewhere, both adjacent to the study area and in the locality.

The proposal will remove a total of approximately 1 ha of SSF, comprising 0.81 ha of SSF in the study area and about 0.19 ha of SSF in the Stage 5 area. The remainder of the SSF in the study area (approximately 0.81 ha) and a proportion of the SSF in the Stage 5 area, will be retained and managed for conservation purposes via an approved vegetation management plan. The precise extent and configuration of the SSF to be retained in Stage 5 will be determined following further detailed design of this part of the proposal.

The proposal may have indirect impacts on the community, mainly arising from edge effects, and changes in hydrology, however appropriate management practices, including the provision of water sensitive urban design principles, have been incorporated into the proposal to control such effects. Other management practices to be implemented include appropriate fencing, sympathetic landscaping, and weed control as well as the preparation of a vegetation management plan for the long-term management of the community by affected landowners in Stage 3 and by the landowner of the Stage 5 area.

In summary the impacts of the proposal on SSF associated with the proposal are considered to be negligible at the regional/landscape and local levels.

5.4 Impacts on Endangered Populations

The proposal will not impact any endangered populations as none are listed in the Shoalhaven local government area.

5.5 Impacts on Threatened Fish

The proposal will not impact any threatened fish or marine vegetation listed by the *NSW Fisheries Management Act 1994*, as none were recorded in the study area and none are expected to occur there.

5.6 Impacts on Habitat Connectivity

The study area provides limited habitat connectivity along existing drainage lines for some terrestrial species, but habitat links have been essentially severed by previous agricultural activities. Some contiguity of vegetation is present, but this is broken in many places resulting in a fragmented landscape. Hence, impacts on habitat connectivity have already occurred in the study area.

The study area provides known habitat for the Glossy Black-cockatoo. The proposal will not isolate currently interconnecting or proximate areas of habitat for this highly mobile species as it is capable of flying over very large distances.

Potential habitat linkages could be re-established in the north-east of the study area through the Stage 5 lands towards the shores of Burrill Lake, but this would require revegetation of lands beyond the study area and beyond Stage 5, that are currently managed for recreational purposes by Shoalhaven City Council. This suggests that the complete re-establishment of habitat connectivity is unlikely to occur.

Nevertheless, the proposal will retain vegetation adjacent to the north-east of the study area within the Stage 5 area and manage it for conservation via an approved vegetation management plan. This vegetation will improve habitat linkages between the coastal floodplain and vegetated freehold land to the east.

The proposal will isolate SSF within the study area in the west from interconnecting or proximate areas of this vegetation community further to the west, but this impact is considered acceptable given the existing break in habitat connectivity further to the east. Even though, the proposal will isolate some SSF within the study area from other areas of native vegetation, this is not considered critical to the continued survival of the community given the current isolation regime. Some genetic exchange is likely to continue to be facilitated by highly mobile fauna species that will continue to inhabit the community from time to time after the proposal has been constructed.

The proposal will not disrupt habitat connectivity for reserved lands to the west and south. Extensive habitat connections will remain for such lands within existing conservation reserves. Connectivity between these lands and Burrill Lake through the study area has already been severed by past and continuing agricultural and residential activities.

5.7 Impacts on Koala Habitat (SEPP No. 44)

State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP No. 44) was gazetted by the NSW Government in 1995. The aims of SEPP No. 44 are:

> *"to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline."*

It requires a judgement to be made about whether the land in a study area is potential and/or core koala habitat based on the proportion of trees present that are listed as Koala Feed Tree Species in Schedule 2 of the policy and/or the presence of koalas. These listed feed trees must constitute at least 15 % of the total number of trees in the upper or lower strata of the tree component for the vegetation to be classified as *potential koala habitat*. *Core koala habitat* is land where there is a resident population of koalas including breeding females.

The policy requires the preparation of plans of management before development consent can be granted in relation to areas of *core koala habitat*, encourages the identification of areas of *core koala habitat*, and encourages the inclusion of areas of *core koala habitat* in environment protection zones.

The policy applies to this proposal because:

- the land is within the Shoalhaven Local Government Area;
- the land has an area of more than 1 ha; and
- a development application has been made for the proposal.

The study area does not contain tree species that are listed as koala feed trees on Schedule 2 of *SEPP No. 44* and thus, the study area does not contain *potential koala habitat*. There is no evidence of koalas occurring within the study area and they were not detected during surveying either through direct observation, call recognition or through characteristic scratchings or scats.

The proposal will not impact on Koala habitat and a Plan of Management for Koala habitat is not required.

5.8 Impacts on Matters of NES (Commonwealth EPBC Act 1999)

The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) contains provisions to protect Commonwealth Land and matters of national environmental significance (NES) listed by the Act, including World Heritage properties, Ramsar wetlands, threatened species, migratory species, nuclear actions and the Commonwealth marine environment.

Under this Act a person may require assessment and/or approval from the Commonwealth Environment Minister if they are undertaking an action that has, will have, or is likely to have, a significant impact on a matter of national environmental significance.

Administrative guidelines have been produced to assist proponents in determining whether an action should be referred to the Commonwealth Environment Minister for a decision on whether approval is required.

The proposal involves the clearing and/or modification of indigenous vegetation, and construction works, which may constitute an action defined by the *EPBC Act*.

The study area does not provide suitable habitat for any matters of National Environmental Significance listed on the schedules of the *EPBC Act* and no World Heritage Properties, Wetlands of National Importance, Commonwealth Marine Areas, or Commonwealth Land will be affected by the proposal.

However, the proposal may indirectly impact a population of the Commonwealth Vulnerable species *Cryptostylis hunteriana*, which is known from adjoining lands.

The study area is unlikely to impact any important populations of *Cryptostylis hunteriana*; necessary for the species' long-term survival and recovery. The known populations occur on densely vegetated lands at least 200m from the boundaries of the study area. As such, the proposal will not directly impact this known population.

The proposal may impose indirect impacts on the adjacent population of the species resulting from unauthorised access into these vegetated lands by vehicles. The population is at sufficient distances from the proposal to be unaffected by weed invasion. The proposal will provide appropriate vehicle-proof fencing of the southern, eastern and western boundaries of Stages 2 and 3 to control vehicle access. The design has already incorporated a perimeter road to avoid building blocks adjoining the State Conservation Area, thereby reducing the potential for incursions by neighbours into this vegetation.

Thus, with respect to Commonwealth Vulnerable Species, the proposal is unlikely to:

- lead to a long-term decrease in the size of an important population of a species; or,
- reduce the area of occupancy of an important population; or,
- fragment an existing important population into two or more populations; or,
- adversely affect habitat critical to the survival of the species; or,
- disrupt the breeding cycle of an important population; or,
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or,

- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; or,
- interfere substantially with the recovery of the species.

The proposal is unlikely to have a significant impact on Commonwealth Vulnerable Species listed by the *EPBC Act* that may occur in the study area.

Following consideration of the administrative guidelines for determining significance for matters of national environmental significance that may be impacted by the proposal, it is concluded that the proposal is unlikely to have a significant impact on any matter of national environmental significance, and that a referral to the Commonwealth Environment Minister is not required.

5.9 Impacts on Waterways

The proposal will involve clearing of some riparian vegetation for roads in the west and for residential lots and roads in the east. This will further fragment the riparian corridor of the creek in the west and will reduce the extent of riparian vegetation along the southern bank of the creek in the east.

The riparian vegetation associated with both creeks has already been extensively disturbed by past and ongoing agricultural practices. Although the proposal will involve additional and permanent modifications to the riparian corridors, it will also include measures to retain and improve the remaining riparian vegetation as outlined in a subsequent section of this report.

The water cycle management for the proposal documented by Patterson Britton (2006) meets the objectives of the relevant statutes pertaining to waterways, including Burrill Lake, and will provide for improvements to the current water quality regime for the study area and downstream habitats.

The impacts of the proposal on waterways are considered acceptable in the context of the measures proposed to retain, and manage riparian vegetation and the measures proposed for water cycle management.

6. IMPACT MITIGATION

6.1 Threatened Species, Populations and Ecological Communities

The extent, magnitude and significance of the impacts of the proposal on threatened species, populations and ecological communities listed on the *TSC Act* and *FM Act* have been assessed in sections 4 and 5 of this report in relation to the conservation importance of the habitat, populations and individuals likely to be affected by the proposal.

The affected threatened species, populations and ecological communities were identified as the Leafless Tongue-orchid, Glossy Black-cockatoo and *Swamp sclerophyll forest*.

The Leafless Tongue-orchid was not recorded in the study area and is not expected to occur there. The proposal may indirectly impact a known population of the species on adjoining lands if unauthorised vehicles enter these lands from roads to be constructed for the proposal. To ameliorate this potential impact, the proposal will provide an appropriate vehicle-proof fence along the western and southern boundaries of Stages 2 and 3 to control vehicle access.

The two known feed trees of the Glossy Black-cockatoo to be removed for the proposal will not impede the ability of the local population to successfully forage in the locality. Impact mitigation for this species will involve preferential use of Black She-oak in landscaping for the proposal to provide future foraging resources for the species.

The assessment identified that the key biodiversity conservation issue for the proposal in the study area is *Swamp sclerophyll forest* and the proposal has been designed to minimise direct impacts on this endangered ecological community and mitigate indirect effects via appropriate hydrological and vegetation management.

Parts of this endangered ecological community in the Stage 5 area will be set aside and managed for long-term biodiversity conservation via an approved vegetation management plan, to provide an offset for the impacts of the proposal on the *Swamp sclerophyll forest* in the study area. The precise extent and configuration of the proposed offset vegetation within the Stage 5 area is yet to be determined, as this part of the proposal is in the conceptual design phase, but the area to be offset will be at least equivalent to that proposed for removal in Stages 2 and 3. Other areas of *Swamp sclerophyll forest* will also be retained within the study area (Stages 2 and 3) and managed for biodiversity conservation, comprising approximately 0.46 ha of Disturbed Paperbark Shrubland, 0.28 ha of Regrowth Paperbark Shrubland and 0.06 ha of Bangalay Swamp Forest.

The locations of vegetation to be removed and vegetation to be retained and managed for biodiversity conservation are shown in Figure 5 (Appendix A). The proposed offset vegetation will be located within the Stage 5 area to the north-east.

The following impact mitigation and offset measures will be implemented for *Swamp sclerophyll forest*:

a) Retention of 0.38 ha of *Swamp sclerophyll forest* in the west of the study area (Stage 3) and 0.43 ha in the east of the study area (Stage 2).

b) Provision of *Swamp sclerophyll forest* to the north-east of the study area (Stage 5) as an offset for disturbances to this vegetation in the study area.

c) Management of retained and offset *Swamp sclerophyll forest* via an approved vegetation management plan.

d) Securing of the management of retained and offset *Swamp sclerophyll forest* by implementation of the approved vegetation management plan by the owners of the affected land via positive covenants placed on the titles of the affected land.

e) Provision of roads adjoining the *Swamp sclerophyll forest* wherever possible to provide a line of demarcation between disturbed areas and protected areas.

f) Provision of an appropriate perimeter fence for the *Swamp sclerophyll forest*.

g) Preparation of a vegetation management plan for the retained and offset *Swamp sclerophyll forest* to address issues such as protection and maintenance of the vegetation, weed control, vegetation enhancement, control of access, monitoring and fire management.

h) Design of water cycle management and water quality treatment systems for the proposal that maintain the existing hydrologic regime in the area of the *Swamp sclerophyll forest* and protect the community from adverse water quality impacts (Patterson Britton 2006).

The vegetation management plan will be prepared by a suitably qualified person and funded by the applicant. The plan will be approved by the consent authority prior to its implementation. Responsibility for implementation of the vegetation management plan will rest with affected landowners.

6.2 Other Components of Biodiversity

The extent, magnitude and significance of the impacts of the proposal on other components of biodiversity have been assessed in sections 4 and 5 of this report as related to the conservation value of the habitat, populations and individuals likely to be affected by the proposal.

In this context, the impacts on vegetation communities, regionally significant flora species, fauna habitats, habitat connectivity and matters of national environmental significance arising from the proposal are not considered significant.

The vegetation communities to be affected by the proposal are not restricted to the study area and are well–reserved in the Shoalhaven local government area and the region. The proposal

has been designed with a perimeter road to avoid residential lots adjoining the State Conservation Area, thereby reducing the potential for incursions by neighbours into this adjoining vegetation. The provision of restrictions on the use of noxious and/or invasive weed species in landscaping for the proposal will further ameliorate indirect impacts on adjoining vegetation in the conservation reserve.

The fauna habitats to be affected by the proposal are not restricted to the study area. There are limited foraging substrates for fauna species and trees with hollows were not inhabited by any fauna species during the survey period. Superior habitats occur on adjacent and nearby lands. Some foraging resources will be retained within the *Swamp sclerophyll forest* community and managed for conservation via an approved vegetation management plan. The proposal includes the requirement to restrain domestic cats and dogs within the dwelling curtilage on all new allotments at all times in recognition of the habitat conservation values of the adjacent conservation reserves.

The proposal will further disrupt habitat connectivity through the study area, but this has already been substantially disrupted by past and ongoing activities. The provision of appropriately managed offset vegetation within the Stage 5 area will improve habitat connectivity between the coastal floodplain and vegetated lands in the east.

6.3 Waterways

The bulk of the existing riparian vegetation associated with the creek in the west will be retained as shown in Figure 5 (Appendix A) and managed in accordance with an approved vegetation management plan to improve its condition. Riparian vegetation will be re-established on either side of this creek wherever possible to maximise the width of the riparian corridor. This re-establishment will be constrained by the road corridor in the south and by asset protection zone requirements for dwellings in the north.

The creek in the east will be provided with an area of riparian and floodplain vegetation along its northern banks as shown in Figure 5 (Appendix A). This vegetation will also be managed in accordance with an approved vegetation management plan to improve its condition.

The management of riparian vegetation will be secured via positive covenants placed on the titles of the affected land requiring implementation of the approved vegetation management plan by the landowners.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

This report has identified and described the biological environment of Stages 2, 3 and 5 of Lot 1 DP 1045990 Princes Highway, Dolphin Point Road. The report has assessed the potential impacts on flora and fauna, including threatened and migratory species, endangered populations and threatened ecological communities, or their habitats, of the proposal to undertake a residential subdivision on the property.

The threatened species, populations and ecological communities given detailed consideration in this report were identified as the Leafless Tongue-orchid, Glossy Black-cockatoo and *Swamp sclerophyll forest*.

The key biodiversity conservation issue associated with the proposal was identified as the endangered ecological community *Swamp sclerophyll forest on the coastal floodplains of the North Coast, Sydney Basin and South East Corner bioregions*.

It is concluded that:

a) The proposal includes actions to avoid, mitigate and offset impacts on *Swamp sclerophyll forest* that will maintain or improve the biodiversity values of this endangered ecological community.

b) The proposal is unlikely to reduce the long-term viability of a local population of the Leafless Tongue-orchid, Glossy Black-cockatoo or *Swamp sclerophyll forest*. The hydrologic and vegetation management practices to be implemented for the proposal along with the design of roads will provide appropriate long-term protection for the *Swamp sclerophyll forest.*

c) The proposal is unlikely to accelerate the extinction of the Leafless Tongue-orchid, Glossy Black-cockatoo or *Swamp sclerophyll forest*. No populations of the Leafless Tongue-orchid or breeding habitat for the Glossy Black-cockatoo were recorded in the study area. The extent of foraging resources for the Glossy Black-cockatoo to be affected by the proposal is very small relative to the home range of this highly mobile fauna species and the presence of extensive foraging resources in adjoining conservation reserves.

d) The proposal will not affect critical habitat as none is listed in the Shoalhaven local government area.

e) The study area does not contain any potential or core Koala habitat pursuant to *NSW State Environmental Planning Policy No 44 – Koala Habitat Protection*.

f) Following consideration of the administrative guidelines for determining significance under the *Commonwealth Environment Protection & Biodiversity Conservation Act 1999*,

the proposal is unlikely to have a significant impact on matters of National Environmental Significance, and a referral to the Commonwealth Environment Minister is not necessary.

7.2 Recommendations to Mitigate Impacts on Biodiversity Values

The proposal will incorporate the following measures to mitigate the impacts on threatened species, populations, ecological communities, migratory species or their habitats, and minimise the impacts of the proposal on the flora and fauna values of the study area in general.

Vegetation and Habitat Management

1. Approximately 0.38 ha of *Swamp sclerophyll forest* in the west of the study area (Stage 3) and 0.43 ha in the east of the study area (Stage 2) will be retained intact by the proposal.

2. An area of *Swamp sclerophyll forest* to the north-east of Stage 2 (within Stage 5) will be provided as an offset for disturbances to this vegetation community in Stages 2 and 3. The offset vegetation will comprise an area at least equivalent to that proposed for removal in Stages 2 and 3 and its location and configuration will be determined during the detailed design phase for the Stage 5 proposal.

3. The extent of *Swamp sclerophyll forest* to be retained and offset will be marked in the field by an appropriately qualified person and the vegetation boundaries surveyed by a registered surveyor.

4. The retained and offset *Swamp sclerophyll forest* will be managed via an approved Vegetation Management Plan.

5. The management of retained and offset *Swamp sclerophyll forest* will be secured by will be secured via positive covenants placed on the titles of the affected land requiring implementation of the approved Vegetation Management Plan by the affected landowners.

6. Roads will be designed to adjoin the *Swamp sclerophyll forest* wherever possible in order to provide a line of demarcation between disturbed areas and protected areas.

7. An appropriate perimeter fence will be constructed around areas of retained and offset *Swamp sclerophyll forest.*

8. Riparian vegetation will be re-established on either side of the creek in the west (southern part of Stage 3) wherever possible, to maximise the width of the riparian corridor.

9. A Vegetation Management Plan will be prepared by a suitably qualified person for the retained and offset *Swamp sclerophyll forest* and for re-established riparian vegetation. The Vegetation Management Plan will address a number of matters including, but not limited to, protection and maintenance of the *Swamp sclerophyll forest*, weed control, vegetation enhancement, control of access, monitoring and fire management.

10. The water cycle management and water quality treatment systems for the proposal will be designed such that they maintain the existing hydrologic regime in the areas of the *Swamp sclerophyll forest* and protect these communities from adverse water quality impacts.

11. A vehicle-proof fenced designed and constructed in consultation with the Department of Environment and Conservation (DEC) will be constructed along the western and southern of Stages 2 and 3 where they adjoin lands managed by the DEC.

12. Subdivision design for Stages 2 and 3 will avoid residential lots that abut the adjoining Barnunj State Conservation Area.

13. Trees will be retained within the proposal wherever possible.

14. All trees and vegetation to be retained will be appropriately protected from compaction of root systems, damage to trunks, and the build-up of soil around tree bases, by appropriate work practices during the construction phase of the proposal.

15. All vegetation to be retained will be protected from unauthorised access during the construction phase of the proposal. An induction program for workers will be developed and implemented to inform them of the limitations of the construction site. Temporary fencing will be installed along the edges of vegetation to be retained and workers will be instructed to avoid encroaching into such vegetation.

16. Trees with hollows to be felled during the construction phase, will be felled in accordance with the following procedures:

    a) Felling will be supervised by a fauna specialist appropriately licensed under the *NSW National Parks and Wildlife Act 1974*, for the purpose of rescuing displaced fauna.

    b) The fauna specialist will be suitably attired with protective clothing and have suitable equipment to undertake the work. A “green card” from an Occupational Health and Safety Induction Training Course for Construction Work will also be held by the fauna specialist, who may also need to be suitably vaccinated (especially if there is potential for handling bats).

    c) An appropriately skilled local wildlife carer must be notified at least 24 hours prior to the tree felling, that animals may be captured and that these animals may need care.

d) Any non-hollow-bearing trees around those with tree hollows to be felled will be removed first. At least one day will be left between clearing of the non-hollow-bearing trees and the hollow-bearing trees to allow fauna time to vacate the trees.

e) Prior to felling of the identified and marked hollow-bearing trees, the trees will be shaken or nudged by tree-felling equipment to encourage any fauna to vacate the trees.

f) If no animals emerge from the hollows after shaking or nudging, then the tree will be felled and lowered to the ground if possible.

g) If an animal emerges from a hollow following shaking or nudging of the tree, then at least 30 minutes will be allowed for the animal to leave the tree. If the animal comes to the ground, or when it is on the lower trunk, attempts will be made to capture the animal using a net. Captured animals will be immediately transferred to a suitably sized cotton bag and checked for obvious injury during the transfer process.

h) Captured animals will be placed in individual bags unless they are a family group to which separation would risk the survival of the young (i.e. a lactating female with young).

i) Once the tree has been felled, a search will be made of the branches around the tree for any fleeing fauna and hollows should be inspected with a torch for the presence of any animals. Attempts will be made to capture any fleeing fauna with a net, and animals inside hollows should be extracted by hand. Captured animals will be immediately transferred to a suitably sized cotton bag and checked for obvious injury during the transfer process.

j) Injured, shocked or immature captured animals will be placed in a cotton bag secured at the top. Bags will be wrapped in appropriate insulating material such as blankets and placed in a quiet, warm and preferably dark place until the wildlife carer can collect them. Details on the location of the capture and proposed release areas will be provided to the wildlife carer.

k) Uninjured animals will be released in appropriate habitat as soon as practicable (at night for nocturnal species).

Drainage Management

17. Drainage management within Stages 2 and 3 of the proposal will be designed to minimise alterations to the hydrologic regime of the catchment of the small coastal floodplain downstream of the study area.

18. Stormwater flows will be returned to the watercourse in the west and to the floodplain vegetation in the east via a stormwater drainage system designed to mimic current flow rates, frequencies and volumes. The proposal will improve water quality for flows leaving the site via the pollutant removal devices, which will reduce the pollutant loads resulting from current agricultural uses.

19. The principles of Water Sensitive Urban Design will be incorporated into the proposal.

Sediment Controls

20. Appropriate sediment control measures will be established before the commencement of work on the proposal and retained in place until all bare areas have been revegetated.

21. An Erosion and Sediment Control Plan will be prepared in accordance with the Blue Book.

Landscaping

22. Exotic perennial grasses will not be sown in any areas that abut native vegetation to be retained or re-established within the proposal or native vegetation on adjoining lands. If grasses are to be used in these areas, for landscaping or soil stabilisation purposes, then indigenous native species or non-invasive exotic species will be used.

23. Native plants from the species list in Table 4 of this report will be included in any landscaping for the proposal.

24. Black She-oak *Allocasuarina littoralis* sourced from local nurseries will be preferentially used in landscaping for the proposal.

25. No known environmental weeds, noxious weeds or known invasive plant species will be planted within the study area in association with the proposal.

Domestic Pet Management

26. Any domestic pets to be kept within the sub-division will be restrained wholly within the dwelling curtilage at all times, unless secured on a leash.

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APPENDIX A: FIGURES

Figure 1: Location of Lot 1 DP 1045990 Princes Highway, Dolphin Point (Stages 2, 3 and 5)

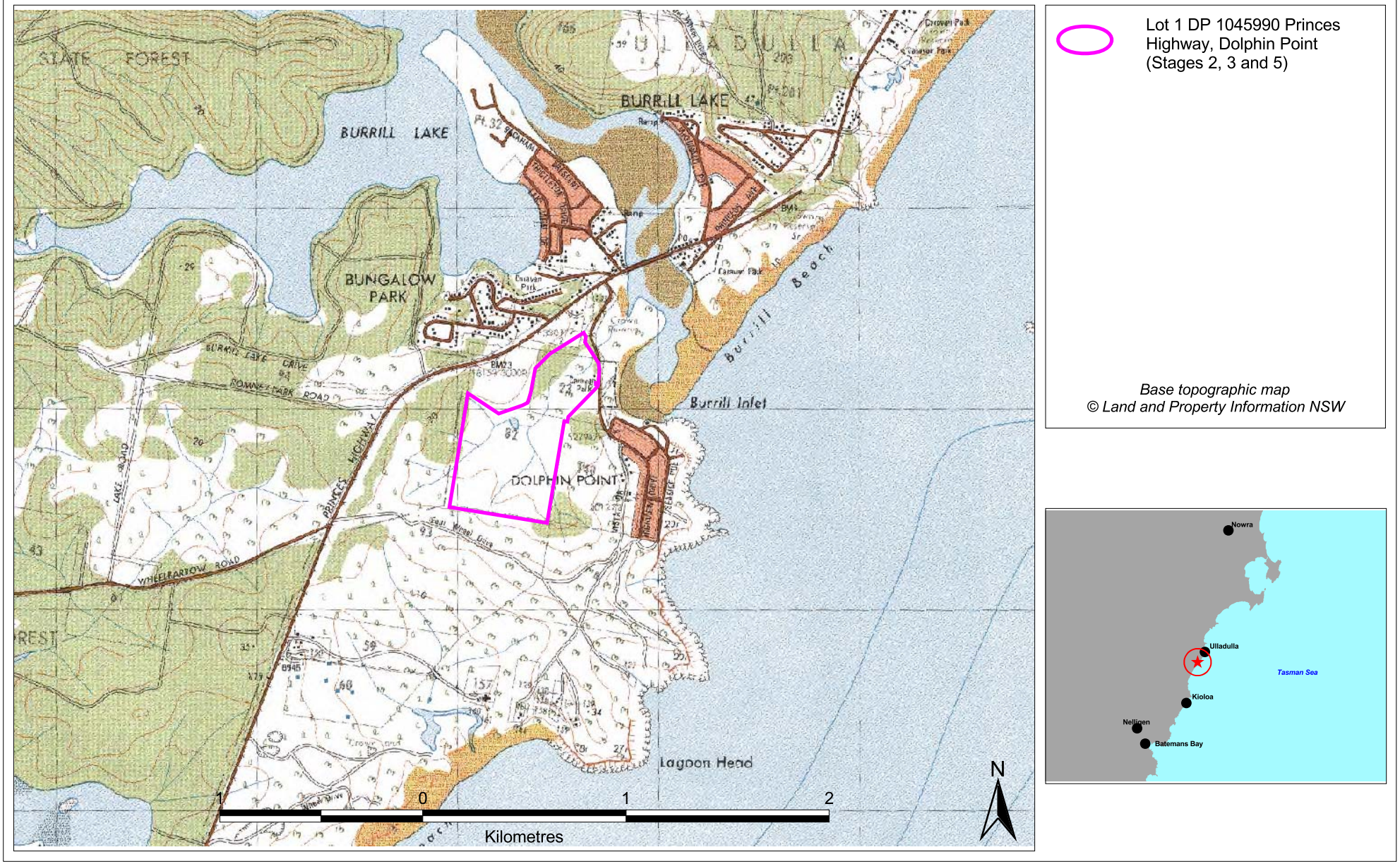

Figure 2: Study area and location of flora and fauna surveys

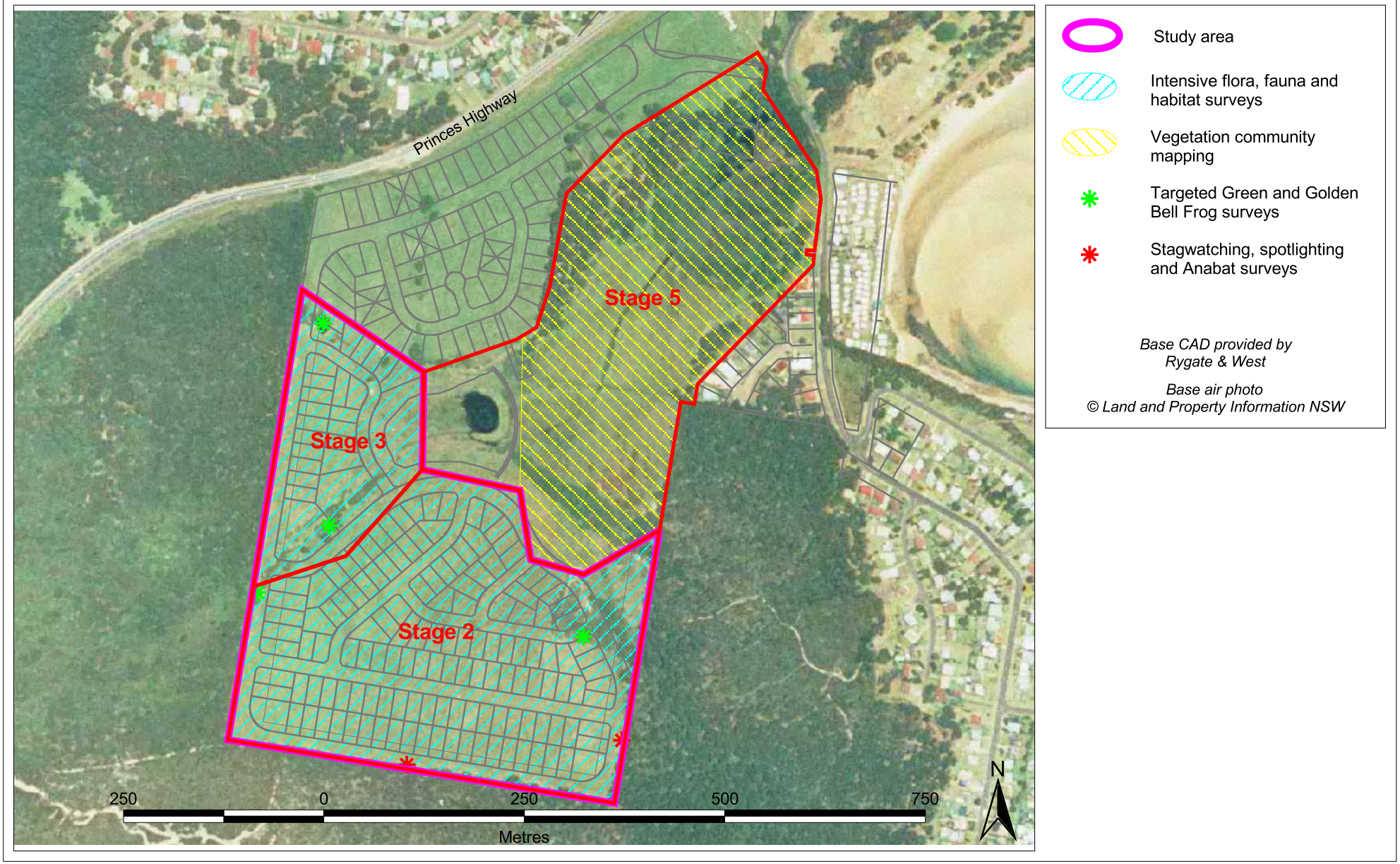

Figure 3: Vegetation in the study area and the Stage 5 area

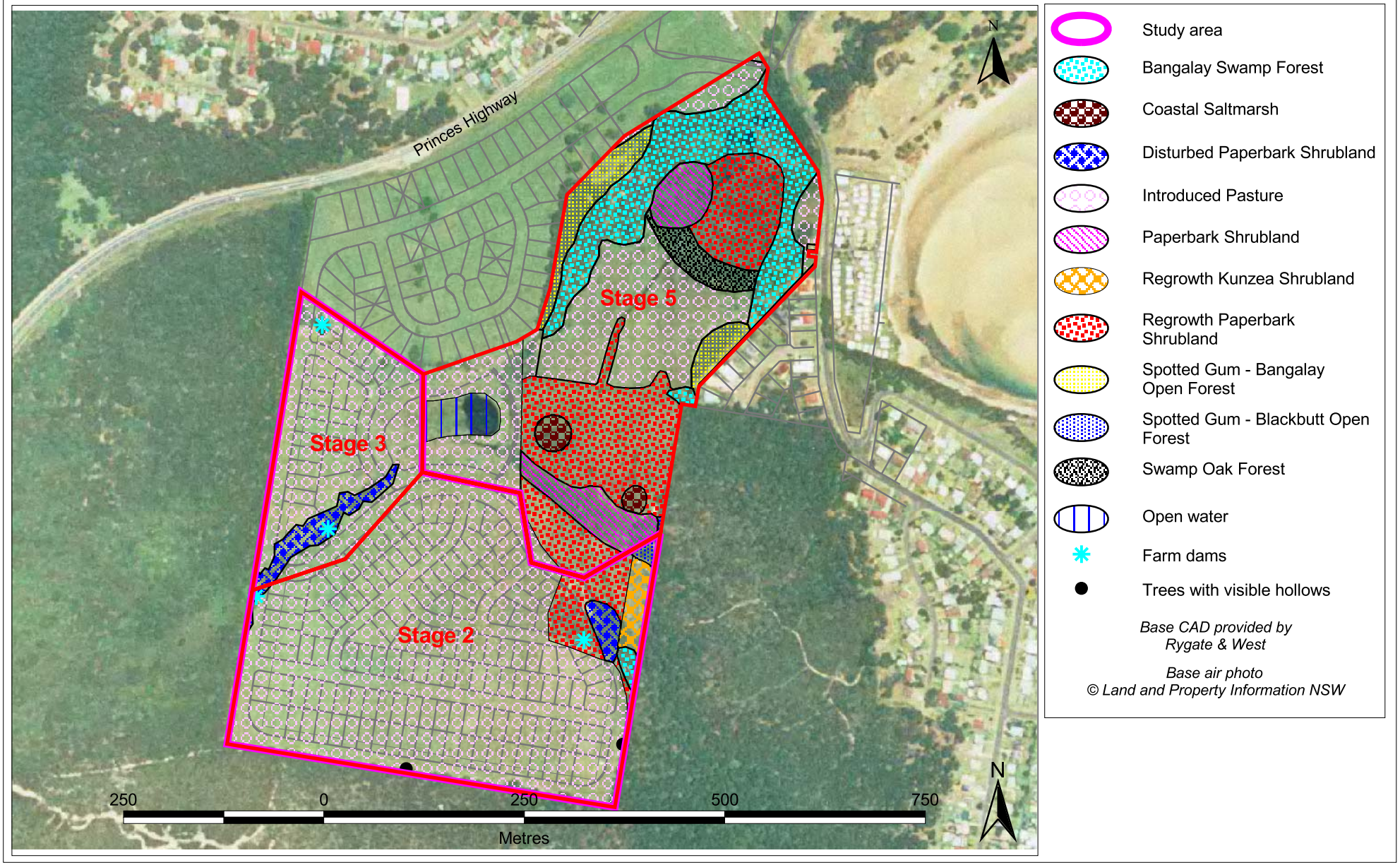

Figure 4: Species and communities of conservation significance

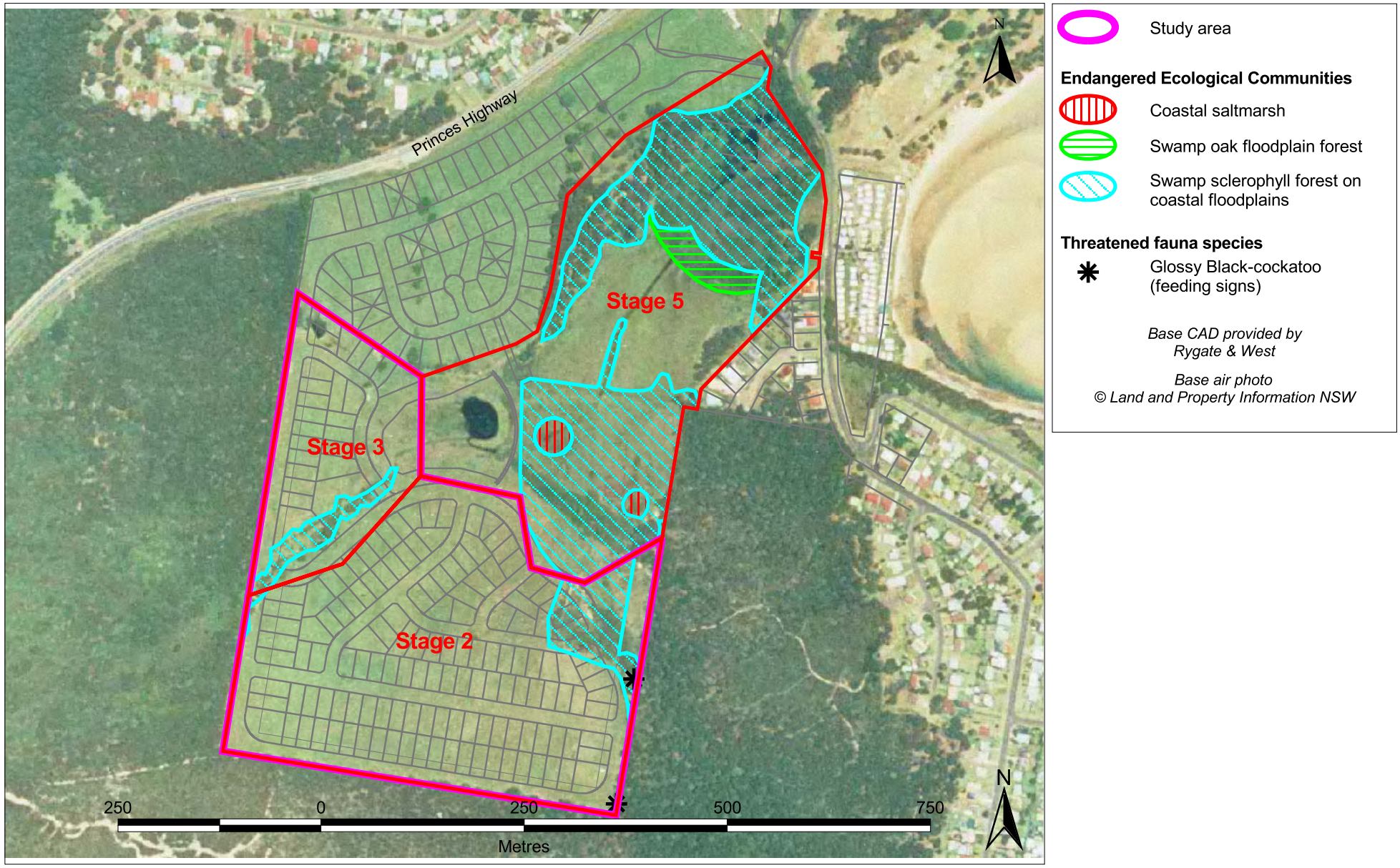

Figure 5: Endangered ecological communities to be retained and removed in Stages 2 and 3