Flora and Fauna Impact Assessment

Lot 99 DP 823635 Hickey Street Iluka Clarence Valley LGA

For: Shallharbour Unit Trust (Stevens Group)

> REF: CVC 14-695 October 2015



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Keystone Ecolo	gical	
Flora and Fauna Specialists		Cover photograph: Asplenium australasicum Bird's
		Nest Fern growing low on an Acacia disparrima
Mail:	PO Box 5095 Empire Bay NSW 2257	subsp. disparrima. Epiphytes are commonly low on
Telephone:	(02) 4368 1106	the trunks, presumably protected from salt-laden
Email:	office@keystone-ecological.com.au	winds.
ABN:	13 099 456 149	
		Photo: E. Ashby, October 2014

### SUMMARY

Keystone Ecological has been contracted by Shellharbour Unit Trust (Stevens Group) to prepare an assessment of the likely impact of the subdivision and subsequent residential development at Lot 99 DP 823635 Hickey Street Iluka in the Clarence Valley Local Government Area, upon nationally and state listed threatened flora and fauna and their habitat.

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 for further assessment is required.

State legislation (Environmental Planning and Assessment (EPA) Act 1979) requires that actions judged to significantly impact upon threatened species, populations or ecological communities, or their habitats listed under the Threatened Species Conservation (TSC) Act (1995) or Fisheries Management (FM) Act (1994) trigger the preparation of a Species Impact Statement. This assessment report applies considerations under Section 5A of the EPA Act (1979) and determines whether a significant impact is likely to occur and, correspondingly, whether a Species Impact Statement is required.

The subject site is an approximately triangular-shaped lot of 19.41 hectares. Its main frontage is on Iluka Road, with Hickey Street and the unformed part of Elizabeth Street forming its northern and southern boundaries respectively. It occurs near the southern end of the Iluka peninsula, a narrow flat coastal sandplain between the coast and the mouth of the Clarence River. A golf course occurs immediately to the north of the subject site and residential development to the south west.

The natural landscape of this area is complex and diverse. Most of the Iluka peninsula is within a virtually uninterrupted band of conservation reserves that stretch from Red Rock in the south to the Richmond River in the north. In the site's immediate vicinity, Iluka Nature Reserve and Bundjalung National Park protect some 35 kilometres of coastline and near-coastal land north to Evans Head. Iluka Nature Reserve is directly to the east of the subject site, separated from the subject site by Iluka Road. It is an outstanding example of littoral rainforest and is part of the World Heritage listed Central Eastern Rainforest Reserves (Australia) World Heritage area.

The European history of the area dates from the 1830s, when timber cutters arrived and plied their trade from the Clarence River to Sydney. Historical local land uses were predominantly forestry, farming and fishing until the granting of sand mining leases in 1935 to extract rutile and zircon at Iluka and Yamba. Commercial mining continued intermittently until 1982. It is likely that the subject site was sand mined sometime between 1966 and 1978.

The subject site is now entirely vegetated but is unfenced and criss-crossed by roads and tracks. Such unfettered access has resulted in dumping of cars, furniture, building materials, oil drums and other rubbish as well as garden refuse. The latter has resulted in many extensive patches of escaped garden weeds. The structure and floristic composition of the site also indicate that it has experienced very hot fires in the recent past.

The proposal is to subdivide the site and create 162 residential lots and three reserved areas (Parks 1 to 3). The internal road system will have wide verges and roundabouts, allowing for significant plantings as part of a formal landscape plan. The street verges will serve a number of purposes besides access, aesthetics and delivery of infrastructure, including biodiversity corridors, water sensitive urban design features and bushfire control. The reserved areas have been carefully located in order to capture the highest value habitats as well as provide important corridors for the local movement of fauna. The site is adjacent to, but not within, a recognised regional wildlife corridor.

Formal consideration has been given to the potential for impact on listed matters of conservation significance that are known to occur or have a high likelihood to occur on site:

- Swamp Sclerophyll Forest occurs along the site's western edge and to be wholly retained in Park 2;
- *Phaius australis* Lesser Swamp Orchid not found on site but known from vegetation directly to the north. Potential habitat in the Swamp Sclerophyll Forest;
- *Acronychia littoralis* Scented Acronychia not found on site but known to occur in the local area;
- Dromaius novaehollandiae Emu scats found across the site;
- Lophoictinia isura Square-tailed Kite observed overhead. May forage on the subject site;
- *Ptilinopus regina* Rose-crowned Fruit-dove observed in the adjacent Nature Reserve and heard on site. May forage on some of the fruits of the occasional rainforest trees scattered across the site;
- *Calyptorhynchus lathami* Glossy Black-Cockatoo evidence of foraging by this species along the northern edge of the site was reported in 2005;
- *Glossopsitta pusilla* Little Lorikeet the site provides potential foraging and breeding habitat for this species;
- *Coracina lineata* Barred Cuckoo-shrike observed nearby and the site provides potential foraging habitat;
- *Carterornis leucotis* White-eared Monarch not recorded during survey but the site provides potential foraging habitat;
- *Rhipidura rufifrons* Rufous Fantail regularly observed foraging across the site during survey and a nest was recorded in the vicinity of the proposed Park 2;
- *Daphoenositta chrysoptera* Varied Sittella observed foraging in the eastern part of the site in the area to be retained in Park 1;
- *Merops ornatus* Rainbow Bee-eater observed foraging along the edges of the site and nesting in the intact sand dune along the site's northern edge. This area is to be retained in Park 2;
- *Hirundapus causacutus* White-throated Needletail observed flying overhead. Terrestrial habitat is largely irrelevant to this species;
- *Phascolarctos cinereus* Koala observed walking across the site from south to north;
- *Pteropus poliocephalus* Grey-headed Flying-fox not recorded during survey but the blossom and fruits of the canopy trees provide potential foraging habitat;
- *Syconycteris australis* Common Blossom Bat not recorded during survey but the blossom and of *Banksia integrifolia* Coast Banksia provides potential foraging habitat;
- *Mormopterus norfolkensis* Eastern Freetail-bat recorded foraging on site during survey. Hollow-bearing trees also provide potential roosting / breeding habitat;
- *Nyctophilus bifax* Eastern Long-eared Bat possibly recorded foraging on site during survey. Prefered habitat in high value vegetation along the western boundary;
- Miniopterus australis Little Bentwing-bat recorded foraging on site during survey; and

Overall, the proposal will remove 16.71 hectares of highly modified Low Acacia Woodland (10.55 hectares) and Open Forest and Woodland (6.16 hectares). These vegetation types are highly modified by past clearing, repeated hot fires and the continued influence of transformer weeds such as *Lantana camara* Lantana. The infestations of Lantana are significant, being impenetrable in places.

While this represents the majority of the vegetation on site, the principles of avoiding, minimising, mitigating and offsetting environmental impacts have been observed by the following elements of the proposal and recommendations arising from this assessment:

- The best quality habitat of the highest conservation value (Swamp Sclerophyll Forest EEC) is to be retained and managed for conservation purposes.
- This area will be further protected from the residential development by a buffer of native vegetation.
- The two large areas of retained vegetation have been located so as to maintain connectivity for the species of most concern that were recorded on site, being *Dromaius novaehollandiae* Emu and *Phascolarctos cinereus* Koala.

- Potential adverse impacts on these species will be further mitigated by the implementation of a landscape plan that includes the planting out of the wide verges with native trees favoured by Koalas, such as *Eucalyptus tereticornis* Forest Red Gum and *Corymbia intermedia* Pink Bloodwood.
- Traffic calming measures will also be employed and the route of traffic flow managed by road design. These measures will decrease the risk of road trauma.
- Domestic pets are to be kept within fenced premises, especially at night.
- The replacement with nest boxes of all hollow-bearing trees to be removed. Most hollow-bearing trees on site are dead and at risk of falling over in the near future. The proposal will allow for the replacement of this resource and thus avoid a bottleneck for hollow-dependent fauna.
- Felled hollow trees will be re-used as terrestrial habitat in the retained vegetation.
- Vegetation clearing will be conducted under ecological supervision to protect resident fauna from direct harm.
- Clearing is to be conducted outside of the breeding season of important fauna species, particularly *Dromaius novaehollandiae* Emu (December to end March).
- Lighting is to be of a type that minimises spill and glare. This is important for microchiropteran bats and other nocturnal species.
- Water sensitive urban design principles are to be incorporated into the development. This will minimise the potential indirect impacts to surrounding bushland.
- Vegetation management in the APZs is to entail the removal of only the aerial parts of plants. This will serve as a soil conservation measure.
- Dumping of garden refuse in bushland areas is to be prohibited.
- Residents are to be encouraged to plant locally native species in their gardens and particularly avoid heavy nectar-bearing plants (such as *Grevillea*) in order to avoid dominance by the aggressive Noisy Miner.
- All erosion and sediment controls are to be strictly observed during works.

The proposal is considered unlikely to result in a significant adverse impact for any matters of import. Thus no further assessment is required: neither a Species Impact Statement need be prepared under guidelines issued by the NSW Office of Environment and Heritage nor a referral to the Commonwealth Department of Environment need be pursued.

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# **1** INTRODUCTION

# 1.1 Background and Objectives

Keystone Ecological has been contracted by the Shellharbour Unit Trust (Stevens Group) 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 subdivide Lot 99 DP 823635, Hickey Street, Iluka in the Clarence Valley Local Government Area (LGA) into 162 residential lots.

The following standard procedures guided this Flora and Fauna Impact Assessment:

- 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;
- 6. Quantitative assessment of the proposed conservation offset; and
- 7. 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 located at Lot 99 DP 823635, Hickey Street, Iluka in the Clarence Valley LGA. It lies in the North Coast Bioregion in the Clarence River Catchment and the centre of the site is approximately at grid reference 534549 E 6747858 N MGA on the Woodburn 1:100,000 topographic map sheet.

The geographic context and topography of the site are shown in Figure 1; the extent of vegetation and development in the local area is illustrated in an aerial photograph at Figures 2 and 3. The site is illustrated in Photographs 1 to 26.

The subject site is an approximately triangular-shaped lot of 19.41 hectares. Its main frontage is on Iluka Road, with Hickey Street and the unformed part of Elizabeth Street forming its northern and southern boundaries respectively.

It occurs near the southern end of the Iluka peninsula, a narrow flat coastal sandplain between the coast and the mouth of the Clarence River. Much of the peninsula is vegetated, with the small township of Iluka more or less restricted to its western side. A golf course occurs immediately to the north of the subject site and residential development to the south west.

The natural landscape of this area is complex and diverse. Most of the Iluka peninsula is within a virtually uninterrupted band of conservation reserves that stretch from Red Rock in the south to the Richmond River in the north. In the site's immediate vicinity, Iluka Nature Reserve and Bundjalung National Park protect some 35 kilometres of coastline and near-coastal land north to Evans Head. Iluka Nature Reserve is directly to the east of the subject site, separated from the subject site by Iluka Road. It is an outstanding example of littoral rainforest and is part of the World Heritage listed Central Eastern Rainforest Reserves (Australia) World Heritage area.

The mouth of the Clarence River is wide and meandering, and includes a number of islands and large areas of tidal flats. These estuarine habitats are favoured by many migratory shorebirds and large fishing hawks, such as the Eastern Osprey and White-bellied Sea-Eagle.

The European history of the area dates from the 1830s, when timber cutters arrived and plied their trade from the Clarence River to Sydney. The township of Iluka began to develop in conjunction with the breakwall works, with the first sale of land in Iluka in 1875 (Iluka History Group, http://www.ilukahistory.org.au/general/timeline.htm).

Historical local land uses were predominantly forestry, farming and fishing until the granting of sand mining leases in 1935 to extract rutile and zircon at Iluka and Yamba. Commercial mining activity began in this area in about 1932 and continued intermittently until 1982 (NSW NPWS 1997). These were some of the most environmentally damaging activities undertaken along the NSW coast, with the vegetation completely stripped away, the soil structure and seedbank destroyed and the minerals extracted from the soil. In many instances the reshaped and depleted sands were not rehabilitated, and in the 1950s huge drifts of unconsolidated sand threatened the township of Iluka. Bitou Bush was planted in a trial stabilisation program at that time, with disastrous ecological results. Bitou Bush is now declared as a Weed of National Significance.

It is likely that the subject site was sand mined as the property was held from 1958 until 1978 under a mineral lease for the purpose of extraction of Zircon, Rutile, etc. (Cardno 2015). A series of aerial photographs of the site provided at Figure 4 also show the historical uses of the site from 1966 to 1996.

In 1966 the vegetation is relatively intact. There are open patches, probably the result of past clearing and / or fire, but linearments are visible, indicating that the dune system was intact. The 1978 aerial photograph shows the site almost completely denuded of vegetation and the loss of the parallel dune structure; rises are visible in only two or three places. This destructive pattern may have been the result of sand mining or "borrowing" of material for the development of the golf course to the north and / or the residential areas to the south west. By 1996 the site has regrown with woody vegetation, albeit sparsely in parts.

The subject site is now entirely vegetated but is unfenced and criss-crossed by roads and tracks. Such unfettered access has resulted in dumping of cars, furniture, building materials (including asbestos), oil drums and other rubbish as well as garden refuse. The latter has resulted in many extensive patches of escaped garden weeds. The structure and floristic composition of the site also indicate that it has experienced at least one very hot fire in the recent past.

The layout of the proposed development is shown in Figure 5 and is the result of a multidisciplinary iterative process, taking into account competing constraints that included zoning and other planning issues, bushfire hazard and biodiversity conservation. The proposal is to subdivide the site and create 162 residential lots and three parks in accordance with its zoning – see Figure 6.

The lots range in size from 500 square metres to 1,062 square metres and are arranged around 10 internal streets. Although 18 of these lots will have frontages to Iluka Road, vehicular access is prohibited from that direction. Pedestrian access to Iluka Road will be facilitated by five accessways.

Vehicular access from the 25 lots along the unformed part of Elizabeth Street is similarly prohibited, as will be access from the western edge of the development area and along the central internal street that runs across the development from north to south.

The internal road system will have wide verges and roundabouts, allowing for significant plantings as part of a formal landscape plan. The street verges will serve a number of purposes besides access, aesthetics and delivery of infrastructure, including biodiversity corridor, water sensitive urban design features and bushfire control.

The proposal includes the retention of some of the existing vegetation as establishment in three parks, primarily for the purposes of conservation of biodiversity and Aboriginal heritage.

Park 1 is 17,647 square metres in extent and located in the north eastern part of the site. It has a frontage to Iluka Road to the east and internal Street 1 to the west. The Asset Protection Zones (APZs) required for bushfire hazard control impinge on the vegetation of the park for a distance of 10 metres on the park's northern and southern boundaries.

Park 2 is 10,004 square metres in extent and located between the western edge of the development and the western boundary of the lot. No clearing or vegetation management is required within this park for bushfire control.

Park 3 is only 756 square metres and intended to protect an Aboriginal scarred tree that has been identified by others. No clearing or other disturbance is required in this area.

The related plans and reports relied upon for this assessment include the following:

- Plan showing the extent of Swamp Sclerophyll Forest, prepared by Steve Brailsford Surveying and based on advice from ecologist Mark Fitzgerald, dated 19/08/05;
- Site Analysis Plan, prepared by JCD, dated 5 September 2014;
- Masterplan, prepared by JCD, dated 22<sup>nd</sup> August 2015;
- Report on PCA and Preliminary Geotechnical Investigation, prepared by Cardno, dated 8 August 2015; and
- Bushfire Hazard Assessment Report, prepared by Building Code and Bushfire Hazard Solutions, dated 28<sup>th</sup> August 2015.

### **1.3 Legislative Context and Scope**

#### **1.3.1 Commonwealth Legislation**

The **Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act)** is a nationally applicable Act that is administered by the Department of Sustainability, Environment, Water, Population and Communities. 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 of the Environment 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 Legislation

The **Environmental Planning and Assessment Act (1979) (EPA Act)** sets out seven factors in Section 5A that require consideration in terms of the likely significance of the impact of an action. This Section 5A Assessment is informally known as a 'seven part test'.

For the purposes of this Act and, in particular, in the administration of sections 78A, 79C (1) and 112, these seven factors must be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats as listed under the Threatened Species Conservation (TSC) Act (1995) and Fisheries Management (FM) Act (1996).

If the application is for development on land that is, or is a part of, critical habitat, or is likely to significantly affect threatened species, populations or ecological communities, or their habitats, a Species Impact Statement must be prepared.

This Flora and Fauna Impact Assessment considers these factors in accordance with the aforementioned legislative requirements. It also provides conclusions in regard to the necessity for a Species Impact Statement.

**State Environmental Planning Policy No 44 – Koala Habitat Protection** is a policy aimed at the encouragement of the conservation and management of natural vegetation that provide habitat for koalas, to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. To this end, SEPP 44 provides a methodology for identification of core Koala habitat and requires the preparation and implementation of management plans for areas so identified.

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 Clarence Valley 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.

# 1.3.3 Regional / Local

The **Draft Koala Plan of Management (2010)** is relevant to the populations of Koalas in the Ashby, Woombah and Iluka localities. It is consistent with the state-wide Recovery Plan for the Koala and its aims are to ensure that the current extent of Koala habitat is maintained and improved (not reduced) and to mitigate processes that are limiting the occupancy rates and / or population sizes of Koalas.

Although this plan has not been adopted by Council, it provides guidance regarding the local distribution and abundance of Koalas, as well as a number of planning and design responses considered by Council as appropriate.

The **Clarence Valley Council Biodiversity Management Strategy** (Wright 2010) addresses the biodiversity conservation issues across the Clarence Valley LGA at a landscape scale, and provides a strategic planning document to assist in development decisions. It details the significant biodiversity of the region and identifies areas considered to contribute to local and regional wildlife corridors. It signals an intention to prevent loss of habitat within those corridors, and requires unavoidable impacts to be offset through BioBanking agreements or similar. Although endorsed by Council, these objectives have no standing until adopted into the Local Environmental Plan; this has not yet occurred.

However, it provides insight into the conservation and planning strategies considered by Council as appropriate.

# 1.4 Review of Relevant Past Studies

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

# Preliminary Assessment of the Ecological Attributes of BGLALC Land at Iluka (Fitzgerald 19 June 2005) and Vegetation Mapping of BGLALC Land at Iluka (Fitzgerald 19 August 2005)

The subject site represented only part of the investigation area, it including the parcels of land to the west and north west of the subject site. The Preliminary Assessment was undertaken in order to:

- 1. identify the ecological features of the site;
- 2. identify environmental constraints to the development of the site; and
- 3. identify what further studies might be required.

It was observed that the eastern part of the investigation area was more disturbed than the western end (which only partially includes the subject site). This was observed to be due to severe fire in the recent past, but mooted that it may also reflect past sand mining activities. The vegetation mapping undertaken established a boundary between disturbed Wattle and Banksia tall open-closed woodland [sic]<sup>1</sup> and less disturbed vegetation along the western boundary. It was suggested that this western fringe of vegetation is made up of two endangered ecological communities (EECs) - Swamp Sclerophyll Forest and Littoral Rainforest.

The Swamp Sclerophyll Forest was observed in two interdunal swales near the western boundary of the current subject site. The vegetation in this area was dominated by *Melaleuca quinquenervia* Broad-leaved Paperbark. What was mooted as Littoral Rainforest was observed on the higher dune slopes on deep sand where the dunes were intact along the western boundary of the subject site. The extent of this vegetation was subsequently mapped *in toto* in the company of a land surveyor; this boundary is also relied upon in this Flora and Fauna Impact Assessment.

The eastern part of the study area (which makes up the majority of the current subject site) was assessed as supporting dense tall closed woodland dominated by the *Acacia aulacocarpa* Brush Ironbark Wattle [sic]<sup>2</sup>. The understorey vegetation was described as highly disturbed. Exotic grasses (such as *Melinus minutiflora* Molasses Grass) dominated the understorey close to the edges and in the open central parts, but *Lantana camara* Lantana was overwhelmingly dominant across most of the site, but often with some native rainforest saplings (such as *Euroschinus falcata* Ribbonwood, *Cupaniopsis anacardioides* Tuckeroo, *Polyscias elegans* Celery Wood and *Acronychia imperforata* Beach Acronychia). Other understorey species observed across the site included *Persoonia stradbrokensis* and a number of epiphytes including *Platycerium superbum* Staghorn, *Asplenium australasicum* Bird's Nest Fern and *Cymbidium* species.

This part of the study area also had many dead standing trees, obviously as a result of the fierce fire that gave rise to the dominant *Acacia*. Some of these dead trees had developed hollows.

Single eucalypts and patches of eucalypt trees were observed as occurring occasionally as emergents above the layers of grass, Lantana and rainforest sapling. These includes *Corymbia intermedia* Pink Bloodwood, *Eucalyptus tereticornis* Forest Red Gum, *Eucalyptus seeana* Narrow-leaved Red Gum and *Lophostemon confertus* Brush Box. *Allocasuarina littoralis* Black She-oak occurred rarely.

Although little fauna survey was undertaken for this preliminary investigation, the presence of two threatened species was inferred. Scats were found beneath a eucalypt in the current subject site (exact location unknown) that were identified as belonging to

<sup>&</sup>lt;sup>1</sup> Woodland has, by definition, an open canopy.

<sup>&</sup>lt;sup>2</sup> What was known as *Acacia aulococarpa* Brush Ironbark Wattle in this area is now classified as *Acacia disparrima* subsp. *disparrima* Brush Ironbark Wattle, which is very common on coastal sands. The taxon that is now recognised as *Acacia aulococarpa* Salwood has a highly restricted distribution in the Grafton district and occurs in sclerophyll woodland on sandstone geology. The two species are very similar and easily confused. Source: The Royal Botanic Gardens and Domain Trust (6<sup>th</sup> October 2015). PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney, Australia. http://plantnet.rbgsyd.nsw.gov.au.

*Phascolarctos cinereus* Koala. Also, characteristically chewed cones that were found beneath a female *Allocasuarina littoralis* Black She-oak along the northern boundary indicate the presence of *Calyptorhynchus lathami* Glossy Black-Cockatoo.

This survey extended to lands to the west and north west of the current subject site. The endangered orchid *Phaius* sp.<sup>3</sup> was located in the Swamp Sclerophyll Forest in the vegetation to the west of the golf course, north west of the current subject site.

# NSW Ecosystems Study (Mitchell 2002) and Description for NSW (Mitchell) Landscapes (Mitchell, unpub and EcoLogical 2008)

The Mitchell Landscape project was a comprehensive exercise in describing and mapping ecosystems across NSW for conservation planning purposes. It integrated available data on topography, geology, soils, vegetation and climate. In that mapping, the subject site is defined as part of the Clarence – Richmond Barriers and Beaches Mitchell Landscape.

This Landscape is made up of beaches, dunes, swamps and lagoons on Quaternary coastal sands, with inner and outer barrier dune sequences. It is low, with a general elevation from 0 to 25 metres and maximum local relief to 10 metres. The landscape elements are:

- siliceous sand on the beach;
- siliceous sand with organic topsoil on the hind dune with; *Cupaniopsis anacardioides* Tuckeroo, *Acacia longifolia* ssp. *sophorae* Coast Wattle, *Melaleuca quinquenervia* Broad-leaved Paperbark, and *Pandanus pedunculata* Coastal Screw Palm;
- Pleistocene high dunes with well-developed podsol profile and *Banksia* spinulosa Hairpin Banksia, *Banksia aemula* Wallum Banksia, *Banksia ericifolia* Heath Banksia, *Melaleuca bracteata* Black Tea-tree, *Corymbia intermedia* Pink Bloodwood, *Eucalyptus acmenoides* Broad-leaved White Mahogany, *Xanthorrhoea* sp. Grass Tree, *Themeda australis* Kangaroo Grass and *Imperata cylindrica* Blady Grass;
- Poorly drained inner low dunes and beach ridges, relief 1 to 2 metres, with humus podsols and peaty podsols with *Melaleuca quinquenervia* Broad-leaved Paperbark, *Callistemon pachyphyllus* Wallum Bottlebrush, *Leptospermum laevigatum* Coast Tea-tree, *Phragmites australis* Common Reed, *Juncus usitatus* Common Rush and *Gleichenia* sp. Coral Fern;
- Back barrier swamps and plains with gradational dark coloured loamy sand, peaty podsol and acid peat with *Melaleuca quinquenervia* Broad-leaved Paperbark, *Casuarina glauca* Swamp Oak, *Eucalyptus robusta* Swamp Mahogany, *Eucalyptus tereticornis* Forest Red Gum, *Corymbia gummifera* Red Bloodwood, *Corymbia intermedia* Pink Bloodwood, *Banksia integrifolia* Coast Banksia, and *Angophora floribunda* Rough-barked Apple on better drained sites; and
- High dunes on the bedrock coastal ramp with shallow podsols and *Eucalyptus pilularis* Blackbutt, *Corymbia intermedia* Pink Bloodwood, *Eucalyptus acmenoides*

<sup>&</sup>lt;sup>3</sup> All *Phaius* species in NSW are now considered to be *Phaius australis* Lesser Swamp Orchid. It is listed as Endangered under both the NSW TSC Act and the Commonwealth EPBC Act. Source: Department of the Environment (2015) *Phaius tancarvilleae* in Species Profile and Threats Database, Department of the Environment, Canberra. Available from: http://www.environment.gov.au/sprat.

Broad-leaved White Mahogany, *Corymbia gummifera* Red Bloodwood and *Callitris macleayana* Brush Cypress Pine.

The subject site is best described as part of the "Back barrier swamps and plains", with elements of "High dunes on the bedrock coastal ramp".

# CRAFTI Upper North East Floristics VIS ID 1108

This vegetation mapping project was part of the Comprehensive Regional Assessment Forest Type Inventory (CRAFTI) for upper north east NSW. It was designed to provide raw data on floristics, growth stage and distribution of eucalypt forests.

The delineation of broad floristic types was achieved by traditional API techniques supplemented with "ancillary" mapping at an adequate scale and classification that had been already undertaken by others. Some of this ancillary mapping included detailed vegetation descriptions. For any one polygon, the level of floristic mapping may vary in resolution from formation to subformation (for special feature mapping) or subformation to community (for Eucalypt and related species mapping) to Forest Types detailed in Research Note 17 or a more detailed classification.

An extract of this mapping is provided at Figure 7 and shows the subject site as supporting two broad vegetation types: Swamp Sclerophyll Forest in the north eastern corner and the remainder being Dry Sclerophyll Forest dominated by "Bloodwood / Apple".

The vegetation in Iluka Nature Reserve to the east is defined as a more complex mosaic of vegetation types, with the vegetation immediately to the east being described as a Wattle forest. To the east of the Wattle Forest is a band of woodland dominated by Forest Red Gum, with Littoral Rainforest occurring between that vegetation and the foredunes.

# Coastal Vegetation of North East NSW, VIS ID 3885

This is fine scale vegetation mapping of reserves in north eastern NSW that was initiated in 1984 and has been continually refined since using aerial photo interpretation specialists. Interpretation was predominantly based on 1:25,000 colour photography, with limited coverage at scales of 1:10,000 and 1:16,000. The structural classification follows Walker and Hopkins (1984); subformation names are an adaptation of the classification proposed by Beadle and Costin (1952). The communities were named after dominant indicator species of the tallest stratum (and occasionally lower stratum), and most could be considered associations using the definition of Beadle (1981) 'a community in which the dominant stratum exhibits uniform floristic composition, the community usually exhibiting uniform structure'. In rainforests, however, floristic composition of the tallest stratum is often somewhat variable within and between stands. Where this is found to be the case, an API group is assigned to the most appropriate suballiance of Floyd (1990).

An extract of this mapping is provided at Figure 7 for comparison with the subject site. The vegetation immediately to the east of the subject site is delineated as a Dry

Sclerophyll Forest and Woodland dominated by Wattle. To the east of that is a series of Forests and Woodlands variously dominated by a mixture of *Eucalyptus tereticornis* Forest Red Gum, *Lophostemon confertus* Brush Box and *Banksia integrifolia* Coast Banksia. Littoral Rainforest occurs further to the east again, between those forests and the foredune.

### Soil Landscapes of the Woodburn 1: 100,000 Sheet Report (Morand 2001a) and Soil Landscapes of the Morand 1:100,000 Sheet Map (Morand 2001b)

Soil landscapes are a good predictor of vegetation types and therefore of threatened species habitat, and so are an important consideration for this Flora and Fauna Impact Assessment.

The subject site is within the Bundjalung Dunefield physiographic region which occupies the coastal plain where it is underlain by Quaternary aeolian and marine sands. Within this region on the Iluka peninsula, the **Iluka soil landscape** is dominant on the landward side of the beach dunes. It is an aeolian soil landscape with two sub-types; the subject site is within variant 'a'.

Iluka soil landscape occurs on extremely low, level to undulating Quaternary sand sheets. Variant "a" is of made up of low beach ridges of Holocene age. Importantly, this Holocene ridge system consist of distinct longitudinal dune-swale ridges, parallel to the coast. Drainage generally consists of sub-surface flow and water tables are high. It is protected by onshore weather by the frontal dune system.

The vegetation in this soil landscape is typically a mix of open forest (various plant community types) and closed forest (Littoral Rainforest).

Dominant tree species of the open forest types are *Corymbia intermedia* Pink Bloodwood, *Eucalyptus tereticornis* Forest Red Gum, *Corymbia gummifera* Red Bloodwood, *Eucalyptus planchoniana* Needlebark Stringybark, Lophostemon suaveolens Swamp Box, Banksia integrifolia Coast Banksia, *Acacia aulacocarpa* Brush Ironbark Wattle [sic]<sup>4</sup> and *Melaleuca quinquenervia* Broad-leaved Paperbark. The ground layer is dominated by grasses (e.g. *Imperata cylindrica* Blady Grass), graminoids (e.g. *Lomandra longifolia* Spiny-headed Matrush) and ferns (e.g. *Pteridium esculentum* Bracken). *Lantana camara* Lantana is a common weed in this soil landscape.

The Littoral Rainforest (closed forest) occurs in the more seaward locations and particularly where the Iluka soil landscape borders the coastal dune system. In Iluka Nature Reserve to the east of the subject site, the Littoral Rainforest is dominated by *Syzygium luehmannii* Riberry and *Acmena hemilampra* Broad-leaved Lilly Pilly. Patches of Palm Forest are dominated by *Livistona australis* Cabbage Tree Palm and *Archontophoenix cunninghamiana* Bangalow Palm are also included.

Extracts of the soil landscape mapping is provided at Figure 8. Notably, the subject site is

<sup>&</sup>lt;sup>4</sup> *Ibid.* [pp 7].

shown as being within an area of "developed terrain".

# 2 FLORA SURVEY AND RESULTS

# 2.1 Survey Methods

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. Colour aerial photography was interpreted prior to field survey to delineate preliminary vegetation community boundaries and areas of disturbance on site.
- 2. A search of the EPBC Act (1999) database using the Protected Matters Search Tool (www.environment.gov.au/erin/ert/epbc/index.html) on the Department of the Environment website 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.
- 3. The online component of the OEH Wildlife Atlas (http://www.bionet.nsw.gov.au/) was interrogated for an area confined to a 10 kilometre radius of the site. This search provided records of species of threatened flora within the locality.
- 4. PlantNet, the online database of the National Herbarium of NSW at the Royal Botanic Gardens was also interrogated (http://plantnet.rbgsyd.nsw.gov.au/floraonline.htm) for rare or threatened species that have been recorded in the locality.
- 5. The Atlas of Living Australia (http://www.ala.org.au/) was interrogated for all threatened plant species recorded within 10 kilometres of the subject site. As well as records held by PlantNet and the OEH Wildlife Atlas, this online database also contains records from other institutions (such as State Forests of NSW) that may not otherwise be displayed.

Preliminary interpretation of aerial photography, available vegetation mapping and the preliminary reports prepared by Fitzgerald (2005) indicate the presence of three main vegetation types:

- Dense woodland dominated by *Acacia*, particularly in the eastern part of the site;
- Open forest / woodland vegetation across the centre of the site; and
- Moist open forest along the site's western edge.

Field sampling of flora for this Flora and Fauna Impact Assessment was conducted from 10<sup>th</sup> to 16<sup>th</sup> October 2014 and 26<sup>th</sup> to 27<sup>th</sup> November 2014. Flora was sampled by way of quadrats and random meander transects. Two quadrats were located in each of the photo patterns, with an additional quadrat in the north eastern corner of the site (Quadrat 7) to capture maximum variability.

As the threatened species *Phaius australis* Lesser Swamp Orchid was reported by Fitzgerald (2005) as occurring in the patch of vegetation to the north west of the subject site, this area was also investigated by targeted random meander for comparisons with habitats present on site. Similarly, the vegetation within Iluka Nature Reserve to the east was also investigated by random meander as the photo patterns are similar to those on site.

The locations of the vegetation survey activities are shown in Figure 9.

The data recorded are consistent with the standards used by the NSW National Parks and Wildlife Service and the Royal Botanic Gardens of the Office of Environment and Heritage. 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 following modified Braun-Blanquet 7 point scale:
  - 1. <5% cover, rare / few individuals (3 or fewer)
  - 2. <5% cover, uncommon (>3 individuals, sparsely scattered)
  - 3. <5% cover, common (consistent throughout)
  - 4a. <5% cover, abundant (many individuals)
  - 4b. 5-25% cover
  - 5.25-50% cover
  - 6. 50-75% cover
  - 7.75-100% cover

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).

# 2.2 Survey Limitations

Although best practice methodology has been employed, all surveys have inherent limitations as they can only ever represent a sample in time and place of the site's flora. Also, movement through this site is constrained by the dense infestations of Lantana and so some areas have not been surveyed. However, the survey was conducted at an optimum season (spring) and coverage of the site is considered adequate to characterise the habitats, species and vegetation types present. For the flora species of interest for this site, the season and method of survey were considered appropriate and adequate.

# 2.3 Floristic Composition

In total, only 83 locally-native species and 25 introduced species were observed within the subject site. A species list is provided in Table 1.1 in Appendix 1.

This is a relatively depauperate result for an area of bushland of almost 20 hectares in extent. However, this is probably a result of a combination of factors including the severity of past land uses, fire history (probably both severe and frequent), the absence of sub-soil moisture, a nutrient-poor substrate, the presence of salt-laden winds and the overwhelming presence of *Lantana camara* Lantana and other weeds.

By contrast, the numbers of families represented are high and diverse. These 108 species are representative of 56 families. The top 5 dominant families account for 26% of the species: Myrtaceae (11 species), Lauraceae (5 species), Rubiaceae (4 species, 1 of which is exotic), Poaceae (4 species, 2 of which are exotic) and Orchidaceae (4 species, 1 of which is exotic). The majority of families (31) are represented on site by a single species alone.

# 2.4 Weeds

Ten of the families found on or immediately adjacent to the site are represented only by exotic species. The site also contains a number of important weeds, including listed noxious species, Weeds of National Significance and species recognised as "transformer" species.

The Noxious Weeds Act (1993) requires all landholders in certain areas to control certain serious weeds that are declared **noxious weeds**. To be declared noxious, a number of criteria must be met:

- a weed must have potential to cause harm to people,
- a weed must be able to be controlled by reasonable means,
- a weed must have the potential to spread within an area and to other areas, and
- the control of a weed must provide a benefit to the community over and above the cost of implementing the control program.

Under the National Weeds Strategy, 32 introduced plants have been identified as **Weeds of National Significance** (WONS). These weeds are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts.

**Transformer weeds** have the potential to seriously alter the structure and function of an ecological community and have serious consequences for biodiversity. Such species often form dense infestations that have significant impacts on many ecosystem processes. For example, scrambling species that can climb up mature trees have the potential to severely affect the growth and health of native vegetation (e.g. Lantana, Cape Ivy).

The following listed Noxious Weeds, WONS or transformer species were all recorded on or immediately adjacent to the site during survey:

- *Asparagus aethiopicus* Asparagus Fern Class 4 Noxious Weed (control requirement: The plant must not be sold, propagated or knowingly distributed), WONS, and transformer weed on the NSW north coast. This species was a common component of the moister vegetation in the western part of the site;
- *Asparagus densiflorus* Asparagus Fern Class 4 Noxious Weed (control requirement: The plant must not be sold, propagated or knowingly distributed). This species was a common component of the moister vegetation in the western part of the site;
- *Bryophyllum delagoense* Mother of Millions Class 3 Noxious Weed (control requirement: The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed). This species occurred in discrete patches but was very dense where it occurred;
- *Cinnamomum camphora* Camphor Laurel Class 4 Noxious Weed (control requirement: The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed). This species was uncommon;
- *Delairea odorata* Cape Ivy transformer weed on the NSW north coast. This species occurred in a dense infestation along the southern edge of the site;
- *Ipomoea cairica* Coastal Morning Glory transformer weed on the NSW north coast. This species was uncommon;
- *Lantana camara* Lantana Class 4 Noxious Weed (control requirement: The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread), WONS and transformer weed on the NSW north coast. This species was by far the most abundant species on site, dominating the understorey and scrambling into the canopy. In the 7 sampling quadrats its cover was recorded as 70%, 60%, 40%, 60%, 10%, 25% and 90% and these quadrats were unconsciously located where the Lantana coverage was relatively low so that access was possible;
- *Ochna serrulata* Mickey Mouse Plant transformer weed on the NSW north coast. This species was common in the moister parts of the site in its western parts;
- *Schefflera actinophylla* Umbrella Tree transformer weed on the NSW north coast. This species occurred across the entire site but was most common in the moister western part; and
- *Senna pendula* var. *glabrata* transformer weed on the NSW north coast. This species was not common and located only in the western part of the site during survey.

# 2.5 Vegetation Types

Aerial photography reveals three obvious patterns in the canopy. Sampling has confirmed that they coincide with three different vegetation types that are driven largely by disturbance history. Their distribution is mapped in Figure 9 and described below.

### Vegetation type 1: Low Wattle Woodland.

Area: 12.01 hectares (62% of the site).

Distribution: Predominantly in the eastern half of the site.

<u>Structure</u>: Data from two sample quadrats (Q3 and Q5). The sampling quadrats are illustrated in Photographs 6 and 7.

Layer	Morphology	Height	Cover	Dominant species
Top	Small tree	8-15 m	35-40%	Acacia disparrima subsp. disparrima
rop				Callitris columellaris
Middle 1	Small tree	5 m	10%	Callitris columellaris
Middle 2	Shrub	1.5 m	10-40%	Lantana camara
Lowest	Grass	0.2 m	15-80%	Melinis minutiflora

Very little fallen timber is in evidence and leaf litter is not well developed...

Large hollow-bearing trees occur, mainly as dead stags, killed by fire.

<u>Dominant species</u>: *Acacia disparrima* subsp. *disparrima* Salwood is the overwhelmingly dominant species in the canopy; few other trees are present. The understorey is sparse in places but is generally dominated by *Lantana camara* Lantana and *Melinis minutiflora* Molasses Grass. Epiphytes are common low on the tree trunks.

<u>Weeds</u>: The numbers of weed species are not numerous. The weeds present are overwhelmingly dominated by *Lantana camara* Lantana and *Melinis minutiflora* Molasses Grass. Other species tend to occur dense patches as a result of past disturbances, such as dumping of garden refuse. Other weed species with this pattern include *Tradescantia zebrina* and *Bryophyllum delagoense* Mother of Millions.

<u>Disturbance</u>: This vegetation type suffers from severe past and ongoing disturbances. These include complete loss of vegetation and removal of the sand (may have been sand mined) as a result of very hot (and probably repeated) fires, dumping of rubbish and garden refuse, weed infestations and edge effects.

#### Vegetation type 2: Open Forest and Woodland.

Area: 6.93 hectares (36% of the site).

<u>Distribution</u>: Predominantly in the centre of the site, with small patches in the north eastern corner and on a remnant dune in the south eastern part.

<u>Structure</u>: Data from three sample quadrats (Q4, Q6 and Q7). The sampling quadrats are illustrated in Photographs 8, 9 and 10.

This is the most diverse of the three vegetation types on site, as the species composition and structure are largely determined by disturbance impacts. Although the species are generally consistent, their heights and cover ratings vary. The upper and mid layers of Q4 are taller and denser than in the other quadrats. The upper canopy in Q7 was almost exclusively made up of *Acacia disparrima* subsp. *disparrima* Salwood, many of which were dead.

Layer	Morphology	Height	Cover	Dominant species	
Top	Troo	10-25 m	25-35%	Corymbia intermedia	
TOP	1166		(10% in Q7)	Acacia disparrima subsp. disparrima	
Middlo 1		15-20 m	45%	Glochidion ferdinandi var. ferdinandi	
(04)	Small tree			Acacia disparrima subsp. disparrima	
(Q4)				Acronychia imperforata	
		3-5 m		Schefflera actinophylla	
Middle 1	Small tree		10%	Glochidion ferdinandi var. ferdinandi	
				Acacia disparrima subsp. disparrima	
(Q6)				Polyscias elegans	
				Acronychia imperforata	
Middle 1		5 m	10%	Acronychia imperforata	
(Q7)	Small tree			Mischocarpus pyriformis	
				Lantana camara scrambling over	
Middle 2	Shrub	1-3 m	25-90%	Lantana camara	
Louroat	Grass / Fern	0.2-1.5 m	10-50%	Melinis minutiflora	
Lowest				Pteridium esculentum	

Very little fallen timber is in evidence and leaf litter is not well developed.

Large hollow-bearing trees occur, mainly as dead stags, killed by fire.

<u>Dominant species</u>: The overwhelmingly dominant species in the canopy are *Corymbia intermedia* Pink Bloodwood and *Acacia disparrima* subsp. *disparrima* Salwood. *Lophostemon confertus* Brush Box is common; other canopy species are rare. As elsewhere, the understorey is dominated by *Lantana camara* Lantana and the ground layer by *Melinis minutiflora* Molasses Grass.

<u>Weeds</u>: The more open parts are particularly infested with weeds, with dense (almost impenetrable) thickets of *Lantana camara* Lantana and head-high exotic grass.

<u>Disturbance</u>: This vegetation type suffers from severe past and ongoing disturbances. These include complete loss of vegetation and removal of the sand (may have been sand mined) as a result of very hot (and probably repeated) fires, dumping of rubbish and garden refuse, weed infestations and edge effects.

### <u>Vegetation type 2/3: Mosaic of Swamp Sclerophyll Forest and Open Forest /</u> <u>Woodland.</u>

Area: 0.47 hectares (2% of the site).

<u>Distribution</u>: Restricted to the western edge of the site in the intact dune / swale sequence.

<u>Structure</u>: Data from two sample quadrats (Q1 and Q2).The sampling quadrats are illustrated in Photographs 11 and 12.

The historical aerial photographs indicate that this part of the site was not cleared and its topographic structure degraded in the 1960s, as occurred across the remainder of the site. Thus, mature trees and a dune-swale sequence are in evidence.

Layer	Morphology	Height	Cover	Dominant species	
		25 m	40%	Corymbia intermedia	
Top	Tree			Lophostemon confertus	
Top				Melaleuca quinquenervia	
				Acacia maidenii	
		10 m	15-20%	Lantana camara	
Middle 1	Small tree /Shrub/Scrambler			Cupaniopsis anacardioides	
				Schefflera actinophylla	
				Smilax australis	
Middle 2	Middle 2 Shrub/Scrambler		60%	Lantana camara	
		0.2-05 m	30%	Asparagus aethiopicus	
Lowest	Herbs/graminoids/ferns/ shrubs			Asparagus densiflorus	
				Passiflora herbertiana	
				Melinis minutiflora	
				Ochna serrulata	

Fallen timber is in evidence. The swales are relatively moist with a well-developed leaf litter layer.

Large hollow-bearing trees occur, mainly as live trees.

<u>Dominant species</u>: The tree canopy is a mixture of myrtaceous species (particularly *Corymbia intermedia* Pink Bloodwood, *Lophostemon confertus* Brush Box, *Melaleuca quinquenervia* Broad-leaved Paperbark) with occasional *Acacia maidenii*. A mid layer of small trees are generally present, many of which are rainforest species (e.g. *Mischocarpus pyriformis* Yellow Pear-fruit. The moist understorey is very diverse, with many species of vines, palms and epiphytes. However, it is not a closed forest and also contains dense infestations of *Lantana camara* Lantana.

<u>Weeds</u>: The overwhelmingly dominant weeds species is *Lantana camara* Lantana, occurring as dense thickets in the mid storey and scrambling up into the tree canopy. *Asparagus aethiopicus* Asparagus Fern and *Schefflera actinophylla* Umbrella tree are more common in this vegetation type than elsewhere, and they are both known transformer species.

<u>Disturbance</u>: Although it was not cleared in the 1960s as was the rest of the site, this vegetation type is not devoid of disturbance impacts. However, as it is a relatively intact ecosystem, the impacts of the disturbances shared with the rest of the site are not so severe.

There is evidence of fire, but it has not transformed the vegetation into a low dense woodland with a virtual monoculture of *Acacia disparrima* subsp. *disparrima* Salwood, as has occurred to the east. Continuing disturbance are generally confined to those associated with weed infestations. This vegetation type is particularly vulnerable to dumped garden refuse along Elizabeth Street. Many serious weeds were observed along this edge, and included transformer weeds such as *Delairia odorata* Cape Ivy and *Ipomoea cairica* Blue Morning Glory.

# 2.6 Threatened Species and Communities

Results from the Protected Matters Search Tool and the OEH Wildlife Atlas online database searches revealed a number of listed species that require consideration as part of this assessment. Their habitat requirements and likelihood to occur on site is explored in Table 1.2 in Appendix 1. Those **Threatened Species** considered to have a high likelihood to occur are:

- 1. Peristeranthus hillii Brown Fairy-chain Orchid -
- 2. Phaius australis Lesser Swamp Orchid
- 3. Acronychia littoralis Scented Acronychia

None of these species were recorded during survey but *Phaius australis* Lesser Swamp Orchid was reportedly observed by Fitzgerald in the swamp forest to the north west of the subject site (Fitzgerald 2005). The potential impact of the proposal will be addressed for all the above species.

Of the **Threatened Ecological Communities** listed under the State TSC Act (1995) and Commonwealth EPBC Act (1999), the Office of Environment and Heritage Threatened Species website lists only 2 Endangered Ecological Communities as occurring or potentially occurring in the Clarence Lowlands sub-region of the North Coast Catchment Management Authority (CMA) region, of which the subject site is a part:

- Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion; and
- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

The threatened community Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions also occurs in this catchment, with the largest occurrence in Australia being within the adjacent Iluka Nature reserve.

Of these, Swamp Sclerophyll Forest is considered to occur in the western part of the site, where it is moist and least disturbed. This is mapped as a mosaic of Swamp Sclerophyll Forest and Open Forest / Woodland, because those other floristic components are also dominant in parts, particularly on the upper parts of the intact dune.

In his preliminary assessment of the vegetation of this site, Fitzgerald (2005) suggested that this western part of the site was a mosaic of Swamp Sclerophyll Forest and Littoral Rainforest. However, the floristic data collected for this Flora and Fauna Impact Assessment do not support that conclusion. While it is recognised that species characteristic of Littoral Rainforest occur as scattered individuals in the understorey across the entire site, their presence alone is not enough to define the presence of this community. As with any vegetation community, Littoral Rainforest is defined by a multiplicity of factors including species composition, relative abundance of species, vegetation structure, soil characteristics, topography and geography.

In the Final Determination (NSW Scientific Committee 2004,) the community is defined as having the following characteristics:

- Generally a closed forest structure;
- Structure and composition are strongly influenced by proximity to the ocean (e.g. may take on the structure of a dense wind-pruned thicket in very exposed situations);
- Plant species are predominantly rainforest species;
- Vines may be a major component;
- Canopy is dominated by rainforest species but may have scattered emergents of sclerophyllous species (e.g. *Banksia integrifolia* Coast Banksia, *Eucalyptus tereticornis* Forest Red Gum);
- Occurs on sand dunes and on soils derived from underlying rocks;
- Generally occurs within 2 kilometres of the sea; and
- Comprises the rainforest alliance described by Floyd (1990) as the *Cupaniopsis anacardioides Acmena* spp. alliance.

No parts of the vegetation on the subject site have a closed forest structure. The densest canopy occurs in the Acacia Woodland, but the maximum measured canopy cover was only 40%. The position of the epiphytes low on the tree trunks rather than high in the canopies probably reflects the influence of salt-laden winds. Vines are present but not a major component for most of the site; vines are more prevalent in the vegetation of the western edge. The canopy is not dominated by rainforest species anywhere on site. Rather, the canopy is uniformly dominated by Corymbia intermedia Pink Bloodwood, Acacia disparrima subsp. disparrima Salwood with Lophostemon confertus Brush Box in the western parts and occasional *Eucalyptus tereticornis* Forest Red Gum and rainforest species scattered across the site in small patches, usually as single trees. Melaleuca quinquenervia Broad-leaved Paperbark is a major component of the vegetation in the swale at the western boundary. Historical aerial photography shows that the sand dune structure was stripped away between 1966 and 1978. The site is within 2 kilometres of the sea. There are species present that occur in the nominated rainforest alliance (Floyd 1990) but they do not dominate the vegetation. Thus, the vegetation types of the site do not align very well with the legal definition of the endangered ecological community Littoral Rainforest as listed under the TSC Act (1995).

In recognition of the difficulties posed by the identification of Littoral Rainforest,

Eurobodalla Shire Council has produced a Fact Sheet detailing important determining features of this community (ESC no date). Tellingly, this highlights the profound influence of fire, quoted below:

Occurrences of Littoral Rainforest may be quite fluid over time. In the absence of fire stands can develop under other vegetation types over a period of a few decades, but they may be eliminated in the course of a single fire event. Mature rainforest stands are not very flammable, but by their nature many littoral stands include sclerophyll elements and may abut sclerophyll forest or scrub with highly flammable groundcover such as bracken and grasses prominent in the groundcover. Although many of the common component tree species are capable of resprouting after fire, mature littoral rainforest cannot develop under a regime of even occasional fires, so complete fire exclusion is necessary for full development of this community.

A formal fire history was not available for this area but the vegetation of the subject site has undoubtedly experienced severe - and probably repeated – fire. This is evidenced by site observations (fire scars, vegetation structure and composition) and is additionally supported by the scientific literature in relation to Koalas in Iluka (see particularly Lunney et al. 2002). Further, the Woombah area has been documented as experiencing a fire every 5 years and Bundjalung National Park and surrounds experienced large and hot fires in 1989 and 1994 (Clarence Valley Council 2010).

The Commonwealth policy statement for this community (DEWHA 2009) is also instructive here. That document provides a checklist of features that must **all** be present in order to determine the presence of the Commonwealth-listed protected entity Littoral Rainforest and Coastal Vine Thickets of Eastern Australia, as shown below.

Feature	Vegetation of the subject site		
The ecological community occurs in a restricted set of bioregions,	$\checkmark$		
including the NSW North Coast.			
Occurs typically within 2 kilometres of the coast.	$\checkmark$		
Occurre en essentel handlande dunce son elitte en ethennileses	×		
occurs on coastal headiands, duries, sea-cliffs or other places	Dunes removed from site between		
innuenceu by the sea.	1966 and 1978.		
Tunically a closed canony of treas but may have temporary gans	×		
through windfall	Canopy structure typical of open		
unougn windian.	forest and woodland.		
Usually has several layers of vegetation.	$\checkmark$		
Typically tall trees in the canopy to 25 metres or emergents.	$\checkmark$		
Range of plant life forms.	$\checkmark$		
Plants with drought-tolerant and succulent features.	×		
Lichen-encrusted tree trunks.	$\checkmark$		
Low diversity of ground ferns and epiphytes.	$\checkmark$		
Feather palms, fan palms and large-leaved epiphytes generally	×		
rare.	These features common.		
	×		
Species are mainly rainforest species.	Only 20 of the species recorded can		
	be considered 'rainforest' species.		
Minimum patch size of 0.1 hectares	$\checkmark$		

Feature	Vegetation of the subject site
	×
Cover of transformer weed species is 70% or less.	The cover of Lantana alone is 90% in
	places.
Of the native species on the site. at least 25% are on the	✓
indicative plant list for the bioregion	56%
OR	
At least 30% of the canopy cover provided by one or more of the	×
rainforest canopy species in the indicative list (excluding Banksia	27%
and <i>Eucalyptus</i> ).	

The site features do not accord with all of these defining characteristics therefore cannot be regarded as an example of the Commonwealth-listed entity.

Overall it is therefore concluded that neither the NSW-listed endangered ecological community Littoral Rainforest or the Commonwealth-listed Littoral Rainforest and Coastal Vine Thickets of Eastern Australia occur on site.

# **3 FAUNA SURVEY AND RESULTS**

### 3.1 Survey Methods

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

- 1. Colour aerial photography was interpreted prior to field survey to delineate preliminary vegetation community boundaries and areas of disturbance on site.
- 2. A search of the EPBC Act (1999) database using the Protected Matters Search Tool (www.environment.gov.au/erin/ert/epbc/index.html) on the Department of the Environment website 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.
- 3. The online component of the OEH Wildlife Atlas (http://www.bionet.nsw.gov.au/) was interrogated for an area confined to a 10 kilometre radius of the site. This search provided records of species of threatened fauna within the locality.
- 4. The Atlas of Living Australia (http://www.ala.org.au/) was interrogated for all threatened fauna species recorded within 10 kilometres of the subject site. As well as records held by the OEH Wildlife Atlas, this online database also contains records from other institutions (such as the Australian Museum and State Forests of NSW) that may not otherwise be displayed.

Survey was conducted for this Flora and Fauna Impact Assessment from 10<sup>th</sup> to 16<sup>th</sup> October 2014 and the 11<sup>th</sup> to 28<sup>th</sup> November 2014 and comprised:

- camera trapping;
- spotlighting;
- stagwatching of tree hollows at dusk;
- recording and identification of calls of microbats;
- nocturnal and diurnal searches for reptiles;
- habitat searches and assessment;
- diurnal bird survey by active searches and audio recording;
- nocturnal bird survey by call playback and spotlighting;
- scat searches for predators, Emu and Koala;
- call playback of Koala and Grey Headed Flying Fox; and
- terrestrial and arboreal hair funnels for mammals.

Locations of the fauna survey effort are depicted in Figure 10 and details of fauna survey effort are provided in Table 2.1 in Appendix 2.

The fauna survey was intended to sample the various habitats present across the site. Weather details during fauna survey are listed in Table 2.2 in Appendix 2.

For reasons of comparison and context, fauna species observed off site in the local area (such as in the township and on the Clarence River estuary) are also reported. Also, observational fauna survey was extended to the patches of vegetation immediately surrounding the subject site: the connected vegetation to the west of the site (habitat assessment, diurnal birds, scat searches), the patch of moist forest to the west of the golf course (habitat assessment, diurnal birds), the golf course (habitat assessment, diurnal birds), the golf course (habitat assessment, diurnal birds) and in the parts of Iluka Nature Reserve closest to the site where the aerial photo pattern of the canopy is similar to that on the subject site.

# 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.

Spotlighting was not very efficient on this site due to the very dense infestations of Lantana. Thus, spotlighting was confined to the internal and external tracks. Live-trapping was not undertaken as it was considered unnecessary for the target species of interest and unnecessarily stressful for the animals. Target species were therefore instead surveyed by direct and indirect observational techniques (e.g. camera traps, scats, tracks and signs). These survey techniques are considered appropriate for medium-sized mammals of interest such as Koalas, Phascogales and Quolls.

In order to overcome these survey limitations, this report includes a detailed 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 a Section 5A Assessment of Significance. 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 Survey Results

Including the species observed off-site, 125 species of fauna were recorded during survey of which 101 species are from the site or in its immediate surrounds and therefore probably using the habitats of the site.

Results from the fauna survey are provided in Appendix 2 and includes a complete list of

species (Table 2.3), results of microchiropteran bat call analysis (Table 2.4), details of hollow-bearing trees (Table 2.5), details of Koala Spot Assessment Technique quadrats (Table 2.6) and results from the camera traps (Table 2.7).

### Amphibians

No amphibians were heard or seen. This reflects the absence of appropriate habitat.

#### Reptiles

Six common species of reptiles were recorded occurring on or immediately near the subject site and included skinks, a dragon, a monitor and a snake:

- 1. *Egernia major* Land Mullet
- 2. Eulamprus quoyii Eastern Water Skink
- *3. Sphenomorphus tympanum* Water Skink
- 4. Amphibolurus muricatus Jacky Lizard
- 5. Varanus varius Lace Monitor
- 6. *Vermicella annulata* Bandy Bandy Snake

The *Vermicella annulata* Bandy Bandy Snake was found dead on Iluka Road, immediately adjacent to the site. This species feeds almost exclusively on blind snakes from the Typhlopidae family, thus also indicating the presence of its prey species.

#### Birds

The bird fauna was well represented with 95 species recorded during the survey period. These characterized many different foraging guilds including forest birds, raptors, birds of open areas and aquatic species recorded during survey of the site and the local area. However, many of these species do not occur on site and will not use the site due to the absence of habitat (e.g. shorebirds).

A total of 74 species were recorded foraging, nesting or otherwise using the habitats of the subject site or were recorded flying overhead or nearby and are judged to be able or likely to use the habitats of the subject site. This included 3 exotic species.

Of the 74 species of the subject site, 9 are listed species under the NSW TSC Act (1995) and / or under the Commonwealth EPBC Act (1999).

- 1. *Dromaius novaehollandiae* Emu Endangered Population (NSW);
- 2. *Lophoictinia isura* Square-tailed Kite Vulnerable species (NSW);
- 3. *Ptilinopus regina* Rose-crowned Fruit-dove Vulnerable species (NSW);
- 4. *Calyptorhynchus lathami* Glossy Black-Cockatoo Vulnerable species (NSW);
- 5. *Hirundapus caudacutus* White-throated Needletail Migratory (Commonwealth);
- 6. *Merops ornatus* Rainbow Bee-eater Migratory (Commonwealth);

- 7. *Coracina lineata* Barred Cuckoo-shrike Vulnerable species (NSW);
- 8. *Rhipidura rufifrons* Rufous Fantail Migratory (Commonwealth); and
- 9. Daphoenositta chrysoptera Varied Sittella Vulnerable species (NSW).

No nocturnal bird species were identified during field surveys.

#### Mammals

Mammals were represented by arboreal, terrestrial and volant species with up to 23 species recorded (7 being exotic). However, only 21 of those species are considered to occur, or potentially occur, on the subject site as 2 of the exotic species found in predator scats (Sheep or Goat) were obviously not from the site.

#### Arboreal species

- 1. *Trichosurus vulpecula* Common Brushtail Possum was recorded in 2 hair funnels and in a Dog scat, but not otherwise observed.
- 2. *Pseudocheirus peregrinus* Common Ringtail Possum was observed during spotlighting in the dense Lantana understorey in the centre of the site. No dreys were found but are likely to occur in that dense understorey.
- 3. The threatened *Phascolarctos cinereus* Koala was recorded in a single image from a terrestrial camera trap on 14<sup>th</sup> October 2014 (see Figure 11 for location). The animal was photographed moving across the ground in a northerly direction (see Table 2.7 in Appendix 2). This species was not recorded otherwise during this survey, but scats of this species were identified by Fitzgerald (2005) somewhere on site.

#### **Terrestrial species**

Small, medium and large terrestrial mammals were recorded on site, none of which are listed threatened species:

- 1. *Perameles nasuta* Long-nosed Bandicoot recorded in a single camera trap image;
- 2. *Rattus tunneyi* Pale field Rat recorded in several camera trap images and from a number of terrestrial hair funnels;
- 3. *Rattus rattus* Black Rat recorded in a Fox scat;
- 4. *Macropus giganteus* Eastern Grey Kangaroo observed nearby on the golf course, its scats and resting areas observed on site, and recorded by several cameras;
- 5. *Wallabia bicolor* Swamp Wallaby multiple images of the species occurring on site were captured during camera trapping; it was not otherwise recorded;
- 6. *Ovis aries* Sheep or Capra hircus Goat a jaw sample of one of these species occurred in a predator scat;
- 7. *Canis familiaris* Dog scats observed on site and recorded in a camera image;
- 8. *Vulpes vulpes* European Red Fox scats observed on site and recorded in a camera image;
- 9. Felis catus Cat observed in the local area and likely to occur on site; and

10. *Oryctolagus cuniculus* Rabbit – observed in the local area and likely to occur on site.

#### Volant species

Nine species of microchiropteran bats were identified from call analysis; 4 of these species listed threatened species:

- 1. *Nyctophilus bifax* Eastern Long-eared Bat threatened species;
- 2. *Saccolaimus flaviventris* Yellow-bellied Sheathtail-bat threatened species;
- 3. Tadarida australis White-striped Freetail-bat;
- 4. *Mormopterus norfolkensis* Eastern Freetail-bat threatened species;
- 5. *Miniopterus australis* Little Bentwing threatened species;
- 6. Scotorepens greyii Little Broad-nosed Bat; and
- 7. Vespadelus pumilus Eastern Forest Bat.

#### 3.4 Habitat Value and Connectivity

The fauna habitats on site have been simplified due to the cumulative impacts of severe fire, weed infestations and past land use. The state of the vegetation indicates that there has been a severe fire or sequence of fires: large canopy trees have been killed and a mass germination event of wattles has created a virtual monoculture of *Acacia disparrima* across most of the site. Weed infestations are also significant, with vast impenetrable thickets of Lantana across large areas. Notably, many weeds that area recognised as "transformer" species occur across the site and in dense thickets. Microhabitats normally associated with the sequence of dune crests and swales has been destroyed across most of the site as a result of past vegetation clearing and soil removal.

However, some important habitat features remain and include:

- Hollow-bearing trees and terrestrial shelter sites in fallen timber. Few hollow bearing trees were recorded and most were dead stags as a result of severe fire. Fallen timber was relatively uncommon. Hollow-bearing trees identified across the site are shown in Figure 11. Note that it is likely that not all hollow-bearing trees on site were identified, as the dense infestations of Lantana impeded survey. These trees provide potential shelter and breeding sites for a number of threatened fauna species including reptiles, birds and mammals. However, no hollow-dependent species were observed using any of these hollow-bearing trees.
- **Tree canopy shelter and nest sites.** The canopies of mature and semi-mature trees (particularly the myrtaceous species) provide shelter, roosting and breeding sites for many species. During this survey, the Rufous Fantail and the Rufous Whistler were both observed on nests in the canopy trees.
- **Foraging resources of the canopy: pollen, nectar, fruit and leaves**. Pollen and nectar is provided by the canopy and mid-storey trees; *Lophostemon confertus*

Brush Box (Dec-Jan), *Banksia integrifolia* Coast Banksia (winter), *Eucalyptus tereticornis* Forest Red Gum (Aug-Oct) and *Eucalyptus propinqua* Small-fruited Grey Gum (Jan-Mar), *Melaleuca quinquenervia* Broad-leaved Paperbark (autumnwinter) being the highest value species in this regard.

Although not abundant, many of the tree species, palms and vines on site also provide fruits known to be exploited by animals such as Fruit-doves and Flyingfoxes.

The leaves of some of the other canopy species on site are recognised food tree species for *Phascolarctos cinereus* Koala, namely *Eucalyptus tereticornis* Forest Red Gum, *Eucalyptus propinqua* Small-fruited Grey Gum and *Corymbia intermedia* Pink Bloodwood.

- **Prey species**. The natural vegetation provides suitable habitat for many species of insects, thus in turn providing foraging resources for insectivorous birds and mammals, many of which are threatened species. Similarly, the higher order predators (such as raptors, carnivorous marsupials and reptiles, many of which are threatened) are also well served by the presence of diverse habitats suitable for their favoured prey species.
- **Sandy substrate**. The light sandy soil and the occurrence (although rare) of the dune-swale sequence provides opportunities for burrowing species to construct fossorial nests. Diggings and burrows of *Rattus tunneyi* were common across the site, but particularly in the swale at the site's western edge and under fallen timber in the site's centre. *Merops ornatus* Rainbow Bee-eater (Migratory species listed under the EPBC Act 1999) was also observed nesting in the swale of the north western corner.

The fauna habitats on site are important in their own right, but they assume an even greater significance when considered in their spatial context. The bushland on site is separated from bushland to the north, south by unformed tracks and to the east by Iluka Road. However, these patches are functionally connected despite this fragmentation for most fauna species as the gaps are only 10 to 20 metres wide. Thus, the site is functionally connected to a vast swathe of bushland, most of which is reserved.

The National Parks and Wildlife Service has identified Key Habitats and Corridors along the east coast of NSW, including those areas considered important for conservation in the advent of climate change (Scotts 2003). These corridors have been delineated according to their known and predicted forest fauna habitats and their ability to contribute to a conservation network at the landscape scale.

The relationship of the site with the mapped Key Habitats and Fauna Corridors in the local area is shown in Figure 12. The bushland on the site and in surrounding lands is mapped as Key Habitat. However, the Fauna Corridors do not extend outside of the reserved lands to the east: the subject site is not part of a recognised fauna corridor.

The recognised regional fauna corridors alongside the subject site link a series of habitats that occur along the coast. They incorporate a number of habitat types, some of which are identified as being particularly important for some fauna species. For example, *Nyctophilus bifax* Eastern Long-eared Bat is an identified focal species for the Iluka-Yaray regional corridor (number 8) that crosses the Clarence River. Similarly, the Tyndale Swamp regional corridor (number 242) is intended to particularly accommodate *Petaurus australis* Yellow-bellied Glider and *Aepyprymnus rufescens* Rufous Bettong. Otherwise, the coastal corridor is identified to facilitate the conservation and movements of a large assemblage of species, the priority ones being (Scotts 2003):

- Crinia tinnula Wallum Froglet
- Litoria olongburensis Olongburra Frog
- Saproscincus oriarus (a rainforest skink)
- Ixobrychus flavicollis Black Bittern
- Pandion cristatus Eastern Osprey
- Phaps elegans Brush Bronzewing
- Gavicalis fasciogularis MangroveHoneyeater
- Syconycteris australis Common Blossom Bat
- Pteropus alecto Black Flying-fox
- *Nyctophilus bifax* Northern Long-eared Bat
- *Melomys burtoni* Grassland Melomys

Of these priority species, *Nyctophilus bifax* Eastern Long-eared Bat was possibly recorded on site during survey.

#### 3.5 Threatened Species

Results from the Protected Matters Search Tool and the OEH Wildlife Atlas online database searches revealed a number of listed species that require consideration as part of this assessment. Their habitat requirements and likelihood to occur on site are explored in Table 2.8 in Appendix 2.

Following survey, those threatened or migratory species considered to have a high likelihood to occur and require further consideration for impact are:

- 1. *Dromaius novaehollandiae* Emu;
- 2. Lophoictinia isura Square-tailed Kite;
- 3. Ptilinopus regina Rose-crowned Fruit-dove;
- 4. Calyptorhynchus lathami Glossy Black-Cockatoo;
- 5. *Glossopsitta pusilla* Little Lorikeet;
- 6. *Hirundapus caudacutus* White-throated Needletail;
- 7. *Merops ornatus* Rainbow Bee-eater;
- 8. Coracina lineata Barred Cuckoo-shrike;
- 9. Carterornis leucotis White-eared Monarch;
- 10. Daphoenositta chrysoptera Varied Sittella;
- 11. Rhipidura rufifrons Rufous Fantail;

- 12. Phascolarctos cinereus Koala;
- 13. Pteropus poliocephalus Grey-Headed Flying-fox;
- 14. Syconycteris australis Common Blossom-bat;
- 15. Mormopterus norfolkensis Eastern Freetail-bat;
- 16. Nyctophilus bifax Eastern Long-eared Bat;
- 17. Miniopterus australis Little Bentwing-bat; and

The potential impact of the proposal will be addressed for all the above species.

# 4 IMPACT AND AMELIORATION

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 proposal has been developed as an iterative process by a multi-disciplinary consultant team made up of ecologists, bushfire specialists and planners. Preliminary investigations were undertaken in order to identify early any absolute ecological constraints, thus giving rise to the pattern of the retained vegetation along the western boundary.

Detailed ecological survey revealed other environmental values of the site and so the proposed layout was altered significantly in order to better accommodate those species. The street layout has been specifically designed in order to minimise road trauma for fauna and also provide the opportunity to establish movement corridors.

# 4.1 Vegetation Clearing

Clearing of vegetation is inevitable for the proposed development.

The distribution of direct impact across the site is illustrated in Figure 11 and detailed below:

Vegetation type	Area on site pre- development	Area to be retained	Area to be managed as APZ	Area to be removed
1 Low Wattle	12.01 ha	1.05 ha	0.41 ha	10.55 ha
Woodland				
2				
<b>Open Forest</b>	(02hc)	0 ( ( ha	0 11 ha	616 ha
and	0.95 11a	0.00 IIa	0.11 lla	0.10 IIa
Woodland				
2/3	0.47 ha	0.47 ha	0	0
Mosaic	0.47 IIa	0.47 IIa	U	U
TOTAL	19.41 ha	2.18 ha	0.52 ha	16.71 ha

The total area of proposed development envelopes and access roads (including some APZ) accounts for approximately 16.71 hectares 86% of the total site area. The remaining 2.7 hectares will be retained, of which 2.18 hectares will be managed entirely for conservation purposes and narrow strips in Park 1 totalling 0.52 hectares will be managed as an APZ.

The high quality vegetation on site is restricted to the sliver along the western edge where remnant vegetation occurs on an intact topographic sequence. The entire occurrence of this high quality vegetation (the Mosaic vegetation type 2/3) will be retained and managed for conservation within Park 2. Thus, impact has been avoided on the most important vegetation feature of the site.

Potential impacts on this vegetation have been further minimised and mitigated by the presence of a vegetation buffer between the high quality vegetation and the development. This in turn is further buffered by a landscaped streetscape using native vegetation.

The losses across the rest of the site have been further mitigated by the location of the development footprint within the areas of least ecological value, areas with significant weed invasion, transformed ecosystems and other modifications (such as loss of soil structure).

# 4.2 Habitat Fragmentation

The subject site is adjacent to, but not part of, the large scale regional corridor recognised and mapped by OEH (see Figure 12). Although the subject site is in very poor condition, it is likely to play some role in connecting this important corridor to other vegetation and habitats to the west and north west, just by reason of its location. Thus, the development of a large part of this site has the potential to interrupt this link.

Therefore, in order to mitigate against this potential impact of habitat fragmentation, the areas to be retained in Parks 1 and 2 have been located so that they will best facilitate fauna movements and for the species most likely to be so advantaged. The significant fauna species recorded on site include *Dromaius novaehollandiae* Emu, *Phascolarctos cinereus* Koala, a number of birds and microchiropteran bats. These are all species that are able to travel long distances and are therefore unlikely to be significantly disadvantaged by the increase in fragmentation resulting from the development of the site.

However, this part of Iluka Road has already been identified as a crossing point for *Dromaius novaehollandiae* Emu (see Photograph 20). Park 1 has therefore been located in order to facilitate east-west fauna movements between Iluka Nature Reserve and the vegetation to the west, north and north west. Scats of *Dromaius novaehollandiae* Emu were also found in this area during survey, thus supporting the retention of this area as a corridor.

The *Phascolarctos cinereus* Koala observed on site was walking along the ground – not foraging in the trees or moving through the canopy – and moving from south to north. Thus, it was also considered important to maintain and enhance the north-south connection.

Park 2 has been increased in size from the original proposal, in order to provide as wide a corridor as possible for north-south movements of fauna, which was the direction in which the Koala was headed. The corridor to be retained and managed for conservation will be approximately 50 metres wide on site. When considered in conjunction with the vegetated lands to the west, Park 2 will be part of a 250 metre wide link between the swamp forest of the subject site with similar vegetation to the north.

Further design elements of the proposal will enhance the functionality of these wildlife corridors. The configuration of the streets and the vehicular access points to the lots will help to control the volume and speed of traffic in and around the development, and direct it away from the corridors. Vehicular access onto Iluka Road will be restricted to the current intersection at Hickey Street, further restricting the traffic impacts.

The landscaping of the streetscape has been informed by the most recent design guidelines to act as a corridor for Koalas (McAlpine et al. 2007). Critical elements to be incorporated are food tree species selection and planting distances. The planting of large native trees will be successful in the streetscape due to the incorporation of very wide verges into the layout.

The other area of vegetation to be retained is in Park 3, which has been located to protect trees of high Aboriginal heritage value. However, it will also provide a stepping stone function for the more mobile species such as bird and bats.

# 4.3 Loss of Fauna Habitat

Fauna habitat will be lost or alienated through the removal of trees and disturbance rising from the occupation of the site by new residents. The trees to be removed represent foraging, roosting and sheltering habitat for a range of fauna species including reptiles, birds and mammals.

However, the losses of the trees within the development area will be mitigated to some extent by the retention and conservation management of Parks 1, 2 and 3. These retained areas contain the most valuable fauna habitat and also maintain links to other important areas of habitat.

The development is concentrated in severely weed-infested vegetation that has been transformed by past clearing, sand removal, repeated fire and ecosystem-changing weeds. By contrast, the retained corridor along the western boundary contains fewer weeds; the moist swales produce higher nutrient leaves as forage for Koalas; and it supports many large and live hollow-bearing trees, thus providing this important breeding and roosting habitat long into the future.

Most of the hollow-bearing trees located on site were in large dead trees, presumably killed by a very hot fire. Not all hollow-bearing trees were located, moving around the site was very difficult due to the overwhelming infestations of *Lantana camara* Lantana.

Of the 15 hollow-bearing trees located within the subject site, one will be retained in Park 1. The loss of hollow-bearing trees is a recognised Key Threatening Process and such losses and impacts must be ameliorated. Therefore, it is recommended that the loss of these potential breeding sites are to be offset by the installation of nest boxes in the retained parks as a ratio of at least 1:1. These boxes are to be of a type suitable for the species that might otherwise use the natural hollow.

Further, if hollows are found within felled trees not otherwise visible from the ground, then these losses are also to be ameliorated by the installation of nest boxes of various sizes at a compensatory ratio of at least 1:1.

As the existing vegetation is relatively young – being largely made up of regrowth following the last set of fires – they do not contain many hollows. When the dead stags inevitably further decay and fall, it will likely leave a resource gap with a critical absence of this important breeding resource until the remaining trees naturally form hollows.

However, natural hollow formation can be very slow: research by State Forests of NSW has shown that *Eucalyptus pilularis* Blackbutt generally do not form hollows suitable for *Petaurus australis* Yellow-bellied Glider until the trees are 180+ years old. Therefore the development provides an opportunity to replace these hollows that will unavoidably be soon lost.

The site's landscape design will be informed by best practice design guidelines for accommodating Koalas in residential areas (McAlpine et al. 2007). Some of the elements to be incorporated include:

- Signage to inform residents of the likely presence of Koalas;
- Traffic calming devices including speed bumps, road narrowing points and combination raised pedestrian crossings;
- Educational material and signage in relation to restrictions of domestic pets;
- Planting of food tree species (such as *Eucalyptus tereticornis Forest Red Gum, Corymbia intermedia* Pink Bloodwood) vegetation in road verges, central medians and roundabouts;
- Plantings to link to retained vegetation corridors; and
- Open style fencing that will not impede Koala movement.

# 4.4 Displacement of Fauna

The felling of hollow-bearing trees will displace fauna resident at the time of felling and also has the potential to harm them during the felling process itself.

Therefore, a fauna handling protocol where animal welfare is paramount is to be followed during felling of hollow-bearing trees. The trees may need to be felled in sections or gently pushed to the ground to avoid injuring resident fauna. This must be done under supervision of an ecologist or wildlife carer so that resident fauna may be relocated into nest boxes erected in the retained bushland.

Hollow sections of trees are to be relocated into retained bushland as terrestrial habitat.

The timing of the felling of the hollow trees is important in order to avoid the breeding

seasons of species likely to be using the hollows for nesting. For most species of interest, this is usually late summer / autumn.

Also, as the dense *Lantana camara* Lantana infestation prevented complete searches for hollow-bearing trees, all vegetation is to be removed under ecological supervision to ensure animal welfare considerations are observed.

# 4.5 Asset Protection Zones

Parks 1 and 2 will pose a bushfire hazard to the surrounding lots. Therefore an APZ is to be implemented. The APZ required to protect the properties from Park 2 will be wholly contained within the road and verges and will not encroach on the retained bushland.

However, the APZ for the lots around Park 1 will encroach into the retained vegetation to a maximum distance of 10 metres. This narrow buffer needs to be managed to the standards of an Inner Protection Area with very little ground and fine fuel, no vertical connectivity between the ground and canopy and no horizontal connectivity between the tree canopies.

It is recommended that only the aerial parts of vegetation is removed during APZ management; the retained roots will serve as a soil conservation measure.

# 4.6 Light Pollution

A study of microchiropteran bat activity among different sites in parklands of Adelaide (Scanlon 2006, Scanlon and Petit 2008) found that dark parks were more important for bat diversity and activity (six species groups in the darkest park) than were artificially lit parkland areas (three species groups in the flood-lit park). *Chalinolobus gouldii* Gould's wattled bat and *Mormopterus* species 4 (94% of calls) were advantaged in urban parklands, being the only species recorded when lights were on at sports parks, whereas five species groups occurred when the lights were off.

Street lighting is also known to interrupt natural foraging behaviour of the threatened species *Miniopterus schreibersii oceanensis* Eastern Bentwing-bat (Hoye and Hall 2008).

Lighting of the subsequent developed lots should be minimised in time and space, limited to the areas where and when lighting is required for amenity or security and of a type that reduces spill and glare.

# 4.7 Indirect Impacts and Runoff

The proposal has the potential to impose indirect impacts on vegetation and habitats that remain on site as well as to those that occur off site. Alteration to the amount and quality of runoff from the development areas has the potential to alter sensitive downslope environments. The introduction of hard surfaces (roofs, driveways, access roads, hard landscaping) interrupt the percolation of rainwater through the soil profile and instead delivers water in greater volumes and at greater speeds downslope through drainage controls.

These usually manifest as enhanced "edge effects" (e.g. increased weeds, increased exposure and instability of trees).

Such potential impacts are to be controlled by Water Sensitive Urban Design and by the conservation management of the retained bushland n Parks 1, 2 and 3. The management of these areas will focus on weed control.

Exposed areas of soil have the potential to mobilise and will be managed with the strategic use of standard erosion and sediment controls.

# 5 IMPACT ASSESSMENT

For the purposes of the impact assessment the following terms of reference are used:

- *Subject site, site* lands within the subject allotment;
- *Local area* lands within 2 kilometres of the subject site;
- Broader study area lands within 10 kilometres of the subject site and includes the Office of Environment and Heritage (OEH) Wildlife Atlas and Commonwealth Department of Environment(DSEWPC) Protected Matters database search areas; and
- *Region* lands within 50 kilometres of the subject site.

For the threatened species of interest recorded within 10 kilometres of the subject site, (see Appendices 1 and 2), the likelihood of occurrence of each species in or near the subject site was determined by analysis of their habitat requirements, the habitats on site and the nature and extent of adjacent habitats.

Each species has been assigned to one of four groups according to their likelihood of occurring on the subject site or within adjacent habitats likely to be impacted by the proposed works:

- High likelihood to occur species whose preferred habitat features occur on the site and / or have been recorded close by in similar habitat, and / or are able to reach the subject site from other known and confirmed locations;
- Moderate likelihood to occur species whose preferred habitat features in a strict sense occur on or near to the site but are considered generally unlikely to occur. This may be due to such things as the nature of habitats and disturbances between confirmed locations and the subject site, movement patterns of the subject species, the extensive and common nature of the available habitat in the local area, the rarity of the species, the length of time since it was last recorded and / or the size of its home range;
- Low likelihood to occur species with specific terrestrial niches and habitat requirements that generally do not occur on or near the subject site or species that have not been found the area for a considerable period of time; and
- *No likelihood to occur* these are generally aquatic or marine species.

The impacts of the proposal on those species observed on site or listed in the first group (*high likelihood to occur*) have been assessed using a Section 5A assessment (or seven part test) as required by the EPA Act (1979). The remaining species assigned to the last three groups (those with no to moderate likelihood to occur) have not been considered in further detail as, although possible, their presence is unlikely.

Section 5A of the EPA Act (1979) requires that the consent authority take into account seven factors when deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats. If a significant impact is judged likely to occur, a Species Impact Statement (SIS) is required.

The potential impact of the proposal on the subset of NSW listed threatened entities recorded on site or considered likely to occur are assessed in full individually in Appendix 3 and summarised below. In keeping with the spirit of the Bilateral Agreement between the Commonwealth and New South Wales State Governments, these assessments are considered adequate in satisfying the EPBC Act (1999) for those species listed under both pieces of legislation for an Environmental Impact Assessment. However, for species listed only under Commonwealth legislation, a separate assessment is provided in accordance with the EPBC Act (1999) below.

# 5.1 Vegetation Communities

### 5.1.1 Swamp Sclerophyll Forest

This vegetation community occurs in the intact swales at the western edge of the site. It will be retained in its entirety and be subject to conservation management, with an emphasis on weed control. It will be further protected from edge effects by the presence of a substantial buffer of Low Acacia Woodland.

The proposal is unlikely to result in a significant adverse impact to this endangered ecological community.

# 5.2 Flora Species

#### 5.2.1 *Phaius australis* Lesser Swamp Orchid

This species was not recorded on the subject site but is known to occur in the swamp forest immediately to the north of the subject site.

The potential habitat on site is within swamp forest vegetation on the western boundary. This area will be wholly retained and managed for conservation purposes.

The proposal is unlikely to result in a significant adverse impact to this threatened species.

#### 5.2.2 Acronychia littoralis Scented Acronychia

This species was not recorded on the subject site during survey. Potential habitat occurs across the site but the best habitat is within the remnant vegetation along the site's western boundary.

The area with the most potential to support this species will be retained and managed for conservation purposes.

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

# 5.3 Birds

## 5.3.1 Dromaius novaehollandiae Emu

Evidence of this endangered population was found on site: a number of scats were collected from the site, with the greatest concentration being in the remnant vegetation on the western boundary that is to be retained and managed for conservation purposes.

The nearby Bundjalung National Park is a known stronghold for this species in this area, but it has declined in recent times with too frequent fires, loss of habitat outside of the reserve, road trauma and predation of eggs and chicks by exotic predators.

The development proposal will remove potential and realised habitat for this species, but the highly modified vegetation dominated by dense thickets of *Lantana camara* Lantana are likely to be of only marginal value to this species as it favours vegetation with a more open understorey. The conservation management of the retained parks will be of benefit to this species by the removal of weeds, the improvement in the condition of native food plants and by the opening up of the understorey structure. Also, Park 1 was located specifically to maintain east-west connectivity in the area known to be frequented by this species.

It is a nomadic and highly mobile species, with home ranges of between 5 to 10 square kilometres. Therefore the animals occurring on site would have access to the protected habitats in the nearby Iluka Nature Reserve and Bundjalung National Park and be part of the population known to frequent those protected areas. In that context, the loss of 16.71 hectares of highly modified poor condition habitat across the subject site represents less than 2% of its home range, most of which is reserved.

It is recommended that clearing is not undertaken during the breeding season (December to end of March) in order to prevent disruption to nesting animals that may be in residence. All clearing is to be conducted under ecological supervision. It is also recommended that domestic pets are kept under control at all times, confined in secure yards and prevented from wandering at night in order to prevent additional predation. Traffic calming controls to be implemented in the development will also minimise road trauma.

The proposal is unlikely to have a significant adverse impact on this endangered population.

# 5.3.2 Lophoictinia isura Square-tailed Kite

This species was observed flying in a thermals near the subject site during survey. It may forage on site, being a specialist hunter of small birds taken from the tree canopy. Favoured prey species include honeyeaters, many of which were observed during survey.

The development will remove much of this potential habitat; but connectivity to other vast areas of potential habitat will not be disrupted for such a highly mobile species. Also, the

retention and conservation management of the vegetation within the parks will improve some of the habitat for its prey and in turn for this species.

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

### 5.3.3 Ptilinopus regina Rose-crowned Fruit-Dove

This species was heard calling on one occasion from the eastern end of the subject site during survey. It was also observed foraging in Littoral Rainforest in Iluka Nature Reserve.

This species is a specialist feeder on rainforest fruits. The potential habitat on the subject site is confined to types 2 and 2/3 mosaic as these are the areas where there is greater diversity in the tree canopy, including some rainforest species that produce the favoured fleshy fruits. However, given the very poor condition of the vegetation on site and the proximity of a large area of reserved good condition habitat, the subject site is unlikely to be important for the survival of a local viable population. Notwithstanding, the retention and conservation management of Parks 1, 2 and 3 is likely to be of advantage to this species as it will improve the condition of potential food plants on site.

The removal of weeds from the development area and control of weeds on site in the parks will also remove a significant source of weed propagules. This will have a positive impact on surrounding lands, such as the Littoral Rainforest in Iluka Nature Reserve.

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

# 5.3.4 Calyptorhynchus lathami Glossy Black-Cockatoo

Characteristically chewed *Allocasuarina* cones were observed on the northern edge of the subject site during preliminary survey in 2005. It was not recorded during recent survey activities.

This species is a habitat specialist, feeding exclusively on *Allocasuarina* fruit and breeding in large tree hollows. Preferred feed trees are rare on site, being observed only in the northern part, but notably in the area to be retained and managed for conservation in Park 1.

Suitable resources are likely to occur in the large expanses of reserved bushland from Iluka Nature reserve north to Bundjalung National Park and beyond. It is a highly mobile species and its ability to move through the landscape will not be altered by the proposal.

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

# 5.3.5 Glossopsitta pusilla Little Lorikeet

This species was not recorded on the subject site during survey. However, it is known form the local area and potential foraging habitat for this species is common across the

site, particularly in the high nectar plants such as *Banksia integrifolia* Coast Banksia. The hollow-bearing trees also provide potential nesting sites.

Losses of potential foraging habitat will be partially mitigated by the retention and conservation management of the vegetation in the parks. The loss of hollow-bearing trees will be offset by the installation of nest boxes. It is a highly mobile species and its ability to move through the landscape will not be altered by the proposal. Given the amount of high quality habitat in reserved lands in the immediate area, the poor condition vegetation of the subject site is unlikely to be important for the survival of a viable local population.

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

# 5.3.6 Coracina lineata Barred Cuckoo-shrike

This species was observed nearby in Iluka Nature Reserve during survey. Thus, the habitats of the subject site are available to this species. It feeds on insects of the canopy and rainforest fruit; the subject site provides such habitat features. The subject site supports poor quality potential habitat, being infested with weeds and containing only scattered rainforest trees, and most of a young age.

The retention and conservation management of the vegetation within the parks will improve the habitat available to this species on site. The east-west corridor provided by Park 1 will also be of benefit to this highly mobile species.

Given the expanse of available habitat in better condition in the reserved lands nearby, the subject site is unlikely to be important in the survival of a viable local population of this species.

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

# 5.3.7 Carterornis leucotis White-eared Monarch

This species was not recorded on the subject site during survey. Favoured habitat is the ecotone from rainforest or swamp forest to adjacent open areas. The best potential habitat for this species on site occurs in the swamp forest to be retained and managed for conservation along the site's western edge.

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

# 5.3.8 Daphoenositta chrysoptera Varied Sittella

This species was observed during survey, foraging on tree trunks in the area to be retained in Park 1.

This species requires well connected expanses of habitat with fallen and dead timber and a complex understorey. The subject site provides such habitat features and can continue

to do so in the post-development landscape outside of the development footprint. It is a highly mobile species and its ability to move through the landscape will not be altered by the proposal.

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

# 5.4 Mammals

#### 5.4.1 Phascolarctos cinereus Koala

This species was recorded on the subject site during survey. A single image was captured by a camera trap placed on the ground in the Low Acacia Woodland. The animal was walking, heading from south to north. As it was not in the canopy, it was not foraging. The head only was evident in the photograph, so there is no information regarding the presence or absence of a joey.

This result prompted further comprehensive survey to be undertaken, including saturation of the site with another 30 camera traps, additional spotlighting and scat searches using the Spot Assessment Technique (*sensu* Phillips and Callaghan 2011) in 14 locations on and adjacent to the subject site (see Figure 10 and Table 2.6).

No further Koalas or evidence of Koalas were found. The few scratches observed on smooth-barked trees may be evidence of other species recorded on site (e.g. *Varanus varius* Lace Monitor, *Trichosurus vulpecula* Common Brushtail Possum)

Koala habitat is defined according to the density and types of recognised food trees on the site. Of the food tree species listed under State Environmental Planning Policy 44, only *Eucalyptus tereticornis* Forest Red Gum is present on site, and in very low numbers. The Approved Recovery Plan (DECC 2008) details more species by region. Of the species listed for the North Coast, *Eucalyptus tereticornis* Forest Red Gum (a primary food tree species) and *Eucalyptus propinqua* Small-fruited Grey Gum (a secondary food tree species) occur on site, again both in very low numbers.

The Draft Koala Management Plan for the Clarence Valley LGA lists *Eucalyptus tereticornis* Forest Red Gum and *Eucalyptus propinqua* Small-fruited Grey Gum as 'preferred food trees' in this area, but also recognises *Corymbia intermedia* Pink Bloodwood as a 'supplementary food tree species'.

Of the 420 trees searched within the SAT plots, there were only 5 *Eucalyptus tereticornis* Forest Red Gum and 3 *Eucalyptus propinqua* Small-fruited Grey Gum. *Corymbia intermedia* Pink Bloodwood was much more plentiful, with 54 trees observed. However, this is still only 13% of the trees and is by no means the dominant species: *Acacia disparrima* subsp. *disparrima* Salwood was represented by 233 individual or 55% of the trees. Such a tree composition is defined as relatively low quality Koala habitat and is probably only capable of supporting low density Koala populations (DECC 2008).

The Clarence Valley Draft Comprehensive Koala Management Plan summarised the

research that has been carried out on the Iluka Koala population in detail and concluded that:

- The Koala population at Iluka has been declining for decades (at least since the 1970s);
- The decline is associated with high mortality due to habitat loss (urban development, feral pigs and repeated severe fire), traffic accidents, stress-related disease, and low fertility;
- Sick and injured Koalas still turn up occasionally and so there may be a surviving small residual population in Iluka Nature Reserve;
- The Bundjalung population was severely impacted by the fires of 1989 and 1994, thus removing a source of migrants; and
- The Iluka Koalas were strongly associated with *Eucalyptus tereticornis* Forest Red Gum, but this species of tree has not regenerated in the sand mining areas. The very low numbers of this species on the subject site is further testament to that observation.

A modelling study of the Iluka population (Lunney et al. 2002) concluded that the decline and eventual extinction of the Iluka population was inexorable, unless there was a major influx of migrating Koalas and significant alterations to the factors influencing disease and mortality. Thus, the provisions of corridors to and from known populations is important, as are improvements in the condition of their habitat, and control of causes of mortality.

The development proposal will remove a substantial area of vegetation, but this is demonstrably very poor habitat. The evidence indicates that the animal recorded on site was moving through the site (and not foraging on the site), presumably to better habitat to the north, where there is no evidence of sand mining and primary Koala food trees are present. For example, both *Eucalyptus tereticornis* Forest Red Gum and *Eucalyptus robusta* Swamp Mahogany (another primary food tree) occur on the golf course.

Thus, the proposed layout has been designed in order to deliver the factors identified as important in maintaining the local Koala population:

- The best quality habitat has been retained along the western edge, thus providing foraging habitat;
- The retained vegetation along the western boundary will maintain a wide buffered link from north to south;
- The retention and conservation management of the vegetation in Park 1 will facilitate east-west movement from Iluka Nature Reserve to habitat on site and beyond to the west and north west;
- The conservation management of Park 1 will improve its condition and value to the Koala;
- Two of the occurrences of *Eucalyptus tereticornis* Forest Red Gum on site are within Park 1, thus confirming its potential habitat value to Koalas;
- The verges of the streets are to be wide and planted out specifically to facilitate Koala movement, using best practice design guidelines (McAlpine 2007);

- The landscape plan will provide the opportunity offset, to some degree, the past losses of *Eucalyptus tereticornis* Forest Red Gum;
- Traffic calming measures will be introduced in the streetscape in order to minimise road trauma;
- Access points to the site are limited and internal traffic flow is minimised, again intended to minimise road trauma;
- Fences are to be of a type that allows for the movement of Koalas; and
- With the advent of more residential properties, fire suppression will continue to be a high priority.

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

# 5.4.2 *Pteropus poliocephalus* Grey-headed Flying-fox

This species was not observed during survey but is likely to occur on site when appropriate feed trees are in flower or fruit. The large areas of vegetated coastal dunes dominated by *Banksia* are recognised important foraging habitat for this species, particularly in the winter months. The potential habitat on site is likely to be of lesser importance but may still be exploited.

This is a highly-mobile species that can exploit even the most isolated of feed trees in highly urbanised situations.

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

# 5.4.3 Syconycteris australis Common Blossom Bat

This species was not observed during survey but a breeding population is known to occur in the adjacent Iluka Nature Reserve. It is a specialist feeder of nectar and pollen and therefore requires high quality foraging habitat such as occurs in the *Banksia*-dominated coastal dunes of the nearby reserves. It roosts hanging from tree branches, near to foraging habitat.

The subject site provides potential habitat of lesser value than is available in the nearby reserves, but the best potential habitat on site is within the swamp forest in the western end of the site. This will be entirely retained and managed for conservation purposes.

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

# 5.4.4 Mormopterus norfolkensis Eastern Freetail-bat

This species was recorded foraging on the subject site during survey.

The subject site provides both foraging habitat for this species and potential breeding sites (hollow-bearing trees). Suitable hollows to be removed will be compensated for with replacement nest boxes. The potential and realised habitat on site would only represent

a very small proportion of what is available locally and regionally as this species is highly mobile, able to exploit widely separated resources.

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

## 5.4.5 Nyctophilus bifax Eastern Long-eared Bat

This species was possibly recorded foraging in the moist forest at the western end of the subject site during survey. A large number of records of this species are known from Iluka Nature Reserve based on a comprehensive study of the movements and roosting behaviour of this species (Lunney et al. 1995). Outside of the Mosaic Open Forest, the subject site provides poor foraging habitat and, given that it does not forage far from its roost sites, it is likely to be restricted to the high quality remnant forest at the western end of the site.

All of the this habitat is to be retained and managed for conservation purposes.

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

### 5.4.6 Miniopterus australis Little Bentwing-bat

This species was recorded foraging on the subject site during survey.

Foraging habitat for this species occurs below the tree canopy in the forested areas and as the site is generally very cluttered, it is likely to forage in the open areas where the Lantana is less dominant and / or in the moist forest at the western boundary.

As this species roosts in caves or mine tunnels, the subject site only contains foraging habitat. This foraging habitat would represent a very small proportion of what is available locally and regionally as this species is highly mobile, able to exploit widely separated resources.

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

#### 5.5 Commonwealth Listed Matters of NES

There are several Matters of National Environmental Significance on or near the site that require consideration:

- 1. Gondwana Rainforests of Australia World Heritage Place Iluka NR
- 2. *Hirundapus caudacutus* White-throated Needletail Migratory species
- 3. Merops ornatus Rainbow Bee-eater Migratory species
- 4. Rhipidura rufifrons Rufous Fantail Migratory species
- 5. Koala Vulnerable species

The EPBC Act Policy Statement 1.1 Significant Impact Guidelines (DE 2013) outlines the procedures that must be followed when assessing likely impacts, and the significance of

those impacts upon matter of National Environmental Significance (NES). These are detailed below within each matter.

#### 5.5.1 Iluka Nature Reserve

For World Heritage places, an action is likely to have a significant impact on the values of a declared World Heritage property if there is a real chance or possibility that it will cause:

- one or more of the World Heritage values to be lost;
- one or more of the World Heritage values to be degraded or damaged; or
- one or more of the World Heritage values to be notably altered, modified, obscured or diminished.

The Gondwana Rainforests are made up of a number of rainforest pockets along the east coast of Australia they represent the remnant forests of Gondwana. They have been declared due to their outstanding natural values:

- as an outstanding example representing major stages of the earth's evolutionary history;
- as an outstanding example representing significant ongoing geological processes and biological evolution; and
- containing important and significant habitats for the in situ conservation of biological diversity.

The Littoral Rainforest in Iluka Nature Reserve is part of that chain of rainforest. The reserve contains the largest single stand in New South Wales of Littoral Rainforest, which is the most constrained and distinctive coastal variant of sub-tropical rainforest. The physical features of this Littoral Rainforest (being on as series of siliceous sand ridges) and its biological components contribute to its World Heritage values.

The proposed residential development of the subject site will not interfere with any of these values. It is sufficiently distant from the Littoral Rainforest within the reserve to not introduce any indirect impacts. The actions within the development (clearing of vegetation, construction of houses, installation of infrastructure and conservation management of retained vegetation) are not of a type or scale likely to interfere with any of the geological and landscape processes determining the presence of the Littoral Rainforest or its biological components. There is potential for some of the fauna species within the reserve to also use habitats on the subject site; thus there is potential for some adverse impact of those species through the loss of those habitats (e.g. *Ptilinopus regina* Rose-crowned Fruit-dove was observed feeding in the reserve and heard calling on the subject site). However, the habitats within the subject site are in very poor condition and likely to be of marginal value only to such species. Also, all such these species are mobile, with large home ranges and able to exploit widely separated resources.

The development proposal will remove significant weed loads from the local area, thus contributing to the success of conservation management programmes undertaken in the reserve. The loss of habitat from the subject site has the potential to further isolate the reserve from other vegetation. However, the site is not part of the formally recognised

regional corridor and so does not provide important biological links. Notwithstanding its lesser value, the proposal includes the retention of vegetation in order to maintain habitat linkages.

Thus, the scale, location and type of actions arising from the proposed development are unlikely to degrade the world heritage values of Iluka Nature Reserve.

### 5.5.2 *Hirundapus caudacutus* White-throated Needletail

The White-throated Needletail is listed as a Migratory species under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999), arising from Japan Australia Migratory Bird Agreement. Its conservation status across its range in Australia is secure.

It is a migratory swift that breeds in Asia. Australia hosts the non-breeding population that disperses southward in September-October along either side of the Great Dividing Range with a similar return journey in the following autumn. While in Australia, it is largely nomadic in response to large scale weather systems, feeding on large nuptial swarms of insects (Simpson and Day 1993).

Individuals have been recorded taking refuge in trees or on the ground in extreme circumstances (e.g. heatwave), but this species spends most of its life in the air while in Australia. However, it is recorded most often over wooded areas and less so over woodland and farmland. There are few threats to the populations of White-throated Needletail (DSEWPC 2012).

This species was observed overhead during survey, indicating it was on its southward migration from the Asian breeding grounds. The subject site probably contributes little if at all to the foraging habitat of this species. The loss of a small area of woodland is unlikely to place any extinction pressure at all on this species.

#### 5.5.3 *Merops ornatus* Rainbow Bee-eater

The Rainbow Bee-eater is listed as a Migratory species under the Schedules of the Environment Protection and Biodiversity Conservation Act (1999), arising from Japan Australia Migratory Bird Agreement. Its conservation status across its range in Australia is secure.

This species is a distinctive and colourful medium sized bird, with a long slim curved bill and a long tail.

It is found throughout mainland Australia, as well as eastern Indonesia, New Guinea and, rarely, the Solomon Islands. In Australia it is widespread, except in desert areas, and breeds throughout most of its range, although southern birds move north to breed. Birds in temperate and sub-tropical Australia migrate as far north as New Guinea to breed.

When breeding, both males and females select a suitable nesting site in a sandy bank and

dig a long tunnel (average length: 89.4 cm) leading to a nesting chamber, which is often lined with grasses. Both parents incubate the eggs and both feed the young, sometimes with the assistance of auxiliaries.

There are over 340 records of this species held in the NSW Wildlife Atlas (BioNet October 2015) from the Clarence Valley LGA. The database contains records from all months.

Its habitat requirements are simply an elevated perch from which to watch for prey and a ground substrate in which to dig their breeding burrow. Because their prey is entirely caught on the wing they are not dependent on any vegetation type: most often found in open forests, woodlands and shrublands, and cleared areas, usually near water, but also on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.

This species was observed foraging along the open forest edges of the site and entering a breeding burrow in the intact sand dune along the northern edge. This area will be retained in Park 1.

An action is likely to have a significant impact on a migratory species 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;

#### Response:

Appropriate foraging habitat is common in the local area and some foraging habitat will be retained by the proposal. The area of breeding habitat is within the area slated for retention in Park 1.

# 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

#### Response:

European Red Foxes dig up the breeding burrows of this species and this species was recorded on site. Removal of dense weedy understorey will aid in the control of this predator.

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

#### Response:

There is no evidence to suggest that the individuals on site make up an ecologically significant proportion of the population.

## 5.5.4 Rhipidura rufifrons Rufous Fantail

This species occurs in the coastal areas from the Kimberley region in the north to Victoria in the south and favours dense moist forests and scrub vegetation (Pizzey 1980). In the southern part of its range it is strongly migratory, virtually disappearing from Victoria and New South Wales by March – April, arriving back in the southern states in the spring (usually October) to breed (Pizzey 1980). Although usually found in forests, woodlands and other woody vegetation with deep shade, it may be found in more open habitats or urban areas during migration.

There are over 600 records of this species held in the NSW Wildlife Atlas (BioNet October 2015) from the Clarence Valley LGA. The database contains records from all months, but it is generally absent May to July and most regularly and reliably recorded during the breeding season.

This species was observed foraging across the site in pairs and as individuals. It was also observed nesting in the vegetation at the western end of the site (see Figure 11).

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

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;

#### **Response:**

Appropriate foraging habitat is common in the local area and some foraging habitat will be retained by the proposal. The area of breeding habitat is within the area slated for retention in Park 1.

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

#### Response:

The habitat loss and modification that will arise are not likely to introduce or favour invasive species that will be harmful to this species or its habitat.

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

#### Response:

There is no evidence to suggest that the individuals on site make up an ecologically significant proportion of the population.

#### 5.5.5 Phascolarctos cinereus Koala

An ecological profile of this species is provided in Appendix 3. This species was detected on site in a single camera trap image; see section 5.4 for further discussion.

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

#### Response:

The Iluka Koala population is not, by definition, an important population: it is not necessary for the species' long-term revival and recovery, a key source population for breeding or dispersal necessary to maintain genetic diversity or at a geographic limit.

#### 2. reduce the area of occupancy of an important population

#### Response:

As it is not an important population by definition, this factor is irrelevant. However, the area of habitat to be removed is unlikely to be of importance to the local population except as a movement corridor. This function will remain.

#### 3. fragment an existing important population into two or more populations

#### Response:

Connectivity of the potential habitat in the local area will be maintained by the layout: retention of Parks 1 and 2 and landscaping of the development to facilitate Koala movements.

#### 4. adversely affect habitat critical to the survival of a species

#### Response:

The habitat on site is of very poor quality, being virtually devoid of primary or preferred food tree species.

#### 5. disrupt the breeding cycle of an important population

#### Response:

There is no evidence of breeding on site.

# 6. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

#### Response:

The loss of habitat in the local area is only one of many processes that are contributing to the decline of this species. Immigration, disease and mortality from road trauma have also been implicated as very important factors and, in the absence of significant controls and improvements to these, the retention of habitat will not halt the decline of the population. Therefore, the proposal is an integrated package of actions that are designed to contribute to the improvement of these processes by retention of the best quality habitat, retention of identified links, enrichment of the remaining habitat through vegetation management, creation of links through the residential landscape, traffic calming and dog control.

# 7. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

#### Response:

The vegetation on site has declined after it was cleared (and presumably sand mined) sometime between 1966 and 1978, compounded by ferocious fires. Transformer weeds are common across the subject site, with *Lantana camara* Lantana being the most abundant. Now the vegetation across the majority of the site is altered and simplified with very few primary food trees now occurring where once they should have been common.

The proposal will retain the best habitat (where clearing and mineral extraction has probably not occurred) and improve the condition of the other areas to be retained by weed control. This will remove invasive species and reverse some of the past harm.

#### 8. introduce disease that may cause the species to decline, or

#### Response:

Infertility from *Chlamydia* is a contributing factor to the current decline in koala numbers. Loss of habitat imposes stress on Koalas and during times of stress, Koalas are prone to outbreaks of *Chlamydia*. However, the habitat on site is of very poor quality and does not provide good quality forage. Other than the image of a single animal passing through, there is no evidence of the site being used by this specie. Importantly, the absence of scats beneath potential food trees during this comprehensive recent survey indicates no foraging on site.

Thus the loss of the habitat on site is unlikely to significantly contribute to the stress and underlying disease of the local Koala population.

#### 9. interfere substantially with the recovery of the species.

#### **Response:**

Recovery of this species in the local area relies on a multi-faceted approach integrating actions regarding habitat loss and degradation, movement corridors, disease, road trauma and dog attacks. This proposal has incorporated all of the best practice design principles developed for residential development in areas of Koala habitat. It is considered therefore that it will not substantially interfere with the recovery of the species.

No further assessments are considered necessary pursuant to the EPBC Act (1999).

# 6 STATE ENVIRONMENT PLANNING POLICY 44

**SEPP 44 Koala Habitat Protection** is a policy aimed at the encouragement of the conservation and management of natural vegetation that provide habitat for koalas, to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. To this end, SEPP 44 provides a methodology for identification of core Koala habitat and requires the preparation and implementation of management plans for areas so identified. In conservation planning it has been overtaken by specific Plans of Management in individual LGAs and by the Approved Recovery Plan. However, this SEPP imposes a statutory obligation for consideration.

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 Clarence Valley 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.

The identification of Koala habitat that attracts protections under this SEPP depends on the presence of (i) recognised Koala food trees and (ii) Koalas themselves.

Of the list of food trees provided within the SEPP for the North Coast region, only one was found on site - *Eucalyptus tereticornis* Forest Red Gum and in low numbers.

Although an individual was observed in a camera trap image, no other evidence of this species was found despite intensive and extensive survey. The Koala population at Iluka is considered to be functionally extinct and is now only recorded very rarely.

The site does not contain core Koala habitat *sensu* SEPP 44 and so no further consideration need be given to the provisions of this SEPP.

# 7 CONCLUSIONS AND RECOMMENDATIONS

Keystone Ecological has undertaken a comprehensive Flora and Fauna Impact Assessment of the likely impact of the subdivision and subsequent residential development at Lot 99 DP 823635 Hickey Street Iluka in the Clarence Valley Local Government Area, upon nationally and state listed threatened flora and fauna and their habitat.

The proposal is to subdivide the site and create 162 residential lots and three reserved areas (Parks 1 to 3). The internal road system will have wide verges and roundabouts, allowing for significant plantings as part of a formal landscape plan. The street verges will serve a number of purposes besides access, aesthetics and delivery of infrastructure, including biodiversity corridors, water sensitive urban design features and bushfire control. The reserved areas have been carefully located in order to capture the highest value habitats as well as provide important corridors for the local movement of fauna. The site is adjacent to, but not within, a recognised regional wildlife corridor.

Formal consideration has been given to the potential for impact on listed matters of conservation significance that are known to occur or have a high likelihood to occur on site:

- Swamp Sclerophyll Forest occurs along the site's western edge and to be wholly retained in Park 2;
- *Phaius australis* Lesser Swamp Orchid not found on site but known from vegetation directly to the north. Potential habitat in the Swamp Sclerophyll Forest;
- *Acronychia littoralis* Scented Acronychia not found on site but known to occur in the local area;
- *Dromaius novaehollandiae* Emu scats found across the site;
- *Lophoictinia isura* Square-tailed Kite observed overhead. May forage on the subject site;
- *Ptilinopus regina* Rose-crowned Fruit-dove observed in the adjacent Nature Reserve and heard on site. May forage on some of the fruits of the occasional rainforest trees scattered across the site;
- *Calyptorhynchus lathami* Glossy Black-Cockatoo evidence of foraging by this species along the northern edge of the site was reported in 2005;
- *Glossopsitta pusilla* Little Lorikeet the site provides potential foraging and breeding habitat for this species;
- *Coracina lineata* Barred Cuckoo-shrike observed nearby and the site provides potential foraging habitat;
- *Carterornis leucotis* White-eared Monarch not recorded during survey but the site provides potential foraging habitat;
- *Rhipidura rufifrons* Rufous Fantail regularly observed foraging across the site during survey and a nest was recorded in the vicinity of the proposed Park 2;
- *Daphoenositta chrysoptera* Varied Sittella observed foraging in the eastern part of the site in the area to be retained in Park 1;

- *Merops ornatus* Rainbow Bee-eater observed foraging along the edges of the site and nesting in the intact sand dune along the site's northern edge. This area is to be retained in Park 2;
- *Hirundapus causacutus* White-throated Needletail observed flying overhead. Terrestrial habitat is largely irrelevant to this species;
- *Phascolarctos cinereus* Koala observed walking across the site from south to north;
- *Pteropus poliocephalus* Grey-headed Flying-fox not recorded during survey but the blossom and fruits of the canopy trees provide potential foraging habitat;
- *Syconycteris australis* Common Blossom Bat not recorded during survey but the blossom and of *Banksia integrifolia* Coast Banksia provides potential foraging habitat;
- *Mormopterus norfolkensis* Eastern Freetail-bat recorded foraging on site during survey. Hollow-bearing trees also provide potential roosting / breeding habitat;
- *Nyctophilus bifax* Eastern Long-eared Bat possibly recorded foraging on site during survey. Prefered habitat in high value vegetation along the western boundary;
- *Miniopterus australis* Little Bentwing-bat recorded foraging on site during survey; and

Overall, the proposal will remove 16.71 hectares of highly modified Low Acacia Woodland (10.55 hectares) and Open Forest and Woodland (6.16 hectares). These vegetation types are highly modified by past clearing, repeated hot fires and the continued influence of transformer weeds such as *Lantana camara* Lantana. The infestations of Lantana are significant, being impenetrable in places.

While this represents the majority of the vegetation on site, the principles of avoiding, minimising, mitigating and offsetting environmental impacts have been observed by the following elements of the proposal and recommendations arising from this assessment:

- 1. The best quality habitat of the highest conservation value (Swamp Sclerophyll Forest EEC) is to be retained and managed for conservation purposes.
- 2. This area will be further protected from the residential development by a buffer of native vegetation.
- 3. The two large areas of retained vegetation have been located so as to maintain connectivity for the species of most concern that were recorded on site, being *Dromaius novaehollandiae* Emu and *Phascolarctos cinereus* Koala.
- 4. Potential adverse impacts on these species will be further mitigated by the implementation of a landscape plan that includes the planting out of the wide verges with native trees favoured by Koalas, such as *Eucalyptus tereticornis* Forest Red Gum and *Corymbia intermedia* Pink Bloodwood.
- 5. Traffic calming measures will also be employed and the route of traffic flow managed by road design. These measures will decrease the risk of road trauma.
- 6. Domestic pets are to be kept within fenced premises, especially at night.

- 7. The replacement with nest boxes of all hollow-bearing trees to be removed. Most hollow-bearing trees on site are dead and at risk of falling over in the near future. The proposal will allow for the replacement of this resource and thus avoid a bottleneck for hollow-dependent fauna.
- 8. Felled hollow trees will be re-used as terrestrial habitat in the retained vegetation.
- 9. Vegetation clearing will be conducted under ecological supervision to protect resident fauna from direct harm.
- 10. Clearing is to be conducted outside of the breeding season of important fauna species, particularly *Dromaius novaehollandiae* Emu (December to end March).
- 11. Lighting is to be of a type that minimises spill and glare. This is important for microchiropteran bats and other nocturnal species.
- 12. Water sensitive urban design principles are to be incorporated into the development. This will minimise the potential indirect impacts to surrounding bushland.
- 13. Vegetation management in the APZs is to entail the removal of only the aerial parts of plants. This will serve as a soil conservation measure.
- 14. Dumping of garden refuse in bushland areas is to be prohibited.
- 15. Residents are to be encouraged to plant locally native species in their gardens and particularly avoid heavy nectar-bearing plants (such as *Grevillea*) in order to avoid dominance by the aggressive Noisy Miner.
- 16. All erosion and sediment controls are to be strictly observed during works.

The proposal is considered unlikely to result in a significant adverse impact for any matters of import. Thus no further assessment is required: neither a Species Impact Statement need be prepared under guidelines issued by the NSW Office of Environment and Heritage nor a referral to the Commonwealth Department of Environment need be pursued.

#### REFERENCES

- Beadle, N.C.W. (1981) The vegetation of Australia. (Gustav Fischer: Stuttgart)
- Beadle, N.C.W. and Costin, A.B. (1952) Ecological classification and nomenclature. *Proceedings of the Linnean Society of New South Wales* 77: 61-82.
- Bishop, T. (1996) Field Guide to the Orchids of New South Wales and Victoria. UNSW Press
- Blakers, M., Davies, S.J.J.F. and Reilly, P.N. (1984) The Atlas of Australian Birds. Globe Press Pty Ltd, Australia
- Churchill, S. (1998) Australian Bats. Reed New Holland, Sydney
- Clarence Valley Council (2010) Draft Comprehensice Koala Plan of Management for the Ashby, Woombah and Iluka localities of he Clarence Valley LGA
- Cogger, H. G. (2000) Reptiles and Amphibians of Australia. Reed New Holland, Sydney
- Department of Environment and Heritage (2006) EPBC Act Policy Statement 1.1 Significant Impact Guidelines Matters of National Environmental Significance. Commonwealth of Australia

Department of the Environment, Water, Heritage and the Arts (2009) Littoral Rainforest and Coastal Vine Thickets of Eastern Australia. EPBC Policy Statement 3.9

- EcoLogical Australia (2008). Editing Mitchell Landscapes, Final Report. A Report prepared for the Department of Environment and Climate Change.
- Environmental Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool [http://deh.gov.au/cgi\_bin/erin/ert/epbc] accessed November 2009
- Eurobodalla Shire Council (no date) Endangered Ecological Communities of the South East Corner Fact Sheet 9 – Littoral Rainforest
- Fairley, A. (2004) Seldom Seen Rare Plants of Greater Sydney. Reed New Holland: Sydney
- Floyd, A.G. (1990) Australian Rainforests in New South Wales. Volumes 1-2 (Surrey Beatty and Sons NSW National Parks and Wildlife Service: Sydney).

Forestry Commission of NSW (1989) Forest Types in New South Wales. Research Note 17. Gibbons, P. and Lindenmayer, D. (2002) *Tree Hollows and Wildlife Conservation in Australia*. CSIRO:Victoria

- Goldingay, R. L. (2011) Characteristics of tree hollows used by Australian arboreal and scansorial mammals. *Australian Journal of Zoology* 59:277–294
- Harden, G. (1990) (ed) Flora of New South Wales Vol. 1 NSW University Press
- Harden, G. (1991) (ed) Flora of New South Wales Vol. 2 NSW University Press
- Harden, G. (1992) (ed) Flora of New South Wales Vol. 3 NSW University Press
- Harden, G. (1993) (ed) Flora of New South Wales Vol. 4 NSW University Press
- Higgins, P.J. (ed) (1999) Handbook of Australian, New Zealand and Antarctic Birds. Vol 4: Parrots to Dollarbird (Oxford University Press)
- Kavanagh, R.P. and Peake, P. (1993) Survey procedures for nocturnal forest birds: An evaluation of the variability in census results due to temporal factors, weather and technique. Pp. 86-100 in *Australian Raptor Studies*, ed. by P. Olsen. Royal Australasian Ornithologists Union, Melbourne
- Lunney D, O'Neill L, Matthews A, Sherwin WB (2002) Modelling mammalian extinction and forecasting recovery: koalas at Iluka (Australia). *Biological Conservation* 106: 101-113
- McAlpine, C., Rhodes, J., Peterson, A., Possingham, H., Callaghan, J., Curran, T., Mitchell, D., and Lunney, D. (2007) Planning guidelines for koala conservation and recovery: A

guide to best planning practice. Australian Koala Foundation / Univeristy of Queensland

- Menkhorst, P and Knight, F. (2001) *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne
- Mitchell, P.B. (2002) NSW Ecosystems Study: Background and Methodology (Unpublished)
- Mitchell, P.B. (unpub). NSW ecosystems study: background and methodology. Unpublished report to the NSW National Parks and Wildlife Service, Hurstville.
- Morand, D.T. (2001a) Soil Landscapes of the Woodburn 1: 100,000 Sheet Report. Department of Land and Water Conservation, Sydney
- Morand, D.T. (2001b) Soil Landscapes of the Woodburn 1: 100,000 Sheet Map. Department of Land and Water Conservation, Sydney
- Morcombe, M. (2000) *Field guide to Australian Birds*. Steve Parish Publishing
- NSW National Parks and Wildlife Service (1997) Broadwater National Park Bundjalung National Park and Iluka Nature Reserve Plan of Management
- Pennay, M., Law, B. and Reinhold, L. (2004) Bat calls of NSW: Region based guide to the echolocation calls of Microchiropteran bats. NSW Department of Environment and Conservation, Hurstville.
- Phillips, S. and Callaghan, J. (2011) The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*. *Australian Zoologist* 35(3):774-780

Pizzey, G. and Knight, F. (1997) A Field Guide to the Birds of Australia. Angus and Robertson

- Scanlon, A.T. (2006) Factors affecting urban insectivorous bat activity and implications for habitat management in the city of Adelaide, South Australia. Bachelor of Applied Science Honours Thesis University of South Australia
- Scanlon, A.T. and Petit, S. (2008) Effects of site, time, weather and light on urban bat activity and richness: considerations for survey effort. *Wildlife Research* 35(8):821–834
- Scotts, D. (2003) Key habitats and corridors for forest fauna: A landscape framework for conservation in north-east New South Wales. NSW NPWS Occasional Paper 32, NSW National Parks and Wildlife Service, Sydney
- Simpson, K. and Day, N. (1999) Field Guide to the Birds of Australia. Sixth Edition. Penguin Books, Australia
- Slater, P., Slater, P. and Slater, R. (1995) The Slater Field Guide to Australian Birds. Lansdowne Publishing, Australia
- Somerville, D. (2002) Honey and Pollen Flora. *Agnote* DAI-115. NSW Department of Agriculture
- Somerville, M. (2009a) Hunter, Central and Lower North Coast Vegetation Classification and Mapping Project Volume 1: Vegetation Classification Technical Report. Hunter-Central Rivers Catchment Management Authority, Tocal, NSW.
- Specht, R.L., Specht, A., Whelan, M.B. and Hegarty, E.E. (1995) Conservation Atlas of Plant Communities in Australia. Southern Cross University Press, Lismore
- Strahan, R. (1994) *Cuckoos, Nightbirds and Kingfishers of Australia*. Angus and Robertson, Sydney
- Strahan, R. (1995) *Photographic guide to the Mammals of Australia*. Reed New Holland, Australia.

- Swan, G. (1990) *A field Guide to Snakes and Lizards of New South Wales.* Three Sisters Publishing
- Swan, G., Shea, G. and Sadlier, R. (2004) *A Field Guide to Reptiles of New South Wales*. Reed New Holland, Sydney

Tame, T. (1992) Acacias of South East Australia. Kangaroo Press Pty Ltd, Kenthurst

- Triggs, B. (1996) *Tracks, Scats and Other Traces: A Field Guide to Australian Mammals.* Oxford University Press: Melbourne
- Wright, R. (2010) Clarence Valley Council Biodiversity Management Strategy 2010