FIGURE 4 PROPOSED DEVELOPMENT FOOTPRINT

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1.3 PROPOSED DEVELOPMENT

The applicant proposes to demolish the existing buildings and infrastructure on the subject site and build holiday apartments. The conceptual footprints of the proposed holiday apartment blocks are shown in Figure 4.

Remnant trees that Scape Landscape Architects Pty Ltd (2006) recommends should be retained or removed are shown in Figure 4. It also recommends the planting of native tree species on the subject site, including melaleucas, she-oaks, turpentine, cabbage palms, forest red gums and bloodwood species.

There is an existing 15-m wide managed bushfire zone along the boundary between the subject site and Clarence Estuary Nature Reserve. An Asset Protection Zone 30 m in width will be established between the boundary of the reserve and proposed resort buildings.

The existing 20-m wide foreshore reserve between the river and the subject site will be retained. There may be the need for the removal of a few of the existing trees and pruning of canopy foliage of others in this reserve for bushfire management purposes.

1.4 STRUCTURE OF REPORT

This report comprises four chapters and two appendices. The contents of subsequent sections of the report are as follows:

Chapter 2 outlines the methods used to survey and assess key fauna habitats within the subject site. This includes reviews of databases and literature, and descriptions of survey techniques and survey effort for fauna species, including threatened species.

Chapter 3 describes the existing fauna and their habitats within the subject site and their overall conditions and conservation significance.

Chapter 4 identifies potential impacts of the proposed development on the status of native fauna and their habitats. It also recommends appropriate measures for avoiding or minimising impacts on fauna and their habitats that may occur as a result of the proposed development.

Appendix A displays plates depicting the subject site and adjacent areas.

Appendix B presents Seven-Part Tests of Significance for threatened and regionally significant fauna species and populations that would be potentially impacted on by the proposed development

Appendix C shows an appropriately-design nest box for microchiropteran bats.

2

METHODOLOGY

2.1 OVERVIEW

Fauna issues relating to the application for development of the subject site were identified by reviewing relevant literature and databases and conducting field surveys. The methods by which this information was collected and analysed are presented below.

2.2 EXISTING RECORDS

Existing literature relevant to the study area, in particular technical environmental reports produced by NPWS, other consultancies and Clarence Valley Council, were reviewed to determine the presence of terrestrial and aquatic habitats, and fauna species of conservation significance, within the locality (a 5 km radius around the subject site).

Records of threatened fauna species, listed under the schedules of the TSC and EPBC Acts and species of regional conservation significance, were obtained from databases for the Clarence Valley LGA.

The databases searched were:

- NPWS Wildlife Atlas Database;
- NSW Field Ornithologists' Club Atlas Database;
- Birds Australia Atlas Database (1977-81) and (1998 onwards);
- EPBC database; and
- Australian Museum specimen collection database.

These databases only contain indicative records of fauna species in the locality and are not the result of a systematic fauna survey. Database records for individual species will vary in quality, reliability and accuracy of the geographic co-ordinates. Therefore, some species records are highly accurate in space and time such as the Birds Australia Atlas Database and the Australian Museum Specimen Collection Database. However, others are more tentative or only contain estimates of geographical locations, for instance, records from the NPWS Wildlife Atlas Database have a limited accuracy based on a 1 km^2 recording grid.

2.3 TAXONOMY

The following references were used to identify and classify animal groups:

- birds - Simpson & Day (1998); Christidis & Boles (1994);
- mammals (excluding bats) - Cronin (2000c), Menkhorst & Knight (2001),
- bats - Richards and Hall (1993), Reinhold *et al*. (2001) Pennay *et al*. (2004); and
- amphibians - Cogger (2000), Anstis (2002);
- reptiles – Cogger (2000), Cronin (2001), Swan *et al*. (2004).

2.4 FIELD SURVEY

2.4.1 Overview

Purcell *et al*. (2005) conducted a comprehensive fauna survey of the subject site and adjoining areas in September 2005. The results of that survey are used to assess the conservation value of the subject site for native fauna and the impacts of the proposed development.

A supplementary fauna survey, involving both diurnal and nocturnal survey time, was conducted on 26 & 27 October 2006 as part of the present study. The subject site and the adjoining areas of the Clarence Estuary Nature Reserve and the Clarence River were surveyed as part of the supplementary survey.

2.4.2 Fauna Habitat Assessment and Survey

(a) Fauna Habitat Assessment

It was not possible to determine with certainty all the fauna that utilise habitats on the subject site and adjoining areas. This is because of the likely seasonal occurrences of some fauna species, the occasional occurrence of vagrant species, and because some species are difficult to detect because of their timid or cryptic behaviour. Therefore, fauna investigations comprised an assessment of fauna habitats present on the site and in adjoining areas, and an indication of their potential to support native wildlife populations and, in particular, threatened species.

The assessment criteria included:

Mammals:	extent of ground cover, shrub layer and tree canopy, hollow-bearing trees, substrate type (for burrowing etc), evidence such as droppings, diggings, footprints, scratches on trees, nests, burrow paths and runways.
Terrestrial Birds:	structural features such as the extent and nature of the canopy, understorey and ground strata and flowering characteristics, bird species.
Estuarine Birds:	extent of mudflats during the tidal cycle, distribution and abundance of mangroves, extent and depth of open water, presence of canopy trees along shoreline that are suitable as nesting, roosting & refuge sites.
Reptiles and Amphibians:	cover, shelter, suitable substrate, basking and breeding site availability. Reptiles and frogs sought in likely sheltering places.
Invertebrates	logs and other debris, leaf and bark accumulations around bases of trees, grass clumps, loose soil for burrowing.
Wildlife Corridor Values	Importance of the creek systems and riparian vegetation as movement corridors for fauna, especially birds, aquatic fauna, mammals (e.g. microchiropteran bats) & amphibians.

(b) Fauna Survey

An active search for fauna species on the subject site and in adjoining areas was conducted from:

- 1230 to 1830 hrs on 26 October 2006;
- 2030 hrs on 26 October to 0130 hrs on 27 October 2006; and
- 0530 to 0830 hrs on 27 October 2006.

Weather conditions were recorded during the time of the survey. In addition to fauna habitat assessment, the results of systematic surveys and incidental sightings of terrestrial vertebrates were used to determine faunal assemblages on the subject site. These techniques are described in greater detail below:

(i) Terrestrial Bird Surveys

Within treed areas, area searches for birds were conducted in which the observer walked at random through the remnant, stopping at will, with a search effort equivalent to a 2 ha coverage over a 30-minute period. All bird species that were observed or heard during the survey were noted. Opportunistic observations of birds within the subject site and adjoining areas were also recorded.

Owl presence was investigated at night (26 October 2006) by playing the calls of owls that could potentially occur in the locality and subsequently searching for owls that may be responding to these calls. Calls of Grass Owls, Masked Owls and Barking Owls were broadcast during the owl surveys.

(ii) Estuarine Bird Surveys

The high- and low-tide times along the Clarence River during the supplementary field survey were at 1347 hrs on 26 October and 0036 hrs on 27 October, respectively. Mudflats that were potential foraging grounds for migratory shorebirds, ibises, herons & egrets were covered at the high-tide time and did not begin to be exposed until after 1530 hrs. Therefore, observations of birds foraging on the mudflats in parts of the river adjoining the subject site and neighbouring Clarence Estuary Nature Reserve were conducted at the following times: 1530 to 1600 hrs; 1630 to 1700 hrs; 1730 to 1800 hrs, 2130 to 2200 hrs on 26 October, and 0100 to 0130 hrs on 27 October. The latter two surveys were conducted with the aid of a spotlight because it was after dark.

(ii) Reptiles and Amphibians

Reptiles and amphibians were identified using indirect observation methods. Species were searched for in fallen logs, suitable rock basking substrates and underneath other fallen material. During the nocturnal survey, responses to playback recordings, together with spotlighting, helped identify frog species that could have potentially occurred in water-logged areas of the subject site.

(iii) Microchiropteran Bats

Microchiropteran bats often fly through woodland or forest habitats by moving along creeks and open areas of forest. They are most easily detected around dusk when they emerge from their day-time roosts and begin to actively forage for food.

Three stationery Anabat II Bat Detectors (Titley Electronics) were placed in locations within the subject site from 1700-1730 hrs on 26 October 2006 (starting time) to 0500-0530 hrs on 27 October 2006 (finishing time). The detectors were placed in the following locations where microbats could potentially occur and where the detectors were least likely to be tampered with or taken by members of the public:

- treed area near the north-western corner of the subject site (Map Area 10 in Figure 3);
- mid-way along the bushfire trail along the boundary between the subject site and the Clarence Estuary Nature Reserve; and
- under the clump of Broad-leaved Paperbarks near the south-eastern corner of the subject site. The microphone was orientated to maximise the possibility of detection of microbats flying through or over the tree canopy along the river foreshore.

A hand-held Anabat II Bat Detector (Titley Electronics) was also used on the subject site during the spotlighting surveys for nocturnal mammals and birds. These surveys were conducted from 2030 to 2130 hrs and 2215 to 2400 hrs on 26 October 2006. All treed and open areas of the subject site were surveyed during the hand-held detector surveys.

Bat calls that are recorded during surveys are routinely identified with the assistance of Anabat 6.3 Software (devised by Mr Chris Corben and Titley Electronics), Richards *et al*. (1993), Reinhold *et al*. (2001) and Pennay et al. (2004).

(iv) Other Mammals

Opportunistic observations were recorded if mammals were seen at night during spotlighting surveys and during the day when searching for other fauna.

2.2.2 Species of Conservation Significance

Native fauna species and populations considered threatened in New South Wales are listed in Schedules 1 and 2 of the *Threatened Species Conservation (TSC) Act 1995*. A Seven-Part Test was conducted for all those threatened species detected on a site or for those considered to potentially occur there due to the availability of habitat.

2.3 ASSESSMENT OF CONSERVATION VALUE

2.3.1 Conservation Value Parameters

The conservation value of fauna habitats on the subject site was determined by reference to the following criteria:

- *representativeness* - whether the vegetation communities of the site are unique, typical or common in the bioregion. In addition, the criteria takes into account whether or not such vegetation units are presently held in conservation reserves;

- the presence of threatened or regionally significant species on the site;

- The extent of human influence on the natural environment of the site and the condition of habitats (e.g. the presence of weeds, fire frequency etc.);

- the uniqueness of the natural values of the site;

- the amount of native vegetation to be cleared or modified by the proposed development in relation to what remnant vegetation will remain in the locality; and

- the relative importance of a site as a corridor for the movement of wildlife.

2.4 KOALA HABITAT ASSESSMENT

An assessment of Koala habitat on the subject site, according to the *State Environment Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44), was completed on 26-27 October 2006 as part of the overall fauna survey and assessment.

It is necessary to identify whether the site consists of *potential* and/or *core* Koala habitat as defined under SEPP 44 when seeking development consent in local government areas to which the policy applies.

Potential Koala habitat is defined as "*areas of native vegetation where the trees of the types listed in Schedule 2 (of SEPP 44) constitute at least 15% of the total number of trees in the upper or lower strata of the tree compone*nt". Trees listed in Schedule 2 are presented in Table 2.1

Core Koala habitat means "*an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings and historical records of a Koala population*". The subject site in the present study is not Potential or Core Habitat according to these definitions.

Table 2.1 TREES LISTED IN SCHEDULE 2 OF SEPP 44

Scientific Name	Common Name
Eucalyptus albens	White Box
Eucalyptus camaldulensis	River Red Gum
Eucalyptus haemastoma	Broad-leaved Scribbly Gum
Eucalyptus microcorys	Tallowwood
Eucalyptus populnea	Bimble Box
Eucalyptus punctata	Grey Gum
Eucalyptus robusta	Swamp Mahogany
Eucalyptus signata	Scribbly Gum
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus viminalis	Ribbon Gum

3

RESULTS

3.1 OVERVIEW

This chapter describes the native fauna and their habitats on the subject site. It describes the fauna habitats that are present on the site, assesses their conservation values and discusses the possibility of threatened and locally significant species occurring there.

3.2 VEGETATION COMMUNITIES

The floristic diversity and structure of vegetation communities on the subject site and adjacent areas are described in detail by Purcell *et al*. (2005) and Clements *et al*. (2006)

3.3 FAUNA PARAMETERS

3.3.1 Fauna Habitats

(a) Subject Site

The highly modified nature of the landscape of the subject site means that it has limited value as habitat for native fauna other than species that are tolerant of urban landscapes. This is despite the close proximity of the subject site to conservation reserves.

The canopies of remnant and planted trees on the subject site have the potential of producing seeds, nectar and/or fruits for nectarivorous and frugivorous birds and arboreal mammals, and foraging substrates for insectivorous birds and microchiropteran bats. It also provides potential nesting and/or roosting sites for common native birds (e.g. parrots and cockatoos, kookaburras, honeyeaters, corvids and artamids) and for some arboreal mammals (e.g. possums). A nocturnal roost of over 100 Rainbow Lorikeets (*Trichoglossus haematodus*) was observed in planted palm trees near the centre of the subject site on 26 October 2006.

Only three trees on the subject site were observed with hollows that are large enough to be used as roosting and breeding habitat and shelter by microchiropteran bats, hollow-dependent birds (e.g. cockatoos and parrots), some arboreal mammals (e.g. gliders, possums) and reptiles. Two of these trees were Broad-leaved Paperbarks outside Cabin DV 5 (see Figure 3 for location) and the third hollow-bearing tree was a mature Coast Banksia, which was located mid-way along the river foreshore reserve.

The scarcity of tree hollows on the subject site is due largely to past habitat clearance, and removal of some limbs and branches from existing trees on the subject site that had structural defects.

The lawned areas of the subject site provide potential foraging habitat for common ground-foraging bird species, such as Masked Lapwings (*Vanellus miles*), Galahs (*Cacatua roseicapilla*), Australian Pipits (*Anthus australis*), Magpie-larks (*Grallina cyanoleuca*) and

Australian Magpies (*Gymnorhina tibicen*). Small raptors such as Australian Kestrels (*Falco cenchroides*) and Black-shouldered Kites (*Elanus notatus*) may also forage for small lizards and large ground-dwelling insects in these areas.

(b) Clarence Estuary Nature Reserve

Forested areas of this reserve are extremely important as habitat for local fauna species that inhabit swamp sclerophyll forest and mangrove areas. All layers of vegetation and fauna habitats in this reserve, especially along the boundary with the subject site, must be protected against impacts from the proposed development.

(c) Clarence River Shoreline

The exposed mudflats are important feeding grounds for migratory shorebirds, oystercatchers, egrets, herons and ibis. The deeper waters are important feeding grounds for seabirds (e.g. terns, cormorants and gulls) and potential feeding grounds for coastal raptors such as Ospreys (*Pandion haliaetus*), White-bellied Sea-Eagles (*Haliaeetus leucogaster*) and Brahminy Kite (*Haliastur indus*).

Extensive mangrove areas occur along the Clarence River, including along the bank of the Clarence Estuary Nature Reserve, but not along the foreshore along the eastern boundary of the subject site. Mangroves are important spawning grounds for fish and feeding areas for estuarine birds and fish. Mature mangrove trees provide important nesting, roosting and refuge sites for estuarine birds.

3.3.2 Fauna

The weather conditions at the time of the fauna surveys are shown in Table 3.1.

Table 3.1 **WEATHER CONDITIONS DURING SURVEY PERIODS**

Survey Period	Temp Range (°C)	Wind	Cloud Cover	Other Comments
1200 – 1800 hrs, 26 October 2006	20-22	Light- moderate	100%	High humidity, no rain
1800 – 2400 hrs 26 October 2006	18-20	Light-moderate	100%	Moderate rainfall in first hour of survey.
0000 – 0130 hrs 27 October 2006	17-18	Light	100%	Moderate humidity, No rain.
0530 –0830 hrs 27 October 2006	17-19	Light-moderate	90%	High humidity, no rain.

Bird activity was subdued during the latter half of the afternoon on 26 October 2006 as a result of increasing humidity and approaching storm, which would have made it difficult to detect some bird species. However, birds were very active during the survey times the following morning as a result of the passing of the previous night's storm and cooler conditions, which made most species relatively easy to detect.

Moderate rainfall fell from 1715 to 1900 hrs on 26 October 2006, which may have also reduced microbat activity in the first part of the evening.

Ninety-two (92) fauna species have been recorded on the subject site, Clarence Estuary Nature Reserve or along the adjoining stretch of the Clarence River (Table 3.2). Purcell *et al*. (2005) did not differentiate between species observed on the subject site and the adjoining areas, whereas this was done in the fieldwork conducted on 26-27 October 2006. In this latter survey period, 34 species were recorded in the Clarence Estuary Nature Reserve (50.0% of total species recorded), 14 species in the Clarence River (20.6%) and 30 species on the subject site (44.1%).

Three threatened bat species, the Grey-headed Flying-fox (*Pteropus poliocephalus*), East Coast Freetail-bat (*Mormopterus norfolkensis*) and Eastern Bentwing-bat (*Miniopterus schreibersii*) have been recorded on the subject site. The remainder of the species that have been recorded on the subject site are urban-tolerant species that are very common within the locality.

Many fauna species that have been recorded in the Clarence Estuary Nature Reserve, particularly the small forest birds, would not use the subject site because of the:

- highly modified nature of the subject site's landscape, most notably, the lack of an understorey and shrub layer and the past removal of most of the remnant trees;
- scarcity of tree hollows;
- relatively high densities of Noisy Miners (*Manorina melanocephala*) and Rainbow Lorikeets (*Trichoglossus haematodus*) on the subject site. Noisy Miners are aggressive and, when in high enough numbers, competitively exclude other fauna species from using the immediate area. Rainbow Lorikeets are noisy and aggressive and can also deter other species from using an area when in high enough numbers.
- high level of human activity on the subject site.

In contrast, the Clarence Estuary Nature Reserve has a range of fauna habitats, including intact canopy, understorey, shrub and groundcover layers, and natural water bodies. The vegetation is too dense for it to be used by Noisy Miners and Rainbow Lorikeets, but is suitable for a broad range of wet forest species.

3.3.3 Threatened Fauna Species & Populations

Overview

Threatened fauna species that have been detected in the locality, their habitat requirements, and their likelihood of occurring on the subject site are shown in Table 3.3.

Subject Site

Three threatened bat species, the Grey-headed Flying-fox (*Pteropus poliocephalus*), East Coast Freetail-bat (*Mormopterus norfolkensis*) and Eastern Bentwing-bat (*Miniopterus schreibersii*) have been recorded on the subject site.

Table 3.2 **FAUNA SPECIES RECORDED ON THE SUBJECT SITE OR ADJOINING AREAS**

Legend:
Purcell *et al*. (2005): Combined species list for Subject Site, Clarence Estuary Nature Reserve and Clarence River reserve.
CENR: Clarence Estuary Nature Reserve.
CR: Clarence River (adjacent to subject site).
E: Endangered Species under the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environmental Protection & Biodiversity Conservation Act, 1999*.
V: Vulnerable Species under the NSW *Threatened Species Conservation Act, 1995* and/or Commonwealth *Environmental Protection & Biodiversity Conservation Act, 1999*..
R: Regionally significant species.
J: Listed on the Japanese and Australian Migratory Bird Agreement (JAMBA).
C: Listed on the Chinese and Australian Migratory Bird Agreement (CAMBA).
* Exotic (introduced) species.

Family	Scientific Name	Common Name	Conservation Status	Purcell *et al*. (2005)	Present Study		
					CENR	CR	Subject Site
REPTILES							
Varanidae	*Varanus varius*	Lace Monitor			X		
Scincidae	*Lampropholis delicata*	Garden Sun-skink		X			X
BIRDS							
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican		X		X	X
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant		X		X	
	Phalacrocorax melanoleucos	Little Pied Cormorant		X			
Anseranatidae	*Cygnus atratus*	Black Swan		X			
Anatidae	*Chenonetta jubata*	Australian Maned Duck		X		X	X
	Anas superciliosa	Pacific Black Duck		X		X	
Ardeidae	*Ardea alba*	Great Egret	R, J, C	X			
	Egretta novaehollandiae	White-faced Heron		X		X	
	Nycticorax caledonicus	Nankeen Night-Heron		X	X		
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis		X	X	X	X

Family	Scientific Name	Common Name	Conservation Status	Purcell *et al.* (2005)	Present Study		
					CENR	CR	Subject Site
	Threskiornis spinicollis	Straw-necked Ibis		X			
Charadriidae	*Vanellus miles*	Masked Lapwing		X	X	X	X
Scolopacidae	*Limosa lapponica*	Bar-tailed Godwit	J, C	X		X	
	Numenius phaeopus	Whimbrel	J, C	X		X	
	Numenius madagascariensis	Eastern Curlew	J, C	X		X	
Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	V	X		X	
Laridae	*Larus novaehollandiae*	Silver Gull		X		X	X
	Sterna caspia	Caspian Tern	J	X			
	Sterna bergii	Crested Tern		X		X	
Accipitridae	*Pandion haliaetus*	Osprey	V	X			
	Haliaeetus leucogaster	White-bellied Sea-eagle	R, C	X			
	Accipiter fasciatus	Brown Goshawk		X			
	Haliastur sphenurus	Whistling Kite		X			
	Haliastur indus	Brahminy Kite	R	X		X	
	Elanus axillaries	Black-shouldered Kite		X			X
Columbidae	*Streptopelia chinensis* *	Spotted Turtledove		X	X		X
	Ocyphaps lophotes	Crested Pigeon		X	X		X
	Geopelia humeralis	Bar-shouldered Dove		X	X		
	Leucosarcia melanoleuca	Wonga Pigeon		X			
Cacatuidae	*Cacatua roseicapilla*	Galah		X			X
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet		X			X
	Glossopsitta pusilla	Little Lorikeet		X	X		
	Glossopsitta concinna	Musk Lorikeet		X	X		
	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet		X			X
	Afsterus scapularis	Australian King-Parrot		X	X		X
	Platycercus eximius	Eastern Rosella		X	X		
Podargidae	*Podargus strigoides*	Tawny Frogmouth		X			X

Family	Scientific Name	Common Name	Conservation Status	Purcell *et al.* (2005)	Present Study		
					CENR	CR	Subject Site
Cuculidae	*Chrysococcyx lucidus*	Shining Bronze-cuckoo		X	X		
Halcyonidae	*Dacelo novaeguinea*	Laughing Kookaburra		X			X
	Todiramphus sanctus	Sacred Kingfisher		X			
Meropidae	*Merops ornatus*	Rainbow Bee-eater	J, C	X	X		
Meliphagidae	*Manorina melanocephala*	Noisy Miner		X			X
	Entomyzon cyanotis	Blue-faced Honeyeater		X	X		
	Anthochaera chrysoptera	Little Wattlebird		X			X
	Philemon corniculatus	Noisy Friabird		X	X		X
	Meliphaga lewinii	Lewin's Honeyeater		X	X		
	Melithreptus albogularis	White-throated Honeyeater		X			
	Lichenostomus fasciogularis	Mangrove Honeyeater	V	X			
	Lichmera indistincta	Brown Honeyeater	R	X			
	Myzomela sanguinolenta	Scarlet Honeyeater		X			
	Plectorhynchia lanceolata	Striped Honeyeater		X	X		
Cinclosomatidae	*Psophodes olivaceus*	Eastern Whipbird		X	X		
Maluridae	*Malurus lamberti*	Variegated Fairy-wren		X	X		
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill		X	X		
	Acanthiza lineata	Striated Thornbill			X		
	Sericornis magnirostris	Large-billed Scrubwren		X	X		
	Sericornis frontalis	White-browed Scrubwren		X	X		
Pardalotidae	*Pardalotus striatus*	Striated Pardalote		X	X		
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin		X	X		
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler		X			
	Pachycephala pectoralis	Golden Whistler		X	X		
	Colluricincla harmonica	Grey Shrike-thrush		X	X		
Dicruridae	*Rhipidura fuliginosa*	Grey Fantail		X	X		
	Rhipidura rufifrons	Rufous Fantail		X	X		
	Rhipidura leucophrys	Willie Wagtail		X			X

Family	Scientific Name	Common Name	Conservation Status	Purcell *et al.* (2005)	Present Study		
					CENR	CR	Subject Site
	Grallina cyanoleuca	Magpie-lark		X			X
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike		X			
Hirundinidae	*Hirundo neoxena*	Welcome Swallow		X			X
Campephagidae	*Lalage leucomela*	Varied Triller		X			
Oriolidae	*Sphecotheres vielloti*	Australasian Figbird		X	X		X
	Oriolus sagittatus	Olive-backed Oriole		X			
Artamidae	*Artamus leucorhynchus*	White-browed Woodlswallow		X			
	Cracticus torquatus	Grey Butcherbird		X			X
	Strepera graculina	Pied Currawong		X			X
	Gymnorhina tibicen	Australian Magpie		X			X
Corvidae	*Corvus orru*	Torresian Crow		X	X		X
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird		X	X		
Zosteropidae	*Zosterops lateralis*	Silvereye		X	X		
Estrildidae	*Neochmia temporalis*	Red-browed Firetail Finch		X			
MAMMALS							
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum					X
Macropodidae	*Wallabia bicolor*	Swamp Wallaby		X			
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	X			
Molossidae	*Mormopterus norfolkensis*	Eastern Freetail-bat	V	X			X
Verspertilionidae	*Miniopterus schreibersi*	Eastern Bentwing-bat	V	X			
	Chalinolobus gouldii	Gould's Wattled Bat		X			X
	Scotorepens orion	Eastern Broad-nosed Bat		X			X
Muridae	*Rattus rattus* *	Black Rat		X			
Leporidae	*Oryctolagus cuniculus* *	European Rabbit			X		
INVERTEBRATES							
Camaenidae	*Sphaerospira fraseri*	Fraser's Snail		X			
Pieridae	*Delias nigrina*	Common Jezebel		X			

Table 3.3 THREATENED FAUNA SPECIES RECORDED WITHIN LOCALITY (5 KM OF SUBJECT SITE)

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven-Part Test Required?
AMPHIBIANS					
Crinia tinnula	Wallum Froglet		V	Occurs in acid *Melaleuca* swamps and wallum areas with poor drainage. No suitable habitat on subject site or adjoining areas.	No
Litoria olongburensis	Oblongburra Frog	V*	V	Occurs around a variety of water bodies where there is adequate fringing vegetation to provide cover, especially sand dune lakes and wallum creeks; mostly in areas of sandy soils where the water tends to be acidic. No suitable habitat on subject site or adjoining areas.	No
REPTILES					
Caretta caretta	Loggerhead Turtle	E*	E	Tropical and warm temperate ocean waters, where it feeds on jellyfish, molluscs and crustaceans. No suitable habitat on subject site or adjoining areas.	No
Chelonia mydas	Green Turtle	V*	V	Tropical and warm temperate ocean waters where it feeds on seagrasses. Known to lay eggs on beaches on the far north coast of NSW, but not known if eggs hatched successfully. No suitable habitat on subject site or adjoining areas.	No
BIRDS					
Dromaius novaehollandiae	Emu (north-coast population)		EP	An isolated population that occurs in the NSW North Coast Bioregion and the Port Stephens LGA. Occurs in a range of predominantly open habitats, including plains, grasslands, woodlands and shrubs, and may occur occasionally in forest. Unlikely to occur on subject site and adjoining areas.	No
Thalassarche melanophris	Black-browed Albatross		V	Oceanic waters along the southern half of the Australian coastline and in the Southern Ocean. No suitable habitat on subject site or adjoining areas.	No
Phaethon rubricauda	Red-tailed Tropicbird		V	Tropical and sub-tropical seas. No suitable habitat on subject site or adjoining areas.	No
Ephippiorhynchus asiaticus	Black-necked Stork		E	River pools, swamps, tidal flats. Unlikely to occur on the subject site or adjoining areas.	No
Hamirostra melanosternom	Black-breasted		V	Occurs in arid scrub, riverine and tropical woodland in inland areas of	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven-Part Test Required?
	Buzzard			NSW. Vagrants may very occasionally reach coastal areas of NSW if there is an irruption of inland populations after successful breeding associated with the breaking of prolonged dry weather events. Unlikely to occur on the subject site or adjoining areas.	
Lophoictinia isura	Square-tailed Kite		V	Open forests, riverine woodland, scrubs and heathland. No suitable habitat on subject site or adjoining areas.	No
Pandion haliaetus	Osprey		V	Occurs in mangroves, around rivers and estuaries, inshore seas and on offshore islands. Unlikely to occur on the subject site, but has been observed foraging for fish in the estuary. Potential nest sites occur in the Clarence Estuary Nature Reserve.	Yes
Calidris alba	Sanderling		V	Occurs on sandy coastal beaches. Unlikely to occur on subject site or adjoining areas.	No
Calidris tenuirostris	Great Knot		V	Found on tidal sands and mudflats. May occasionally occur on the Clarence River estuarine mudflats, adjoining the subject site.	Yes
Limicola falcinellus	Broad-billed Sandpiper		V	Favours estuarine mudflats, salt marshes and reefs as feeding and roosting habitat. Occasionally recorded in sewage farms and within shallow freshwater lagoons. Prefers intertidal mudflats where there are areas of soft mud on the seaward side of mangroves. May occasionally occur on the Clarence River estuarine mudflats, adjoining the subject site.	Yes
Limosa limosa	Black-tailed Godwit		V	Found on tidal mudflats and inland wetlands. May occasionally occur on the Clarence River estuarine mudflats, adjoining the subject site.	Yes
Xenus cinereus	Terek Sandpiper		V	Found on tidal mudflats and beaches. May occasionally occur on the Clarence River estuarine mudflats, adjoining the subject site.	Yes
Burhinus grallarius	Bush Stone-curlew		E	Open woodland, often near beaches. No suitable habitat on subject site or adjoining areas.	No
Esacus negelctus	Beach Stone-curlew		E	Reefs, beaches and coastal mudflats. Observed on Dart and Hickey Islands in Clarence River estuary.	Yes
Haematopus fuliginosus	Sooty Oystercatcher		V	Usually occurs around exposed rocky parts of wave-cut shore platforms, on rocky promontories and stony beaches. No suitable habitat on subject site or adjoining areas.	No
Haematopus longirostris	Pied Oystercatcher		V	Occurs on ocean beaches and coastal estuaries around Australia. Often seen feeding in estuaries at low tide when rich beds of marine animals	Yes

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven-Part Test Required?
				are uncovered. Observed foraging in mudflats adjacent to the subject site.	
Charadrius leschenaultii	Greater Sand Plover		V	Occurs on ocean beaches and coastal estuaries around Australia. May occasionally occur on the Clarence River estuarine mudflats, adjoining the subject site.	Yes
Charadrius mongolus	Lesser Sand Plover		V	Occurs on ocean beaches and coastal estuaries around Australia. May occasionally occur on the Clarence River estuarine mudflats, adjoining the subject site.	Yes
Sterna albifrons	Little Tern		E	Forages along the coast and in estuaries. Australian populations breed on sandy beaches and spits. May occasionally feed in the Clarence River, adjacent to the subject site.	Yes
Ptilinopus magnificus	Wompoo Fruit-Dove		V	Occurs in rainforest. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Ptilinopus regina	Rose-crowned Fruit-Dove		V	Occurs in rainforest, monsoon and paperbark forests, mangroves, eucalypt woodland, vine groves and in fruit trees. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Calyptorhynchus lathami	Glossy Black-Cockatoo		V	Eucalypt forests of eastern Australia. Feeds exclusively on *Allocasuarina* (sheoak) seeds, particularly *A. littoralis* and *A. torulosa.* Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Ninox strenua	Powerful Owl		V	Wet sclerophyll forest along coast hills and Great Dividing Range. More recently observed in urban areas where they search for common prey items such as possums and flying foxes. No suitable habitat on subject site or adjoining areas.	No
Lichenostomus fasciogularis	Mangrove Honeyeater		V	Occurs in mangrove forests. Has been recorded in the Clarence Estuary Nature Reserve, but not the subject site. The proposed development will not impact on this habitat.	No
Pomatostomus temporalis	Grey-crowned Babbler		V	Occurs in drier, more open forest, scrubby woodland, trees along road verges, etc. No suitable habitat on subject site or in adjoining areas.	No
Monarcha leucotis	White-eared Monarch		V	Occurs in rainforests and mangroves. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven-Part Test Required?
				development will not impact on this habitat.	
Coracina lineata	Barred Cuckoo-shrike		V	Occurs in rainforest and open forest. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
MAMMALS					
Dasyurus maculatus	Spotted-tailed Quoll	V*	V	Wet and dry sclerophyll forests, rainforests, woodlands and coastal heaths. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Phascogale tapoatafa	Brush-tailed Phascogale		V	Sparsely distributed outside the semi-arid zone in dry sclerophyll forest and monsoonal forest and woodland. No suitable habitat on subject site or adjoining areas.	No
Planigale maculata	Common Planigale		V	Occurs in rainforest and wet sclerophyll forest. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Phascolarctus cinereus	Koala		V	Eucalypt forests and woodlands. No core or potential foraging or roosting habitat on the subject site. Highly unlikely to occur in the study area as a result of the past history of clearing in the suburb.	No
Petaurus australis	Yellow-bellied Glider		V	Wet and dry eucalypt forests and woodlands, often in mountainous areas. No suitable habitat on subject site or adjoining areas.	No
Petaurus norfolcensis	Squirrel Glider		V	Occurs mostly in dry sclerophyll forest on inland slopes and nearby riverine corridors; also occurs in damp coastal eucalypt/banksia forest and woodland. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Pteropus alecto	Black Flying-fox		V	Common in tropical and sb-tropical forests and woodlands around the north coast of Australia. Camps formed in mangroves, paperbark forest and rainforest. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Pteropus poliocephalus	Grey-headed Flying-fox		V	Wet and dry sclerophyll forests, rainforests, paperbark swamps and mangroves to 700 m elevation. At least one individual observed on the subject site.	Yes

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven-Part Test Required?
Syconycteris australis	Eastern Blossom Bat		V	Roosts in rainforest and forages in a variety of habitats including rainforest, tropical woodland and heathland. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Mormopterus norfolkensis	East Coast Freetail Bat		V	Sclerophyll forests, woodlands and, occasionally, rainforests. Detected on the subject site by Anabat recording.	Yes
Chalinolobus nigrogriseus	Hoary Wattle Bat		V	Occurs in a range of habitats, including vine forest, tropical savannah, dry sclerophyll forest and coastal scrub. May potentially forage on the subject site.	Yes
Miniopterus australis	Little Bentwing-bat		V	Found in rainforest, wet and dry sclerophyll forests, woodland and grasslands. Roosts in culverts and mines. May potentially forage on the subject site.	Yes
Miniopterus schreibersii	Eastern Bent-wing Bat		V	From Kimberly to the Top End and from Cape York Peninsula on eastern side of the Great Dividing Range through to the south-east corner of South Australia. Found in rainforest, wet and dry sclerophyll forests, woodland and grasslands. Roosts in culverts and mines. Detected on the subject site by Anabat recording.	Yes
Myotis adversus	Large-footed Mouse-eared Bat		V	Forages on fish and insects from the permanent freshwater rivers, dams and creeks of coastal eastern and northern Australia. The species makes maternity roosts in caves close to freshwater, under bridges and buildings and other such structures, and among dense foliage and pandanus leaves. Its preferred natural habitats are sclerophyll forests, mangroves, paperbark swamps, woodlands and rainforests near slow-flowing creeks, lakes and estuaries. May potentially forage on subject site.	Yes
Nyctophilus bifax	Northern Long-eared Bat		V	Usually found in wet forest including rainforest, monsoon forest and riparian forest, sometimes in dry sclerophyll forest and woodland. In NSW, known only from rainforest. Potential habitat in the Clarence Estuary Nature Reserve, but not on the subject site. The proposed development will not impact on this habitat.	No
Scoteanax ruepellii	Greater Broad-nosed Bat		V	Found in sclerophyll forests, rainforests, woodlands and moist gullies below 500 m above sea level. Potential foraging habitat within forested area of subject site. Not detected on subject site.	Yes

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven-Part Test Required?
Dugong dugon	Dugong			Occurs in sheltered coastal areas and estuaries of northern Australia. No suitable habitat on subject site or in adjoining areas.	No
Physeter macrocephalus	Sperm Whale			Occurs in deep water off the continental shelves. No suitable habitat on subject site or in adjoining areas.	No

Notes: Habitat requirements for birds taken from Simpson & Day (2004).
Habitat requirements for reptiles and amphibians taken from Cogger (2000) and Cronin (2001).
Habitat requirements for mammals taken from Cronin (2000b) and Menkhorst & Knight (2001).
** = Listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).*
E1 = Endangered under Schedule 1 of the NSW Threatened Species Conservation Act 1995 (TSC Act).
E4 = Presumed Extinct under Schedule 1 of the NSW Threatened Species Conservation Act 1995 (TSC Act).
E1 = Endangered under Schedule 1 of the TSC Act and EPBC Act.*
E4 = Presumed Extinct under Schedule 1 of the NSW Threatened Species Conservation Act 1995 (TSC Act).*
V = Vulnerable under Schedule 2 of the TSC Act.
V = Vulnerable under Schedule 2 of the TSC Act and EPBC Act.*

Potential habitat also occurs for the following threatened species: Osprey (*Pandion haliaetus*), Hoary Wattle Bat (*Chalinolobus nigrogriseus*), Little Bentwing-bat (*Miniopterus australis*), Large-footed Mouse-eared Bat (*Myotis adversus*) and Greater Broad-nosed Bat (*Scoteanax ruepelli*).

The potential impacts of the proposed development on these fauna are discussed in Chapter 4 and Appendix B.

Clarence River

Two threatened species, the Osprey and Pied Oystercatcher (*Haematopus longirostris*), have been observed in the section of the Clarence River that adjoins the subject site.

Potential habitat also occurs for the following threatened species: Great Knot (*Calidris tenuirostris*), Broad-billed Sandpiper (*Limicola falcinellus*), Black-tailed Godwit (*Limosa limosa*), Terek Sandpiper (*Xenus cinereus*), Beach Stone-curlew (*Esacus neglectus*), Greater Sand Plover (*Charadrius leschenaultii*), Lesser Sand Plover (*Charadrius mongolus*) and Little Tern (*Sterna albifrons*).

The potential impacts of the proposed development on these fauna are discussed in Chapter 4 and Appendix B.

Clarence Estuary Nature Reserve

One threatened species, the Mangrove Honeyeater (*Lichenostomus fasciogularis*) has been recorded in the Clarence Estuary Nature Reserve.

Potential habitat also occurs for the following threatened species: Osprey, Wompoo Fruit-Dove (*Ptilinopus magnificus*), Rose-crowned Fruit-Dove (*Ptilinopus regina*), Glossy Black-Cockatoo (*Calyptorhynchos lathami*), White-eared Monarch (*Monarcha leucotis*), Barred Cuckoo-shrike (*Coracina lineata*), Spotted-tailed Quoll (*Dasyurus maculatus*), Common Planigale (*Planigale maculata*), Squirrel Glider (*Petaurus norfolcensis*), Black Flying-fox (*Pteropus alecto*), Grey-headed Flying-fox, Eastern Blossom Bat (*Syconycteris australis*), East Coast Freetail Bat, Hoary Wattle Bat (*Chalinolobus nigrogriseus*), Little Bentwing Bat, Eastern Bentwing-bat, Large-footed Mouse-eared Bat, Northern Long-eared Bat (*Nyctophilus bifax*) and Greater Broad-nosed Bat.

The Clarence Estuary Nature Reserve will not be impacted by the proposed development of the subject site. Therefore, these species and their habitats are not considered further unless they have the potential of occurring on the subject site.

3.3.4 Likelihood of Listed Migratory Species

Migratory species that are protected under the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) are listed under the schedules of the EPBC Act.

The Lesser Sandplover (*Charadrius mongolus*), Whimbrel (*Numenius phaeopus*), Pacific Golden Plover (*Pluvialis fulva*), Great Egret (*Ardea alba*) and Cattle Egret (*Ardea ibis*) may forage on the exposed mudflats of the Clarence River. The Great Egret and Cattle Egret may also

establish roosts or breeding colonies in mature mangrove areas along the banks of the Clarence River. There is no mature mangrove forest on the subject site, but this forest type does occur in the Clarence Estuary Nature Reserve and on Dart and Hickey Islands.

The White-bellied Sea-eagle (*Haliaeetus leucogaster*) has been observed foraging for fish in the Clarence Estuary. Potential nesting and roosting habitat occurs in the Clarence Estuary Nature Reserve and on Dart and Hickey Islands.

The Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Xanthomyza phrygia*) may occasionally forage within the canopy in forested areas of the subject site, but these species are likely to be, at best, occasional vagrants to the site. Latham's Snipe (*Gallinago hardwicki*) may occasionally forage in the disturbed, cleared areas of the subject site. Fork-tailed Swifts (*Apus pacificus*) and White-throated Needletails (*Hirundapus caudacutus*) may occasionally fly high over the subject site. The area of habitat on the subject site is a negligible amount of area available to these species.

The Rainbow Bee-eater (*Merops ornatus*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) have been observed on the subject site and/or in the Clarence Estuary Nature Reserve.

The impacts of the proposed development on listed migratory species are discussed in Chapter 4 of the present report.

3.4 WILDLIFE CORRIDOR VALUES OF SUBJECT SITE

3.4.1 Wildlife Corridors & Principles

Wildlife corridors allow movement of flora and fauna between patches of wildlife habitat (Soule & Gilpin 1991). The preservation or establishment of corridors to link habitats has been proposed as a practical conservation measure to ameliorate habitat loss and fragmentation effects (Bennett 1990).

Corridor habitats are thought to help conserve invertebrates, can protect certain forest types, act as fauna refuges, link adjoining reserve areas and provide shelter and nesting sites for fauna (Taylor 1991).

It is essential for a corridor to have the following characteristics if they are to be effective:

- Vegetated corridors that comprise a mosaic of different habitats are considered more likely to contain the necessary food, shelter and nesting resources for fauna. Seasonal resource requirements are essential for survival and may only be found between a range of habitats at different altitudes and geographic variations (Recher 1993). Therefore, corridors that link patches over the entire ecological gradient from ridge to gully would conserve more species, especially those that have large home ranges and changing seasonal requirements (Lindenmayer *et al*. 1994).

- The quality of the habitat within the corridor is important. Some fauna would reluctantly utilise corridors of low quality, such as areas invaded by weeds or subject to frequent fires, or due to a reduction in the availability of essential resources (such as feeding, shelter, roosting and breeding sites).

- The size of the corridor is also important. For example, corridors with mature trees, but with little or no understorey may afford good habitat links for birds, bats and some arboreal fauna, but not for ground-dwelling fauna.

  Corridors that are 200 or more metres in width tend to facilitate the movement of all fauna by providing at least some core interior habitat that is not affected by edge environments (Lindenmayer 1994). Corridors between 80 and 200 m width tend to be effective at moving many fauna, including some fauna that do not tolerate urban disturbance and fragmentation (such as Sugar Gliders and some forest-dependent birds) (Bennett 1990, Saunders & de Rebeira 1991, Catterall *et al.* 1991, Bentley & Catterall 1997). Corridors less than 30 m in width tend to effective only for servicing the most tolerant of urban fauna (for instance, Brushtail Possums, Bush Rats, common urban birds, and fauna habitat generalists) (Bentley 1990, Lindenmayer 1994, Catterall *et al*. 1991, Bentley & Catterall 1997).

  Gaps between vegetation links should be narrow. Catterall *et al*. (1991) found that gaps greater than 15 m in width represent a significant barrier to the movement of forest dependent birds. Barnett (1978) found that a small mammal's ability to cross an unvegetated gap was inversely proportional to the size of the gap. Lynch & Saunders (1991) found that the existence of a well-developed understorey was the single most important vegetation-related factor in corridor use by small bushland birds (Sewell & Catterall 1998).

3.4.2 Application to the Subject Site

The Clarence Estuary Nature Reserve is part of a fragmented wildlife corridor that extends along the southern bank of the Clarence River and then extends southwards to undeveloped land and Yuraygir National Park. The subject site has been largely cleared of its native vegetation and is not part of this corridor (Figure 5).

The mature trees along the eastern boundary of the subject site (i.e. along the river front) has limited value in assisting fauna to move through the subject site because the trees do not have a continuous canopy, they are used by Noisy Miners which chase other fauna species out of the trees, and they do not form a link between the Clarence Estuary Nature Reserve and other remnant habitat in the locality.

3.5 KOALA HABITAT ASSESSMENT

There are no known records of Koalas occurring on the subject site. The Forest Red Gum (*Eucalyptus tereticornis*) is the only tree species on the subject site that is a recognised roost or food tree species of Koalas, as defined under SEPP 44. However, these trees constitute less than 15% of the total number of trees that are on the subject site and, therefore, the site is not regarded as Potential Core Habitat for Koalas.

No Koala scats or scratchings were observed on trees within the subject site or neighbouring bushland areas, suggesting that Koalas do not use these areas on a regular basis and, at best, are likely to be occasional vagrants. Koalas are most unlikely to occur on the subject site because of the urbanised nature of the surrounding landscape (including busy roads), the site's isolation from remnant areas of bushland, its small size, and the lack of recent records of Koalas occurring in the locality in recent times.