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Flora and Fauna
Impact Assessment

Le Clos Verdun Rural Residential Estate
Sancrox Road
Port Macquarie LGA

For: Riverpark Sancrox Pty Ltd

REF: PMHC 07-060
December 2008

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This document may be cited as:

Ashby, E. (2008) Flora and Fauna Impact Assessment, Sancrox, Port Macquarie LGA. Unpublished report, Keystone Ecological

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Cover: Photo looking north west across the Hastings River that bounds the site. The vegetation fringing the river is a narrow band of mangroves (foreground) and riverine eucalypts and rainforest (background).

Photo: E. Ashby, 21 Aug 08

SUMMARY

Keystone Ecological has been contracted by Riverpark Sancrox Pty Ltd to assess the ecological constraints associated with the proposed development at Lot 51 DP 775871, Lots 1-13, 15-66, 68, 70-72, 74-80, 83-84, 86-88 DP 79119 and Lots 90-95 DP 805549, Sancrox Road, Sancrox in the Port Macquarie Local Government Area. It is proposed to develop "Le Clos Verdun Rural Residential estate", a complex of 144 rural residential lots in Community Title.

This proposal has been designated as a Major Project and therefore its assessment procedure is guided by the Director-General's Requirements. Accordingly, this Flora and Fauna Impact Assessment has considered the potential impact of the proposal on nationally and state listed threatened species, populations, endangered ecological communities and their habitat as required by the Draft Guidelines for Threatened Species Assessment (DEC 2005).

Commonwealth legislation (Environment Protection and Biodiversity Conservation (EPBC) Act 1999) requires that actions judged to significantly impact upon matters of National Environmental Significance are to be assessed via a formal referral process. This assessment report determines whether a referral to be made to the Department of Environment and Water Resources for further assessment is required.

The subject site is currently managed as a grazing property and supports large areas of cleared grassland, some woodland and riparian vegetation. It is adjacent to other rural or residential development but still supports significant ecological features such as endangered ecological communities, threatened species and a number of mature hollow-bearing trees. The important areas of habitat and vulnerable communities have already been incorporated into Zone 7(h) Environment Protection – habitat.

The flora and fauna survey identified the following on the subject site:

Endangered ecological communities

Swamp Oak Floodplain Forest
Lowland Rainforest on Floodplain
Freshwater Wetlands on Coastal Floodplains
Subtropical Coastal Floodplain Forest on Coastal Floodplains

Threatened fauna

Glossopsitta pusilla Little Lorikeet
Mormopterus norfolkensis Eastern Freetail-bat
Miniopterus australis Little Bentwing-bat
Myotis macropus Large-footed Myotis

Habitat was also assessed for significant species with the potential to occur, but not recorded during surveys. This included:

Threatened Flora:

Melaleuca biconvexa
Maundia triglochinoides
Phaius tancarvilleae Greater Swamp-orchid

Threatened Fauna:

Ephippiorhynchus asiaticus Black-necked Stork
Pandion cristatus Eastern Osprey
Ptilinopus magnificus Wompoo Fruit-dove
Ptilinopus regina Rose-crowned Fruit-dove
Calyptorhynchus lathami Glossy Black-Cockatoo
Ninox strenua Powerful Owl
Tyto capensis Grass Owl
Tyto novaehollandiae Masked Owl
Phascogale tapoatafa Brush-tailed Phascogale
Phascolarctos cinereus Koala
Pteropus poliocephalus Grey-Headed Flying-fox
Miniopterus schreibersii oceanensis Eastern Bent-wing Bat

SUMMARY

A number of hollow-bearing trees occur in the ridge line open forest remnant and in the site's south eastern corner. Both of these areas are zoned for protection.

Some very small areas of realised and potential habitat for Swamp Oak Floodplain Forest will be filled. These minor losses will be more than offset by the retention of the vast majority of the swamp forests associated with Haydons Creek.

Also, low-lying areas that are now semi-cleared and subject to grazing will be allowed to regenerate naturally when the cattle are removed from the rural residential estate. Active vegetation management will also be implemented for sensitive vegetation types that are susceptible to weed invasion, such as the Rainforest and Swamp Oak Floodplain Forest.

On site effluent disposal shall be accommodated in the new lots and directed away from the downslope environments. The existing dams are to be retained and incorporated into open space, allowing for the retention of their fauna habitat values.

The current crossing at Haydons Creek is unformed and unregulated. The formalisation of the crossing will allow for the removal of threatening processes from the riparian zone and shall comply with the requirements of the Water Management Act (2005) and Regulations (2008).

The major conclusion arising from this Flora and Fauna Impact Assessment is that the proposed works are unlikely to result in a significant impact on any listed species or communities and will satisfy the "improve or maintain" test for biodiversity values, principally by the removal of grazing, implementation of a landscape / vegetation management plan, control of nutrients and stormwater and construction of a formal crossing over Haydons Creek.

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1 INTRODUCTION

1.1 Objectives

Keystone Ecological has been contracted by Riverpark Sancrox Pty Ltd to prepare an assessment of the likely impact of a proposed development upon nationally and state listed threatened flora and fauna and their habitats. It is proposed to develop "Le Clos Verdun Rural Residential Estate", a residential subdivision at Sancrox, approximately 11 kilometres west of Port Macquarie.

This development proposal has been designated as a Major Project (number MP-06-0212) to which Part 3A of the Environmental Planning and Assessment Act (1979) applies. As a consequence, its environmental assessment procedures and scope are determined by the Director General's Requirements (DGRs) as issued by the Department of Planning on 12th January 2007.

The Environmental Assessment for this project was submitted in April 2008 with associated documents, including the ecological impact assessment by Salter (2008). Subsequently, the Department of Environment and Climate Change (DECC) requested that more information be supplied and, after a site visit with Keystone Ecological, further refined their issues to be addressed. This Flora and Fauna Impact Assessment is a result of DECC's request.

The DGRs and DECC specified the need to address:

1. Assessment of all threatened or vulnerable flora and fauna species, including the Koala and highly mobile species such as birds and bats, which may be present on the site;
2. Identify any measures to protect or mitigate for any adverse impacts;
3. Assessment of native vegetation clearing;
4. Identify areas suitable for rehabilitation and revegetation, including the riparian corridor along the Hastings River and Haydons Creek;
5. Provide mapping of buffers to waterways and wetlands;
6. Address the impact on threatened species;
7. Address the impact on potential endangered ecological communities;
8. Identify offsets where necessary; and
9. Address the impact on corridor links and wildlife movement, particularly at the proposed crossing point of Haydons Creek.

Thus, this assessment has been guided by the above, along with the following procedures:

1. Review of the existing literature and information currently available for the subject site and general locality to determine issues for consideration;
2. Flora survey to identify species and vegetation communities present on the subject site;
3. Fauna survey to identify species present on the subject site;
4. Assessment of the conservation value of the species and communities recorded or identified with potential to occur on the subject site. This includes assessment of the condition of vegetation communities and the value of the subject site as fauna habitat;
5. Analysis of the likely significance of the impacts of the proposed action in accordance with Commonwealth and State legislative requirements and local guidelines; and
6. Identification of specific measures that may be incorporated into the design of the proposed action to provide for amelioration of likely impacts upon the native flora and fauna of the subject site.

1.2 The Site and the Proposal

The subject site is known as Le Clos Verdun Rural Residential estate on Sancrox Road, Sancrox in the Port Macquarie Hastings LGSA. It is comprised of a number of lots namely:

Lot 51 DP 775871;
Lots 1-13, 15-66, 68, 70-72, 74-80, 83-84, 86-88 DP 79119; and
Lots 90-95 DP 805549.

It lies in the North Coast Bioregion in the Macleay Hastings Catchment sub-region and the centre of the site is approximately at grid reference 480417 E 3522253 N MGA on the Port Macquarie 1:25,000 topographic map sheet. The site and its immediate surrounds are shown in Figure 1.

Being a composite of a number of lots, the site is an odd shape, occupying approximately 187 hectares and situated at Sancrox, 11 kilometres to the west of Port Macquarie and 6 kilometres north east of Wauchope.

The site was previously developed as a number of shared vineyards and small residential lots. The original layout can be seen in the topographic map at Figure 1. Surrounding lands are rural and rural residential with a pet cemetery and boarding kennel immediatey to the east.

The site is bounded by a narrow band of Crown land along the Hastings River on the north western side and along Haydons Creek on its eastern boundary. The upper reaches of Haydons Creek traverses the southern part of the site. In keeping with its development as a vineyard, the site is mostly cleared, except for the low lying areas below the 1% flood line and some scattered small patches of trees.

A few residences and outbuildings are spread across the northern half of the site. The vines have been removed and the extensive areas of open grassland are grazed by a small number of cattle. Feral deer also occur on the site.

The site occupies the floodplain and low rises associated with the Hastings River and Haydons Creek. The site straddles two physiographic regions, with the Gladstone Alluvial Plains on the lower parts and the Kempsey Low Hills on the rises. The swampland and swamp forest remaining on the site coincide with the Alluvial Plains.

Very little of the site supports native vegetation, with approximately 82% or 153.6 hectares being cleared grassland. Woodland and forest vegetation is confined primarily to the east and south eastern corner and, together with the scattered patches of remnant and planted trees and a small swampy area, occupies approximately 33.4 hectares. These areas have been subjected to varying degrees of disturbance, including tree removal, firewood collection, grazing and weed incursion.

The distribution of vegetation across the site is shown in Figure 2.

The proposal has been developed as an iterative process whereby Keystone Ecological and others assessed the physical and biological constraints of the site. The proposal is to subdivide the site into 144 rural residential lots under community title. The developable area has been determined largely by the constraints imposed by the flood zone and the distribution of important ecological features such as endangered ecological communities and hollow-bearing trees. The important riparian and vegetated parts have been zoned 7(h) Environment Protection – Habitat. The low-lying vegetation will remain essentially untouched.

Relevant parts of the proposed works associated with the subdivision include:

1. Minor filling for part Lots 110-111 and Lots 87-90 in the community title subdivision;
2. Landscaping works will include the management of existing landscaping within the estate and re-planting within access and drainage routes, ridgelines, gullies and the revegetation and rehabilitation of disturbed sections within the Haydons Creek Riparian Zone;
3. Integrated Surface and Stormwater Management strategy incorporating existing inter-allotment drainage, proposed bio-retention systems, culvert crossings for Haydons Creek road access, sediment control/detention dams to be located within community land, and a new dam structure to the northeast of the proposed cluster lots;
4. An integrated system of fire-trails within the rear of bushfire prone sites, acting as linkages within the proposed internal road system for emergency vehicle access; and
5. Establishment of future nature walkways along the Hastings River and Haydons Creek Crown Reserves on the perimeter of the development site.

The proposal is detailed in drawings prepared by Hopkins Consultants (reference number 6096, dated 14/10/2008) and discussed in the Environmental Assessment (dated April 2008) and Preferred Project Report (dated February 2009) and it is this proposal that is the subject of this Flora and Fauna Impact Assessment.

1.3 Legislative Background

1.3.1 Commonwealth

The Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act) is a nationally applicable Act that is administered by the Department of the Environment, Water, Heritage and the Arts. This Act requires approval for actions that are likely to have a significant impact on matters of National Environmental Significance (NES).

There are seven matters of NES that are triggers for Commonwealth assessment and approval. These are:

1. World Heritage properties;
2. National Heritage places;
3. Ramsar wetlands of international importance;
4. Nationally threatened species and communities;
5. Migratory species;
6. Nuclear actions; and
7. Commonwealth marine environment.

Threatened species and ecological communities are listed under Part 13, Division 1, Subdivision A of the EPBC Act (1999). Migratory species are listed under Part 13, Division 2, Subdivision A of the Act.

The Department the Environment, Water Heritage and the Arts identifies the following:

> *"Under the EPBC Act a person must not take an action that has, will have or is likely to have a significant impact on any of these matters of NES without approval from the Commonwealth Environment Minister. There are penalties for taking such an action without approval.*
>
> *In general, an action that may need approval under the Act will involve some physical interaction with the environment, such as clearing native vegetation, building a new road, discharging pollutants into the environment, or offshore seismic survey.*
>
> *If, following a referral, it is determined that an action is likely to have a significant impact, and approval is therefore required, the action is called a 'controlled action'. The proposal will then undergo a formal assessment and approval process, and cannot proceed unless approval is granted.*
>
> *If it is determined that an action is not likely to have a significant impact, then the action is not a controlled action. Approval under the EPBC Act is not required and the action may proceed, subject to obtaining any other necessary permits or approvals."*

1.3.2 State

This proposal has been designated a Major Project, thus extinguishing many of the notifications and processes enshrined within the Environmental Planning and Assessment Act (1979) (EPA Act) and the Threatened Species Conservation Act (TSC Act) (1995).

The DGRs specify that the potential impact on threatened species, populations or endangered ecological communities are to be assessed by application of the Draft Guidelines for Threatened Species Assessment (DEC 2005).

The objectives of these guidelines are to deliver the following environmental outcomes:

1. Maintain or improve biodiversity values (i.e. no net impact on threatened species or native vegetation);
2. Conserve biological diversity and promote ecologically sustainable development;
3. Protect areas of high conservation value;
4. Prevent the extinction of threatened species;

5. Protect the long-term viability of local populations of a species, population or ecological community; and
6. Protect aspects of the environment that are matters of national environmental significance.

The assessment procedures to be employed are aimed at evaluating the magnitude, direction and reversibility of impacts. These matters are to be particularly assessed in regard to:

1. Impacts on areas of high conservation value;
2. Populations that are important for a threatened species' long term viability; and
3. Critical features of the habitat.

Where possible, mechanisms are to be employed to avoid, mitigate and / or offset potential impacts to listed matters.

State Environmental Planning Policy No 44 – Koala Habitat Protection: This planning policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas.

In regards to development applications, this policy applies to land that has or is a part of a parcel of land of more than 1 hectare within listed LGAs, including the Port Macquarie Hastings LGA. Moreover, before Council may grant consent to develop land to which SEPP 44 applies, it must satisfy itself whether or not the land is potential or core Koala habitat. If it is deemed to be core habitat, then the development must conform to a Comprehensive Koala Plan of Management or, in its absence, to a site-specific Koala Plan of Management.

1.4 Relevant Literature

A literature review was carried out. Of particular importance were records of species of conservation significance. This background information informed the field survey and impact assessment.

The following general information was relied upon in regard to local conservation and planning issues for this study.

Soil Landscapes of the Port Macquarie Hastings-Korogoro Point 1:100,000 sheet Report (Atkinson 1999a) and Soil Landscapes of the Port Macquarie Hastings-Korogoro Point 1:100,000 Sheet Map (Atkinson 1999b)

This report and map covers that part of the mid North Coast from Port Macquarie to just south of South West Rocks. It describes geology, vegetation and soil landscapes for the region.

The subject site falls within two of the five physiographic regions defined for the map. The Kempsey Low Hills occupy the undulating to rolling low hills of the coastal range, upslope and inland from the broad Gladstone Alluvial Plains. They form the lower valley slopes and narrow floodplains of the Macleay, Wilson and Hastings valleys.

The underlying geology in the area occupied by the subject site is principally that of the metamorphic complexes of the Port Macquarie Block. There is little relationship between the parent material and soil type in this area as the regolith is deep and weathered.

The Kempsey Low Hills are dominated by residual soil landscapes near the coast (such as Thrumster near Port Macquarie) in the lower parts of the valleys and erosional landscapes inland (such as Euroka). Transferral, Alluvial and Swamp soil landscapes also occur as minor features in the lower parts of the valleys and in coastal areas.

The site contains a number of soil landscapes, reflecting the series of landscape positions: Kundabung, Cairncross, Austral Eden, Long Flat and Blackmans Point and this mapping is reproduced at Figure 3.

Kundabung is a residual soil landscape and dominates the site. Underlying geology is deeply weathered Permian mudstones of the Kempsey Beds and Beechwood Beds; there is no rocky outcropping. It typically occupies undulating rises with broad crests, extensive footslopes and drainage plains. Slopes are usually fairly gentle but range from 3% to 10% and elevations are between 5 metres and 30 metres ASL. This unit was the coastline in the early Pleistocene prior to

the formation of sand barriers and alluvial infill and therefore was exposed to salt-laden winds, giving the soils a high level of exchangeable sodium or sodicity.

The natural vegetation supported by this soil landscape is tall, open dry sclerophyll forest dominated by *Eucalyptus pilularis* Blackbutt, with *Melaleuca quinquenervia* Broad-leaf Paperbark or "scrub" in the drainage lines. Open forests of *Eucalyptus propinqua* Small-fruited Grey Gum, *Eucalyptus paniculata* Grey Ironbark and *Eucalyptus carnea* Tick-leaved Mahogany are also common, with *Corymbia gummifera* Red Bloodwood and *Eucalyptus signata* Scribbly Gum in the better drained drainage depressions.

Most of this soil landscape remains vegetated within private and State Forests, although parts of the urban areas of Kempsey and Wauchope are on Kundabung. Clearing for rural residential or agricultural purposes is limited, and its acidic soil characteristics have been ameliorated for the vineyards at Sancrox by lime-slotting.

The soils are hard-setting and have poor permeability, so revegetation of cleared areas is slow. As a result sheet erosion is common in cleared paddocks and gully erosion is common along roadsides.

Cairncross is a transferral soil landscape that borders and links the residual Kundabung soil landscape with depositional areas below. It is made up of poorly-drained alluvial and colluvial material and occurs in broad open depressions and footslopes of low relief.

Vegetation supported by this soil landscape are primarily swamp complexes dominated by *Melaleuca quinquenervia* Broad-leaf Paperbark or swamp sclerophyll forests dominated by *Eucalyptus robusta* Swamp Mahogany and / or *Casuarina glauca* Swamp Oak. Common associated species include *Melaleuca styphelioides* Prickly-leaved Tea Tree, *Eucalyptus tereticornis* Forest Red Gum and *Corymbia gummifera* Red Bloodwood. The understorey is usually composed of sedges, sometimes with a shrub layer of *Melaleuca ericifolia* Swamp Paperbark, various species of *Leptospermum* and *Callistemon pachyphyllus* Wallum Bottlebrush.

This soil landscape is generally uncleared and undeveloped, due to limitations imposed by its wet nature. However, some areas that have been cleared but not maintained have reverted to wet heath vegetation.

Blackmans Point is an estuarine soil landscape that occurs along the lower estuarine portion of Haydons Creek, below the Cairncross soil landscape. It contains deep unconsolidated Holocene estuarine sediments of saturated sand, silt, clay and mud.

Typical vegetation of these estuarine creeks is mangrove forest and woodland, saltmarsh and swamp sclerophyll forests.

Austral Eden and **Long Flat** are both alluvial soil landscapes that occur in narrow strips along the Hastings River and Haydons Creek.

Austral Eden typically occurs as a single levee crest on the edge of rivers. It comprises deep unconsolidated Holocene alluvial loams and contains the highest quality agricultural soils in the region. These have therefore been extensively cleared of their original riverine rainforests and now support cattle grazing.

Long Flat occurs in open depressions and narrow plains on Holocene fluvial sands, loams and gravels. The soils are stratified and erode into terraces along the bank of the river. Most of the original vegetation has been cleared for the establishment of improved pasture, but small existing remnants indicate that it naturally supports woody riverine vegetation dominated by *Casuarina cunninghamiana* River Oak and *Eucalyptus grandis* Flooded Gum as well as riverine rainforest in parts.

Port Macquarie-Hastings State of the Environment Report (Port Macquarie-Hastings Council 2004-2005)

This annual stocktake of the biodiversity of the LGA reported that a significant proportion (24.7%) of the LGA is protected within the National Park estate and that the area under native vegetation is relatively steady.

Principal among the responses to native vegetation clearing are the implementation of the Tree Preservation Order, requirement for supplementary plantings of Koala food trees when they are to be removed and the enhancement of wildlife corridors on an ad hoc basis.

The LGA supports a significant Koala population and although there is reportedly a slight decline in Koala mortality and morbidity, the data indicate that impacts of urban development on Koalas are still significant. This species is regarded as an indicator species of impacts on other native wildlife.

Introduced species continue to be a problem in the LGA with 18 introduced fauna species and 142 introduced flora species (22 being noxious weeds) known to occur. Anecdotal evidence indicates that there is an increase in the occurrence of Camphor Laurel across the LGA.

The Bioregions of New South Wales: their biodiversity, conservation and history (NSW National Parks and Wildlife Service 2003)

The subject site is within the North Coast Bioregion, which extends from the Hunter in the south to the NSW-Queensland border in the north. In the north of the bioregion, soils derived from basalts support sub-tropical and warm temperate rainforests or wet sclerophyll forests. Rainforests are also found inhabiting protected gullies where plant nutrients have accumulated through organic cycling in litter.

Over 200 flora and 150 fauna species found in the North Coast Bioregion are listed threatened species in the TSC Act (1995). Several of these flora species are endemic to the bioregion.

There have been declines in the numbers of birds of the grassland, woodland and forest. The numbers of rainforest species remain stable (probably due to reservation of habitat), but there is likely to be a continued loss of woodland birds, particularly those sensitive to fragmentation as clearing of this environment continues. The impact of climate change is unknown.

More than 18% of the North Coast Bioregion is in secure conservation tenure, such as in national park, nature reserve and flora reserve. The rainforests from Newcastle to Brisbane have further conservation recognition by their World Heritage listing as the Central Eastern Rainforest Reserves, representing approximately 5.4 % of the bioregion.

State Forests, that are managed primarily for forestry activities but still retain native vegetation at various levels of disturbance, occupy about or 13% of the bioregion.

The subject site occurs in the Manning-Macleay subregion, which has a complex landscape pattern resulting from a complex geology. Vegetation patterns also reflect this underlying complexity.

Threatened Plants Project (Richards 1999)

As part of the Comprehensive Regional Assessment for the North East Regional Forestry Agreement, this project aimed to provide data on the distribution and abundance of threatened plant species across the region. Specific habitats and species were targeted, resulting in the location of 252 populations of 48 targeted species and 848 incidentally recorded populations of 342 other significant plant taxa.

Although two species previously thought to be extinct were discovered, a further 10 taxa could not be found. These were mainly cryptic species, such as geophytic orchids, and their absence was also likely to be attributable to the extraordinarily dry conditions during survey.

Of the 3 significant species considered during this Flora and Fauna Impact Assessment (see Appendix 1), none were located by Richards.

Addendum to Ecological Assessment dated 9 February 2004 for proposed rezoning, subsequent subdivision and dwelling construction, Le Clos Verdun Estate (Salter 2004) and Second Addendum to Ecological Assessment dated 9 February 2004 and First Addendum Report dated 26 May 2004 for a proposed subdivision into 144 rural residential lots (Salter 2008)

As well as the general literature cited above, the site and the proposal have been the subject of a previous environmental assessment initially prepared by Salter (2004) for the rezoning proposal and updated (Salter 2008) for the current subdivision. In that study, it was found that the site

supports one endangered ecological community – Lowland Rainforest as a small remnant in the north eastern corner – and one threatened species was detected – scats identified as *Phascolarctos cinereus* Koala were found in the site's south eastern corner.

Formal assessments of significance pursuant to section 5A of the EPA Act (1979) and the EPBC Act (1999) concluded that the proposed subdivision and subsequent development of the available developable areas would not result in a significant adverse impact on any matters of import.

2 FLORA SURVEY AND RESULTS

2.1 Survey Methodology

2.1.1 Pre-survey Investigations

Prior to the detailed survey of the subject site, and in addition to the literature review as described in Section 1 above, the following was carried out:

1. An initial site inspection and assessment occurred on 19th August 2008.

2. Colour aerial photography was interpreted prior to field survey to delineate preliminary vegetation community boundaries and areas of disturbance on site.

3. A search of the EPBC Act (1999) database using the Protected Matters Search Tool on the Department of the Environment and Water Resources website (www.environment.gov.au/erin/ert/epbc/index.html) was completed. The search area was confined to a 10 kilometre radius of the site. This identified species of conservation significance under the EPBC Act (1999) that may require habitat assessment or targeted survey.

4. The online component of the Atlas of NSW Wildlife (NSW NPWS 2008, http://wildlifeatlas.nationalparks.nsw.gov.au) was interrogated for the Kempsey 1:100,000 scale map sheet. A search was also performed for an area confined to a 10 kilometre radius of the site. This search provided records of species of threatened flora within the locality.

5. PlantNet, the online database of the National Herbarium of NSW at the Royal Botanic Gardens were interrogated (http://plantnet.rbgsyd.nsw.gov.au/floraonline.htm) for rare or threatened species that have been recorded in the locality.

2.1.2 Botanical Survey

Botanical survey was conducted on the 19th, 20th, 21st and 22nd August 2008 across the subject site. Flora were sampled by way of full floristics quadrats, transects and random meander across the entire site.

Six quadrats of 400 square metres each in area were located across the site, sampling each of the photo patterns observed on the aerial photography. Their locations are shown in Figure 4.

The data recorded are consistent with the standards used by the NSW NPWS and the Royal Botanic Gardens. The data recorded included:

1. Geographical information (MGA, location, relevant aerial photography and topographic map);
2. Physical features (topographic position, elevation, slope, aspect and general soil type);
3. Disturbance history (including grazing, clearing/logging, weeds and fire);
4. Structural features of the vegetation according to Specht et al. (1995) (numbers and types of layers present, their heights, canopy cover, and three most dominant species in each layer); and
5. Species and their cover abundance using a modified Braun-Blanquet scale.

Specimens were collected for later identification of plants not readily identifiable in the field. Such specimens were identified according to Harden (1990, 1991, 1992, 1993) and the interactive flora (Flora Online) provided online by NSW National Herbarium of the Royal Botanic Gardens (http://plantnet.rbgsyd.nsw.gov.au/floraonline.htm).

2.1.3 Survey Limitations

All surveys have inherent limitations as they can only ever represent a sample in time and place of the site's flora. Besides the unavoidable sampling bias to the area actually surveyed, in this instance, the results of the survey are also constrained by weather, disturbance history and season.

At the time of survey, south eastern Australia was experiencing the worst drought on record, thus many species may occur on the site as undetectable seed and root stock.

The season of survey also influences the plant species recorded. Many grasses, for example, can only be identified when they are flowering and fruiting; many orchids can only be detected when they are flowering. The survey was conducted in late winter prior to the flowering season of most species.

For the 3 flora species of interest for this site, the season and method of survey was appropriate for *Melaleuca biconvexa* and *Maundia triglochinoides*. The season of survey was too early to easily detect *Phaius tancarvilleae* Greater Swamp-orchid. However, it is thought that this species only occurs north of the Hastings River and may be extinct in the southern part of its range. Thus the potential habitat on site is marginal for this species and it is unlikely to occur.

The details of survey adequacy are given in Appendix 1.

The sampling quadrats were located within the naturally-vegetated areas. The cleared areas were sampled by transect because of their extent, nature and high level of disturbance. As a consequence, the occurrence of introduced species within the grassland areas may be under-reported.

2.2 Floristic Composition

In total, 141 locally-native species and 46 introduced species were observed within the subject site. A species list is provided in Appendix 1.

These 187 species are representative of 76 families, five of which dominate: the Myrtaceae (22 species), Poaceae (17 species), Asteraceae (12 species), Fabaceae (10 species) and Cyperaceae (7 species) are represented by more than 4 species. These five families account for more than a third of all flora species recorded on the subject site and a third of the weeds. The other major groups represented are the Apiaceae, Mimosaceae, Juncaceae and Pittosporaceae, all with 4 species each.

This diversity of species is a reflection of the site's size, soil types and the number of vegetation types. Myrtaceous species dominate the woodland and forest of the hills and flats (*Eucalyptus* species) and the low-lying areas (*Melaleuca* species). The dominance of the Poaceae reflects the extent of the cleared open grassland and most of the Asteraceae recorded are also weeds of disturbed areas. This area has experienced a consistent agricultural pressure over many years. Its fire history is unknown.

Notable is the contribution of the Rainforest vegetation type to the numbers and types of species on the subject site. Although accounting for only 0.3% of the area of the site, this diverse vegetation contained 68 species (37%) and 24 families (32%) that only occurred in that vegetation type.

No threatened plant species were recorded, however four endangered ecological communities were observed – Swamp Oak Floodplain Forest, Freshwater Wetlands, Rainforest and Subtropical Coastal Floodplain Forest. These are discussed below.

2.3 Vegetation Description

The distribution of the vegetation types delineated on the subject site is shown in Figure 4.

2.3.1 Cleared Open Grassland

This vegetation type occurs across approximately 154 hectares or 82% of the subject site and is illustrated in Photograph 1.

The pasture lands are derived grasslands, the result of clearing natural woodland and sedgeland for viticulture and its subsequent removal, sowing of pasture species and grazing.

It is dominated and characterised by grass species (Poaceae) and also supports many weeds (see Table 1.1 in Appendix 1). As there are only small numbers of grazing cattle, there are many areas where the pasture is high (up to 1 metre) and dense (up to 100% cover).

Although this is the dominant vegetation type on the site in terms of area, floristic sampling was restricted to walking transects and random meander. This is due to the fact that it has been the

subject of very intense and sustained disturbance, and therefore highly unlikely to support species of conservation significance.

This vegetation type is concentrated on the hills and rises and occurs principally on the Kundabung soil landscape.

Most of the proposed development is concentrated in this vegetation type.

2.3.2 Swamp Oak Floodplain Forest

This vegetation type occurs across approximately 24.2 hectares or 13% of the subject site and is illustrated in Photograph 2. It is made up of highly disturbed remnants in the upper reaches of Haydons Creek that are regenerating naturally (at C1, C2 and D3 in Figure 4) and large patches of forest that are relatively intact in the creek's lower reaches (at D3, E3, E4, E5 and E6). A very small patch of recovering Swamp Oak Floodplain Forest occurs in the north western part of the site near the Hastings River (C7).

It is a dense - low dense forest, dominated by *Casuarina glauca* Swamp Oak and occasional *Melaleuca styphelioides* Prickly-leaved Tea Tree. The understorey is generally suppressed by the fallen *Casuarina* leaf litter and the dense canopy and is restricted to patches of *Juncus* species. Some areas of open water occur, sometimes as a result of constructed drainage channels and dams, but also occur naturally in low-lying depressions.

Details of this vegetation type are given in Appendix 1.

It is restricted to the low-lying areas and occurs principally on the Blackmans Point and Cairncross soil landscapes.

This vegetation type represents an endangered ecological community, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.

2.3.3 Blackbutt Open Forest

This vegetation type occurs across approximately 4.3 hectares or 2.3% of the subject site and is illustrated in Photograph 3. It is distributed across the site in three small patches (at B3, C5 and D4 in Figure 4).

This is a highly modified vegetation type, with mature canopy trees and a grazed or mown understorey. The canopy trees are *Eucalyptus pilularis* Blackbutt, *Eucalyptus microcorys* Tallowwood, *Eucalyptus propinqua* Small-fruited Grey Gum, *Eucalyptus* siderophloia Grey Ironbark and *Corymbia intermedia* Pink Bloodwood. Understorey species are dominated by weeds and grasses, although some native species occur where mowing and grazing pressure is least, such as under fallen branches or around the bases of trees. These are principally hardy species such as *Lomandra longifolia* Spiky-headed Mat rush, *Daviesia ulicifolia* Gorse Bitter Pea and *Dichondra repens* Kidney Weed.

Details of this vegetation type are given in Appendix 1.

It occurs on the extensive Kundabung soil landscape on the hills and slopes and therefore was probably the dominant vegetation type prior to clearing for viticulture.

The remnant of mature trees on the ridgeline at C5 contains 4 hollow-bearing trees. A pair of the threatened species *Glossopsitta pusilla* Little Lorikeet was observed investigating a hollow in tree number 14, a large *Eucalyptus pilularis* Blackbutt.

2.3.4 Turpentine – Pink Bloodwood Open Forest

This vegetation type occurs across approximately 2.8 hectares or 1.5% of the subject site and is illustrated in Photograph 4. It occurs on the lower slopes in one relatively large patch of 2.4 hectares adjacent to Swamp Oak Floodplain Forest (at C2) and one very small and highly disturbed remnant (at D6) surrounded by cleared grassland.

Details of this vegetation type are given in Appendix 1.

The dominant canopy trees in this vegetation type are *Syncarpia glomulifera* Turpentine and *Corymbia intermedia* Pink Bloodwood but a diverse array of other myrtaceous trees are also present, including *Eucalyptus microcorys* Tallowwood, *Eucalyptus botryoides* Bangalay, *Eucalyptus umbra* Broad-leaved White Mahogany and *Eucalyptus acmenoides* White Mahogany. Because of its location adjacent to the lower-lying swamp forest, there are also moist elements in the flora including *Melaleuca quinquenervia* Broad-leaf Paperbark, *Melaleuca sieberi*, *Melaleuca decora* and *Melaleuca linariifolia* Snow in Summer.

The large remnant at C2 has been previously partly cleared and the understorey has been regularly underscrubbed and experienced light grazing. Many woody species were regenerating in the understorey at the time of survey, including the shrubs *Leptospermum polygalifolium* Lemon Scented Tea Tree, *Callistemon salignus* Willow Bottlebrush, *Glochidion ferdinandii* Cheese Tree and a number of wattles such as *Acacia elongata* and *Acacia longissima* Long-leaf Wattle. A variety of herbs, grasses and twiners occurred in the ground layer.

By contrast, the understorey in the small remnant is highly modified with no structural complexity. This is a direct result of high grazing pressure as some of this small remnant is within cattle holding yards.

This vegetation type occurs on the Cairncross and Kundabung soil landscapes, with most on Cairncross.

The large remnant also supports 13 hollow-bearing trees (see Appendix 2 and Figures 4 and 5) that were used by *Trichosurus vulpecula* Common Brushtail Possum and possibly *Cacatua roseicapilla* Galah at the time of survey. They provide potential habitat for a number of other fauna species, including threatened species.

2.3.5 Rainforest

This vegetation type occurs on the subject site in a single remnant of approximately 0.5 hectares (at E7), or 0.3% of the site and is illustrated in Photograph 5. A narrow band of Rainforest vegetation also occurs along the Hastings River and Haydons Creek in the Crown land adjacent to the subject site. In places, this riverine Rainforest is only one tree wide and is illustrated in Photograph 6.

Details of this vegetation type are given in Appendix 1.

As is typical of Rainforest, the vegetation remnant on site has considerable structural complexity and therefore provides potential habitat for many species of birds and mammals. The diversity of plant species is very high, accounting for approximately one third of the species recorded on the subject site.

The remnant of Rainforest on the site occurs on a sheltered south east facing slope that is at the interface between the Kundabung and Long Flat soil landscapes. The riverine Rainforest occurs exclusively on the alluvial Austral Eden soil landscape that occurs as a narrow band along the Hastings River and Haydons Creek.

This vegetation type represents an endangered ecological community, Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion.

2.3.6 Swamp

This vegetation type occurs in a small patch of approximately 0.6 hectares or 0.3% of the subject site and is illustrated in Photograph 7. It is located at E6, along the drainage depression leading from the slope that supports Rainforest to the low-lying Swamp Oak Floodplain Forest and occurs on the Long Flat alluvial soil landscape.

Details of this vegetation type are given in Appendix 1.

This is a structurally simple vegetation type, dominated by *Juncus* species. Cattle have access to this vegetation and have caused damage to the wet soil and broken up the vegetation that would otherwise be a closed Herbland.

This vegetation type represents an endangered ecological community, Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

2.3.7 Subtropical Coastal Floodplain Forest

This vegetation type occurs in a very small patch in approximately 0.6 hectares or 0.3% of the subject site and is illustrated in Photograph 8. It is located in the western extremity of the site (at A4).

Details of this vegetation type are given in Appendix 1.

This area has been cleared and subsequently regularly slashed for bushfire control. There is a single large remnant tree of *Eucalyptus grandis* Flooded Gum and a few *Eucalyptus amplifolia* Cabbage Gum and *Eucalyptus tereticornis* Forest Red Gum saplings. The understorey is highly modified and dominated by exotic grasses.

Habitat for this vegetation type is highly restricted, occurring on the small and narrow band of Long Flat alluvial soil landscape at the edge of the Hastings River. More extensive potential and realised habitat occurs off site to the south along the Hastings River.

This vegetation type represents an endangered ecological community, Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion. However, it is so highly modified and disturbed and the habitat on site so restricted, that its viability and ability to recover has been significantly affected.

2.3.8 Dams

There are 3 dams on the subject site, two of which occur in the open cleared grassland (at B2 and C6, see Photograph 9) and the third at the edge of remnant Subtropical Coastal Floodplain Forest (at A4, see Photograph 10).

The areas around the dams at B2 and C6 have been planted with trees and some native understorey has also been allowed to regenerate. Water plants (such as *Bolboschoenus caldwellii*, *Nymphaea* species Waterlily and *Philydrum lanuginosum* Woolly Waterlily) occur in the shallower parts with taller sedges (*Eleocharis sphacelata* Tall Spike-rush) occurring in the deeper water.

The vegetation around the dam at A4 is denser and its more natural structure indicates it is unlikely to have been planted. However, the dams and their associated vegetation are regarded as man-made features.

2.4 Flora of Conservation Significance

2.4.1 Commonwealth

Results from the Protected Matters Search Tool and the Atlas of NSW Wildlife database searches revealed some EPBC Act (1999) listed species that require consideration as part of this assessment (see Appendix 1).

Of these species, none were observed and the subject site supports potential habitat for two - *Melaleuca biconvexa* and *Phaius tancarvilleae* Greater Swamp-orchid. Assessments of the potential impact of the proposal on these species are detailed in Section 5 of this document.

2.4.2 State

The search of the Atlas of NSW Wildlife (NSW NPWS 2008) database revealed that a number of threatened flora species have been recorded within 10 kilometres of the subject site (Appendix 1).

Of those species, the following have realised or potential habitat within the study area:

1. *Maundia triglochinoides*
2. *Melaleuca biconvexa*
3. *Phaius tancarvilleae* Greater Swamp-orchid

None of these species were found during survey but an assessment of significance of impact using the assessment guidelines for major projects (DEC 2005) has been completed for them. These assessments are detailed in Section 6 of this document.

2.5 Communities of Conservation Significance

2.5.1 Endangered Ecological Communities

Of the Endangered Ecological Communities listed in the TSC Act (1995), the Department of Environments and Climate Change (DECC) Threatened Species website lists 8 as occurring or potentially occurring in the Macleay Hastings Catchment Management Authority (CMA) sub-region, of which the subject site is a part. These are:

1. Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
2. Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
3. Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
4. Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion ;
5. Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion;
6. Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
7. Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions; and
8. Lowland Rainforest in the NSW North Coast and Sydney Bioregions.

The subject site supports examples of four endangered ecological communities: Swamp Oak Floodplain Forest, Freshwater Wetland, Lowland Rainforest and Subtropical Coastal Floodplain Forest on Coastal Floodplains (albeit in a highly disturbed state).

3 FAUNA SURVEY AND RESULTS

3.1 Survey Methodology

3.1.1 Pre-survey Investigations

Prior to the detailed survey of the subject site, and in addition to the literature review as described in Section 1 above, the following was carried out:

1. An initial site inspection and assessment occurred on 18th August 2008.

2. Colour aerial photography was interpreted prior to field survey to delineate preliminary habitat areas on site.

3. A search of the EPBC Act (1999) database using the Protected Matters Search Tool on the Department of the Environment, Water, Heritage and the Arts website (www.environment.gov.au/erin/ert/epbc/index.html) was completed. The search area was confined to a 10 kilometre radius of the site. This identified species of conservation significance under the EPBC Act (1999) that may require habitat assessment or targeted survey.

4. The online component of the Atlas of NSW Wildlife (NSW NPWS 2008, http://wildlifeatlas.nationalparks.nsw.gov.au) was interrogated for the Kempsey 1:100,000 scale map sheet. A search was also performed for an area confined to a 10 kilometre radius of the site. This search provided records of species of threatened fauna within the locality.

5. BioNet, the online database of collections held by the Australian Museum, National Parks and Wildlife Service and State Forests was interrogated (http:// http://www.bionet.nsw.gov.au) for rare or threatened species that have been recorded in the locality.

3.1.2 Fauna Survey

Fauna surveys were conducted for a total of 65.5 person hours from the 19th of August 2008 to 6th of September 2008 across the subject site. The fauna survey was designed to sample the various habitats present.

Details of the fauna survey effort are documented in Appendix 2 and depicted in Figure 4.

In summary, fauna were surveyed by spotlighting, call detection and playback, hair tubes, visual observation and specific habitat searching as well as other signs of their presence (tracks or traces). The subject site was searched for hollow-bearing trees.

Amphibians were surveyed opportunistically and by targeted survey of likely habitat. Calls were recorded at the dams and soaks as well as at the isolated patch of Rainforest on site.

Reptiles were surveyed using both systematic searches and via opportunistic observations. The hours of highest reptile activity are generally between 10 a.m. and 4 p.m. and so surveys were therefore concentrated during this period.

Searches of any likely habitat, such as leaf litter, rocks and fallen logs were carried out to locate sheltering reptiles. Nocturnal surveys of these areas were also employed to account for night time movements of reptiles. However, the survey was undertaken during late August, when daytime temperatures peaked at 22.2^0C and the night time minimum temperature was 3.6^0C; most reptile species likely to use the site would not be active under these conditions.

Diurnal birds were surveyed during periods of high bird activity in the early morning and late afternoon at formal survey points within each vegetation type (see Figure 4). At each of these 18 points, the observer stood still and quiet for a period of 10 minutes, recording all birds heard or seen. Opportunistic observations of diurnal birds were also made during all other survey periods on the subject site. Birds were identified by sight and call.

Nocturnal bird survey primarily targeted threatened species of owls, although nocturnal birds such as other owls, nightjars and frogmouths were also recorded when encountered.

Survey for threatened owls was completed using the methodology of Kavanagh and Peake (1993) on 19th, 20th and 21st August 2008. Survey points were located at the northern, central and southern parts of the site (see Figure 4).

The survey was initiated at approximately 20 minutes after dusk and continued for approximately 40 minutes of darkness. At the survey point, a quiet listening period of approximately 20 minutes was employed to detect any nocturnal fauna already vocalising. Following this period, tape recorded calls of threatened bird species were played using a 10W speaker.

Calls of the Masked Owl, Sooty Owl, Barking Owl, Powerful Owl and Grass Owl were broadcast. Each call was broadcast for 5 minutes and was followed by 2 minutes of quiet listening. After the final broadcasted call, a further 5 minutes of quiet listening was employed, followed by a 10 minute spotlight of the area. Grass Owls were also surveyed by the flushing of ground birds during walking transects across dense and tall grassland.

Other evidence of owl activity was also sought, such as white wash and regurgitated pellets for expert analysis of their contents.

Terrestrial mammals were surveyed by hair sampling, habitat analysis and searches for tracks and traces such as diggings, prints, scratches and scats. Ten Faunatech "Universal Hair Funnels" were placed in each of 4 transects in likely habitat across the development area for a period of 14 days from 23rd August 2008 to 6th September 2008 (see Figure 4). The bait chambers were baited with the standard mix of peanut butter, rolled oats and honey. Wafers with hair samples were then analysed by Barbara Triggs for identification to species.

Arboreal mammals were surveyed by call playback and spotlighting on 19th, 20th, 21st and 22nd August 2008 (see Figure 4).

Searches were also carried out for scats at the base of trees for identification according to Triggs (1996). This searching was conducted generally during all survey activities across the entire site but was particularly intensive in areas with suitable habitat for arboreal mammals (including Koalas) such as food trees and hollow-bearing trees. Such survey was concentrated in the Turpentine – Pink Bloodwood Open Forest of the south eastern corner, the grassy Subtropical Coastal Floodplain Forest in the south western corner and the scattered small patches of Blackbutt Open Forest across the cleared open grassland. Other signs of presence such as diggings, prints and scratches were also searched for and used in species identification.

Spotlighting for nocturnal arboreal fauna was conducted with a 50W spotlight. Particular emphasis was placed on examining flowering trees that provide foraging habitat (blossom and nectar) for gliders and flying foxes. This spotlighting was conducted on foot by two observers in all of the likely habitats listed above and from a slow-moving vehicle in the cleared open grassland habitats.

Calls of the Yellow-bellied Glider, Squirrel Glider and Koala were broadcast in order to elicit a response from any of these species that may be present on the subject site and in the local area.

Stag watches of likely hollow-bearing habitat trees were commenced from 15 minutes before dusk and carried on through a further 15 minutes of darkness. This occurred at two hollow-bearing trees in the Turpentine – Pink Bloodwood Open Forest in the south eastern corner (at D2) and at two hollow-bearing trees on the edge of the Hastings River, in Crown land adjacent to the Subtropical Coastal Floodplain Forest in the south western corner (at A4).

Koalas were given special consideration. State Environmental Planning Policy No. 44 - Koala Habitat Protection (SEPP 44) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas. In regards to development applications, this policy applies to land that:

1. Occurs within the listed Local Government Areas;
2. Has an area of more than 1 hectare; and
3. Has, together with any adjoining land in the same ownership, an area of more than 1 hectare, whether or not the development application applies to the whole, or only part, of the land.

Before a council may grant consent to develop land to which SEPP 44 applies, it must satisfy itself whether or not the land is potential or core Koala habitat.

Potential Koala habitat is defined as areas of native vegetation where the trees of the types listed in SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. *Core Koala habitat* is an area of land with a resident population of Koalas, evidenced by the presence of breeding females (that is, females with young) and / or recent or historical records of a population.

As well as survey for the presence of Koalas as detailed above, the potential of the site to provide habitat for Koalas was also assessed by measuring the density of food tree species as defined by SEPP 44 in 4 sample quadrats of 400 square metres each in the treed areas dominated by eucalypts (see Figure 4 and Appendix 1).

Megachiropteran bats were surveyed by spotlighting trees. Vocalisations of these bats were also listened for during nocturnal surveys.

Microchiropteran bats were surveyed via recording and analysis of their echolocation calls. Calls were recorded using an Anabat II bat detector placed in areas where microchiropteran bats were likely to be roosting and / or foraging (see Figure 4). A voice-activated bat detector was placed in a stationary position at the edge of the central dam for 12 hours on the night of 19th August and again overnight on 20th August 2008 in the Turpentine – Pink Bloodwood Open Forest in the south eastern corner.

Analysis of the results from the overnight surveys revealed that the bats were active and calls were only recorded in the early part of the night, before the temperatures dropped too low. Therefore, survey was subsequently restricted to the early evening on the 21st and 22nd August 2008 in the Subtropical Coastal Floodplain Forest on the western side and at the edge of the Rainforest in the northern part of the site.

Microchiropteran bat calls were analysed using the Anabat 5.1 software package and compared to a known call library for identification to species (Pennay et al. 2004).

3.2 Survey Limitations

It is an acknowledged limitation that, no matter how much effort or expertise is employed, not all species that use a site will be recorded during ecological survey. For many fauna species, this is due to their mobility, cryptic nature and unpredictable movement throughout their habitat. In addition, migratory species may be present on the site at some times of the year, and absent at others. In addition to ecological reasons, environmental factors (such as weather, drought and bushfire) may impact on the type and number of species recorded within a site at any one time.

The survey was conducted in late winter, a season not appropriate for many amphibians, reptiles and microchiropteran bats. However, for the fauna species of interest for this site, the season and method of survey was appropriate and optimal for all except *Dasyurus maculatus* Spotted-tailed Quoll, *Phascogale tapoatafa* Brush-tailed Phascogale, *Pteropus poliocephalus* Grey-headed Flying-fox and *Miniopterus schreibersii australis* Little Bentwing-bat.

Targeted trapping was not undertaken for *Dasyurus maculatus* Spotted-tailed Quoll and *Phascogale tapoatafa* Brush-tailed Phascogale; suitable forage trees for *Pteropus poliocephalus* Grey-headed Flying-fox were not flowering at the time of survey; and *Miniopterus australis* Little Bentwing-bat is not usually active until mid-spring. However, it is considered that expert habitat assessment is adequate in place of extra survey for these species.

The details of survey adequacy are given in Appendix 2.

In order to overcome all of the survey limitations, this report includes a detailed expert assessment of the habitat present on the site. This habitat analysis is then compared to the results of database searches for threatened species occurring within a 10 kilometre radius of the site. This comparison allows for the prediction of potential use of the site by species of conservation significance. Any threatened species (flora or fauna) considered to have potential habitat within the site is then made subject to this assessment of significance of impact. This process ensures that all threatened species with potential to use the site are considered in the impact assessment, rather than only those that were recorded during survey.

3.3 Faunal Assemblage

A total of 78 native and 5 introduced species of fauna were recorded in and near the subject site during the current and past surveys and by anecdotal reporting. This included 4 species of amphibians, 4 species of reptiles, 56 species of birds and 19 species of mammals (see Table 2.3 in Appendix 2).

Amphibians: Four common species of native amphibians have been recorded from the subject site – 2 during this survey (a tree frog and a froglet) and another 2 tree frogs during survey by Salter (2004). These were all recorded within the small soaks and dams. If survey had been conducted in the warmer and wetter months, it is likely that more species would have been recorded. However, it is unlikely that any of these extra species would be of conservation significance as the habitat is highly disturbed, isolated from other habitat and otherwise unsuitable.

Reptiles: Only 4 common species of reptiles have been recorded from the subject site, only one of which was observed during this survey (*Physignathus lesueurii* Eastern Water Dragon from the dam in the south western corner of the site on the Hastings River). This poor result is a direct consequence of the season of survey, although it is also a reflection of the simplified reptile habitats available: terrestrial sheltering sites are few as the understorey is grazed and fuel managed and no rocky outcrops or other complex habitat features occur. This simplified habitat also results in a lack of prey species for the predatory reptiles to feed on.

Birds: Fifty six species of birds were recorded from the subject site during survey, all native species. Two of these species are of conservation significance: *Glossopsitta pusilla* Little Lorikeet has been recently listed in a preliminary determination as a threatened species under the TSC Act (1995) and *Ardea ibis* Cattle Egret is a listed migratory species under the EPBC Act (1999).

The avifauna of the subject site is diverse, reflecting the diversity of vegetation types and habitat niches available. These include species that live in the open grassland (e.g. *Cisticola exilis* Golden-headed Cisticola, *Anthus novaeseelandiae* Richards Pipit), or forage above it (*Aquila audax* Wedge-tailed Eagle, *Elanus axillaris* Black-shouldered Kite); water birds of the dams (e.g. *Anas castanea* Chestnut Teal *Gallinula tenebrosa* Dusky Moorhen), estuarine and riverine environments (e.g. *Pelecanus conspicillatus* Pelican) and swamplands (e.g. *Gallirallus philippensis* Buff-banded Rail, *Threskiornis spinicollis* Straw-necked Ibis); birds that need dense forest and scrub (e.g. *Psophodes olivaceus* Eastern Whipbird, *Centropus phasianinus* Pheasant Coucal), as well as those tolerant of open woodland that are native to the coast (e.g. *Dacelo novaeguineae* Laughing Kookaburra) and those that have spread from the inland following the clearing of woody vegetation (e.g. *Cacatua roseicapilla* Galah); small forest birds (e.g. *Rhipidura fuliginosa* Grey Fantail); a number of nectar-feeders (e.g. *Lichenostomus chrysops* Yellow-faced Honeyeater); and birds tolerant of disturbed environments inhabited by people (*Gymnorhina tibicen* Australian Magpie) and cattle (*Ardea ibis* Cattle Egret).

Arboreal and Terrestrial Mammals: The site has been highly modified for agriculture and therefore does not provide extensive habitat for mammals. Only 7 native and 5 introduced species of arboreal and terrestrial mammals have been recorded on the subject site.

Two common species of arboreal mammals were observed during survey - *Pseudocheirus peregrinus* Common Ringtail Possum and *Trichosurus vulpecula* Common Brushtail Possum.

The threatened *Phascolarctos cinereus* Koala was reportedly seen by a neighbour on one occasion – an individual was observed walking through the south eastern corner of the site. Salter (2004) also reported Koala scats in this part of the site.

The same neighbour also reported that his hen house was raided on one occasion many years ago by *Dasyurus maculatus* Spotted-tailed Quoll.

The other native terrestrial species observed during survey were the macropods, *Macropus rufogriseus* Red-necked Wallaby and *Macropus giganteus* Eastern Grey Kangaroo. Otherwise, the terrestrial fauna of the site is dominated by introduced species: *Rattus rattus* Black Rat was recorded in the Rainforest; a small herd of *Cervus elaphus* Red Deer roams the grassland and shelters in the Swamp Oak Floodplain Forest; and a resident Domestic Dog has unfettered access to the entire site. Although no signs of *Oryctolagus cuniculus* Rabbit were observed, they were reported by the residents as present at some time in the past.

Microchiropteran bats: As is typical in eastern Australia, the mammalian fauna was dominated by microchiropteran bats, with 8 species recorded, 3 of which are threatened species - *Tadarida australis* White-striped Freetail-bat, *Chalinolobus gouldii* Gould's Wattled Bat, *Chalinolobus morio* Chocolate Wattled Bat, *Vespadelus pumilus* Eastern Forest Bat, *Vespadelus regulus* Southern Forest Bat, *Mormopterus norfolkensis* Eastern Freetail-bat, *Miniopterus australis* Little Bentwing-bat and *Myotis macropus* Large-footed Myotis. The latter three species are listed as threatened.

Megachiropteran bats: No megachiropteran bats were recorded during survey as no food trees were flowering.

3.4 Habitat Value and Connectivity

Although the subject site has been largely cleared and grazed for many years, it still provides some important potential habitat for a number of fauna groups. The main fauna habitat features are sheltering and foraging resources provided by the remnant trees, water resources in the drainage lines, and foraging resources of understorey and ground cover vegetation.

The 17 hollow-bearing trees on the subject site provide potential roosting and nesting habitat for many species of birds and mammals. A number of species that rely on hollows were observed on the site, including a threatened species of bird (*Glossopsitta pusilla* Little Lorikeet) and two threatened microchiropteran bats (*Mormopterus norfolkensis* Eastern Freetail-bat and *Myotis macropus* Large-footed Myotis. The understorey of the remnant Blackbutt Open Forest, Turpentine – Pink Bloodwood Open Forest and disturbed parts of the Swamp Oak Floodplain Forest is simple and open, thus providing an uncluttered foraging space favoured by many species of microchiropteran bats.

The dams also provide important watering points for many species and habitat for waterfowl. The rivers provide foraging habitat for many birds and the microchiropteran bat *Myotis macropus* Large-footed Myotis. The associated riparian vegetation also provides further foraging opportunities for microchiropteran bats that specialise in feeding along the edge of such vegetation.

The dominant tree species of the site are of the family Myrtaceae, the blossom of which may be exploited by *Pteropus poliocephalus* Grey-headed Flying-fox, a threatened species. The nectar and pollen of the Eucalypts and Paperbarks would also provide forage to many other fauna species such as birds and insects.

Eucalyptus microcorys Tallowwood is a primary food tree for *Phascolarctos cinereus* Koala and the secondary food tree species *Eucalyptus propinqua* Small-fruited Grey Gum was also present. However, these are present in such low numbers that the site cannot be regarded as providing important or core habitat for this species. Given the observation of a Koala moving through the site and the presence of scats beneath *Eucalyptus microcorys* Tallowwood trees during a previous survey, the site should be regarded as contributing to a local corridor that may be exploited on rare occasions by this species.

There was little regeneration of canopy trees across the site in the open forest communities, thus there is little potential for tree replacement when the old trees senesce and die. It is therefore likely that the site will experience a bottleneck in the future when hollow-bearing trees will be a limiting resource.

The open cleared Grassland habitat provides foraging resources for a number of birds that use open areas as well as for raptors and their prey. The Swamp provides good cover, although few foraging resources, for small birds. The dams, soaks and drainage lines supported a number of amphibians and provide a potential source of water for other fauna species.

Fallen timber is scarce but also may provide sheltering habitat for mammals and reptiles.

Aerial photography shows that the subject site vegetation is part of the highly fragmented farming country that is concentrated along the Hastings River valley. Significant areas of vegetation occur 4 kilometres to the north in Rawdon Creek Nature Reserve and 3 kilometres to the south in Cowarra State Forest. The remnant vegetation on site would provide small stepping stone links between these patches for only the most mobile of species such as bats and birds with large home ranges.

This vegetation to the south of the subject site has been identified by the NSW National Parks and Wildlife Service as part of the region's key fauna habitat and wildlife corridor system (http://maps.nationalparks.nsw.gov.au/keyhabs/default.htm). This Lake Innes – Cowarra Corridor is a subregional link between Lake Innes National Park in the east and Partridge Creek. The subject site is separated from this vegetation corridor by cleared farmland.

3.5 Fauna of Listed Conservation Significance

3.5.1 Commonwealth

Results from the Protected Matters Search Tool and the Atlas of NSW Wildlife database searches revealed a number of EPBC Act (1999) listed species that require consideration as part of this assessment (see Appendix 2).

Of these species, none were observed during survey. *Dasyurus maculatus* Spotted-tailed Quoll was reportedly observed by a neighbour on an adjacent property on one occasion, raiding his hen house. However, except for the small patch of Rainforest, the habitats on the subject site are too exposed and too highly simplified to provide den sites or suitable foraging habitat for this species. Therefore, it is not further assessed in this report.

By contrast, the subject site supports potential habitat for *Pteropus poliocephalus* Grey-headed Flying-fox. An assessment of the potential impact of the proposal on this species is detailed in Section 5 of this document.

3.5.2 State

The results of the Atlas of NSW Wildlife (NSW NPWS 2008) database search indicated that a number of threatened fauna species were recorded within 10 kilometres of the subject site (see Appendix 2).

Of those species (excluding *Dasyurus maculatus* Spotted-tailed Quoll – see above), the following have realised or potential habitat within the study area:

1. *Ephippiorhynchus asiaticus* Black-necked Stork
2. *Pandion cristatus* Eastern Osprey
3. *Ptilinopus magnificus* Wompoo Fruit-dove
4. *Ptilinopus regina* Rose-crowned Fruit-dove
5. *Calyptorhynchus lathami* Glossy Black-Cockatoo
6. *Glossopsitta pusilla* Little Lorikeet
7. *Ninox strenua* Powerful Owl
8. *Tyto capensis* Grass Owl
9. *Tyto novaehollandiae* Masked Owl
10. *Phascogale tapoatafa* Brush-tailed Phascogale
11. *Phascolarctos cinereus* Koala
12. *Pteropus poliocephalus* Grey-Headed Flying-fox
13. *Mormopterus norfolkensis* Eastern Freetail-bat
14. *Miniopterus schreibersii oceanensis* Eastern Bent-wing Bat
15. *Miniopterus australis* Little Bentwing-bat
16. *Myotis macropus* Large-footed Myotis

The likelihood of the subject site to support *Syconycteris australis* Eastern Blossom Bat was considered as this species feeds in Rainforest and Paperbark swamps. However, it was rejected as a species for further consideration as it relies heavily on coastal heathland for foraging in the southern parts of its range and these feeding grounds are usually adjacent to roosts in coastal Rainforest (Law and Spencer 2008). Similarly, the Paperbark swamps that are used when the heathland is not flowering are also coastal. It is considered that the potential habitat on site is too far inland and distant from the preferred coastal habitat and not extensive enough to attract this species.

Glossopsitta pusilla Little Lorikeet, *Mormopterus norfolkensis* Eastern Freetail-bat, *Miniopterus australis* Little Bentwing-bat and *Myotis macropus* Large-footed Myotis were recorded on site during survey.

An assessment of significance of impact using the DEC guidelines (DEC 2005) has been completed for the listed species for which the subject contains known or potential habitat. These assessments are detailed in Section 6 of this document.

4 IMPACT AND AMELIORATION

4.1 Potential Impacts of the Proposal

4.1.1 Vegetation clearing

Given the nature of the proposal and the nature of the site, almost no clearing of native vegetation is required. The small area of fill required in lots Lots 110-111 and Lots 87-90 will account for the loss of approximately 8,000 square metres of the endangered ecological community Swamp Oak Floodplain Forest and its habitat.

The development of the western-most lot will require the loss of a maximum of approximately 6,000 square metres of realised and potential habitat for the endangered ecological community Subtropical Coastal Floodplain Forest. This area has been cleared and regularly slashed and now supports a single mature tree, some saplings and an open grassy ground cover dominated by introduced grasses.

The other type of vegetation that will be cleared is derived grassland, made up of pasture grasses. This area was once under grape vines and has since been grazed and so provides very little habitat fro native species of flora or fauna.

4.1.2 Habitat fragmentation and edge effects

The forest and open forest vegetation on the site occurs as either small remnants surrounded by cleared pasture land or as a large block of vegetation with significant distances of interface with cleared grassland.

The development proposal is confined to the already-cleared areas and so the edge effects (such as the impact of exposure to sun and wind and incursions of weeds) will not be exacerbated.

Given that no new areas will be cleared and the mobile nature of most of the species of fauna that may use the site, the degree of connectivity of the site with other nearby habitat will not be significantly altered.

4.2 Amelioration of Impacts

A general principle of environmental management is to, in order of preference:

1. Avoid the impacts;
2. Minimise the impacts;
3. Mitigate the impacts; and
4. Compensate for residual impacts once all of the above options have been exhausted.

The developable areas have been largely restricted to the already-cleared parts so that it avoids as many potential impacts as possible.

To this end, it does not impinge on the important vegetation communities in the low-lying parts of the site nor will it impact on the riparian zones.

The very small loss of natural vegetation on site is more than offset by the retention of the large expanse of the endangered ecological communities Swamp Oak Floodplain Forest, Freshwater Wetland and the remnant of Rainforest on site, along with the remnant of Turpentine – Pink Bloodwood Open Forest.

The proposed lot layout may require the removal of some of the trees within the highly modified remnants of Blackbutt Open Forest, however the land use history in these areas has compromised the longevity of the trees and the habitat values of these remnants.

The potential impact on hollow-bearing trees was minimised by the recasting of the proposed layout in the site's south eastern corner. This allowed for all of the hollow-bearing trees to remain in retained bushland. This area will also be allowed to regenerate naturally.

Impact on the hollow-bearing trees in the isolated remnant of Blackbutt Open Forest will be avoided by their retention in the residential lots to be located on the central ridge. The positioning

of the driveways and other structures are constrained by the required root zones of these trees.

The impacts of current land management practices on the Rainforest will be ameliorated by the re-location of the existing effluent disposal outlet. It will also benefit from the implementation of a weed control program.

Similarly, all of the sensitive downslope environments will be protected from added nutrient loads by the proper siting of effluent disposal in the open cleared grassy areas with significant buffers between.

The current crossing of Haydons Creek is unformed and unregulated. It is within a cleared opening that is used by cattle and occasionally by vehicles. It is proposed to replace this with a formal culvert / piped crossing in accordance with the Water Management Act (2000) and Regulations (2008).

One of the ameliorative strategies with the greatest potential for restorative action is the cessation of grazing. The removal of stock from the site will result in a number of environmental benefits. It will allow natural regeneration to occur in many areas that are currently suppressed by grazing. Damage to the soil structure will cease – particularly in the wetter areas – restoring natural processes and preventing erosion and sedimentation. The removal of the nutrient load from the manure will also protect the riparian areas from pollution and further weed infestation.

Weed control will also occur across the site, with particular emphasis in the naturally occurring vegetation. This shall be the subject of a separate management plan and will recommend integrated control actions that have the greatest chance of success without doing harm. To this end, herbicide will only be used where necessary and spraying will be minimised in order to protect waterways and their fauna. Manual weed control methods will be preferred where possible and planting (if required) will be of local provenance material only that is appropriate to the landscape position and vegetation community.

It is also further recommended that a number of nest boxes be erected across the site as the use of the site for agriculture has interrupted the regeneration processes of the forested environments. It is anticipated that not all of the hollow-bearing trees will be replaced by natural processes before they senesce and die and so at least an equivalent number of nest boxes should be erected over a number of years in young and maturing trees.

A Construction Environmental Management Plan or similar is also to be prepared and implemented. This plan will identify the appropriate erosion and sediment control measures to be used as well as identify the emergency spill response during any construction phase.

5 COMMONWEALTH ASSESSMENT

Of the species listed under the EPBC Act (1999), the subject site provides potential habitat for the threatened species *Melaleuca biconvexa*, *Phaius tancarvilleae* Greater Swamp-orchid and *Pteropus poliocephalus* Grey-headed Flying-fox. A number of the migratory species *Ardea ibis* Cattle Egret were observed foraging with the small herd of cattle.

The EPBC Act Policy Statement 1.1 Significant Impact Guidelines (2006) outlines the procedures that must be followed when assessing likely impacts, and the significance of those impacts upon matter of National Environmental Significance (NES).

The criteria set out by the guidelines vary slightly according to the specific NES matter (i.e. wetlands, threatened species, endangered ecological communities, migratory species).

For migratory species that are not threatened, an action is likely to have a significant impact if there is a real chance or possibility that it will:

1. substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
2. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
3. seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

An area of 'important habitat' for a migratory species is:

1. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
2. habitat that is of critical importance to the species at particular life-cycle stages; and/or
3. habitat utilised by a migratory species which is at the limit of the species range; and/or
4. habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

For **threatened species**, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. lead to a long-term decrease in the size of an important population of a species;
2. reduce the area of occupancy of an important population;
3. fragment an existing important population into two or more populations;
4. adversely affect habitat critical to the survival of a species;
5. disrupt the breeding cycle of an important population;
6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
8. introduce disease that may cause the species to decline; or
9. interfere substantially with the recovery of the species.

An *important population* is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

1. Key source populations either for breeding or dispersal;
2. Populations that are necessary for maintaining genetic diversity; and/or

3. Populations that are near the limit of the species range.

Some of the criteria for threatened species and endangered ecological communities refer to the concept of 'habitat critical to the survival of a species or ecological community'. The guidelines indicate that the absence of a recovery plan or the fact that an area may not be listed on the Register of Critical Habitat does not mean that there is no habitat critical to the survival of the species or community.

Habitat critical to the survival of a species or ecological community may include areas that are necessary:

1. for activities such as foraging, breeding, roosting, or dispersal;
2. for succession;
3. to maintain genetic diversity and long term evolutionary development; or
4. for the reintroduction of populations or recovery of the species or community.

Habitat critical to the survival of a species or ecological community will depend largely on the particular requirements of the species or community in question. For example, areas only incidentally used by a vulnerable species, and which the species is unlikely to be dependent upon for its survival or recovery, are not areas of habitat critical to the survival of a species or ecological community.

Some of the criteria refer to actions likely to lead to a "long-term decrease" in the size of a population or a "long-term adverse affect" on a community. Depending on the level of endangerment and the nature of the action, not all actions which create an immediate decrease in the population of a nationally listed threatened species or impact on a community will have long-term consequences. For example, an action which causes injury or death to only one or a very small number of a species will not, except in the case of the most endangered of species, generally lead to a long-term or irreversible decrease in the population that normal processes, rates of mortality and recruitment could not buffer.

5.1 *Ardea ibis* Cattle Egret

A small number of individuals (perhaps 20) of this Migratory species were observed foraging alongside the small herd of cattle across the subject site.

This species was originally only found in Africa, Europe and Asia, but it has spread to Australia from Asia. It is most common the tropical parts of the continent but occurs as far south as Tasmania (Marchant and Higgins 1990). It forages in grasslands, woodlands and wetlands, and also uses pastures and croplands, especially where drainage is poor. It will also forage at garbage dumps, but is most often seen with cattle and other stock where it eats insects, frogs, lizards and small mammals that are disturbed by the cattle. *Ardea ibis* Cattle Egret is partially migratory, moving during winter. Clearing and the provision of water for stock in dry areas have favoured the expansion of the Cattle Egret's range. They breed in colonies large wetland areas across the Top End and along the east coast as far south as Newcastle (McKilligan 2005).

Cattle Egrets are numerous and widespread, with the total population probably being 150,000 of which there are 50,000 breeding pairs (McKilligan 2005). The small number of this species does not constitute an 'important population' nor does it represent an 'ecologically significant proportion' of the total population. It is a species that is increasing in numbers and range and breeding habitat is elsewhere.

The removal of the cattle will alter the suitability of the site as foraging habitat but such habitat is commonly available in the grazing lands in the local area along the Hastings River.

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

i) **substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory*, or***

Response: The habitat of the subject site is not important habitat as it is restricted to foraging habitat, of a relatively small size and is commonly available locally within the cleared grazing lands of the Hastings River valley.

ii) **result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species*, or***

Response: The change in land use from grazing lands to rural residential will not result in the establishment of a harmful invasive species.

iii) **seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.**

Response: The proposal will impact on a small area of foraging habitat only and the small number of birds using the site is not regarded as an ecologically significant proportion of the total population of 150,000 birds.

5.2 *Melaleuca biconvexa*

Potential habitat for this Vulnerable species occurs in the low-lying swamp forests and edges of rainforests that are on alluvial soils. Alluvial soil landscapes on and near the site are Austral Eden and Long Flat, and occur along the Hastings River and Haydons Creek. Distributional patterns observed for this species in the Central Coast and Port Macquarie areas indicate that it does not grow where the subsoil is saline and probably relies on fresh water underground springs in near-estuarine environments (pers ob).

Populations in the Port Macquarie area are near the northern geographic limit of the species. It has been recorded in the Thrumster area to the east and large and important populations have been observed near Sea Acres Nature Reserve. Suitable habitat is common but discontinuous across the LGA.

Although it is unlikely that a large population occurs on the subject site, sampling may have missed isolated individuals. Potential habitat for this species on site occurs in the Swamp Oak Floodplain Forest, which will be retained and managed for conservation.

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

i) ***lead to a long-term decrease in the size of an important population of a species, or***

Response: The subject site is unlikely to support a large and important population of this species. Notwithstanding that assertion, the proposal will not remove and is unlikely to degrade the potential habitat of this species. In fact, the development will result in the cessation of grazing in and adjacent to this potential habitat.

ii) ***fragment an existing important population into two or more populations, or***

Response: As the proposal will not remove any individuals of this species or alienate any habitat, it will not fragment any existing population into two or more populations.

iii) ***adversely affect habitat critical to the survival of a species, or***

Response: Critical habitat has not been declared for this species. However, throughout its range, this species is restricted to damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects (DECC 2008, pers obs). In a comprehensive study of this species in the Wyong LGA, it was observed that it is mostly confined to low-lying floodplain landscapes (Duncan 2002). The area containing such habitat on the subject site will not be impacted upon by the development proposal.

iv) ***disrupt the breeding cycle of an important population, or***

Response: This species relies heavily on vegetative spread, with sexual reproduction a very rare event (Duncan 2002). The main species likely to effect pollination is the European Honey Bee and germination rates of the abundant seeds are higher (although still low) in saturated soils (Duncan 2002). The development is unlikely to adversely impact on any of these life cycle features.

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

Response: The swamp habitat in which this species may occur on the subject site will not be disturbed or reduced. The area to be redeveloped is already cleared and alienated for this species, and very few parts probably ever supported appropriate habitat. This species relies heavily on saturated soils and may be restricted to small areas within alluvial landscapes, perhaps fed by freshwater springs (pers obs). The development will not further interrupt the hydrological regime of the potential habitat for this species.

vi) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat, or

Response: Although the nature and extent of the development will not change appreciably - the development footprint will resemble the area now alienated by clearing or development – its potential to aid establishment of invasive species will actually be less as the grazing of cattle and access to the swamp habitats will cease.

vii) introduce disease that may cause the species to decline

Response: There are no recorded diseases to which this species is susceptible.

viii) interferes substantially with the recovery of the species.

Response: Recovery strategies identified for this species (DECC 2008) include**–**

1. Apply fire regimes which maintain floristic and structural diversity;
2. Survey thoroughly for the presence of Biconvex Paperbark before the approval of development applications;
3. Retain or reintroduce ecologically sustainable water flows to swampland habitat;
4. Ensure run-off into swamps is controlled; and
5. Avoid the introduction of heavy, prolonged grazing on sites where Biconvex Paperbark occurs.

The proposed works do not interfere with these recovery strategies and contributes to the success of them all.

5.3 *Phaius tancarvilleae* Greater Swamp-orchid

Potential habitat for this Endangered species occurs in the vegetation in the low-lying swampy areas, particularly the Swamp Oak Floodplain Forest. The riverine Rainforest in the adjacent Crown land along the Hastings River and Haydons Creek would also support potential habitat for this species. These areas were sampled by quadrat and random meander survey, but isolated individuals may have been overlooked.

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

i) lead to a long-term decrease in the size of an important population of a species, or

Response: Any occurrences of this species are likely to qualify as important populations. However, the proposal will not remove and is unlikely to degrade the potential habitat of this species. In fact, the development will result in the cessation of grazing in and adjacent to this potential habitat, which is an identifiable recovery strategy.

ii) fragment an existing important population into two or more populations, or

Response: As the proposal will not remove any individuals of this species or alienate any habitat, it will not fragment any existing population into two or more populations.

iii) adversely affect habitat critical to the survival of a species, or

Response: Critical habitat has not been declared for this species. However, this species is restricted to swampy environments; the area containing such habitat on the subject site will not be impacted upon by the development proposal.

iv) disrupt the breeding cycle of an important population, or

Response: The reproductive biology of this species is unknown but the retention of its potential habitat on site is likely to support processes critical to its life cycle.

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

Response: The swamp habitat in which this species may occur on the subject site will not be disturbed or reduced.

vi) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat, or

Response: The proposal includes the conservation management of the potential habitat on site for this species, including the removal of stock and control of weeds.

vii) introduce disease that may cause the species to decline

Response: There are no recorded diseases to which this species is susceptible.

viii) interferes substantially with the recovery of the species.

Response: Recovery strategies identified for this species (DECC 2008, DEWHA 2008) include**–**

1. Discouragement of collecting from the wild, particularly by control of access to known sites;
2. Control invasive weeds using appropriate methods that do not endanger this species;
3. Control feral pigs;
4. Protect wetland areas from frequent fire;
5. Protect wetland areas from pollution;
6. Control grazing with some of the most sensitive areas to be fenced off; and
7. Protect areas of habitat from clearing, draining or development.

The proposal is consistent with these recovery strategies in that survey was conducted in suitable habitat and the sensitive low-lying areas will be retained, managed for conservation with weeds controlled and stock removed.

5.4 *Pteropus poliocephalus* Grey-headed Flying-fox

Potential habitat for this Vulnerable species occurs particularly in the myrtaceous canopy trees in the Blackbutt Open Forest, Turpentine – Pink Bloodwood Open Forest, Subtropical Coastal Floodplain Forest and Swamp Oak Floodplain Forest. The fruiting trees and vines of the Rainforest would also provide foraging resources for this species.

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

i) lead to a long-term decrease in the size of an important population of a species, or

Response: This species was not recorded on the subject site although survey was not undertaken when the major forage trees were flowering or fruiting. The retention of the low-lying areas that support foraging habitat for this species is a major design constraint; very few potential food trees will be removed and these will be restricted to scattered isolated trees in the small and highly modified remnants surrounded by grassland. Therefore, even if this site provides realised habitat for this species, the removal of only a few trees in the Blackbutt Open Forest is unlikely to lead to a long-term decrease in the size of any population which may exploit this resource.

ii) fragment an existing important population into two or more populations, or

Response: The proposal will not fragment an existing important population into two or more populations. This is particularly so, given the highly mobile nature of the species and to the fact that it is unlikely to rely on the subject site to any significant degree.

iii) adversely affect habitat critical to the survival of a species, or

Response: Habitat critical to the survival of species can include foraging, breeding, roosting or dispersal habitat. The small area of potential foraging habitat that may be removed would not constitute habitat critical to the species' survival.

iv) disrupt the breeding cycle of an important population, or

Response: Any potential population using the subject site is judged to be not an important one as defined by the EPBC Act (1999). However, a negligible area of habitat for this species will be affected by the proposal and there are no breeding sites or camps known nearby. Therefore the proposed development is unlikely to disrupt the breeding cycle of this population.

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

Response: The degree of disruption to areas of potential habitat is outweighed by the likely increase in quality of habitat across the remainder of the woodland as a result of the removal of grazing.

vi) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species´ habitat, or

Response: The subject site is already dominated by pasture grasses and weeds. The cessation of grazing and introduction of conservation management of the retained woodland areas should result in a lessening of risk of invasive species.

vii) introduce disease that may cause the species to decline

Response: Although they are a vector for human disease, there is little reported regarding diseases affecting this Grey-headed Flying-fox. Parasites are few, principally bat-flies, nematodes and protozoans. However, despite this dearth of information, it is unlikely that the development will influence the level of disease in this species.

viii) interferes substantially with the recovery of the species.

Response: The proposal will not interfere substantially with the recovery of the Grey-headed Flying Fox as the habitat on site is considered to be relatively unimportant for this species.

In conclusion, it is considered that a significant negative impact is unlikely to occur on any of these species in accordance with the criteria as set out by the Department of the Environment, Water Heritage and the Arts. A referral to the Department is therefore not required.

6 STATE ASSESSMENT OF IMPACT

This Flora and Fauna Impact Assessment has identified realised or potential habitat for a number of state-listed threatened species and ecological communities or their habitats in the subject site. The potential impact on these are assessed below against the criteria as required by the DGRs and Guidelines for Threatened Species Assessment (DEC 2005).

Of particular importance are consideration of the following:

1. Impact on the life cycle of threatened species and / or populations;
2. Impact on the habitat of threatened species, populations or ecological community;
3. Impact on threatened species or populations at the limit of their known distribution;
4. Impact on current disturbance regimes; and
5. Impact on connectivity of habitat.

6.1 Swamp Oak Floodplain Forest

6.1.1 Profile

Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions is listed as an endangered ecological community under Schedule 1 of the Threatened Species Conservation Act (1995). This community is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

This community is restricted to environments where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains and typically occurs below 20 m elevation (Scientific Committee 2004).

The structure of the community is variable and its species composition is primarily determined by the frequency and duration of waterlogging and the level of salinity in the groundwater. *Casuarina glauca* Swamp Oak is the dominant tree species northwards from Bermagui. Co-dominants may include *Acmena smithii* Lilly Pilly, *Glochidion* spp. Cheese Trees and *Melaleuca* spp. Paperbarks, and are found most frequently in stands of the community northwards from Gosford.

The understorey is characterised by frequent occurrences of vines, (such as *Parsonsia straminea* Common Silkpod*, Geitonoplesium cymosum* Scrambling Lily and *Stephania japonica* var. *discolor* Snake Vine), a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter (NSW Scientific Committee 2004). As well as salinity, the composition and structure of the understorey is also influenced by grazing history, changes to hydrology and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.

This community does not provide significant habitat for waterbirds, but may provide food resources for cockatoos as well as habitat for amphibians (NSW Scientific Committee 2004).

It is likely that this community occupies less than 30% of its original range and has been extensively cleared and modified, particularly for cropping and grazing. Remaining stands are fragmented and further threatened by continuing clearing and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils' and rubbish dumping (NSW Scientific Committee 2004).

The following listed Key Threatening Processes are relevant to this community: Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change and High frequency fire.

Weeds are common in Swamp Oak Floodplain Forest and, in general, those examples from the most saline environments are in better condition, while those from less saline habitats are generally more degraded.

Small areas of this community are recorded within existing conservation reserves, including Stotts

Island, Ukerebagh, Tuckean, Pambalong, Wamberal, Towra Point and Cullendulla Creek Nature Reserves and Bongil Bongil, Myall Lakes and Conjola National Parks and some areas of Swamp Oak Floodplain Forest are protected by State Environmental Planning Policy 14.

6.1.2 Assessment

This endangered ecological community is restricted to the low-lying parts of the subject site, below the 1% flood line. This is an absolute constraint on development and no works shall be carried out in that area other than formalisation of the crossing of Haydons Creek.

This is part of a relatively intact remnant of Swamp Oak Floodplain Forest that extends into the adjoining properties to the east. It possesses intrinsic high conservation value, as it is an example of an endangered ecological community, and it also plays an important role in the hydrological functioning of the Hastings River system.

A very small area within part of Lots 110-111 (at C3) and Lots 87-90 (at C1) will need to be filled to provide developable areas above the flood zone. In all, this will total no more than approximately 8,000 square metres, and is located outside the 7(h) Environment Protection Zone.

Other than this minor fill, none of the area containing Swamp Oak Floodplain Forest or its habitat is proposed for development. Those parts of the lots that contain this community are restrained by zoning and shall be further constrained by covenant.

The offset area of Swamp Oak Floodplain Forest in good condition to be retained and managed for conservation amounts to approximately 13.3 hectares and that in poorer condition totals approximately 10.9 hectares. Thus, the offset ratio for the 8,000 square metres to be filled is 16:1 of vegetation in good condition and an offset of 30:1 in total. This far exceeds the likely "maintain and improve" threshold.

The proposal will also result in a change in land use, from agricultural to rural residential. The resultant removal of cattle will allow for the repair of the wet soils that have been badly pugged (particularly at Haydons Creek crossing), will give regenerating native plants a chance to mature, and will eventually result in a lighter weed burden with fewer nutrients delivered to the sensitive riparian zones.

Thus it is concluded that the proposed development is unlikely to have an adverse impact on Swamp Oak Floodplain Forest.

6.2 Rainforest

6.2.1 Profile

Lowland Rainforest on Floodplain now occurs only as small remnants in scattered localities on the NSW north coast, with less than 1,000 hectares in total thought to remain (DECC 2008). In an undisturbed state, it is a closed canopy forest characterised by high species richness and structural complexity. In disturbed stands the canopy continuity may be broken, or the canopy may be smothered by exotic vines (NSW Scientific Committee 1999).

Because of its high floristic diversity, it is difficult to typify its floristic composition, but it commonly includes figs (*Ficus macrophylla, F. obliqua* and *F. watkinsiana*), palms (*Archontophoenix cunninghamiana* and *Livistona australis*), and lilly pillies (*Syzygium australe* and *Syzygium francisii*). Many threatened species of fauna also rely on the diversity of resources provided by this vegetation including the fruit-eating rainforest pigeons, flying foxes and rainforest snails (DECC 2008).

Because this community occurs on fertile soils in lowland river valleys, the major historical cause of loss of this type of Rainforest was clearing for agriculture. Subsequent to clearing, the disturbed and exposed edges of remnant stands were vulnerable to invasion by exotic plant species; nearly all surviving remnants are subject to this threat (NSW Scientific Committee 1999).

The effects of clearing, fragmentation and isolation on the functional ecology of the remnant stands has been little studied, but impacts on plant regeneration (including pollination and seed dispersal) are likely. Many of the tree and shrub species are obligate outbreeders so that

disruption to pollinator systems could have long term, deleterious consequences (NSW Scientific Committee 1999).

Other threats include fire, grazing, rubbish dumping, clearing for competing land uses (including clearing of understorey for recreational facilities) and dissection by vehicular and foot tracks.

While many remnant patches are reserved within the national parks estate, their size is typically small and represents only a small proportion of the total distribution of the vegetation community (NSW Scientific Committee 1999).

6.2.2 Assessment

Rainforest on site is restricted to a small discrete remnant that will be retained and managed for conservation. The weeds will be controlled and possible nutrient inputs from on site effluent disposal stopped. It will be entirely protected from the proposed development envelopes by distance, vegetation buffering and stormwater control.

The narrow band of Rainforest in the Crown land along the river edge will similarly be protected from cattle and by the removal of stock with the development of the uplands of the subject site. Water sensitive design principles and appropriate on site effluent disposal distant from the Rainforest will further protect it from pollution, nutrients and weeds.

Thus it is concluded that the proposed development is unlikely to have an adverse impact on Rainforest.

6.3 Freshwater Wetland

6.3.1 Profile

Freshwater Wetlands on Coastal Floodplains are associated with areas periodically or semi-permanently inundated by fresh water, although some may have a minor saline influence (NSW Scientific Committee 2004). They typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. The structure of the community may vary from sedgelands and reedlands to herbfields, and woody species of plants are generally scarce. Typically these wetlands form mosaics with other floodplain communities, and often they include or are associated with ephemeral or semi-permanent standing water (NSW Scientific Committee 2004).

The floristic composition of Freshwater Wetlands on Coastal Floodplains is primarily determined by the frequency, duration and depth of waterlogging and may be influenced by the level of nutrients and salinity in the water and substrate. Therefore, typical floristic assemblages are difficult to identify but they are all water plants or terrestrial plants adapted to wet environments. Also, the species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance history. The number and relative abundance of species will change with time since flooding or significant rainfall, and may also change in response to changes in grazing regimes and land use in the catchment. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers.

Freshwater Wetlands on Coastal Floodplains may adjoin or intergrade with several other endangered ecological communities, including Lowland Rainforest on, Subtropical Floodplain Forest, Subtropical Coastal Floodplain Forest on Coastal Floodplains, Swamp Sclerophyll Forest on Coastal Floodplains and Swamp Oak Floodplain. In addition, Freshwater Wetlands may adjoin or intergrade with Coastal Saltmarsh and Sydney Freshwater Wetlands.

The extent of the Freshwater Wetlands prior to European settlement is unknown, but it is likely that there is less than one third remaining today overall, with distribution in some areas even worse (e.g. less than 3% of the Freshwater Wetlands in the Tweed lowlands remained in 1985 (NSW Scientific Committee 2004).

Current threats still include land clearing as only a small minority of the remaining area occurs on public land. The remaining stands mostly occur on productive agricultural land or in close proximity to rural centres and are severely fragmented by past clearing and are further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, filling

associated with urban and industrial development, pollution and eutrophication from urban and agricultural runoff, weed invasion, overgrazing, trampling by livestock, soil disturbance by pigs, activation of 'acid sulfate soils' and rubbish dumping (DECC 2008).

Large areas of habitat formerly occupied by Freshwater Wetlands on Coastal Floodplains have been directly drained by construction of artificial channels and on the north coast of NSW, expansion of *Melaleuca quinquenervia* Broad-leaf Paperbark and *Casuarina glauca* Swamp Oak into open floodplain swamps has been attributed to artificial drainage and shortening of the hydroperiod (NSW Scientific Committee 2004). In addition, sedimentation and eutrophication of wetlands is associated with development of their catchments for intensive agriculture or urban or industrial infrastructure. Harmful runoff from developed catchments may include herbicides, pesticides, fertilisers, sewerage, industrial waste and polluted stormwater.

Very few examples of Freshwater Wetlands on Coastal Floodplains remain unaffected by weeds. Major recovery strategies include pig control, exclusion of grazing, weed control and restoration of natural drainage conditions (DECC 2008).

6.3.2 Assessment

Freshwater Wetlands on site is restricted to the small area mapped as "Swamp". This part of the site is within the area to be retained, excluded from grazing and otherwise managed for conservation purposes.

The cessation of grazing will result in the most significant positive change to the habitat of this community. It will be protected particularly from further degradation of the soil structure and allow dor the community's regeneration.

Appropriately designed and located on-site effluent disposal systems for each lot will also protect the Freshwater Wetlands by not delivering nutrient-laden run off. The removal of cattle will also halt the addition of manure to the wetlands.

Thus it is concluded that the proposed development is unlikely to have an adverse impact on Freshwater Wetland.

6.4 Subtropical Coastal Floodplain Forest

6.4.1 Profile

Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion is listed as an endangered ecological community under the NSW Threatened Species Conservation Act (1995). It is not listed under the schedules of the Commonwealth Environmental Protection and Biodiversity Conservation Act (1999).

This community is associated with clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains (NSW Scientific Committee 2004). It occurs typically as tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. They may also form mosaics with other floodplain communities and often fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (NSW Scientific Committee 2004).

The species composition is primarily determined by the frequency and duration of waterlogging and the texture, nutrient and moisture content of the soil. Dominant trees often include *Eucalyptus tereticornis* Forest Red Gum, *Eucalyptus siderophloia* Grey Ironbark, *Corymbia intermedia* Pink Bloodwood and, north of the Macleay floodplain, *Lophostemon suaveolens* Swamp Turpentine (DECC 2008). *Eucalyptus amplifolia* Cabbage Gum may also occur.

Other trees may be scattered throughout at low abundance or locally common at few sites, particularly where there is an influence from lithic substrates upslope. These include *Eucalyptus moluccana* Grey Box, Eucalyptus *propinqua* Grey Gum, Eucalyptus *seeana* Narrow-leaved Red Gum, *Angophora subvelutina* Broad-leaved Apple, *Eucalyptus robusta* Swamp Mahogany, *Eucalyptus resinifera* subsp. *hemilampra* Red Mahogany, *Eucalyptus acmenoides* White Mahogany, *Angophora woodsiana,* Angophora *paludosa* and rainforest trees such as *Ficus* spp. Figs and *Cupaniopsis* spp. Tuckeroos (DECC 2008). A layer of small trees may be present, including

Allocasuarina torulosa Forest Oak, *Alphitonia excelsa* Red Ash, *Glochidion ferdinandi* Cheese Tree, *Callistemon* spp., *Melaleuca* spp. and *Casuarina glauca* Swamp Oak.

Scattered shrubs include *Breynia oblongifolia, Acacia concurrens, Commersonia* spp., and *Hibiscus* spp. Occasional vines include *Eustrephus latifolius, Parsonsia straminea* and *Geitonoplesium cymosum*. The groundcover is composed of abundant forbs, scramblers and grasses including *Imperata cylindrica, Themeda australis, Vernonia cinerea, Dianella caerulea, Pratia purpurascens, Cheilanthes sieberi* and *Dichondra repens* (DECC 2008).

This community has been extensively cleared and modified and nearly all remnants are impacted by weeds. Small areas of the community are contained within a handful of existing conservation reserves including Stotts Island, Ukerebagh and Limeburners Creek Nature Reserves and Bundjalung and Myall Lakes National Parks. However, these are unevenly distributed throughout the range and unlikely to represent the full diversity of the community (NSW Scientific Committee 2004).

Current threats to this community include further clearing for urban and rural development and the subsequent impacts from fragmentation, activation of acid sulfate soils, removal of dead wood, rubbish dumping, frequent burning, flood mitigation and drainage works, grazing and trampling by stock and feral animals, changes in water quality, particularly increased nutrients and sedimentation, weed invasion and climate change.

6.4.2 Assessment

This community is confined to a very small area (approximately 6,000 square metres) in one lot at the western side of the site on the edge of the Hastings River. It is highly modified, being once cleared and regularly slashed for the protection from bushfire of adjacent dwellings. Submarine cables and a boat ramp occur in front of this lot on the Hastings River shoreline and presumably this lot was disturbed when these facilities were constructed.

The vegetation on this lot has none of the structural integrity of this community in its natural state, now with only a single overstorey tree, a few saplings and no shrubs. The ground layer is dominated by introduced grasses (*Paspalum dilatatum* Paspalum, *Setaria sphacelata* South African Pigeon Grass) and a native grass species adapted to disturbance (*Imperata cylindrica* Blady Grass).

Even if this lot were not developed, this disturbance regime would likely continue because of its strategic location for protection of adjacent properties. The location of the boat ramp will also ensure that this area will continue to be used for and disturbed by recreational activities.

The alluvial soil landscape that supports this community occurs as a narrow band that runs south from the subject site along the Hastings River. This area is largely cleared and developed and so the vegetation on the subject site is isolated from other occurrences of this community.

The development of the lot will permanently alienate this small area of degraded habitat for this vegetation community. However, given the very small extent of this loss, the land use history, the current condition of the vegetation and its isolation, it is unlikely that its removal will result in a significant adverse impact on this community at the local or regional level.

Thus it is concluded that the proposed development is unlikely to have an adverse impact on Subtropical Coastal Floodplain Forest.

6.5 *Melaleuca biconvexa*

6.5.1 Profile

Melaleuca biconvexa is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is listed as Vulnerable under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

Melaleuca biconvexa is Paperbark that grows to a small tree of 15 metres in height (Wilson 1991). It occurs in damp places, often beside streams, in coastal districts and associated tablelands (Wilson 1991). Melaleuca biconvexa occurs in disjunct populations from Jervis Bay to Port Macquarie, but the main concentration of records is in the Gosford/Wyong area. This species

flowers in summer (Wilson 1991), where pale fluffy flowers form in dense heads on short spikes (NSW NPWS 2002). The species may occur in dense stands forming a narrow strip adjacent to watercourses in association with other Melaleuca species or as an understorey species in wet forest. Multiple stems may arise from single rootstocks so that an estimate of population size is not possible from visual inspection of stands (NSW Scientific Committee 1998).

6.5.2 Assessment

This species was not recorded on the subject site but is considered here as potential habitat exists within the moist riparian habitats and within the Swamp Oak Floodplain Forest on alluvium. As the site provides potential habitat only, it cannot be regarded as an area that provides important habitat for the species' long term viability. However, the potential habitat on site will be retained and managed for conservation and so the proposal will not disturb or disrupt important life cycle features (pollination cycle, seed bank), disturb or disrupt potential habitat for this species or fragment its habitat. Moreover, the proposal will remove threatening processes such as weed invasion and stock grazing.

The proposal is therefore unlikely to have a significant impact on this species.

6.6 *Maundia triglochinoides*

6.6.1 Profile

Maundia triglochinoides is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

Maundia triglochinoides is an erect rhizomatous perennial aquatic plant, with spongy inflated emergent leaves (Benson and McDougall 1995) that are triangular in cross section and up to 80 centimetres long (DECC 2008). It spreads vegetatively along the rhizome, but is known to flower from November to January and its small seeds are probably dispersed by water (Benson and McDougall 1995).

It grows in swamps or shallow fresh water on heavy clay, north from southern Sydney (Jacobs 1993). The populations around Sydney are probably extinct (DECC 2008). This species has been recorded from coastal NSW and extends into southern Queensland (DECC 2008).

6.6.2 Assessment

This species was not recorded on the subject site but marginal potential habitat occurs in the small example of Freshwater Wetland in the cleared grassland adjoining Swamp Oak Floodplain Forest in the northern part of the site. This area will be incorporated into the protected zone and managed for conservation purposes.

Critical features of its habitat are associated with the functioning of its wetland habitat, so the removal of threats from stock (such as trampling, grazing, degradation of water quality) will enhance the site's potential to support this species. Also, the protection of contiguous areas of low-lying vegetation will provide connectivity between habitats and access to dispersal mechanisms, such as floodwaters.

The proposal is unlikely to have a significant impact on this species.

6.7 *Phaius tancarvilleae* Greater Swamp-orchid

6.7.1 Profile

Phaius tancarvilleae Greater Swamp-orchid is listed as Endangered under Schedule 1 of the Threatened Species Conservation Act (1995). This species is listed as Endangered under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

This is a terrestrial evergreen orchid with showy flower stems up to 2 metres tall and large broad leaves with a pleated appearance, both arising from fleshy bulbs near ground level. It has large white and brown flowers with a mauve and yellow tongue with lobes curling inwards to form a tube (DECC 2008). Most flowers do not set fruit (PlantNet 2008). *Phaius tancarvilleae* is often confused

with *Phaius australis* and recent genetic analysis suggests that Australian *Phaius* spp. should be classified as a single species (Harrison et al. 2005).

This species tends to occur in sunny positions in swamp forest ecotones (DEWHA 2008) in swampy grassland or swampy forest, including rainforest, eucalypt and paperbark forest (DECC 2008). Associated vegetation includes swamp sclerophyll forest (*Melaleuca quinquenervia* Broad-leaf Paperbark - *Eucalyptus robusta* Swamp Mahogany *Lophostemon suaveolens*), swampy rainforest (often with sclerophyll emergents), or fringing open forest. It is often associated with rainforest elements such as *Archontophoenix cunninghamiana* or *Livistona australis* (Harden 1993, Benwell 1994, Bishop 1996). Soil parent materials include marine aeolian sand, alluvium, granite, metasediments and sandstone. On sand, soils range from shallow peat to humus or podzols (Harden 1993, Benwell 1994, Bishop 1996).

Although widespread through Asia and south into Queensland, it is seriously depleted and may be extinct in northern New South Wales (DECC 2008). While it has been collected from north of the Hastings River, it is chiefly known from north of the Brunswick Heads district (PlantNet, November 2008).

As the flowers are large and numerous, it is threatened by illegal collecting (DECC 2008) but is easily propagated and grown (ASGAP 2008). Loss of habitat is also an important threat to this species as are draining or polluting of swamps, frequent fire, grazing and trampling by stock and feral pigs and invasion by weeds (DECC 2008), particularly *Lantana camara* Lantana, *Schefflera actinophylla*, *Baccharis* sp. and *Eugenia uniflora* (DEWHA 2008).

6.7.2 Assessment

This species was not recorded on the subject site but potential habitat occurs in the low-lying swamp and riverine vegetation. However, this is of a marginal nature as the site is south of its known southern distributional limit, the Hastings River.

All of the potential habitat in the low-lying forests on the subject site will be protected and enhanced by the removal of stock and control of weeds. The protection of riparian lands also provides a corridor for movement of propagules and pollinators.

Thus, the proposal is unlikely to have a significant impact on this species.

6.8 *Ephippiorhynchus asiaticus* Black-necked Stork

6.8.1 Profile

The Black-necked Stork is listed as Endangered under Schedule 1 of the *Threatened Species Conservation Act* (1995). This species is not listed under the Schedules of the *Environment Protection and Biodiversity Conservation Act* (1999).

The Black-necked Stork (also known as the Jabiru) is a large, pied stork with an iridescent patch on the back of the neck and head. It has long, bright red legs and a massive, black beak. This species is recorded from Broome in Western Australia, along the north coast and down to approximately Newcastle in New South Wales (Slater et al. 1995). In eastern Australia the Black-necked Stork has been recorded as far south as Victoria and inland to the Macquarie Marshes and Griffith (NSW Scientific Committee No Date). This species is an uncommon vagrant further south.

Habitat for the Black-necked Stork includes swamps, large areas of shallow water and occasionally mangrove mudflats (Slater et al. 1995). It feeds in these shallow waters and feeds on fish, frogs, eels, turtles, crabs and snakes (DECC 2008). This species is occasionally recorded in dry pasture and scrub (Flegg 2002). Nests are large stick structures up to 2 metres in the tops of live or dead trees in or near a freshwater swamp (DECC 2008, Garnett and Crowley 2000).

6.8.2 Assessment

This species was not recorded on the subject site but potential foraging and breeding habitat occurs in the low-lying forests, swampy areas and grasslands. However, this is of a marginal nature as the freshwater swamp area is very small and unlikely to provide good foraging habitat.

Notwithstanding their value to this species, these low-lying areas will be retained and their condition improved with the removal of cattle.

The proposal is unlikely to have a significant impact on this species.

6.9 *Pandion cristatus* Eastern Osprey

6.9.1 Profile

The Eastern Osprey is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Eastern Osprey is a medium to large fishing hawk with narrow wings (Hollands 2003). This species is recorded along most of coastal Australia except for Tasmania, Victoria and eastern South Australia (DECC 2008). This species usually remains along the coastal fringe, nesting high in dead trees, but occasionally occurs further inland along the larger rivers (Pizzey 1980).

Ospreys are often seen hovering or patrolling over water, diving into the water to capture its prey (Slater et al. 1995), or grasping it from the surface with its feet (Pizzey and Knight 1997). They occur as single birds or dispersed pairs within large foraging and breeding territories, defended against other Ospreys, with active nests usually more than 1 kilometre apart (Bischoff 2001).

Optimal habitat for the Osprey is a shallow estuary or other water body containing sufficient fish of 25-35cm in length, a vantage point and feeding platform such as a tall dead tree or sometimes a human-built structure, and a tall dead tree for nesting, with suitable nesting material in the form of a stand of preferred vegetation nearby. Feeding perches near the nest are used by the male during the breeding cycle, and by the fledgling Ospreys (Clancy 1991).

Breeding adults are resident; juveniles are dispersive. Nests are usually built in tall dead or dead-topped live trees, but are also built on rocky foreshores and islands, cliff faces, telegraph poles and occasionally transmission towers. Ospreys construct stick nests from standing dead wood and line them with grass, bark and seaweed. *Melaleuca quinquenervia* Broad-leaf Paperbark and *Casuarina glauca* Swamp Oak are commonly used for nesting material. The presence nearby of a stand of vegetation suitable for nesting material is probably a critical factor in the selection of a nest site. Nests are situated up to 30 metres above ground level and are usually within 1 – 2 kilometres of water, often on elevated land (Clancy 1991).

The breeding season in NSW, from nest construction to fledging, occurs from March to November (Rose 2000). It is thought that this species is declining in southern areas of its distribution, largely due to pesticides (Pizzey 1980, Slater et al. 1995) but in NSW the population appears to be stable or increasing (DECC 2008).

The Osprey is sensitive to pollution, particularly pesticides. Water pollution, hydrological modifications and increased turbidity may affect this species by a reduction in quality or quantity of food resources or in foraging efficiency. Removal or disturbance of nesting sites, feeding platforms or the vegetation providing nesting materials reduces the number of sites containing the critical elements for breeding success. Some Ospreys are killed or injured by entanglement in fishing line, and by electrocution or collision with power lines (DECC 2008).

6.9.2 Assessment

This species was not recorded on the subject site during survey. Potential nest sites occur in the large trees on site and in the adjacent Crown land along the Hastings River and Haydons Creek. The subject site also provides a source of suitable nesting material in the low-lying swamp forests.

The proposal will not impact on its potential foraging habitat. The large trees within which it might nest will be retained as will the source of nesting material. Thus all of the critical habitat features of that the subject site offers this threatened species will remain in the post-development landscape.

The proposal is unlikely to have a significant impact on this species.

6.10 *Ptilinopus magnificus* Wompoo Fruit-Dove

6.10.1 Profile

The Wompoo Fruit-Dove is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Wompoo Fruit-dove is a large, multi-coloured rainforest pigeon, up to 56 cm long, with a pale grey head shading into rich green back and wings. There is a broken yellow band across each wing. The breast and belly are plum-purple and the underparts are yellow (DECC 2008).

It occurs along the coast and ranges from the Hunter River in NSW north to Cape York Peninsula. It is rare south of Coffs Harbour with only historical records from the Illawarra (DECC 2008).

It feeds alone or in loose flocks on a diverse range of tree and vine fruits in rainforest, low elevation moist eucalypt forest and brush box forests (DECC 2008). It feeds almost entirely on fruit, and relies on a diversity of irregularly fruiting trees in a mosaic within large contiguous tract of forest (NPWS 2002). It is most often seen in mature forests, but is also found in remnant and regenerating rainforest (DECC 2008)

6.10.2 Assessment

This species was not recorded on the subject site during survey. The subject site provides potential habitat in the Rainforest remnant as well as in the riverine Rainforest in the narrow strip in the adjacent Crown land.

These patches of potential habitat will be retained and somewhat improved with the control of weeds.

The proposal is unlikely to have a significant impact on this species.

6.11 *Ptilinopus regina* Rose-crowned Fruit-Dove

6.11.1 Profile

The Rose-crowned Fruit-Dove is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Rose-crowned Fruit-Dove is a small and colourful (adult) or plain green pigeon (juvenile) with a yellow belly and tail tip in adults (Slater et al. 1995). Males and females have a rose crown with grey / lavender on the remainder of the head and breast. Females are slightly paler in colour (Flegg 2002).

This species is a common to rare resident in rainforest, forest, mangroves and melaleuca forests from Cape Leveque in Western Australia south to Newcastle in New South Wales (Slater et al. 1995). This species then becomes rare further south (Flegg 2002). This species is notoriously difficult to sight in the forest canopy, and is often located from falling fruit (Slater et al. 1995). This species is less wary than other similar species (Flegg 2002). Nests consist of a flimsy twig platform, often in a bush or low tree (Slater et al. 1995).

6.11.2 Assessment

This species was not recorded on the subject site during survey but potential foraging and nesting habitat occurs in the dense patch of remnant Rainforest and in the extensive low-lying swamp forests.

Both of these important elements to its potential habitat will be retained and managed for conservation with the implementation of weed control and the cessation of grazing.

The proposal is unlikely to have a significant impact on this species.

6.12 *Calyptorhynchus lathami* Glossy Black-Cockatoo

6.12.1 Profile

The Glossy Black-Cockatoo is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). A population of this species in the Riverina has been listed as an Endangered Population (NSW Scientific Committee 1999) due to considerable pressure form a number of identified threats. This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Glossy Black-Cockatoo is the smallest of the black cockatoo species in Australia. It inhabits open forests on generally poor soils, particularly those areas with preferred Allocasuarina feed species. It is reported to prefer dry forest types in intact, less rugged landscapes (NSW NPWS 1999). The Glossy Black-Cockatoo is distributed mainly along the eastern half of New South Wales and the south eastern corner of Queensland (Slater et al. 1995). In New South Wales, this species is recorded in highest densities to the east of the Great Dividing range, however scattered records exist as far west as the Riverina and Pilliga Scrub (Garnett and Crowley 2000).

The Glossy Black-Cockatoo is a highly specialised feeder, requiring cones from specific *Allocasuarina* and *Casuarina* species (Garnett and Crowley 2000). However, while *Allocasuarina* seeds are the principal food source of this species, Higgins (1999) provides a more comprehensive list of alternative food plant sources, i.e. seeds of *Callitris* (Cupressaceae), *Pinus endlecheri* and *P. radiata* (Pinaceae), *Helianthus annuus* (Asteraceae), *Casuarina cristata* and *C. glauca* (Casuarinaceae), *Acacia* spp. (Mimosaceae), *Angophora* and *Eucalyptus* spp. (Myrtaceae) and *Hakea* spp. (Proteaceae).

This species breeds in autumn and winter and requires large hollows for nesting.

6.12.2 Assessment

This species was not recorded on the subject site during survey. Potential high quality foraging habitat is restricted to a few individual *Allocasuarina* trees in the Turpentine – Pink Bloodwood Open Forest; marginal forage may be found in the *Casuarina glauca* Swamp Oak. Potential nesting habitat occurs also in the largest of the hollows in the Turpentine – Pink Bloodwood Open Forest.

All of the features of the site that may provide important resources for critical life cycle stages for this species will be retained.

It is also recommended that some nest boxes are erected in the retained forest that are suitable for use by bats, birds and arboreal mammals. This enrichment action will help to alleviate the inevitable bottleneck that will occur in the medium to long term when the mature trees of the site eventually die and fall.

6.13 *Ninox strenua* Powerful Owl

6.13.1 Profile

The Powerful Owl is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Powerful Owl is the largest of the Australia Owls, with bold chevrons across the chest. This species is recorded from most types of sclerophyll forest along the south east coast of Australia (Slater et al. 1995), generally on the eastern slopes of the Great Dividing Range. Habitat ranges from tall open forests to woodland, however it is often found roosting or nesting in large trees along gullies (Simpson and Day 1999). The Powerful Owl requires large hollows (generally with a diameter greater than 30 cm) for breeding. Home ranges for territorial pairs appear to range from 800 to 1,000 hectares (although much larger territories have been recorded) (Kavanagh 2002). This species can be observed roosting in dense vegetation during the day, often clutching the remains of prey species in its talons.

The Powerful Owl is a specialist predator of arboreal marsupials, particularly the Common Ringtail Possum in coastal lowland areas and the Greater Glider in the tablelands, but the Sugar Glider, Common Brushtail Possum and Grey-headed Flying-fox are also common prey species (NSW DEC 2005). Its diet is also supplemented by diurnal birds, particularly the Pied Currawong and many parrot species (NSW DEC 2005). Scansorial and terrestrial mammals (particularly rats) are also recorded in Powerful Owl pellets, although rarely (NSW DEC 2005).

6.13.2 Assessment

This species was not recorded on the subject site during survey but the site provides potential foraging habitat, albeit of a marginal nature as the numbers of prey species are few.

The wooded areas that provide potential foraging habitat for this species will remain intact and the extent and distribution of this habitat will remain essentially unchanged. This species is highly mobile with enormous home ranges and so the subject site may contribute only a very small portion of foraging habitat. Nonetheless, this habitat will be retained as will its likely ecological function as a "stepping stone" in the large home range of this species.

The proposal is unlikely to have a significant impact on this species.

6.14 *Tyto longimembris* Eastern Grass Owl

6.14.1 Profile

The Eastern Grass Owl is listed as Vulnerable under the Schedules of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Eastern Grass Owl resembles a ground-dwelling Barn Owl. This species is more commonly found in north-eastern and northern Australia, however distribution can vary according to prey availability (particularly mouse and rat plagues (Slater et. al 1995).

Habitats range considerably, with records from tussock-grasslands, heaths, swamps, coastal dunes, tree-lined creeks, treeless plains, grassy plains and cropping country (Garnett and Crowley 2000). It has been recorded in derived grasslands where woody vegetation once occurred as well as in crops.

This species nests on the ground, often underneath tussocks or in dense grass (Garnett and Crowley 2000). Breeding attempts and timing are often in response to food availability.

6.14.2 Assessment

This species was not recorded on the subject site during survey or otherwise but potential foraging and nesting habitat probably occurs across the site in the dense pasture grass as well as in the native treeless swamp vegetation.

The change in land use is likely to alienate a lot of its potential habitat in the cleared grassland. This species has been recorded from a number of parks and reserves in the local area to the north and south east and so secure habitat is available. Also, similar habitat will remain in grazing lands along the Hastings River valley and in other nearby pastures and naturally treeless areas. The most important determinant of the distribution and abundance of this species is probably the availability of prey and so the presence of static habitat does not necessarily provide the resources required.

As this is a highly mobile species, the partial development of the lots for dwellings will not significantly interrupt the connectivity of this species' habitat.

The proposal is unlikely to have a significant impact on this species, principally due to the site providing potential habitat only and the continued availability of suitable habitat in the local area.

6.15 *Tyto novaehollandiae* Masked Owl

6.15.1 Profile

The Masked Owl is listed as Vulnerable under the Schedules of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Masked Owl resembles a large Barn Owl, however is darker on the upper parts of the body. This species generally occurs in sub-coastal habitats of eastern Australia, but there are also

records from inland watercourses (Garnett and Crowley 2000).

It is shy and secretive, roosting by day in hollows or thick foliage and hunts by night in woodlands and clearings (Pizzey 1980). This species appears to be a dietary specialist, with the majority of prey species being small, terrestrial mammals (Kavanagh 2002b), although some birds or small arboreal mammals are also taken. The Masked Owl is believed to be a stationary hunter, using a regular series of low perches within its territory to wait for prey, which it locates by sound. Prey appears to be taken in a slow deliberate attack rather than by pursuit (Smith and Smith 2000).

Large hollow bearing trees are required for nesting and daytime roosting. Nest sites are often within riparian forest habitats (Garnett and Crowley 2000). Home ranges sizes have been estimated at between 800 – 1200 hectares for this species (Kavanagh 2002a), however this has potential to vary greatly.

6.15.2 Assessment

This species was not recorded on the subject site during survey and the site provides potential foraging habitat in the open forest and forest / grassland ecotones. The site is far too open to provide likely roosting habitat.

The potential foraging habitat that the site offers to this species will remain essentially unchanged. The understorey regeneration that will occur once grazing pressure is removed is likely to provide more and better habitat for prey species and so may in fact produce a positive impact on this species.

The proposal is unlikely to have a significant impact on this species.

6.16 *Phascogale tapoatafa* Brush-tailed Phascogale

6.16.1 Profile

The Brush-tailed Phascogale is listed as Vulnerable under Schedule 1 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Brush-tailed Phascogale is tree-dwelling marsupial carnivore with a characteristic, black, bushy 'bottlebrush' tail, resembling a small lithe possum.

It has a patchy distribution around the coast of Australia. In NSW it is more frequently found in forest on the Great Dividing Range in the north-east and south-east of the State with a few records from central NSW (DEC 2006). It prefers dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter (DEC 2006) primarily where the annual rainfall exceeds 500mm (NSW NPWS 1999). This species also inhabits heath, swamps, rainforest and wet sclerophyll forest (NSW NPWS 1999).

It is an agile climber and forages preferentially on the larger rough barked trees, feeding mainly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates (NSW NPWS 1999). The Brush-tailed Phascogale nests and shelters in tree hollows with entrances 2.5 - 4 centimetres wide and use many different hollows over a short time period (NSW NPWS 1999).

Mating occurs in autumn and winter. Like the smaller Dasyurids, males die soon after the mating season but females may live up to three years, although they usually produce only one litter (NSW NPWS 1999). Females have exclusive territories of between 20 and 60 hectares, while males have overlapping territories of up to 100 hectares (DECC 2008).

6.16.2 Assessment

This species was not recorded on the subject site during survey but potential foraging and nesting habitat occurs in the small remnant patch of Turpentine – Pink Bloodwood Open Forest in the site's south eastern corner.

This part of the site will only change for the better as a result of the proposal: the removal of grazing will enhance the regeneration of the understorey and provide more and better habitat for the potential prey of this species. Also, all hollow-bearing trees will be retained and supplementary

nest boxes installed. The level of fragmentation of habitat for this species will not be significantly altered by the partial development of the cleared lands for dwellings. In fact, as it is likely that the new residents will keep poultry, foraging opportunities for this species may increase with the development.

The proposal is unlikely to have a significant impact on this species.

6.17 *Phascolarctos cinereus* Koala

6.17.1 Profile

The Koala is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999). An endangered population of Koalas has been declared for the Pittwater Local Government Area as well as for the Hawks Nest and Tea Gardens areas.

The Koala is a medium to large sized marsupial with a round head, dense woolly coat, long limbs with strong claws and a very short tail (Martin 1995). This species has an extensive, but disjunct distribution from northern Queensland to southern Victoria (Martin 1995).

With very specific dietary ranges, Koalas are restricted to eucalypt forests and woodland bearing certain favoured feed tree species (Strahan 1995). In south eastern Australia, up to 24 species of *Eucalyptus* are known to be eaten by Koalas (Lee and Carrick 1989) with *Eucalyptus punctata* Grey Gum and *Eucalyptus tereticornis* Forest Red Gum favoured across New South Wales and in Queensland (Eberhard 1978, quoted in Lee and Carrick 1989).

The suitability of habitat for Koalas is dependant on a number of variables, including size and species of trees, soil nutrients, climate, rainfall and disturbance history (NSW NPWS 1999). There is considerable local and regional variation in preferences for feed tree species (Martin and Handasyde 1995) and the food preferences may also change with season (Lee and Carrick 1989).

Koalas are agile climbers and principally arboreal, only coming to the ground to move between trees (Smith 1979a). However they can gallop swiftly across the ground, and are also excellent swimmers (Martin 1995).

Due to the low nutritional value of their diet, Koalas are inactive for up to 20 hours a day (Menkhorst and Knight 2001). They spend most of the day resting in trees and are most active in the late afternoon and at night, which coincides with a peak in feeding behaviour (Hindell et al. 1985).

Breeding occurs in spring and summer and cubs are not wholly independent until 18-24 months of age (Smith 1979b).

Studies of Koalas on Kangaroo Island, South Australia, revealed that adults were generally sedentary, using about 15 trees within a largely exclusive home range of 1 – 2.5 hectares (Eberhard 1978). The home ranges of some males may spatially overlap those of females and they may also share some trees. Juveniles disperse from the maternal range between 18 months and 2 years of age and may continue to wander until up to 5 years of age (Eberhard 1978).

A review of diseases thought to afflict Koalas (Dickens 1978, quoted in Lee and Carrick 1989) revealed the most demographically significant in natural populations as being anaemia, massive tick infections, malignant blood disease, pneumonia and a group of diseases (some leading to infertility) that have been associated with the bacterium *Chlamydia psittaci*. It seems likely that chlamydiosis was responsible for most of the declines in Koala populations between 1887-89 and 1900-03 (Lee and Carrick 1989).

Historically, the principal predators of Koalas were likely to have been Aborigines and the dingo (Lee and Carrick 1989). Today, the only known predators are *Aquila audax* Wedge-tailed Eagle and *Ninox strenua* Powerful Owl, both of which are known to take juveniles (Eberhard 1978).

Threats to the conservation of this species (in order of their general importance throughout NSW) include habitat loss and fragmentation, habitat degradation, road kills, dog attacks, fire, logging, disease, severe weather conditions, swimming pools and overbrowsing (NSW NPWS 2003).

Surveys across NSW indicate that, since 1949, Koala populations have been lost from many areas, particularly on the southern and western edges of their distribution (Reed et al. 1990, quoted in NSW NPWS 2003). Despite the presence of suitable habitat, Koalas still occur in fragmented populations perhaps demonstrating the difficulty of recovery of populations in fragmented habitats suffering ongoing threats (NSW NPWS 2003, DECC 2008).

Food trees have been categorised as primary, secondary and supplementary based on the measured level of use by Koalas (NSW NPWS 2003). Further, the potential value of habitat to Koalas has been determined by the relative abundance of primary, secondary and supplementary food trees (NSW NPWS 2003).

The Koala was recorded on the subject site during previous survey by the indirect observation of scats attributed to this species (Salter 2004). A neighbour also reported observing an individual walking across the south eastern corner of the site on one occasion in the past.

The most common tree species present on site outside of the Swamp Oak Floodplain Forest are *Eucalyptus pilularis* Blackbutt, *Corymbia intermedia* Pink Bloodwood and *Syncarpia glomulifera* Turpentine. Co-dominant species in the south eastern corner also includes *Eucalyptus propinqua* Small-fruited Grey Gum, which is a secondary food tree species (DECC 2008) with some *Eucalyptus microcorys* Tallowwood, a primary food tree species (DECC 2008). However, these potential food trees are not abundant enough to qualify the site as Potential Koala habitat *sensu* SEPP 44.

Applying the categories of Koala habitat developed by Callaghan and reported in DECC (2008), parts of the subject site comprises Secondary Habitat (Class C) i.e. *"Areas of forest or woodland where koala habitat is comprised of secondary and supplementary food tree species (primary koala food tree species absent), where secondary food tree species comprise less than 30% of the overstorey trees."* Such habitat is regarded as capable of supporting low-density koala populations.

Applying the alternative habitat definition developed by Phillips and reported in DECC (2008), parts of the subject site comprises Secondary Habitat (Class B) i.e. *"Primary food tree species absent, habitat comprised of secondary and supplementary food tree species only."* Such habitat is regarded as capable of supporting viable, low density (< 0.10 koala per hectare) populations.

The Subtropical Coastal Floodplain Forest has higher intrinsic value to this species as it is naturally dominated by primary food tree species. However, the patch on the site is very small, isolated from other habitat, cleared of nearly all large trees with only a few saplings as understorey and is located close to dwellings. These factors all diminish its potential value and likelihood of being classified as potential Koala habitat.

6.17.2 Assessment

This species was reported as occurring in the south eastern corner of the subject site during past survey. No evidence of this species were found during the current survey.

The proposal will retain all of the area in the south eastern corner that may be used by Koalas on rare occasions, perhaps for local movements. The habitat in the Port Macquarie hinterland such as on the subject site is of a lesser quality than that along the coastal strip. This can be directly linked to the richer soil landscapes of the coastal strip and the higher quality forage they produce compared with those of the hinterland.

The draft Comprehensive Koala Plan of Management (Connell Wagner 2003) that was not adopted by Council has identified the subject site as supporting a small finger of secondary habitat along Haydons Creek leading to a patch of primary habitat in the lower reaches of Haydons Creek that then inturn connects with other primary habitat to the east.

However, the size and fragmented nature of this habitat militates against it playing an important role for the local Koala population. This is recognised by the nomination by Connell Wagner (2003) of the bushland to the south of the site as providing a corridor function for the east – west movement of this species.

Notwithstanding the likely unimportant role of the subject site's vegetation to this species, the area mapped as providing primary and secondary habitat will be retained and its connectivity to other nearby habitat will not be altered.

The proposal is unlikely to have a significant impact on this species.

6.18 *Pteropus poliocephalus* Grey-headed Flying-fox

6.18.1 Profile

The Grey-headed Flying-fox is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is listed as Vulnerable under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Grey-headed Flying-fox is a large flying-fox with a white or greyish head, reddish mantle around the neck and thick, shaggy fur extending to the ankles (Strahan 1995). This species has a distribution along eastern coastal Australia from Rockhampton in Queensland to western Victoria (Churchill 1998). The Grey-headed Flying-fox is a common species in rainforest and wet sclerophyll forest (Strahan 1995), also frequenting mangroves, paperbark swamps and cultivated areas (Churchill 1998). It is usually seen in large, noisy colonies, or in day 'camps' usually placed close to water in gullies with dense forest canopies (Tidemann 1995). This is a highly mobile species, and camps are regularly moved in response to local food availability (Churchill 1998). Most births occur around October (Strahan 1995). They forage widely at night for rainforest fruits and native blossoms (Strahan 1995), and is likely to be an important pollinator for many native species (Tidemann 1995).

Grey-headed Flying-foxes forage on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia* (Eby 2000), as well as on the fruits of rainforest trees and vines.

The availability of native fruits, nectar and pollen varies over time and throughout the range of the species. This species is highly nomadic in response to the uneven distribution of their food plants, sometimes travelling hundreds of kilometres to find suitable resources and / or feeding in domestic gardens, parks and orchards. Such characteristics make it very difficult to define key habitat areas (Eby and Lunney 2002). Also, the areas that offer foraging resources at any time are small and vary in location between years (Eby and Lunney 2002).

Although variable, a general pattern of movement can be discerned. Almost half of the eucalypt species used by the Grey-headed Flying-fox flower in summer and such summer-flowering species are distributed throughout their range. Thus, in summer, this species is generally widely dispersed.

However, the winter-flowering species they use are largely restricted to the woodlands of the western slopes or the lowland coastal communities (Eby and Lunney 2002). Thus, they are usually highly aggregated in winter, depending on where the nectar is flowing.

This winter convergence makes the species vulnerable to changes in these coastal communities, particularly as it coincides with the areas of greatest development. High rates of mortality can result from result from losses of small areas of key winter habitat (Eby and Lunney 2002). These losses are compounded by removal and fragmentation of other resource patches used at other times.

Even in areas of remaining forest, nectar flow itself is impacted upon by dieback, drought, fire, and local fluctuations in temperature and rainfall (Eby and Lunney 2002).

The spring also presents potential bottlenecks for this species as several key spring-flowering trees are primarily confined to relatively flat and fertile land such as has already been extensively cleared and is still favoured by development (Eby and Lunney 2002). This also coincides with the time of birth of young when there is an added nutritional requirement and the females do not venture far from the maternity camp to feed.

These camps may contain tens of thousands animals, depending upon the abundance of locally available food sources. They are generally located in close proximity (20 km or less) to a regular food source, often in stands of riparian rainforest, Paperbark or Casuarina forest (Eby 1995). Site fidelity is high and some camps in NSW have been used for over a century (Eby 2000). Just such a long term camp is located at Port Macquarie, approximately 11 kilometres to the east of the subject site.

Being so highly mobile, connectivity of forest patches is not critical for this species to be able to exploit different areas of vegetation. However, they are impacted by direct loss of habitat as well

as via long term changes on critical features such as nectar flow wrought by dieback and other consequences of forest fragmentation.

The number of species of fruits and flowers exploited by this species is large, as befitting its extraordinarily broad distribution along the east coast of Australia.

6.18.2 Assessment

This species was not recorded on the subject site during survey but potential foraging occurs in all of the myrtaceous trees in the forest and woodland areas as well as in the dense patch of remnant Rainforest on site.

All of the potential food resources on site will be retained. The general health of these stands of trees is also likely to improve with the removal of cattle and so the blossom and nectar available is likely to be increased over time.

The partial development of the cleared areas for dwellings will not alter this species' ability to access foraging resources on and off the site. It is a highly mobile species able to exploit resources in the most disturbed places and so the rural residential development will not disrupt or fragment the connectivity of habitat for this species.

The proposal is unlikely to have a significant impact on this species.

6.19 *Mormopterus norfolkensis* Eastern Freetail-bat

6.19.1 Profile

The Eastern Freetail-bat is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Eastern Freetail-bat has dark brown to reddish brown fur on the back and is slightly paler below. Like other freetail-bats it has a long (3 - 4 cm) bare tail protruding from the tail membrane (DECC 2008).

The Eastern Freetail-bat is an insectivore but nothing specific is known about its diet (Churchill 1998). It is thought that they forage within a few kilometres of their roost (Hoye et al. 2008).

It is found along the east coast from south eastern Queensland to southern NSW (DECC 2008). Most records are from dry eucalypt forest and woodland, although a number have been caught flying low over a rocky river through rainforest and wet sclerophyll forest (Hoye et al. 2008). Research in coastal forests near Coffs Harbour have shown that it is more active on upper slopes where the flyways are open and uncluttered, rather than along creeks (Hoye et al. 2008).

Although it has been recorded roosting in the roof of a hut, under bark and the caps of telegraph poles, it is more usually found in tree hollows (Churchill 1998). All natural roost sites have been found in large mature eucalypts and will use paddock trees and remnant vegetation in farmland (Hoye et al. 2008). Young are born in late November or early December and are free-flying by late January (Hoye et al. 2008).

6.19.2 Assessment

This species was recorded foraging on the subject site during survey. The quality of the calls were such that this species has been definitely identified. Foraging habitat occurs in the open eucalypt forest remnants and the disturbed open parts of the Swamp Oak Floodplain Forest. Potential roosting sites occur in the large hollow-bearing trees in the Turpentine – Pink Bloodwood Open Forest and in the Blackbutt Open Forest.

The areas to be developed – open cleared grassland – does not provide important habitat for this species. The important resources for this species on site will remain – the hollow-bearing trees will be retained and protected and the nearby open forest areas dominated by eucalypts will be largely retained. A small area of potential foraging habitat in the Subtropical Coastal Floodplain Forest will be removed and the regeneration of the disturbed Swamp Oak Floodplain Forest may alienate a

small area of foraging habitat as the understorey regrows and becomes more cluttered. However, on the whole, the habitat on site for this species will remain.

Potential roost sites may be boosted and the bottleneck avoided when the large trees senesce and die, by the provision of nest boxes some of which will be suitable for this species.

The proposal is unlikely to have a significant impact on this species.

6.20 *Miniopterus schreibersii oceanensis* Eastern Bentwing-bat

6.20.1 Profile

The Eastern Bent-wing Bat is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Eastern Bent-wing Bat has recently been identified as a result of revision to the taxonomy of the Common Bent-wing Bat (*Miniopterus schreibersii*). The Eastern Bent-wing Bat closely resembles the Little Bentwing-bat, however is larger (Strahan 1995). This species is distributed across the well-watered parts of eastern and northern Australia, however it hibernates in the southern parts of the range (Strahan 1995). Its range extends along the entire east coast of Australia, with a gap forming along the Gulf of Carpentaria, where records begin again in the Kimberley (Churchill 1998).

Primary roost sites include caves with colonies reaching thousands in number (Strahan 1995), however they also use other man-made structures. The 12 maternity roosts that are known to throughout the range of this species are located in limestone and sandstone caves, abandoned gold mines, concrete bunkers and lava tubes (Hoye and Hall 2008).

In the southern, non-tropical parts of its range mating occurs in early winter but implantation is delayed until August. After that time they form discrete populations of pregnant females, non-breeding females and juvenile males at a maternity cave in the spring and summer (Hoye and Hall 2008), but will disperse several hundreds of kilometres from the maternity cave at other times of the year (DECC 2008).

Overwintering roosts depend on the sex and age of individuals with bats often selecting cool areas located within caves, mines, tunnels, drains and bridges during the colder months of the year when insects are few (Hoye and Hall 2008). In such sites they may enter periodic torpor as an energy-saving strategy, reducing their metabolic temperatures and prolong fat reserves over winter (Churchill 1998). In the tropical areas, however, diurnal shelter sites may be found in roofs of buildings (Hoye and Hall 2008).

It has a fast and direct flight (Hoye and Hall 2008) and forages principally on moths, usually snatched high above the forest canopy, although it can also forage low to the ground over open grassy areas (Churchill 1998) and along waterways and tracks (Hoye and Hall 2008). It also regularly forages around street lights and may be active throughout winter in coastal locations (Hoye and Hall 2008).

This species is vulnerable to losses of maternity sites and increased mortality is observed at overwintering roosts that are frequently disturbed (Hoye and Hall 2008). Foxes and cats are major predators (Hoye and Hall 2008), and bats overwintering in urban areas show high levels of injury from collisions with cars and trains, flooding and other urban hazards (Hoye and Spence 2004).

6.20.2 Assessment

This species was not recorded on the subject site during survey but potential foraging habitat occurs across the entire site in the open areas and above the forest and open forest. No habitat suitable for maternity roosts occur on or near the site.

The habitat features appropriate for this species – the patches of open forest and open areas - will remain essentially unchanged in the post-development landscape. This species is highly mobile, able to fly hundreds of kilometres between breeding and overwintering sites, so the development of parts of the cleared areas is not likely to interrupt connectivity between patches of habitat.

The proposal is unlikely to have a significant impact on this species.

6.21 *Miniopterus australis* Little Bentwing-bat

6.21.1 Profile

The Little Bentwing-bat is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Little Bentwing-bat is distinguished from other bentwing-bats by its small size and very long terminal joint in the third digit of the forelimb (Strahan 1995). This species has a distinctively short muzzle and a domed head (Churchill 1998).

These bats have a distribution running along the east coast of Australia from Cape York to northern New South Wales (Churchill 1998). In tropical areas, it ranges from the coast to higher elevations but further south it is largely restricted to the coast (Hoye and Hall 2008).

In the southern part of their range, Little Bentwing-bats may hibernate during winter months (Churchill 1998) but are known to remain active through much of winter, emerging to feed on many nights (Hoye and Hall 2008). It forages via aerial pursuit of small insects (moths, wasps and ants) beneath the canopy of well-timbered habitats including rainforest, paperbark swamps and wet and dry sclerophyll forest (Hoye and Hall 2008).

This species roosts communally in caves or similar suitable spaces, often with *Miniopterus schreibersii oceanensis* Eastern Bentwing-bat (Hoye and Hall 2008). Females gather in large maternity colonies in summer (Menkhorst and Knight 2001), and a single young is born in December (Strahan 1995). Non-breeding roost sites have included one observation of use of a tree hollow, but it is not known whether this occurs regularly (Hoye and Hall 2008).

6.21.2 Assessment

This species was recorded foraging on the subject site during survey. The quality of the calls were such that this species has been definitely identified.

Foraging habitat occurs within the low-lying swamp forests, particularly the Swamp Oak Floodplain Forest. Although it is known to forage in Rainforest, the remnant on site is highly cluttered in the understorey and unlikely to be used by any microchiropteran bats as foraging habitat.

The areas that provide suitable habitat for this species will be retained and managed for conservation. It is highly mobile and so the partial development of the cleared grassland areas for dwellings is unlikely to interrupt this connectivity of habitat for this species.

The proposal is unlikely to have a significant impact on this species.

6.22 *Myotis macropus* Large-footed Myotis

6.22.1 Profile

The Large-footed Myotis is listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act (1995). This species is not listed under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999).

The Large-footed Myotis is a small bat, distinguished by its large feet (Strahan 1995). This is a predominantly coastal species, and rarely extends further than 100 kilometres inland (Churchill 1998). It has a distribution from the Kimberley to Victoria and South Australia and occurs inland along some major river systems such as the Murray River (Churchill 1998).

This species has been recorded from most habitat types, with proximity to water thought to be the main habitat determinant (Churchill 1998). A maternity roost for example was located under a wooden bridge in a rural landscape (Law et al. 2001). However, a radio-tracking study of this species in south east Queensland revealed that it may travel up to 10 kilometres several times a night from its communal roost site to its foraging habitat (Barclay et al. 2000).

It roosts communally in caves (Strahan 1995), but also roosts in tree hollows, amongst vegetation, in mines and stormwater drains (Churchill 1998), tunnels (Barclay et al. 2000), buildings (DEC 2005) and under bridges (Law et al. 2001). Each male sets up and defends a small harem of females and young within the larger maternity colony (Barclay et al. 2000, Law et al. 2001).

They are generally torpid over winter (Richards 1995). In the southern parts of its range, a single young is born from November to December (Menkhorst and Knight 2001). When not breeding, males either roost alone or form bachelor groups of up to 20 individuals (Richards et al. 2008).

It may hunt individually or in groups, using its large feet to rake the surface of the water and catch small fish or aquatic insects from rivers and lakes (Richards et al. 2008). It is also known to forage for aerial insects in a downward spiralling flight (Richards et al. 2008).

6.22.2 Assessment

This species was "probably" recorded foraging over the dam in the centre of the site. The shape and frequency of calls of this species are very similar to *Nyctophilus* species (Long-eared Bats), but the frequency and shape of the calls were more like those of *Myotis macropus* Large-footed Myotis. Also, the Hastings River and Haydons Creek are likely to provide foraging habit for this species and potential roosting habitat occurs in the hollow-bearing trees in the patches of open forest.

The important habitat features for this species will not be altered by the proposed development of some of the cleared parts of the site. The dams are to be retained and all of the hollow-bearing trees are to be protected.

Moreover, additional nest boxes may provide roost sites when the larger trees senesce and die.

The proposal is unlikely to have a significant impact on this species.

7 CONCLUSIONS

This Flora and Fauna Impact Assessment has considered the likely impacts of the proposed development at Lot 51 DP 775871, Lots 1-13, 15-66, 68, 70-72, 74-80, 83-84, 86-88 DP 79119 and Lots 90-95 DP 805549, Sancrox Road, Sancrox upon species, populations and communities of conservation significance.

The proposed development has been constrained by low-lying flood prone land and ecological attributes such as the distribution of endangered ecological communities. As a result, the development's footprint is restricted to the upper reaches of the site.

The site has been used for viticulture and grazed for some time and is dominated by open grassland. Some hollow-bearing trees occur in two remnants that are both to be retained.

As a designated Major Project, the assessment procedure has been determined by the Director-General's Requirements and the flora and fauna impact assessment guidelines prepared by the then DEC (2005).

Commonwealth legislation remains unaffected by the declaration of a Major Project and so the standard assessment procedure as required by the EPBC Act (1999) was carried out.

Accordingly, the potential impact was assessed for nationally and state listed threatened species, populations or ecological communities, or their habitats.

Survey established the presence of a number of communities and species of interest, namely:

1. Swamp Oak Floodplain Forest
2. Rainforest on Coastal Floodplains
3. Freshwater Wetlands
4. Subtropical Coastal Floodplain Forest
5. *Glossopsitta pusilla* Little Lorikeet
6. *Mormopterus norfolkensis* Eastern Freetail-bat
7. *Miniopterus australis* Little Bentwing-bat
8. *Myotis macropus* Large-footed Myotis.

It was further determined that potential habitat for a number of other species of interest also occurred on the subject site. The potential impact of the proposal was also assessed for these species:

1. *Melaleuca biconvexa*
2. *Maundia triglochinoides*
3. *Phaius tancarvilleae* Greater Swamp-orchid
4. *Ephippiorhynchus asiaticus* Black-necked Stork
5. *Pandion cristatus* Eastern Osprey
6. *Ptilinopus magnificus* Wompoo Fruit-dove
7. *Ptilinopus regina* Rose-crowned Fruit-dove
8. *Calyptorhynchus lathami* Glossy Black-Cockatoo
9. *Ninox strenua* Powerful Owl
10. *Tyto capensis* Grass Owl
11. *Tyto novaehollandiae* Masked Owl
12. *Phascogale tapoatafa* Brush-tailed Phascogale
13. *Phascolarctos cinereus* Koala
14. *Pteropus poliocephalus* Grey-Headed Flying-fox
15. *Miniopterus schreibersii oceanensis* Eastern Bent-wing Bat

The proposal will not impact on the life cycle of any species or population of import. The development of already-cleared lands will not disrupt important life cycle parameters such as dispersal mechanisms, deplete seed banks or interrupt pollinator activity. The retained riparian zones and low-lying forests may contribute to links to recognised regional corridors and key habitat to the north and south. Water bodies on the site (both natural and man-made) will be retained and enhanced by the removal of cattle. The low-lying areas will be further managed for conservation with the control of weeds and Haydons Creek protected from further degradation by the formal construction of a crossing.

All of the objectives of the DEC assessment guidelines are served or satisfied by the proposed development in the following ways:

- **Maintain or improve biodiversity values (i.e. no net impact on threatened species or native vegetation).** The proposed development is concentrated in the cleared grassland areas and largely excluded from the areas of high biodiversity value (such as endangered ecological communities and habitat for threatened species) or critical ecological function (such as riparian zones or areas of high concentration of hollow-bearing trees). Thus, the important areas will be maintained. The major threatening processes in evidence on the site are related to its management as a grazing property. Its development as rural residential land will effectively halt these processes and improve the ecological integrity of the site into the future. This will be achieved primarily by the removal of cattle, the protection of riparian environments and the return of native plant regeneration.
- **Conserve biological diversity and promote ecologically sustainable development.** All vegetation types and habitats currently supported by the subject site will be maintained in the post-development landscape. The lot yield of this site has been determined by its ecological and physical constraints. An important element of the project is the use of best practice Water Sensitive Urban Design principles. These matters all contribute to ecologically sustainable development.
- **Protect areas of high conservation value.** The endangered ecological communities Rainforest on Coastal Floodplains and Freshwater Wetlands will be entirely protected from development within this proposal. A very small area of Swamp Oak Floodplain Forest (approximately 8,000 square metres) will be filled across a number of lots. This is more than adequately offset with the retention and long-term conservation management of an area 30 times the size of that to be filled. The example of Subtropical Coastal Floodplain Forest on site is tiny (approximately 6,000 square metres) and confined to one lot. It is also highly modified with significant alterations to structure and floristic composition, thus it is of lesser conservation value. This condition status will also remain due to the need to continue to manage the understorey for bushfire protection. All of the hollow-bearing trees identified on site will be retained in reserved areas of open forest and protected within lots. It is also recommended that nest boxes are erected across the landscape to compensate for the inevitable bottleneck of this resource when the mature trees die before newly-recruited trees are old enough to form hollows.
- **Prevent the extinction of threatened species.** The conservation measures within and observance of ecological constraints by this proposal have been demonstrated as not imposing a significant adverse impact on threatened species or endangered ecological communities, thus, supporting the conservation of threatened species.
- **Protect the long-term viability of local populations of a species, population or ecological community.** The retention of the remnant vegetation of the low-lying parts of the subject site further contributes to the maintenance of significant local populations as it provides connectivity to other fragmented remnant vegetation to the east and also provides stepping stones for highly mobile fauna to move in a north – south direction. This in turn links with areas of recognised sensitive lands and wildlife corridors.
- **Protect aspects of the environment that are matters of national environmental significance.** No matters of national environmental significance were detected on the subject site. However, potential habitat was observed for three threatened species and assessments pursuant to the EPBC Act (1999) were performed. These assessments showed that there is unlikely to be a significant adverse impact on these species and concluded that a referral to the Department of Environment, Water, Heritage and the Arts is not required.

Although it is judged that no significant adverse impact will occur as a result of the proposed development of Le Clos Verdun Estate as a rural residential development, the following recommendations are made in order to ameliorate any impacts:

1. Driveways and other structures on the central ridge are to avoid conflict with the tree protection zones of the hollow-bearing trees.

2. Nest boxes of various sizes suitable for birds, bats and arboreal mammals should be placed in retained trees across the site to compensate for the loss of hollows in the future when mature trees senesce and die. These nest boxes may be erected gradually over time and should at least equal the number of hollow-bearing trees currently on site.

3. The on-site effluent disposal systems for the new dwellings will be located as far as

possible away from the sensitive downslope vegetation, providing the maximum buffer of grassed or otherwise landscaped / vegetated lands.

4. Asset protection zones are to be excluded from the Swamp Oak Floodplain Forest, Rainforest or Freshwater Wetland vegetation.

5. Widespread grazing by hard-hoofed animals should be prohibited.

6. Weed management strategies should be implemented across the site, but particularly in the Rainforest and Swamp Oak Floodplain Forest.

7. Plant species used in landscaping of the development area should preferentially be of locally-native species from local prevenance material.

8. Any plantings required as part of the weed management control should also be of local provenance material only.

9. Approaches should be made to the local Rural Lands Protection authority regarding feral animal control strategies that target the feral deer that occur in this area.

10. Firewood collection should be prohibited.

11. A formal crossing over Haydons Creek should be constructed in the existing clearing. This crossing is to be strictly in accordance with the requirements under the Water Management Act (2000) and regulations (2008).

It is recommended that no further ecological impact assessment is required.

Acknowledgements

Thanks go to Joe Carlin his assistance in the field and for analysis of the microchiropteran bat calls; and Barbra Triggs for analysing the hair samples.

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NSW Scientific Committee (No Date) Glossy Black-Cockatoo – Vulnerable Species Listing. Final Determination

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FIGURES

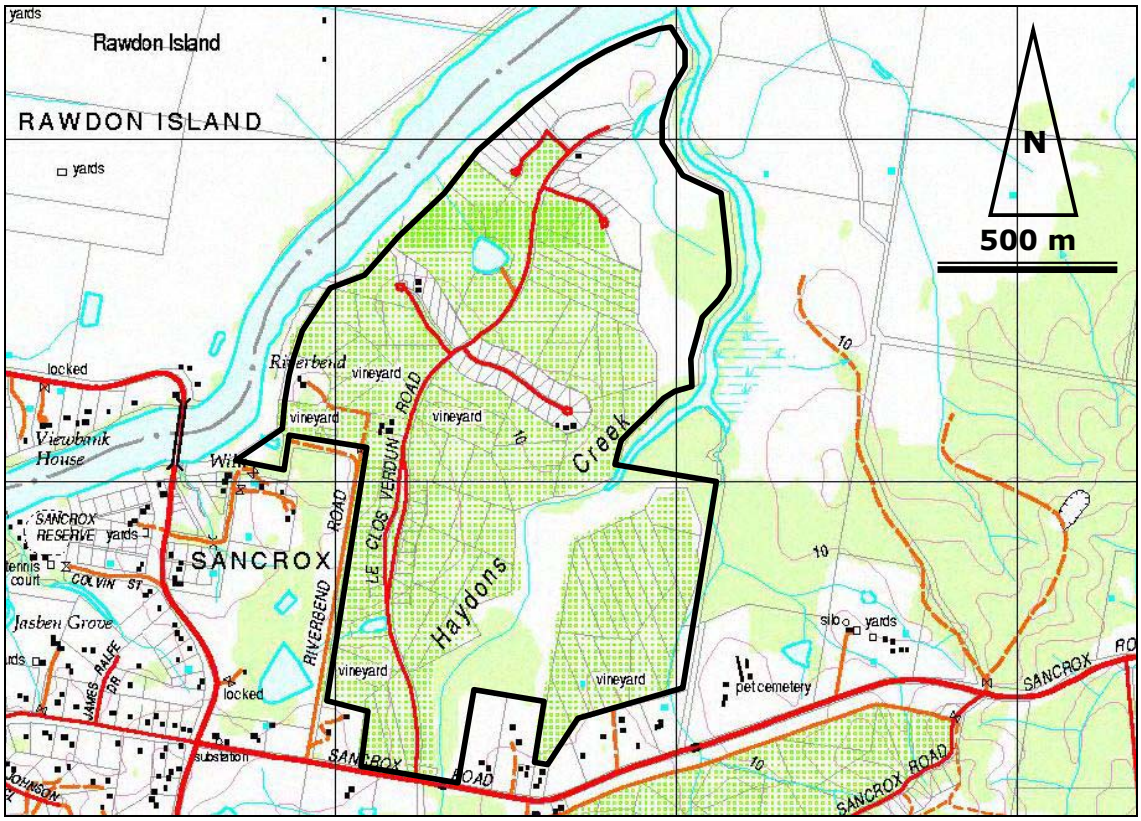

Figure 1: Subject site (boundary in black) in relation to local topography. Map source: Dept of Lands, Port Macquarie 1:25,000 topographic map.

Figure 2: Aaerial photograph showing the distribution of vegetation on site and in the immediate vicinity. Cleared areas once supported vineyards and, other than a few small patches, remnant woody vegetation is principally confined to the swamplands. Source: Hopkins Consultants.

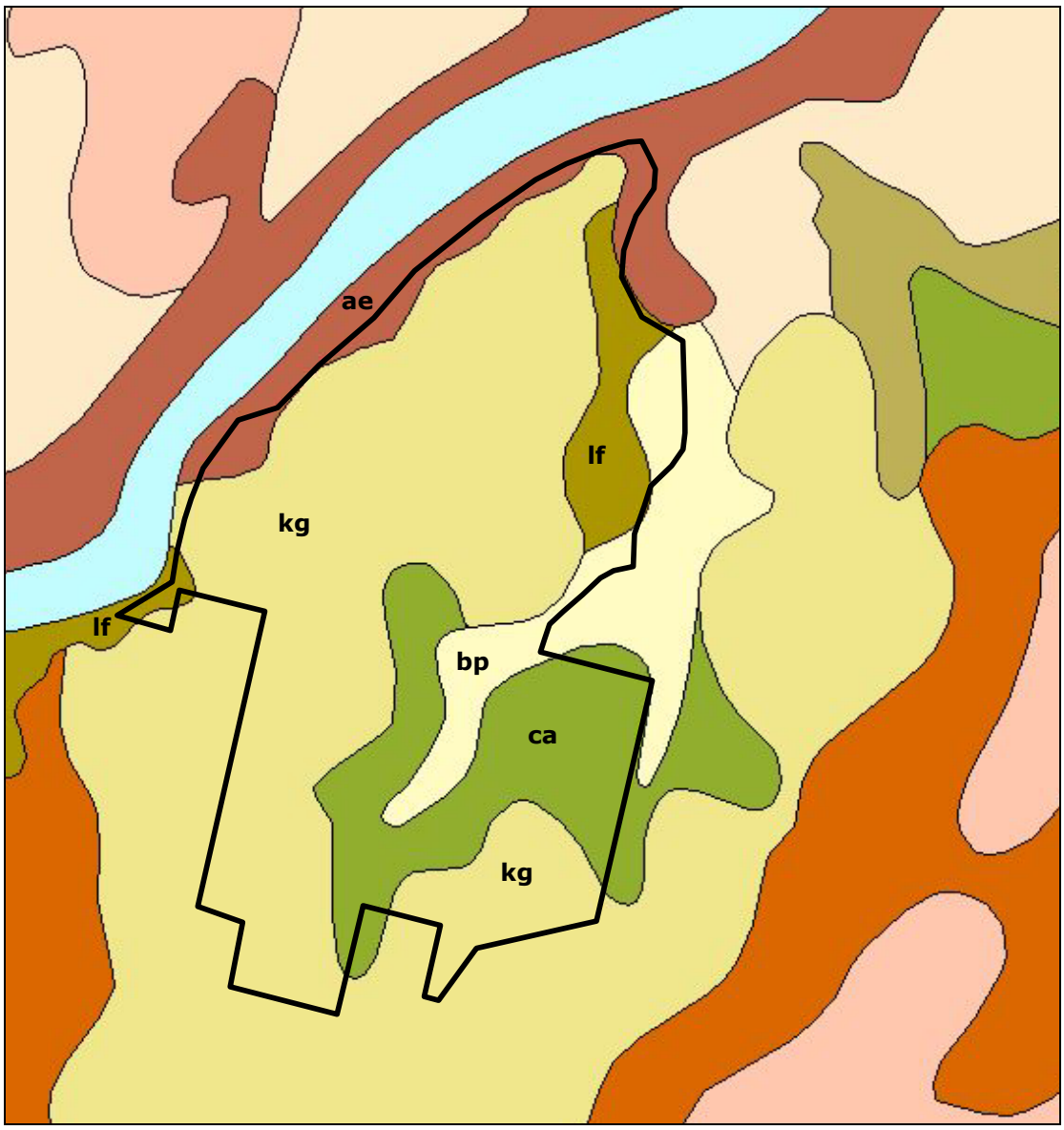

Figure 3: Soil landscapes of the subject site (black). kg=Kundabung, ca=Cairncross, au=Austral Eden, lf=Long Flat, bp=Blackmans Point. Source: Atkinson (1999b).

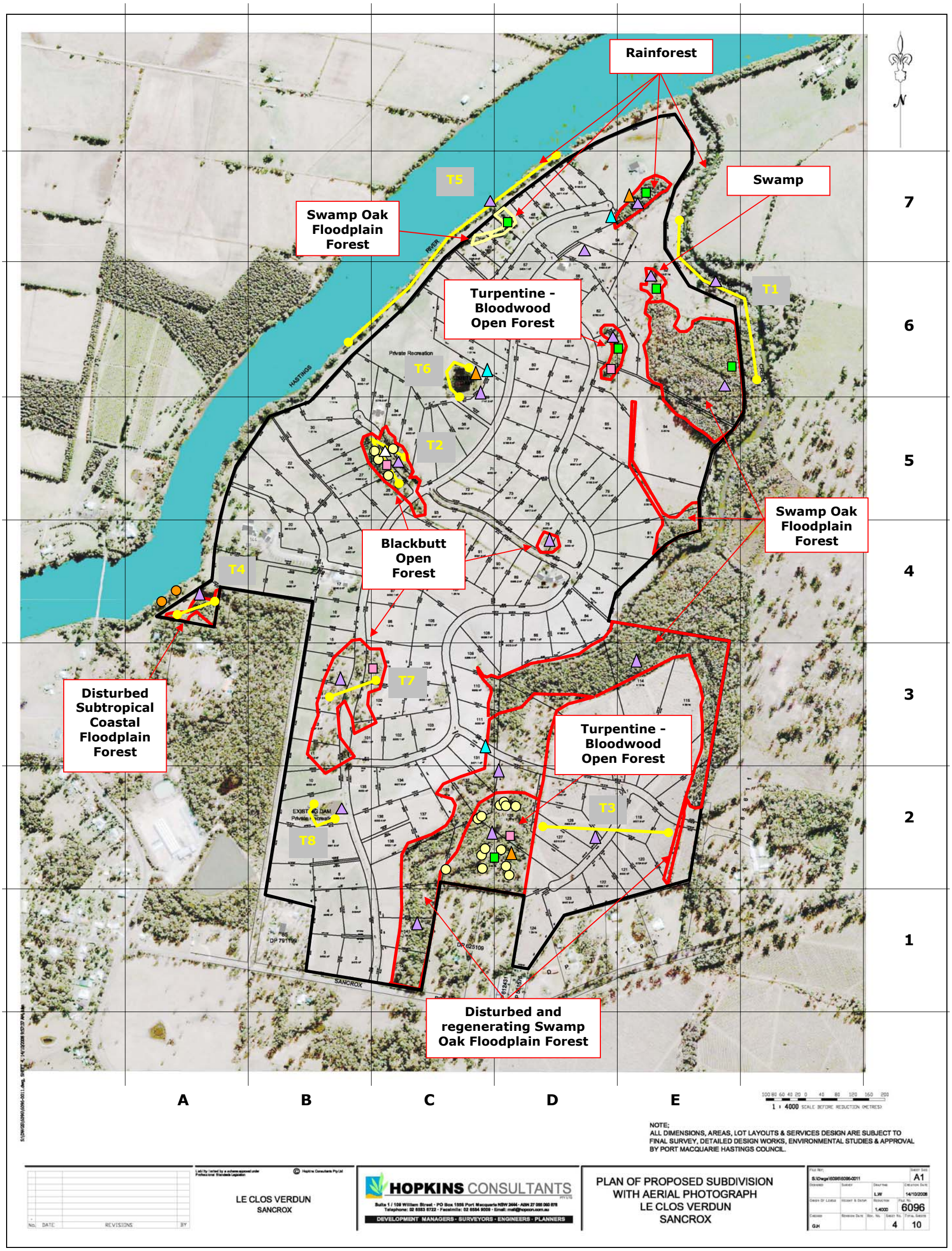

Figure 4: Aerial photograph showing the subject site and the proposed lot layout in relation to the flora and fauna survey and vegetation types (red). Flora survey comprised 6 full floristics quadrats of 400 square metres (green squares), 4 tree quadrats of 400 square metres (pink squares) and 5 transects (gold lines) and random meander (not shown for reasons of clarity). Fauna survey comprised stationary Anabat call recording over 3 nights (orange triangles), call broadcast of nocturnal mammals and birds on 3 occasions (blue triangle), 10 minute observation points for birds in each vegetation type (purple triangles), spotlighting and mobile Anabat recording on foot in all woody vegetation types and from a slow-moving vehicle in open grassland areas (not shown for reasons of clarity), amphibian call recording at the dams, soaks and rivers (not shown for reasons of clarity), searches for scats and other signs across the site and "stagwatching" of hollow-bearing trees. Hollow-bearing trees on the site are numbered and tagged (yellow circles), those off site are not labelled (orange circles).

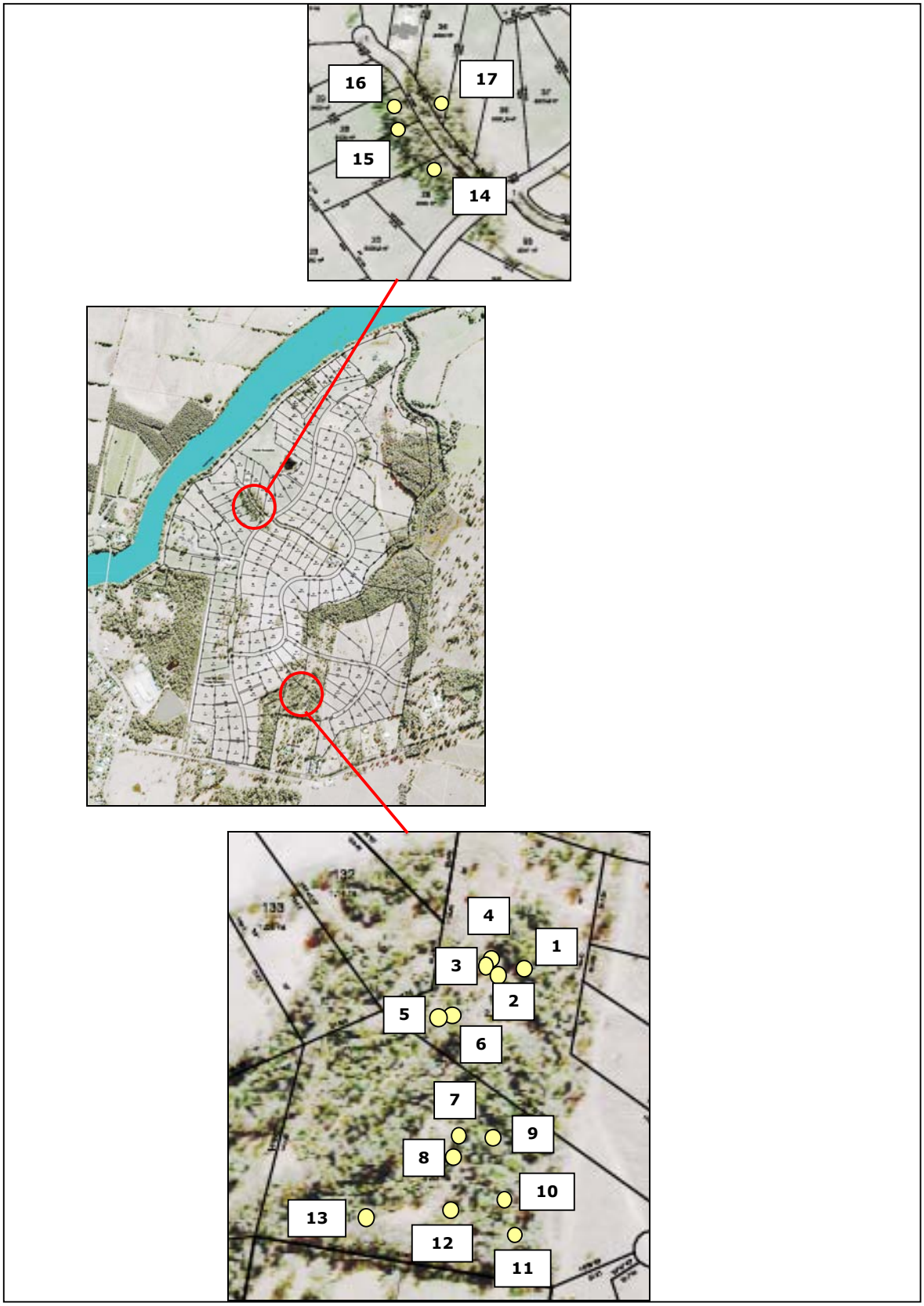

Figure 5: Aerial photograph showing the locations of the 17 tagged hollow-bearing trees on the subject site.

PHOTOGRAPHS

Photo 1: Cleared Open Grassland – Transect 3. The remains of the vines can be seen in amongst the tussock grasses as well as some scattered *Acacia floribunda* Sally Wattle.

Photo 2: Swamp Oak Floodplain Forest – near Quadrat 1. This vegetation type contains drainage channels and dams as well as areas of open water that are natural back swamps associated with Haydons Creek.

Photo 3: Blackbutt Open Forest – Transect 7. Three remnants occur on the ridges and upper slopes and are highly modified with mown or grazed understorey.

Photo 4: Turpentine – Pink Bloodwood Open Forest – Quadrat 4. Two remnants occur on the lower slopes in the east and are made up of remnant canopy trees and a highly simplified and open understorey.

Photo 5: Rainforest – Quadrat 6. Note the dense and diverse nature of this vegetation type on the subject site.

Photo 6: Riverine Rainforest – Transect 5. The Rainforest vegetation off site consists of a narrow strip along the edge of the Hastings River and Haydons Creek.

Photo 7: Swamp – Quadrat 5. The low-lying drainage line in the northern part of the subject site adjacent to the Swamp Oak Floodplain Forest supports swampland dominated by *Juncus* species.

Photo 8: Subtropical Coastal Floodplain Forest – Transect 4. This area is mostly cleared and regularly slashed for bushfire protection of nearby residences.

Photo 9: Dam alongside the Subtropical Coastal Floodplain Forest near the Hastings River – near Transect 4. Unlike the other dams on site, this is more enclosed by natural vegetation and supports a different suite of fauna species.

Photo 10: Dam in the southern part of the site – Transect 8. The two dams along the central road are highly modified with small areas of (largely) planted vegetation on their western sides.

APPENDIX 1

FLORA DETAILS

Table 1.1: Flora species observed on the subject site in quadrats (Q) and transects (T) across the various vegetation types. SO = Swamp Oak Floodplain Forest, FS = Freshwater Swamp, D = in and around dams, Bb = Blackbutt Open Forest, Tu = Turpentine-Pink Bloodwood Open Forest, SF = Subtropical Coastal Floodplain Forest, C = Cleared pasture land. Abundance scores are modified Braun-Blanquet projective foliage cover scores: 1 = <5% cover and few individuals, 2 = <5% cover and many many individuals, 3 = 5-25% cover, 4 = 25-50% cover, 5 = 50-75% cover, 6 = 75-100% cover; x = species observed in transects or near quadrats; * = introduced species; N4, N5 = noxious weed class 4 or 5. Locations of quadrats and transects shown in Figure 4.

Family	Scientific Name	Common Name	SO	Sw	D		Rf				Bb		Tu		SF	C
			Q1	Q5	T6	T8	Q6	Q2	T1	T5	T2	T7	Q4	Q3	T4	T3
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower					2						1			
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair												x		
Apiaceae	*Centella asiatica*	Swamp Pennywort				x										
Apiaceae	*Daucus carota**	Wild Carrot											1			
Apiaceae	*Hydrocotyle laxiflora*	Stinking Pennywort												1		
Apiaceae	*Hydrocotyle peduncularis*	Pennywort												1		
Apocynaceae	*Araujia sericifera**	Moth Vine						1								
Apocynaceae	*Parsonsia straminea*	Common Silkpod	1		x		2									
Araceae	*Alocasia brisbanensis*	Cunjevoi					x									
Araceae	*Gymnostachys anceps*	Settlers Flax					x									
Araceae	*Philodendron bipinnatifidum**	-					x									
Araliaceae	*Polyscias sambucifolia*	Elderberry Panax												1		
Arecaceae	*Phoenix canariensis**	Canary Island Date Palm				x										
Asclepiadaceae	*Gomphocarpus fruticosus**	Narrow Leaf Cotton Bush						1								
Asteraceae	*Ageratum houstonianum**	-													x	
Asteraceae	*Bidens pilosa**	Cobbler's Pegs	2					1					1			
Asteraceae	*Cirsium vulgare**	Spear Thistle	1										1			
Asteraceae	*Conyza* sp.*	-	1										1	1		x
Asteraceae	*Hypochaeris radicata**	Flatweed										x		1		x
Asteraceae	*Onopordum acanthium* subsp. *acanthium**	Scotch Thistle						1						1	x	x
Asteraceae	*Ozothamnus argophyllus*	Spicy Everlasting												1		
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting				x										
Asteraceae	*Senecio madagascariensis**	Fireweed	1	1							x	x	2	2	x	x
Asteraceae	*Soliva pterosperma**	Bindii														x

Table 1.1 (cont'd): Flora species observed on the subject site in quadrats (Q) and transects (T) across the various vegetation types. SO = Swamp Oak Floodplain Forest, FS = Freshwater Swamp, D = in and around dams, Bb = Blackbutt Open Forest, Tu = Turpentine-Pink Bloodwood Open Forest, SF = Subtropical Coastal Floodplain Forest, C = Cleared pasture land. Abundance scores are modified Braun-Blanquet projective foliage cover scores: 1 = <5% cover and few individuals, 2 = <5% cover and many many individuals, 3 = 5-25% cover, 4 = 25-50% cover, 5 = 50-75% cover, 6 = 75-100% cover; x = species observed in transects or near quadrats; * = introduced species; [N4, N5] = noxious weed class 4 or 5. Locations of quadrats and transects shown in Fig 4.

Family	Scientific Name	Common Name	SO	Sw	D		Rf				Bb		Tu		SF	C
			Q1	Q5	T6	T8	Q6	Q2	T1	T5	T2	T7	Q4	Q3	T4	T3
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle	1													
Asteraceae	*Taraxacum officinale**	Dandelion												x		
Azollaceae	*Azolla filiculoides*	Pacific Azolla				x										
Bignoniaceae	*Pandorea pandorana*	Wonga Vine						1		x						
Boraginaceae	*Echium plantagineum**	Patterson's Curse											1			x
Brassicaceae	*Capsella bursa-pastoris**	Shepherds purse											1			
Caryophyllaceae	*Stellaria media**	Common Chickweed											1			
Casuarinaceae	*Allocasuarina littoralis*	Black She-oak												x		
Casuarinaceae	*Casuarina glauca*	Swamp Oak	4	1	x	x									x	x
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	1													
Commelinaceae	*Commelina cyanea*	Scurvy Weed											1			
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew					x									
Convolvulaceae	*Dichondra repens*	Kidney Weed					1	2			x		1	1		
Convolvulaceae	*Ipomoea cairica**	Blue Morning Glory						1								
Convolvulaceae	*Ipomoea indica**	Coastal Morning Glory													x	
Cyatheaceae	*Cyathea australis*	Rough Tree-fern					x									
Cyperaceae	*Bolboschoenus caldwellii*	-	3		x	x										
Cyperaceae	*Carex appressa*	Tall Sedge	3					3					3			
Cyperaceae	*Cyperus eragrostis**	Umbrella Sedge				x										
Cyperaceae	*Eleocharis sphacelata*	Tall Spike-rush				x										
Cyperaceae	*Gahnia aspera*	Saw Sedge												1		
Cyperaceae	*Isolepis cernua*	Nodding Club-rush												3		x
Cyperaceae	*Lepidosperma laterale*	Variable Sword-sedge												x		

Table 1.1 (cont'd): Flora species observed on the subject site in quadrats (Q) and transects (T) across the various vegetation types. SO = Swamp Oak Floodplain Forest, FS = Freshwater Swamp, D = in and around dams, Bb = Blackbutt Open Forest, Tu = Turpentine-Pink Bloodwood Open Forest, SF = Subtropical Coastal Floodplain Forest, C = Cleared pasture land. Abundance scores are modified Braun-Blanquet projective foliage cover scores: 1 = <5% cover and few individuals, 2 = <5% cover and many many individuals, 3 = 5-25% cover, 4 = 25-50% cover, 5 = 50-75% cover, 6 = 75-100% cover; x = species observed in transects or near quadrats; * = introduced species; [N4, N5] = noxious weed class 4 or 5. Locations of quadrats and transects shown in Fig 4.

Family	Scientific Name	Common Name	SO	Sw	D		Rf				Bb		Tu		SF	C
			Q1	Q5	T6	T8	Q6	Q2	T1	T5	T2	T7	Q4	Q3	T4	T3
Dennstaedtiaceae	*Pteridium esculentum*	Bracken												1		
Dicksoniaceae	*Calochlaena dubia*	Harsh Ground-fern					2									
Dilleniaceae	*Hibbertia obtusifolia*	Grey Guinea Flower												x		
Dioscoreaceae	*Dioscorea transversa*	Native Yam					2									
Droseraceae	*Drosera peltata*	Sundew												x		
Ericaceae	*Leucopogon juniperinus*	Prickly Beard-heath										x				
Euphorbiaceae	*Glochidion ferdinandi* var. *ferdinandi*	Cheese Tree			x			2		x				1	x	
Euphorbiaceae	*Omalanthus populifolius*	Bleeding Heart					1									
Fabaceae	*Austrosteenisia blackii*	Blood Vine					2	2								
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea									x	x				
Fabaceae	*Desmodium varians*	-												1		
Fabaceae	*Hardenbergia violacea*	False Sarsparilla										x		1		
Fabaceae	*Hovea linearis*	-										x				
Fabaceae	*Kennedia rubicunda*	Dusky Coral Pea												1	x	
Fabaceae	*Pultenaea villosa*	-												1		
Fabaceae	*Senna odorata*	-													x	
Fabaceae	*Senna pendula var. glabrata**	-													x	
Fabaceae	*Trifolium repens**	White Clover											1	2		x
Flacourtiaceae	*Scolopia braunii*	Flintwood						1		x						
Flagellariaceae	*Flagellaria indica*	Whip Vine					1									
Geraniaceae	*Geranium solanderi var. solanderi*	Native Geranium											1			
Goodeniaceae	*Dampiera stricta*	Blue Dampiera												x		
Goodeniaceae	*Goodenia hederacea var. hederacea*	Ivy-leaved Goodenia										x				

Table 1.1 (cont'd): Flora species observed on the subject site in quadrats (Q) and transects (T) across the various vegetation types. SO = Swamp Oak Floodplain Forest, FS = Freshwater Swamp, D = in and around dams, Bb = Blackbutt Open Forest, Tu = Turpentine-Pink Bloodwood Open Forest, SF = Subtropical Coastal Floodplain Forest, C = Cleared pasture land. Abundance scores are modified Braun-Blanquet projective foliage cover scores: 1 = <5% cover and few individuals, 2 = <5% cover and many many individuals, 3 = 5-25% cover, 4 = 25-50% cover, 5 = 50-75% cover, 6 = 75-100% cover; x = species observed in transects or near quadrats; * = introduced species; [N4, N5] = noxious weed class 4 or 5. Locations of quadrats and transects shown in Fig 4.

Family	Scientific Name	Common Name	SO	Sw	D		Rf				Bb		Tu		SF	C
			Q1	Q5	T6	T8	Q6	Q2	T1	T5	T2	T7	Q4	Q3	T4	T3
Haloragaceae	*Gonocarpus micranthus* subsp. *micranthus*	-												x		
Haloragaceae	*Gonocarpus teucrioides*	Raspwort												1		
Haloragaceae	*Myriophyllum sp.*	Milfoil		1												
Juncaceae	*Juncus continuus*	-				x										
Juncaceae	*Juncus krausii*	Sea Rush	4	5												
Juncaceae	*Juncus polyanthemus*	-		2												
Juncaceae	*Juncus usitatus*	Common Rush		2									2	1		x
Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower												1		
Lauraceae	*Cinnamomum camphora**	Camphor Laurel					1			x						
Lauraceae	*Cryptocarya glaucescens*	Jackwood					3									
Lauraceae	*Litsea reticulata*	Bolly Gum					1									
Lobeliaceae	*Lobelia alata*	-	1													
Lobeliaceae	*Pratia purpurascens*	Whiteroot												1		
Lomandraceae	*Lomandra filiformis* var. *filiformis*	Wattle Mat-rush										x				
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush				x				x		x		1		
Loranthaceae	*Amyema congener* subsp. *congener*	Mistletoe			x											
Loranthaceae	*Amyema gaudichaudii*	Mistletoe								x						
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry					2								x	
Malvaceae	*Hibiscus heterophyllus*	Native Rosella						1								
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne						1					3			
Meliaceae	*Synoum glandulosum*	Scentless Rosewood					3									
Mimosaceae	*Acacia elongata*	-										x		x		
Mimosaceae	*Acacia floribunda*	Sally Wattle			x	x										x

Table 1.1 (cont'd): Flora species observed on the subject site in quadrats (Q) and transects (T) across the various vegetation types. SO = Swamp Oak Floodplain Forest, FS = Freshwater Swamp, D = in and around dams, Bb = Blackbutt Open Forest, Tu = Turpentine-Pink Bloodwood Open Forest, SF = Subtropical Coastal Floodplain Forest, C = Cleared pasture land. Abundance scores are modified Braun-Blanquet projective foliage cover scores: 1 = <5% cover and few individuals, 2 = <5% cover and many many individuals, 3 = 5-25% cover, 4 = 25-50% cover, 5 = 50-75% cover, 6 = 75-100% cover; x = species observed in transects or near quadrats; * = introduced species; [N4, N5] = noxious weed class 4 or 5. Locations of quadrats and transects shown in Fig 4.

Family	Scientific Name	Common Name	SO	Sw	D		Rf				Bb		Tu		SF	C
			Q1	Q5	T6	T8	Q6	Q2	T1	T5	T2	T7	Q4	Q3	T4	T3
Mimosaceae	*Acacia longissima*	Long-leaf Wattle												1	x	
Mimosaceae	*Acacia maidenii*	Maiden's Wattle			x			3		x					x	
Monimiaceae	*Wilkiea huegeliana*	Wilkiea					2									
Moraceae	*Maclura cochinchinensis*	Cockspur Thorn	x				3	z		x						
Myrsinaceae	*Aegiceras corniculatum*	River Mangrove								x						
Myrsinaceae	*Myrsine howittiana*	Brush Muttonwood	1													
Myrsinaceae	*Myrsine variabilis*	Muttonwood						3								
Myrtaceae	*Backhousia myrtifolia*	Grey Myrtle					3									
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush									x			1		
Myrtaceae	*Corymbia intermedia*	Pink Bloodwood									x		3	3	x	
Myrtaceae	*Eucalyptus acmenoides*	White Mahogany												x		
Myrtaceae	*Eucalyptus amplifolia*	Cabbage Gum													x	
Myrtaceae	*Eucalyptus botryoides*	Bangalay												x		
Myrtaceae	*Eucalyptus grandis*	Flooded gum													x	
Myrtaceae	*Eucalyptus microcorys*	Tallowwood									x	x	x	x		
Myrtaceae	*Eucalyptus pilularis*	Blackbutt									x	x				
Myrtaceae	*Eucalyptus propinqua* var. *propinqua*	Small Fruited Grey Gum									x	x	x		x	
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark				x					x	x				
Myrtaceae	*Eucalyptus umbra*	Broad-leaved White Mahogany											3	x		
Myrtaceae	*Leptospermum polygalifolium*	Lemon Scented Tea Tree												3	x	
Myrtaceae	*Lophostemon confertus*	Brush Box								x						
Myrtaceae	*Melaleuca decora*	-												x		
Myrtaceae	*Melaleuca ericifolia*	Swamp Paperbark			x											
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer				x								x		

Table 1.1 (cont'd): Flora species observed on the subject site in quadrats (Q) and transects (T) across the various vegetation types. SO = Swamp Oak Floodplain Forest, FS = Freshwater Swamp, D = in and around dams, Bb = Blackbutt Open Forest, Tu = Turpentine-Pink Bloodwood Open Forest, SF = Subtropical Coastal Floodplain Forest, C = Cleared pasture land. Abundance scores are modified Braun-Blanquet projective foliage cover scores: 1 = <5% cover and few individuals, 2 = <5% cover and many many individuals, 3 = 5-25% cover, 4 = 25-50% cover, 5 = 50-75% cover, 6 = 75-100% cover; x = species observed in transects or near quadrats; * = introduced species; [N4, N5] = noxious weed class 4 or 5. Locations of quadrats and transects shown in Fig 4.

Family	Scientific Name	Common Name	SO	Sw	D		Rf				Bb		Tu		SF	C
			Q1	Q5	T6	T8	Q6	Q2	T1	T5	T2	T7	Q4	Q3	T4	T3
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark				x								1		
Myrtaceae	*Melaleuca sieberi*	-												2		
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	3			x	3	x								
Myrtaceae	*Syncarpia glomulifera*	Turpentine											3	3		
Myrtaceae	*Syzygium francisii*	Giant Water Gum					3									
Nymphaeaceae	*Nymphaea* sp.	Waterlily				x									x	
Ochnaceae	*Ochna serrulata**	Mickey Mouse Plant					1	1								
Oleaceae	*Ligustrum lucidum**	Large-leaved Privet					4	1								
Oleaceae	*Ligustrum sinense**	Small-leaved Privet													x	
Oleaceae	*Notelaea longifolia*	Mock Olive					2	1		x						
Orchidaceae	*Cymbidium suave*	Native Cymbidium	x													
Orchidaceae	*Plectorrhiza tridentata*	Tangle Orchid	1													
Oxalidaceae	*Oxalis corniculata**	Yellow Wood Sorrel											1			
Peperomiaceae	*Peperomia tetraphylla*	Four-leaved Peperomia					x									
Philydraceae	*Philydrum lanuginosum*	Woolly Waterlily				x										
Phormiaceae	*Dianella caerulea*	Flax Lily												x		
Phytolaccaceae	*Phytolacca octandra**	Inkweed	2													
Pittosporaceae	*Billardiera scandens* var. *scandens*	Apple Dumplings												1		
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Blackthorn					x									
Pittosporaceae	*Hymenosporum flavum*	Native Frangipani					x									
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	2				2	3								
Plantaginaceae	*Plantago lanceolata**	Ribwort									x	x	2			x
Poaceae	*Andropogon virginicus**	Whisky Grass				x								3	x	x
Poaceae	*Chloris gayana**	Rhodes Grass				x					x				x	x

Table 1.1 (cont'd): Flora species observed on the subject site in quadrats (Q) and transects (T) across the various vegetation types. SO = Swamp Oak Floodplain Forest, FS = Freshwater Swamp, D = in and around dams, Bb = Blackbutt Open Forest, Tu = Turpentine-Pink Bloodwood Open Forest, SF = Subtropical Coastal Floodplain Forest, C = Cleared pasture land. Abundance scores are modified Braun-Blanquet projective foliage cover scores: 1 = <5% cover and few individuals, 2 = <5% cover and many many individuals, 3 = 5-25% cover, 4 = 25-50% cover, 5 = 50-75% cover, 6 = 75-100% cover; x = species observed in transects or near quadrats; * = introduced species; [N4, N5] = noxious weed class 4 or 5. Locations of quadrats and transects shown in Fig 4.

Family	Scientific Name	Common Name	SO	Sw	D		Rf				Bb		Tu		SF	C
			Q1	Q5	T6	T8	Q6	Q2	T1	T5	T2	T7	Q4	Q3	T4	T3
Poaceae	*Cynodon dactylon*	Common Couch											3			
Poaceae	*Echinopogon caespitosus* var. *caespitosus*	Tufted Hedgehog Grass									x			3		
Poaceae	*Ehrharta erecta**	Panic Veldtgrass	2													
Poaceae	*Entolasia stricta*	Wiry Panic										x	2	2		
Poaceae	*Eragrostis brownii*	Brown's Lovegrass									x					
Poaceae	*Imperata cylindrica* var. *major*	Blady Grass									x			1	x	
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass					1	3					1	3		
Poaceae	*Oplismenus imbecillis*	-	2										1	1		
Poaceae	*Paspalum dilatatum**	Paspalum									x		5		x	x
Poaceae	*Pennisetum clandestinum**	Kikuyu			x			1					3			
Poaceae	*Poa labillardieri* var. *labillardieri*	Tussock Grass												3		
Poaceae	*Setaria sphacelata**	South African Pigeon Grass				x									x	
Poaceae	*Stenotaphrum secundatum**	Buffalo Grass		3												
Poaceae	*Themeda australis*	Kangaroo Grass											1			
Poaceae	*Zoysia macrantha*	Coast Couch	3	5												
Polypodiaceae	*Pyrrosia rupestris*	Rock Felt Fern	x													
Proteaceae	*Banksia marginata*	Silver Banksia												x		
Proteaceae	*Grevillea robusta**	Silky Oak			x											
Ranunculaceae	*Ranunculus inundatus*	River Buttercup		1												
Rhamnaceae	*Alphitonia excelsa*	Red Ash						3								
Rhamnaceae	*Pomaderris aspera*	-								x						
Rhamnaceae	*Pomaderris elliptica*	-	1													
Ripogonaceae	*Ripogonum brevifolium*	Small-leaved Supplejack					1									
Rubiaceae	*Opercularia aspera*	Common Stinkweed										x				
Rutaceae	*Citrus limon**	Lemon Tree						1								

Table 1.1 (cont'd): Flora species observed on the subject site in quadrats (Q) and transects (T) across the various vegetation types. SO = Swamp Oak Floodplain Forest, FS = Freshwater Swamp, D = in and around dams, Bb = Blackbutt Open Forest, Tu = Turpentine-Pink Bloodwood Open Forest, SF = Subtropical Coastal Floodplain Forest, C = Cleared pasture land. Abundance scores are modified Braun-Blanquet projective foliage cover scores: 1 = <5% cover and few individuals, 2 = <5% cover and many many individuals, 3 = 5-25% cover, 4 = 25-50% cover, 5 = 50-75% cover, 6 = 75-100% cover; x = species observed in transects or near quadrats; * = introduced species; [N4, N5] = noxious weed class 4 or 5. Locations of quadrats and transects shown in Fig 4.

Family	Scientific Name	Common Name	SO	Sw	D		Rf				Bb		Tu		SF	C
			Q1	Q5	T6	T8	Q6	Q2	T1	T5	T2	T7	Q4	Q3	T4	T3
Rutaceae	*Melicope micrococca*	White Euodia					3									
Rutaceae	*Sarcomelicope simplicifolia*	-					2									
Rutaceae	*Zieria arborescens* subsp. *arborescens*	Stinkwood					2									
Sapindaceae	*Cupaniopsis parvifolia*	Small-leaved Tuckeroo						2		x						
Sapindaceae	*Dodonaea triquetra*	Hop Bush					1									
Sapindaceae	*Jagera pseudorhus*	Foambark Tree	1				3	2								
Smilacaceae	*Smilax australis*	Lawyer Vine					1									
Solanaceae	*Solanum mauritianum**	Wild Tobacco Bush			x		1						1			
Solanaceae	*Solanum nigrum**	Black Nightshade											1			
Solanaceae	*Solanum pseudocapsicum**	-											1			
Thelypteridaceae	*Cyclosorus interruptus*	-								x						
Thymelaeaceae	*Pimelea linifolia subsp. linifolia*	Slender Rice Flower												x		
Ulmaceae	*Aphananthe philippinensis*	Rough-leaved Elm							x							
Ulmaceae	*Trema tomentosa* var. *viridis*	Native Peach					2									
Verbenaceae	*Lantana camara**	Lantana	2		x		4	2		x					x	
Verbenaceae	*Verbena bonariensis**	Purpletop											1			x
Verbenaceae	*Verbena quadrangularis*	-						1								
Violaceae	*Melicytus dentatus*	Tree Violet					1									
Violaceae	*Viola betonicifolia*	-												1		
Viscaceae	*Notothixos incanus*	-														
Vitaceae	*Cissus hypoglauca*	Water Vine								x						

Table 1.2: SEPP 44 tree assessment. Quadrat locations as per the grid in Figure 4.

Quadrat location	Species	Common Name	No. of stems	%	Koala food tree	Potential Koala habitat
D2	*Corymbia intermedia*	Pink Bloodwood	1	12.5%	No	No
	Syncarpia glomulifera	Turpentine	5	62.5%	No	
	Eucalyptus umbra	Broad-leaved White Mahogany	2	25%	No	
C3	*Eucalyptus pilularis*	Blackbutt	7	87.5%	No	No
	Eucalyptus propinqua	Grey Gum	1	12.5%	Secondary	
D6	*Syncarpia glomulifera*	Turpentine	6	75%	No	No
	Eucalyptus umbra	Broad-leaved White Mahogany	1	12.5%	No	
	Corymbia intermedia	Pink Bloodwood	1	12.5%	No	
C5	*Eucalyptus pilularis*	Blackbutt	2	40%	No	No
	Eucalyptus propinqua	Grey Gum	1	20%	Secondary	
	Corymbia intermedia	Pink Bloodwood	2	40%	No	

Table 1.3: Flora species of conservation significance recorded within 10 km of subject site. Source: NPWS Atlas database, 2008.

Family	Scientific Name	Common Name	Status TSC Act (1995)	Status EPBC Act (1999)	Potential Habitat on Site	Recorded on Site
Casuarinaceae	*Allocasuarina defungens*	-	E	E	No	No
Juncaginaceae	*Maundia triglochinoides*	-	V	-	Yes	No
Myrtaceae	*Melaleuca biconvexa*	-	V	V	Yes	No
Orchidaceae	*Phaius tancarvilleae*	Greater Swamp-orchid	E	E	Yes	No

Table 1.4: Flora species of interest and their survey requirements.

Subject Species	Survey considerations (DECC 2008)	Adequacy of current survey
Maundia triglochinoides	Detectable all year but best when in flower during the warmer months, especially November to January.	Adequate.
Melaleuca biconvexa	Identifiable all year.	Adequate.
Phaius tancarvilleae	Detectable al year but most easily found when showy flower spikes appear September to October.	Survey conducted outside of flowering period but vegetative parts still visible at that time.

APPENDIX 2

FAUNA DETAILS

Table 2.1: Fauna survey effort on the subject site.

Fauna Group	Survey Technique	Survey Effort	No of people	Date
Amphibians	Calls recorded	1 hour	1	19/08/2008
		1 hour	1	20/08/2008
		1.75 hours	1	21/08/2008
		1.75 hours	1	22/08/2008
Reptiles	Habitat searches	1 hour	2	19/08/2008
		1 hours	2	20/08/2008
		1 hours	1	22/08/2008
Nocturnal Reptiles	Spotlighting	1 hour	2	19/08/2008
		1 hour	2	20/08/2008
		1 hour	2	21/08/2008
		1 hour	2	22/08/2008
Diurnal Birds	Direct observation - incidental	3 hours	2	19/08/2008
		9.5 hours	2	20/08/2008
		10 hours	2	21/08/2008
		14.5 hours	2	22/08/2008
		6 hours	2	23/08/2008
	Direct observation – spot points	1 hour	1	20/08/2008
		1 hour	1	21/08/2008
		1 hour	1	22/08/2008
Nocturnal Birds	Call playback- Powerful Owl Barking Owl Masked Owl Sooty Owl Grass Owl	45 minutes	2	19/08/2008
		45 minutes	2	20/08/2008
		45 minutes	2	21/08/2008
	Spotlighting	1 hour	2	19/08/2008
		1 hour	2	20/08/2008
		1 hour	2	21/08/2008
		1 hour	2	22/08/2008
Terrestrial Mammals	Habitat searches	1 hours	2	19/08/2008
		1 hour	2	20/08/2008
		30 minutes	2	21/08/2008
	Hair funnels	560 trap nights	NA	23/08/2008 to 06/09/2008
Arboreal Mammals	Call playback- Squirrel-Glider Yellow-bellied Glider	40 minutes	2	19/08/2008
		40 minutes	2	20/08/2008
		40 minutes	2	21/08/2008
	Spotlighting	1 hour	2	19/08/2008
		1 hour	2	20/08/2008
		1 hour	2	21/08/2008
		1 hour	2	22/08/2008
Microchiropteran Bats	Anabat II continuous recording	12 hours	NA	19/08/2008 to 20/08/2008
		12 hours	NA	20/08/2008 to 21/08/2008
		2 hours	NA	22/08/2008
		2 hours	NA	23/08/2008
Megachiropteran Bats	Spotlighting	1 hour	2	19/08/2008
		1 hour	2	20/08/2008
		1 hour	2	21/08/2008
		1 hour	2	22/08/2008

Table 2.2: Weather details from Port Macquarie weather station on days of fauna survey. Source: Bureau of Meteorology, 2008. Note: there was no weather data for the 19th August 2008.

Date	Temperature (^{0}C)				Rain (mm)	Relative Humidity (%)		Wind at 9 a.m.	
	Min	Max	9 a.m.	3 p.m.		9 a.m.	3 p.m.	Direction	Speed (kph)
19/08/2008	-	-	-	-	-	-	-	-	-
20/08/2008	3.6	19.8	11.3	18.4	0	63	32	WNW	17
21/08/2008	4	22.4	11.2	19.7	0	77	48	NW	6
22/08/2008	6.9	17.6	10.3	16.8	3	94	75	SSE	7
23/08/2008	8.6	16.2	12.9	15.2	4	58	53	SW	46
24/08/2008	8	17.9	14.1	17.2	0	60	39	SW	24
25/08/2008	5.7	18.6	13.5	17.4	0	64	53	WSW	13
26/08/2008	4.5	21.6	12.5	20.2	0	84	54	NW	9
27/08/2008	6.5	20.6	17.7	19.4	0	59	41	WSW	17
28/08/2008	10.1	17.3	15.4	15.8	0	65	67	SW	17
29/08/2008	10.1	17.7	12.8	15.9	0.8	88	73	WNW	7
30/08/2008	6.9	20.7	14.8	19.9	0	80	70	W	6
31/08/2008	14.5	18.8	16.4	17.8	0	93	95	N	19
01/09/2008	9.5	22.2	18.4	20.2	4	69	51	SW	7
02/09/2008	8.6	21.1	16.9	19.4	0	69	56	WSW	11
03/09/2008	6.8	20.9	16.7	18.4	0	69	58	WSW	13
04/09/2008	13	19.7	18	15.4	1	60	86	SE	19
05/09/2008	14.7	17.3	14.9	16.1	34	96	96	SE	26
06/09/2008	14.3	19.6	18	18	59	65	55	W	26

Table 2.3: Fauna recorded on the subject site. Species listed under TSC Act (1995) or EPBC Act (1999) are indicated in bold. * = introduced species.

Fauna Group	Scientific Name	Common Name	Type of record
Amphibian	*Litoria fallax*	Eastern Dwarf Tree Frog	Salter (2008)
	Litoria peronii	Peron's Tree Frog	Heard
	Litoria tyleri	Tyler's Tree Frog	Salter (2004)
	Crinia signifera	Common Eastern Froglet	Heard
Reptile	*Physignathus lesueurii*	Eastern Water Dragon	Observed
	Varanus varius	Lace Monitor	Anecdotal
	Pseudechis porphyriacus	Red-Bellied Black Snake	Anecdotal
	Pseudonaja textilis	Eastern Brown Snake	Anecdotal
Bird	*Pelecanus conspicillatus*	Australian Pelican	Observed
	Egretta novaehollandiae	White-faced Heron	Observed
	Ardea ibis	**Cattle Egret**	**Observed**
	Threskiornis spinicollis	Straw-necked Ibis	Observed
	Chenonetta jubata	Australian Wood Duck	Observed
	Anas castanea	Chestnut Teal	Observed
	Anas supercilliosa	Pacific Black Duck	Observed
	Elanus axillaris	Black-shouldered Kite	Salter (2004)
	Aquila audax	Wedge-tailed Eagle	Observed
	Fulica atra	Eurasian Coot	Salter (2004)
	Gallinula tenebrosa	Dusky Moorhen	Observed
	Gallirallus philippensis	Buff-banded Rail	Observed
	Porphyrio porphyrio	Purple Swamphen	Observed
	Geopelia humeralis	Bar-shouldered Dove	Salter (2004)
	Ocyphaps lophotes	Crested Pigeon	Observed

Table 2.3 (cont'd): Fauna recorded on the subject site. Species listed under TSC Act (1995) or EPBC Act (1999) are indicated in bold. * = introduced species.

Fauna Group	Scientific Name	Common Name	Type of record
Bird	*Cacatua roseicapilla*	Galah	Observed
	Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	Observed
	Glossopsitta pusilla	**Little Lorikeet**	**Observed**
	Trichoglossus haematodus	Rainbow Lorikeet	Observed
	Platycercus eximius	Eastern Rosella	Observed
	Eudynamys scolopacea	Common Koel	Salter (2004)
	Cacomantis flabelliformis	Fan-tailed Cuckoo	Observed
	Cacomantis variolosus	Brush Cuckoo	Salter (2004)
	Centropus phasianinus	Pheasant Coucal	Salter (2004)
	Ninox novaeseelandiae	Southern Boobook	Observed
	Tyto alba	Barn Owl	Anecdotal
	Podargus strigoides	Tawny Frogmouth	Observed
	Eurostopodus mystacalis	White-throated Nightjar	Salter (2008)
	Alcedo azurea	Azure Kingfisher	Observed
	Dacelo novaeguineae	Laughing Kookaburra	Observed
	Eurystomus orientalis	Dollarbird	Salter (2004)
	Hirundo neoxena	Welcome Swallow	Observed
	Anthus novaeseelandiae	Richard's Pipit	Observed
	Coracina novaehollandiae	Black-faced Cuckoo-shrike	Observed
	Rhipidura fuliginosa	Grey Fantail	Observed
	Rhipidura leucophrys	Willie Wagtail	Observed
	Eopsaltria australis	Eastern Yellow Robin	Observed
	Psophodes olivaceus	Eastern Whipbird	Observed
	Cisticola exilis	Golden-headed Cisticola	Observed
	Malurus cyaneus	Superb Fairy-wren	Observed
	Gerygone mouki	Brown Gerygone	Observed
	Acanthiza nana	Yellow Thornbill	Observed
	Acanthorhynchus tenuirostris	Eastern Spinebill	Observed
	Anthochaera carunculata	Red Wattlebird	Observed
	Lichenostomus chrysops	Yellow-faced Honeyeater	Observed
	Manorina melanocephala	Noisy Miner	Observed
	Meliphaga lewinii	Lewin's Honeyeater	Observed
	Phylidonyris nigra	White-cheeked Honeyeater	Salter (2004)
	Pardalotus punctatus	Spotted Pardalote	Observed
	Pardalotus striatus	Striated Pardalote	Heard
	Ptilonorhynchus violaceus	Satin Bowerbird	Observed
	Grallina cyanoleuca	Australian Magpie-Lark	Observed
	Cracticus nigrogularis	Pied Butcherbird	Observed
	Cracticus torquatus	Grey Butcherbird	Observed
	Gymnorhina tibicen	Australian Magpie	Observed
	Corvus coronoides	Australian Raven	Heard

Table 2.3 (cont'd): Fauna recorded on the subject site. Species listed under TSC Act (1995) or EPBC Act (1999) are indicated in bold. * = introduced species.

Fauna Group	Scientific Name	Common Name	Type of record
Mammal	***Dasyurus maculatus***	**Spotted-tailed Quoll**	**Anecdotal**
	Phascolarctos cinereus	**Koala**	**Anecdotal observation, also scats reported in Salter (2004)**
	Pseudocheirus peregrinus	Common Ringtail Possum	Observed
	Trichosurus vulpecula	Common Brushtail Possum	Observed, hair sample
	Macropus rufogriseus	Red-necked Wallaby	Observed
	Macropus giganteus	Eastern Grey Kangaroo	Observed
	Tadarida australis	White-striped Freetail-bat	Call recorded definite
	Mormopterus norfolkensis	**Eastern Freetail-bat**	**Call recorded definite**
	Miniopterus australis	**Little Bentwing-bat**	**Call recorded definite**
	Chalinolobus gouldii	Gould's Wattled Bat	Call recorded definite
	Chalinolobus morio	Chocolate Wattled Bat	Call recorded definite
	Myotis macropus	**Large-footed Myotis**	**Call recorded probable**
	Vespadelus pumilus	Eastern Forest Bat	Call recorded probable
	Vespadelus regulus	Southern Forest Bat	Call recorded probable
	*Rattus rattus**	Black Rat	Hair sample
	*Oryctolagus cuniculus**	Rabbit	Anecdotal
	*Vulpes vulpes**	European Red Fox	Anecdotal
	*Canis familiaris**	Domestic Dog	Observed
	*Cervus elaphus**	Red Deer	Observed

Table 2.4: Fauna species of conservation significance recorded within 10 km of subject site. Source: NPWS Atlas database, 2008

Fauna Group	Scientific Name	Common Name	Status TSC Act (1995)	Status EPBC Act (1999)	Potential Habitat on Site	Recorded on Site
Amphibian	*Litoria brevipalmata*	Green-thighed Frog	V	-	No	No
	Litoria aurea	Green and Golden Bell Frog	E	V	No	No
	Crinia tinnula	Wallum Froglet	V	-	No	No
Bird	*Botaurus poiciloptilus*	Australasian Bittern	V	-	No	No
	Ixobrychus flavicollis	Black Bittern	V	-	No	No
	Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Yes	No
	Oxyura australis	Blue-billed Duck	V	-	No	No
	Pandion cristatus	Eastern Osprey	V	-	Yes	No
	Lophoictinia isura	Square-tailed Kite	V	-	No	No
	Haemotopus fuliginosus	Sooty Oystercatcher	V	-	No	No
	Haemotopus longirostris	Australian Pied Oystercatcher	V	-	No	No
	Charadrius mongolus	Lesser Sand-plover	V	-	No	No
	Xenus cinereus	Terek Sandpiper	V	-	No	No
	Ptilinopus magnificus	Wompoo Fruit-dove	V	-	Yes	No
	Ptilinopus regina	Rose-crowned Fruit-dove	V	-	Yes	No
	Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Yes	No
	Glossopsitta pusilla	Little Lorikeet	V	-	Yes	Yes
	Lathamus discolor	Swift Parrot	E	E	No	No
	Tyto tenebricosa	Sooty Owl	V	-	No	No
	Ninox strenua	Powerful Owl	V	-	Yes	No
	Tyto capensis	Grass Owl	V	-	Yes	No
	Tyto novaehollandiae	Masked Owl	V	-	Yes	No
	Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	-	No	No
	Anthochaera phrygia	Regent Honeyeater	E	E	No	No
Mammal	*Dasyurus maculatus*	Spotted-tailed Quoll	V	V	Yes, marginal	Yes, nearby
	Phascogale tapoatafa	Brush-tailed Phascogale	V	-	Yes	No
	Planigale maculata	Common Planigale	V	-	No	No
	Phascolarctos cinereus	Koala	V	-	Yes	Yes, scats
	Petaurus australis	Yellow-bellied Glider	V	-	No	No
	Petaurus norfolcensis	Squirrel Glider	V	-	No	No
	Aepyprymnus rufescens	Rufous Bettong	V	-	No	No
	Pteropus poliocephalus	Grey-Headed Flying-fox	V	V	Yes	No
	Syconycteris australis	Eastern Blossom-bat	V	-	No	No
	Mormopterus norfolkensis	Eastern Freetail-bat	V	-	Yes	Yes
	Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	Yes	No
	Miniopterus australis	Little Bentwing-bat	V	-	Yes	Yes
	Myotis macropus	Large-footed Myotis	V	-	Yes	Yes, possible calls recorded
	Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	No	No
	Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	No	No
	Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V	-	No	No

Table 2.5: Terrestrial fauna species of interest and their survey requirements.

Subject Species	Survey considerations (DECC 2008)	Adequacy of current survey
Ephippiorhynchus asiaticus Black-necked Stork	Detectable all year.	Adequate.
Pandion cristatus Eastern Osprey	Detectable all year.	Adequate.
Ptilinopus magnificus Wompoo Fruit-dove	Detectable when feeding in suitable habitat.	Adequate. Foraging habitat available at time of survey.
Ptilinopus regina Rose-crowned Fruit-dove	Detectable all year. May be less detectable in winter.	Adequate.
Calyptorhynchus lathami Glossy Black-Cockatoo	Detectable all year.	Adequate.
Ninox strenua Powerful Owl	Detectable all year by call playback.	Adequate.
Tyto capensis Grass Owl	Detectable all year by call playback and flushing from grassy cover.	Adequate.
Tyto novaehollandiae Masked Owl	Detectable all year by call playback.	Adequate.
Dasyurus maculatus Spotted-tailed Quoll	Detectable all year by terrestrial trapping, spotlighting and scat collection.	Targeted trapping not undertaken, but habitat is too open and simple and devoid of prey to be regarded as likely to occur on site.
Phascogale tapoatafa Brush-tailed Phascogale	Detectable all year by spotlighting, tree-trapping and hair tube sampling, but particularly in mating season (May-July) when males seeking mates.	Targeted trapping not undertaken, but habitat is too open and simple and devoid of prey to be regarded as likely to occur on site.
Phascolarctos cinereus Koala	Detectable all year.	Adequate.
Pteropus poliocephalus Grey-Headed Flying-fox	Detectable when foraging habitat fruiting and/or flowering.	Survey not undertaken while major food trees in the subject site flowering. However, this is not a major obstacle to impact assessment as habitat assessment can compensate for lack of survey.
Syconycteris australis Eastern Blossom-bat	Detectable all year by spotlighting.	Adequate.
Mormopterus norfolkensis Eastern Freetail-bat	Detectable all year.	Adequate. Detected on site.
Miniopterus australis Little Bentwing-bat	Detectable from mid spring to mid-autumn.	Survey conducted in late winter.
Miniopterus schreibersii oceanensis Eastern Bent-wing Bat	Most detectable from mid spring to mid-autumn.	Adequate. Detected on site.
Myotis macropus Large-footed Myotis	Detectable all year.	Adequate. Possibly detected on site.

Table 2.6: Hollow-bearing trees identified and tagged across the subject site. TPZ = Tree Protection Zone according to a local adaptation of the British Standard (BS 5837:2005 Trees in relation to construction – Recommendations). The TPZ distances are measured from the outside edge of the trunk of the tree. Positions of tagged trees are shown in Figures 4 and 5.

Tag	Species	Height (m)	DBH (cm)	TPZ (m)	Location	Easting	Northing	Notes
1	*Eucalyptus acmenoides* White Mahogany	20	65	6.2	C2	480617	6521505	2 x large branch hollows suitable for possums, gliders, medium birds 1 x small trunk hollow suitable for gliders, medium birds and microchiropteran bats No scats
2	Dead	15	80	7.7	C2	480604	6521503	1 x large trunk hollow suitable for possums, gliders, medium birds No scats
3	Dead	12	50	4.8	C2	480601	6521504	1 x large trunk hollow suitable for possums, gliders, medium birds 1 x hollow at base of tree suitable for microchiropteran bats No scats
4	*Eucalyptus acmenoides* White Mahogany	15	60	5.8	C2	480602	6521508	2 x small branch hollows suitable for small-medium birds and microchiropteran bats No scats
5	*Eucalyptus acmenoides* White Mahogany	15	40	3.8	C2	480577	6521480	1 x small branch hollows suitable for small-medium birds and microchiropteran bats No scats
6	*Eucalyptus botryoides* Bangalay	15	50	4.8	C2	480579	6521482	1 x medium trunk hollow suitable for possums, gliders, medium birds 1 x arboreal termite nest with (Kingfisher?) nest hole No scats
7	*Eucalyptus umbra* Broad-leaved White Mahogany	20	40	3.8	C2	480584	6521423	1 x medium trunk hollow suitable for possums, gliders, medium birds No scats
8	*Corymbia intermedia* Pink Bloodwood	25	110	10.6	C2	480580	6521412	Many large hollows in trunk and branches suitable for possums, gliders, large – medium birds No scats
9	*Eucalyptus umbra* Broad-leaved White Mahogany	25	60	5.8	C2	480601	6521421	1 x small trunk hollow suitable for small birds, microchiropteran bats No scats
10	*Corymbia intermedia* Pink Bloodwood	25	75	7.2	C2	480611	6521373	4 or more medium branch hollows. Brushtail Possum observed emerging from one hollow and Galah observed investigating another No scats

Table 2.6 (cont'd): Hollow-bearing trees identified and tagged across the subject site. TPZ = Tree Protection Zone according to a local adaptation of the British Standard (BS 5837:2005 Trees in relation to construction – Recommendations). The TPZ distances are measured from the outside edge of the trunk of the tree. Positions of tagged trees are shown in Figures 4 and 5.

Tag	Species	Height (m)	DBH (cm)	TPZ (m)	Location	Easting	Northing	Notes
11	*Eucalyptus microcorys* Tallowwood	25	100	9.6	C2	480607	6521390	1 x large trunk hollow suitable for possums, gliders and medium – large birds Nesting material observed at hollow entrance No scats
12	*Eucalyptus acmenoides* White Mahogany	20	100	9.6	C2	480580	6521386	1 x large trunk spout from lightning strike, may be suitable for large parrots No scats
13	*Eucalyptus propinqua* Small-fruited Grey Gum	15	50	4.8	C2	480535	6521382	1 or 2 x small branch hollows suitable for microchiropteran bats No scats
14	*Eucalyptus pilularis* Blackbutt	20	80	7.7	C5	480276	6522446	1 x medium branch hollow suitable fro small – medium birds Pair Little Lorikeets observed investigating this hollow on two occasions No scats
15	*Eucalyptus microcorys* Tallowwood	20	60	5.8	C5	480247	6522483	1 x small branch hollow suitable for small birds and microchiropteran bats No scats
16	*Eucalyptus pilularis* Blackbutt	28	120	11.5	C5	480239	6522501	1 x small branch hollow suitable for small birds and microchiropteran bats No scats
17	*Eucalyptus pilularis* Blackbutt	28	120	11.5	C5	480287	6522505	Many medium branch hollows being investigated by Galahs No scats
no tag	*Eucalyptus propinqua* Small-fruited Grey Gum	20	100	9.6	A4	no GPS record		Not on subject site, in crown reserve on edge of Hastings River. Medium branch hollow suitable for possums, gliders. Scratches, no scats.
no tag	*Corymbia intermedia* Pink Bloodwood	20	120	11.5	A4	no GPS record		Not on subject site, in crown reserve on edge of Hastings River. Medium branch hollow suitable for possums, gliders. No scats.