TERRESTRIAL AND FRESHWATER FLORA AND FAUNA IMPACT ASSESSMENT

ELLA BAY INTEGRATED RESORT PROJECT, INNISFAIL

Report prepared
for
Ella Bay Developments Pty Ltd

Prepared by:	**Paula Boosamra, Chris Schell, Mark Sanders,**
Checked by:	**Paulette Jones**
Date:	**February, 2007**
File no:	**0096-003**

Biodiversity Assessment
and Management Pty Ltd
38 Middle Street
CLEVELAND 4163

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Managing Director

Date: 12.02.07

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List of Abbreviations

BAAM	-	Biodiversity Assessment and Management Pty Ltd
CG	-	Co-ordinator General
DEH	-	Department of Environment and Heritage (Commonwealth)
DPI	-	Department of Primary Industries (Queensland)
EIS		Environmental Impact Statement
EPA	-	Environmental Protection Agency (Queensland)
EPBC Act	-	*Environment Protection and Biodiversity Conservation Act 1999*
EVR	-	Endangered, Vulnerable, Rare
FIFA		Flora and Fauna Impact Assessment
GBRMPA	-	Great Barrier Reef Marine Park Authority
IPA	-	*Integrated Planning Act 1997*
JSC	-	Johnstone Shire Council
LPA	-	*Lands Protection (Pest and Stock Route Management) Act 2002*
NES	-	Commonwealth Matters of National Environmental Significance
NCA	-	*Nature Conservation Act 1992*
NRW	-	Department of Natural Resources and Water (Queensland)
PMAV	-	Property Map of Assessable Vegetation
RE	-	Regional Ecosystem
TFFA	-	Draft Terrestrial and Freshwater Fauna Assessment
ToR	-	Terms of Reference (for proposed development)
VMA	-	*Vegetation Management Act 1999*
WONS	-	Weed of National Significance
WTMA	-	Wet Tropics Management Authority
WTWHA	-	Wet Tropics World Heritage Area

1.0 INTRODUCTION

This report has been prepared for Ella Bay Developments Pty Ltd for the purpose of providing an assessment of potential impacts to terrestrial and freshwater flora and fauna and associated habitat values resulting from the proposed Ella Bay Integrated Resort Project, Innisfail. This report has been prepared to respond to the specific requirements of the Terms of Reference (ToR) for an Environmental Impact Statement (EIS)issued by the Co-ordinator General's (CG) office in December 2005 with regard to flora and fauna (CG, 2005).

It is understood that the EIS will provide relevant documentation, maps and background studies including but not exclusive to: Cassowary Studies, Flora and Fauna baseline studies; soil survey and land suitability study; base maps; and any other relevant background information required to adequately address the ToR.

The purpose of this report is to address the following 'Key Issues' (CG, 2005: 2) identified in the ToR for this proposal with regard to flora and fauna, specifically:

- 'Impacts on the terrestrial environment';
- 'Impacts on aquatic areas …' [aquatic vertebrate species…]; and
- 'Impacts on natural heritage values including the Wet Tropics Heritage Area'.

This assessment will specifically address the following sections of the ToR (CG, 2005) with regard to flora and fauna:

- 1.5.1: Relevant legislation and policy requirements;
- 1.6: Accredited process for controlled actions under Commonwealth legislation;
- 3.4: Land Tenure (with regard to Wet Tropics World Heritage Area); and
- 4.7: Nature Conservation.

This Terrestrial and Aquatic Flora & Fauna Impact Assessment is a stand-alone document and as such will be appended to the Environmental Impact Statement.

The findings of this report are drawn primarily from baseline studies conducted by Biodiversity Assessment and Management Pty Ltd (BAAM), 3D Environmental (2006a & b) and Moore (2006 Volumes I-III) on the subject site and surrounds including:

1. *Vegetation Survey Report of the Proposed 'Ella Bay Integrated Resort Project'* (3D Environmental, 2006a);
2. *Ella Bay Integrated Resort Project Supplementary Section: Southern Access Corridor Vegetation Mapping'* (3D Environmental, 2006b);
3. *Terrestrial and Freshwater Fauna Assessment for the Proposed 'Ella Bay Integrated Resort Project, Innisfail'* (TFFA) (BAAM, 2006);
4. *Cassowary Assessment of the 'Ella Bay Integrated Resort Project' North Queensland 6 – 14 November 2006: Volume I – Cassowary Field Survey; Volume II – Impacts and Mitigation; and Volume III – Population Viability Analysis* (L.A. Moore, 2006);

This report does not address issues relating to local surface water, groundwater, palaeontological or geomorphological values, and relies on relevant background information provided by Ella Bay Developments Pty Ltd regarding the project description and other technical reports and specialist studies as available at the time of writing.

2.0 DESCRIPTION OF PROPOSED ACTION

This section describes relevant aspects of the subject site and the proposed development and identifies relevant legislation and/or policy requirements for with regard to flora and fauna.

2.1 LOCATION

The Ella Bay Integrated Resort Project is located on Lot 320 on Crown plan N157629, County Nares, Parish Glady (the subject site). This lot is situated approximately 10km to the north-west of Innisfail (see Figure 2.1) and encompasses an area of approximately 450 hectares.

The subject site shares a common boundary with Ella Bay National Park in the north, south and west. Most of the surrounding area is located within the WTWHA (Environment Australia, 2006) and is included in the Wet Tropics bioregion of Queensland (Wet Tropics Management Authority (WTMA), 2006). Pacific Ocean marine environments adjacent to the coastal boundary to the east are included in World Heritage Area (Islands) and the Great Barrier Reef Marine Park (Great Barrier Reef Marine Park Authority (GBRMPA), 2003) (See Figure 2.2).

2.2 PROPOSED ACTIVITIES

Ella Bay Developments Pty Ltd proposes to transform the existing 450-hectare operating cattle station into a fully master-planned, integrated tourism and residential lifestyle community over a ten to fifteen year period. The proposed development incorporates 540 residences located around an 18-hole golf course, four five-star resort precincts with ocean frontage and beach access, a village precinct comprising mixed retail, professional services, dining and office usage, an educational precinct comprising a proposed St Peter's Lutheran College international school, a proposed sustainable development research institute in partnership with James Cook University and The University of Queensland, a 'signature' championship 18-hole golf course, and associated public infrastructure including sewerage treatment and access and internal road networks. Appropriate areas will be identified for environmental buffers, rehabilitation, revegetation (approximately 500 000 rainforest trees) and wildlife fencing. A concept plan of the proposed development is shown in Figure 2.3.

A road and/or upgrades to the existing road will be required to gain access to the proposed resort development at Ella Bay. The proposed route is through the south via the existing access road which passes through Ella Bay National Park. Three options are currently being investigated regarding the alignment of this road (see Figure 2.4). These options are:

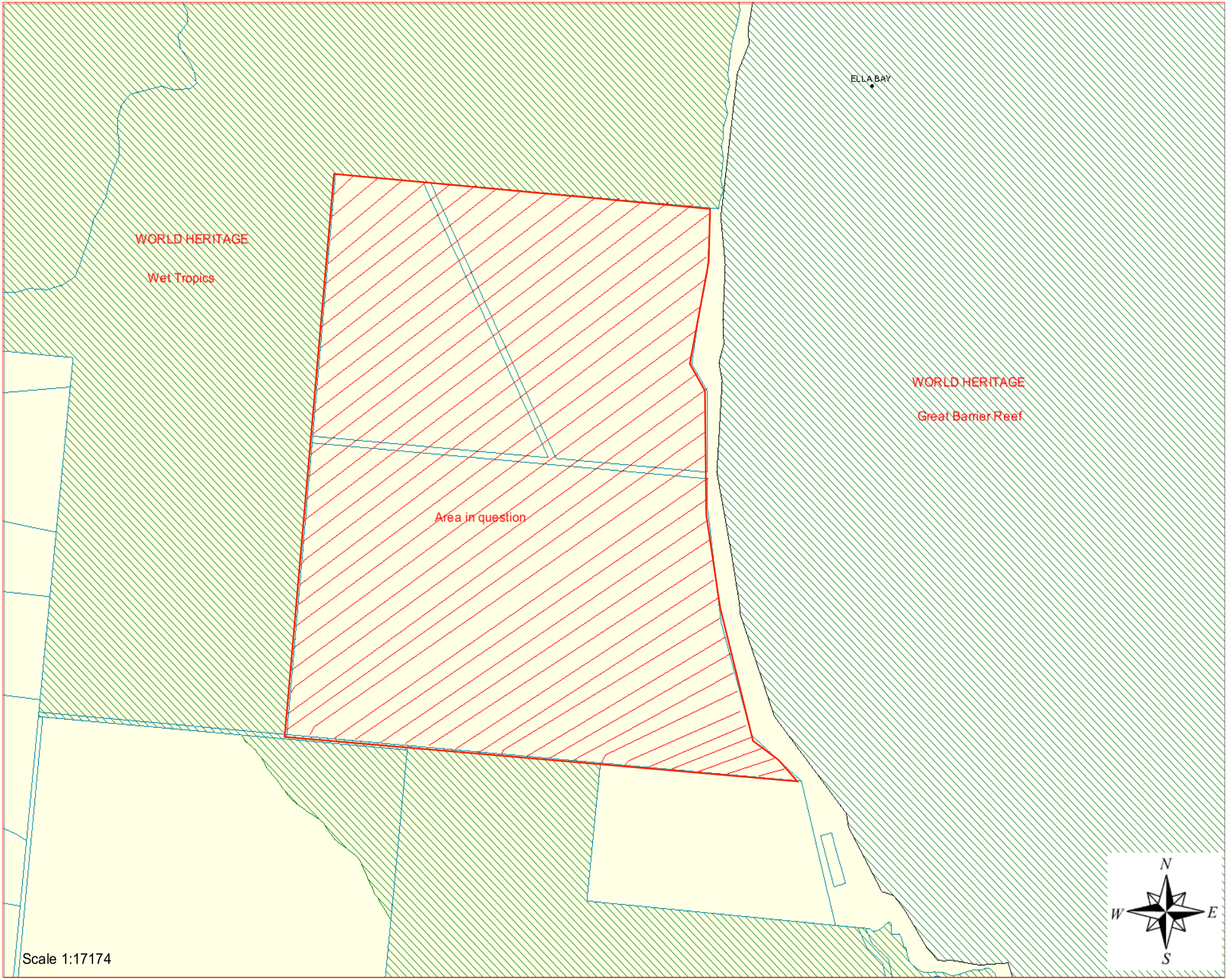
Option 1: This option follows the existing Ella Bay Road.

Option 2: This option follows the coastal road through Flying Fish Point, then deviates from the coast to follow the southern boundary of the fish farm before joining the existing Ella Bay Road.

Option 3: Option 2 follows option 1 through the centre of Flying Fish point but continues north through the town to follow the coast line east of the fish farm before connecting to Ella Bay Road.

All three options will require the widening of the existing unsealed road within the road reserve between Heath Point and the subject site. The entire road will need to be sealed.

Figure 2.1: Subject Site Location



Legend

- Land Parcels/Cadastre
- Aust Coastline/Borders 100K
- Localities - 250K
  - Mountain
  - Places
- World Heritage Places
- Coastal Waters Limit - 3NM
- Aust Terrestrial 100K
- Subject Site

FIGURE 2.2
WORLD HERITAGE AREAS

Australian Government
Department of the Environment and Heritage

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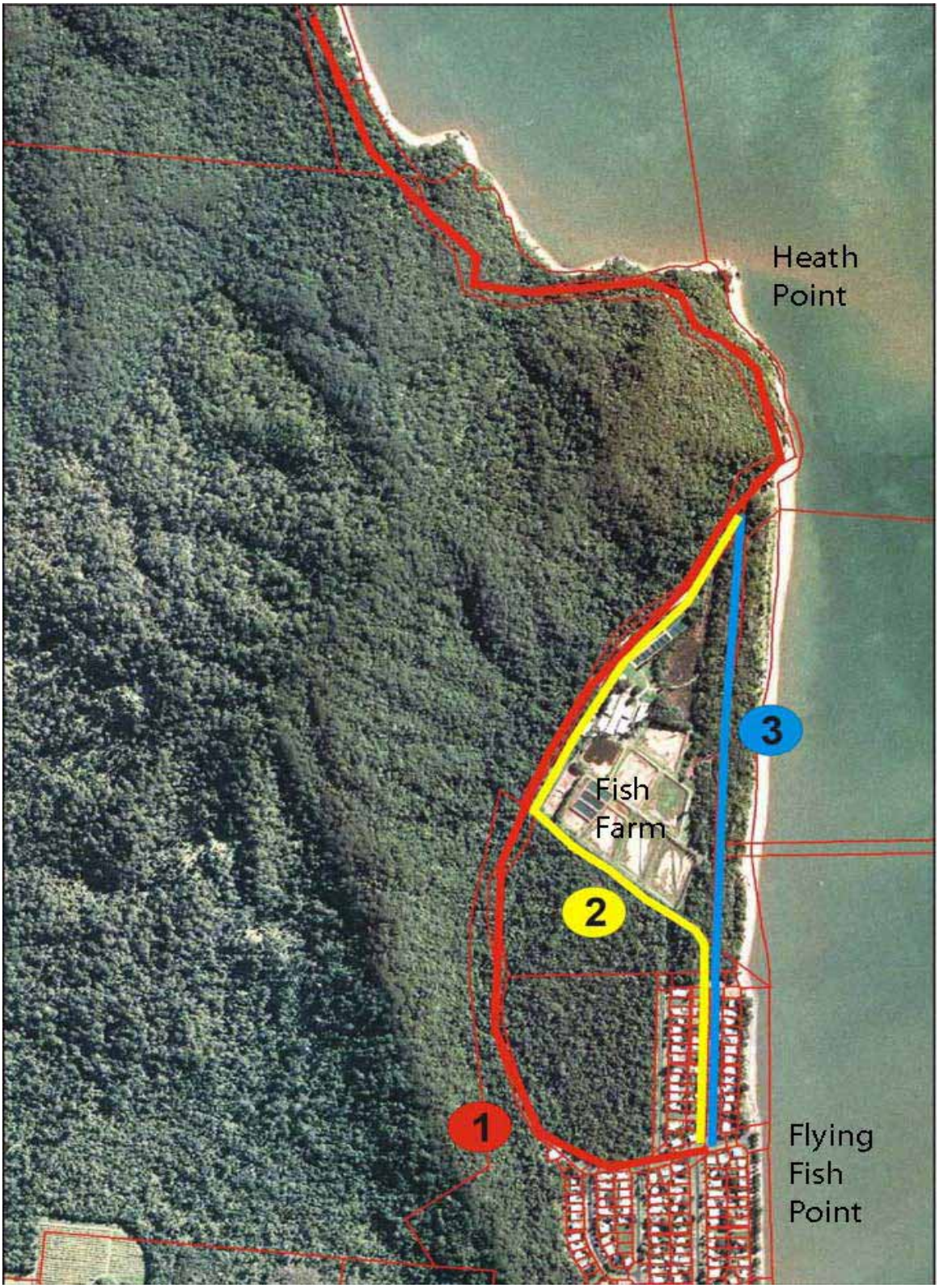
FIGURE 2.3
PROPOSED DEVELOPMENT CONCEPT PLAN

Figure 2.4. Road Route Options



2.3 RELEVANT LEGISLATION AND POLICY REQUIREMENTS

2.3.1 *Commonwealth Matters of National Environmental Significance*

The FFIA for the proposed development and associated access corridors must address Commonwealth Matters of National Environmental Significance (NES). This FFIA identifies impacts and mitigation strategies on the surrounding Wet Tropics World Heritage Area (WTWHA) and for listed threatened species and communities listed under the *Environment Protection and Biodiversity Protection Act 1999* (EPBC Act).

The WTWHA consists of a variety of land uses and tenure The Wet Tropics Management Plan 1998(Queensland Government (QG), 1998) designated areas included in the WTWHA into four distinct zones: Zone A-D with A having the highest conservation value. Lands directly to the north and south-east of the subject site are designated as Zone A while areas to the west and south are designated as Zone B (See Figure 2.5). Zones A and B are:

Zone A:
Land included in zone A has a high degree of integrity and is remote from the disturbances associated with modern technological society. It is in its natural ecological, physical and aesthetic condition and sustaining this condition is the intent of this zoning. Visitors may expect to find solitude and no obvious management presence. To qualify for inclusion in zone A, land must:

- *be at least 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structures; and*
- *be at least 700 metres from clearings; and*
- *include a minimum area of 150 hectares of undisturbed habitat; and*
- *no obvious signs of disturbance in the last 40 years (such as logging, for example).*

Zone B:
Like land in zone A, it has a high degree of ecological integrity and it is in a natural state but is not necessarily remote from disturbance. There is a reasonable expectation that it could be restored to a condition which would qualify for inclusion in Zone A. Visitors can expect solitude and limited evidence of a management presence (infrastructure, etc.). Lands in zone B must:

- *be less than 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structure; or,*
- *be less than 700 metres from clearings; or*
- *include an area of up to 150 hectares of undisturbed habitat;*
- *have some obvious signs of disturbance in the last 40 years; and*
- *not overlap with Zones A, C and D.*

Ella Bay National Park is also listed on the Register of the National Estate.

The matters of national environmental significance raised in this report are provided as a separate document in Appendix 1.

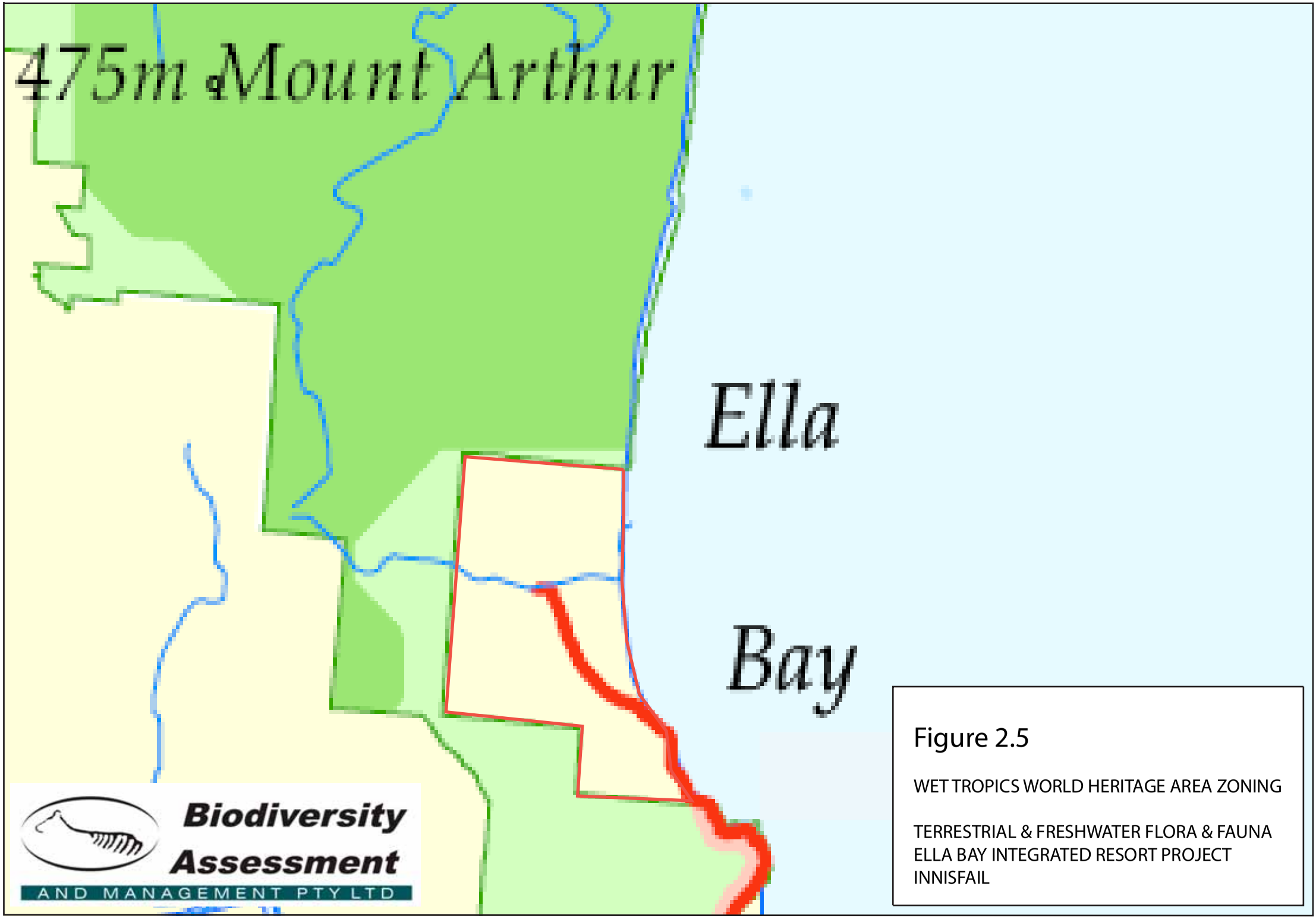


Figure 2.5

WET TROPICS WORLD HERITAGE AREA ZONING

TERRESTRIAL & FRESHWATER FLORA & FAUNA
ELLA BAY INTEGRATED RESORT PROJECT
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2.3.2 *State Legislation*

Planning for the proposed development must address the guidelines and provisions of relevant legislation with regard to flora and fauna. The Queensland *Nature Conservation Act 1992* (NCA) identifies listed species of significance at a state level. The provisions of the Queensland *Integrated Planning Act 1997* (IPA) and the Queensland *Vegetation Management Act 1999* (VMA) address clearing and or disturbance to mapped significant Regional Ecosystems (REs).

The development footprint will be subject to setback and buffer requirements under IPA and the VMA. The VMA refers to setbacks/buffers in Schedule 10 of IPA. Buffer zones are required as part of 'essential management' for firebreaks under IPA and to achieve compliance with the Material Change of Use (MCU) codes for clearing vegetation as stated in the VMA. IPA, Schedule 10, section 4.3.22 defines 'essential management' as:

> *'... clearing native vegetation—*
>
> *(a) for establishing or maintaining a necessary fire break to protect infrastructure other than a fence or road, if the maximum width of the fire break is equivalent to 1.5 times the height of the tallest vegetation adjacent to the infrastructure, or 20m, whichever is the greater;*

An application to clear remnant vegetation mapped by Queensland Department of Natural Resources and Water (NRW) as regional ecosystems, must be lodged prior to any works requiring clearing of vegetation unless otherwise exempt.

The *Wet Tropics Coast Regional Management Plan* (Regional Coastal Plan) (EPA 2003) provides a regional direction for the implementation of the *State Coastal management Plan – Queensland's Coastal Policy* (State Coastal Plan) in the Wet Tropical Coast Region, including Ella Bay. The Plan has been developed by the Queensland Government under the *Coastal Protection and Management Act 1995,* and describes how the costal zone of the Wet Tropical Coast Region is to be managed.

The State Coastal Plan has the effect of a State planning policy under the *Integrated Planning Act 1997* (IPA) and is therefore a matter of State interest. The Plan will be one of the matters that are coordinated and integrated into new planning schemes during their preparation, had regard to for impact assessment applications, and considered in Ministerial community infrastructure designations.

Under the Regional Coastal Plan, the subject site is within a Key Coastal Site – Key Coastal Site 5: Ella Bay. The key coastal site is:

> *"largely framed by the rugged and forested Seymour Range and incorporates Flying Fish, Heath and Cooper Points, the township of Coconuts and Ella Bay National Park (listed on the Register of the National Estate)."*

Of particular significance to the subject land, Ella Bay Swamp, immediately north of the proposed development area, is listed as a significant coastal resource. The freshwater wetland, including the dune system, forms the Ella Bay Swamp, which is listed and described in the Directory of Important Wetlands in Australia (2nd edition, 1996). The Ella Bay Swamp is the only remaining pristine or near pristine catchment area of mixed mesophyll vine forest on foothills (EPA 2003).

In relation to ecological matters, the subject land is also mapped under the Regional Coastal Plan as:

- bordering an Area of State Significance (natural resources) – Significant Coastal Wetlands (Ella Bay Swamp to the north of the proposed development area)

- bordering an Area of State Significance (natural resources) – Significant Coastal Due Systems (on the coastline to the north of the proposed development area.

Ella Bay Swamp is mostly incorporated within Ella Bay National Park, although mapping shows a small portion of the swamp within the subject land, outside of the area proposed for development. Appendix 2 provides the details of the listing of Ella Bay Swamp under the Directory of Important Wetlands in Australia (2nd edition, 1996).

2.3.3 *Johnstone Shire Council Statutory Planning Framework*

Johnstone Shire's Planning Scheme 2005 (JSC 2005) identifies the northern section of the subject site as 'Rural Zone' (Conservation Precinct) and the southern Section of the subject site as 'Rural Zone' (Rural Precinct) (See Figure 2.6). The subject site is surrounded by lands zoned as 'Conservation Zone'.

The JSC Planning Scheme states that one of the purposes of the rural precinct is to '…protect the ecosystem function by promoting protection from removal and destruction of habitat in the rural conservation precinct…'. This application must comply with the requirements and provisions of the Johnstone Shire Council Planning Scheme, associated policies and codes with particular reference to vegetation works in protected areas, weed and pest infestations and habitat values.

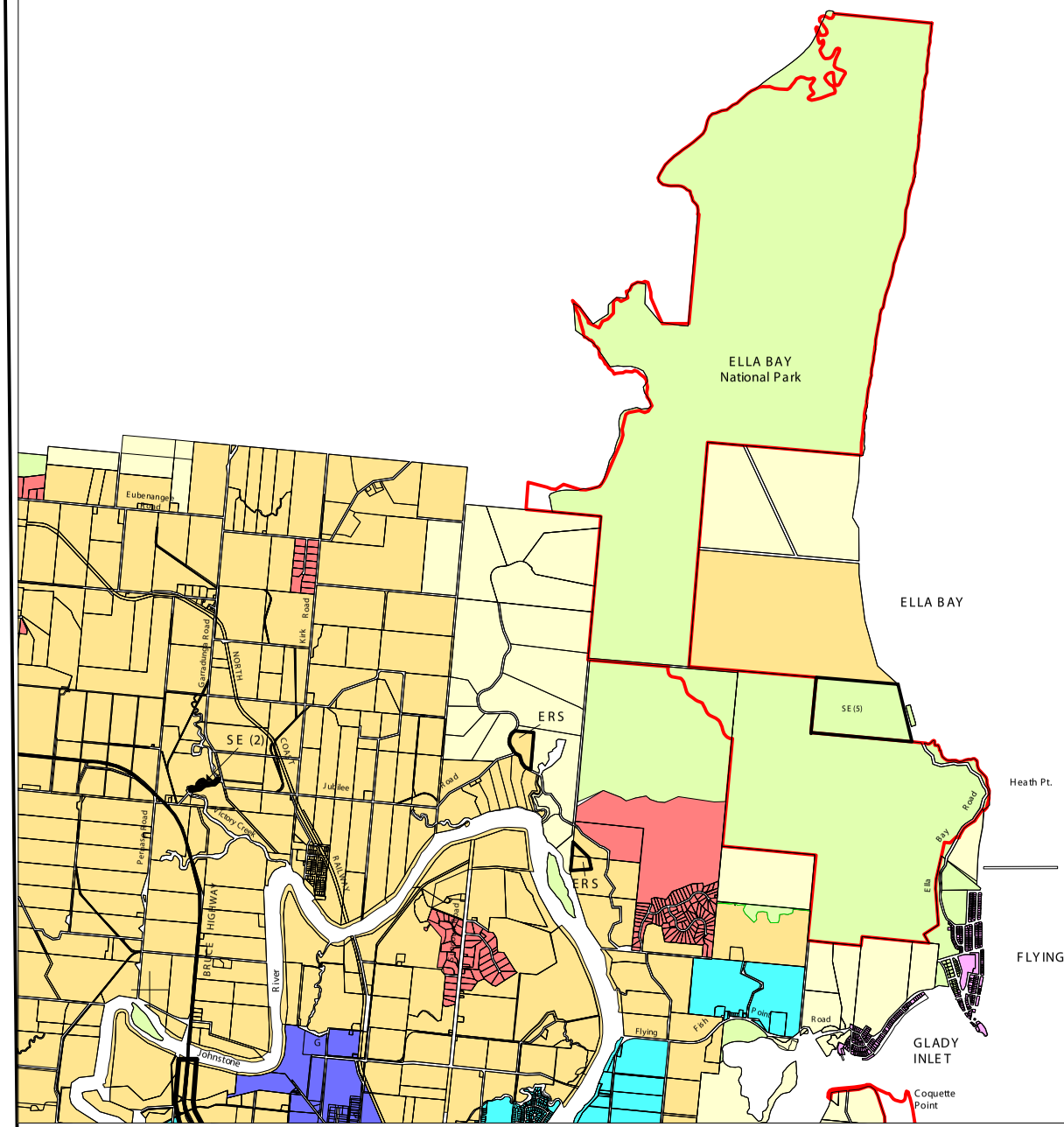
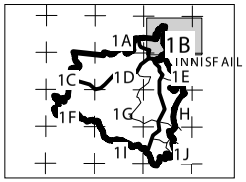


FIGURE 2.6
JOHNSTONE SHIRE ZONING



REVISIONS	DATE

LEGEND

- Rural Zone (Rural Precinct)
- Rural Zone (Rural Conservation Precint)
- Conservation Zone
- Rural Residental Zone
- Industry Zone (Industry Area Precinct)
- Industry Zone (Industry Site Precinct)
- Innisfail Zone
- Mission Beach Zone
- Villiage Zone
- SE (?) Specified Exemption (Ref No.)
- Wet Tropics World Heritage Boundary
- Area Boundary

NOTES

"ERS"-Extractive Resource Site

- Powerlink Electricity Corridor

Approved route for electricity transmission operating works includes land affected by -
a. Existing transmission and operating works;
b. Proposed operating works the subject of a notice under the Electricity Act 1994, section 118;
c. Community infrastructure - operating works under the Electricity Act 1994, designated under the Intergrated Planning Act 1997; and
d. Other land. (This includes land that has been the subject of a future corridor study and determined by Powerlink as appropriate for proposed operating works and may be designated for community infrastructure in the future.)

- State Controlled Roads

N

JOHNSTONE SHIRE COUNCIL

0 1
Kilometres
SCALE 1:75,000

The Johnstone Shire Planning Scheme,2005

ZONING MAP

1B

3.0 VEGETATION AND FLORA

3.1 BASELINE INVESTIGATIONS

3.1.1 *Regional Ecosystems*

Under the VMA, the Department of Natural Resources and Water (NRW) has mapped six 'endangered' and 'of concern' REs within the subject site (see Figure 3.1). A list of NRW mapped REs for the subject site and surrounding areas is provided in Table 3.1.

Table 3.1: NRW Mapped REs for the subject site

Regional Ecosystem	Vegetation Management Status
7.1.1	Not of Concern
7.2.1	**Endangered**
7.2.4	**Of Concern**
7.3.3	**Of Concern**
7.3.5	Not of Concern
7.3.10	**Of Concern**
7.11.1	Not of Concern
7.11.24	**Of Concern**
7.11.25	**Of Concern**

A description of REs recorded from detailed flora surveys of the subject site (3D Environmental 2006a) is provided in Table 3.3 and their distribution is shown on Figure 3.2. The new mapping indicates the presence of one 'Endangered' (7.2.1) and nine 'Of Concern' REs within the subject site boundary. None of the vegetation communities/Regional Ecosystems recorded for the subject site are listed as Threatened Ecological Communities under the EPBC.

Table 3.2: Regional Ecosystems observed on the subject site

RE	Description	VMA Status
7.2.1i	Mesophyll vine forest. Beach ridges and sand plains of beach origin, mainly in small patches in the lee of coastal beach ridges in very high rainfall areas	**Endangered**
7.2.1d	Swampy mesophyll vine forest with *Archontophoenix alexandrae* (feather palm) in the sub-canopy. Seasonally inundated lowland areas on dune sands.	**Endangered**
7.2.4	*Eucalyptus* spp. open forest and/or *L.suaveolens* (swamp mahogany) open forest on swampy sandplains of beach origin, and Pleistocene beach ridges.	**Of Concern**
7.2.7a	Coastal foredune complex with *Casuarina equisetifolia.*	**Of Concern**
7.2.8	*Melaleuca leucadendra* (weeping tea tree) open forest to woodland. Beach.	**Of Concern**
7.2.9	*Melaleuca quinquenervia* shrubland to closed forest, or *Lepironia articulata* open to closed sedgeland. Dune swales and swampy sandplains.	**Of Concern**
7.3.3a	Mesophyll vine forest with *Archontophoenix alexandrae* (feather palm).	**Of Concern**
7.3.10a	Simple to complex mesophyll to notophyll vine forest on moderate to poorly drained alluvial plains of moderate fertility.	**Of Concern**
7.3.25a	*Melaleuca leucadendra* open forest and woodland. Stream levees and prior streams on well-drained sandy clay loam alluvial soils.	**Of Concern**
7.11.1	Simple-complex mesophyll to notophyll vine forest on moderately to poorly drained metamorphics of moderate fertility of the moist wet lowlands, foothills and uplands.	Not of Concern
7.11.1a	Mesophyll vine forest. Very wet and wet lowlands and foothills.	Not of Concern
7.11.1b	Mesophyll vine forest recovering from disturbance, with *Acacia* canopy or emergents. Very wet and wet lowlands and foothills.	Not of Concern
7.11.8b	*Acacia mangium* and *A. celsa* open to closed forest. Wet lowlands and foothills	**Of Concern**
7.11.24a	Closed vineland of wind disturbed vine forest.	**Of Concern**

With regards to road access from the south, a number of REs, including one 'Endangered' (7.2.1i) and eight 'Of Concern' REs (Figure 3.3) are present between the southern boundary of the subject site, and Flying Fish Point. Between Heath Point and the Ella Bay property, the road is already is place and will require minor widening in places.

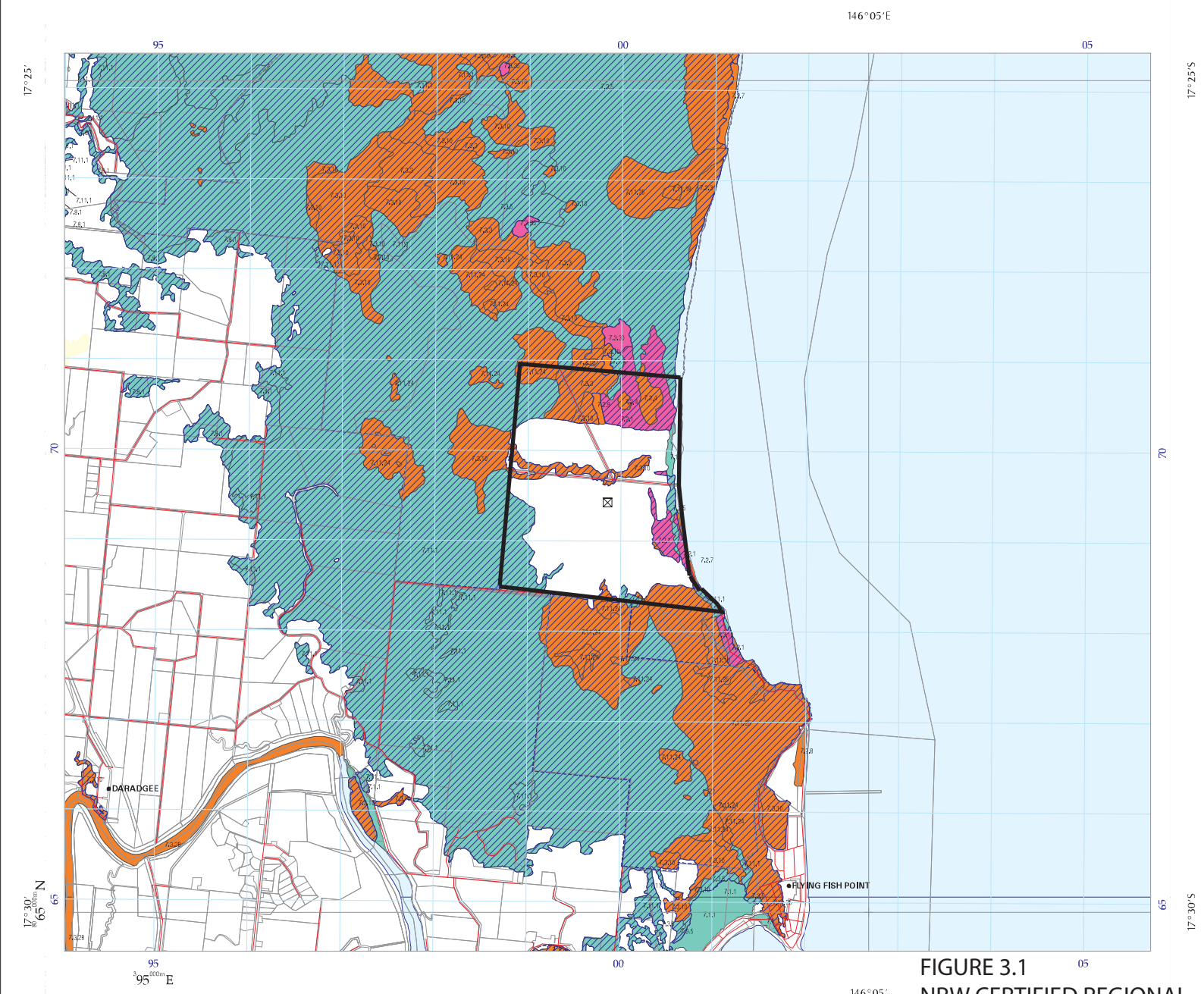


FIGURE 3.1
NRW CERTIFIED REGIONAL ECOSYSTEMS FOR THE SUBJECT SITE

2003 REGIONAL ECOSYSTEM MAP

Based on 2003 Landsat TM imagery

Requested By: CHRIS@BIODIVERSITY.TV
Date: 29 Jan 07 Time: 15.54.06

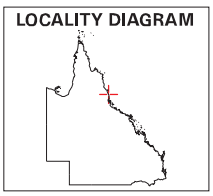
Centered on point position:
Latitude: -17.4589 Longitude: 146.0569 (decimal degrees)

This is a copy of the certified regional ecosystem map defined by the map extent for the purpose of the *Vegetation Management Act 1999*. Areas of property maps of assessable vegetation (PMAVs) are not shown on this map.

- 2003 Remnant endangered regional ecosystem
- Dominant
- Sub-dominant
- 2003 Remnant of concern regional ecosystem
- Dominant
- Sub-dominant
- 2003 Remnant not of concern regional ecosystem
- Non-remnant
- Plantation Forest
- Dam or Reservoir
- 2003 Remnant Vegetation Cover (RVC)
- Vegetation Management Act Essential Habitat
  Area identified as essential habitat by the EPA for a species of wildlife listed as endangered, vulnerable, near threatened or rare under the *Nature Conservation Act 1992*.
  For further information on VMA Essential Habitat, please see the attached VMA Essential Habitat map.
- Certified Map Amendment area
- Roads
  © MapInfo Australia Pty Ltd 2006
- Bioregion boundary
- National Park, Conservation Area State Forest and other reserves
- Cadastre line
  The maximum spatial error of parcels extracted for this map from the Digital Cadastral Data Base(DCDB) range from: 14m to 251m at a 95% confidence level. Property boundaries shown are provided as a locational aid only.
- Towns
- ⊠ Coordinate entered

Queensland Government

LOCALITY DIAGRAM



1000 0 1000 m

Defined map areas are labelled with the regional ecosystem (RE) code along with the percentage breakdown if more than one RE occurs within the area. Detailed definitions of regional ecosystems are available from www.epa.qld.gov.au/REDD. Defined map areas smaller than 5ha may not be labelled.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/-100 metres. The extent of remnant regional ecosystems as of 2003, depicted on this map is based on rectified 2003 Landsat TM imagery (supplied by SLATS, Department of Natural Reources and Water).

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All datasets are updated as they become available to provide the most current information as of the date shown on this map.

Additional information is required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.nrw.qld.gov.au/vegetation or contact the Department of Natural Resources and Water.

Digital regional ecosystem data is available in shapefile format, for Lot on Plans from www.epa.qld.gov.au/REDATA or from the Queensland Herbarium for larger areas.
Email: regional.ecosystem@epa.qld.gov.au

Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)

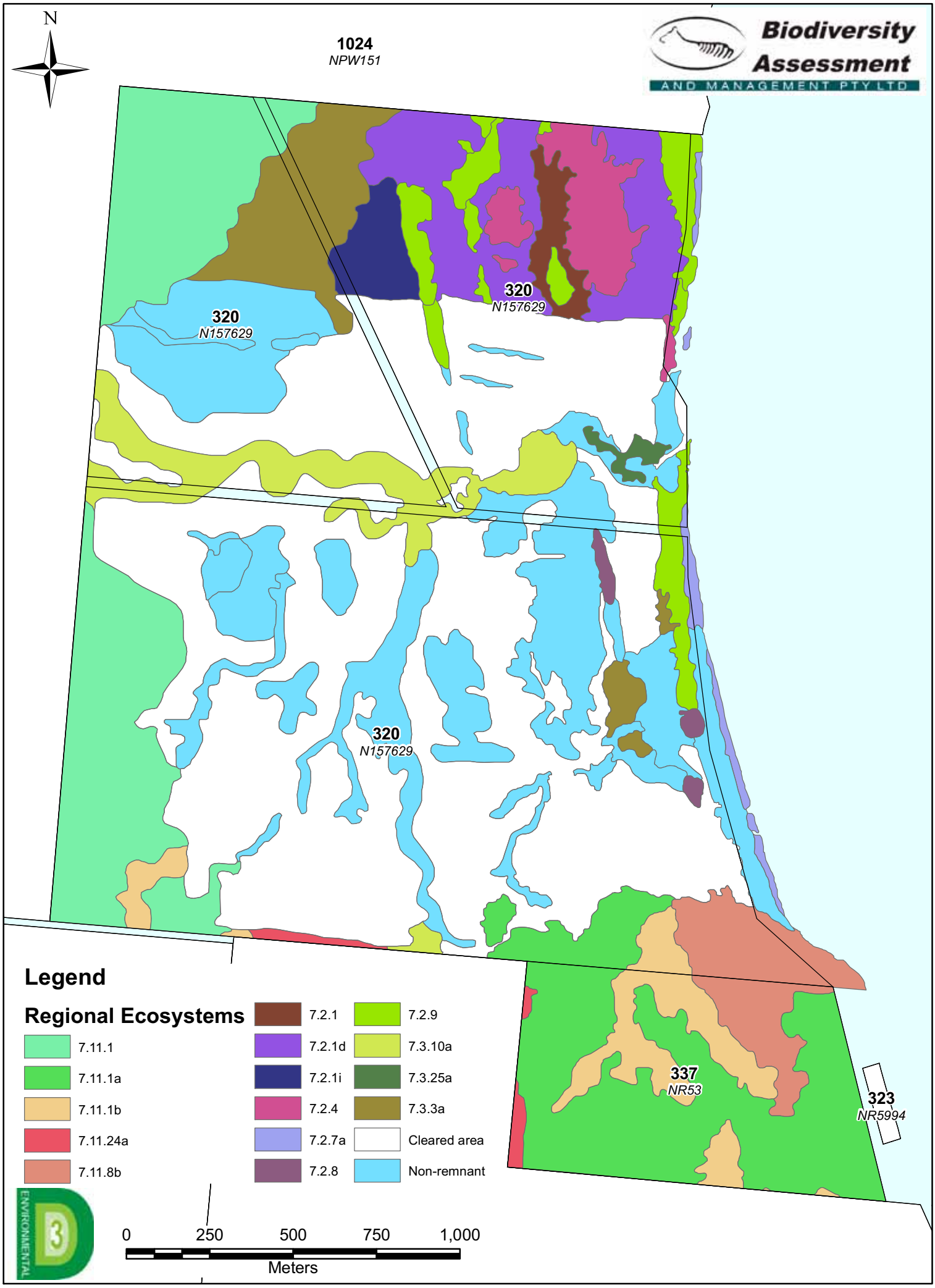

FIGURE 3.2

3D ENVIRONMENTAL (2006) REGIONAL ECOSYSTEMS

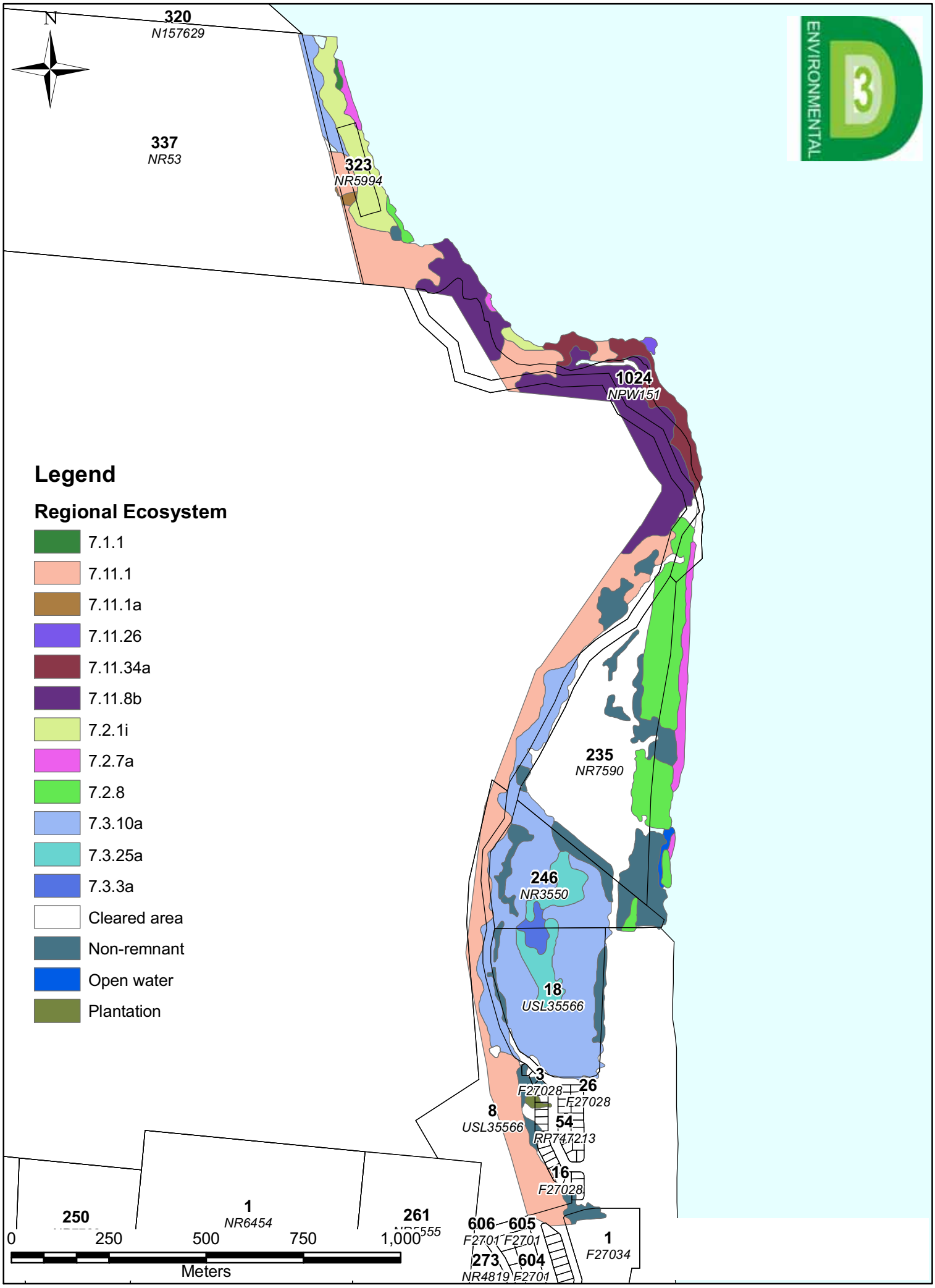

FIGURE 3.3

3D ENVIRONMENTAL (2006) REGIONAL ECOSYSTEMS IN ACCESS ROAD OPTION AREA

3.1.2 *Flora Species of Significance*

The provisions of the EPBC and the NCA identify listed species of significance at a Commonwealth and state level. Species of significance that were recorded considered likely to occur on the subject land are listed in Tables 3.3 (for the subject land) and 3.4 (for the access road corridor options) (3D Environmental, 2006: a & b). Two species listed under the NCA were observed on the subject site or in surrounding lands: *Endiandra globosa;* and *Macaranga polyadenia*. In addition, several other species were considered as potentially occurring. Their habitat areas for the subject site are shown in Figures 3.4 (Known Significant Flora) and 3.5 (Potential Significant Flora). Figure 3.6 shows potential significant flora habitat within the area traversed by the proposed access road corridor options, although the preferred option would require minor widening of the existing road within the road reserve between Heath Point and the subject site, rather than the construction of a new access road (Section 7.1).

Table 3.3: Known, Likely or Possible Significant Flora Species on the subject site (R = rare; V = Vulnerable, E = Endangered)

Species Name	EPBC	NCA	Known	Likely	Possible
Aphyllorchis queenslandica	Not Listed	R		X	
Aponogeton cuneatus	Not Listed	R			X
Aponogeton proliferus	E	E			X
Arenga australasica	V	Not listed		X	
Canarium acutifolium var. *acutifolium*	V	Not listed		X	
Carronia pedicellata	E	Not listed			X
Dendrobium mirbelianum	E	Not listed			X
Dendrobium superbiens	V	Not listed			X
Dioclea hexandra	Not listed	V		X	
Elaeocarpus stellaris	Not listed	R			X
Endiandra globosa	**Not Listed**	**R**	**X**		
Fimbristylis adjuncta	E	E			X
Garnotia stricta var. *longiseta*	Not listed	R			X
Ilex sp. (Gadgarra B.P.Hyland RFK2011)	Not listed	R			X
Macaranga polyadenia	**Not listed**	**R**	**X**		
Phaius tancarvilleae	E				X
Piper mestonii	Not listed	R		X	
Polyalthia sp. (Wyvuri B.P.Hyland RFK2632)	Not listed	R		X	
Pseuduvaria villosa	Not listed	R			X

Table 3.4: Likely or Possible Significant Flora Species traversed by the proposed road corridor options (R = rare; V = Vulnerable, E = Endangered)

Species Name	EPBC	NCA	Likely	Possible	Unlikely
Aphyllorchis queenslandica		R		X	
Arenga australasica	V			X	
Canarium acutifolium var *acutifolium*	V			X	
Carronia pedicellata	E			X	
Dendrobium mirbelianum	E	E		X	
Dendrobium superbiens	V			X	
Dioclea hexandra		V	X		
Elaeocarpus stellaris		R		X	
Endiandra globosa		R	X		
Garnotia stricta var. longiseta		R		X	
Hupzeria prolifera	V	V		X	
Ilex sp. (Gadgarra B.P.Hyland		R		X	
Macaranga polyadenia		R	X		
Microsorum membranifolium		R		X	
Piper mestonii		R		X	
Polyalthia sp. (Wyvuri B.P.Hyland RFK2632)		R		X	
Pseuduvaria villosa		R		X	
Rourea brachyandra		R	X		

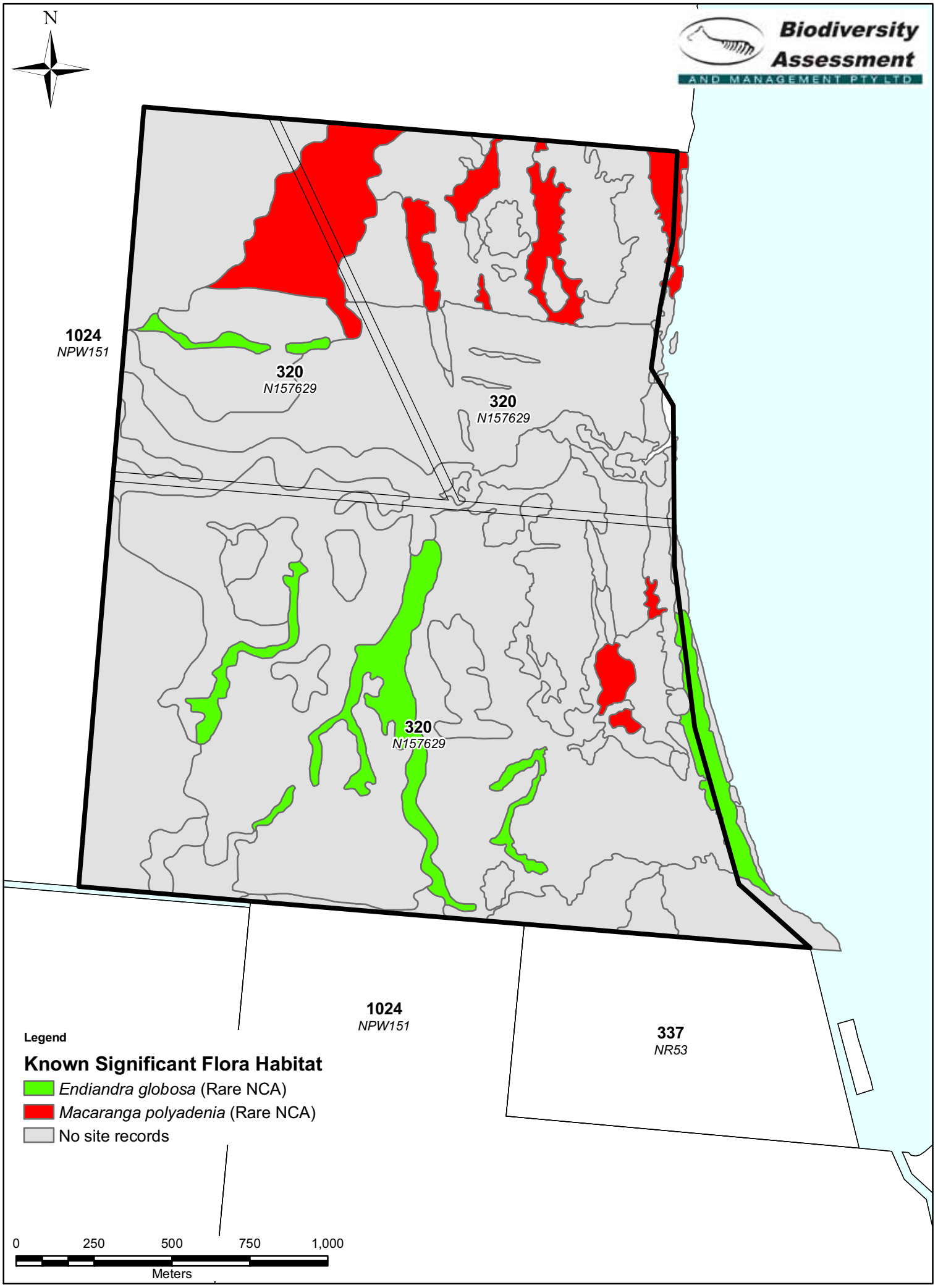

FIGURE 3.4
KNOWN SIGNIFICANT FLORA HABITAT

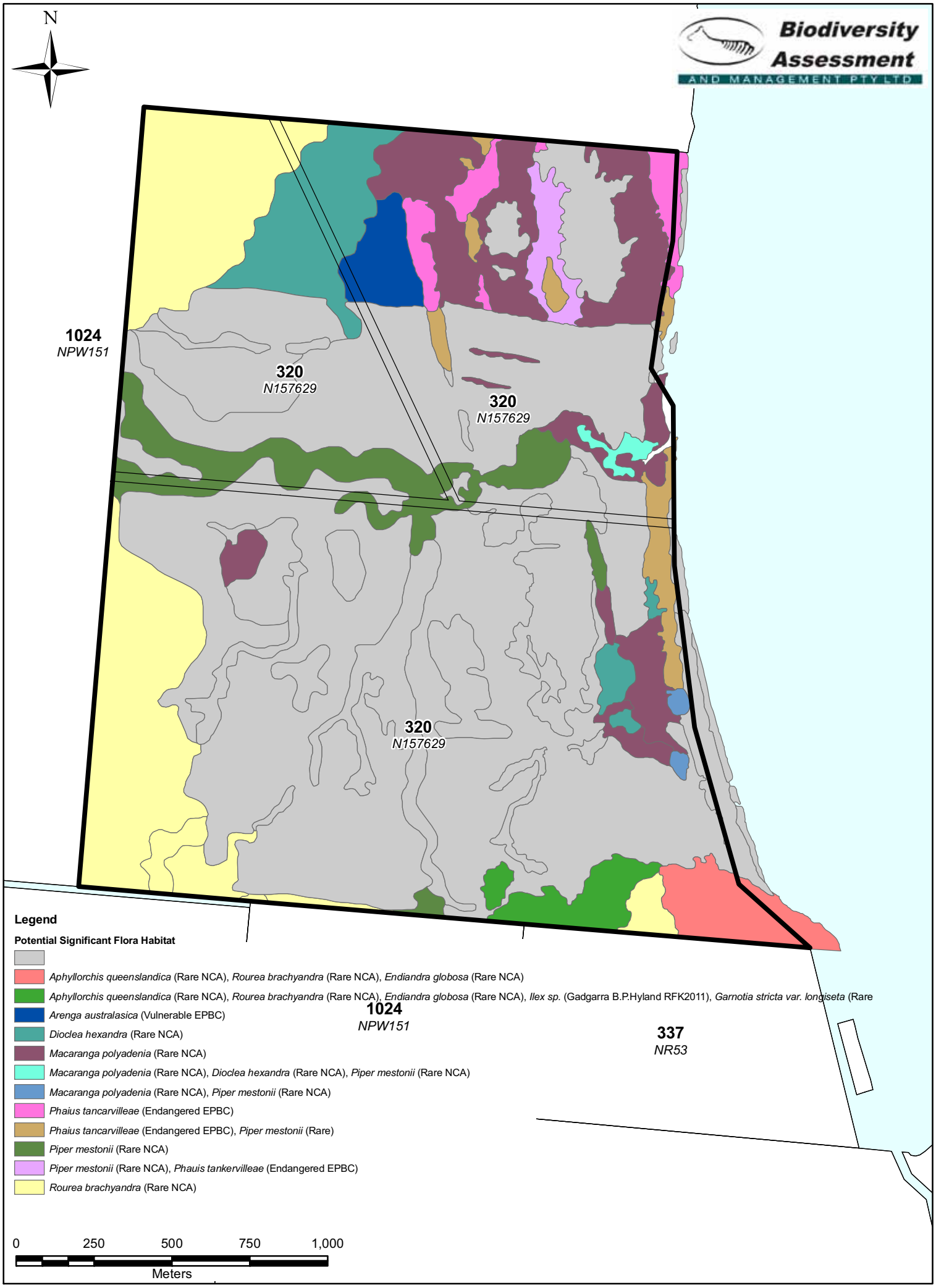

FIGURE 3.5
POTENTIAL SIGNIFICANT FLORA HABITAT

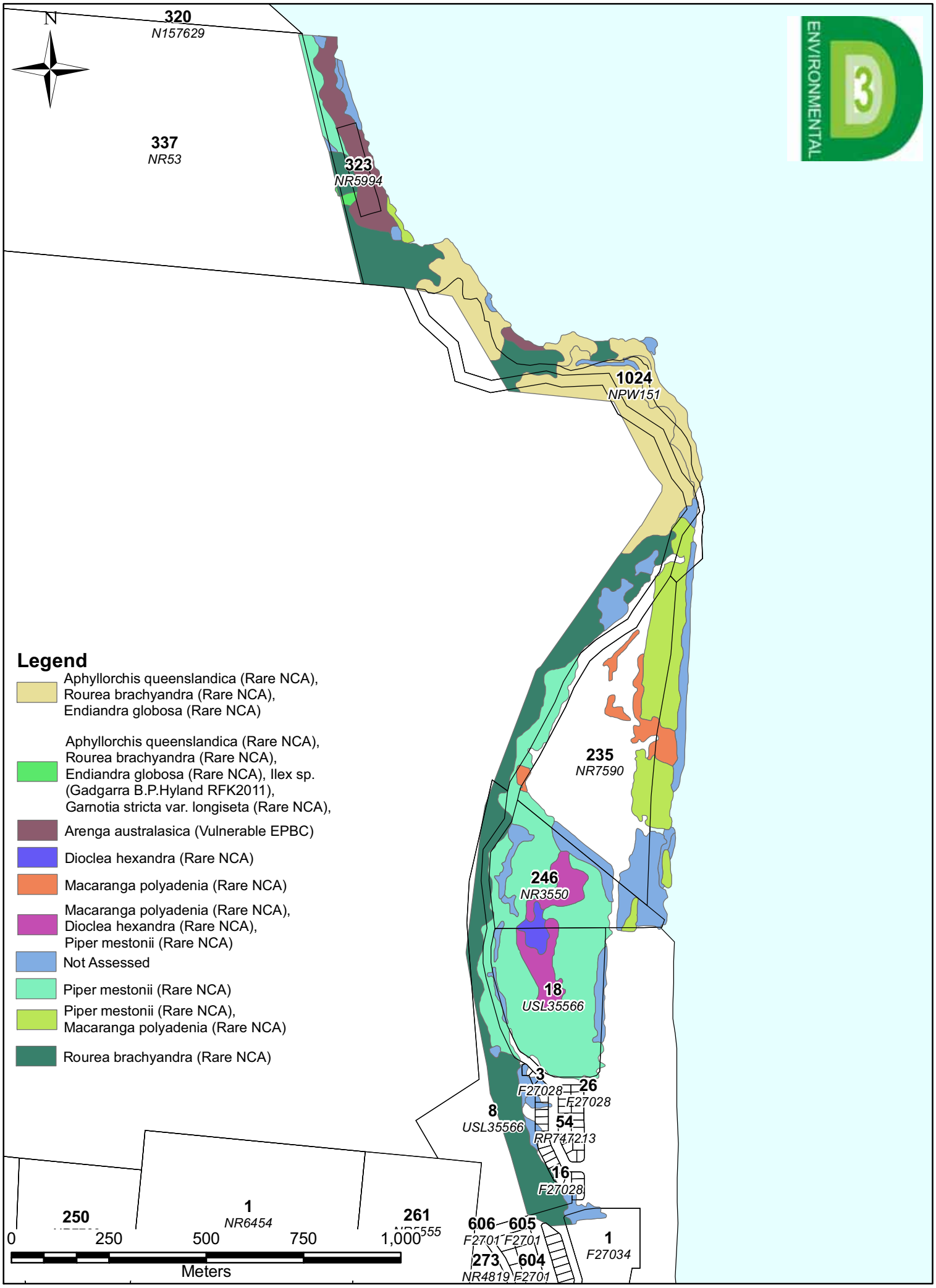

FIGURE 3.6
POTENTIAL HABITAT FOR SIGNIFICANT FLORA SPECIES
ACCESS ROAD OPTION AREA

3.1.3 *Weed Species*

Several declared weeds (under the provisions of the Land Protection Act 1999 (LPA) were recorded within the study area. Pond Apple (*Annona glabra*), Hymenachne (*Hymenachne amplexicaule*), and Sickle Pod (*Senna obtusifolia*) formed stands of sufficient density to allow separation into mappable units (see 3D Environmental 2006a).

3.1.3.1 Pond Apple (*Annona squamosa*)

Pond Apple is Class 2 highly invasive tree weed of swamps in the wet tropical lowlands, and is listed as a Weed of National Significance (WONS) and subject to a Strategic Plan under the National Weeds Strategy (AWC, 2006). This species presents the most serious threat to biodiversity of all exotic species on the site. Of particular concern are the swampland communities of the adjacent Ella Bay National Park which due to the recent disturbance created by Cyclone Larry, are likely to present suitable edaphic conditions for this weed to penetrate otherwise undisturbed areas.

With the tendency for this weed to be spread by animals, both exotic and native, it is likely that this species has already found a niche in several locations within the national park boundary. Within the subject site, the most severe infestations occur on disturbed drainage lines or swamplands where near pure stands of the species often prevail. By law, all landholders must take reasonable steps to keep their lands free of Class 2 pests.

3.1.3.2 Hymenachne (*Hymenachne amplexicaulis*)

Hymenachne is a robust, swamp-dwelling, perennial, exotic grass commonly 1-2.5 m in height that has established on wet drainage lines within the cleared areas on the Ella Bay property. In Queensland it is a declared Class 2 pest, and is a WONS and subject to a Strategic Plan under the National Weeds Strategy Framework (ARMCANZ et al. 2000). The grass has the potential to completely smother wetland communities effectively suffocating native species and destroying aquatic habitats (Stanton 1998). It is generally found as a monoculture able to grow and thrive in water up to 1.5 metres in depth and can form floating mats (Stanton 1998).

When colonising rivers, drains, and wetlands infestations act as silt and nutrient traps and will exacerbate flooding problems through reduction in flood flows (Johnstone Shire Pest Management Plan (2004). There is high potential for this species to spread into undisturbed wetland of National Significance within the adjacent Ella Bay National Park. This threat is significantly increased in the advent of Cyclone Larry which increased light penetration into natural swampland communities. Infestations within the LGA are known from the South Maria Creek System, Mena Creek area, Liverpool Creek and small infestations in the North Johnstone River (Johnstone Shire Council, 2004).

3.1.3.3 Sicklepod (*Senna obtusifolia*)

Sicklepod is an invasive legume that has established within extensive areas of exotic grassland. It is a declared plant that is common throughout LGA on pastures and poorly managed land (Johnstone River Shire 2004) and otherwise occurs between Bamaga to just south of Mackay on coastal areas and on alluvial margins (Mackey et al. 1997). This species favours better drained and more fertile soils, typically on alluvial soils.

Infestations on the subject site are extensive, yet patchy and generally constrained by the dense cover of the *Brachiaria* spp. dominated improved pastures. Large seed reserves that remain in the soil may germinate at any time of the year under favourable conditions (Johnstone River Shire 2004).

3.1.3.4 Other Weed Species

A number of additional exotic species were found on the site, most of these being pasture imports found in association with severely degraded habitats. Species include:

- Hyptis (*Hyptis capitata* and *H. suaveolens*)
- Blue Top (*Aegeratum conyzioides*)
- Broad-leaved Carpet Grass (*Axonopus compressus*)
- Indian Calapo (*Calopogonium mucunoides*)
- Devils Apple (*Solanum torvum*)
- Thick Head (*Crassocephalum crepidioidesare*)
- Tropical Chickweed (*Drymaria cordata*)
- Sensitive Weed (*Mimosa pudica*)
- Giant Panic (*Panicum maximum*)
- Snake Weed (*Stachytarpheta cayennensis*)
- Lantern Burr (*Urena lobata*)

Lantana (*Lantana camara*) (Declared Class 3) and Giant Rats Tail Grass (*Sporobolus pyramidalis*), (declared Class 2) were also recorded at several locations within the study area.

A significant infestation of Yellow Allamanda (*Allamander cathartica*) was observed within the subject site along the access road between the entrance gate and the homestead. Yellow Allamander is a rampant climber known otherwise from isolated infestations in the Johnstone Shire area (Johnstone River Shire 2004).

Infestations of Singapore Daisy were observed along the foredunes of Ella Bay.

3.2 POTENTIAL IMPACTS AND MITIGATION MEASURES

In development planning, the Proponent has largely avoided areas currently supporting remnant vegetation, with the exception of several locations in the south-eastern and eastern portions of the subject site.

Areas of particular sensitivity associated with the proposed development are located within the northern, south-eastern and eastern portions of the subject site. These areas support Regional Ecosystems listed under State legislation (*Vegetation Management Act* (VMA) 1999) and species listed under the EPBC. In addition, a drainage line bisects the site within its central portion, in an east-west direction. The associated riparian vegetation constitutes a protected community under the Queensland VMA.

Potential direct impacts on Regional Ecosystems identified from the current proposal are:

- Disturbance to vegetation within and/or adjacent to Endangered and Of Concern REs;
- Habitat Fragmentation;
- Physical Impacts during the construction phase in the few areas where construction occurs adjacent to remnant vegetation, such as root damage through soil compaction by heavy equipment, and erosion and sedimentation; and
- The introduction and/or spread of exotic species.

Potential cumulative impacts are:

- The introduction and/or spread of exotic species;
- Impacts on wetland vegetation to the north of the proposed development through hydrological and water quality effects;
- Edge-related effects where clearing occurs within and adjacent to remnant vegetation; and
- Increased human and vehicle presence within the remnant vegetation areas, potentially causing trampling or damage to vegetation from vehicles within and surrounding the development area.

As the potential impacts, both direct and cumulative are intimately related, as are the various aspects of the biophysical environment, the following discussion integrates impacts and mitigation solutions to address the potential effects of the development and the planning, design, construction and operational responses to impact management.

Areas where the proposed footprint of the current Concept Masterplan for this development overlaps certified mapped REs are shown in Figure 3.7. Figure 3.8 shows the current Concept Masterplan overlaid with the field-verified Regional Ecosystems (3D Environmental 2006a).

Recommendation V1: The Regional Ecosystems map prepared for this assessment (3D Environmental 2006a) has been based on intensive ground-truthing. A request for a mapping amendment should be made to the Queensland Herbarium.

While the majority of the planned development falls outside of these significant Regional Ecosystems, there is a relatively small node of development partially within 'Of Concern'and 'Not of Concern' REs in the south-eastern portion of the property. The affected 'Of Concern' RE is 7.11.8b (3D Environmental 2006a). On the existing RE mapping (DNW 2005) the RE is shown as 7.11.25 (Of Concern). The affected 'Not of Concern' RE is 7.11.1a (3D Environmental 2006a).

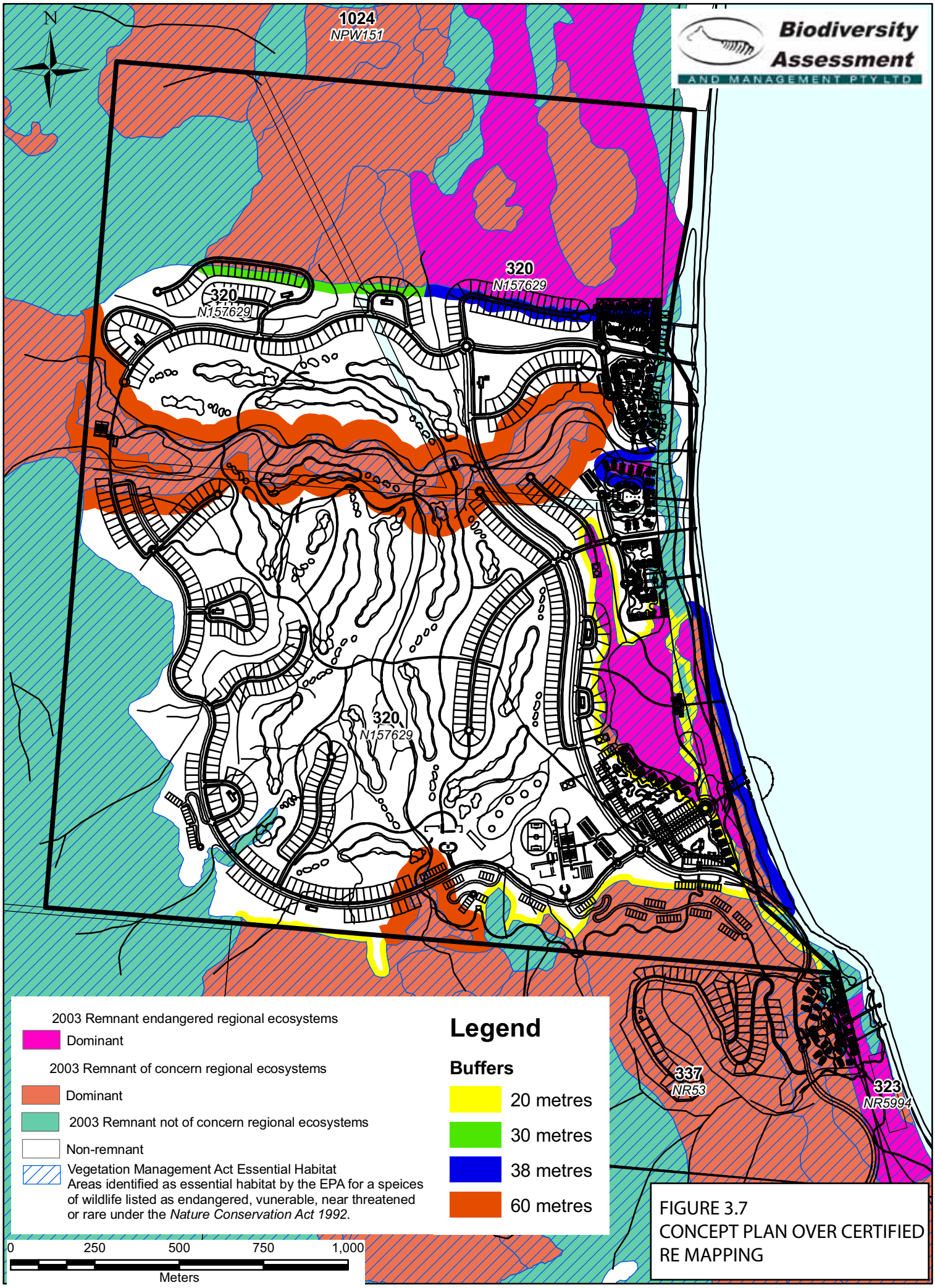

FIGURE 3.7
CONCEPT PLAN OVER CERTIFIED RE MAPPING

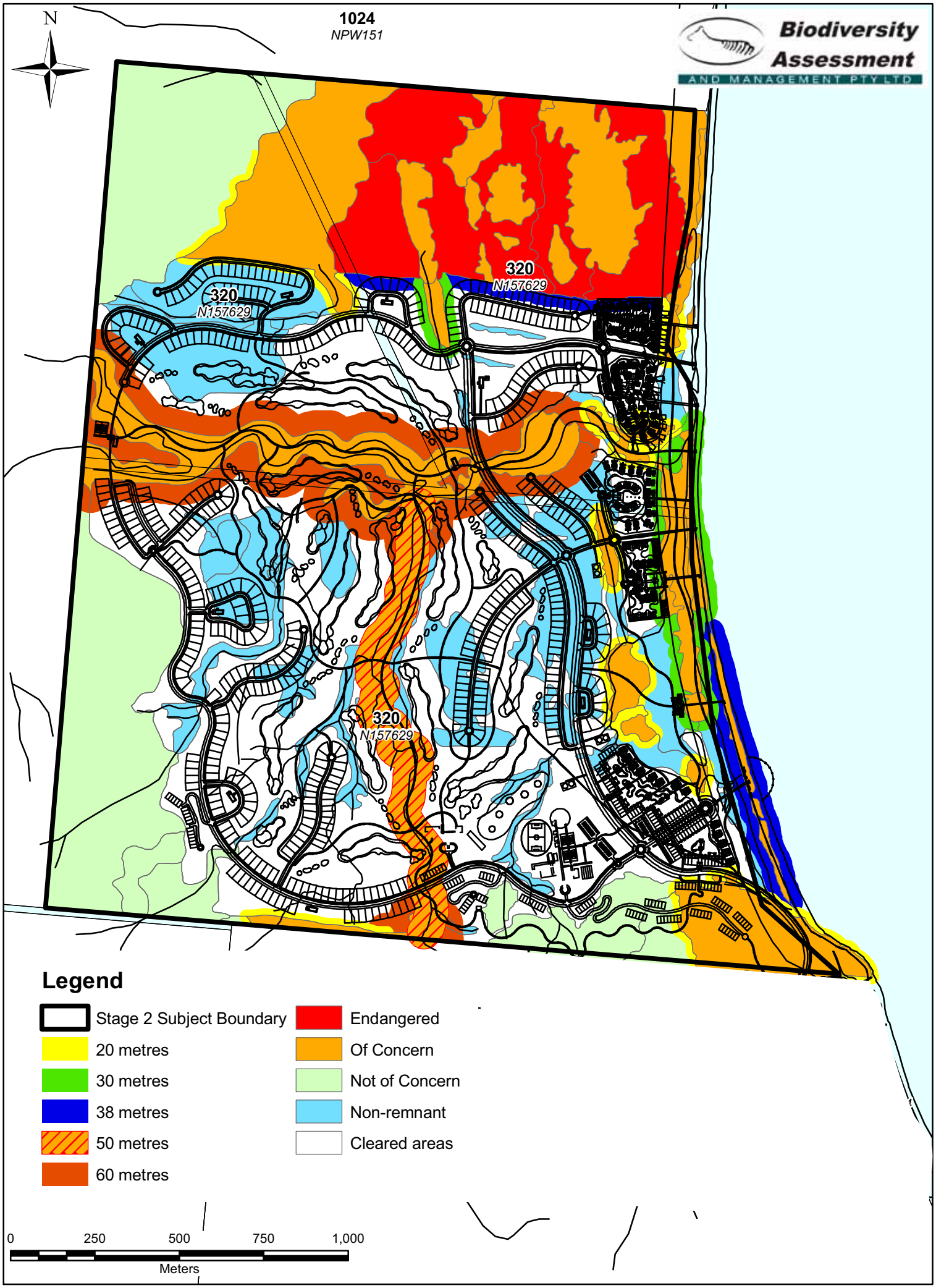

FIGURE 3.8
DRAFT DEVELOPMENT FOOTPRINT OVER
3D ENVIRONMENTAL (2006a) REGIONAL ECOSYSTEMS

Under the Concurrence Agency Policy for Material Change of Use (NRW 2006a), clearing as a result of an Material Change of Use (MCU) in an area to which a Property Map of Assessable Vegetation (PMAV) does not apply, within remnant vegetation containing an *endangered, of concern* or *not of concern* regional ecosystem, and where the project is declared to be a significant project under the State Development and Public Works Organisation Act 1971, section 26, the development is subject to Part S (Requirements for clearing for significant projects) of the Regional Vegetation Management Code for Coastal Bioregions (NRW 2006b).

Appendix 3 provides an assessment of the proposed development under Part S of the Code.

The current Concept Masterplan does not comply with the Acceptable Solutions of Part S of the Code in that:

- It proposes clearing within an 'Of Concern' Regional Ecosystem listed in Table 2 of the Code;
- It proposes clearing within an area mapped under the VMA as 'Essential Habitat' for the Southern Cassowary (*Casuarius casuarius johnsonii*).

There is also potential non-compliance with regards to development of slopes where soils are unstable, although the available information does not currently allow full assessment.

The construction of the proposed access road and the roadways and pedestrian pathways on the eastern edge of the development will require clearing corridors no greater than 10 metres, and most often significantly less, through a mosaic of Regional Ecosystems of 'Endangered', 'Of Concern' and 'Not of Concern' Status. A Construction Vegetation Management Plan is required to guide the construction process. Some of these areas are low-lying and planning of final locations for access needs to consider the requirement for avoiding discharge areas. Construction will also require measures to prevent exposure of acid sulphate soils. Clearing in these areas must carried out in accordance with an acid sulphate soils environmental management plan as outlined in the *State Planning Policy 2/02 Guideline: Planning and Managing Development involving Acid Sulfate Soils*; and follow management principles in accordance with the Soil Management Guidelines in the *Queensland Acid Sulphate Soil Technical Manual*.

Vegetation issues specifically within the access road option area are provided in Section 7.0.

It is understood that the current Concept Masterplan is in draft form, and that legislative requirements for environmental protection, and other site restrictions for construction will guide the final form of the development Infrastructure Plan. As such, the final Infrastructure Plan will take into account the requirements of Part S of the Code, and acceptable or alternative solutions for non-compliance areas under Part S of the Code can be determined in negotiation with NRW.

Recommendation V2: The final Infrastructure Plan to consider the requirements of Part S of the Regional Vegetation Management Code for Coastal Bioregions (NRW 2006b) and acceptable or alternative solutions to be reached in negotiation with NRW to achieve the performance requirements of the Code.

The management status of the significant areas of intact remnant vegetation occurring inside the property boundary but outside of the development footprint is to be determined.

It is recommended that these areas are incorporated into the conservation estate, or be subject to strict conservation orders.

Recommendation V3. The tenure/management status of the significant areas of intact remnant vegetation occurring within the property boundary but outside of the development footprint is to be established via a mechanism that retains their conservation values in perpetuity.

Areas of extant and rehabilitated native vegetation that form major nodes and corridors (e.g. the north-south and east-west corridors) throughout the development area are to be incorporated into a Conservation Covenant with an appropriate management regime in place.

Recommendation V4. Prepare a Conservation Management Plan for native vegetation nodes and corridors within the development area.

The VMA refers to setbacks/buffers in Schedule 10 of IPA which require buffer zones for development with regard to these areas. Buffer zones are required as part of 'essential management' for firebreaks under IPA and to achieve compliance with the Material Change of Use (MCU) codes for clearing vegetation as stated in the VMA

IPA, Schedule 10, section 4.3.22 defines 'essential management' as:

> *'... clearing native vegetation—*
>
> *(a) for establishing or maintaining a necessary fire break to protect infrastructure other than a fence or road, if the maximum width of the fire break is equivalent to 1.5 times the height of the tallest vegetation adjacent to the infrastructure, or 20m, whichever is the greater;*

Figures 3.7 and 3.8 show these buffer areas as calculated from maximum tree heights within the 'Endangered' and 'Of Concern' Regional Ecosystems.

Recommendation V5. A Fire Management Plan to be prepared that calculates appropriate setbacks for development from the adjacent vegetation. The buffer distances can then be negotiated with NRW based on the findings of the study. The Fire Management Plan should also be relevant to the operational phase of the development, and include guidelines for land managers and residents.

Recommendation V6. Once appropriate buffer distances have been established, the Concept Masterplan can be revised to avoid buffer areas. These buffer areas can incorporate fences and roads.

The Concept Masterplan also shows a small number of lots located adjacent to remnant vegetation approximately 40m from the eastern boundary of Ella Bay National Park. While development of these lots would not require any clearing of vegetation, or directly impinge on the vegetation of the park, establishment of residences immediately adjacent to the park boundary has the potential to increase edge effects on park vegetation beyond those currently present. The primary potential impacts on vegetation are (1) the introduction of non-native

species to gardens that may spread to the National Park; (2) an increase in fire risk associated with increased human presence; (3) access to the National Park by residents and associated trampling of vegetation. A proposed Cassowary fence between the development and remnant vegetation to the east would assist in mitigating these impacts.

Construction of the development will require the use of heavy machinery and will introduce a significant construction population to the subject site. While the significant majority of development is proposed for areas already cleared for agricultural purposes, the preparation of a Construction Vegetation Management Plan is required to guide the management of sensitive vegetation during all construction activities. The Plan will include such measures as:

- Equipment washdown procedures to prevent the introduction and spread of weeds from machinery from outside locations;
- Boot and clothing checks for all workers entering the site to ensure that no weed seeds are transported to the construction areas;
- Crossing of vegetated corridors by pedestrian or vehicular paths to be undertaken so as to reduce impacts on riparian vegetation. Clearing to be limited to the width of the crossing, retaining the canopy cover over the crossing area where possible. Any disturbed areas must be rehabilitated immediately;
- Clear demarcation of all vegetation to be retained, and a limit on the distance within which heavy machinery is allowed to prevent soil compaction and subsequent root damage;
- Soil and materials stockpiles to be located in cleared areas;
- Any soil stockpiles to be stabilised using non-fertile vegetative cover to prevent sedimentation and spread of seeds from exotic species; and
- Guidelines for recreational use of surrounding areas.

Recommendation V7. A Construction Vegetation Management plan is prepared to ensure that retained vegetation is protected from construction impacts.

Recommendation V8. A Weed Management Plan is prepared for the construction and operational phases of the development. Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring procedures are to be incorporated into the Plan.

Recommendation V9. An Environmental Code of Conduct is prepared for construction workers and residents to ensure that responsibilities for vegetation protection, fire management and weed management are clear and that National Park regulations are understood. The Environmental Code of Conduct should be incorporated into the induction of any site workers, and should be the subject of community information sessions.

Recommendation V10. Residential allotments should not directly adjoin remnant vegetation to prevent the clandestine dumping of garden waste into natural areas. Roadways between residences and natural areas provide suitable buffers against the spread of garden escapes and other weeds.

The current proposed footprint indicates existing corridors following watercourses will be mostly retained. However, some further fragmentation of these will be necessary to allow traffic and pedestrian movement.

Recommendation V11. When access road and pedestrian access locations are finalised, these areas are to be subject to targeted searches for EVR flora species. Where they are located, the routes will be amended to avoid them where possible. If avoidance is not possible, species-specific management plans are to be prepared to guide the removal and relocation of individuals in accordance with the requirements of the NCA.

Recommendation V12. Within remnant vegetation, pedestrian walkways should be constructed so as to prevent significant ground and vegetation disturbance.

Recommendation V13. Wherever remnant vegetation is traversed by vehicular or pedestrian access ways, construction should be guided by the Construction Vegetation Management Plan, the Weed Management Plan, and the Erosion and Sedimentation Control Plan.

Vegetated corridors within the development area do not currently link with the extensive remnant vegetation to the north.

Recommendation V14. Development design to incorporate the corridor linkages recommended by Moore (2006) (see Figure 4.6), linking the north-south riparian corridor to habitat to the north through rehabilitation.

The significant regional corridor of intact native vegetation of the Seymour Range, within Ella Bay National Park, which borders the development area to the west will not be affected by the proposed development.

Recommendation V15. There are currently no hydrological or water quality specialist studies available for the subject site and surrounds. The presence of a wetland of national and state significance – the Ella Bay Wetland – north of the proposed development area will require a significant level of investigation to determine:

a) Whether runoff and/or groundwater from the proposed development area contributes to wetland area, and to what extent;

b) water quality, flora and fauna of the swamp over a considerable period to capture data for a range of climatic conditions; and

c) the stormwater management and water quality controls that are proposed for the development to protect the integrity of the swamp and its associated biota.

3.2.1 *Rehabilitation and Landscaping*

Rehabilitation and landscaping works have the potential to introduce exotic species to the site, which may spread to surrounding conservation areas, including Ella Bay National Park.

Recommendation V16. A Rehabilitation and Landscaping plan is to be prepared for the development area. All plant species used for rehabilitation and landscaping (both by the developer during construction and on private property during operation) are to be of local provenance, although no species attractive to Cassowaries should be planted outside of the Cassowary corridor areas.

The mechanism by which this is achieved for private property is likely to be through the Body Corporate, although guidelines can be included in the *Environmental Code of Conduct*.

Rehabilitation and landscaping works may require the use of soils and other materials sourced from outside of the subject site. These materials may contain pathogens that can damage native vegetation, as well as the seeds of undesirable species that could spread to adjacent conservation areas.

Recommendation V17. All soil and other materials to be used for rehabilitation or landscaping purposes (both by the developer during construction and on private property during operation) to be restricted to materials certified as free of pathogens and weeds.

Recommendation V18. The Rehabilitation and Landscaping Plan is to include a guide to suitable plant species and materials suppliers that can meet the specified conditions of Recommendations V15 and V16.

3.2.2 *Golf Course Development*

The proposed golf course will require the introduction of grass species that are not native to the area. Such species will require fertilisation, herbicide and pesticide treatment, with the resultant runoff of these pollutants to native vegetation and drainage lines.

Herbicides have direct effects upon aquatic vegetation and indirect effects upon both invertebrate and vertebrate communities (Van den Brink et al 2006; Guiseppe et al 2006). Within aquatic ecosystems vegetation, particularly algae are extremely sensitive to herbicides which may significantly alter flora community structure over time (Van den Brink et al 2006). This has been observed to lead to alteration in the invertebrate community (i.e. increases in detritus feeding species and decreases in suspension feeding organisms).

Pesticides have a direct effect on invertebrates and an indirect effect on plants within aquatic ecosystems (Wendt-Rasch et al 2004). Pesticides have been observed to directly reduce the level of invertebrate herbivores and suspension feeders which results in an increase in algal biomass (Wendt-Rasch et al 2004).

Increases in nutrients within aquatic ecosystems decrease species richness by weakening stabilizing effects (Romanuk et al 2006) such as predation, grazing and species interactions. In addition, the enrichment of water by nutrients especially compounds of nitrogen and phosphorus, causes an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms and the quality of the water concerned (known as eutrophication). Nutrient enrichment tends to stimulate phytoplankton in lakes because micro-algae and cyanobacteria usually grow faster than larger algae or plants, and the resulting biomass absorbs light and so shades out benthic micro-algae or macrophytes.

On and surrounding the subject site, the receiving waterbodies can all be considered to be highly sensitive to external pollutants, and the most strict water quality management conditions will apply.

The prediction of the nature and scale of impacts of golf course operation on groundwater, surface water, and near-shore coastal water quality and wetlands requires state-of-the-art risk assessment and simulation modelling, particularly in high rainfall environments. To achieve the best results from modelling, it is important to obtain site-specific data for these risk assessments such as soil sampling, test borings, stream surveys, and coastal surveys. To run the model, daily weather records must be obtained or generated.

Sophisticated modelling is required for complex drainage patterns at the basin and sub-basin scale, as with golf courses where annual and storm-event runoff values should be computed for pesticides, nutrients, runoff water, and sediments. The results will help fine tune turf management programs and may indicate the need for design changes. On the subject site, modelling may show that the installation of detention basins is required for water quality protection.

Recommendation V19. The golf course is to be designed to prevent pollutants from entering the natural environment. Application of risk assessment and simulation modelling is required to accurately identify potential impacts and design measures to mitigate impacts.

Recommendation V20. A Surface Water and Groundwater Quality Management Plan is required for the operational phase of the project. Water quality standards must be set to protect native terrestrial and aquatic flora, including regular monitoring of receiving waters to detect levels of herbicides, fertilisers and sediment entering natural waterways, and planned responses to adverse results.

The Queensland Government, with funding from the Australian Government has established the Great Barrier Reef Wetlands Protection Programme to develop and implement measures for the long term conservation and management of wetlands in the Great Barrier Reef (GBR) catchment as per strategies contained in the Reef Water Quality Protection Plan (Reef Plan). The objectives of this plan are to: halt and reverse the decline in the quality of water entering the Reef; and to rehabilitate and conserve areas of reef catchment that have a role in removing water-borne pollutants.

Recommendation V21. The Coastal Management Plan and Great Barrier Reef Wetlands Protection Program to be consulted in development and golf course planning.

3.2.3 *Weeds*

Johnstone Shire Council has incorporate a specific code in the draft planning scheme to reduce the probability of new weed incursion occurring on newly developed land. This code requires that any development involving the movement of soil or plant material on the land to be carried out occurs in a manner that does not cause weed spread within the land or to other surrounding lands. The performance criteria identify the following requirements:

- Disturbance of soil and vegetation is limited to the footprint area of the buildings and/ or development;
- Earthmoving and vegetation control machinery and vehicles leave the land only after being thoroughly washed down at a location whereby material will be contained within the land (i.e. not in drainage ways or near the boundaries of the land);
- Any soil or vegetation removed from the area will be in covered loads to reduce the spread of any weeds along the transport corridor;
- Any soil/sand/gravel, hydromulch or vegetation bought into the land will not contain any plant material of any weeds stated schedule 4 (State legislation, or Council's Local Laws and Pest Management Plans).

Table 3.5 summarises the declared plants found in the Johnstone Shire and identifies the priority and measures for control as determined by the Pest Management Plan for the LGA.

Table 3.5: Control Priority and Measures for Declared Plants. Source: Johnstone Shire Council – Pest Management Plan July 2002 – 2006 - Version 1 - 7 May, 2004

Weed Species	Control Priority	Control Measures	Declaration Status (LPA)
Pond Apple (*Annona glabra*)	E	3	C2
Hymenachne (*Hymenachne amplexicaulis*)	B	2	C2
Lantana (*Lantana camara*)	D	4	C3
Sicklepod (*Senna obtusifolia*)	C	3	C2

B. Declared plants found generally in the Johnstone Shire and it is the intent to eradicate the plant from the Shire over time.

C. Declared plants found in the Johnstone Shire which are to be destroyed by owners where found.

D. Declared Plants found generally in Johnstone Shire and are to be controlled by the owners.

E. Declared plants found generally in the Johnstone Shire and information on identification and treatment by owners is promoted.

2. Owner to control plants where they are found. It is the aim of Council that plants in this category are to be eradicated from the Shire over a period of time.

3. Owner to destroy declared plants within time stipulated on notice. Property Management Plan may be entered into providing the Declared Plants ability to multiply is reduced/eliminated.

4. Notice is not generally served, with owners encouraged and informed to be able to identify and treat these plants. Council may serve notice where an owner neglects this general duty, to the detriment of surrounding owners.

Within the project area, the significant weed species is Pond Apple (Annona Squamosa), with the most severe infestations occurring on disturbed drainage lines or swamplands where near pure stands of the species often prevail. Control of feral pigs, should be considered a fundamental practice in any weed eradication program. By law, all landholders must take reasonable steps to keep their lands free of Class 2 pests.

Recommendation V22. Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring are to be incorporated into the Plan, which is to be guided by the Johnstone Shire Pest Management Plan (2004).

4.0 TERRESTRIAL FAUNA

4.1 BASELINE INVESTIGATIONS

4.1.1 *Fauna Survey Results: Listed Species under the Commonwealth's EPBC and Queensland's NCA*

A total of 91 vertebrate fauna species (excluding exotic species) were recorded during the terrestrial fauna survey within the site (BAAM 2006) including seven amphibians, four reptiles, 59 birds, 16 mammals and five fish. In addition, 22 species of butterfly were also opportunistically recorded.

From database searches for the site and surrounds a total of 27 species listed as Endangered, Vulnerable or Rare under both National EPBC and Queensland State NCA legislation are known from the local area (Queensland Museum Database, WildNet and Birds Australia) or may occur (EPBC Online). Results of database searches are found in the appendices of BAAM (2006).

The majority of the recorded species are currently listed in Queensland's as 'Least Concern' wildlife (i.e. native animals that are not currently listed as 'Presumed Extinct, Endangered, Vulnerable or Rare', although are still prescribed as protected wildlife). However seven recorded species are recognised as Endangered, Vulnerable or Rare under Commonwealth's EPBC Act and/or Queensland's NCA. Following the field-based site assessment and consideration of the habitats present within the study area, only some of those species listed are considered likely to occur. (see Tables 4.1 and 4.2).

These species may have been absent from the survey for a variety of reasons including unsuitable prevailing climatic conditions, or due to their cryptic nature making them difficult to detect in one off, short-duration surveys. Until further survey work fails to locate any potential species, they should be considered present in the planning of the project. Potential impacts to species of conservation significance that were observed, or that are considered likely to occur in the subject site and in proposed access road option areas, are discussed in detail in Section 7.0.

The location of observations for significant species under the EPBC and NCA during the survey are shown in Figure 4.1.

Table 4.1: Terrestrial Fauna Survey Results: Relevant listed species under the Commonwealth's EPBC Act recorded in the BAAM survey (2006) or considered likely to occur

Scientific Name	Common Name	EPBC Status	Occurrence
Birds			
Casuarius casuarius johnsonii	Southern Cassowary (Australian)	Endangered	**Recorded BAAM 2006**
Amphibians			
Litoria rheocola	Common Mistfrog	Endangered	**Recorded BAAM 2006**
Nyctimystes dayi	Lace-eyed Tree Frog, Australian Lacelid	Endangered	Potential
Mammals			
Pteropus conspicillatus	Spectacled Flying-fox	Vulnerable	**Recorded BAAM 2006**
Reptiles			
Chelonia mydas	Green Turtle	Vulnerable	Possible but unlikely

Table 4.2: Fauna Survey Results: Relevant species listed under the NCA recorded in the BAAM survey (2006) or considered likely to occur

Scientific Name	Common Name	NCA Status	Occurrence
Birds			
Accipiter novaehollandiae	Grey Goshawk	Rare	**Recorded BAAM 2006**
**Casuarius casuarius*	Southern Cassowary	Endangered	**Recorded BAAM 2006**
Collocalia spodiopygius	White-rumped Swiftlet	Rare	Expected
Cyclopsitta diophthalma macleayana	Double-eyed Fig-parrot	Vulnerable	**Recorded BAAM 2006**
Esacus neglectus	Beach Stone-curlew	Vulnerable	**Recorded BAAM 2006**
Neochmia phaeton	Crimson Finch	Vulnerable	Expected to occur
Ninox rufa queenslandica	Rufous Owl	Vulnerable	Potential
Amphibians			
Cophixalus infacetus		Rare	**Recorded BAAM 2006**
**Litoria rheocola*	Common Mist Frog	Endangered	**Recorded BAAM 2006**
**Nyctimystes dayi*	Australian Lacelid	Endangered	Potential
Mammals			
Taphozous australis	Coastal Sheathtail Bat	Rare	Potential
Reptiles			
Coeranoscincus frontalis		Rare	Potential
Crocodylus porosus	Saltwater Crocodile	Vulnerable	Expected
Eulamprus tigrinus		Rare	Expected
Insects			
Hypochrysops apollo apollo	Apollo Jewel	Vulnerable	Potential

* Also listed as under EPBC

Six migratory species listed under the EPBC have been recorded from the site. In addition to these six species, three other migratory species are expected to occur (Table 4.3).

Table 4.3: Fauna Survey Results: Observed or Likely Migratory Bird Species

Scientific Name	Common Name	Habitat
OBSERVED		
Ardea ibis	Cattle Egret	Pasture and open wetlands
Haliaeetus leucogaster	White-bellied Sea-eagle	Coastal habitats, estuaries, inland rivers.
Monarcha trivirgatus	Spectacled Monarch	Mesic vegetation including rainforest.
Monarcha melanopsis	Black-faced Monarch	Mesic vegetation including rainforest.
Rhipidura rufifrons	Rufous Fantail	Mesic vegetation including rainforest.
Merops ornatus	Rainbow Bee-eater	Aerial forager over a variety of habitats
POTENTIAL OCCURRENCE		
Hirundo rustica	Barn Swallow	Aerial species mostly over open habitats
Hirundapus caudacutus	White-throated Needletail	Aerial species which forages over all terrestrial habitats.
Apus pacificus	Fork-tailed Swift	Aerial species which forages over all terrestrial habitats.

All observed migratory species are considered to be common within the bioregion and local area. All species except White-bellied Sea-eagle are likely to be represented by multiple pairs or groups within the development site and local area. White-bellied Sea-eagles usually occur in pairs that defend a large territory. No potential White-bellied Sea-eagle nests are known from the site.

White-throated Needletail, Fork-tailed Swifts and Barn Swallows are aerial feeders, taking insects on the wing and rarely landing. They forage over large areas, including urban and agricultural lands.

Figure 4.1: Location of Significant Species Records

4.1.2 *Macropus agilis (Agile Wallaby)*

While not significant in terms of its conservation status, the presence of the Agile Wallaby has significance in terms of the size of the resident population. Thousands of individuals inhabit the exotic grasslands and surrounding native forests of the subject site.

4.1.3 *Exotic Fauna*

Two exotic fauna species were recorded during the survey, these were Feral Pigs (Sus scrofa) and House Mouse (Mus musculus). Feral Pigs are listed as Class 2 pests under the Land Protection (Pest and Stock Route Management) Act 2002 (LPA). A Class 2 pest is one that is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact. Landowners must take reasonable steps to keep land free of Class 2 pests.

Feral Pigs and Dogs have the potential to cause significant harm to Cassowary populations. They are known to attack and kill Cassowaries as well as compete for food, destroy habitat, promote invasive weed species and to destroy entire Cassowary clutches. Feral Pigs are currently recognised as a Key Threatening Process under the EPBC.

4.2 POTENTIAL IMPACTS AND MITIGATION MEASURES

Areas of particular sensitivity associated with the proposed development are located within the northern, south-eastern and eastern portions of the subject site. These areas support remnant vegetation. In addition, a drainage line bisects the site within its central portion, in an east-west direction, the associated riparian vegetation supports a range of fauna species and contributes to fauna movement opportunities across the otherwise cleared development area.

Potential direct impacts on fauna habitat identified from the current proposal are:

- Disturbance and/or removal of habitat within or adjacent to significant remnant habitat or other habitat supporting significant species;
- Habitat fragmentation and subsequent impacts on fauna movement;
- Physical impacts during the construction phase such as root damage to standing vegetation and erosion and sedimentation;
- The introduction and/or spread of exotic pest species;
- Rehabilitation improving the condition of, and widening the network of corridors for fauna movement; and
- Removal of cattle from the property, and the cessation of associated habitat degradation, particularly along the creeklines.

Potential cumulative impacts are:

- The introduction and/or spread of exotic pest species;

- Hydrological and water quality impacts of the development on the creeks within the subject site;
- Impacts on the wetland ecosystem to the north of the proposed development through hydrological and water quality effects;
- Edge-related effects where clearing occurs within and adjacent to intact habitat;
- Increased vehicular traffic on roads leading to increased fauna road deaths;
- Introduction of domestic pets/animals which potentially prey on native species or create a disease risk for native species;
- Increased human and vehicle presence within habitat areas within and surrounding the development area, including the foreshore, potentially causing trampling or damage to habitat from vehicles.
- Habitat under long term management to control weeds and pest animal species; and
- Fauna research opportunities through partnerships with academic institutions.

The following sections provide assessment of direct and cumulative impacts and mitigation solutions for each of the significant fauna species and their habitats to address the potential effects of the development and the appropriate planning, design, construction and operational responses to impact management.

Issues related to the proposed road access route options are discussed briefly in the following sections, with a more detailed analysis provided in Section 7.0.

4.2.1 *Casuarius casuarius (Southern Cassowary)*

4.2.1.1 Presence on the Subject Site

Southern Cassowaries have been recorded several times within and surrounding the development site. Furthermore, vegetation surrounding the development area is mapped as essential habitat for this species by the EPA. Due to the sensitivity of this species, it has been the subject of targeted and specific work (Moore, 2006). Results of this report are summarised in this section.

The Ella Bay Cassowary field survey and subsequent analyses undertaken by Les Moore (2006) encompassed the local Cassowary population and included all Cassowaries that inhabit or pass through the project site or adjacent, nearby areas.

Approximately 9.5 km2 were surveyed on foot over a period of eight days (6-14 November 2005). The total search effort resulted in the location of 72 cassowary signs comprising sightings, measured footprints, partial footprints, and droppings. Three cassowaries comprising two adult males and one adult female were utilising the Ella Bay Property during the field survey (Figure 4.2).

There were no indications, by either sightings or footprints, of the presence of juvenile or young subadult Cassowaries in this part of the study area and Moore (2006) concluded

that the majority of the dependent chicks and young subadults in the study area died during or following Cyclone Larry.

Although few fruits were visible on the trees, a number of Cassowary food species were recorded in droppings. Food items recorded in droppings included:

- Foxtail Palm *Wodyetia bifurcata* (exploited garden plants);
- Wait-a-while *Calamus australis*;
- Currywood *Polyathalia michaelii*;
- Zamia Palm *Lepidozamia hopei*;
- Blue Quandong *Elaeocarpus angustifolius*;
- *Ficus* sp.;
- *Cryptocarya* sp.; and
- Bracket fungi.

A number of Cassowary habitat types recognised by EPA occur within the subject site. An analysis of their relative values, role in connectivity, provision of known, likely or supplementary resources for food, water, breeding and shelter has been undertaken by Moore (2006). The recognised Cassowary habitat types within the Ella Bay Property are shown on Figure 4.3.

Figure 4.2: Areas of Activity of Ella Bay Property and Little Cove Cassowaries 6-12 November, 2006

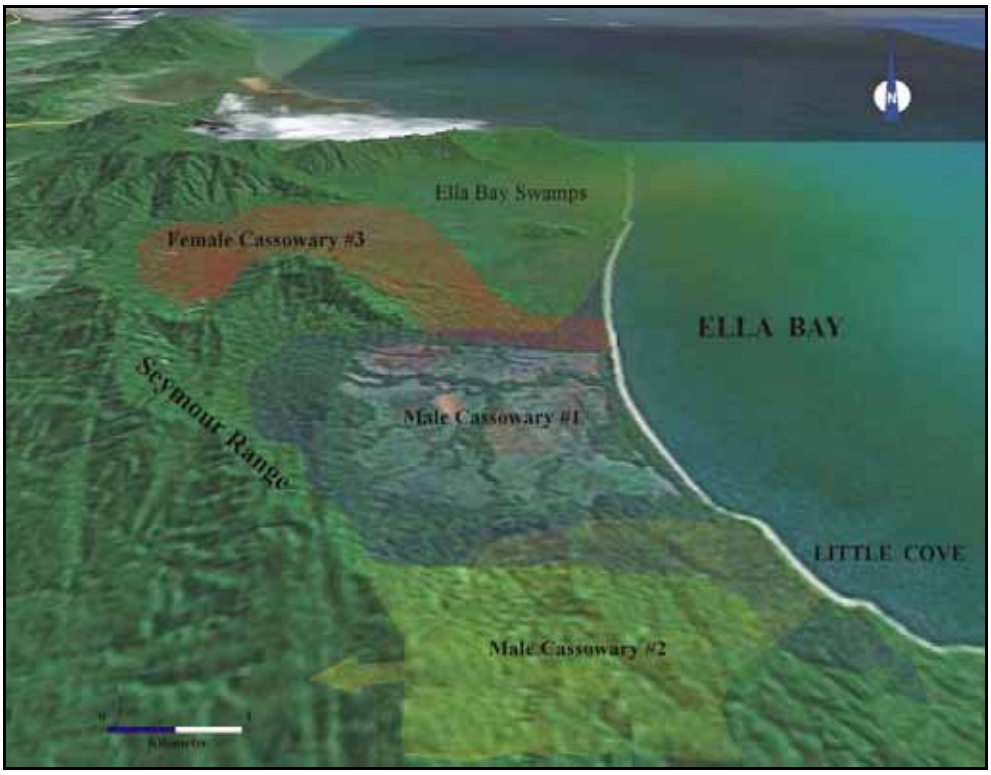

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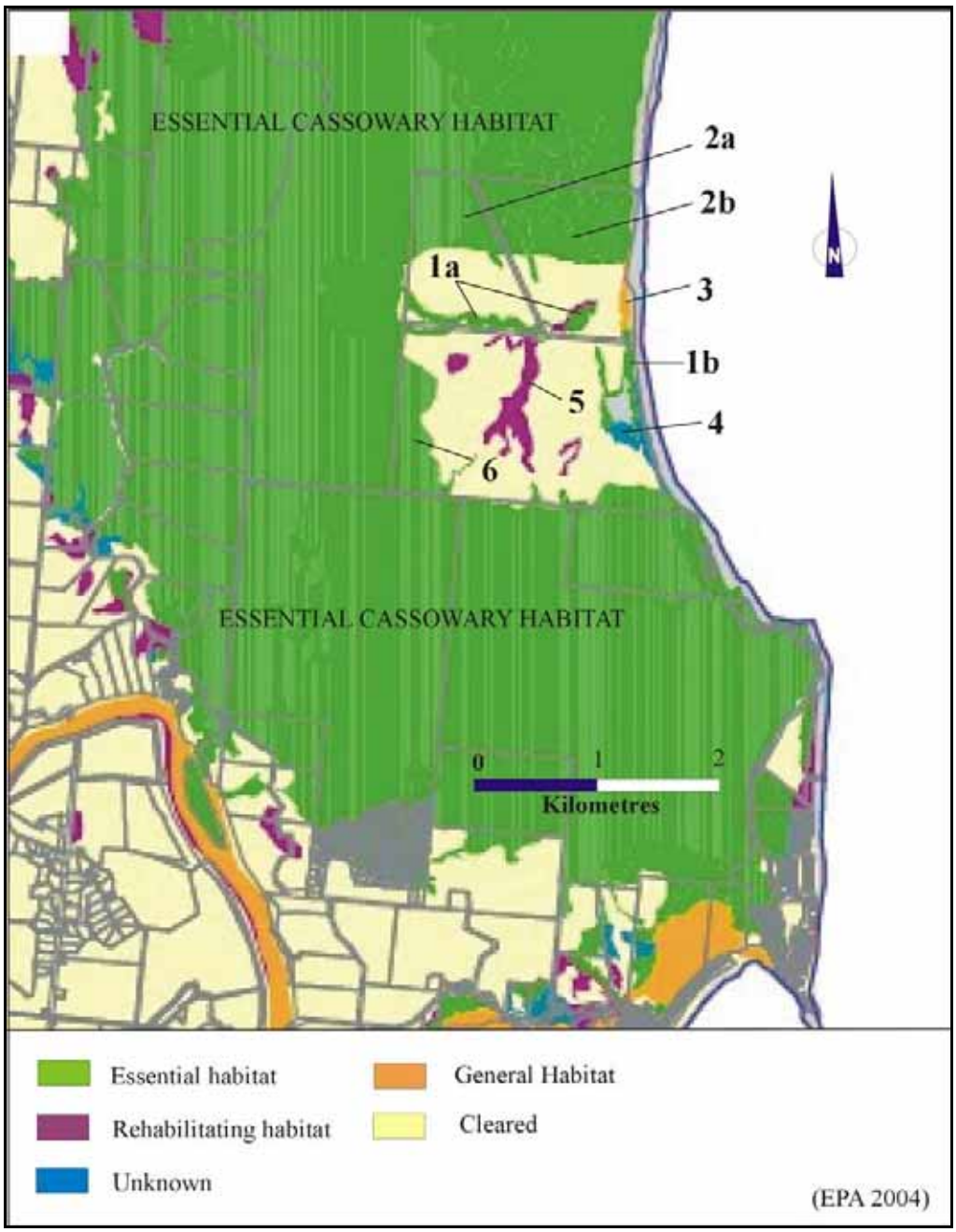
Figure 4.3: Cassowary habitat types at the Ella Bay Property



4.2.1.2 Essential Habitat under the VMA

While the majority of the planned development falls outside of areas of significant fauna habitat, there is a relatively small node of proposed development in the south-eastern portion of the property that is situated within remnant vegetation.

Under the Concurrence Agency Policy for Material Change of Use (NRW 2006a), clearing as a result of an Material Change of Use (MCU) in an area to which a PMAV does not apply, within remnant vegetation containing an *endangered, of concern* or *not of concern* regional ecosystem, and where the project is declared to be a significant project under the State Development and Public Works Organisation Act 1971, section 26, the development is subject to Part S (Requirements for clearing for significant projects) of the Regional Vegetation Management Code for Coastal Bioregions (NRW 2006b). Appendix 3 provides an assessment of the proposed development under Part S of the Code.

The current Concept Masterplan does not comply with the Acceptable Solutions of Part S of the Code in that it proposes clearing within an area mapped under the VMA as 'Essential Habitat' for the Southern Cassowary (*Casuarius casuarius*).

It is understood that the current Concept Masterplan is in draft form, and that legislative requirements for environmental protection, and other site restrictions for construction will guide the final form of the development Infrastructure Plan. As such, the final Infrastructure Plan will take into account the requirements of Part S of the Code, and acceptable or alternative solutions for non-compliance areas under Part S of the Code can be determined in negotiation with NRW.

Recommendation F1: The final Infrastructure Plan to consider the requirements of Part S of the Regional Vegetation Management Code for Coastal Bioregions (NRW 2006b) and acceptable or alternative solutions to be reached in negotiation with NRW to achieve the performance requirements of the Code.

4.2.1.3 Potential Direct, Indirect and Cumulative Impacts

The potential direct impacts of developing a resort within the Ella Bay Property on the Cassowary population include:

- Loss of 'essential' and 'general' Cassowary habitat within the development footprint;
- Loss of safe access to retained remnants of Cassowary habitat within the development;
- Interactions with people including habituation due to feeding;
- Interactions with domestic animals including dogs;
- Collision with vehicles.

Indirect impacts on Cassowaries are sometimes more difficult to pin down but certainly include:

- A reduced carrying capacity from loss of habitat leading to pressures on reproductive productivity and recruitment;
- Barriers to traditional movement corridors leading to disruption of social breeding systems;
- Increased human activity and noise resulting in animals withdrawing from adjacent forest;

- Increased risk of road death to Cassowaries occupying adjacent or nearby habitat due to increased traffic flows;
- Negative interactions between humans and Cassowaries resulting from the attraction of Cassowaries into urban areas created by the planting of domestic and native fruiting trees, and the presence of standing water in backyard pools or ponds (Cassowaries have to drink two to three times per day);
- Disturbance from night lighting along streets and in residences;
- Potential transmission of disease from domestic animals to Cassowaries e.g., poultry, dogs, and cats;
- Rehabilitation improving the condition of, and widening the network of corridors for Cassowary movement; and
- Removal of cattle from the property, and the cessation of associated habitat degradation, particularly along the creeklines.

This causal pathway approach recognises that although individual actions may be insignificant by themselves, the *aggregate* of these effects have a significant effect. For the subject site, cumulative impacts on Cassowaries are considered to include:

- increased likelihood of further subdivision on the remaining freehold lots in the area, although the proponent has advised that the Local Area Plan will not allow for intensification of development;
- increased pressure on surrounding remnant vegetation and population linkages;
- increased traffic flow to and from the development.
- Habitat under long term management to control weeds and pest animal species; and
- Research opportunities through partnerships with academic institutions.

4.2.1.4 Impact Assessment Methodology

To provide a transparent assessment of the potential impacts on the Cassowary population of the proposed development, an analysis of the Significance and the Magnitude of each effect has been applied to the subject site. The overall score is gained by multiplying the Significance by the Magnitude. Brief definitions of these terms are given below:

Significance: Reflects the effect of the change that may take place (Wood, 1995). In this instance, the main elements used in assessing significance of impacts are scientific and professional judgement, the extent of disturbance to the valued ecological system or species, and the level of public concern.

Magnitude: The estimation of the degree, extensiveness, and scale of the interaction, and varies according to the extent of the action and the significance of the environmental effects involved.

While the Significance criteria are self-explanatory, an explanation is given below for the terms used to represent the predicted Magnitude of an affect. These are:

Some change: Denotes occasional exposure to an effect which significantly alters normal cassowary behaviour, and which results in a persistent low risk to individual birds or the population.

Moderate change: Denotes regular exposure to an effect that results in a moderate risk to individual birds or the population.

Large change: Denotes a constant exposure to an effect which places an individual Cassowary or the population to high to extreme risk on a daily basis.

It is important to note that the criteria used in weighting the Magnitude scores are not empirical, but instead are based on professional judgements. The guideline criteria are given in Table 4.4.

Table 4.4: Guideline Criteria for Impacts to Cassowaries

Significance		Magnitude	
No perceived negative impact	0	No perceived change	0
Impact on individual bird within subject site	-2	Some change	2
Impact on study area cassowary population	-4	Moderate change	4
Impact on Seymour Range cassowary population	-6	Large change	6
Impact on the Wet Tropics cassowary population	-8		

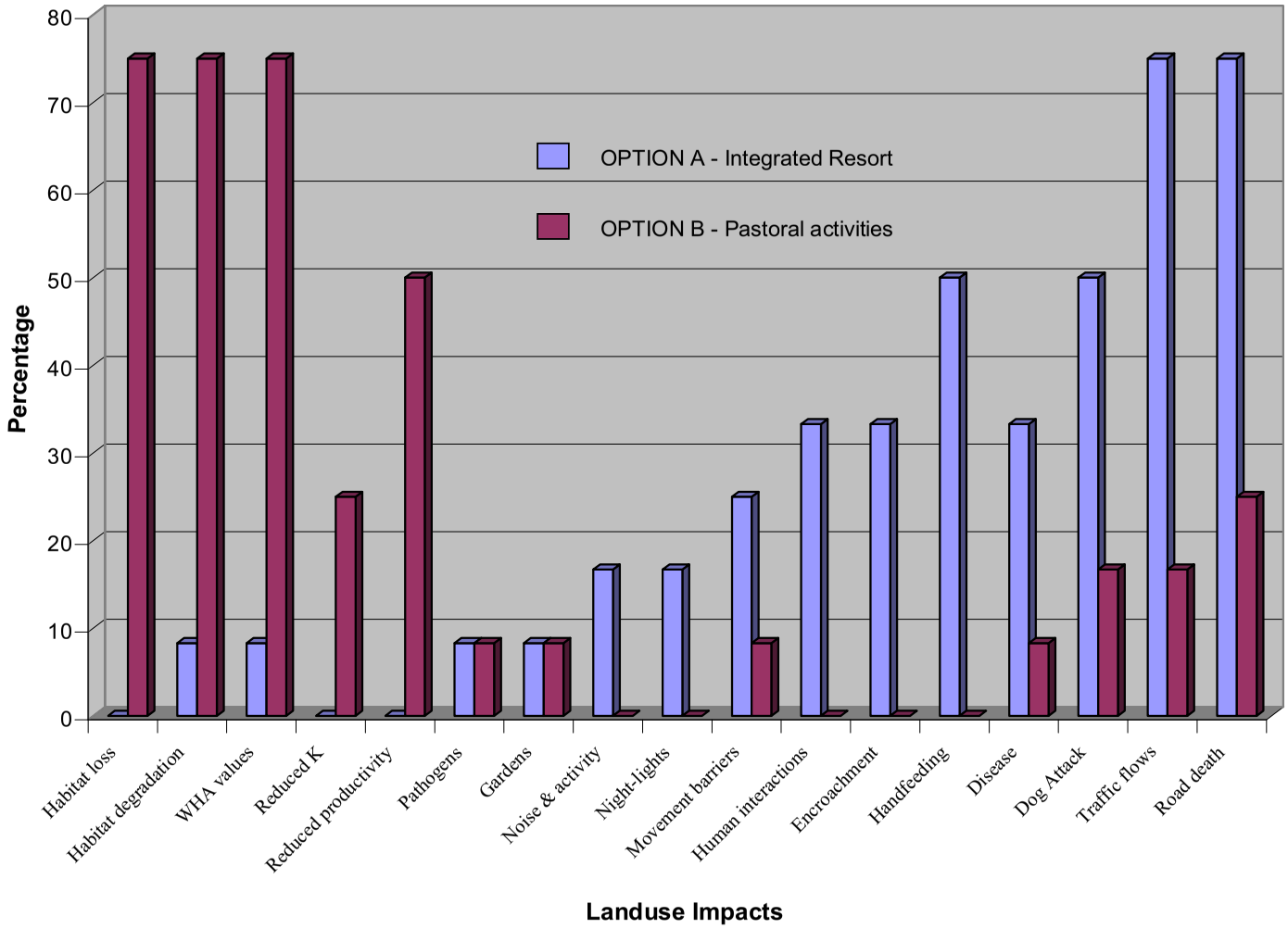
Table 4.5: Cassowary Impact Assessment for Ella Bay Integrated Resort

Development Impacts	Significance	Magnitude	Overall Score[2] (Max = -48)	% of Maximum Impact
Habitat loss on site	0	0	0	0
Habitat degradation (edge effect) and encroachment (e.g., off-property pathways and picnic spots)	-2	2	-4	8.3
Traffic flows	-6	6	-36	75.0
Road death	-6	6	-36	75.0
Dog attack	-4	6	-24	50.0
Movement barriers (fences/roads)	-2	6	-12	25.0
Negative interactions with humans[1]	-4	4	-16	33.3
Hand-feeding issues[1]	-4	6	-24	50.0
Disease	-4	4	-16	33.3
Usage of adjoining forest by people (disturbance & interactions)	-4	4	-16	33.3
Domestic fruit trees and water sources	-2	2	-4	8.3
Increased noise and activity	-2	4	-8	16.7
Night lighting adjoining forest area	-2	4	-8	16.7
Invasion of pathogens affecting habitat quality (e.g., *Phytopthora*)	-2	2	-4	8.3
Reduced population carrying capacity (K)	0	0	0	0
Reduced productivity and recruitment	0	0	0	0
Impact on adjoining WHA National Parks (weed invasion)	-2	2	-4	8.3
Total Effect			**-200**	**416.5**
Maximum Possible Total Effect			-816	1700
Change as Percentage of Maximum			**-24.5**	**24.5**

[1] Subsequent risk of relocation and disruption to local social breeding systems.
[2] Magnitude x Significance

The results of the impact assessment analysis for the Ella Bay Integrated Resort Master Plan development option are presented in Table 4.5. Those impacts considered extreme i.e., scores from -24 to -48, are shaded in pink, while those that have a significant negative impact i.e., scores greater than ten, are shaded in light yellow. A comparison of the potential impacts of the proposed development vs existing land use (pastoral activities) is provided in Figure 4.4.

Figure 4.4: Comparison of Environmental Impacts for the Integrated Resort Project vs. Pastoral Activities



Although all Overall Scores less than -8 (n = 8 of 17 identified impacts) indicate a considerable negative impact on Cassowaries from the proposed development, those scores from -24 to -48 (n = 4) represent impacts judged to have "extreme" impacts on the viability of the Cassowary population of the Ella Bay Property, and that of the Seymour Range Cassowary population. These effects include road death (75%), increased traffic flows (75%), hand-feeding (50%), and dog attack (50%).

Other issues resulting from the development that potentially impact on Cassowaries at the Ella Bay Property result from an increase in long-term human activity of the area, and the problems associated with cassowary and human interactions. These include negative interactions with humans (33.3%); the potential for an increased use of the adjoining forests by residents and visitors (33.3%); disease (33.3%); and movement barriers (25%).

Analysis of the "do nothing" option (Moore 2006 – Volume II) shows that generic potential for impact is more or less identical between the two activities i.e., 24.5% (proposed development) compared to 23.0% (pastoral activities). However, the nature of the specific impacts influencing the total outcomes differs markedly. The major impacts associated with the integrated resort relate to the threats posed by the increased traffic flow along Ella Bay Road, and people and wildlife management issues associated with a permanent human population using the Ella Bay Property. In contrast, the major impacts associated with continued pastoral land use involve the permanent loss or degradation of Cassowary habitat within the site, and the potential devaluing of World Heritage Area values resulting from habitat degradation, edge effects, and the spread of declared weeds into the adjoining Ella Bay National Park.

The impacts resulting from the continued use of the Ella Bay Property as a pastoral property are not easily addressed. As freehold ownership includes an 'as of right' entitlement to agricultural activities within the property, there are few, if any, mitigation strategies that are assured of being enacted outside the requirement for controlling pond apple. For example, there is no statutory obligation on the landowner to fence off the drainage lines or the remnant vegetation to prevent ongoing habitat degradation. In addition, while a permit is required to undertake further vegetation clearing, there is no obligation on the landowner to revegetate already cleared land or restore degraded habitat.

4.2.1.5 Mitigation Strategies

In the case of the proposed development, there are a number of possible mitigation strategies, in addition to those which have been identified in the Master Plan, which can be applied to reduce the identified impacts. The primary objective of these mitigation strategies should be to maintain or preferably reduce impacts in the area of road risk and human/wildlife management to that approximating those for the existing pastoral land use.

The following mitigation proposals are inherent in the current proposal and have been identified in discussions with the developers and through an ecological appraisal of the Ella Bay Master Plan:

1. All lost or compromised habitat will be compensated for by revegetation and remnant enhancement, with the aim of increasing the total amount of essential Cassowary habitat above what currently exists at the site.

2. All declared weed species currently exploited by Cassowaries i.e., pond apple *Annona glabra*, will be removed from the property in a weed-control program.

3. Approved Cassowary and people-proof fencing will be erected to prevent interactions between the Cassowary(s) and the Integrated Resort.

4. All pedestrian walkways through Cassowary corridors will be elevated above the forest floor to separate Cassowaries and people, and to provide unhindered Cassowary use of the creek and associated vegetation.

5. Such pedestrian walkways will be strategically located to minimise any disturbance to the normal behaviour of the Cassowary(s).

6. The pedestrian 'walkovers' may serve as a focal point for ecological interpretation, particularly that of the endangered Cassowary.

7. A strict dog control program will be enforced.

8. There will be limited vehicle use within the grounds of the Integrated Resort.

9. Existing cattle fences will be removed to improve access to the vegetated corridors.

Further mitigation strategies are required to facilitate the continuation of normal Cassowary behaviour while minimising the possibility of adverse contact between Cassowaries and humans. In the context of this impact assessment, 'contact' includes injury or death of Cassowaries from collision with vehicles, and dog attack. As such, an approved Cassowary Management Plan will need to be developed for the Ella Bay Property and the road connecting it with the Flying Fish Point township. This management plan should present the specific locations and types of mitigation to be used in detail, and include a long-term monitoring component. Those specific strategies that comprise the cassowary management plan are dependant on the final design of the Master Plan and the location and form of the Ella Bay Road upgrade, but should include the following elements:

Rehabilitating and augmenting Cassowary habitat so there is no net loss:

The distribution of Cassowary habitat in the Wet Tropics bioregion was mapped by the Environmental Protection Agency (EPA) in 2004. The habitat types used by EPA for categorising cassowary habitat in this mapping project are provided in Moore (2006, Volume I). The EPA habitat types, in order of their relative importance to cassowaries, are listed below:

1. Essential habitat;
2. General habitat;
3. Rehabilitating habitat;
4. Other vegetation;
5. Unknown;
6. Cleared;
7. Cultivated.

As indicated in the Ella Bay vegetation survey results (3D - BAAM 2006a), the Ella Bay Property contains vegetation mapped as 'Essential Habitat', 'General Habitat', and 'Rehabilitating Habitat' for the endangered Southern Cassowary *Casuarius casuarius johnsonii* (EPA 2004). The recognised Cassowary habitat types are shown in Figure 4.5. Cassowary corridors on the subject site as determined from field survey are shown in Figure 4.6. A summary of the relative values to the species of each numbered location is provided in Table 4.6 along with possible mitigation strategies for each identified location.

Figure 4.5: Cassowary Corridors on the subject site

Table 4.6: Values and Recommended Mitigation Strategies for impacts of Cassowary Habitat in the area of the Ella Bay Integrated Resort (Recommendation F2)

Location no. (Figure 4.3)	Cassowary Habitat Type (EPA 2004)	Values	Recommended Mitigation Strategies (Recommendation F2)
1a	"Essential Cassowary Habitat"	The Cassowary survey concluded that the resident adult male cassowary (Cassowary #1) made regular use of this riparian corridor. The corridor contains numerous potential Cassowary food trees, the most common being Blue Quandong *Elaeocarpus angustifolius*. It also allows an alternative access route for Cassowaries to forage in the feather palm dominated mesophyll forest to the north of the property.	It will be necessary to ensure Cassowaries have safe access to the area. In addition, the inclusion and revegetation of an additional movement corridor, shown as (B) on Figure 4.5, will facilitate Cassowary movement into the Ella Bay Swamp, to the north of the Ella Bay Property.

Location no. (Figure 4.3)	Cassowary Habitat Type (EPA 2004)	Values	Recommended Mitigation Strategies (Recommendation F2)
1b	"Essential Cassowary Habitat" Should be reclassified to "General Habitat" (Moore 2006)	This area comprises *Melaleuca* dominated open forest/woodland, degraded in places by cattle grazing and weed infestations. It is considered that it holds little in the way of ecological benefits for Cassowaries while potentially allowing adverse interactions between birds and visitors.	It is recommended that this area be closed off to Cassowaries. Any Cassowary habitat lost as a result should be compensated for by the inclusion and revegetation of a Cassowary movement corridor linking the main east-west corridor to the Ella Bay Swamp forest block to the north of the Ella Bay Property ('B' on Figure 4.5).
2a	"Essential Cassowary Habitat"	This area currently provides habitat for two adult Cassowaries (Cassowary #1 and Cassowary #3), and acts as an important buffer for the Ella Bay Swamp, listed as an '*Important Wetland in Australia* (WTMA 2005)'.	Acceptable solutions to allow the preservation of the essential cassowary habitat in this area include Cassowary-proof fencing, a restriction on use by residents and visitors to the resort, and a strict dog control program.
2b	"Essential Cassowary Habitat"	This area comprises a mosaic of open eucalypt forest with a vine forest sub-canopy, and feather palm dominated mesophyll vine forest. The area was significantly damaged by Cyclone Larry but is an important habitat for Cassowaries.	Acceptable solutions to allow the preservation of the essential cassowary habitat in this area include Cassowary-proof fencing, a restriction on use by residents and visitors to the resort, and a strict dog control program.
3	"General Habitat" Should be reclassified to "Other Vegetation" (Moore 2006)	This location contains no worthwhile habitat for Cassowaries, being comprised of shrubland dominated by exotic and declared weed species. Weed control programs will remove these weeds, thus making it unattractive to Cassowaries.	It is recommended that the area be closed off to Cassowaries.
4	"Unknown" Should be reclassified to "Other Vegetation" (Moore 2006)	This area comprises an exotic shrubland dominated by infestations of pond apple *Annona glabra* and is not natural or suitable Cassowary habitat. In addition, as this non-native food source will be removed in any future weed control for the site.	It is recommended that the area be closed off to Cassowaries.
5	"Rehabilitating Habitat"	This north-south drainage line does not currently provide much in the way of food resources for Cassowaries, and for much of its length comprises secondary regrowth forest with little sub-canopy. If allowed to return to a remnant state, however, the corridor would be categorised as general cassowary habitat. In addition, it provides an alternative movement corridor for Cassowaries in the south of the property allowing them to access the main east-west corridor, and thus to the National Park located west and north of the site.	Given the potential significance of this corridor to the local Cassowary population, it will be necessary to ensure Cassowaries have safe use of the site.
6	"Essential Cassowary Habitat"	This area comprises disturbed notophyll to mesophyll vine forest on the foothills of the Seymour Range. Although severely impacted by Cyclone Larry, this habitat currently provides important food and water resources for Cassowaries.	Acceptable solutions to allow preservation of this essential habitat must be met, if consent to develop is to be granted.

Retaining and creating connecting corridors of vegetation through the site:

In the fauna assessment of the Ella Bay Property (BAAM 2006), it is recommended that a buffer zone of at least 50 metres be established and revegetated either side of the existing drainage lines to protect the habitat of the threatened mist frog *Litoria rheocola*. This 100 metre-wide corridor, in addition to the requirement for the construction of appropriate Cassowary-proof fences lining the movement corridors, is considered an adequate minimum width for Cassowaries.

Figure 4.5 shows the major Cassowary movement corridors within the Ella Bay Property superimposed onto the Resort Master Plan. The location and extent of the Cassowary-proof fences, the approximate locations of the Ring Road crossing points over the cassowary corridors, and the additional north corridor component ('B' on Figure 4.5), are also illustrated.

Recommendation F3. The main east-west corridor does not allow Cassowary access to that part of the foreshore represented by Locations 1b, 3 and 4 (Figure 4.4). Any Cassowary habitat lost by doing so should be compensated for by increasing the revegetation planned to take place in the new northern corridor 'B' and throughout the remainder of the site, or be the subject of an 'offset' i.e., either the gifting to the protected estate of an agreed part of the subject site or the purchase and donation to the protected estate of alternative compensatory habitat elsewhere.

Cassowary-Proof Fence:

Recommendation F4. A Cassowary-proof fence should surround the entire integrated resort along the existing vegetation line and extend into selected areas of revegetation where appropriate. The fence should be at least 1.8 metres in height to guarantee the exclusion of Cassowaries and be constructed of natural material e.g., tea-tree or similar, on a backing structure of 50mm diamond-shape chain mesh fencing. The fence should be densely screened with plants so that birds cannot run into it by accident, or be attracted by people or food resources. There should be a gap between the lower section of the fence and the ground of approximately 100 mm, to allow the passage of small mammals and reptiles, but not large enough to give access to small Cassowary chicks.

Such a fence serves a dual purpose: separating birds from humans, while protecting and enhancing the adjoining Cassowary habitat, in this instance the Ella Bay National Park.

Walking Trails:

Recommendation F5. No walking trails should be located outside the Cassowary-proof fence surrounding the development. All ground level walking trails and pedestrian paths inside the development should be located outside the Cassowary movement corridors, or if located within the corridor, be raised approximately 2.5 metres above ground level to prevent interactions between cassowaries and people.

Roads:

Recommendation F6. Road over-passes should be constructed on the 'Ring Road' to cross above sections of the Cassowary corridors, or existing gullies and creeks. These over-passes are essential to facilitate the unhindered movement of cassowary and other fauna.

Recommendation F7. All roads within the resort should also be constructed following appropriate QDMR guidelines. Where necessary, traffic calming devices should be located on the roads within the resort.

Dog Control:

Recommendation F8. Dogs can harm and have the potential to kill Cassowaries, as well as transmit disease. A strict dog control program should be enforced and dog management requirements should be included in an "Environmental Code of Conduct" for residents.

Landscaping:

Any planting of Cassowary food trees within the development may attract Cassowaries into the resort, with the accompanying risk of injury to both humans and birds. This strategy will also avoid issues with flying foxes concentrating within the resort.

Recommendation F9. The planting of accessible native or domestic fruiting trees within the resort precincts should be restricted to avoid attracting Cassowaries.

Water Sources:

Recommendation F10. Apart from existing natural streams, no standing water e.g., ponds or fountains should be accessible to Cassowaries in or around the development. Cassowaries have to drink a number of times per day and it is probable that in many areas the presence of water is as big an attraction to Cassowaries as fruiting trees.

Weed Control

The implementation and monitoring of a rigorous weed control to remove declared weeds, plus a garden-escapee education program for residents and resort management (see Section 3.2.

Lighting

Recommendation F11. To reduce the possibility of disturbance to Cassowaries and other fauna using the adjoining areas, all external lighting within the development should be directed away from the surrounding rainforest vegetation.

Education Programs

Recommendation F12. A Queensland Parks and Wildlife Service (QPWS) education program on the risks associated with hand feeding of Cassowaries should be initiated.

Human behaviour is not predictable in hand feeding situations, and naiveté of most people with wild animals will eventually promote an attack. Cassowaries can also 'bully' non-food items from adults and children if they are attracted to them e.g., toys, keys, jewellery, pens. This non-natural feeding behaviour can result in illness and death for the Cassowary and possible trauma for humans who are confronted. In addition, experience has shown that people often feed harmful products to wild animals (e.g., in zoo situations), either deliberately or in ignorance e.g. plastics, contaminated food etc.

4.2.2 *Litoria rheocola (Common Mountain Mist Frog) and Nyctimystes dayi (Australian Lacelid)*

Litoria rheocola and *Nyctimystes dayi* are ecologically similar, both occurring in lotic streams within mesic vegetation, particularly where riffle zones are present (in the upper stream reaches). Consequently, the impacts on the two species are likely to be similar and are address together.

Litoria rheocola was located within streams where riffle zones occur on the southern boundary of the subject site, upstream and outside of the proposed development area. None were recorded along similar streams within the development area, which may be due to surrounding land use (e.g. grazing) affecting water quality. The species is also expected in other similar stream bodies to the west of the development site. Specific surveys for the species within streams crossing the potential road alignment options were not conducted, but the species is expected to occur in these areas. With in its distribution the species has been located in streams from around sea level to approximately 1200m (Barker *et. al.* 1995). However the species has significantly declined from locations above 300m (Ingram and McDonald 1993; Hodgkinson and Hero 2003) but has persisted in lowland areas (McDonald and Alford 1999). Lowland populations appear to be stable, but the long-term survival of the species is now heavily dependant on its persistence in such locations. Consequently, populations associated with the Seymour Range and the project site may be of local and regional significance.

Nyctimystes dayi may occur in all locations where *L. rheocola* has been located, in rainforest streams with riffle zones. It is not likely to occur in the lower stretches of streams within the development area where large pooling water bodies occur. Similar to *L. rheocola,* surrounding land use may also restrict species distribution.

The species only breeds during the warmer months, typically between late October and April (DEH 2006). Its absence from the current survey may therefore reflect survey timing (early October) rather than the absence of the species. Further survey effort would be required to determine the presence/absence of this species and to determine its distribution within the subject site, although habitat protection and impact mitigation measures adopted for *L. rheocola* would also protect the habitat of *Nyctimystes dayi*.

Impacts on these two species may include the loss of habitat and road mortality. Adverse impacts related to water quality are not considered likely as all development activities are downstream of known or likely populations.

Habitat Loss:

Loss of habitat will be largely restricted to streamlines along the access road. This area was not surveyed, but *L. rheocola* is expected to occur and *N. dayi* may occur. Road widening is likely to require the alteration of streamside vegetation adjacent to the existing road. The loss of this area however, is not likely to be a significant proportion of suitable habitat upstream of the roads and within the Seymour Range. Consequently, impacts are likely to be relatively low in the local context. Clearing of vegetation should be minimised.

Road Mortality:

The upgrading of the existing National Park road will pass through areas of suitable stream habitat. Movements by *L. rheocola* and *N. dayi* across the road, particularly at night during rainfall periods, is likely to result in an increased number of deaths due to increased traffic flow unless mitigation measures are put in place. *L. rheocola* is known from other streams in the Seymour Range which will not be affected by the proposed activities. The long-term survival of the species in the local area is unlikely to be threatened by the development. However, a potential increase in the number of road mortalities for *L. rheocola* and *N. dayi* relating to increased traffic may have a local impact on these populations. Impacts therefore, are likely to be localised. Road crossings over drainage lines should be of a suitable design to allow the safe movement of these frog species, preferably bridging streams and leaving stream-banks in tact.

Recommendation F13. A potential increase in the number of road mortalities for *L. rheocola* and *N. dayi* relating to increased traffic may have a local impact on these populations. Impacts therefore, are likely to be localised. Road crossings over drainage lines should be of a suitable design to allow the safe movement of these frog species, preferably through bridging streams and leaving stream-banks intact.

4.2.3 *Pteropus conspicillatus (Spectacled Flying-fox)*

Spectacled Flying-foxes have been recorded from the development area where they are associated with rainforest vegetation and riparian corridors. Cleared grazing land has no value for this species. As the species is highly mobile, impacts are likely to be restricted to the loss of habitat.

Habitat Loss:

Areas of rainforest habitat and the riparian corridors will not be impacted by the proposed activities on the subject site. However, widening of the existing road between Heath Point and the subject site is required (a distance of at least 1km). In places this section of road will need to be widened by approximately 2-3m, which will require clearing of some roadside habitat.

This loss of habitat, in the context of available habitat within the Seymour Range is not expected to be significant. No known camps or roosting locations of Spectacled Flying-foxes occur within the development zone. Consequently, impacts resulting from the resort development on this species are likely to be minor.

Recommendation F14. The minor loss of habitat for Spectacled Flying-foxes associated with the access road upgrading may be compensated by the careful selection of fruiting plant species for revegetation areas. This may actually increase the value of the development site for local populations.

4.2.4 *Chelonia mydas (Green Turtle)*

Green Turtles are found in coastal and marine areas around Australia from Adelaide north to Carnarvon in north-west Western Australia. They live almost their entire lives in marine environments. Only the females come to land to lay their eggs in beach foreshores. Breeding only occurs once every several years due to the high energy demands involved in producing large quantities of eggs. Marine turtles can lay more than 100 eggs in each clutch. (Wilson and Swan, 2003).

Generally, most turtle species and particularly the Green Turtle prefer continental waters including bays and reefs. Breeding occurs on ocean beaches.

At the time of survey, no individuals, tracks or signs were observed in the beachfront area. Databases which record actual observations of Green Turtles indicate that no observations of this species have been previously recorded within the area. These factors, and the narrow nature of the beach with its narrow high tide area suggest that while use of the beach by Green Turtles is possible, it is unlikely, and the numbers of individuals potentially present would not constitute a significant proportion of the nesting population of this species on the North Queensland coast.

Marine turtles are susceptible to threats at all stages of their life cycles including human disturbance of nesting individuals and increased egg mortality through predation from pigs, dogs and foxes.

Human Activity:

Disturbance by humans may include direct disturbance resulting from:

- interference with nesting individuals through curiosity;
- damage/destruction of nests through use of the foreshore by vehicles;
- lights from the development affecting the ability of adults and hatchlings to navigate to the ocean.

Recommendation F15. Regular monitoring of the foreshore during Green Turtle nesting season is required, and should any nests be detected, these should be cordoned-off to prevent their disturbance by humans and feral animals. The record should be registered with the EPA.

Predation:

Recommendation F16. A Pest Animal Management Plan is required to control the numbers of feral species present, in particular pigs, foxes and dogs, within and surrounding the development. Consultation with QPWS will be required to co-ordinate management responses with management practices within Ella Bay National Park.

4.2.5 *Hypochrysops apollo (Apollo Jewel)*

No *Hypochrysops apollo* individuals or similar Lycinid butterflies were identified during the survey. However the species has been recorded from nearby in swamp vegetation to the

north of the proposed development site. It occurs in coastal areas, particularly lowland paperbark woodlands and swamps.

The Apollo Jewel feeds exclusively on the ant-plant *Myrmecodia tuberosa* which in turn grows on *Melaleucas* and sometimes *Lophostemon suaveolens*. Larvae are usually attended by small golden ants (*Philidris cordatus*) (Braby 2000). The Apollo Jewel, if present is likely to be largely restricted to the heavily vegetated northern portion of the site in *Melaleuca* and *Lophostemon* communities where the food plant occurs. These areas will not be impacted by the proposed development.

Activities within cleared portions of the site are not likely to affect this species as these areas hold little habitat value.

Recommendation F17. Inclusion of the ant-plant *Myrmecodia tuberosa* in Melaleuca vegetation within the rehabilitation areas may increase the value of the study area for the Apollo Jewel Butterfly by supplying additional food sources.

While there are no studies on the movement and dispersal patterns of the species, it is likely to be relatively mobile, able to cover large distances and follow strips of vegetation. Consequently, no impacts on this species are considered likely from the proposed development activities.

4.2.6 *Cophixalus infacetus*

Cophixalus infacetus is a small rainforest frog restricted to the wet tropics between Cairns and Ingham (Barker *et. al.* 1995). The species does not require water to breed, and eggs are laid in damp areas beneath logs, litter, etc. with frogs emerging fully-formed. This species was not found on the subject site during the fauna surveys as no significant rainfall occurred during this period, although the presence of suitable habitat and local records suggest that the species is highly likely to occur. Suitable habitat occurs anywhere within the development site and road alignment options where rainforest and mesic vegetation occur.

Impacts from the development are likely to be related to habitat loss and fragmentation, altered fire regimes and road mortality.

Habitat Loss and Fragmentation:

While most of the rainforest habitat on the subject site is proposed to be retained, some habitat where this species is likely to occur will be lost due to elements of the proposed activities. These areas are particularly associated with residential development in the south-east of the subject land, and access road construction/upgrading. Further fragmentation of habitat will result from these elements of the development, although in the context of the significant tracts of continuous habitat to the west, the impacts would not significantly affect the ability of the species to persist in the local area or region.

Altered Fire Regimes:

Increased human presence can increase the risk of accidental or deliberate bushfires. While the vegetation types surrounding the proposed development area are not ordinarily susceptible to fire, under extreme dry conditions, risks will be increased. This species is not adapted to fire and would be lost from any burnt areas.

Recommendation F18: The preparation of a Fire Risk Assessment is required to determine any need for a Fire Management Plan to protect fire-intolerant fauna and fauna habitat.

Road Mortality:

Current proposed access road options traverse areas of suitable habitat. Regular movement along/across this road by *C. infacetus*, particularly at night during rainfall periods, is likely to result in the road death of individuals unless mitigation measures are put in place. Increases in the volume of traffic would result in an increasing number of road deaths under these conditions. As the species is not restricted to waterways, facilitation of their safe movement across roadways is not simple.

Recommendation F19. The installation of small-diameter culverts at regular intervals beneath the access road through rainforest habitat would provide *Cophixalus infacetus* a means for safe crossing, as the species is secretive and more likely to traverse a dark, damp culvert than an open road surface. Monitoring of selected sections of the road for road kills following wet night-time conditions is required to accurately assess the impact of the road and the success of mitigation measures.

In terms of preferred road alignment options, Option 4, which follows the coast until heading west along the fish farm boundary to join the existing National Park road is preferred with regard to this species. This option will result in the least isolation and clearing of habitat.

4.2.7 *Coeranoscincus frontalis*

Coeranoscincus frontalis is a limbless wormlike reptile. The species has not been previously recorded from the development area but is known from the local area as indicated on database searches. It typically inhabits lowland and upland rainforests where it shelters in rotting logs and deep leaf litter. It is rarely encountered due to its cryptic habits.

Considering the presence of local records, suitable habitat present in rainforest remnants, and its cryptic nature, the species is considered likely to occur. However, its distribution on the site is likely to be predominantly within larger remnant areas such as vegetation to the north, west and south of the development footprint. It may occur within linear riparian habitats, but is less likely in these locations. The species is also likely to be present in habitats traversed by the access road corridor options.

Predicted impacts of the proposed development are related to habitat loss, increased fire risk and increased road mortality.

Habitat Loss:

While most of the rainforest habitat on the subject site is proposed to be retained, some habitat where this species is likely to occur will be lost due to elements of the proposed activities. These impacts are particularly associated with residential development in remnant vegetation in the south-east of the subject land, and access road construction/ upgrading. Further fragmentation of habitat will result, isolating relatively small areas of habitat, although in the context of the significant tracts of continuous habitat to the west, the impacts would not affect the ability of the species to persist in the local area or region.

Altered Fire Regimes:

Increased human presence can increase the risk of accidental or deliberate bushfires. While the vegetation types surrounding the proposed development area are not ordinarily susceptible to fire, under extreme dry conditions, risks will be increased. This species is not adapted to fire and would be lost from any burnt areas. Preparation of a Fire Risk Assessment is required to determine the level of risk and potential mitigation measures.

Road Mortality:

The access road options traverse rainforest habitats that may be inhabited by this species. With traffic levels increasing as a result of the proposed development, animals attempting to move across the roadway will have an increased chance of being struck by vehicles. However, the species is reluctant to venture into the open, and hence road mortality is not expected to be sufficiently high to have long-term effects and impacts would be minor and highly localised.

4.2.8 *Eulamprus tigrinus*

This skink species occurs in rainforest habitats throughout the wet tropics area where it can be found sheltering in rotten logs. The species has not been previously recorded within the development area, although it has been recently recorded on nearby properties on the western slopes of the Seymour Range. Within the site, the species is likely to occur within rainforest areas, but is less likely to occur in the riparian corridors. The close proximity of known records and the presence of suitable habitat indicate that the species is likely to occur within rainforest habitats on the subject site and areas traversed by the access road corridor options.

Habitat Loss:

While most of the rainforest habitat on the subject site is proposed to be retained, some habitat where this species is likely to occur will be lost due to elements of the proposed activities. These areas are particularly associated with residential development in the south-east of the subject land, and access road construction/upgrading. Further fragmentation of habitat will result from these elements of the development, although in the context of the significant tracts of continuous habitat to the west, the impacts would not significantly affect the ability of the species to persist in the local area or region.

Altered Fire Regimes:

Increased human presence can increase the risk of accidental or deliberate bushfires. While the vegetation types surrounding the proposed development area are not ordinarily susceptible to fire, under extreme dry conditions, risks will be increased. This species is not adapted to fire and would be lost from any burnt areas. Preparation of a Fire Risk Assessment is required to determine the level of risk and potential mitigation measures.

Road Mortality:

The access road options traverse rainforest habitats that may be inhabited by this species. With traffic levels increasing as a result of the proposed development, animals attempting to move across the roadway will have an increased chance of being struck by vehicles. However, the species is reluctant to venture into the open, and hence road mortality is not expected to be sufficiently high to have long-term effects and impacts would be minor and highly localised.

4.2.9 *Esacus neglectus (Beach Stone-curlew)*

Beach Stone-curlews were observed above the high tide mark, roosting within ocean debris on the foreshore outside of the eastern edge of the development site. It is expected that the species commonly uses the beachfront area. The species was not observed utilising alternative habitats such as beachfronts or mudflats at Flying-fix Point. The beachfront associated with Ella Bay may therefore be of some importance to resident pairs.

Suitable habitat where this species is likely to occur is restricted to the coastal dunes, which will not be directly impacted by the development. However, the species is typically very shy of human activity (Marchant and Higgins 1993) and will readily abandon territories where human activity is high.

Human Disturbance:

Human activity along the beach front is likely to significantly increase due to the development. This activity will be largely restricted to daylight hours, but may also extend into the early hours of the night. It is conceivable that the increased level of activity will render the Ella Beach front unsuitable for the species.

The extent of the local population of this species is unclear, but it is possible that the observed birds are the only resident pair that utilises the Ella Bay beach and nearby beaches at Flying Fish Point. Local impacts therefore could be significant. Further assessment of the number of local and regional pairs may assist in clarifying the severity of likely impacts.

Human disturbance may result in the loss of this species from the local area. No recommendations are considered likely to reduce human activity along the beach front and hence impacts are difficult to mitigate.

Recommendation F20. Further assessment of the number of local and regional pairs of the Beach Stone Curlew is required to assist in clarifying the severity of likely impacts.

4.2.10 *Accipiter novaehollandiae (Grey Goshawk)*

One Grey Goshawk was observed during the terrestrial fauna survey, circling over cleared grazing land in the northern portion of the development area. The species is likely to be widespread though the site and local area, making use of areas of non-fragmented habitat and riparian corridors traversing cleared land.

Impacts on the highly mobile Grey Goshawk are likely to be restricted to the loss of some foraging habitat.

Habitat Loss:

While the species is likely to periodically forage over cleared areas, it will also readily forage over forested areas. Suitable habitat for the species is abundant in the local area. In this context, the loss of habitat within the development area is unlikely to affect local populations. No nest or potential nests of this species were identified during the survey, and impacts on this species as a result of the proposed development are predicted to be minor.

4.2.11 *Cyclopsitta diophthalma macleayana (Macleay's Fig-parrot or Double-eyed Fig-parrot)*

Macleay's Fig-parrots (*Cyclopsitta diophthalma macleayana*) were recorded during the terrestrial vertebrate survey at several locations. Most observations were located in:

- Rainforest on the northern edge of cleared areas;
- Riparian habitat in the northern-most creekline; and
- Melaleuca forest in the central east of the subject land.

The species is highly mobile and can often be recorded in urban gardens and parks feeding in individual trees. It is likely to be widespread throughout the subject land and within habitat along the access road options.

Impacts associated with the proposed activities on this species are likely to be restricted to the loss of some food trees, although most of the habitats in which the species was recorded are proposed to be retained as conservation lands. The species is highly mobile and known to move through urban Cairns. Consequently, the development is not expected to impact its dispersal or movement patterns.

Recommendation F.21. The proposed minor loss of food trees for the Macleay Fig-parrot may be mitigated by the careful selection of plant species for revegetation. Fruiting plants favoured by this species, particularly *Ficus* spp. may increase the value of the development site for the local Macleay Fig-parrot population.

4.2.12 *Ninox rufus queenslandica (Rufous Owl)*

No Rufous Owls have been noted form the development site. However suitable habitat is present within rainforest and riparian areas and it is considered that the species may occur. Impacts from the development are likely to be restricted to the loss of some habitat. The species is highly mobile and hence it is unlikely that the development would affect local movements.

Habitat Loss:

Some areas of potential habitat would be lost in association with residential development within remnant forest in the south-east of the development area, and along the access road. This is not likely to be significant in the context of surrounding habitat within the Seymour Range. The species is known to roost in heavily vegetated parks and gardens and hence activity on the development site is not likely to affect their continued presence.

4.2.13 *Collocalia spodiopygius (White-rumped Swiftlet)*

White-rumped Swiftlets nest in caves and move out into nearby regions to forage entirely from the air. Activity and ground cover seem to have little impact in their foraging behaviour. They are readily observed foraging over open grazing land and urban areas. No nesting caves occur within the development site. Consequently, no impacts on this species are expected.

4.2.14 *Neochmia phaeton (Crimson Finch)*

Survey efforts have not located Crimson Finches within the development site or road alignment options. However the species has been recorded in recent studies located in close proximity to the subject site. They can be regularly recorded along the edges of roads and paddocks where grasses provide foraging resources. The close proximity of these records suggests that the species may occur, although suitable resources are not abundant.

The species is highly mobile, can utilise disturbed habitat and can move considerable distances. Consequently, the loss of any minor areas of habitat within the development site is not expected to impact the local population.

4.2.15 *Taphozous australis (Coastal Sheathtail Bat)*

The species occurs in a variety of habitats including along rainforest edges, linear corridors and open country such as that of the development site. However, it is only known to roost in sea caves. Suitable caves are not common in the area, and do not occur on the subject site.

While *Taphozous australis* has not been recorded from the subject site, calls were recorded from an unidentified *Taphozous* species using an ANABAT detector.

Should this species be present, potential subtle impacts are difficult to identify due to the lack of robust information and knowledge about the species. It is possible that the development may reduce some foraging habitat. However, the species is highly mobile and able to traverse large distances quickly and easily. It can therefore access nearby remnant habitats which are abundant along the Seymour Range. Consequently, based on what is known of this species, no impacts are expected as a result of the development.

4.2.16 *Crocodylus porosus (Saltwater Crocodile)*

This species is located along northern Australia from near Rockhampton to around Broome and is only occasionally found in more southern locations. The Saltwater Crocodile occurs in coastal rivers, swamps, mangroves, mudflats and other estuarine areas. No individuals or their signs were located during the survey. However, discussion with locals during the survey indicated that they can be occasionally observed in swamps to the north of the subject site. Consequently, the species is expected to occur, particularly in the creekline running east/west through the site. However the lack of evidence of their presence during the survey suggests that they may occur in this location sporadically.

Impacts of the proposed development would be related to a decrease in habitat for the species on the subject land due to increased human activity and the presence of infrastructure which may limit access.

The potential impacts of the development on Ella Bay Swamp to the north are currently unknown. Impacts on swamp ecology resulting from natural water quality and/or hydrological regimes may impact on the suitability of the swamp for breeding and feeding purposes.

Recommendation F22. Detailed surface water, groundwater and water quality investigations are required to determine the potential impacts of the proposed development on the ecology of Ella Bay Swamp.

Recommendation F23. A Queensland Parks and Wildlife Service (QPWS) education program on the risks associated with living with Saltwater Crocodiles should be initiated.

4.2.17 *Macropus agilis (Agile Wallaby)*

The effects of the development on the Agile Wallaby population of the development area are likely to be:

- Decreased feeding areas and subsequent population pressures;
- Alteration in grass species available for grazing;
- Regular disturbance from feeding and resting as a result of increased human activity; and
- Increased mortalities from vehicle strikes on roads.

As resources for the species reduce over the period of construction of the proposed development, the Agile Wallabies will move to undeveloped areas, where pressure for food resources is likely to be significant enough to affect breeding. Over time, less young will be produced. In the meantime, there may be signs of stress, aggression, starvation and disease among the thousands of individuals currently present.

Recommendation F24. In the interests of the welfare of the Agile Wallabies on site, it is recommended that an Agile Wallaby Management Plan is prepared and implemented to ease the transition for the population from a pastoral to an urban environment. The Agile Wallaby Management Plan should also address the operational phase of the development. These animals are likely to become a feature of the development and their condition and behaviour will be scrutinised by residents.

4.2.18 *Movement Corridors*

The subject site is located within a coastal enclave, bound to the north, west and south by the broadly circular Seymour Range which pinches into the coastline at Cooper Point to the north, and Heath Point to the south. To the immediate north, south and west of the site the forested slopes of the Seymour Range are incorporated within Ella Bay National Park. The largely cleared nature of the subject site reduces the likelihood of its contribution to local corridor values in this context.

Movement of fauna within the significant north-south regional corridor bordering the west of the development area along the Seymour Range will not be affected by the proposed development.

At a local scale, corridors of riparian vegetation on the subject site facilitate the movement of some species between larger, intact patches of vegetation in the south and west to coastal vegetation in the east (see Figure 4.6). The riparian vegetation is inhabited by a range of species. Macropods, rodents, bats and birds in particular move through these areas.

Moore (2006) identified the degraded riparian strip that traverses the subject land as being used by a resident male Cassowary, but concluded that due to the narrowness of the

remaining vegetation and its degraded and cyclone damaged condition, the importance of this corridor to the maintenance of Cassowaries at Ella Bay has been reduced significantly.

Currently the riparian strip serves as a movement corridor facilitating access for Cassowaries to pond apple infestations that occur on the disturbed swamplands and stream edges in the central and foreshore areas of the property. This exotic food source is currently of increased importance to the Cassowary following the dearth of native fruit following the cyclone, but its contribution to the ecology of the birds at Ella Bay is dubious.

The presence of significant numbers of the favoured Cassowary food tree Blue Quandong *Elaeocarpus angustifolius*, in the central reaches of this creek, however, would provide an important food resource for Cassowaries. The movement corridors of the Southern Cassowary as mapped by Moore (2006) are shown in Figure 4.5.

Recommendation F.25. The current proposed footprint indicates existing corridors following watercourses will be mostly retained. It is recommended that all riparian vegetation is retained, and that the corridors are at least 50m width either side of the high bank of the creeklines. In some areas this will require rehabilitation to broaden the corridor. The proponent proposes to significantly widen the corridors subject to negotiation with NRW.

Recommendation F.26. The locations of corridors and linkages recommended by Moore (2006) as shown in Figure 4.6 should be adopted, with particular attention to linkages between the north-south corridors and surrounding vegetation. The Proponent also proposes to enhance habitat associated with the network of sub-corridors along minor drainage lines within the development area.

Further fragmentation of riparian areas will be necessary to allow traffic and pedestrian movement. Mobile species such as birds and bats will not be affected by these minor breaks. However, there is potential to impact the movement of terrestrial species such as rodents and macropods. Furthermore, arboreal species will be required to venture to the ground to traverse these structures.

The species that would be most adversely affected by the fragmentation of these corridors by roadways is the Southern Cassowary. To mitigate adverse impacts, Moore (2006) has recommended that:

- No walking trails should be located outside the recommended Cassowary-proof fence surrounding the development. All ground level walking trails and pedestrian paths inside the development should be located outside the Cassowary movement corridors, or if located within the corridor, be raised approximately 2.5 metres above ground level to prevent interactions between cassowaries and people; and
- Road over-passes should be constructed on the ‘Ring Road’ to cross above sections of the Cassowary corridors, or existing gullies and creeks. These over-passes are essential to facilitate the unhindered movement of Cassowary and other fauna.

Figure 4.6: Potential Fauna Movement Corridors

The provision of habitat and movement corridors within the development area exposes species utilising the corridors to the impacts associated with adjacent human habitation. In particular the presence of domestic dogs and cats is detrimental to many species.

Recommendation F27. There are a number of small, ground-dwelling fauna species of special conservation significance present in habitat within and surrounding the proposed development area, and the presence of cats and dogs would present a direct threat to those species through harassment and predation. As such, it is recommended that the keeping of cats, which are more difficult to confine, within the proposed development area is prohibited, and that the conditions for keeping of dogs are strictly controlled.

Areas of extant and rehabilitated native vegetation that form nodes and corridors throughout the development area are to be incorporated into a Conservation Covenant with an appropriate management regime in place.

Recommendation F28. Prepare a Conservation Management Plan for habitat nodes and corridors within the development area.

The management status of the significant areas of intact remnant vegetation occurring inside the property boundary but outside of the development footprint is to be determined. These areas should be incorporated into the conservation estate, or be subject to strict conservation orders as discussed in Section 3.2.

Little study has been conducted within Australia on the effects of lighting on terrestrial vertebrate species. Consequently, impacts are difficult to predict.

Most study has been conducted on bat species, which may be attracted to increased insect abundance around lights, or may shy away from increased lighting. Adams *et. al.* (2005) found that the use of artificial light increased the abundance of insectivorous bat species in New South Wales forests. However, their research did not include the effect of light intensity or duration. By contrast, overseas studies on the emergence of roosting *Pipistrellus pygmaeus* found that high light white intensity affected emergence patterns. Their research also identified that bats were less affected by red light.

In contrast to bat species which can benefit from localized light sources, overseas studies have found that lighting can have significant impacts on sea turtle hatchlings. Once emerged from the sand, the hatchlings make their way to the ocean by moving away from silhouettes of the sand dunes and trees. Artificial lighting can alter this behaviour (Salmon 2003).

Impacts on amphibians, birds and mammals are less clear. It is possible that some species are benefited by lights. For example, lorikeets can congregate in large numbers in lighted carpark trees while some common native frogs such as *Litoria caerulea* readily feed on insects attracted to lit areas. However, other species, particularly nocturnal birds and mammals may avoid lit areas. Until further research identifies the magnitude of possible impacts, conclusions drawn from inferences would be purely speculative.

A discussion of lighting for marine turtles is included in Section 4.2.5.

Recommendation F29. All lighting associated with the development should be designed so that there is no spillage into conservation areas.

4.2.19 *Golf Course Development*

Golf courses have the potential to provide habitat for a range of species, and as there is no clearing of significant vegetation required to construct the proposed golf course, any habitat that is created will be additional to the habitat currently available on this mostly cleared site.

Recommendation F30. Golf course planning should incorporate plant species that can be utilised by native species (other than Cassowaries). The recommended Landscaping and Rehabilitation Plan (Recommendation V16) should consider fauna habitat requirements in its preparation, and is to be used as a guide for planting.

The proposed golf course will require the introduction of grass species that are not native to the area. Such species will require fertilisation, herbicide and pesticide treatment, with the resultant runoff of these pollutants to native vegetation and drainage lines. This will have implications for aquatic fauna at the base of the food chain, as described in Section 3.2.2.

In addition, research has shown that pesticide levels not considered to be acutely toxic have deleterious effects on tadpoles, exposed over longer periods of time (Howard *et al.* 2002). These effects include decreased hatching success and an increase in deformities, both of which may have negative effects on population persistence (Howard *et al.* 2002). The presence of several frogs of conservation significance within and surrounding the subject site will require that pesticide use in particular is carefully planned and managed. In particular the types of pesticide that can be used must be carefully researched.

Recommendation F31. An Integrated Pest Management (IPM) program to be prepared for the golf course that will keep pests at acceptable levels using carefully selected methods, while minimizing the effect on the environment.

The following recommendations regarding pesticide use for golf courses has been adapted from Brunea *et al.* (2005) as a guide.

- **Knowledgeable Superintendent:** Knowledge is the cornerstone to any successful IPM program. The Superintendent should know about the grasses being grown, the pests which are likely to be a problem, and the conditions that may impact the pests and grasses being maintained.
- **A Written Plan:** This plan should include objectives for each section of the course and the degree of acceptable injury from pests. It will help define pest threshold levels. Include specific management practices for non-chemical control. They will vary with each section of the course.
- **Defining Pest Threshold Levels:** Determine what is acceptable for your course, such as whether weeds should be allowed in roughs or how many insects should be tolerated per square foot. Recommendations are available regarding threshold levels for certain insects.

- **Implementing Appropriate Cultural Practices:** Use of agronomically sound cultural practices results in a healthy, dense, vigorous turf that is better able to ward off pests and pest injury.
- **Monitoring Pest Activity:** Most pests are easiest to manage when they are immature. Frequent scouting can help determine the stage of pest activity or injury.
- **Maintaining Accurate Records:** Keeping accurate and up-to-date records of pest activity, actions taken, and the results of those actions will assist in future planning.

As discussed in Section 3.2.2, the prediction of the nature and scale of impacts of golf course operation on groundwater, surface water, and near-shore coastal water quality and wetlands requires state-of-the-art risk assessment and simulation modelling, particularly in high rainfall environments. To achieve the best results from modelling, it is important to obtain site-specific data for these risk assessments such as soil sampling, test borings, stream surveys, and coastal surveys.

Sophisticated modelling is required for complex drainage patterns at the basin and sub-basin scale, as with golf courses where annual and storm-event runoff values should be computed for pesticides, nutrients, runoff water, and sediments. The results will help fine tune turf management programs and may indicate the need for design changes. On the subject site, modelling may show that the installation of detention basins is required for water quality protection, although these will need to be designed so that they are not attractive to frogs or other animals.

Recommendation F32. A Surface Water and Groundwater Quality Management Plan is required for the operational phase of the project that guided by the results of modelling for pesticides, nutrients, runoff water, and sediments from the development. Water quality standards must be set based on the Queensland Water Quality Guidelines 2006 (EPA, 2006) to protect native terrestrial and aquatic fauna, including regular monitoring of receiving waters to detect levels of herbicides, fertilisers and sediment entering natural waterways, and planned responses to adverse results.

5.0 AQUATIC FAUNA

5.1 BASELINE INVESTIGATIONS

While aquatic macroinvertebrate samples were taken from water present within the subject site at the time of the fauna survey (BAAM 2006), on request these samples were not analysed and are in storage.

Freshwater fish were trapped from the creeks within subject site, and five species were recorded. These comprised three relatively common local species, Jungle Perch (*Kuhlia rupestris*), the Empire Gudgeon (*Hypseleotris compressa*, the Eastern Rainbowfish (*Melanotaenia splendida splendida*, McCulloch's Rainbowfish (*Melanotaenia maccullochi*), as well as the relatively rare Cairns Rainbowfish (*Cairnsichthys rhombosomoides*)[Site 4]. The latter is listed on the IUCN Red List (*2006 Red List of Threatened Species*) as vulnerable because of its restricted distribution and uncommon occurrence. A search of the Queensland Museum database for the general area revealed the possible presence of additional species. Some of these comprise species of tidal inlets and creeks which do not occur on the subject site.

Overall, fish diversity was considered to be comparatively low which could be related to factors such as the trapping methodology not targeting all species present, the short sampling period not taking into account seasonal variation, or the historical disturbance of the site.

5.2 POTENTIAL IMPACTS AND MITIGATION MEASURES

Nutrients, organics and pesticides, metals and solids are common pollutants in urban runoff.

Nutrients: Nitrogen- and phosphorus-containing compounds are found in urban runoff primarily from roads. Nitrates result both from vehicular exhaust on the road and adjacent soils from fertilization of landscaped areas beside the roads. Nitrate is very soluble and does not sorb well to soil components during infiltration. Road runoff also contains phosphorus from motor oils, fertilizers, bird droppings, and animal remains. Phosphorus tends to sorb to soil components during infiltration, thus preventing phosphorus from reaching the groundwater. However, as the sorption sites fill, i.e., the cation exchange capacity of the soil is exceeded, and phosphorus removal decreases.

Organics and Pesticides: Pesticides are used in urban areas for weed and insect control along roadsides, in parks, on golf courses, and on private lawns. Pesticides leach to the groundwater when their residence time in soils is less than the time required to filter them or biologically or chemically convert them. Most organics are either removed or reduced in concentration during percolation through the soil. Groundwater contamination occurs most readily in areas with pervious soils, such as sand and gravel, and where the distance to the aquifer is small.

Herbicides have direct effects upon aquatic vegetation and indirect effects upon both invertebrate and vertebrate communities (Van den Brink et al 2006; Guiseppe et al 2006). Within aquatic ecosystems vegetation, particularly algae are extremely sensitive to herbicides which may significantly alter flora community structure over time (Van den Brink et al 2006). This has been observed to lead to alteration in the invertebrate community (i.e. increases in detritus feeding species and decreases in suspension feeding organisms).

Pesticides have a direct effect on invertebrates and an indirect effect on plants within aquatic ecosystems (Wendt-Rasch et al 2004). Pesticides have been observed to directly reduce the level of invertebrate herbivores and suspension feeders which results in an increase in algal biomass (Wendt-Rasch et al 2004).

Increases in nutrients within aquatic ecosystems decrease species richness by weakening stabilizing effects (Romanuk et al 2006) such as predation, grazing and species interactions. In addition, the enrichment of water by nutrients especially compounds of nitrogen and phosphorus, causes an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms and the quality of the water concerned (known as eutrophication). Nutrient enrichment tends to stimulate phytoplankton in lakes because micro-algae and cyanobacteria usually grow faster than larger algae or plants, and the resulting biomass absorbs light and so shades out benthic micro-algae or macrophytes.

Metals: The heavy metals of most concern in urban runoff are lead, zinc, copper, nickel, and chromium. Metals in urban runoff originate on roads, etc., as part of the exhaust and other residue left by vehicular use.

Solids: Suspended solids contained in stormwater enter natural waterbodies, altering the water chemistry by decreasing water clarity, and altering stream profiles by causing sedimentation, with resultant impacts on instream flora and fauna.

The receiving waters for the proposed development area have not been identified or characterised, and the impacts of increased stormwater volumes and velocities due to the construction of hardstand areas and building roofs on receiving waters has not been determined. On and surrounding the subject site, the receiving waterbodies can all be considered to be highly sensitive to external pollutants, and the most strict water quality management conditions will apply. Under the Queensland Water Quality Guidelines 2006 (EPA 2006) there will be a requirement for no impact on the receiving waters.

The relationship of the site, both via groundwater and surface water, to Ella Bay Swamp and the Great Barrier Reef must be determined before any meaningful assessment of impacts on these important areas can be assessed in this high rainfall environment.

Recommendation A1. Detailed pre- and post-development surface and groundwater modelling are required to identify receiving waters from the proposed development area. Receiving waters are subject to extensive water quality and quantity data collection. Analysis of the macroinvertebrate samples taken from the study area will assist in the characterisation of on-site water quality and should form a component of a Waterway Health Monitoring Program.

6.0 NATURAL HERITAGE VALUES

From the Wet Tropics Conservation Strategy (2004) (Wet Tropics Management Authority, 2004), the Wet Tropics World Heritage Area (WTWHA)meets all four natural criteria specified by the World Heritage Committee for inclusion as a property on the world heritage list, summarised as follows:

Be outstanding examples representing major stage of earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features.
The Wet Tropics contains one of the most complete and diverse living records of the major stages in the evolution of land plants, from the very first land plants to higher plants (gymnosperms and angiosperms), as well as one of the most important living records of the history of marsupials and songbirds.

Be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.
Levels of species diversity and endemism in the Wet Tropics are exceptionally high, reflecting the long isolated, ancient biota of the Australian Wet Tropics.

Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
The Wet Tropics contains one of the most significant regional ecosystems in the world, with outstanding features of natural beauty and magnificent sweeping landscapes. Exceptional is the coastline scenery, which contains tropical rainforest, white sandy beaches and fringing reefs just offshore.

Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.
The Wet Tropics provides the only habitat for numerous rare or threatened species of plants and animals.

The WTWHA consists of a variety of land uses and tenure The Wet Tropics Management Plan 1998(Queensland Government (QG), 1998) designated areas included in the WTWHA into four distinct zones: Zone A-D with A having the highest conservation value. Lands directly to the north and south-east of the subject site are designated as Zone A while areas to the west and south are designated as Zone B (See Figure 2.4). Zones A and B are:

Zone A:
Land included in zone A has a high degree of integrity and is remote from the disturbances associated with modern technological society. It is in its natural ecological, physical and aesthetic condition and sustaining this condition is the intent of this zoning. Visitors may expect to find solitude and no obvious management presence. To qualify for inclusion in zone A, land must:

- *be at least 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structures; and*
- *be at least 700 metres from clearings; and*
- *include a minimum area of 150 hectares of undisturbed habitat; and*
- *no obvious signs of disturbance in the last 40 years (such as logging, for example).*

Zone B:
Like land in zone A, it has a high degree of ecological integrity and it is in a natural state but is not necessarily remote from disturbance. There is a reasonable expectation that it could be restored to a condition which would qualify for inclusion in Zone A. Visitors can expect solitude and limited evidence of a management presence (infrastructure, etc.). Lands in zone B must:

- *be less than 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structure; or,*
- *be less than 700 metres from clearings; or*
- *include an area of up to 150 hectares of undisturbed habitat;*
- *have some obvious signs of disturbance in the last 40 years; and*
- *not overlap with Zones A, C and D.*

An assessment of the development layout, the Regional Ecosystems, and plant and animal species of particular conservation significance that would be affected by the proposed development indicates that no part of the project would alter the current zoning of the WTWHA on lands surrounding the subject site, and that any direct impacts on the WTWHA would be highly localised and can be mitigated against.

Cumulative impacts are more difficult to predict, although they are most likely to be related to:

- increased visitor numbers to Ella Bay National Park and other WTWHA places;
- increased vehicles on local roads; and
- water quality impacts from stormwater runoff, particularly any impact on Ella Bay Swamp would be of significance.

Recommendation N1. The proponent to enter into discussions with the QPWS regarding the potential for the development to generate increased visitors to Ella Bay National Park, and to determine any need for additional infrastructure to protect the environment from increased visitor numbers.

Recommendations have been made to reduce the impacts of increased vehicular traffic on roads affected by the development. It is considered that, with the appropriate road route selection and management measures in place, the impacts of the road can be managed to ensure biodiversity impacts associated with road kills do not accumulate over time, and that local fauna populations are maintained.

Even minor annual increments in pollutant contributions to natural receiving waters from the development could have significant impacts on the ecology of waterways and

wetlands over time. Surface water and groundwater characterisation and management have not yet been undertaken, and will be carefully scrutinised to ensure that water bodies within the WTWHA are unaffected.

Impacts on the Great Barrier Reef World Heritage Area have not been addressed in this report, but should be part of a Water Quality Impact Assessment Study.

Recommendation N2. There are significant areas of remnant forest to the north and west of the development area that are located within the subject property but outside of the development footprint. The incorporation of these areas into the WTWHA through one of a number of agreements such as Conservation Covenants, Cooperative Management, Land for Wildlife, Nature Refuge or Commonwealth Conservation Agreement would be a valuable contribution to the conservation estate.

7.0 ACCESS ROUTE CORRIDOR OPTIONS

7.1 ACCESS ROAD ALTERNATIVES

The development is predicted to generate a maximum range of between 2,570 and 3,990 vehicle movements per day during peak holiday times, and considerably less for other times. The peak times for traffic generation that were predicted by ETS Group (2007) are 9.00am, 11.00 am and 2.00-3.00pm.

The Traffic Report (ETS Group, 2007) has determined that the existing capacity of Ella Bay road will not be of adequate standard to carry the traffic from the proposed development, and an alternative means of road access is required to support the project.

One of the following alternative means of road access or upgrading of the existing road is required to support the project:

Upgrade of Ella Bay Road
Part of the existing development at Little Cove, immediately south of the subject site, is the upgrade of the Ella Bay Road to a bitumen road from its current gravel condition. The width of the road from Flying Fish Point to Heath Point is to be 6m then 4m wide, continuing to the development. The upgraded road will only support a low speed environment (40-50k) due to the topography and winding geometry.

Mountainous Road Option
A second road access from the west was investigated to supplement Ella Bay Road. The route of the option was located outside of the National Park boundaries, although traversing high parts of the Seymour Range through sensitive vegetation. Discussion by the proponent with the EPA and DEH resulted in not pursuing the option further.

Tunnel Option
To eliminate the topographical and environmental problems with a mountainous road, a tunnel option was investigated. A dedicated road reserve currently exists along the

southern boundary of the site heading west and then south, and preliminary data showed that a tunnel was possible. However, due to the associated issues and excessive cost, this option was determined not to be viable.

Inland Option
The proponent investigated an alternative inland route via the Bruce highway, Garradunga Road and Jubilee Road. At a preliminary meeting with the EPA and WTMA both expressed the opinion that the inland route would incur a number of negative environmental externalities.

7.2 PREFERRED ACCESS

After the initial analysis and discussions with relevant stakeholders and government departments, it was concluded that the upgrading of Ella Bay Road was the best option for the proponent to pursue There are three alternative routes through Flying Fish Point (described in Section 7.3).

7.3 ALTERNATIVES THROUGH FLYING FISH POINT

7.3.1 *Option descriptions*

The three alternative routes are shown in Figure 7.1.

Option 1: A route following the existing Ella Bay Road.

Option 2: A route requiring construction of a new section of road along the southern boundary of the fish farm, joining with the existing Ella Bay Road on the south-western corner of the fish farm property.

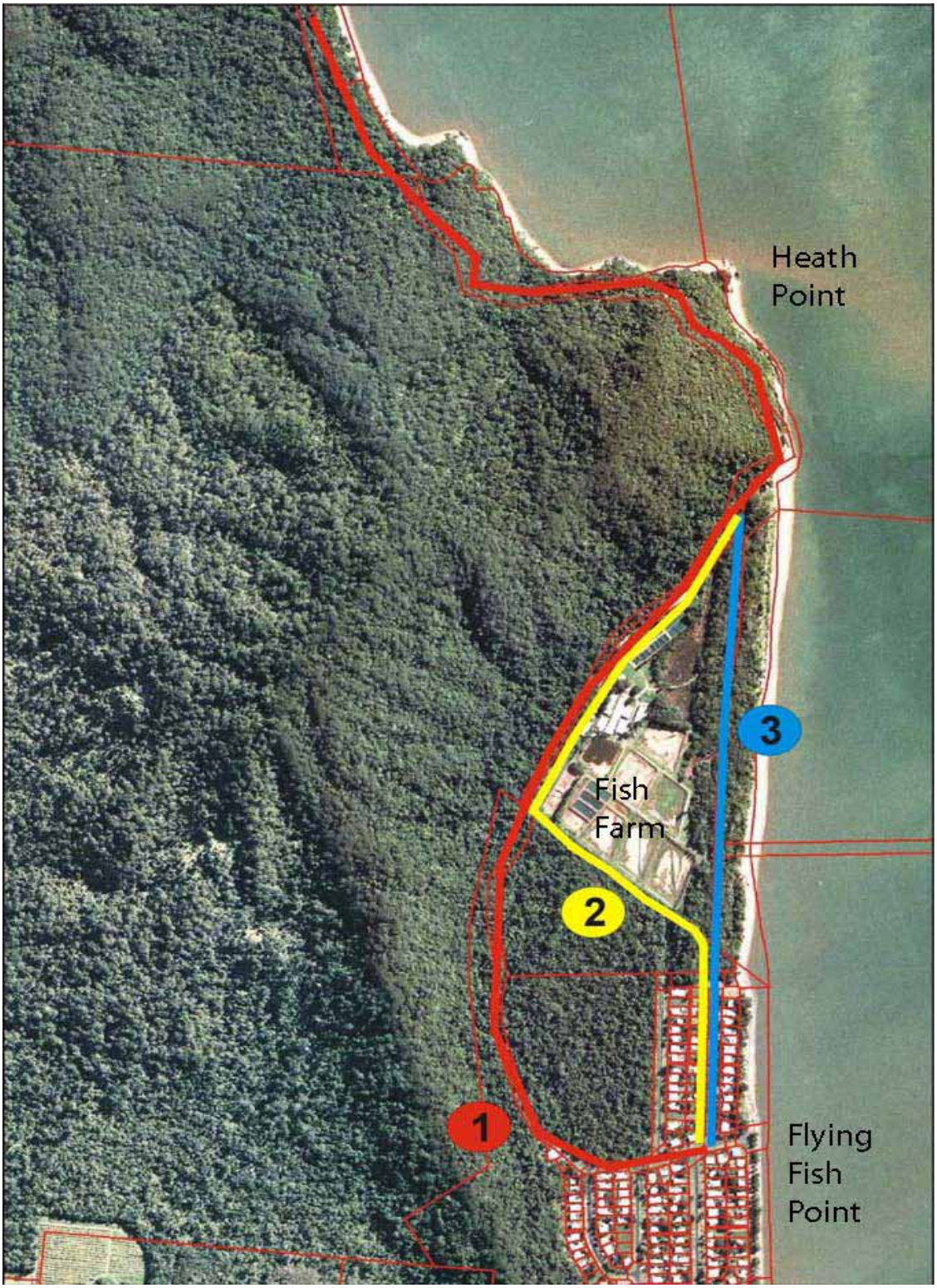
Option 3: A route requiring construction of a new section of road along the narrow strip of coastline between the eastern boundary of the fish farm property and the ocean.

7.3.2 *Vegetation and Flora*

Although located on a narrow coastal corridor, the southern access corridor study area demonstrates some geomorphic diversity with coastal outwash plains, metamorphic headlands and ridgelines, with minor sections located on stabilised dune sands. Heath Point forms the most easterly feature rising from the coastline westward as a poorly defined spur to join the north- south trending Seymour Range to the west. Heath Point divides the coastal alluvial plains formed behind Ella Bay to the north and Flying Fish Point to the south. Both coastal plains possess a narrow fringe of low dune ridges on their seaward margins, which have minor incursions into the road access corridor.

As identified in 3D Environmental (2006b), database searches indicate that 36 plant species of special conservation significance occur within the locality. An online search of the EPBC database indicates that 14 plant species, or habitats for these plants occur within the locality. Six of these species are Endangered and eight are Vulnerable.

Figure 7.1: Road Route Options



A search of the EPA Queensland Herbariums Herbrecs database and the Wildlife Online Database reveals 22 species listed on the Schedule of the NCA. Four of these species are Endangered, four species are Vulnerable, and 12 species are Rare. Desk top analysis indicates that ten of these are considered unlikely to occur within the proposed access corridor.

Suitable habitat for those species likely to occur within the road access corridor option area are shown on Figure 7.2.

Recommendation R1. Once a preferred access road route alignment has been selected, a detailed flora survey will be required to determine the presence of species of significance, and determine the most suitable strategies for impact mitigation.

Following is a brief summary of regional ecosystems and their component vegetation communities occurring within the route option area (Figure 7.2), including additional information on their specific nature which may require further clarification. As the study was completed through aerial photograph interpretation only, this information is largely limited to notes on community distribution and condition.

Regional Ecosystem 7.1.1 **Mangrove low closed forest to open shrubland Status - Not of Concern (VMA).** A narrow fringe of mangrove woodland is mapped on a tidal drainage feature in the northern section of the access corridor. This community is likely to be dominated by *Hibiscus tiliaceus* with a limited range of mangrove species indicative of brackish conditions and frequent flushing during high rainfall events.

Regional Ecosystem 7.2.1 **Mesophyll vine forest. Beach ridges and sand plains of beach origin, mainly in small patches in the lee of coastal beach ridges in very high rainfall areas**. **Status - Endangered (VMA).** This regional ecosystem is limited to two linear strips of vegetation, fringing and parallel to the coastline in the northern section of the access corridor. The current unsealed access road skirts the western fringes of this community.

Regional Ecosystem 7.2.7a: **Coastal foredune complex with *Casuarina equisetifolia.* Sands of beach origin. Status - Of Concern (VMA).** Narrow linear strips of this regional ecosystem occupy coastal foredunes within the access corridor. Due to its location immediately adjacent to the zone of upper tidal influence, disturbance of this community may result in severe erosion of the coastal foredune. Disturbance to this community should be avoided.

Regional Ecosystem 7.2.8**: *Melaleuca leucadendra* (weeping tea tree) open forest to woodland. Sands of beach origin and dune swales. Status - Of Concern (VMA)** This regional ecosystem occupies a relatively large area behind the coastal foredune at the northern end of Flying Fish Point. Several of the areas mapped have suffered severe canopy disturbance related to partial clearing. Due to its buffered location within a larger area of undisturbed vine forest, it is unlikely that this community will be impacted during access construction.

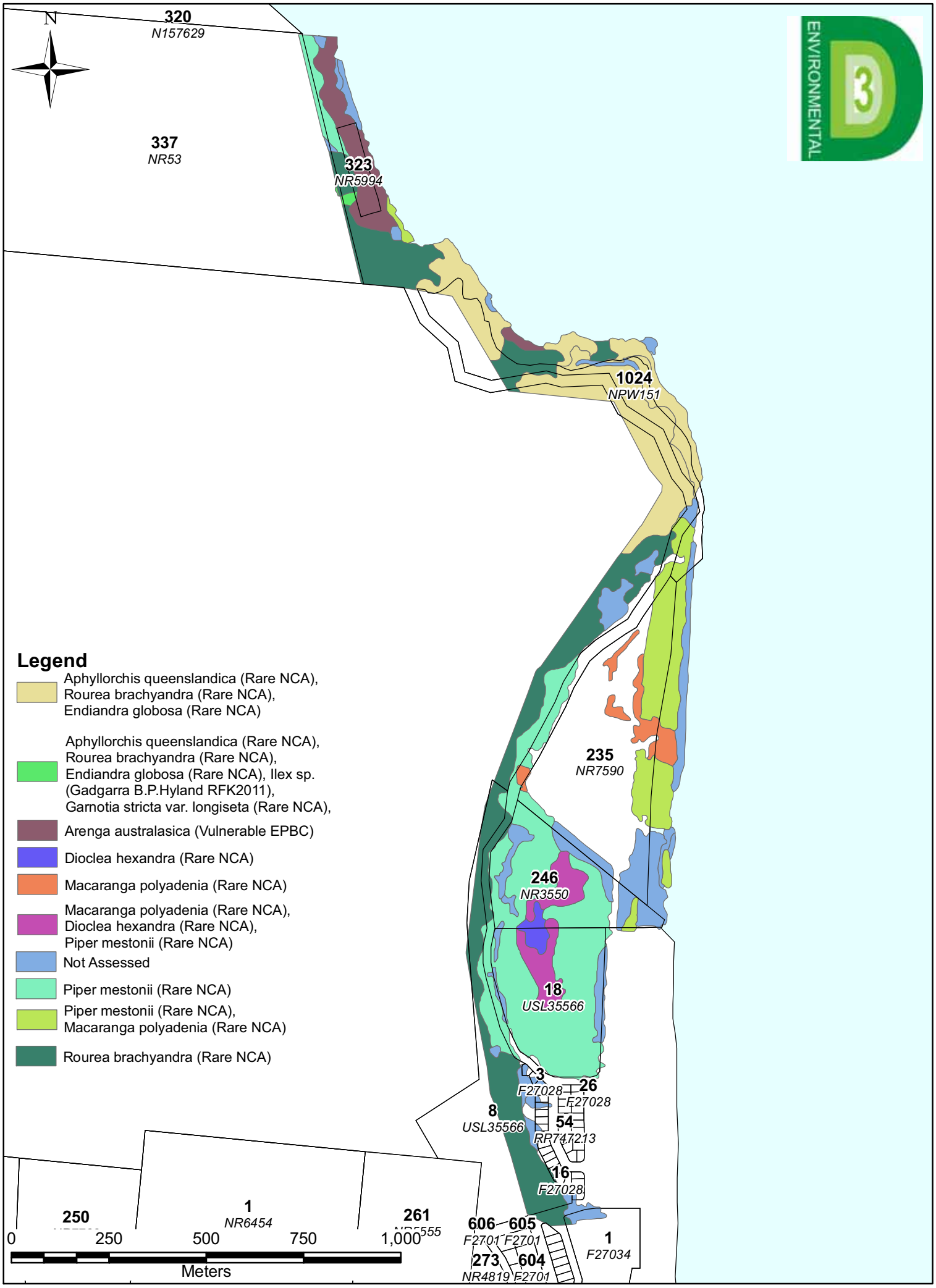


FIGURE 7.2
POTENTIAL HABITAT FOR SIGNIFICANT FLORA SPECIES
ACCESS ROAD OPTION AREA

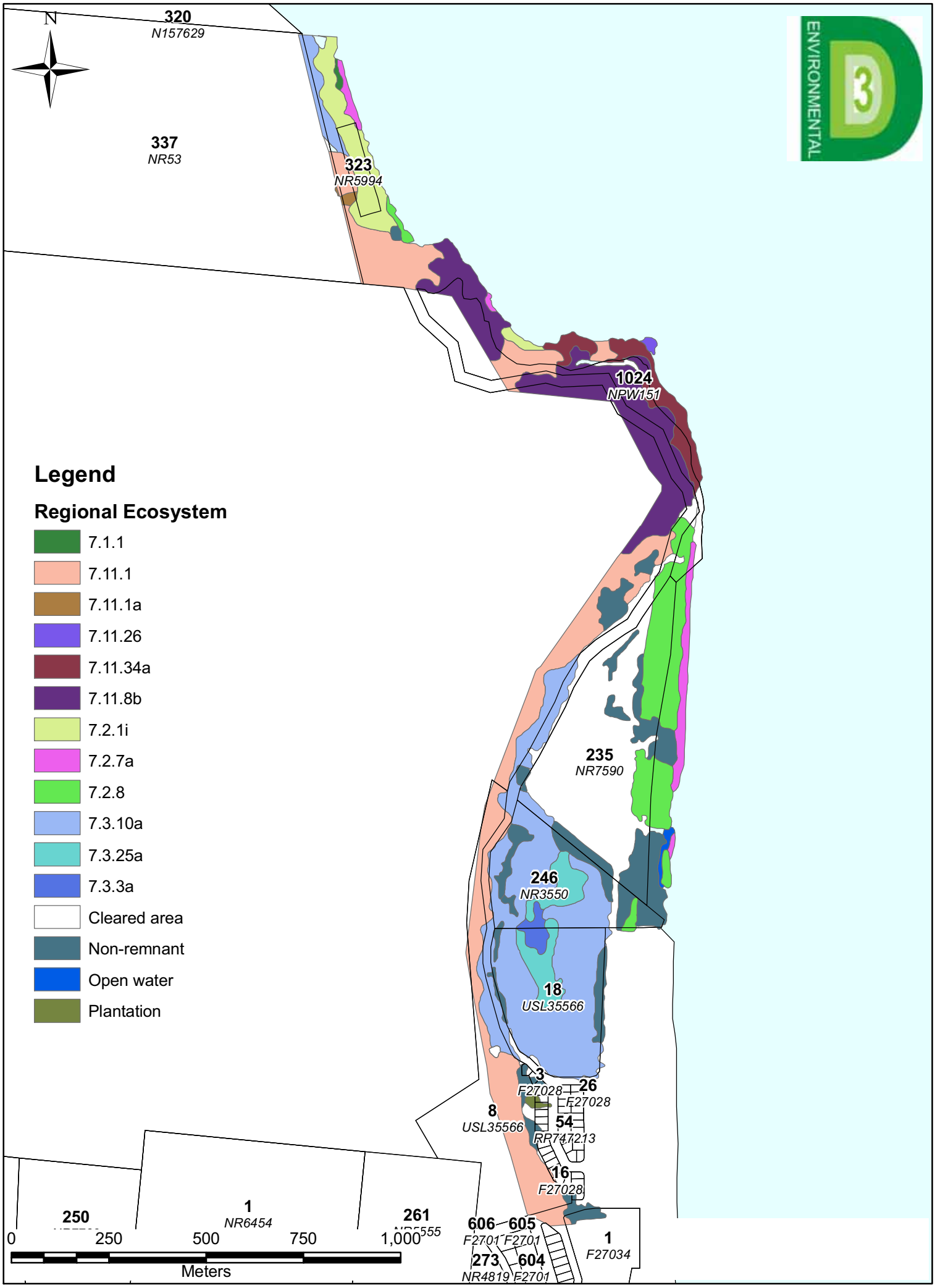


FIGURE 7.3

3D ENVIRONMENTAL (2006) REGIONAL ECOSYSTEMS IN ACCESS ROAD OPTION AREA

Regional Ecosystem 7.3.3a - **Mesophyll Vine Forest with *Archontophoenix alexandrae* (feather palms). Status - Of Concern (VMA).** Feather palm forest is restricted to the central portion of the large area of mesophyll vine forest on alluvium (RE 7.3.10), spanning Unallocated State Land (USL 35566) and Nature Reserve (NR 3550).

Regional Ecosystem 7.3.10a: **Simple to complex mesophyll to notophyll vine forest on moderate to poorly drained alluvial plains of moderate fertility. Status – Of Concern (VMA).** Rainforest types on alluvium are rare vegetation types in the Wet Tropics Bioregion having been severely impacted by clearing on lowland coastal plains. This community forms a relatively intact remnant on USL35566 and NR3550 and is traversed by the current unsealed access road.

Regional Ecosystem 7.3.25a: ***Melaleuca leucadendra*** **open forest and woodland. Stream levees and prior streams on well-drained sandy clay loam alluvial soils. Status – Of Concern (VMA)** Tall *Melaleuca* woodlands on alluvium are located in the southern portion of the access corridor, central to the large tract of vine forest on lot 18 USL35566. This community is generally indicative of seasonal waterlogging (seasonal swampland) and should be avoided during route determination. This community provides potential habitat to *Macaranga polyadenia* and may be subject to invasion by Pond Apple.

Regional Ecosystem 7.11.1: **Simple-complex mesophyll to notophyll vine forest on moderately to poorly drained metamorphics (excluding amphibolites) of moderate fertility of the moist and wet lowlands, foothills and uplands. Status – Not of Concern (VMA).** This community is relatively extensive in the western fringes of the access corridor where it occupies coastal footslopes and associated colluvial aprons. The current access road traverses this community in several locations. The type has suffered from extreme wind disturbance. Better developed variants located on sheltered gully lines have been mapped as RE7.11.1a.

Regional Ecosystem 7.11.8b- Acacia mangium and A. celsa open to closed forest. Very wet and wet lowlands and foothills. **Status – Of Concern (VMA).** This '*of concern'* regional ecosystem occupies steep coastal slopes, footslopes and headlands in the Heath Point area where it is directly impacted by the current road alignment. Further impact to this community is inevitable if access development proceeds from the south.

Regional Ecosystem 7.11.26 – Rock Pavement Communities. **Status – Of Concern (VMA).** Small areas of this RE are mapped in the vicinity of Heath Point where the community is comprised of a mosaic of shrubland and bare metamorphic rock face. The floristic composition of this community has not been determined.

Regional Ecosystem 7.11.34a **– Complex of shrubland, low heathy or shrubby woodlands or open forests dominated by *Corymbia tessellaris* and *Lophostemon suaveolens.* Status – Of Concern (VMA).** This community occupies low footslopes of coastal headlands in the vicinity of Heath Point, generally forming a transitional community to rock pavements below, and better developed sclerophyll open forest and vine forest above. The current road alignment fringes the upper margin of this community.

The majority of vegetation communities within the mapped corridor are 'of concern' under current VMA (1999) classifications and disturbance to a number of these communities is inevitable if a southern approach to the proposed resort area is utilised, particularly on coastal headland communities where route location is tightly constrained by topography. Disturbance to the only 'endangered' regional ecosystem in the study area (RE 12.2.1) can be readily

avoided by ensuring future access route development is confined to the west of the existing unsealed road.

3D Environmental (2006b) recommended that route options following the existing road alignment are utilised wherever possible, resulting in the least loss of vegetation.

7.3.3 *Fauna (Cassowaries)*

An assessment of the impacts of the proposed options was undertaken by Moore (2006) with regards to Cassowary issues. The results are as follows:

Option 1 – Retain the existing alignment

This is considered the least preferable of the three possible road alignments for Cassowary management. Currently there are two adult Cassowaries and a chick that regularly cross the Ella Bay Road between Flying Fish Point and the fish farm to exploit the vegetation within the Reserve. This places them at risk of collision with vehicles, and that risk will increase significantly if the road is upgraded and traffic flow increases.

Option 2 – Fish Farm boundary

This option allows Cassowaries to access the Reserve without having to cross the upgraded Ella Bay Road. In addition, it enables the Reserve to be incorporated into or managed with the adjoining National Park. However, there is still the possibility that birds may occur on the road near the fish farm. As such, there would be a need to incorporate a Cassowary-proof fence along the new road if this option were adopted. Although not the preferred option, this placement significantly reduces the risk of road death for Cassowaries.

Option 3 – Coastal alignment

This road placement is the preferred option for Cassowary management in that it provides maximum protection for the resident Cassowaries. The boundary fences of the fish farm could be extended to meet the new road, leaving only a small length of Cassowary-proof fencing to ensure that Cassowaries are not able to access the road at these points. As with Option 2, this road alignment enables the Reserve to be incorporated into or managed with the adjoining National Park.

Recommendation R2. A Road Management Plan for known and likely Cassowary crossing points on the Ella Bay Road should be developed and implemented. The points currently used by Cassowaries to cross the Ella Bay Road have been identified and mapped; however, the exact placement of traffic calming points will be dependent on the final location and form of any road upgrade.

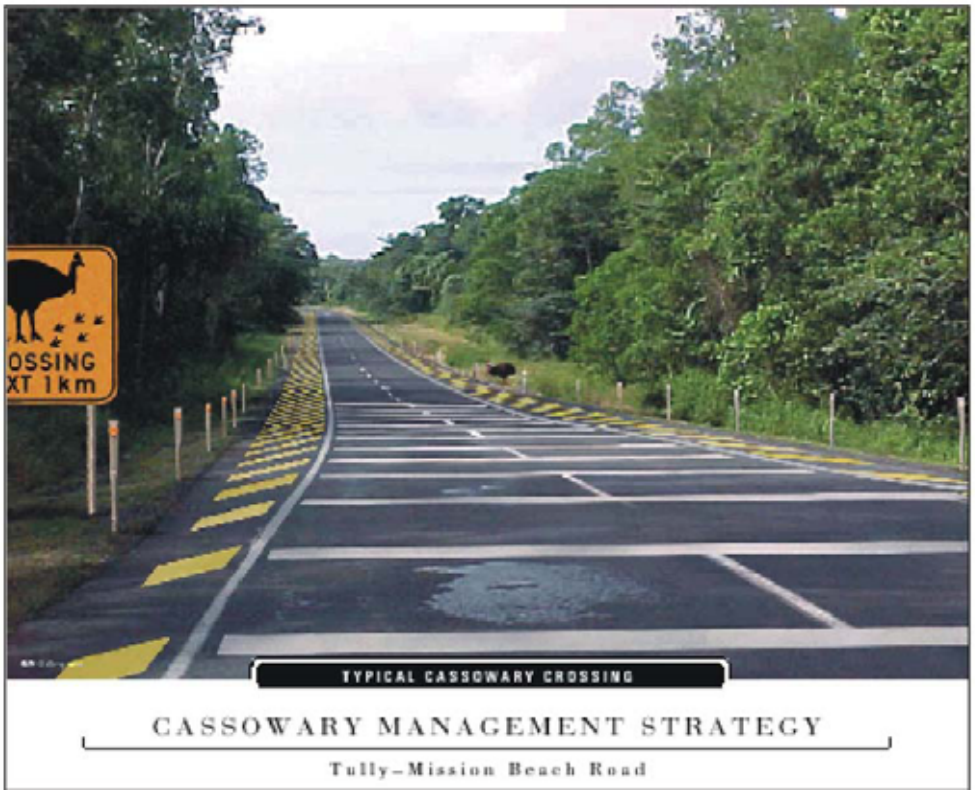
An example of a Mission Beach road crossing indicating possible traffic calming suitable for use on the Ella Bay Road is illustrated in Figure 7.4, with generic measurements detailed in Moore (1998, 1999). This crossing has been designed to comply with Queensland Department of Main Roads standards.

Another wildlife collision prevention strategy that may be suitable for the Ella Bay Road Cassowary road crossings is a 'Wildlife Protection System' (WPS). This technology has been used extensively in Canada and is designed to alert approaching drivers with 'real time' information of the presence of wildlife on the road. The WPS uses infrared cameras to detect the presence of wildlife on or near the roadway. When the cameras detect wildlife, flashing

lights at both ends of the road segment are triggered, thus allowing drivers to reduce speed and anticipate wildlife on the road.

Recommendation R3. All upgrade works should be undertaken with reference to the best practice guidelines as presented in "Queensland Department of Main Roads: Roads in the Wet Tropics: Planning, Design, Construction, Maintenance and Operation Best Practice Manual (2000)".

Figure 7.4: Illustration of Standard Cassowary Road Crossing Design



7.3.4 *Fauna (General)*

In a study of the impacts of roads and powerlines on the Wet Tropics of Queensland World Heritage Area, Goosem and Turton (2000) found that natural habitat fragmented by networks of roads may cause the subdivision of populations of many fauna species, but that the problem of fragmentation is exacerbated for strictly arboreal species.

The only arboreal species present or likely to be present within the access road corridor is *Dactylopsila trivirgata* (Striped Possum). Neither are strictly aboreal and are known to come to ground level for dispersal movements (Goosem and Turton, 2000). Striped Possums are often recorded as road kill, therefore the provision of canopy connection over the roadway will be important to reduce the impacts of the road on this species.

The significant frog species *Cophixalus infacetus* and *Litoria rheocola* will require bridging structures over drainage lines, leaving streambank conditions intact.

Nyctimystes dayi will require the provision of small culverts along the length of the roadway.

The Agile Wallaby (*Macropus agilis*) is likely to become the species most often encountered along the access road. This species will cross the road to move between habitat areas, and the presence of grassed verges is an attractant to this species, and it may frequent roadside locations. Lower road speeds and warning signs will reduce the risk of vehicle strike.

Due to their mobility and ability to fly across road corridors, the majority of bird and bat species would be unaffected by the location of the access road, and it will not significantly sever habitat connections. Although for ground-dwelling species, such as the Orange-footed Scrubfowl (*Megapodius reinwardt*), the road will present a hazard.

Direct impacts of road construction or upgrading would require the removal of some habitat within a narrow corridor, the effects of which would be mitigated by the considerable size of similar habitat present in the local area and in the region. However the cumulative impacts associated with consistent road deaths of a range of species would be far more serious.

Roads have been found to reduce fauna population densities in adjacent areas through edge effects, stress-response and directly through road kill (Findlay and Bourdages 2000; Haskell 2000, cited in Chenoweth EPLA 2003). This is particularly significant for fauna populations that are small, fragmented or declining, or that repeatedly come into contact with roads (Brown 1989, Bennet 1991 and Jones 2000, cited in Dique *et.al.* 2003). In situations where small or discrete populations cannot sustain high levels of mortality through natural replacement, road mortality could cause local extinction (Broadbent *et al.* 1981, cited in Jones 2000).

There is a significant body of work reporting the impacts of vehicle speed on the likelihood and severity of vehicle collisions with pedestrians. The same principles can be applied to determine the likelihood of fauna collisions related to vehicle speed, although the problem is compounded by the lower visibility of fauna due to their smaller size, and by the lack of avoidance behaviour by most animals. It is known that a doubling in vehicle speed results in a stopping distance four times as long and with four times as much kinetic energy being absorbed during an impact. A small increase in road traffic speed results in a disproportionately large increase in pedestrian fatalities as shown in Table 7.1.

Table 7.1: Odds of pedestrian deaths over a range of vehicles speeds

Vehicle Speed	Odds of Pedestrian Death (McLean *et al*., 1994)	Odds of Pedestrian Death (UK Dept. of Transport, 1994)
32 km/h	5%	5%
48 km/h	37%	45%
64 km/h	83%	85%

Logically, this can be applied to fauna. The lower the road speed, the less fauna casualties can be expected.

Recommendation R4. To minimise the potential impacts of the access road and increased traffic on the greatest range of local fauna populations, including species of conservation significance, the following actions are recommended:

- **Consider the option that isolates the least amount of habitat to minimise likely fauna "traffic" across the road corridor;**
- **Once the preferred road route is selected, carry out a detailed fauna investigation, with the results contributing to the design of the road, including necessary fauna crossing infrastructure and its optimal locations;**
- **Ensure that road speeds are maintained at no greater than 50km/hr.**

7.3.5 *Summary of Options*

The Traffic Report (ETS Group, 2007) determined that the existing capacity of Ella Bay road will not be of adequate standard to carry the traffic from the proposed development, and an alternative means of road access is required to support the project. A number alternative means of road access or upgrading of the existing road were investigated, including:

- **Mountainous Road Option**
  The possibility of road access from the west was investigated to supplement Ella Bay Road. The route of the option was located outside of the National Park boundaries, although traversing high parts of the Seymour Range through sensitive vegetation. Discussion by the proponent with the EPA and DEH resulted in not pursuing the option further.
- **Inland Option**
  The proponent investigated an alternative inland route via the Bruce highway, Garradunga Road and Jubilee Road. At a preliminary meeting with the EPA and WTMA both expressed the opinion that the inland route would incur a number of negative environmental externalities.
- **Tunnel Option**
  To eliminate the topographical and environmental problems with a mountainous road, a tunnel option was investigated. A dedicated road reserve currently exists along the southern boundary of the site heading west and then south, and preliminary data showed that a tunnel was possible. However, due to the associated issues and excessive cost, this option was determined not to be viable.

The most environmentally and economically viable option is to upgrade the existing Ella Bay Road. Three alternative upgrade options have been investigated. The flora and fauna impacts associated with each option are as follows:

Option 1: While the portion of habitat between the existing Ella Bay Road and the township of Flying Fish Point is already isolated by Ella Bay Road, it is currently an unsealed, low-traffic bearing road with minor impact on fauna movement. The necessary upgrading of the road and increase in traffic would further isolate this area of habitat, which is significant particularly for the Cassowary. The threat of vehicle strike would increase significantly and works such as the installation of guide fencing and construction of underpasses would be required to allow continued safe movement for fauna across the road. This option requires the least habitat removal.

Option 2: This option utilises part of the existing Ella Bay Road, but requires the construction of a new section of road along the southern boundary of the fish farm, resulting in increased habitat loss, but reducing the effects of habitat isolation. Some fencing would be required to reduce the risk of vehicle strikes for Cassowaries.

Option 3: This option requires the construction of a new stretch of road north from Flying Fish Point and east of the fish farm. The road would traverse a sensitive Coastal Management Area, with significant coastal erosion issues. This option requires the greatest amount of habitat removal, although it would result in the least amount of habitat fragmentation.

Each option has positive and negative aspects in relation to flora and fauna, although mitigation works, such as the provision of fauna crossings and fencing, can alleviate impacts associated with Options 1 and 2.

8.0 COLLABORATION WITH RESEARCH ORGANISATIONS

In December 2006 a Letter of Agreement between the Proponent and James Cook University and The University of Queensland to collaborate in the development of joint initiatives addressing both research and training and focussed on the development of a sustainable town as well as reducing environmental impacts in the Ella Bay project.

A more detailed agreement is being planned with the aim of developing specific projects in priority areas.

Both universities have expertise in vegetation and wildlife management, and wastewater and stormwater management and will be involved in designing and auditing mitigation solutions.

The resources and expertise brought together under this agreement will be well-placed to prioritise and address the range of recommendations made in this assessment of terrestrial and freshwater flora and fauna impacts.

9.0 SUMMARY OF RECOMMENDATIONS

9.1 VEGETATION AND FLORA RECOMMENDATIONS

Recommendation V1: The Regional Ecosystems map prepared for this assessment (3D Environmental 2006a) has been based on intensive ground-truthing. A request for a mapping amendment should be made to the Queensland Herbarium.

Recommendation V2: The final Infrastructure Plan to consider the requirements of Part S of the Regional Vegetation Management Code for Coastal Bioregions (NRW 2006b) and acceptable or alternative solutions to be reached in negotiation with NRW to achieve the performance requirements of the Code.

Recommendation V3: The tenure/management status of the significant areas of intact remnant vegetation occurring within the property boundary but outside of the development footprint is to be established via a mechanism that retains their conservation values in perpetuity.

Recommendation V4: Prepare a Conservation Management Plan for native vegetation nodes and corridors within the development area.

Recommendation V5: A Fire Management Plan to be prepared that calculates appropriate setbacks for development from the adjacent vegetation. The buffer distances can then be negotiated with NRW based on the findings of the study. The Fire Management Plan should also be relevant to the operational phase of the development, and include guidelines for land managers and residents.

Recommendation V6: Once appropriate buffer distances have been established, the Concept Masterplan can be revised to avoid buffer areas. These buffer areas can incorporate fences and roads.

Recommendation V7: A Construction Vegetation Management plan is prepared to ensure that retained vegetation is protected from construction impacts.

Recommendation V8: A Weed Management Plan is prepared for the construction and operational phases of the development. Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring procedures are to be incorporated into the Plan.

Recommendation V9: An Environmental Code of Conduct is prepared for construction workers and residents to ensure that responsibilities for vegetation protection, fire management and weed management are clear and that National Park regulations are understood. The Environmental Code of Conduct should be incorporated into the induction of any site workers, and should be the subject of community information sessions.

Recommendation V10: No residential allotments should directly adjoin the National Park or other remnant vegetation to prevent the clandestine dumping of garden waste into natural areas. Roadways between residences and natural areas provide suitable buffers against the spread of garden escapes and other weeds.

Recommendation V11: When access road and pedestrian access locations are finalised, these areas are to be subject to targeted searches for EVR flora species. Where they are located, the routes will be amended to avoid them where possible. If avoidance is not possible, species-specific management plans are to be prepared to guide the removal and relocation of individuals in accordance with the requirements of the NCA.

Recommendation V12: Within remnant vegetation, pedestrian walkways to be suspended to prevent significant ground and vegetation disturbance. Railings should confine pedestrians to the walkways.

Recommendation V13: Wherever remnant vegetation is traversed by vehicular or pedestrian access ways, construction should be guided by the Construction Vegetation Management Plan, the Weed Management Plan, and the Erosion and Sedimentation Control Plan.

Recommendation V14: Development design to incorporate the corridor linkages recommended by Moore (2006) (see Figure 4.6), linking the north-south riparian corridor to habitat to the north through rehabilitation.

Recommendation V15: There are currently no hydrological or water quality specialist studies available for the subject site and surrounds. The presence of a wetland of national and state significance – the Ella Bay Wetland – north of the proposed development area will require a significant level of investigation to determine:

a) Whether runoff and/or groundwater from the proposed development area contributes to wetland area, and to what extent;

b) water quality, flora and fauna of the swamp over a considerable period to capture data for a range of climatic conditions; and

c) the stormwater management and water quality controls that are proposed for the development to protect the integrity of the swamp and its associated biota.

Recommendation V16: A Rehabilitation and Landscaping plan is to be prepared for the development area. All plant species used for rehabilitation and landscaping (both by the developer during construction and on private property during operation) are to be of local provenance, although no species attractive to Cassowaries should be planted outside of the Cassowary corridor areas.

Recommendation V17: All soil and other materials to be used for rehabilitation or landscaping purposes (both by the developer during construction and on private property during operation) to be restricted to materials certified as free of pathogens and weeds.

Recommendation V18: The Rehabilitation and Landscaping Plan is to include a guide to suitable plant species and materials suppliers that can meet the specified conditions of Recommendations V15 and V16.

Recommendation V19: The golf course is to be designed to prevent pollutants from entering the natural environment. Application of risk assessment and simulation modelling is required to accurately identify potential impacts and design measures to mitigate impacts.

Recommendation V20: A Surface Water and Groundwater Quality Management Plan is required for the operational phase of the project. Water quality standards must be set to protect native terrestrial and aquatic flora, including regular monitoring of receiving waters to detect levels of herbicides, fertilisers and sediment entering natural waterways, and planned responses to adverse results.

Recommendation V21: The Coastal Management Plan and Great Barrier Reef Wetlands Protection Program to be consulted in development and golf course planning.

Recommendation V22: Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring are to be incorporated into the Plan, which is to be guided by the Johnstone Shire Pest Management Plan (2004).

9.2 FAUNA RECOMMENDATIONS

Recommendation F1: The final Infrastructure Plan to consider the requirements of Part S of the Regional Vegetation Management Code for Coastal Bioregions (NRW 2006b) and acceptable or alternative solutions to be reached in negotiation with NRW to achieve the performance requirements of the Code.

Recommendation F2: See Table 4.6, Section 4.2.1.5.

Recommendation F3: The main east-west corridor does not allow Cassowary access to that part of the foreshore represented by Locations 1b, 3 and 4 (Figure 4.4). Any Cassowary habitat lost by doing so should be compensated for by increasing the revegetation planned to take place in the new northern corridor 'B' and throughout the remainder of the site, or be the subject of an 'offset' i.e., either the gifting to the protected estate of an agreed part of the subject site or the purchase and donation to the protected estate of alternative compensatory habitat elsewhere.

Recommendation F4: A Cassowary-proof fence should surround the entire integrated resort along the existing vegetation line and extend into selected areas of revegetation where appropriate. The fence should be at least 1.8 metres in height to guarantee the exclusion of Cassowaries and be constructed of natural material e.g., tea-tree or similar, on a backing structure of 50mm diamond-shape chain mesh fencing. The fence should be densely screened with plants so that birds cannot run into it by accident, or be attracted by people or food resources. There should be a gap between the lower section of the fence and the ground of approximately 100 mm, to allow the passage of small mammals and reptiles, but not large enough to give access to small Cassowary chicks.

Recommendation F5: No walking trails should be located outside the Cassowary-proof fence surrounding the development. All ground level walking trails and pedestrian paths inside the development should be located outside the Cassowary movement corridors, or if located within the corridor, be raised approximately 2.5 metres above ground level to prevent interactions between cassowaries and people.

Recommendation F6: Road over-passes should be constructed on the 'Ring Road' to cross above sections of the Cassowary corridors, or existing gullies and creeks. These over-passes are essential to facilitate the unhindered movement of cassowary and other fauna.

Recommendation F7: All roads within the resort should also be constructed following appropriate QDMR guidelines. Where necessary, traffic calming devices should be located on the roads within the resort.

Recommendation F8: Recommendation F8. Dogs can harm and have the potential to kill Cassowaries, as well as transmit disease. A strict dog control program should be enforced and dog management requirements should be included in an "Environmental Code of Conduct" for residents.

Recommendation F9: The planting of accessible native or domestic fruiting trees within the resort precincts should be restricted to avoid attracting Cassowaries.

Recommendation F10: Apart from existing natural streams, no standing water e.g., ponds or fountains should be accessible to Cassowaries in or around the development. Cassowaries have to drink a number of times per day and it is probable that in many areas the presence of water is as big an attraction to Cassowaries as fruiting trees.

Recommendation F11: To reduce the possibility of disturbance to Cassowaries and other fauna using the adjoining areas, all external lighting within the development should be directed away from the surrounding rainforest vegetation.

Recommendation F12: A Queensland Parks and Wildlife Service (QPWS) education program on the risks associated with hand feeding of Cassowaries should be initiated.

Recommendation F13: A potential increase in the number of road mortalities for *L. rheocola* and *N. dayi* relating to increased traffic may have a local impact on these populations. Impacts therefore, are likely to be localised. Road crossings over drainage lines should be of a suitable design to allow the safe movement of these frog species, preferably through bridging streams and leaving stream-banks intact.

Recommendation F14: The minor loss of habitat for Spectacled Flying-foxes associated with the access road upgrading may be compensated by the careful selection of fruiting plant species for revegetation areas. This may actually increase the value of the development site for local populations.

Recommendation F15: Regular monitoring of the foreshore during Green Turtle nesting season is required, and should any nests be detected, these should be cordoned-off to prevent their disturbance by humans and feral animals. The record should be registered with the EPA.

Recommendation F16: A Pest Animal Management Plan is required to control the numbers of feral species present, in particular pigs, foxes and dogs, within and surrounding the development. Consultation with QPWS will be required to co-ordinate management responses with management practices within Ella Bay National Park.

Recommendation F17: Inclusion of the ant-plant *Myrmecodia tuberosa* in Melaleuca vegetation within the rehabilitation areas may increase the value of the study area for the Apollo Jewel Butterfly by supplying additional food sources.

Recommendation F18: The preparation of a Fire Risk Assessment is required to determine any need for a Fire Management Plan to protect fire-intolerant fauna and fauna habitat.

Recommendation F19: The installation of small-diameter culverts at regular intervals beneath the access road through rainforest habitat would provide *Cophixalus infacetus* a means for safe crossing, as the species is secretive and more likely to traverse a dark, damp culvert than an open road surface. Monitoring of selected sections of the road for road kills following wet night-time conditions is required to accurately assess the impact of the road and the success of mitigation measures.

Recommendation F20: Further assessment of the number of local and regional pairs of the Beach Stone Curlew is required to assist in clarifying the severity of likely impacts.

Recommendation F.21: The proposed minor loss of food trees for the Macleay Fig-parrot may be mitigated by the careful selection of plant species for revegetation. Fruiting plants favoured by this species, particularly *Ficus* spp. may increase the value of the development site for the local Macleay Fig-parrot population.

Recommendation F22: Detailed surface water, groundwater and water quality investigations are required to determine the potential impacts of the proposed development on the ecology of Ella Bay Swamp.

Recommendation F23: A Queensland Parks and Wildlife Service (QPWS) education program on the risks associated with living with Saltwater Crocodiles should be initiated.

Recommendation F24: In the interests of the welfare of the Agile Wallabies on site, it is recommended that an Agile Wallaby Management Plan is prepared and implemented to ease the transition for the population from a pastoral to an urban environment. The Agile Wallaby Management Plan should also address the operational phase of the development. These animals are likely to become a feature of the development and their condition and behaviour will be scrutinised by residents.

Recommendation F.25. The current proposed footprint indicates existing corridors following watercourses will be mostly retained. It is recommended that all riparian vegetation is retained, and that the corridors are at least 50m width either side of the high bank of the creeklines. In some areas this will require rehabilitation to broaden the corridor. The proponent proposes to significantly widen the corridors subject to negotiation with NRW.

Recommendation F.26: The locations of corridors and linkages recommended by Moore (2006) as shown in Figure 4.6 should be adopted, with particular attention to linkages between the north-south corridors and surrounding vegetation. The Proponent also proposes to enhance habitat associated with the network of sub-corridors along minor drainage lines within the development area.

Recommendation F27: There are a number of small, ground-dwelling fauna species of special conservation significance present in habitat within and surrounding the proposed development area, and the presence of cats and dogs would present a direct threat to those species through harassment and predation. As such, it is recommended that the keeping of cats and dogs within the proposed development area is prohibited.

Recommendation F28: Prepare a Conservation Management Plan for habitat nodes and corridors within the development area.

Recommendation F29: All lighting associated with the development should be designed so that there is no spillage into conservation areas.

Recommendation F30: Golf course planning should incorporate plant species that can be utilised by native species (other than Cassowaries). The recommended Landscaping and Rehabilitation Plan (Recommendation V16) should consider fauna habitat requirements in its preparation, and is to be used as a guide for planting.

Recommendation F31: An Integrated Pest Management (IPM) program to be prepared for the golf course that will keep pests at acceptable levels using carefully selected methods, while minimizing the effect on the environment.

Recommendation F32: A Surface Water and Groundwater Quality Management Plan is required for the operational phase of the project that guided by the results of modelling for pesticides, nutrients, runoff water, and sediments from the development. Water quality standards must be set based on the Queensland Water Quality Guidelines 2006 (EPA, 2006) to protect native terrestrial and aquatic fauna, including regular monitoring of receiving waters to detect levels of herbicides, fertilisers and sediment entering natural waterways, and planned responses to adverse results.

9.3 AQUATIC FAUNA RECOMMENDATIONS

Recommendation A1: Detailed pre- and post-development surface and groundwater modelling are required to identify receiving waters from the proposed development area. Receiving waters are subject to extensive water quality and quantity data collection. Analysis of the macroinvertebrate samples taken from the study area will assist in the characterisation of on-site water quality and should form a component of a Waterway Health Monitoring Program.

9.4 NATURAL HERITAGE RECOMMENDATIONS

Recommendation N1: The proponent to enter into discussions with the QPWS regarding the potential for the development to generate increased visitors to Ella Bay National Park, and to determine any need for additional infrastructure to protect the environment from increased visitor numbers.

Recommendation N2: There are significant areas of remnant forest to the north and west of the development area that are located within the subject property but outside of the development footprint. The incorporation of these areas into the WTWHA through one of a number of agreements such as Conservation Covenants, Cooperative Management, Land for Wildlife, Nature Refuge or Commonwealth Conservation Agreement would be a valuable contribution to the conservation estate.

9.5 ACCESS ROAD RECOMMENDATIONS

Recommendation R1: Once a preferred access road route alignment has been selected, a detailed flora survey will be required to determine the presence of species of significance, and determine the most suitable strategies for impact mitigation.

Recommendation R2: A Road Management Plan for known and likely Cassowary crossing points on the Ella Bay Road should be developed and implemented. The points currently used by Cassowaries to cross the Ella Bay Road have been identified and mapped; however, the exact placement of traffic calming points will be dependent on the final location and form of any road upgrade.

Recommendation R3: All upgrade works should be undertaken with reference to the best practice guidelines as presented in “Queensland Department of Main

Roads: Roads in the Wet Tropics: Planning, Design, Construction, Maintenance and Operation Best Practice Manual (2000)".

Recommendation R4. To minimise the potential impacts of the access road and increased traffic on the greatest range of local fauna populations, including species of conservation significance, the following actions are recommended:

- Consider the option that isolates the least amount of habitat to minimise likely fauna "traffic" across the road corridor;
- Once the preferred road route is selected, carry out a detailed fauna investigation, with the results contributing to the design of the road, including necessary fauna crossing infrastructure and its optimal locations;
- Ensure that road speeds are maintained at no greater than 50km/hr.

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Appendix 1:
Terrestrial and Freshwater Flora and Fauna Matters of National Environmental Significance Ella Bay Integrated Resort Project, Innisfail

Terrestrial and Freshwater Flora and Fauna
Matters of National Environmental Significance
Ella Bay Integrated Resort Project, Innisfail

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Attachment 3: Ella Bay Swamp Description
Directory of Important Wetlands in Australia (3rd Edition, 2001)

List of Abbreviations

BAAM	-	Biodiversity Assessment and Management Pty Ltd
CG	-	Co-ordinator General
DEH	-	Department of Environment and Heritage (Commonwealth)
DPI	-	Department of Primary Industries (Queensland)
EIS		Environmental Impact Statement
EPA	-	Environmental Protection Agency (Queensland)
EPBC Act	-	*Environment Protection and Biodiversity Conservation Act 1999*
EVR	-	Endangered, Vulnerable, Rare
FIFA		Flora and Fauna Impact Assessment
GBRMPA	-	Great Barrier Reef Marine Park Authority
JSC	-	Johnstone Shire Council
LPA	-	*Lands Protection (Pest and Stock Route Management) Act 2002*
NES	-	Commonwealth Matters of National Environmental Significance
NCA	-	*Nature Conservation Act 1992*
RE	-	Regional Ecosystem
ToR	-	Terms of Reference (for proposed development)
VMA	-	*Vegetation Management Act 1999*
WTMA	-	Wet Tropics Management Authority
WTWHA	-	Wet Tropics World Heritage Area

1.0 INTRODUCTION

This appendix has been prepared for Ella Bay Developments Pty Ltd for the purpose of documenting issues of potential National Environmental Significance (where they relate to terrestrial and freshwater flora and fauna) associated with the Ella Bay Integrated Resort Project, Innisfail.

The findings of this report are drawn primarily from baseline studies conducted by Biodiversity Assessment and Management Pty Ltd (BAAM), 3D Environmental (2006a & b) and Moore (2006 Volumes I-III) on the subject site and surrounds including:

1. *Vegetation Survey Report of the Proposed 'Ella Bay Integrated Resort Project'* (3D Environmental, 2006a);
2. *Ella Bay Integrated Resort Project Supplementary Section: Southern Access Corridor Vegetation Mapping'* (3D Environmental, 2006b);
3. *Terrestrial and Freshwater Fauna Assessment for the Proposed 'Ella Bay Integrated Resort Project, Innisfail'* (TFFA) (BAAM, 2006);
4. *Cassowary Assessment of the 'Ella Bay Integrated Resort Project' North Queensland 6 – 14 November 2006: Volume I – Cassowary Field Survey; Volume II – Impacts and Mitigation; and Volume III – Population Viability Analysis* (L.A. Moore, 2006);

This report does not address issues relating to local surface water, groundwater, palaeontological or geomorphological values, and relies on relevant background information provided by Ella Bay Developments Pty Ltd regarding the project description and other technical reports and specialist studies as available at the time of writing.

2.0 DESCRIPTION OF PROPOSED ACTION

This section describes relevant aspects of the subject site and the proposed development and identifies relevant legislation and/or policy requirements for with regard to flora and fauna.

2.1 LOCATION

The Ella Bay Integrated Resort Project is located on Lot 320 on Crown plan N157629, County Nares, Parish Glady (the subject site). This lot is situated approximately 10km to the north-west of Innisfail (see Figure 2.1) and encompasses an area of approximately 450 hectares.

The subject site shares a common boundary with Ella Bay National Park in the north, south and west. Most of the surrounding area is located within the WTWHA (Environment Australia, 2006) and is included in the Wet Tropics bioregion of Queensland (Wet Tropics Management Authority (WTMA), 2006). Pacific Ocean marine environments adjacent to the coastal boundary to the east are included in World Heritage Area (Islands) and the Great Barrier Reef Marine Park (Great Barrier Reef Marine Park Authority (GBRMPA), 2003) (See Figure 2.2).

2.2 PROPOSED ACTIVITIES

Ella Bay Developments Pty Ltd proposes to transform the existing 450-hectare operating cattle station into a fully master-planned, integrated tourism and residential lifestyle community over a ten to fifteen year period. The proposed development incorporates 540

residences located around an 18-hole golf course, four five-star resort precincts with ocean frontage and beach access, a village precinct comprising mixed retail, professional services, dining and office usage, an educational precinct, a proposed sustainable development research institute in partnership with James Cook University and The University of Queensland, a 'signature' championship 18-hole golf course, and associated public infrastructure including sewerage treatment and access and internal road networks. Appropriate areas will be identified for environmental buffers, rehabilitation, revegetation (approximately 500 000 rainforest trees) and wildlife fencing. A concept plan of the proposed development is shown in Figure 2.3.

A road and/or upgrades to the existing road will be required to gain access to the proposed resort development at Ella Bay. The proposed route is through the south via the existing access road which passes through Ella Bay National Park. Three options are currently being investigated regarding the alignment of this road (see Figure 2.4). These options are:

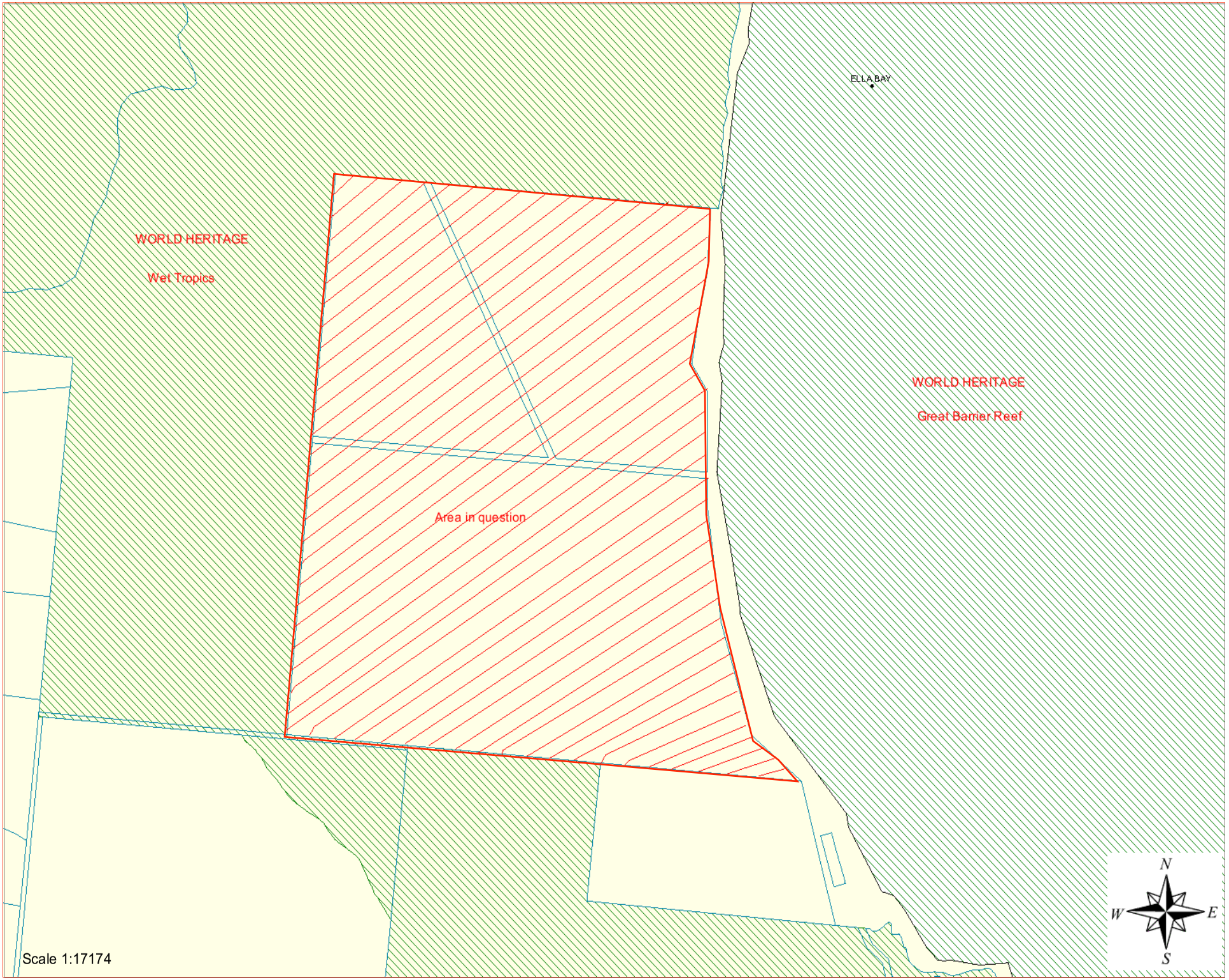
Option 1: This option follows the existing Ella Bay Road.

Option 2: This option follows the coastal road through Flying Fish Point, then deviates from the coast to follow the southern boundary of the fish farm before joining the existing Ella Bay Road.

Option 3: Option 2 follows option 1 through the centre of Flying Fish point but continues north through the town to follow the coast line east of the fish farm before connecting to Ella Bay Road.

All three options will require the widening of the existing unsealed road within the road reserve between Heath Point and the subject site. The entire road will need to be sealed..

Figure 2.1: Subject Site Location



Legend

- Land Parcels/Cadastre
- Aust Coastline/Borders 100K
- Localities - 250K
  - Mountain
  - Places
- World Heritage Places
- Coastal Waters Limit - 3NM
- Aust Terrestrial 100K
- Subject Site

FIGURE 2.2
WORLD HERITAGE AREAS

Australian Government
Department of the Environment and Heritage

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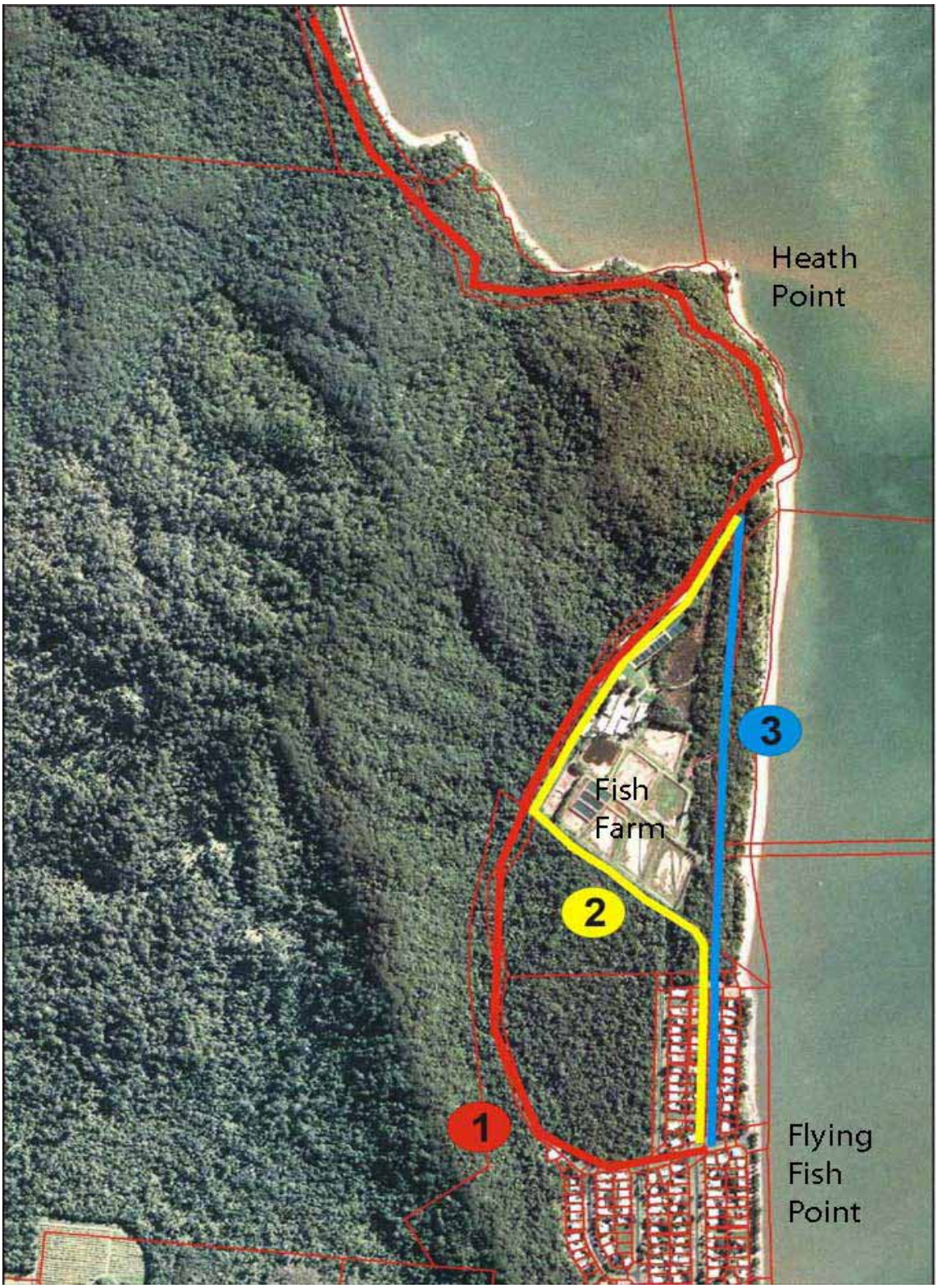
FIGURE 2.3
PROPOSED DEVELOPMENT CONCEPT PLAN

Figure 2.4: Road Route Options



2.3 RELEVANT LEGISLATION AND POLICY REQUIREMENTS

2.3.1 *Commonwealth Matters of National Environmental Significance*

The terrestrial and freshwater flora a fauna assessment for the proposed development and associated access corridors must address Commonwealth Matters of National Environmental Significance (NES). This report identifies impacts and mitigation strategies on the surrounding Wet Tropics World Heritage Area (WTWHA) and for listed threatened species under the *Environment Protection and Biodiversity Protection Act 1999* (EPBC Act).

The WTWHA consists of a variety of land uses and tenure The Wet Tropics Management Plan 1998(Queensland Government (QG), 1998) designated areas included in the WTWHA into four distinct zones: Zone A-D with A having the highest conservation value. Lands directly to the north and south-east of the subject site are designated as Zone A while areas to the west and south are designated as Zone B (See Figure 2.5). Zones A and B are:

Zone A:
Land included in zone A has a high degree of integrity and is remote from the disturbances associated with modern technological society. It is in its natural ecological, physical and aesthetic condition and sustaining this condition is the intent of this zoning. Visitors may expect to find solitude and no obvious management presence. To qualify for inclusion in zone A, land must:

- *be at least 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structures; and*
- *be at least 700 metres from clearings; and*
- *include a minimum area of 150 hectares of undisturbed habitat; and*
- *no obvious signs of disturbance in the last 40 years (such as logging, for example).*

Zone B:
Like land in zone A, it has a high degree of ecological integrity and it is in a natural state but is not necessarily remote from disturbance. There is a reasonable expectation that it could be restored to a condition which would qualify for inclusion in Zone A. Visitors can expect solitude and limited evidence of a management presence (infrastructure, etc.). Lands in zone B must:

- *be less than 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structure; or,*
- *be less than 700 metres from clearings; or*
- *include an area of up to 150 hectares of undisturbed habitat;*
- *have some obvious signs of disturbance in the last 40 years; and*
- *not overlap with Zones A, C and D.*

Ella Bay National Park is also listed on the Register of the National Estate.

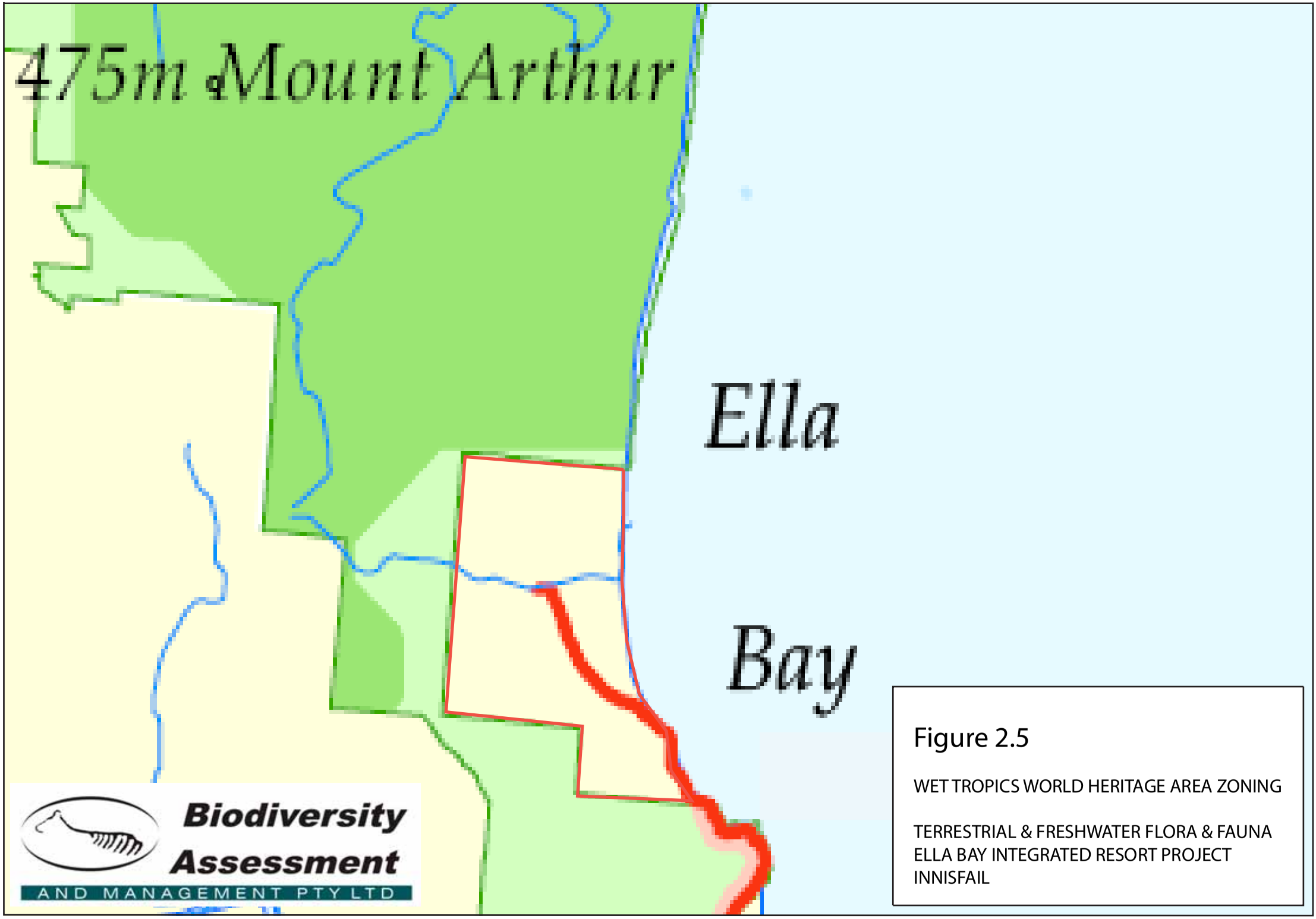


Figure 2.5

WET TROPICS WORLD HERITAGE AREA ZONING

TERRESTRIAL & FRESHWATER FLORA & FAUNA
ELLA BAY INTEGRATED RESORT PROJECT
INNISFAIL

3.0 VEGETATION AND FLORA

3.1 BASELINE INVESTIGATIONS

3.1.1 *Regional Ecosystems*

A description of Regional Ecosystems (REs) recorded from detailed flora surveys of the subject site (3D Environmental 2006a) is provided in Table 3.1.

None of the vegetation communities/Regional Ecosystems recorded for the subject site are listed as Threatened Ecological Communities under the EPBC Act.

Table 3.1: Regional Ecosystems observed on the subject site

RE	Description	VMA Status
7.2.1i	Mesophyll vine forest. Beach ridges and sand plains of beach origin, mainly in small patches in the lee of coastal beach ridges in very high rainfall areas	**Endangered**
7.2.1d	Swampy mesophyll vine forest with *Archontophoenix alexandrae* (feather palm) in the sub-canopy. Seasonally inundated lowland areas on dune sands.	**Endangered**
7.2.4	*Eucalyptus* spp. open forest and/or *L.suaveolens* (swamp mahogany) open forest on swampy sandplains of beach origin, and Pleistocene beach ridges.	**Of Concern**
7.2.7a	Coastal foredune complex with *Casuarina equisetifolia.*	**Of Concern**
7.2.8	*Melaleuca leucadendra* (weeping tea tree) open forest to woodland. Beach.	**Of Concern**
7.2.9	*Melaleuca quinquenervia* shrubland to closed forest, or *Lepironia articulata* open to closed sedgeland. Dune swales and swampy sandplains.	**Of Concern**
7.3.3a	Mesophyll vine forest with *Archontophoenix alexandrae* (feather palm).	**Of Concern**
7.3.10a	Simple to complex mesophyll to notophyll vine forest on moderate to poorly drained alluvial plains of moderate fertility.	**Of Concern**
7.3.25a	*Melaleuca leucadendra* open forest and woodland. Stream levees and prior streams on well-drained sandy clay loam alluvial soils.	**Of Concern**
7.11.1	Simple-complex mesophyll to notophyll vine forest on moderately to poorly drained metamorphics of moderate fertility of the moist wet lowlands, foothills and uplands.	Not of Concern
7.11.1a	Mesophyll vine forest. Very wet and wet lowlands and foothills.	Not of Concern
7.11.1b	Mesophyll vine forest recovering from disturbance, with *Acacia* canopy or emergents. Very wet and wet lowlands and foothills.	Not of Concern
7.11.8b	*Acacia mangium* and *A. celsa* open to closed forest. Wet lowlands and foothills	**Of Concern**
7.11.24 a	Closed vineland of wind disturbed vine forest.	**Of Concern**

With regards to road access from the south, a number of REs, including one 'Endangered' and eight 'Of Concern' REs are present between the southern boundary of the subject site, and Flying Fish Point. Between Heath Point and the Ella Bay property, the road is already is place and will require minor widening in places. None are listed under the EPBC Act.

3.1.2 *Flora Species of Significance*

The provisions of the EPBC Act identify listed species of national significance. While none of these species were recorded during the vegetation survey, species of significance that are considered likely or possibly to occur are listed in Tables 3.2 (for the subject land) and 3.3 (for the access road corridor options) (3D Environmental, 2006: a & b). Attachment 1 provides an analysis of the likelihood of all database species occurring.

No species listed under the EPBC were observed on the subject site or in surrounding lands, although several species were considered as potentially occurring. Their habitat areas for the subject site are shown in Figure 3.1 (Potential Significant Flora).

Figure 3.2 shows potential significant flora habitat within the area traversed by the proposed access road corridor options, although the preferred option would require minor widening of the existing road within the road reserve between Heath Point and the subject site, rather than the construction of a new access road (Section 7.1).

Table 3.2: Likely or Possible EPBC listed Flora Species on the subject site (R = rare; V = Vulnerable, E = Endangered)

Species Name	EPBC	Likely	Possible
Aponogeton proliferus	E		X
Arenga australasica	V	X	
Canarium acutifolium var. *acutifolium*	V	X	
Carronia pedicellata	E		X
Dendrobium mirbelianum	E		X
Dendrobium superbiens	V		X
Fimbristylis adjuncta	E		X
Phaius tancarvilleae	E		X

Table 3.3: Likely or Possible Significant Flora Species traversed by the proposed road corridor options (R = rare; V = Vulnerable, E = Endangered)

Species Name	EPBC	Likely	Possible
Arenga australasica	V		X
Canarium acutifolium var. *acutifolium*	V		X
Carronia pedicellata	E		X
Dendrobium mirbelianum	E		X
Dendrobium superbiens	V		X
Hupzeria prolifera	V		X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320
N157629
337
NR53
323
NR5994
RP
Legend
Stage 2 Subject Boundary
Potential Significant Flora Habitat
Arenga australasica (Vulnerable EPBC)
Phaius tancarvilleae (Endangered EPBC)
Phaius tancarvilleae (Endangered EPBC), Piper mestonii (Rare)
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500
750
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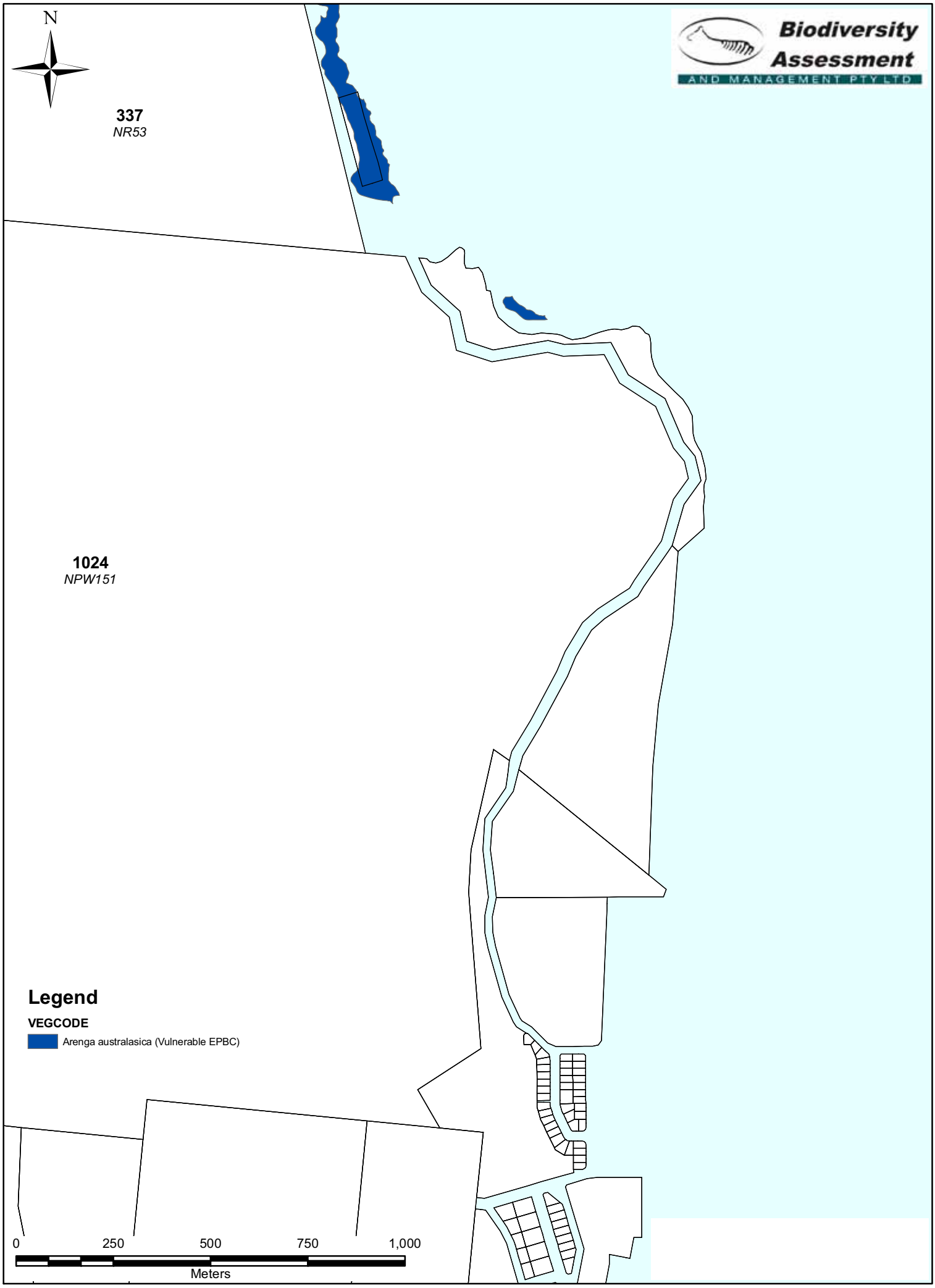
Meters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Arenga australasica (Vulnerable EPBC)
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3.2 POTENTIAL IMPACTS AND MITIGATION MEASURES

In development planning, the Proponent has largely avoided areas currently supporting remnant vegetation, with the exception of several locations in the south-eastern and eastern portions of the subject site.

Areas of particular sensitivity associated with the proposed development are located within the northern, south-eastern and eastern portions of the subject site. These areas support species listed under the EPBC Act.

Potential direct impacts on remnant vegetation identified from the current proposal are:

- Disturbance to vegetation within and/or adjacent to remnant vegetation supporting significant species;
- Habitat Fragmentation;
- Physical Impacts during the construction phase in the few areas where construction occurs adjacent to remnant vegetation, such as root damage through soil compaction by heavy equipment, and erosion and sedimentation; and
- The introduction and/or spread of exotic species.

Potential cumulative impacts are:

- The introduction and/or spread of exotic species;
- Impacts on wetland vegetation to the north of the proposed development through hydrological and water quality effects;
- Edge-related effects where clearing occurs within and adjacent to remnant vegetation; and
- Increased human and vehicle presence within the remnant vegetation areas, potentially causing trampling or damage to vegetation from vehicles within and surrounding the development area.

As the potential impacts, both direct and cumulative are intimately related, as are the various aspects of the biophysical environment, the following discussion integrates impacts and mitigation solutions to address the potential effects of the development and the planning, design, construction and operational responses to impact management.

Figure 3.1 shows the Masterplan layout over the habitats supporting or potentially supporting EPBC Act listed flora species.

While the majority of the planned development falls outside of areas supporting remnant vegetation , there are some access tracks shown through habitat potentially supporting the EPBC Endangered orchid *Phaius tancarvilleae*, although no specimens of this species were recorded during field investigations.

Figure 3.2 shows the proposed road route options over a map showing the habitat which potentially supports EPBC listed species. None of the road route options affect habitat that potentially supports these species.

The construction of the proposed access road and the roadways and pedestrian pathways on the eastern edge of the development where *Phaius tancarvilleae* potentially occurs will require clearing corridors no greater than 10 metres, and most often significantly less, through a mosaic of remnant vegetation types. A Construction Vegetation Management Plan is required to guide the construction process.

Some of these areas are low-lying and planning of final locations for access needs to consider the requirement for avoiding discharge areas. Construction will also require measures to prevent exposure of acid sulphate soils. Clearing in these areas must carried out in accordance with an acid sulphate soils environmental management plan as outlined in the *State Planning Policy 2/02 Guideline: Planning and Managing Development involving Acid Sulfate Soils*; and follow management principles in accordance with the Soil Management Guidelines in the *Queensland Acid Sulphate Soil Technical Manual*.

Vegetation issues specifically within the access road option area are provided in Section 7.0.

It is understood that the current Concept Masterplan is in draft form, and that legislative requirements for environmental protection, and other site restrictions for construction will guide the final form of the development Infrastructure Plan.

The management status of the significant areas of intact remnant vegetation occurring inside the property boundary but outside of the development footprint is to be determined. It is recommended that these areas are incorporated into the conservation estate, or be subject to strict conservation orders.

Recommendation V3. The tenure/management status of the significant areas of intact remnant vegetation occurring within the property boundary but outside of the development footprint is to be established via a mechanism that retains their conservation values in perpetuity.

Areas of extant and rehabilitated native vegetation that form major nodes and corridors (e.g. the north-south and east-west corridors) throughout the development area are to be incorporated into a Conservation Covenant with an appropriate management regime in place.

Recommendation V4. Prepare a Conservation Management Plan for native vegetation nodes and corridors within the development area.

The Concept Masterplan also shows a small number of lots located adjacent to remnant vegetation approximately 40m from the eastern boundary of Ella Bay National Park. While development of these lots would not require any clearing of vegetation, or directly impinge on the vegetation of the park, establishment of residences immediately adjacent to the park boundary has the potential to increase edge effects on park vegetation beyond those currently present. The primary potential impacts on vegetation are (1) the introduction of non-native species to gardens that may spread to the National Park; (2) an increase in fire risk associated with increased human presence; (3) access to the National Park by residents and associated trampling of vegetation. A proposed Cassowary fence between the development and remnant vegetation to the east would assist in mitigating these impacts.

Construction of the development will require the use of heavy machinery and will introduce a significant construction population to the subject site. While the significant majority of development is proposed for areas already cleared for agricultural purposes, the preparation of a Construction Vegetation Management Plan is required to guide the management of sensitive vegetation during all construction activities. The Plan will include such measures as:

- Equipment washdown procedures to prevent the introduction and spread of weeds from machinery from outside locations;
- Boot and clothing checks for all workers entering the site to ensure that no weed seeds are transported to the construction areas;
- Crossing of vegetated corridors by pedestrian or vehicular paths to be undertaken so as to reduce impacts on riparian vegetation. Clearing to be limited to the width of the crossing, retaining the canopy cover over the crossing area where possible. Any disturbed areas must be rehabilitated immediately;
- Clear demarcation of all vegetation to be retained, and a limit on the distance within which heavy machinery is allowed to prevent soil compaction and subsequent root damage;
- Soil and materials stockpiles to be located in cleared areas;
- Any soil stockpiles to be stabilised using non-fertile vegetative cover to prevent sedimentation and spread of seeds from exotic species; and
- Guidelines for recreational use of surrounding areas.

Recommendation V7. A Construction Vegetation Management plan is prepared to ensure that retained vegetation is protected from construction impacts.

Recommendation V8. A Weed Management Plan is prepared for the construction and operational phases of the development. Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring procedures are to be incorporated into the Plan.

Recommendation V9. An Environmental Code of Conduct is prepared for construction workers and residents to ensure that responsibilities for vegetation protection, fire management and weed management are clear and that National Park regulations are understood. The Environmental Code of Conduct should be incorporated into the induction of any site workers, and should be the subject of community information sessions.

Recommendation V10. Residential allotments should not directly adjoin remnant vegetation to prevent the clandestine dumping of garden waste into natural areas. Roadways between residences and natural areas provide suitable buffers against the spread of garden escapes and other weeds.

The current proposed footprint indicates existing corridors following watercourses will be mostly retained. However, some further fragmentation of these will be necessary to allow traffic and pedestrian movement.

Recommendation V11. When access road and pedestrian access locations are finalised, these areas are to be subject to targeted searches for EPBC Act listed flora species. Where they are located, the routes will be amended to avoid them where possible. If avoidance is not possible, species-specific management plans are to be prepared to guide the removal and relocation of individuals in accordance with the requirements of the DEH.

Recommendation V12. Within remnant vegetation, pedestrian walkways should be constructed so as to prevent significant ground and vegetation disturbance.

Recommendation V13. Wherever remnant vegetation is traversed by vehicular or pedestrian access ways, construction should be guided by the Construction Vegetation Management Plan, the Weed Management Plan, and the Erosion and Sedimentation Control Plan.

Vegetated corridors within the development area do not currently link with the extensive remnant vegetation to the north.

Recommendation V14. Development design to incorporate the corridor linkages recommended by Moore (2006) (see Figure 4.6), linking the north-south riparian corridor to habitat to the north through rehabilitation.

The significant regional corridor of intact native vegetation of the Seymour Range, within Ella Bay National Park, which borders the development area to the west will not be affected by the proposed development.

Recommendation V15. There are currently no detailed hydrological or water quality specialist studies available for the subject site and surrounds. The presence of a wetland of national and state significance – the Ella Bay Wetland – north of the proposed development area will require a significant level of investigation to determine:

a) Whether runoff and/or groundwater from the proposed development area contributes to wetland area, and to what extent;

b) water quality, flora and fauna of the swamp over a considerable period to capture data for a range of climatic conditions; and

c) the stormwater management and water quality controls that are proposed for the development to protect the integrity of the swamp and its associated biota.

3.2.1 *Rehabilitation and Landscaping*

Rehabilitation and landscaping works have the potential to introduce exotic species to the site, which may spread to surrounding conservation areas, including Ella Bay National Park.

Recommendation V16. A Rehabilitation and Landscaping plan is to be prepared for the development area. All plant species used for rehabilitation and landscaping (both by the developer during construction and on private property during operation) are to be of local provenance, although no species attractive to Cassowaries should be planted outside of the Cassowary corridor areas.

The mechanism by which this is achieved for private property is likely to be through the Body Corporate, although guidelines can be included in the *Environmental Code of Conduct*.

Rehabilitation and landscaping works may require the use of soils and other materials sourced from outside of the subject site. These materials may contain pathogens that can damage native vegetation, as well as the seeds of undesirable species that could spread to adjacent conservation areas.

Recommendation V17. All soil and other materials to be used for rehabilitation or landscaping purposes (both by the developer during construction and on private property during operation) to be restricted to materials certified as free of pathogens and weeds.

Recommendation V18. The Rehabilitation and Landscaping Plan is to include a guide to suitable plant species and materials suppliers that can meet the specified conditions of Recommendations V15 and V16.

3.2.2 *Golf Course Development*

The proposed golf course will require the introduction of grass species that are not native to the area. Such species will require fertilisation, herbicide and pesticide treatment, with the resultant runoff of these pollutants to native vegetation and drainage lines.

Herbicides have direct effects upon aquatic vegetation and indirect effects upon both invertebrate and vertebrate communities (Van den Brink *et. al.* 2006; Guiseppe *et. al.* 2006). Within aquatic ecosystems vegetation, particularly algae are extremely sensitive to herbicides which may significantly alter flora community structure over time (Van den Brink *et. al.* 2006). This has been observed to lead to alteration in the invertebrate community (i.e. increases in detritus feeding species and decreases in suspension feeding organisms).

Pesticides have a direct effect on invertebrates and an indirect effect on plants within aquatic ecosystems (Wendt-Rasch *et. al.* 2004). Pesticides have been observed to directly reduce the level of invertebrate herbivores and suspension feeders which results in an increase in algal biomass (Wendt-Rasch *et. al.* 2004).

Increases in nutrients within aquatic ecosystems decrease species richness by weakening stabilizing effects (Romanuk *et. al.* 2006) such as predation, grazing and species interactions. In addition, the enrichment of water by nutrients especially compounds of nitrogen and phosphorus, causes an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms and the quality of the water concerned (known as eutrophication). Nutrient enrichment tends to stimulate phytoplankton in lakes because micro-algae and cyanobacteria usually grow faster than larger algae or plants, and the resulting biomass absorbs light and so shades out benthic micro-algae or macrophytes.

On and surrounding the subject site, the receiving waterbodies can all be considered to be highly sensitive to external pollutants, and the most strict water quality management conditions will apply.

The prediction of the nature and scale of impacts of golf course operation on groundwater, surface water, and near-shore coastal water quality and wetlands requires state-of-the-art risk assessment and simulation modelling, particularly in high rainfall environments. To achieve the best results from modelling, it is important to obtain site-specific data for these risk assessments such as soil sampling, test borings, stream surveys, and coastal surveys. To run the model, daily weather records must be obtained or generated.

Sophisticated modelling is required for complex drainage patterns at the basin and sub-basin scale, as with golf courses where annual and storm-event runoff values should be computed for pesticides, nutrients, runoff water, and sediments. The results will help fine tune turf management programs and may indicate the need for design changes. On the subject site, modelling may show that the installation of detention basins is required for water quality protection.

Recommendation V19. The golf course is to be designed to prevent pollutants from entering the natural environment. Application of risk assessment and simulation modelling is required to accurately identify potential impacts and design measures to mitigate impacts.

Recommendation V20. A Surface Water and Groundwater Quality Management Plan is required for the operational phase of the project. Water quality standards must be set to protect native terrestrial and aquatic flora, including regular monitoring of receiving waters to detect levels of herbicides, fertilisers and sediment entering natural waterways, and planned responses to adverse results.

The Queensland Government, with funding from the Australian Government has established the Great Barrier Reef Wetlands Protection Programme to develop and implement measures for the long term conservation and management of wetlands in the Great Barrier Reef (GBR) catchment as per strategies contained in the Reef Water Quality Protection Plan (Reef Plan). The objectives of this plan are to: halt and reverse the decline in the quality of water entering the Reef; and to rehabilitate and conserve areas of reef catchment that have a role in removing water-borne pollutants.

Recommendation V21. The Coastal Management Plan and Great Barrier Reef Wetlands Protection Program to be consulted in development and golf course planning.

3.2.3 *Weeds*

Johnstone Shire Council has incorporate a specific code in the draft planning scheme to reduce the probability of new weed incursion occurring on newly developed land. This code requires that any development involving the movement of soil or plant material on the land to be carried out occurs in a manner that does not cause weed spread within the land or to other surrounding lands. The performance criteria identify the following requirements:

- Disturbance of soil and vegetation is limited to the footprint area of the buildings and/ or development;
- Earthmoving and vegetation control machinery and vehicles leave the land only after being thoroughly washed down at a location whereby material will be contained within the land (i.e. not in drainage ways or near the boundaries of the land);
- Any soil or vegetation removed from the area will be in covered loads to reduce the spread of any weeds along the transport corridor;
- Any soil/sand/gravel, hydromulch or vegetation bought into the land will not contain any plant material of any weeds stated schedule 4 (State legislation, or Council's Local Laws and Pest Management Plans).

Table 3.5 summarises the declared plants found in the Johnstone Shire and identifies the priority and measures for control as determined by the Pest Management Plan for the LGA.

Table 3.5: Control Priority and Measures for Declared Plants. Source: Johnstone Shire Council – Pest Management Plan July 2002 – 2006 - Version 1 - 7 May, 2004

Weed Species	Control Priority	Control Measures	Declaration Status (LPA)
Pond Apple (*Annona glabra*)	E	3	C2
Hymenachne (*Hymenachne amplexicaulis*)	B	2	C2
Lantana (*Lantana camara*)	D	4	C3
Sicklepod (*Senna obtusifolia*)	C	3	C2

B. Declared plants found generally in the Johnstone Shire and it is the intent to eradicate the plant from the Shire over time.

C. Declared plants found in the Johnstone Shire which are to be destroyed by owners where found.

D. Declared Plants found generally in Johnstone Shire and are to be controlled by the owners.

E. Declared plants found generally in the Johnstone Shire and information on identification and treatment by owners is promoted.

2. Owner to control plants where they are found. It is the aim of Council that plants in this category are to be eradicated from the Shire over a period of time.

3. Owner to destroy declared plants within time stipulated on notice. Property Management Plan may be entered into providing the Declared Plants ability to multiply is reduced/eliminated.

4. Notice is not generally served, with owners encouraged and informed to be able to identify and treat these plants. Council may serve notice where an owner neglects this general duty, to the detriment of surrounding owners.

Within the project area, the significant weed species is Pond Apple (Annona Squamosa), with the most severe infestations occurring on disturbed drainage lines or swamplands where near pure stands of the species often prevail. Control of feral pigs, should be considered a fundamental practice in any weed eradication program. By law, all landholders must take reasonable steps to keep their lands free of Class 2 pests.

Recommendation V22. Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring are to be incorporated into the Plan, which is to be guided by the Johnstone Shire Pest Management Plan (2004).

4.0 TERRESTRIAL FAUNA

4.1 BASELINE INVESTIGATIONS

4.1.1 *Fauna Survey Results: Listed Species under the Commonwealth's EPBC Act*

A total of 91 vertebrate fauna species (excluding exotic species) were recorded during the terrestrial fauna survey within the site (BAAM 2006) including seven amphibians, four reptiles, 59 birds, 16 mammals and five fish. In addition, 22 species of butterfly were also opportunistically recorded.

From the EPBC Online database, a total of 12 species listed as Endangered, Vulnerable or Rare and 14 listed as Migratory under the EPBC Act are listed as potentially present in habitats within and surrounding the subject site. Results of the EPBC Online database searches are provided in Attachment 2.

Following the field-based site assessment and consideration of the habitats present within the study area, only some of those species listed are considered likely to occur. Those that are known or considered to have potential to occur are listed in Tables 4.1 and 4.2. Those unlikely to occur are discussed in Attachment 3.

The locations where significant species under the EPBC Act were observed during the survey are shown in Figure 4.1. A detailed study of the Cassowary population has been undertaken by Moore (2006) and is summarised in Section 4.2.1.

Table 4.1: Fauna species listed under the EPBC Act recorded in the BAAM survey (2006) or considered likely to occur

Scientific Name	Common Name	EPBC Status	Occurrence
Birds			
Casuarius casuarius johnsonii	Southern Cassowary (Australian)	Endangered	**Recorded BAAM 2006**
Amphibians			
Litoria rheocola	Common Mistfrog	Endangered	**Recorded BAAM 2006**
Nyctimystes dayi	Lace-eyed Tree Frog, Australian Lacelid	Endangered	Potential
Mammals			
Pteropus conspicillatus	Spectacled Flying-fox	Vulnerable	**Recorded BAAM 2006**
Reptiles			
Chelonia mydas	Green Turtle	Vulnerable	Possible but unlikely

Table 4.3: Observed or Likely Migratory Bird Species

Scientific Name	Common Name	Habitat
OBSERVED		
Ardea ibis	Cattle Egret	Pasture and open wetlands
Haliaeetus leucogaster	White-bellied Sea-eagle	Coastal habitats, estuaries, inland rivers.
Monarcha trivirgatus	Spectacled Monarch	Mesic vegetation including rainforest.
Monarcha melanopsis	Black-faced Monarch	Mesic vegetation including rainforest.
Rhipidura rufifrons	Rufous Fantail	Mesic vegetation including rainforest.
Merops ornatus	Rainbow Bee-eater	Aerial forager over a variety of habitats
POTENTIAL OCCURRENCE		
Hirundo rustica	Barn Swallow	Aerial species mostly over open habitats
Hirundapus caudacutus	White-throated Needletail	Aerial species foraging over all terrestrial habitats.
Apus pacificus	Fork-tailed Swift	Aerial species foraging over all terrestrial habitats.

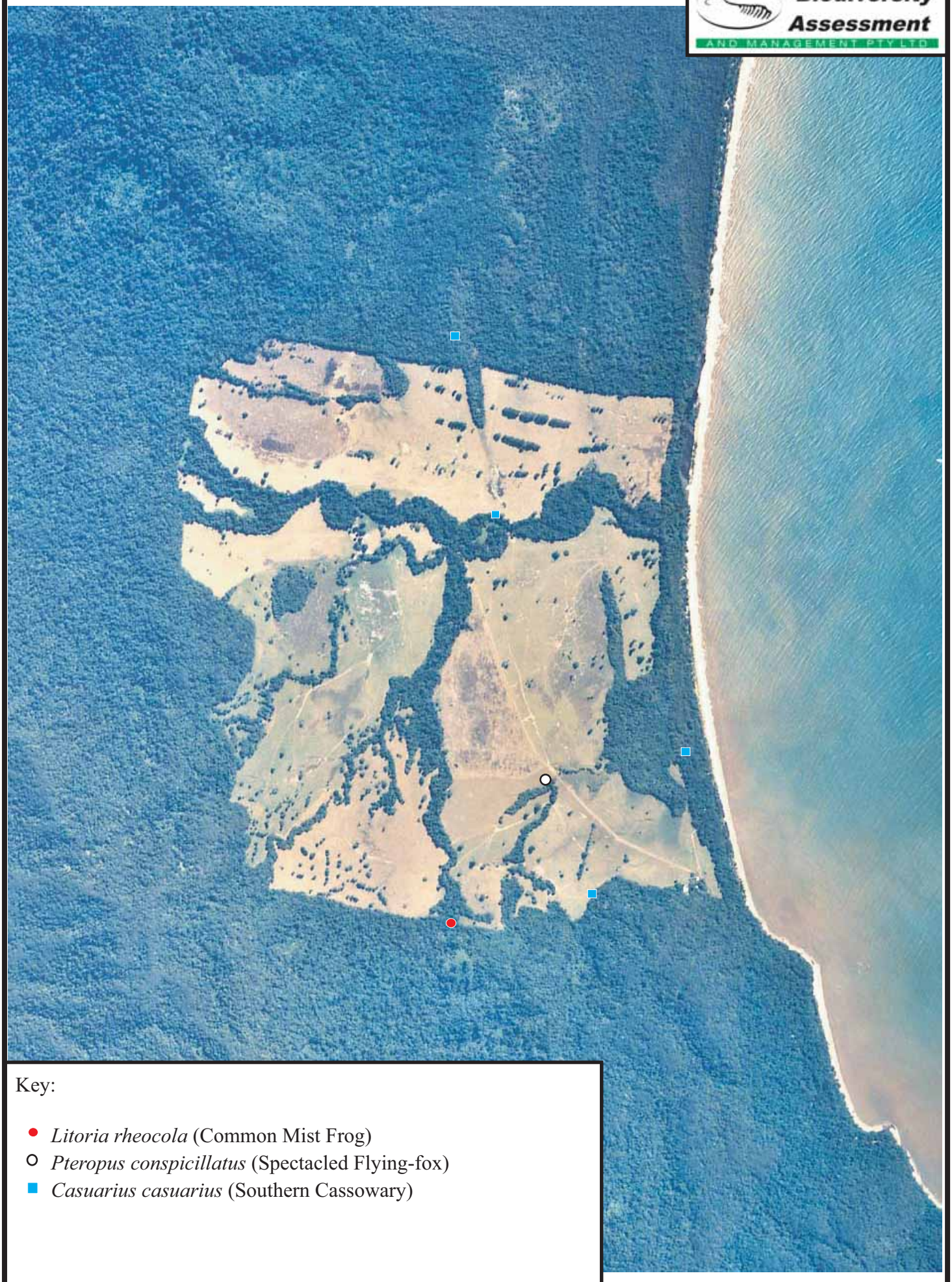


Figure 4.1: Locations of Significant Fauna Species Records

All observed migratory species are considered to be common within the bioregion and local area. All species except White-bellied Sea-eagle are likely to be represented by multiple pairs or groups within the development site and local area. White-bellied Sea-eagles usually occur in pairs that defend a large territory. No potential White-bellied Sea-eagle nests are known from the site.

White-throated Needletail, Fork-tailed Swifts and Barn Swallows are aerial feeders, taking insects on the wing and rarely landing. They forage over large areas, including urban and agricultural lands.

4.1.2 *Exotic Fauna*

Two exotic fauna species were recorded during the survey, these were Feral Pigs (Sus scrofa) and House Mouse (Mus musculus). Feral Pigs are listed as Class 2 pests under the Land Protection (Pest and Stock Route Management) Act 2002 (LPA). A Class 2 pest is one that is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact. Landowners must take reasonable steps to keep land free of Class 2 pests.

Feral Pigs and Dogs have the potential to cause significant harm to Cassowary populations. They are known to attack and kill Cassowaries as well as compete for food, destroy habitat, promote invasive weed species and to destroy entire Cassowary clutches. Feral Pigs are currently recognised as a Key Threatening Process under the EPBC.

4.2 POTENTIAL IMPACTS AND MITIGATION MEASURES

Areas of particular sensitivity for EPBC matters that area associated with the proposed development are located in the eastern portion of the subject site, where the endangered orchid *Phaius tancarvilleae* potentially occurs.

In addition the proximity of the proposed development to the Wet

within the northern, south-eastern and eastern portions of the subject site. These areas support remnant vegetation. In addition, a drainage line bisects the site within its central portion, in an east-west direction, the associated riparian vegetation supports a range of fauna species and contributes to fauna movement opportunities across the otherwise cleared development area.

Potential direct impacts on fauna habitat identified from the current proposal are:

- Disturbance and/or removal of habitat within or adjacent to significant remnant habitat or other habitat supporting significant species;
- Habitat fragmentation and subsequent impacts on fauna movement;
- Physical impacts during the construction phase such as root damage to standing vegetation and erosion and sedimentation;

- The introduction and/or spread of exotic pest species;
- Rehabilitation improving the condition of, and widening the network of corridors for fauna movement; and
- Removal of cattle from the property, and the cessation of associated habitat degradation, particularly along the creeklines.

Potential cumulative impacts are:

- The introduction and/or spread of exotic pest species;
- Hydrological and water quality impacts of the development on the creeks within the subject site;
- Impacts on the wetland ecosystem to the north of the proposed development through hydrological and water quality effects;
- Edge-related effects where clearing occurs within and adjacent to intact habitat;
- Increased vehicular traffic on roads leading to increased fauna road deaths;
- Introduction of domestic pets/animals which potentially prey on native species or create a disease risk for native species;
- Increased human and vehicle presence within habitat areas within and surrounding the development area, including the foreshore, potentially causing trampling or damage to habitat from vehicles.
- Habitat under long term management to control weeds and pest animal species; and
- Fauna research opportunities through partnerships with academic institutions.

The following sections provide assessment of direct and cumulative impacts and mitigation solutions for each of the significant fauna species and their habitats to address the potential effects of the development and the appropriate planning, design, construction and operational responses to impact management.

Issues related to the proposed road access route options are discussed briefly in the following sections, with a more detailed analysis provided in Section 7.0.

4.2.1 *Casuarius casuarius (Southern Cassowary)*

4.2.1.1 Presence on the Subject Site

Southern Cassowaries have been recorded several times within and surrounding the development site. Furthermore, vegetation surrounding the development area is mapped as essential habitat for this species by the EPA. Due to the sensitivity of this species, it has been the subject of targeted and specific work (Moore, 2006). Results of this report are summarised in this section.

The Ella Bay Cassowary field survey and subsequent analyses undertaken by Les Moore (2006) encompassed the local Cassowary population and included all Cassowaries that inhabit or pass through the project site or adjacent, nearby areas.

Approximately 9.5 km2 were surveyed on foot over a period of eight days (6-14 November 2005). The total search effort resulted in the location of 72 cassowary signs comprising sightings, measured footprints, partial footprints, and droppings. Three cassowaries comprising two adult males and one adult female were utilising the Ella Bay Property during the field survey (Figure 4.2).

There were no indications, by either sightings or footprints, of the presence of juvenile or young subadult Cassowaries in this part of the study area and Moore (2006) concluded that the majority of the dependent chicks and young subadults in the study area died during or following Cyclone Larry.

Although few fruits were visible on the trees, a number of Cassowary food species were recorded in droppings. Food items recorded in droppings included:

- Foxtail Palm *Wodyetia bifurcata* (exploited garden plants);
- Wait-a-while *Calamus australis*;
- Currywood *Polyathalia michaelii*;
- Zamia Palm *Lepidozamia hopei*;
- Blue Quandong *Elaeocarpus angustifolius*;
- *Ficus* sp.;
- *Cryptocarya* sp.; and
- Bracket fungi.

A number of Cassowary habitat types recognised by EPA occur within the subject site. An analysis of their relative values, role in connectivity, provision of known, likely or supplementary resources for food, water, breeding and shelter has been undertaken by Moore (2006). The recognised Cassowary habitat types within the Ella Bay Property are shown on Figure 4.3.

Figure 4.2: Areas of Activity of Ella Bay Property and Little Cove Cassowaries 6-12 November, 2006

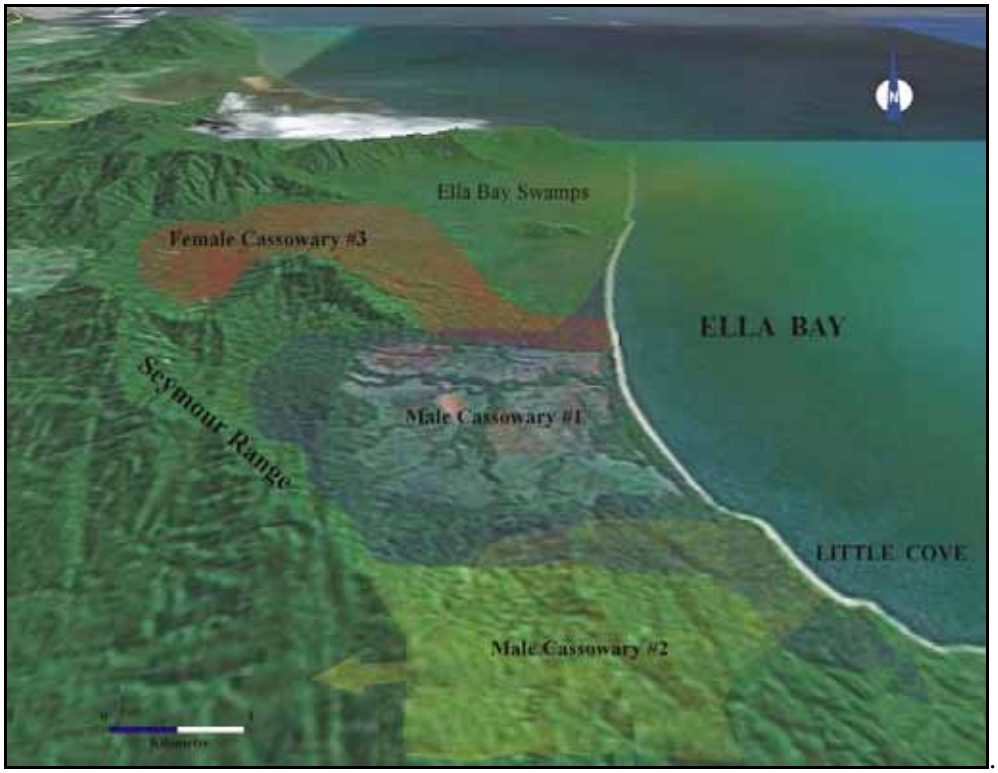
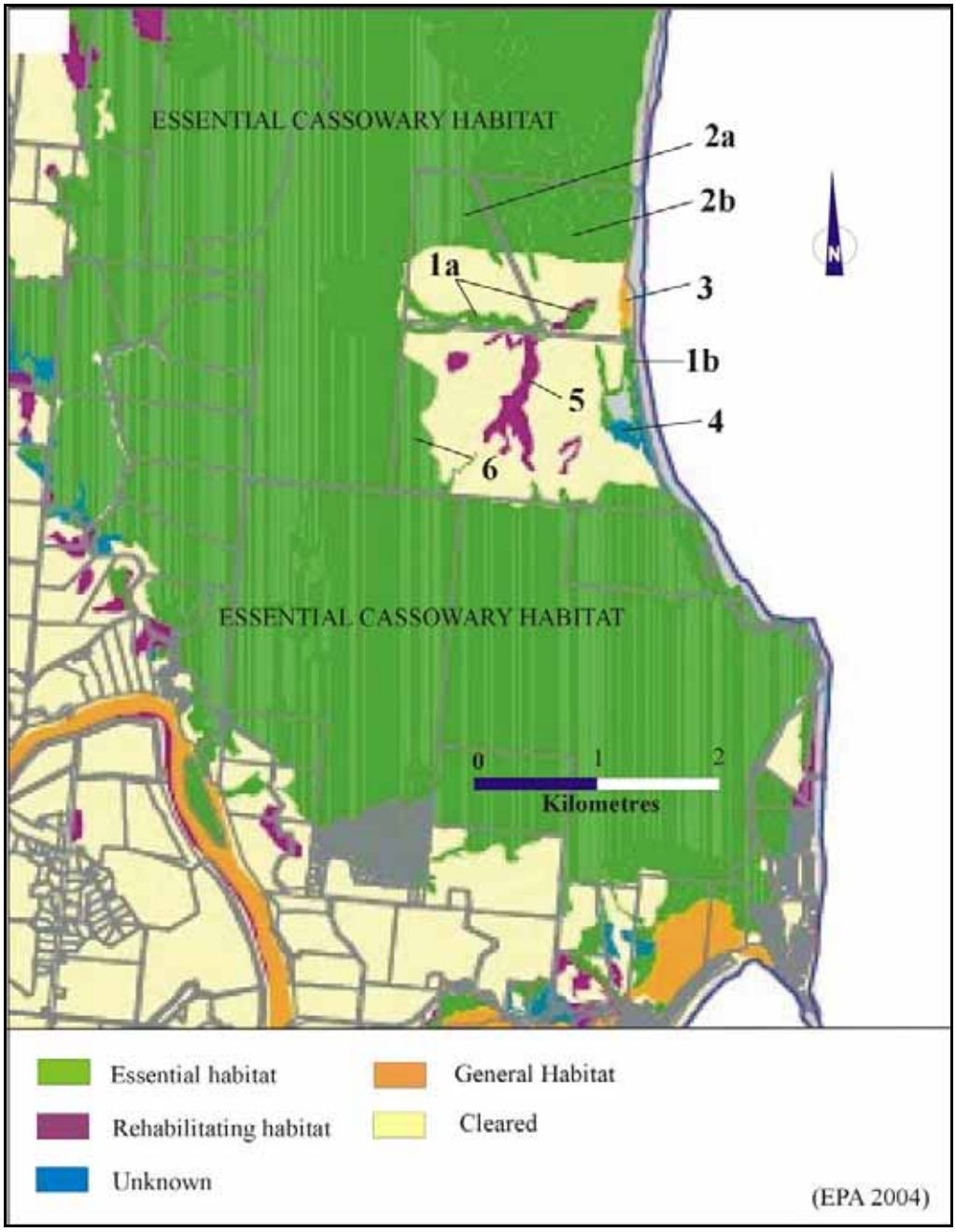

Ella Bay Swamps
Female Cassowary #3
ELLA BAY
Seymour Range
Male Cassowary #1
LITTLE COVE
Male Cassowary #2

Figure 4.3: Cassowary habitat types at the Ella Bay Property



4.2.1.2 Potential Direct, Indirect and Cumulative Impacts

The potential direct impacts of developing a resort within the Ella Bay Property on the Cassowary population include:

- Loss of 'essential' and 'general' Cassowary habitat within the development footprint;
- Loss of safe access to retained remnants of Cassowary habitat within the development;
- Interactions with people including habituation due to feeding;
- Interactions with domestic animals including dogs;
- Collision with vehicles.

Indirect impacts on Cassowaries are sometimes more difficult to pin down but certainly include:

- A reduced carrying capacity from loss of habitat leading to pressures on reproductive productivity and recruitment;
- Barriers to traditional movement corridors leading to disruption of social breeding systems;
- Increased human activity and noise resulting in animals withdrawing from adjacent forest;
- Increased risk of road death to Cassowaries occupying adjacent or nearby habitat due to increased traffic flows;
- Negative interactions between humans and Cassowaries resulting from the attraction of Cassowaries into urban areas created by the planting of domestic and native fruiting trees, and the presence of standing water in backyard pools or ponds (Cassowaries have to drink two to three times per day);
- Disturbance from night lighting along streets and in residences;
- Potential transmission of disease from domestic animals to Cassowaries e.g., poultry, dogs, and cats;
- Rehabilitation improving the condition of, and widening the network of corridors for Cassowary movement; and
- Removal of cattle from the property, and the cessation of associated habitat degradation, particularly along the creeklines.

This causal pathway approach recognises that although individual actions may be insignificant by themselves, the *aggregate* of these effects have a significant effect. For the subject site, cumulative impacts on Cassowaries are considered to include:

- increased likelihood of further subdivision on the remaining freehold lots in the area, although the proponent has advised that the Local Area Plan will not allow for intensification of development;
- increased pressure on surrounding remnant vegetation and population linkages;
- increased traffic flow to and from the development.
- Habitat under long term management to control weeds and pest animal species; and
- Research opportunities through partnerships with academic institutions.

4.2.1.3 Impact Assessment Methodology

To provide a transparent assessment of the potential impacts on the Cassowary population of the proposed development, an analysis of the Significance and the Magnitude of each effect has

been applied to the subject site. The overall score is gained by multiplying the Significance by the Magnitude. Brief definitions of these terms are given below:

Significance: Reflects the effect of the change that may take place (Wood, 1995). In this instance, the main elements used in assessing significance of impacts are scientific and professional judgement, the extent of disturbance to the valued ecological system or species, and the level of public concern.

Magnitude: The estimation of the degree, extensiveness, and scale of the interaction, and varies according to the extent of the action and the significance of the environmental effects involved.

While the Significance criteria are self-explanatory, an explanation is given below for the terms used to represent the predicted Magnitude of an affect. These are:

Some change: Denotes occasional exposure to an effect which significantly alters normal cassowary behaviour, and which results in a persistent low risk to individual birds or the population.

Moderate change: Denotes regular exposure to an effect that results in a moderate risk to individual birds or the population.

Large change: Denotes a constant exposure to an effect which places an individual Cassowary or the population to high to extreme risk on a daily basis.

It is important to note that the criteria used in weighting the Magnitude scores are not empirical, but instead are based on professional judgements. The guideline criteria are given in Table 4.4.

Table 4.4: Guideline Criteria for Impacts to Cassowaries

Significance		Magnitude	
No perceived negative impact	0	No perceived change	0
Impact on individual bird within subject site	-2	Some change	2
Impact on study area cassowary population	-4	Moderate change	4
Impact on Seymour Range cassowary population	-6	Large change	6
Impact on the Wet Tropics cassowary population	-8		

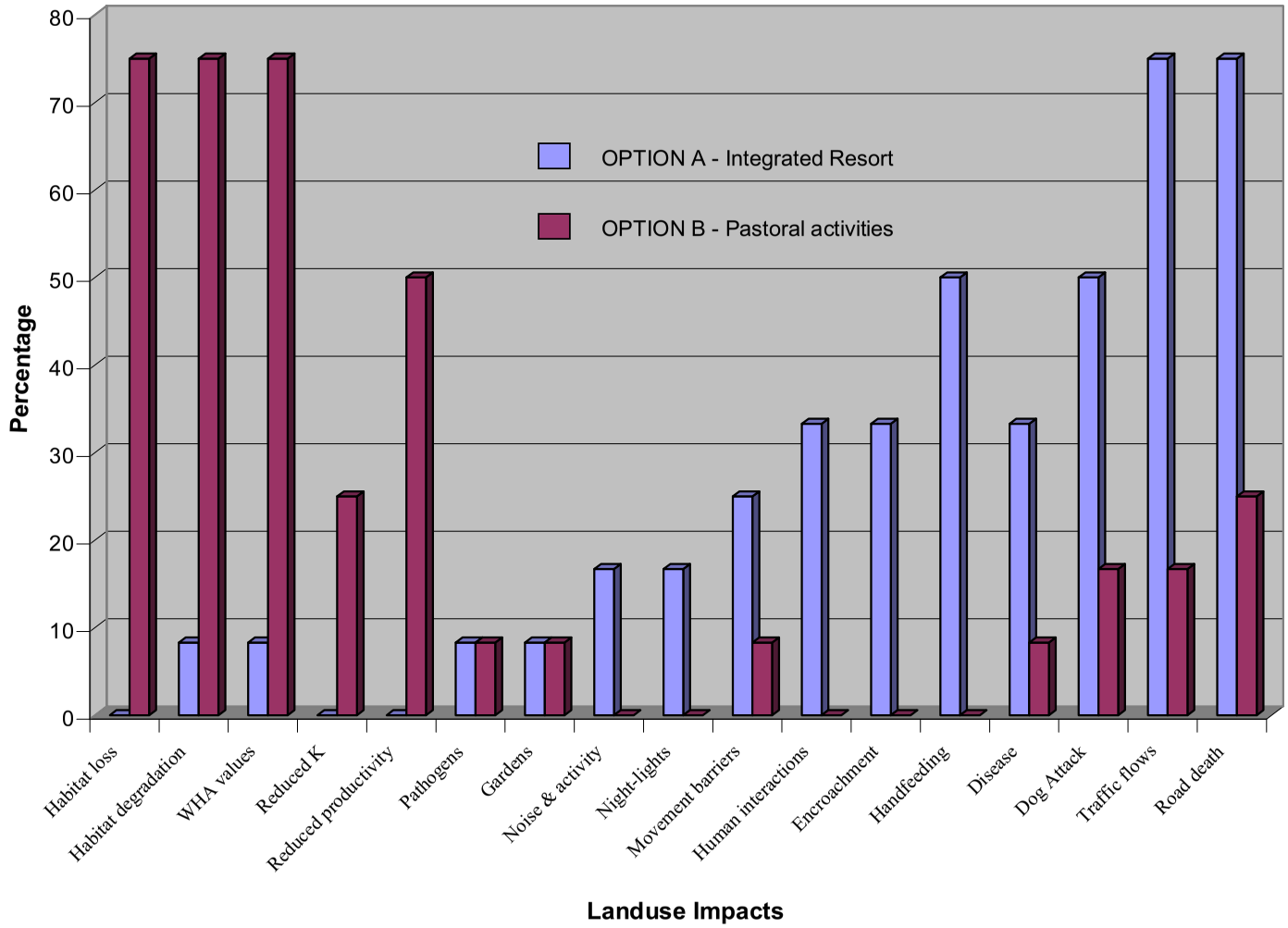
The results of the impact assessment analysis for the Ella Bay Integrated Resort Master Plan development option are presented in Table 4.5. Those impacts considered extreme i.e., scores from -24 to -48, are shaded in pink, while those that have a significant negative impact i.e., scores greater than ten, are shaded in light yellow. A comparison of the potential impacts of the proposed development vs existing land use (pastoral activities) is provided in Figure 4.4.

Table 4.5: Cassowary Impact Assessment for Ella Bay Integrated Resort

Development Impacts	Significance	Magnitude	Overall Score[2] (Max = -48)	% of Maximum Impact
Habitat loss on site	0	0	0	0
Habitat degradation (edge effect) and encroachment (e.g., off-property pathways and picnic spots)	-2	2	-4	8.3
Traffic flows	-6	6	-36	75.0
Road death	-6	6	-36	75.0
Dog attack	-4	6	-24	50.0
Movement barriers (fences/roads)	-2	6	-12	25.0
Negative interactions with humans[1]	-4	4	-16	33.3
Hand-feeding issues[1]	-4	6	-24	50.0
Disease	-4	4	-16	33.3
Usage of adjoining forest by people (disturbance & interactions)	-4	4	-16	33.3
Domestic fruit trees and water sources	-2	2	-4	8.3
Increased noise and activity	-2	4	-8	16.7
Night lighting adjoining forest area	-2	4	-8	16.7
Invasion of pathogens affecting habitat quality (e.g., *Phytopthora*)	-2	2	-4	8.3
Reduced population carrying capacity (K)	0	0	0	0
Reduced productivity and recruitment	0	0	0	0
Impact on adjoining WHA National Parks (weed invasion)	-2	2	-4	8.3
Total Effect			**-200**	**416.5**
Maximum Possible Total Effect			-816	1700
Change as Percentage of Maximum			**-24.5**	**24.5**

[1] Subsequent risk of relocation and disruption to local social breeding systems.
[2] Magnitude x Significance

Figure 4.4: Comparison of Environmental Impacts for the Integrated Resort Project vs. Pastoral Activities



Although all Overall Scores less than -8 (n = 8 of 17 identified impacts) indicate a considerable negative impact on Cassowaries from the proposed development, those scores from -24 to -48 (n = 4) represent impacts judged to have "extreme" impacts on the viability of the Cassowary population of the Ella Bay Property, and that of the Seymour Range Cassowary population. These effects include road death (75%), increased traffic flows (75%), hand-feeding (50%), and dog attack (50%).

Other issues resulting from the development that potentially impact on Cassowaries at the Ella Bay Property result from an increase in long-term human activity of the area, and the problems associated with cassowary and human interactions. These include negative interactions with humans (33.3%); the potential for an increased use of the adjoining forests by residents and visitors (33.3%); disease (33.3%); and movement barriers (25%).

Analysis of the "do nothing" option (Moore 2006 – Volume II) shows that generic potential for impact is more or less identical between the two activities i.e., 24.5% (proposed development) compared to 23.0% (pastoral activities). However, the nature of the specific impacts influencing the total outcomes differs markedly. The major impacts associated with the integrated resort relate to the threats posed by the increased traffic flow along Ella Bay Road, and people and wildlife management issues associated with a permanent human population using the Ella Bay Property. In contrast, the major impacts associated with continued pastoral land use involve the permanent loss or degradation of Cassowary habitat within the site, and the potential devaluing of World Heritage Area values resulting from habitat degradation, edge effects, and the spread of declared weeds into the adjoining Ella Bay National Park.

The impacts resulting from the continued use of the Ella Bay Property as a pastoral property are not easily addressed. As freehold ownership includes an 'as of right' entitlement to agricultural activities within the property, there are few, if any, mitigation strategies that are assured of being enacted outside the requirement for controlling pond apple. For example, there is no statutory obligation on the landowner to fence off the drainage lines or the remnant vegetation to prevent ongoing habitat degradation. In addition, while a permit is required to undertake further vegetation clearing, there is no obligation on the landowner to revegetate already cleared land or restore degraded habitat.

4.2.1.4 Mitigation Strategies

In the case of the proposed development, there are a number of possible mitigation strategies, in addition to those which have been identified in the Master Plan, which can be applied to reduce the identified impacts. The primary objective of these mitigation strategies should be to maintain or preferably reduce impacts in the area of road risk and human/wildlife management to that approximating those for the existing pastoral land use.

The following mitigation proposals are inherent in the current proposal and have been identified in discussions with the developers and through an ecological appraisal of the Ella Bay Master Plan:

1. All lost or compromised habitat will be compensated for by revegetation and remnant enhancement, with the aim of increasing the total amount of essential Cassowary habitat above what currently exists at the site.

2. All declared weed species currently exploited by Cassowaries i.e., pond apple *Annona glabra*, will be removed from the property in a weed-control program.

3. Approved Cassowary and people-proof fencing will be erected to prevent interactions between the Cassowary(s) and the Integrated Resort.

4. All pedestrian walkways through Cassowary corridors will be elevated above the forest floor to separate Cassowaries and people, and to provide unhindered Cassowary use of the creek and associated vegetation.

5. Such pedestrian walkways will be strategically located to minimise any disturbance to the normal behaviour of the Cassowary(s).

6. The pedestrian 'walkovers' may serve as a focal point for ecological interpretation, particularly that of the endangered Cassowary.

7. A strict dog control program will be enforced.

8. There will be limited vehicle use within the grounds of the Integrated Resort.

9. Existing cattle fences will be removed to improve access to the vegetated corridors.

Further mitigation strategies are required to facilitate the continuation of normal Cassowary behaviour while minimising the possibility of adverse contact between Cassowaries and humans. In the context of this impact assessment, 'contact' includes injury or death of Cassowaries from collision with vehicles, and dog attack. As such, an approved Cassowary Management Plan will need to be developed for the Ella Bay Property and the road connecting it with the Flying Fish Point township. This management plan should present the specific locations and types of mitigation to be used in detail, and include a long-term monitoring component. Those specific strategies that comprise the cassowary management plan are dependant on the final design of the Master Plan and the location and form of the Ella Bay Road upgrade, but should include the following elements:

Rehabilitating and augmenting Cassowary habitat so there is no net loss:

The distribution of Cassowary habitat in the Wet Tropics bioregion was mapped by the Environmental Protection Agency (EPA) in 2004. The habitat types used by EPA for categorising cassowary habitat in this mapping project are provided in Moore (2006, Volume I). The EPA habitat types, in order of their relative importance to cassowaries, are listed below:

1. Essential habitat;
2. General habitat;
3. Rehabilitating habitat;
4. Other vegetation;
5. Unknown;
6. Cleared;
7. Cultivated.

As indicated in the Ella Bay vegetation survey results (3D - BAAM 2006a), the Ella Bay Property contains vegetation mapped as 'Essential Habitat', 'General Habitat', and 'Rehabilitating Habitat' for the endangered Southern Cassowary *Casuarius casuarius johnsonii* (EPA 2004). The recognised Cassowary habitat types are shown in Figure 4.5. Cassowary corridors on the subject site as determined from field survey are shown in Figure 4.6. A summary of the relative values to the species of each numbered location is provided in Table 4.6 along with possible mitigation strategies for each identified location.

Figure 4.5: Cassowary Corridors on the subject site

Table 4.6: Values and Recommended Mitigation Strategies for impacts of Cassowary Habitat in the area of the Ella Bay Integrated Resort (Recommendation F2)

Location no. (Figure 4.3)	Cassowary Habitat Type (EPA 2004)	Values	Recommended Mitigation Strategies (Recommendation F2)
1a	"Essential Cassowary Habitat"	The Cassowary survey concluded that the resident adult male cassowary (Cassowary #1) made regular use of this riparian corridor. The corridor contains numerous potential Cassowary food trees, the most common being Blue Quandong *Elaeocarpus angustifolius*. It also allows an alternative access route for Cassowaries to forage in the feather palm dominated mesophyll forest to the north of the property.	It will be necessary to ensure Cassowaries have safe access to the area. In addition, the inclusion and revegetation of an additional movement corridor, shown as (B) on Figure 4.5, will facilitate Cassowary movement into the Ella Bay Swamp, to the north of the Ella Bay Property.

Location no. (Figure 4.3)	Cassowary Habitat Type (EPA 2004)	Values	Recommended Mitigation Strategies (Recommendation F2)
1b	"Essential Cassowary Habitat" Should be reclassified to "General Habitat" (Moore 2006)	This area comprises *Melaleuca* dominated open forest/woodland, degraded in places by cattle grazing and weed infestations. It is considered that it holds little in the way of ecological benefits for Cassowaries while potentially allowing adverse interactions between birds and visitors.	It is recommended that this area be closed off to Cassowaries. Any Cassowary habitat lost as a result should be compensated for by the inclusion and revegetation of a Cassowary movement corridor linking the main east-west corridor to the Ella Bay Swamp forest block to the north of the Ella Bay Property ('B' on Figure 4.5).
2a	"Essential Cassowary Habitat"	This area currently provides habitat for two adult Cassowaries (Cassowary #1 and Cassowary #3), and acts as an important buffer for the Ella Bay Swamp, listed as an '*Important Wetland in Australia* (WTMA 2005)'.	Acceptable solutions to allow the preservation of the essential cassowary habitat in this area include Cassowary-proof fencing, a restriction on use by residents and visitors to the resort, and a strict dog control program.
2b	"Essential Cassowary Habitat"	This area comprises a mosaic of open eucalypt forest with a vine forest sub-canopy, and feather palm dominated mesophyll vine forest. The area was significantly damaged by Cyclone Larry but is an important habitat for Cassowaries.	Acceptable solutions to allow the preservation of the essential cassowary habitat in this area include Cassowary-proof fencing, a restriction on use by residents and visitors to the resort, and a strict dog control program.
3	"General Habitat" Should be reclassified to "Other Vegetation" (Moore 2006)	This location contains no worthwhile habitat for Cassowaries, being comprised of shrubland dominated by exotic and declared weed species. Weed control programs will remove these weeds, thus making it unattractive to Cassowaries.	It is recommended that the area be closed off to Cassowaries.
4	"Unknown" Should be reclassified to "Other Vegetation" (Moore 2006)	This area comprises an exotic shrubland dominated by infestations of pond apple *Annona glabra* and is not natural or suitable Cassowary habitat. In addition, as this non-native food source will be removed in any future weed control for the site.	It is recommended that the area be closed off to Cassowaries.
5	"Rehabilitating Habitat"	This north-south drainage line does not currently provide much in the way of food resources for Cassowaries, and for much of its length comprises secondary regrowth forest with little sub-canopy. If allowed to return to a remnant state, however, the corridor would be categorised as general cassowary habitat. In addition, it provides an alternative movement corridor for Cassowaries in the south of the property allowing them to access the main east-west corridor, and thus to the National Park located west and north of the site.	Given the potential significance of this corridor to the local Cassowary population, it will be necessary to ensure Cassowaries have safe use of the site.
6	"Essential Cassowary Habitat"	This area comprises disturbed notophyll to mesophyll vine forest on the foothills of the Seymour Range. Although severely impacted by Cyclone Larry, this habitat currently provides important food and water resources for Cassowaries.	Acceptable solutions to allow preservation of this essential habitat must be met, if consent to develop is to be granted.

Retaining and creating connecting corridors of vegetation through the site:

In the fauna assessment of the Ella Bay Property (BAAM 2006), it is recommended that a buffer zone of at least 50 metres be established and revegetated either side of the existing drainage lines to protect the habitat of the threatened mist frog *Litoria rheocola*. This 100 metre-wide corridor, in addition to the requirement for the construction of appropriate Cassowary-proof fences lining the movement corridors, is considered an adequate minimum width for Cassowaries.

Figure 4.5 shows the major Cassowary movement corridors within the Ella Bay Property superimposed onto the Resort Master Plan. The location and extent of the Cassowary-proof fences, the approximate locations of the Ring Road crossing points over the cassowary corridors, and the additional north corridor component ('B' on Figure 4.5), are also illustrated.

Recommendation F3. The main east-west corridor does not allow Cassowary access to that part of the foreshore represented by Locations 1b, 3 and 4 (Figure 4.4). Any Cassowary habitat lost by doing so should be compensated for by increasing the revegetation planned to take place in the new northern corridor 'B' and throughout the remainder of the site, or be the subject of an 'offset' i.e., either the gifting to the protected estate of an agreed part of the subject site or the purchase and donation to the protected estate of alternative compensatory habitat elsewhere.

Cassowary-Proof Fence:

Recommendation F4. A Cassowary-proof fence should surround the entire integrated resort along the existing vegetation line and extend into selected areas of revegetation where appropriate. The fence should be at least 1.8 metres in height to guarantee the exclusion of Cassowaries and be constructed of natural material e.g., tea-tree or similar, on a backing structure of 50mm diamond-shape chain mesh fencing. The fence should be densely screened with plants so that birds cannot run into it by accident, or be attracted by people or food resources. There should be a gap between the lower section of the fence and the ground of approximately 100 mm, to allow the passage of small mammals and reptiles, but not large enough to give access to small Cassowary chicks.

Such a fence serves a dual purpose: separating birds from humans, while protecting and enhancing the adjoining Cassowary habitat, in this instance the Ella Bay National Park.

Walking Trails:

Recommendation F5. No walking trails should be located outside the Cassowary-proof fence surrounding the development. All ground level walking trails and pedestrian paths inside the development should be located outside the Cassowary movement corridors, or if located within the corridor, be raised approximately 2.5 metres above ground level to prevent interactions between cassowaries and people.

Roads:

Recommendation F6. Road over-passes should be constructed on the 'Ring Road' to cross above sections of the Cassowary corridors, or existing gullies and creeks. These over-passes are essential to facilitate the unhindered movement of cassowary and other fauna.

Recommendation F7. All roads within the resort should also be constructed following appropriate QDMR guidelines. Where necessary, traffic calming devices should be located on the roads within the resort.

Dog Control:

Recommendation F8. Dogs can harm and have the potential to kill Cassowaries, as well as transmit disease. A strict dog control program should be enforced and dog management requirements should be included in an "Environmental Code of Conduct" for residents.

Landscaping:

Any planting of Cassowary food trees within the development may attract Cassowaries into the resort, with the accompanying risk of injury to both humans and birds. This strategy will also avoid issues with flying foxes concentrating within the resort.

Recommendation F9. The planting of accessible native or domestic fruiting trees within the resort precincts should be restricted to avoid attracting Cassowaries.

Water Sources:

Recommendation F10. Apart from existing natural streams, no standing water e.g., ponds or fountains should be accessible to Cassowaries in or around the development. Cassowaries have to drink a number of times per day and it is probable that in many areas the presence of water is as big an attraction to Cassowaries as fruiting trees.

Weed Control

The implementation and monitoring of a rigorous weed control to remove declared weeds, plus a garden-escapee education program for residents and resort management (see Section 3.2.

Lighting

Recommendation F11. To reduce the possibility of disturbance to Cassowaries and other fauna using the adjoining areas, all external lighting within the development should be directed away from the surrounding rainforest vegetation.

Education Programs

Recommendation F12. A Queensland Parks and Wildlife Service (QPWS) education program on the risks associated with hand feeding of Cassowaries should be initiated.

Human behaviour is not predictable in hand feeding situations, and naiveté of most people with wild animals will eventually promote an attack. Cassowaries can also 'bully' non-food items from adults and children if they are attracted to them e.g., toys, keys, jewellery, pens. This non-natural feeding behaviour can result in illness and death for the Cassowary and possible trauma for humans who are confronted. In addition, experience has shown that people often feed harmful products to wild animals (e.g., in zoo situations), either deliberately or in ignorance e.g. plastics, contaminated food etc.

4.2.2 *Litoria rheocola (Common Mountain Mist Frog) and Nyctimystes dayi (Australian Lacelid)*

Litoria rheocola and *Nyctimystes dayi* are ecologically similar, both occurring in lotic streams within mesic vegetation, particularly where riffle zones are present (in the upper stream reaches). Consequently, the impacts on the two species are likely to be similar and are address together.

Litoria rheocola was located within streams where riffle zones occur on the southern boundary of the subject site, upstream and outside of the proposed development area. None were recorded along similar streams within the development area, which may be due to surrounding land use (e.g. grazing) affecting water quality. The species is also expected in other similar stream bodies to the west of the development site. Specific surveys for the species within streams crossing the potential road alignment options were not conducted, but the species is expected to occur in these areas. With in its distribution the species has been located in streams from around sea level to approximately 1200m (Barker *et. al.* 1995). However the species has significantly declined from locations above 300m (Ingram and McDonald 1993; Hodgkinson and Hero 2003) but has persisted in lowland areas (McDonald and Alford 1999). Lowland populations appear to be stable, but the long-term survival of the species is now heavily dependant on its persistence in such locations. Consequently, populations associated with the Seymour Range and the project site may be of local and regional significance.

Nyctimystes dayi may occur in all locations where *L. rheocola* has been located, in rainforest streams with riffle zones. It is not likely to occur in the lower stretches of streams within the development area where large pooling water bodies occur. Similar to *L. rheocola,* surrounding land use may also restrict species distribution.

The species only breeds during the warmer months, typically between late October and April (DEH 2006). Its absence from the current survey may therefore reflect survey timing (early October) rather than the absence of the species. Further survey effort would be required to determine the presence/absence of this species and to determine its distribution within the subject site, although habitat protection and impact mitigation measures adopted for *L. rheocola* would also protect the habitat of *Nyctimystes dayi*.

Impacts on these two species may include the loss of habitat and road mortality. Adverse impacts related to water quality are not considered likely as all development activities are downstream of known or likely populations.

Habitat Loss:

Loss of habitat will be largely restricted to streamlines along the access road. This area was not surveyed, but *L. rheocola* is expected to occur and *N. dayi* may occur. Road widening is likely to require the alteration of streamside vegetation adjacent to the existing road. The loss of this area however, is not likely to be a significant proportion of suitable habitat upstream of the roads and within the Seymour Range. Consequently, impacts are likely to be relatively low in the local context. Clearing of vegetation should be minimised.

Road Mortality:

The upgrading of the existing National Park road will pass through areas of suitable stream habitat. Movements by *L. rheocola* and *N. dayi* across the road, particularly at night during rainfall periods, is likely to result in an increased number of deaths due to increased traffic flow unless mitigation measures are put in place. *L. rheocola* is known from other streams in the Seymour Range which will not be affected by the proposed activities. The long-term survival of the species in the local area is unlikely to be threatened by the development. However, a potential increase in the number of road mortalities for *L. rheocola* and *N. dayi* relating to increased traffic may have a local impact on these populations. Impacts therefore, are likely to be localised. Road crossings over drainage lines should be of a suitable design to allow the safe movement of these frog species, preferably bridging streams and leaving stream-banks in tact.

Recommendation F13. A potential increase in the number of road mortalities for *L. rheocola* and *N. dayi* relating to increased traffic may have a local impact on these populations. Impacts therefore, are likely to be localised. Road crossings over drainage lines should be of a suitable design to allow the safe movement of these frog species, preferably through bridging streams and leaving stream-banks intact.

4.2.3 *Pteropus conspicillatus (Spectacled Flying-fox)*

Spectacled Flying-foxes have been recorded from the development area where they are associated with rainforest vegetation and riparian corridors. Cleared grazing land has no value for this species. As the species is highly mobile, impacts are likely to be restricted to the loss of habitat.

Habitat Loss:

Areas of rainforest habitat and the riparian corridors will not be impacted by the proposed activities on the subject site. However, widening of the existing road between Heath Point and the subject site is required (a distance of at least 1km). In places this section of road will need to be widened by approximately 2-3m, which will require clearing of some roadside habitat.

This loss of habitat, in the context of available habitat within the Seymour Range is not expected to be significant. No known camps or roosting locations of Spectacled Flying-foxes occur within the development zone. Consequently, impacts resulting from the resort development on this species are likely to be minor.

Recommendation F14. The minor loss of habitat for Spectacled Flying-foxes associated with the access road upgrading may be compensated by the careful selection of fruiting plant species for revegetation areas. This may actually increase the value of the development site for local populations.

4.2.4 *Chelonia mydas (Green Turtle)*

Green Turtles are found in coastal and marine areas around Australia from Adelaide north to Carnarvon in north-west Western Australia. They live almost their entire lives in marine environments. Only the females come to land to lay their eggs in beach foreshores. Breeding only occurs once every several years due to the high energy demands involved in producing large quantities of eggs. Marine turtles can lay more than 100 eggs in each clutch. (Wilson and Swan, 2003).

Generally, most turtle species and particularly the Green Turtle prefer continental waters including bays and reefs. Breeding occurs on ocean beaches.

At the time of survey, no individuals, tracks or signs were observed in the beachfront area. Databases which record actual observations of Green Turtles indicate that no observations of this species have been previously recorded within the area. These factors, and the narrow nature of the beach with its narrow high tide area suggest that while use of the beach by Green Turtles is possible, it is unlikely, and the numbers of individuals potentially present would not constitute a significant proportion of the nesting population of this species on the North Queensland coast.

Marine turtles are susceptible to threats at all stages of their life cycles including human disturbance of nesting individuals and increased egg mortality through predation from pigs, dogs and foxes.

Human Activity:

Disturbance by humans may include direct disturbance resulting from:

- interference with nesting individuals through curiosity;
- damage/destruction of nests through use of the foreshore by vehicles;
- lights from the development affecting the ability of adults and hatchlings to navigate to the ocean.

Recommendation F15. Regular monitoring of the foreshore during Green Turtle nesting season is required, and should any nests be detected, these should be cordoned-off to prevent their disturbance by humans and feral animals. The record should be registered with the EPA.

Predation:

Recommendation F16. A Pest Animal Management Plan is required to control the numbers of feral species present, in particular pigs, foxes and dogs, within and surrounding the development. Consultation with QPWS will be required to co-ordinate management responses with management practices within Ella Bay National Park.

Recommendation F18: The preparation of a Fire Risk Assessment is required to determine any need for a Fire Management Plan to protect fire-intolerant fauna and fauna habitat.

4.2.5 *Movement Corridors*

The subject site is located within a coastal enclave, bound to the north, west and south by the broadly circular Seymour Range which pinches into the coastline at Cooper Point to the north, and Heath Point to the south. To the immediate north, south and west of the site the forested slopes of the Seymour Range are incorporated within Ella Bay National Park. The largely cleared nature of the subject site reduces the likelihood of its contribution to local corridor values in this context.

Movement of fauna within the significant north-south regional corridor bordering the west of the development area along the Seymour Range will not be affected by the proposed development.

At a local scale, corridors of riparian vegetation on the subject site facilitate the movement of some species between larger, intact patches of vegetation in the south and west to coastal vegetation in the east. The riparian vegetation is inhabited by a range of species. Macropods, rodents, bats and birds in particular move through these areas.

Moore (2006) identified the degraded riparian strip that traverses the subject land as being used by a resident male Cassowary, but concluded that due to the narrowness of the remaining vegetation and its degraded and cyclone damaged condition, the importance of this corridor to the maintenance of Cassowaries at Ella Bay has been reduced significantly.

Currently the riparian strip serves as a movement corridor facilitating access for Cassowaries to pond apple infestations that occur on the disturbed swamplands and stream edges in the central and foreshore areas of the property. This exotic food source is currently of increased importance to the Cassowary following the dearth of native fruit following the cyclone, but its contribution to the ecology of the birds at Ella Bay is dubious.

The presence of significant numbers of the favoured Cassowary food tree Blue Quandong *Elaeocarpus angustifolius*, in the central reaches of this creek, however, would provide an important food resource for Cassowaries. The movement corridors of the Southern Cassowary as mapped by Moore (2006) are shown in Figure 4.5.

Recommendation F.25. The current proposed footprint indicates existing corridors following watercourses will be mostly retained. It is recommended that all riparian vegetation is retained, and that the corridors are at least 50m width either side of the high bank of the creeklines. In some areas this will require rehabilitation to broaden the corridor. The proponent proposes to significantly widen the corridors subject to negotiation with the Queensland Government.

Recommendation F.26. The locations of corridors and linkages recommended by Moore (2006) as shown in Figure 4.6 should be adopted, with particular attention to linkages between the north-south corridors and surrounding vegetation. The Proponent also proposes to enhance habitat associated with the network of sub-corridors along minor drainage lines within the development area.

Further fragmentation of riparian areas will be necessary to allow traffic and pedestrian movement. Mobile species such as birds and bats will not be affected by these minor breaks. However, there is potential to impact the movement of terrestrial species such as rodents and macropods. Furthermore, arboreal species will be required to venture to the ground to traverse these structures.

The species that would be most adversely affected by the fragmentation of these corridors by roadways is the Southern Cassowary. To mitigate adverse impacts, Moore (2006) has recommended that:

- No walking trails should be located outside the recommended Cassowary-proof fence surrounding the development. All ground level walking trails and pedestrian paths inside the development should be located outside the Cassowary movement corridors, or if located within the corridor, be raised approximately 2.5 metres above ground level to prevent interactions between cassowaries and people; and
- Road over-passes should be constructed on the 'Ring Road' to cross above sections of the Cassowary corridors, or existing gullies and creeks. These over-passes are essential to facilitate the unhindered movement of Cassowary and other fauna.

The provision of habitat and movement corridors within the development area exposes species utilising the corridors to the impacts associated with adjacent human habitation. In particular the presence of domestic dogs and cats is detrimental to many species.

Recommendation F27. There are a number of small, ground-dwelling fauna species of special conservation significance present in habitat within and surrounding the proposed development area, and the presence of cats and dogs would present a direct threat to those species through harassment and predation. As such, it is recommended that the keeping of cats, which are more difficult to confine, within the proposed development area is prohibited, and that the conditions for keeping of dogs are strictly controlled.

Areas of extant and rehabilitated native vegetation that form nodes and corridors throughout the development area are to be incorporated into a Conservation Covenant with an appropriate management regime in place.

Recommendation F28. Prepare a Conservation Management Plan for habitat nodes and corridors within the development area.

The management status of the significant areas of intact remnant vegetation occurring inside the property boundary but outside of the development footprint is to be determined. These areas should be incorporated into the conservation estate, or be subject to strict conservation orders as discussed in Section 3.2.

Little study has been conducted within Australia on the effects of lighting on terrestrial vertebrate species. Consequently, impacts are difficult to predict.

Most study has been conducted on bat species, which may be attracted to increased insect abundance around lights, or may shy away from increased lighting. Adams *et. al.* (2005) found that the use of artificial light increased the abundance of insectivorous bat species in New South Wales forests. However, their research did not include the effect of light intensity or duration. By contrast, overseas studies on the emergence of roosting *Pipistrellus pygmaeus* found that high light white intensity affected emergence patterns. Their research also identified that bats were less affected by red light.

In contrast to bat species which can benefit from localized light sources, overseas studies have found that lighting can have significant impacts on sea turtle hatchlings. Once emerged from the sand, the hatchlings make their way to the ocean by moving away from

silhouettes of the sand dunes and trees. Artificial lighting can alter this behaviour (Salmon 2003).

Impacts on amphibians, birds and mammals are less clear. It is possible that some species are benefited by lights. For example, lorikeets can congregate in large numbers in lighted carpark trees while some common native frogs such as *Litoria caerulea* readily feed on insects attracted to lit areas. However, other species, particularly nocturnal birds and mammals may avoid lit areas. Until further research identifies the magnitude of possible impacts, conclusions drawn from inferences would be purely speculative.

A discussion of lighting for marine turtles is included in Section 4.2.5.

Recommendation F29. All lighting associated with the development should be designed so that there is no spillage into conservation areas.

4.2.6 *Golf Course Development*

Golf courses have the potential to provide habitat for a range of species, and as there is no clearing of significant vegetation required to construct the proposed golf course, any habitat that is created will be additional to the habitat currently available on this mostly cleared site.

Recommendation F30. Golf course planning should incorporate plant species that can be utilised by native species (other than Cassowaries). The recommended Landscaping and Rehabilitation Plan (Recommendation V16) should consider fauna habitat requirements in its preparation, and is to be used as a guide for planting.

The proposed golf course will require the introduction of grass species that are not native to the area. Such species will require fertilisation, herbicide and pesticide treatment, with the resultant runoff of these pollutants to native vegetation and drainage lines. This will have implications for aquatic fauna at the base of the food chain, as described in Section 3.2.2.

In addition, research has shown that pesticide levels not considered to be acutely toxic have deleterious effects on tadpoles, exposed over longer periods of time (Howard *et al.* 2002). These effects include decreased hatching success and an increase in deformities, both of which may have negative effects on population persistence (Howard *et al.* 2002). The presence of several frogs of conservation significance within and surrounding the subject site will require that pesticide use in particular is carefully planned and managed. In particular the types of pesticide that can be used must be carefully researched.

Recommendation F31. An Integrated Pest Management (IPM) program to be prepared for the golf course that will keep pests at acceptable levels using carefully selected methods, while minimizing the effect on the environment.

The following recommendations regarding pesticide use for golf courses has been adapted from Brunea *et al.* (2005) as a guide.

- **Knowledgeable Superintendent:** Knowledge is the cornerstone to any successful IPM program. The Superintendent should know about the grasses being grown, the pests which are likely to be a problem, and the conditions that may impact the pests and grasses being maintained.

- **A Written Plan:** This plan should include objectives for each section of the course and the degree of acceptable injury from pests. It will help define pest threshold levels. Include specific management practices for non-chemical control. They will vary with each section of the course.
- **Defining Pest Threshold Levels:** Determine what is acceptable for your course, such as whether weeds should be allowed in roughs or how many insects should be tolerated per square foot. Recommendations are available regarding threshold levels for certain insects.
- **Implementing Appropriate Cultural Practices:** Use of agronomically sound cultural practices results in a healthy, dense, vigorous turf that is better able to ward off pests and pest injury.
- **Monitoring Pest Activity:** Most pests are easiest to manage when they are immature. Frequent scouting can help determine the stage of pest activity or injury.
- **Maintaining Accurate Records:** Keeping accurate and up-to-date records of pest activity, actions taken, and the results of those actions will assist in future planning.

As discussed in Section 3.2.2, the prediction of the nature and scale of impacts of golf course operation on groundwater, surface water, and near-shore coastal water quality and wetlands requires state-of-the-art risk assessment and simulation modelling, particularly in high rainfall environments. To achieve the best results from modelling, it is important to obtain site-specific data for these risk assessments such as soil sampling, test borings, stream surveys, and coastal surveys.

Sophisticated modelling is required for complex drainage patterns at the basin and sub-basin scale, as with golf courses where annual and storm-event runoff values should be computed for pesticides, nutrients, runoff water, and sediments. The results will help fine tune turf management programs and may indicate the need for design changes. On the subject site, modelling may show that the installation of detention basins is required for water quality protection, although these will need to be designed so that they are not attractive to frogs or other animals.

Recommendation F32. A Surface Water and Groundwater Quality Management Plan is required for the operational phase of the project that guided by the results of modelling for pesticides, nutrients, runoff water, and sediments from the development. Water quality standards must be set based on the Queensland Water Quality Guidelines 2006 (EPA, 2006) to protect native terrestrial and aquatic fauna, including regular monitoring of receiving waters to detect levels of herbicides, fertilisers and sediment entering natural waterways, and planned responses to adverse results.

5.0 AQUATIC FAUNA

5.1 BASELINE INVESTIGATIONS

While aquatic macroinvertebrate samples were taken from water present within the subject site at the time of the fauna survey (BAAM 2006), on request these samples were not analysed and are in storage.

Freshwater fish were trapped from the creeks within subject site, and five species were recorded. These comprised three relatively common local species, Jungle Perch (*Kuhlia rupestris*), the Empire Gudgeon (*Hypseleotris compressa*, the Eastern Rainbowfish (*Melanotaenia splendida splendida*, McCulloch's Rainbowfish (*Melanotaenia maccullochi*), as well as the relatively rare Cairns Rainbowfish (*Cairnsichthys rhombosomoides*)[Site 4]. The latter is listed on the IUCN Red List (*2006 Red List of Threatened Species*) as vulnerable because of its restricted distribution and uncommon occurrence. A search of the Queensland Museum database for the general area revealed the possible presence of additional species. Some of these comprise species of tidal inlets and creeks which do not occur on the subject site.

Overall, fish diversity was considered to be comparatively low which could be related to factors such as the trapping methodology not targeting all species present, the short sampling period not taking into account seasonal variation, or the historical disturbance of the site.

5.2 POTENTIAL IMPACTS AND MITIGATION MEASURES

Nutrients, organics and pesticides, metals and solids are common pollutants in urban runoff.

Nutrients: Nitrogen- and phosphorus-containing compounds are found in urban runoff primarily from roads. Nitrates result both from vehicular exhaust on the road and adjacent soils from fertilization of landscaped areas beside the roads. Nitrate is very soluble and does not sorb well to soil components during infiltration. Road runoff also contains phosphorus from motor oils, fertilizers, bird droppings, and animal remains. Phosphorus tends to sorb to soil components during infiltration, thus preventing phosphorus from reaching the groundwater. However, as the sorption sites fill, i.e., the cation exchange capacity of the soil is exceeded, and phosphorus removal decreases.

Organics and Pesticides: Pesticides are used in urban areas for weed and insect control along roadsides, in parks, on golf courses, and on private lawns. Pesticides leach to the groundwater when their residence time in soils is less than the time required to filter them or biologically or chemically convert them. Most organics are either removed or reduced in concentration during percolation through the soil. Groundwater contamination occurs most readily in areas with pervious soils, such as sand and gravel, and where the distance to the aquifer is small.

Herbicides have direct effects upon aquatic vegetation and indirect effects upon both invertebrate and vertebrate communities (Van den Brink et al 2006; Guiseppe et al 2006). Within aquatic ecosystems vegetation, particularly algae are extremely sensitive to herbicides which may significantly alter flora community structure over time (Van den Brink et al 2006). This has been observed to lead to alteration in the invertebrate community (i.e. increases in detritus feeding species and decreases in suspension feeding organisms).

Pesticides have a direct effect on invertebrates and an indirect effect on plants within aquatic ecosystems (Wendt-Rasch et al 2004). Pesticides have been observed to directly reduce the level of invertebrate herbivores and suspension feeders which results in an increase in algal biomass (Wendt-Rasch et al 2004).

Increases in nutrients within aquatic ecosystems decrease species richness by weakening stabilizing effects (Romanuk et al 2006) such as predation, grazing and species interactions. In addition, the enrichment of water by nutrients especially compounds of nitrogen and phosphorus, causes an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms and the quality of the water concerned (known as eutrophication). Nutrient enrichment tends to stimulate phytoplankton in lakes because micro-algae and cyanobacteria usually grow faster than larger algae or plants, and the resulting biomass absorbs light and so shades out benthic micro-algae or macrophytes.

Metals: The heavy metals of most concern in urban runoff are lead, zinc, copper, nickel, and chromium. Metals in urban runoff originate on roads, etc., as part of the exhaust and other residue left by vehicular use.

Solids: Suspended solids contained in stormwater enter natural waterbodies, altering the water chemistry by decreasing water clarity, and altering stream profiles by causing sedimentation, with resultant impacts on instream flora and fauna.

The receiving waters for the proposed development area have not been identified or characterised, and the impacts of increased stormwater volumes and velocities due to the construction of hardstand areas and building roofs on receiving waters has not been determined. On and surrounding the subject site, the receiving waterbodies can all be considered to be highly sensitive to external pollutants, and the most strict water quality management conditions will apply. Under the Queensland Water Quality Guidelines 2006 (EPA 2006) there will be a requirement for no impact on the receiving waters.

The relationship of the site, both via groundwater and surface water, to Ella Bay Swamp and the Great Barrier Reef must be determined before any meaningful assessment of impacts on these important areas can be assessed in this high rainfall environment.

Recommendation A1. Detailed pre- and post-development surface and groundwater modelling are required to identify receiving waters from the proposed development area. Receiving waters are subject to extensive water quality and quantity data collection. Analysis of the macroinvertebrate samples taken from the study area will assist in the characterisation of on-site water quality and should form a component of a Waterway Health Monitoring Program.

6.0 NATURAL HERITAGE VALUES

From the Wet Tropics Conservation Strategy (2004) (Wet Tropics Management Authority, 2004), the Wet Tropics World Heritage Area (WTWHA)meets all four natural criteria specified by the World Heritage Committee for inclusion as a property on the world heritage list, summarised as follows:

Be outstanding examples representing major stage of earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features.
The Wet Tropics contains one of the most complete and diverse living records of the major stages in the evolution of land plants, from the very first land plants to higher plants (gymnosperms and angiosperms), as well as one of the most important living records of the history of marsupials and songbirds.

Be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.
Levels of species diversity and endemism in the Wet Tropics are exceptionally high, reflecting the long isolated, ancient biota of the Australian Wet Tropics.

Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.
The Wet Tropics contains one of the most significant regional ecosystems in the world, with outstanding features of natural beauty and magnificent sweeping landscapes. Exceptional is the coastline scenery, which contains tropical rainforest, white sandy beaches and fringing reefs just offshore.

Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.
The Wet Tropics provides the only habitat for numerous rare or threatened species of plants and animals.

The WTWHA consists of a variety of land uses and tenure The Wet Tropics Management Plan 1998(Queensland Government (QG), 1998) designated areas included in the WTWHA into four distinct zones: Zone A-D with A having the highest conservation value. Lands directly to the north and south-east of the subject site are designated as Zone A while areas to the west and south are designated as Zone B (See Figure 2.4). Zones A and B are:

Zone A:
Land included in zone A has a high degree of integrity and is remote from the disturbances associated with modern technological society. It is in its natural ecological, physical and aesthetic condition and sustaining this condition is the intent of this zoning. Visitors may expect to find solitude and no obvious management presence. To qualify for inclusion in zone A, land must:

- *be at least 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structures; and*
- *be at least 700 metres from clearings; and*
- *include a minimum area of 150 hectares of undisturbed habitat; and*
- *no obvious signs of disturbance in the last 40 years (such as logging, for example).*

Zone B:
Like land in zone A, it has a high degree of ecological integrity and it is in a natural state but is not necessarily remote from disturbance. There is a reasonable expectation that it could be restored to a condition which would qualify for inclusion in Zone A. Visitors can expect solitude and limited evidence of a management presence (infrastructure, etc.). Lands in zone B must:

- *be less than 500 metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structure; or,*
- *be less than 700 metres from clearings; or*
- *include an area of up to 150 hectares of undisturbed habitat;*
- *have some obvious signs of disturbance in the last 40 years; and*
- *not overlap with Zones A, C and D.*

An assessment of the development layout, the Regional Ecosystems, and plant and animal species of particular conservation significance that would be affected by the proposed development indicates that no part of the project would alter the current zoning of the

WTWHA on lands surrounding the subject site, and that any direct impacts on the WTWHA would be highly localised and can be mitigated against.

Cumulative impacts are more difficult to predict, although they are most likely to be related to:

- increased visitor numbers to Ella Bay National Park and other WTWHA places;
- increased vehicles on local roads; and
- water quality impacts from stormwater runoff, particularly any impact on Ella Bay Swamp would be of significance.

Recommendation N1. The proponent to enter into discussions with the QPWS regarding the potential for the development to generate increased visitors to Ella Bay National Park, and to determine any need for additional infrastructure to protect the environment from increased visitor numbers.

Recommendations have been made to reduce the impacts of increased vehicular traffic on roads affected by the development. It is considered that, with the appropriate road route selection and management measures in place, the impacts of the road can be managed to ensure biodiversity impacts associated with road kills do not accumulate over time, and that local fauna populations are maintained.

Even minor annual increments in pollutant contributions to natural receiving waters from the development could have significant impacts on the ecology of waterways and wetlands over time. Surface water and groundwater characterisation and management have not yet been undertaken, and will be carefully scrutinised to ensure that water bodies within the WTWHA are unaffected.

Impacts on the Great Barrier Reef World Heritage Area have not been addressed in this report, but should be part of a Water Quality Impact Assessment Study.

Recommendation N2. There are significant areas of remnant forest to the north and west of the development area that are located within the subject property but outside of the development footprint. The incorporation of these areas into the WTWHA through one of a number of agreements such as Conservation Covenants, Cooperative Management, Land for Wildlife, Nature Refuge or Commonwealth Conservation Agreement would be a valuable contribution to the conservation estate.

7.0 ACCESS ROUTE CORRIDOR OPTIONS

7.1 ACCESS ROAD ALTERNATIVES

The development is predicted to generate a maximum range of between 2,570 and 3,990 vehicle movements per day during peak holiday times, and considerably less for other times. The peak times for traffic generation that were predicted by ETS Group (2007) are 9.00am, 11.00 am and 2.00-3.00pm.

The Traffic Report (ETS Group, 2007) has determined that the existing capacity of Ella Bay road will not be of adequate standard to carry the traffic from the proposed development, and an alternative means of road access is required to support the project.

The following alternatives have been studied by the proponent:

Upgrade of Ella Bay Road
Part of the existing development at Little Cove, immediately south of the subject site, is the upgrade of the Ella Bay Road to a bitumen road from its current gravel condition. The width of the road from Flying Fish Point to Heath Point is to be 6m then 4m wide, continuing to the development. The upgraded road will only support a low speed environment (40-50k) due to the topography and winding geometry.

Mountainous Road Option
A second road access from the west was investigated to supplement Ella Bay Road. The route of the option was located outside of the National Park boundaries, although traversing high parts of the Seymour Range through sensitive vegetation. Discussion by the proponent with the EPA and DEH resulted in not pursuing the option further.

Tunnel Option
To eliminate the topographical and environmental problems with a mountainous road, a tunnel option was investigated. A dedicated road reserve currently exists along the southern boundary of the site heading west and then south, and preliminary data showed that a tunnel was possible. However, due to the associated issues and excessive cost, this option was determined not to be viable.

Inland Option

The proponent investigated an alternative inland route via the Bruce highway, Garradunga Road and Jubilee Road. At a preliminary meeting with the EPA and WTMA both expressed the opinion that the inland route would incur a number of negative environmental externalities.

7.2 PREFERRED ACCESS

After the initial analysis and discussions with relevant stakeholders and government departments, it was concluded that the upgrading of Ella Bay Road was the best option for the proponent to pursue There are three alternative routes through Flying Fish Point (described in Section 7.3).

7.3 ALTERNATIVES THROUGH FLYING FISH POINT

7.3.1 *Option descriptions*

The three alternative routes are shown in Figure 2.4.

Option 1: A route following the existing Ella Bay Road.

Option 2: A route requiring construction of a new section of road along the southern boundary of the fish farm, joining with the existing Ella Bay Road on the south-western corner of the fish farm property.

Option 3: A route requiring construction of a new section of road along the narrow strip of coastline between the eastern boundary of the fish farm property and the ocean.

7.3.2 *Vegetation and Flora*

Although located on a narrow coastal corridor, the southern access corridor study area demonstrates some geomorphic diversity with coastal outwash plains, metamorphic headlands and ridgelines, with minor sections located on stabilised dune sands. Heath Point forms the most easterly feature rising from the coastline westward as a poorly defined spur to join the north- south trending Seymour Range to the west. Heath Point divides the coastal alluvial plains formed behind Ella Bay to the north and Flying Fish Point to the south. Both coastal plains possess a narrow fringe of low dune ridges on their seaward margins, which have minor incursions into the road access corridor.

An online search of the EPBC database indicates that 14 plant species, or habitats for these plants occur within the locality. Six of these species are Endangered and eight are Vulnerable.

Suitable habitat for those species likely to occur within the road access corridor option area are shown on Figure 3.2.

Recommendation R1. Once a preferred access road route alignment has been selected, a detailed flora survey will be required to determine the presence of species of significance, and determine the most suitable strategies for impact mitigation.

3D Environmental (2006b) recommended that route options following the existing road alignment are utilised wherever possible, resulting in the least loss of vegetation.

7.3.3 *Fauna (Cassowaries)*

An assessment of the impacts of the proposed options was undertaken by Moore (2006) with regards to Cassowary issues. The results are as follows:

Option 1 – Retain the existing alignment

This is considered the least preferable of the three possible road alignments for Cassowary management. Currently there are two adult Cassowaries and a chick that regularly cross the Ella Bay Road between Flying Fish Point and the fish farm to exploit the vegetation within the Reserve. This places them at risk of collision with vehicles, and that risk will increase significantly if the road is upgraded and traffic flow increases.

Option 2 – Fish Farm boundary

This option allows Cassowaries to access the Reserve without having to cross the upgraded Ella Bay Road. In addition, it enables the Reserve to be incorporated into or managed with the adjoining National Park. However, there is still the possibility that birds may occur on the road near the fish farm. As such, there would be a need to incorporate a Cassowary-proof fence along the new road if this option were adopted. Although not the preferred option, this placement significantly reduces the risk of road death for Cassowaries.

Option 3 – Coastal alignment

This road placement is the preferred option for Cassowary management in that it provides maximum protection for the resident Cassowaries. The boundary fences of the fish farm could be extended to meet the new road, leaving only a small length of Cassowary-proof fencing to ensure that Cassowaries are not able to access the road at these points. As with Option 2, this

road alignment enables the Reserve to be incorporated into or managed with the adjoining National Park.

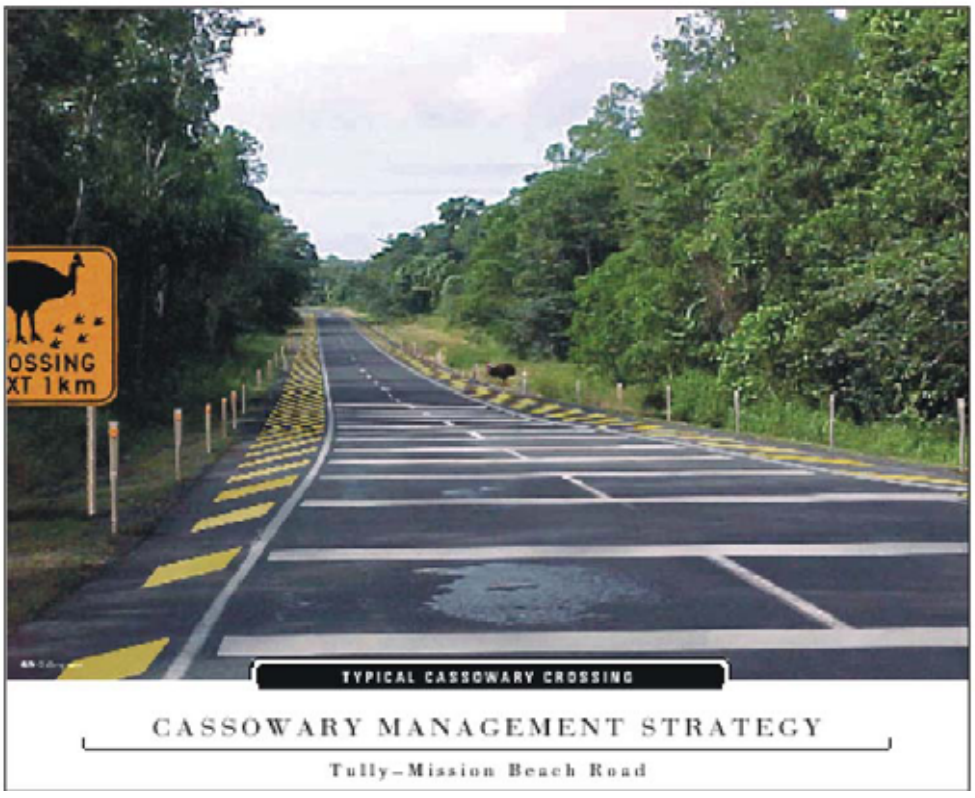
Recommendation R2. A Road Management Plan for known and likely Cassowary crossing points on the Ella Bay Road should be developed and implemented. The points currently used by Cassowaries to cross the Ella Bay Road have been identified and mapped; however, the exact placement of traffic calming points will be dependent on the final location and form of any road upgrade.

An example of a Mission Beach road crossing indicating possible traffic calming suitable for use on the Ella Bay Road is illustrated in Figure 7.4, with generic measurements detailed in Moore (1998, 1999). This crossing has been designed to comply with Queensland Department of Main Roads standards.

Another wildlife collision prevention strategy that may be suitable for the Ella Bay Road Cassowary road crossings is a 'Wildlife Protection System' (WPS). This technology has been used extensively in Canada and is designed to alert approaching drivers with 'real time' information of the presence of wildlife on the road. The WPS uses infrared cameras to detect the presence of wildlife on or near the roadway. When the cameras detect wildlife, flashing lights at both ends of the road segment are triggered, thus allowing drivers to reduce speed and anticipate wildlife on the road.

Recommendation R3. All upgrade works should be undertaken with reference to the best practice guidelines as presented in "Queensland Department of Main Roads: Roads in the Wet Tropics: Planning, Design, Construction, Maintenance and Operation Best Practice Manual (2000)".

Figure 7.4: Illustration of Standard Cassowary Road Crossing Design



7.3.4 *Fauna (General)*

In a study of the impacts of roads and powerlines on the Wet Tropics of Queensland World Heritage Area, Goosem and Turton (2000) found that natural habitat fragmented by networks of roads may cause the subdivision of populations of many fauna species, but that the problem of fragmentation is exacerbated for strictly arboreal species.

The only arboreal species present or likely to be present within the access road corridor is *Dactylopsila trivirgata* (Striped Possum). Neither are strictly aboreal and are known to come to ground level for dispersal movements (Goosem and Turton, 2000). Striped Possums are often recorded as road kill, therefore the provision of canopy connection over the roadway will be important to reduce the impacts of the road on this species.

The significant frog species *Litoria rheocola* will require bridging structures over drainage lines, leaving streambank conditions intact.

*Nyctimyste*s *dayi* will require the provision of small culverts along the length of the roadway.

Due to their mobility and ability to fly across road corridors, the majority of bird and bat species would be unaffected by the location of the access road, and it will not significantly sever habitat connections.

Direct impacts of road construction or upgrading would require the removal of some habitat within a narrow corridor, the effects of which would be mitigated by the considerable size of similar habitat present in the local area and in the region. However the cumulative impacts associated with consistent road deaths of a range of species would be far more serious.

Roads have been found to reduce fauna population densities in adjacent areas through edge effects, stress-response and directly through road kill (Findlay and Bourdages 2000; Haskell 2000, cited in Chenoweth EPLA 2003). This is particularly significant for fauna populations that are small, fragmented or declining, or that repeatedly come into contact with roads (Brown 1989, Bennet 1991 and Jones 2000, cited in Dique *et.al.* 2003). In situations where small or discrete populations cannot sustain high levels of mortality through natural replacement, road mortality could cause local extinction (Broadbent *et al.* 1981, cited in Jones 2000).

There is a significant body of work reporting the impacts of vehicle speed on the likelihood and severity of vehicle collisions with pedestrians. The same principles can be applied to determine the likelihood of fauna collisions related to vehicle speed, although the problem is compounded by the lower visibility of fauna due to their smaller size, and by the lack of avoidance behaviour by most animals. It is known that a doubling in vehicle speed results in a stopping distance four times as long and with four times as much kinetic energy being absorbed during an impact. A small increase in road traffic speed results in a disproportionately large increase in pedestrian fatalities as shown in Table 7.1.

Table 7.1: Odds of pedestrian deaths over a range of vehicles speeds

Vehicle Speed	Odds of Pedestrian Death (McLean *et al.*, 1994)	Odds of Pedestrian Death (UK Dept. of Transport, 1994)
32 km/h	5%	5%
48 km/h	37%	45%
64 km/h	83%	85%

Logically, this can be applied to fauna. The lower the road speed, the less fauna casualties can be expected.

Recommendation R4. To minimise the potential impacts of the access road and increased traffic on the greatest range of local fauna populations, including species of conservation significance, the following actions are recommended:

- **Consider the option that isolates the least amount of habitat to minimise likely fauna "traffic" across the road corridor;**
- **Once the preferred road route is selected, carry out a detailed fauna investigation, with the results contributing to the design of the road, including necessary fauna crossing infrastructure and its optimal locations;**
- **Ensure that road speeds are maintained at no greater than 50km/hr.**

7.3.5 *Summary of Options*

The Traffic Report (ETS Group, 2007) determined that the existing capacity of Ella Bay road will not be of adequate standard to carry the traffic from the proposed development, and an alternative means of road access is required to support the project. A number alternative means of road access or upgrading of the existing road were investigated, including:

- **Mountainous Road Option**
  The possibility of road access from the west was investigated to supplement Ella Bay Road. The route of the option was located outside of the National Park boundaries, although traversing high parts of the Seymour Range through sensitive vegetation. Discussion by the proponent with the EPA and DEH resulted in not pursuing the option further.
- **Inland Option**
  The proponent investigated an alternative inland route via the Bruce highway, Garradunga Road and Jubilee Road. At a preliminary meeting with the EPA and WTMA both expressed the opinion that the inland route would incur a number of negative environmental externalities.
- **Tunnel Option**
  To eliminate the topographical and environmental problems with a mountainous road, a tunnel option was investigated. A dedicated road reserve currently exists along the southern boundary of the site heading west and then south, and preliminary data showed that a tunnel was possible. However, due to the associated issues and excessive cost, this option was determined not to be viable.

The most environmentally and economically viable option is to upgrade the existing Ella Bay Road. Three alternative upgrade options have been investigated. The flora and fauna impacts associated with each option are as follows:

Option 1: While the portion of habitat between the existing Ella Bay Road and the township of Flying Fish Point is already isolated by Ella Bay Road, it is currently an unsealed, low-traffic bearing road with minor impact on fauna movement. The necessary upgrading of the road and increase in traffic would further isolate this area of habitat, which is significant particularly for the Cassowary. The threat of vehicle strike would increase significantly and works such as the installation of guide fencing and construction of underpasses would be required to allow continued safe movement for fauna across the road. This option requires the least habitat removal.

Option 2: This option utilises part of the existing Ella Bay Road, but requires the construction of a new section of road along the southern boundary of the fish farm, resulting in

increased habitat loss, but reducing the effects of habitat isolation. Some fencing would be required to reduce the risk of vehicle strikes for Cassowaries.

Option 3: This option requires the construction of a new stretch of road north from Flying Fish Point and east of the fish farm. The road would traverse a sensitive Coastal Management Area, with significant coastal erosion issues. This option requires the greatest amount of habitat removal, although it would result in the least amount of habitat fragmentation.

Each option has positive and negative aspects in relation to flora and fauna, although mitigation works, such as the provision of fauna crossings and fencing, can alleviate impacts associated with Options 1 and 2.

8.0 COLLABORATION WITH RESEARCH ORGANISATIONS

In December 2006 a Letter of Agreement between the Proponent and James Cook University and The University of Queensland to collaborate in the development of joint initiatives addressing both research and training and focussed on the development of a sustainable town as well as reducing environmental impacts in the Ella Bay project.

A more detailed agreement is being planned with the aim of developing specific projects in priority areas.

Both universities have expertise in vegetation and wildlife management, and wastewater and stormwater management and will be involved in designing and auditing mitigation solutions.

The resources and expertise brought together under this agreement will be well-placed to prioritise and address the range of recommendations made in this assessment of terrestrial and freshwater flora and fauna impacts.

9.0 SUMMARY OF RECOMMENDATIONS

9.1 VEGETATION AND FLORA RECOMMENDATIONS

Recommendation V3: The tenure/management status of the significant areas of intact remnant vegetation occurring within the property boundary but outside of the development footprint is to be established via a mechanism that retains their conservation values in perpetuity.

Recommendation V4: Prepare a Conservation Management Plan for native vegetation nodes and corridors within the development area.

Recommendation V7: A Construction Vegetation Management plan is prepared to ensure that retained vegetation is protected from construction impacts.

Recommendation V8: A Weed Management Plan is prepared for the construction and operational phases of the development. Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring procedures are to be incorporated into the Plan.

Recommendation V9: An Environmental Code of Conduct is prepared for construction workers and residents to ensure that responsibilities for vegetation protection, fire management and weed management are clear and that National Park regulations are understood. The Environmental Code of Conduct should be incorporated into the induction of any site workers, and should be the subject of community information sessions.

Recommendation V10: No residential allotments should directly adjoin the National Park or other remnant vegetation to prevent the clandestine dumping of garden waste into natural areas. Roadways between residences and natural areas provide suitable buffers against the spread of garden escapes and other weeds.

Recommendation V11: When access road and pedestrian access locations are finalised, these areas are to be subject to targeted searches for EVR flora species. Where they are located, the routes will be amended to avoid them where possible. If avoidance is not possible, species-specific management plans are to be prepared to guide the removal and relocation of individuals in accordance with the requirements of the NCA.

Recommendation V12: Within remnant vegetation, pedestrian walkways to be suspended to prevent significant ground and vegetation disturbance. Railings should confine pedestrians to the walkways.

Recommendation V13: Wherever remnant vegetation is traversed by vehicular or pedestrian access ways, construction should be guided by the Construction Vegetation Management Plan, the Weed Management Plan, and the Erosion and Sedimentation Control Plan.

Recommendation V14: Development design to incorporate the corridor linkages recommended by Moore (2006) (see Figure 4.6), linking the north-south riparian corridor to habitat to the north through rehabilitation.

Recommendation V15: There are currently no hydrological or water quality specialist studies available for the subject site and surrounds. The presence of a wetland of national and state significance – the Ella Bay Wetland – north of the proposed development area will require a significant level of investigation to determine:

a) Whether runoff and/or groundwater from the proposed development area contributes to wetland area, and to what extent;

b) water quality, flora and fauna of the swamp over a considerable period to capture data for a range of climatic conditions; and

c) the stormwater management and water quality controls that are proposed for the development to protect the integrity of the swamp and its associated biota.

Recommendation V16: A Rehabilitation and Landscaping plan is to be prepared for the development area. All plant species used for rehabilitation and landscaping (both by the developer during construction and on private property during operation) are to be of local provenance, although no species attractive to Cassowaries should be planted outside of the Cassowary corridor areas.

Recommendation V17: All soil and other materials to be used for rehabilitation or landscaping purposes (both by the developer during construction and on private property during operation) to be restricted to materials certified as free of pathogens and weeds.

Recommendation V18: The Rehabilitation and Landscaping Plan is to include a guide to suitable plant species and materials suppliers that can meet the specified conditions of Recommendations V15 and V16.

Recommendation V19: The golf course is to be designed to prevent pollutants from entering the natural environment. Application of risk assessment and simulation modelling is required to accurately identify potential impacts and design measures to mitigate impacts.

Recommendation V20: A Surface Water and Groundwater Quality Management Plan is required for the operational phase of the project. Water quality standards must be set to protect native terrestrial and aquatic flora, including regular monitoring of receiving waters to detect levels of herbicides, fertilisers and sediment entering natural waterways, and planned responses to adverse results.

Recommendation V21: The Coastal Management Plan and Great Barrier Reef Wetlands Protection Program to be consulted in development and golf course planning.

Recommendation V22: Control measures for Pond Apple and other weed species present (in particular Hymenache, Sicklepod and Lantana) should be incorporated into the Weed Management Plan for both the construction and operational phases of the project. Issue identification, actions, responsibilities and monitoring are to be incorporated into the Plan, which is to be guided by the Johnstone Shire Pest Management Plan (2004).

9.2 FAUNA RECOMMENDATIONS

Recommendation F2: See Table 4.6, Section 4.2.1.5.

Recommendation F3: The main east-west corridor does not allow Cassowary access to that part of the foreshore represented by Locations 1b, 3 and 4 (Figure 4.4). Any Cassowary habitat lost by doing so should be compensated for by increasing the revegetation planned to take place in the new northern corridor 'B' and throughout the remainder of the site, or be the subject of an 'offset' i.e., either the gifting to the protected estate of an agreed part of the subject site or the purchase and donation to the protected estate of alternative compensatory habitat elsewhere.

Recommendation F4: A Cassowary-proof fence should surround the entire integrated resort along the existing vegetation line and extend into selected areas of revegetation where appropriate. The fence should be at least 1.8 metres in height to guarantee the exclusion of Cassowaries and be constructed of natural material e.g., tea-tree or similar, on a backing structure of 50mm diamond-shape chain mesh fencing. The fence should be densely screened with plants so that birds cannot run into it by accident, or be attracted by people or food resources. There should be

a gap between the lower section of the fence and the ground of approximately 100 mm, to allow the passage of small mammals and reptiles, but not large enough to give access to small Cassowary chicks.

Recommendation F5: No walking trails should be located outside the Cassowary-proof fence surrounding the development. All ground level walking trails and pedestrian paths inside the development should be located outside the Cassowary movement corridors, or if located within the corridor, be raised approximately 2.5 metres above ground level to prevent interactions between cassowaries and people.

Recommendation F6: Road over-passes should be constructed on the 'Ring Road' to cross above sections of the Cassowary corridors, or existing gullies and creeks. These over-passes are essential to facilitate the unhindered movement of cassowary and other fauna.

Recommendation F7: All roads within the resort should also be constructed following appropriate QDMR guidelines. Where necessary, traffic calming devices should be located on the roads within the resort.

Recommendation F8: Recommendation F8. Dogs can harm and have the potential to kill Cassowaries, as well as transmit disease. A strict dog control program should be enforced and dog management requirements should be included in an "Environmental Code of Conduct" for residents.

Recommendation F9: The planting of accessible native or domestic fruiting trees within the resort precincts should be restricted to avoid attracting Cassowaries.

Recommendation F10: Apart from existing natural streams, no standing water e.g., ponds or fountains should be accessible to Cassowaries in or around the development. Cassowaries have to drink a number of times per day and it is probable that in many areas the presence of water is as big an attraction to Cassowaries as fruiting trees.

Recommendation F11: To reduce the possibility of disturbance to Cassowaries and other fauna using the adjoining areas, all external lighting within the development should be directed away from the surrounding rainforest vegetation.

Recommendation F12: A Queensland Parks and Wildlife Service (QPWS) education program on the risks associated with hand feeding of Cassowaries should be initiated.

Recommendation F13: A potential increase in the number of road mortalities for *L. rheocola* and *N. dayi* relating to increased traffic may have a local impact on these populations. Impacts therefore, are likely to be localised. Road crossings over drainage lines should be of a suitable design to allow the safe movement of these frog species, preferably through bridging streams and leaving stream-banks intact.

Recommendation F14: The minor loss of habitat for Spectacled Flying-foxes associated with the access road upgrading may be compensated by the careful selection of fruiting plant species for revegetation areas. This may actually increase the value of the development site for local populations.

Recommendation F15: Regular monitoring of the foreshore during Green Turtle nesting season is required, and should any nests be detected, these should be cordoned-off to prevent their disturbance by humans and feral animals. The record should be registered with the EPA.

Recommendation F16: A Pest Animal Management Plan is required to control the numbers of feral species present, in particular pigs, foxes and dogs, within and surrounding the development. Consultation with QPWS will be required to co-ordinate management responses with management practices within Ella Bay National Park.

Recommendation F18: The preparation of a Fire Risk Assessment is required to determine any need for a Fire Management Plan to protect fire-intolerant fauna and fauna habitat.

Recommendation F.25. The current proposed footprint indicates existing corridors following watercourses will be mostly retained. It is recommended that all riparian vegetation is retained, and that the corridors are at least 50m width either side of the high bank of the creeklines. In some areas this will require rehabilitation to broaden the corridor. The proponent proposes to significantly widen the corridors subject to negotiation with NRW.

Recommendation F.26: The locations of corridors and linkages recommended by Moore (2006) as shown in Figure 4.6 should be adopted, with particular attention to linkages between the north-south corridors and surrounding vegetation. The Proponent also proposes to enhance habitat associated with the network of sub-corridors along minor drainage lines within the development area.

Recommendation F27: There are a number of small, ground-dwelling fauna species of special conservation significance present in habitat within and surrounding the proposed development area, and the presence of cats and dogs would present a direct threat to those species through harassment and predation. As such, it is recommended that the keeping of cats and dogs within the proposed development area is prohibited.

Recommendation F28: Prepare a Conservation Management Plan for habitat nodes and corridors within the development area.

Recommendation F29: All lighting associated with the development should be designed so that there is no spillage into conservation areas.

Recommendation F30: Golf course planning should incorporate plant species that can be utilised by native species (other than Cassowaries). The recommended Landscaping and Rehabilitation Plan (Recommendation V16) should consider fauna habitat requirements in its preparation, and is to be used as a guide for planting.

Recommendation F31: An Integrated Pest Management (IPM) program to be prepared for the golf course that will keep pests at acceptable levels using carefully selected methods, while minimizing the effect on the environment.

Recommendation F32: A Surface Water and Groundwater Quality Management Plan is required for the operational phase of the project that guided by the

results of modelling for pesticides, nutrients, runoff water, and sediments from the development. Water quality standards must be set based on the Queensland Water Quality Guidelines 2006 (EPA, 2006) to protect native terrestrial and aquatic fauna, including regular monitoring of receiving waters to detect levels of herbicides, fertilisers and sediment entering natural waterways, and planned responses to adverse results.

9.3 AQUATIC FAUNA RECOMMENDATIONS

Recommendation A1: Detailed pre- and post-development surface and groundwater modelling are required to identify receiving waters from the proposed development area. Receiving waters are subject to extensive water quality and quantity data collection. Analysis of the macroinvertebrate samples taken from the study area will assist in the characterisation of on-site water quality and should form a component of a Waterway Health Monitoring Program.

9.4 NATURAL HERITAGE RECOMMENDATIONS

Recommendation N1: The proponent to enter into discussions with the QPWS regarding the potential for the development to generate increased visitors to Ella Bay National Park, and to determine any need for additional infrastructure to protect the environment from increased visitor numbers.

Recommendation N2: There are significant areas of remnant forest to the north and west of the development area that are located within the subject property but outside of the development footprint. The incorporation of these areas into the WTWHA through one of a number of agreements such as Conservation Covenants, Cooperative Management, Land for Wildlife, Nature Refuge or Commonwealth Conservation Agreement would be a valuable contribution to the conservation estate.

9.5 ACCESS ROAD RECOMMENDATIONS

Recommendation R1: Once a preferred access road route alignment has been selected, a detailed flora survey will be required to determine the presence of species of significance, and determine the most suitable strategies for impact mitigation.

Recommendation R2: A Road Management Plan for known and likely Cassowary crossing points on the Ella Bay Road should be developed and implemented. The points currently used by Cassowaries to cross the Ella Bay Road have been identified and mapped; however, the exact placement of traffic calming points will be dependent on the final location and form of any road upgrade.

Recommendation R3: All upgrade works should be undertaken with reference to the best practice guidelines as presented in “Queensland Department of Main Roads: Roads in the Wet Tropics: Planning, Design, Construction, Maintenance and Operation Best Practice Manual (2000)”.

Recommendation R4. To minimise the potential impacts of the access road and increased traffic on the greatest range of local fauna populations, including species of conservation significance, the following actions are recommended:

- Consider the option that isolates the least amount of habitat to minimise likely fauna "traffic" across the road corridor;
- Once the preferred road route is selected, carry out a detailed fauna investigation, with the results contributing to the design of the road, including necessary fauna crossing infrastructure and its optimal locations;
- Ensure that road speeds are maintained at no greater than 50km/hr.

10.0 CONCLUSIONS

With the implementation of the recommendations set out in Section 9.0, impacts on the habitats of EPBC listed species are able to be managed sufficiently to reduce the potential effects of the development to acceptable levels, where the project would not significantly affect the ability of any of the listed species to persist in the local area.

Insufficient data are available to determine the potential impacts of the development on the off-site freshwater environment. Data collection, modelling, monitoring and planning are required for surface and groundwater movement. Development of best practice stormwater, golf course and wastewater design are required in this high rainfall environment, surrounded by sensitive and significant aquatic ecosystems.

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Attachment 1:
Analysis of the likelihood of the occurrence of EPBC Act listed Flora Species from the Protected Matters Search Tool database results

Species Name	EPBC	NCA	Habit	Likely	Possible	Unlikely	Comments
Aponogeton bullosus	E	Not Listed	Rooted, submerged, perennial aquatic.			X	Grows in cool rapidly flowing freshwater rivers and streams. Confined to northern Queensland in fast-flowing rivers on and running off the Atherton Tableland and in the Palmerston, South Johnstone and Mirriwinni districts (Hellquist and Jacobs 1998). Closest known record to subject site is to the north at Josephine Creek near Mt Bartle Frere (S. Jacobs 8249, B.Hellquist, J.Wiersema, 14 Aug 1997, BRI, NASC, NSW) (Hellquist and Jacobs 1998). No Herbrecs record from 10 km radius of subject site. The species was not observed during the survey.
Aponogeton proliferus	E	E	Perennial freshwater herb.		X		An extremely rare species known only from the Innisfail region in narrow shallow and heavily shaded coastal streams, presumably now restricted because of extensive clearing and habitat loss (Hellquist and Jacobs 1998). One record in Herbrecs from Innisfail district in creek through rainforest (S. Jacobs 7148) (Hellquist and Jacobs 1998). Observations within potential habitat during the field survey did not locate this species. There remains a possibility however that the species occurs within the subject site.
Arenga australasica	V	Not listed	A Palm	X			Known from Type 2b forests in the Mission Beach area and from MVF on basalt at Clump Point to the south of the study area. No Herbrecs records however areas mapped as 2b/RE 7.2.1 are considered high potential habitat for this species. Not recorded in Site EB8. In the absence of additional search effort throughout the community the potential for this species should be considered as high.
Canarium acutifolium var. *acutifolium*	V	Not listed	A tree.	X			Occurs in NEQ and restricted to coastal lowlands between Mossman and Tully between sea level and 100m where it is confined to creek and river banks (Hyland et al. 2002). The species was not observed during the survey however potential habitat exists.
Carronia pedicellata	E	Not listed	A vine.		X		Occurs in NEQ in well developed lowland rainforest between sea level and 150m. Recorded in targeted surveys of proposed Tully – Innisfail 274 kva powerline (http://biotropica.com.au/PROJECTS/targeted.html). No Herbrecs records in the 10km radius search area. Not recorded in this survey however potential habitat occurs within the site in rainforest of metamorphic footslopes..
Dendrobium mirbelianum	E	Not listed	Epiphytic orchid.		X		Grows on trees or exposed rocks from sea level to 600m often in mangroves and on trees overhanging beaches and in coastal forests (Laverack et al. 2006). One imprecise Herbrecs record from Babinda area. Not recorded in this survey.
Dendrobium superbiens	V	Not listed	Epiphytic orchid.		X		No Herbrecs records in the 10km radius search area. Not recorded in this survey.

Species Name	EPBC	NCA	Habit	Likely	Possible	Unlikely	Comments
Eleocharis retroflexa	V	V	A small tufted and mat forming sedge.			X	Five Herbrecs records all from Eubanangee Swamp. No suitable habitat within the subject site.
Fimbristylis adjuncta	E	E	A tufted, oblique to erect sedge 4-6 in.		X		A single Herbarium record from Eubenangee Swamp N of Garradunga. Suitable habitat within the subject site.
Hodgkinsonia frutescens	V	V	A shrub.			X	No Herbrecs records from the vicinity of the site. Known from the understorey in upland and lowland rainforest in NEQ and CYP (Hyland et al. 2002). Unlikely to occur as this species generally prefers basalt soils typically in type 5b forests of the Atherton Tableland.
Hupzeria phlegmarioides	V	V	A pendulous epiphyte.			X	In Australia, restricted to north-eastern Qld; also from Indonesia to the Pacific. In Qld, it occurs as an epiphyte in rainforest. Records indicate unsuitable habitat within the subject site (*Flora of Australia* Volume 48 (1998).
Phaius tancarvilleae	E		Terrestrial Orchid.		X		Suitable habitat occurs within the subject site. No Herbrecs records. Not recorded in field survey.
Polyscias bellendenkerensis	V	V	A tall shrub.			X	Known only from mountain top areas of Bartle Frere, Bellenden Kerr, and Daintree (Hyland et al. 2002). Discounted on the basis of unsuitable habitat.

Attachment 2:
EPBC PROTECTED MATTERS SEARCH TOOL
DATABASE SEARCH RESULTS

Attachment 3:
Ella Bay Swamp Description
Directory of Important Wetlands in Australia (3rd Edition, 2001)

11.1 ELLA BAY SWAMP - QLD144

Level of importance: National - Directory

Location: 17 degrees 25' 15" S, 146 degrees 03' 10" E; the site has a north-south length of c. 6 km and is up to 3.5 km wide, with its centre 67 km south southeast of Cairns. It falls within the Johnstone catchment (Queensland Department of Primary Industries 1993).

Biogeographic region: Wet Tropics

Shire: Johnstone and Cairns City.

Area: 1 310 ha.

Elevation: 0-10 m ASL.

Other listed wetlands in same aggregation: None.

Wetland type: A5, A7, A8, A9, B1, B2, B14

Criteria for inclusion: 1, 3, 5,

Site description: The site runs from Cooper Point in the northeast along the base of the Seymour Range to its southeastern point about 3 km north of Heath Point. It is a low lying coastal plain completely surrounded on the land side by the Seymour Range.

Physical features: Landform: alluvial plain with, beach ridge plain, backplain, beach, beach ridge, drainage depression, dune, foredune, drainage depression, stream bed, stream channel, tidal flat, swale, swamp and tidal creek. General geology: Quaternary alluvium, Quaternary beach sands and a small area of Barron River Metamorphics cropping out on a hill near the centre of the site (de Keyser 1962). Soils: basic regolithic orthic tenosols, bleached mesotrophic yellow kandosols, bleached mottled yellow kandosols and mesotrophic kandosolic oxyaquic hydrosols (Isbell et al. 1968; Stanton & Godwin 1989; Isbell 1993). Climate: mean annual rainfall 3609 mm; driest quarter mean rainfall 413 mm (data for Innisfail 17 31" S, 146 02" E, altitude 7 m).

Hydrological features: The site consists of alluvials washed from the Seymour Range and isolated from the sea by consolidated beach dunes. The alluvials appear to be more permeable than the beach sands, hence the sands act as a porous dam holding water back on the alluvial plain and creating the swamp. Most of the water flowing off Seymour Range is gathered by Cooper Creek, which runs northeast, parallel to the range (between the range and the swamp) to enter the sea just south of Cooper Point. Water entering the site from the southwest flows in several small creeks, whose channels disappear as they enter the swamp.

Ecological features: Plant structural formations: open forest, groved woodland, closed forest. The frontal dune system occupies about 260 ha and supports a variety of vegetation. A few small patches of pink bloodwood (Corymbia intermedia) open forest grow on the dunes and on sandy soils on the landward edge of the swamp. This forest generally has a rainforest like midstorey with species such as hard milkwood (Alstonia muelleriana), toothed wattle (Acacia flavescens), brown salwood (A. crassicarpa), golden bouquet tree (Deplanchea tetraphylla) and Endiandra glauca. This grades into simple mesophyll vine forest which includes the species listed above plus Syzygium angophoroides and quandongs Elaeocarpus spp. Complex mesophyll vine forest with pink euodia (Melicope elleryana), Flindersia bourjotiana, Acmena

graveolens, Endiandra montana and White Oak Musgravea heterophylla grows on the northern side of the small hill near the centre of the site. This type also grows on heavier soils on the landward edge of the swamp. It is an unusual forest type that contains a number of rare and/or restricted species. As conditions become wetter, Alexandra palm (Archontophoenix alexandrae) becomes common and the type grades into Alexandra palm swamp forest, which is described below. The southern side of the hill is occupied by a vine forest with ivory basswood (Polyscias australiana) and brown salwood (Acacia crassicarpa). The difference is probably largely due to the southern hillside being more exposed to destructive winds.

Significance: Ella Bay Swamp is unique amongst the remaining wetlands on the coastal plain in the Wet Tropics bioregion in that its whole catchment is relatively undisturbed. The site contains one of the largest and least disturbed areas of Melaleuca quinquenervia open forest remaining in the region.

Notable flora: Rare species occurring in the site include poison walnut (Cryptocarya pleurosperma) (Sr), Backhousia bancroftii (Sr), yellow penda (Ristantia pachysperma) (Nr, Sr), Rourea brachyandra (Sr) and onion wood (Syzygium alliiligneum) (Sr). There is a small area (c. 90 ha) of mangroves and associated vegetation around the tidal reach of Cooper Creek. The mangroves are dominated by red mangrove (spotted mangrove (Rhizophora stylosa)). Northern paperbark (Melaleuca leucadendra) swamp forest with coastal lolly bush (Clerodendrum inerme), Gymnanthera nitida, looking-glass mangrove (looking-glass mangrove (Heritiera littoralis)), lolly berry (Salacia chinensis), Leptocarpus elatior and marine couch (Sporobolus virginicus) fringes the mangroves. It grows in a narrow band, often as a single line of trees, because its existence is dependent on soil factors that occur in the narrow ecotone between saline and non saline conditions. As salinity decreases red beech (Dillenia alata) becomes more common and dominates in a dune swale in which there is some saline intrusion, to the south of the mangrove area. swamp paperbark (Melaleuca quinquenervia) open forest occupies the largest proportion of the site (c. 800 ha). Several varieties of this type have been recognised. The variations appear to be produced by variations in elevation (affecting the depth and period of inundation), salinity and possibly swamp age (as suggested by the development or otherwise of a peat layer). swamp paperbark (Melaleuca quinquenervia) swamp forest with milky mangrove (Excoecaria agallocha), looking-glass mangrove, wrinkle pod mangrove (Cynometra ramiflora) and mangrove fern (Acrostichum aureum) grows where the saline influence is strongest. Permanent freshwater seepage maintains brackish conditions and the water table rises and falls with tidal movements or in response to rainfall events. Semi permanent swamp paperbark (Melaleuca quinquenervia) swamp forest grows on higher and/or better drained areas, most often on the landward swamp margin. This type has a groundstorey dominated by sedges (e.g. Stenochlaena palustris, giant sedge (Thoracostachyum sumatranum), red seeded saw sedge (Gahnia sieberiana) and Scleria polycarpa). Where deep peat soils cover the sand of the alluvial plain swamp paperbark (Melaleuca quinquenervia) permanent swamp forest occurs with a groundstorey dominated by sedges (red seeded saw sedge and Lepironia articulata). Where the peat layer has barely developed and inundation is seasonal, false gardenia (Randia sessilis) and red beech become common. Alexandra palm (Archontophoenix alexandrae) swamp forest grows in areas with heavy soils that are inundated for much of the year (particularly around the base of the small hill). Other canopy species present are northern silky oak (Cardwellia sublimis), red beech and Macaranga polyadenia (Nr, Sv). Wait-a-while (Calamus australis) is a common liana. Pandanus monticola and giant sedge are prominent in the understorey, often forming dense thickets. Groved woodland with large open areas dominated by sedges (mostly giant sedge) grows along the middle reaches of Cooper Creek

when standing water is present for all or most of the year. Species likely to be present in the groves are Barringtonia racemosa, umbrella tree (Schefflera actinophylla), Ilex arnhemensis, Macaranga polyadenia (Nr, Sv), red leaf fig (Ficus congesta), swizel bush (Timonius timon) and coast cottonwood (Hibiscus tiliaceus) (Tracey & Webb 1975; Tracey 1982; Stanton & Godwin 1989).

Notable fauna: The site supports an isolated population of southern cassowary (Casuarius casuarius johnsonii) (Nv, Sv) (Garnett 1992).

Other Fauna:

Social and Cultural values: None known.

Land tenure: Ella Bay National Park. Surrounding is Ella Bay National Park and freehold.

Current land use: Conservation. Conservation and agriculture.

Disturbance or threat: Past/present: None known.

Potential: Displacement of native species by Pond Apple Annona glabra.

Conservation measures taken: Declaration of Ella Bay National Park. Protection under World Heritage Properties Act 1984. The State Coastal Management Plan - Queensland Coastal Policy (August 2001) provides policy that prevents, minimises or mitigates further loss or degradation and impacts on coastal wetlands.

Management authority and jurisdiction: Queensland Parks and Widlife Service.

References: Garnett, S. (1992); Isbell, R.F. (1993); Isbell, R.F. et al. (1968); Queensland Department of Primary Industries. (1993); Stanton, J.P. & Godwin, M.D. (1989); Tracey, J.G. (1982); Tracey, J.G. & Webb, L.J. (1975). See Queensland Reference List

Compiler & date: Perry, T.W., 1995. Edited Miller, G.J. and Worland, J.L., 2004.

Drainage:

AWRC Division	NORTH-EAST COAST
AWRC Region	BARRON
AWRC Basin	MULGRAVE-RUSSELL RIVERS
Catchment	Russell River
Sub-catchment	

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when standing water is present for all or most of the year. Species likely to be present in the groves are Barringtonia racemosa, umbrella tree (Schefflera actinophylla), Ilex arnhemensis, Macaranga polyadenia (Nr, Sv), red leaf fig (Ficus congesta), swizel bush (Timonius timon) and coast cottonwood (Hibiscus tiliaceus) (Tracey & Webb 1975; Tracey 1982; Stanton & Godwin 1989).

Notable fauna: The site supports an isolated population of southern cassowary (Casuarius casuarius johnsonii) (Nv, Sv) (Garnett 1992).

Other Fauna:

Social and Cultural values: None known.

Land tenure: Ella Bay National Park. Surrounding is Ella Bay National Park and freehold.

Current land use: Conservation. Conservation and agriculture.

Disturbance or threat: Past/present: None known.

Potential: Displacement of native species by Pond Apple Annona glabra.

Conservation measures taken: Declaration of Ella Bay National Park. Protection under World Heritage Properties Act 1984. The State Coastal Management Plan - Queensland Coastal Policy (August 2001) provides policy that prevents, minimises or mitigates further loss or degradation and impacts on coastal wetlands.

Management authority and jurisdiction: Queensland Parks and Widlife Service.

References: Garnett, S. (1992); Isbell, R.F. (1993); Isbell, R.F. et al. (1968); Queensland Department of Primary Industries. (1993); Stanton, J.P. & Godwin, M.D. (1989); Tracey, J.G. (1982); Tracey, J.G. & Webb, L.J. (1975). See Queensland Reference List

Compiler & date: Perry, T.W., 1995. Edited Miller, G.J. and Worland, J.L., 2004.

Drainage:

AWRC Division	NORTH-EAST COAST
AWRC Region	BARRON
AWRC Basin	MULGRAVE-RUSSELL RIVERS
Catchment	Russell River
Sub-catchment	

Appendix 3:
Assessment of the Development Under Part S: Requirements for Clearing for Significant Projects of the Regional Vegetation Management Code for Coastal Bioregions

Part S: Requirements for clearing for Significant Projects

Significant projects includes clearing that is for a project declared to be a significant project under the *State Development and Public Works Act 1971*, section 26.

Performance Requirement		
PRS.1: Limits to clearing To regulate the clearing of vegetation in a way that conserves remnant regional ecosystems, does not cause land degradation, prevents the loss of biodiversity and maintains ecological processes – subject to the limitations required to meet PR S.2 to PR S.10 – clearing is limited to the extent that is necessary for the project, any associated ancillary works, and the operation of works that comprise a project declared to be a significant project under the *State Development and Public Works Organisation Act 1971* section 26.		
Performance Requirement	**Acceptable Solution** *(applicants can propose an alternative solution to meet the performance requirement)*	**Proposed Development**
PR S.2: Wetlands To regulate the clearing of vegetation in a way that prevents the loss of biodiversity and maintains ecological processes – maintain the current extent of assessable vegetation associated with any natural significant wetland and/or natural wetland to provide – a) water quality by filtering sediments, nutrients and other pollutants; and b) aquatic habitat; and c) terrestrial habitat.	**AS S.2** S.2.1 Clearing does not occur – b) in any natural wetland; and c) within 100 metres from any natural wetland; and d) in any natural significant wetland; and e) within 200 metres from any natural significant wetland.	The proposed clearing does not occur within, or closer than 200 metres to any natural wetland or natural significant wetland.
PR S.3: Watercourses To regulate the clearing of vegetation in a way that does not cause land degradation, prevents the loss of biodiversity and maintains ecological processes – maintain the current extent of assessable vegetation associated with any watercourse to provide – a) bank stability by protecting against bank erosion; and b) water quality by filtering sediments, nutrients and other pollutants; and c) aquatic habitat; and d) terrestrial habitat.	**AS S.3** S.3.1 Clearing does not occur – a) in any watercourse; and b) within the relevant distance stipulated in Table 1, of each high bank of each watercourse.	The distance specified in Table 1 is 25m from Stream Order 1,2,3 & 4; and 50m from Stream Order 1. There is no Stream Order 1 in the area proposed for clearing. The proposed clearing will be located at least 25m from drainage lines.

PR S.4: Connectivity To regulate the clearing of vegetation in a way that prevents the loss of biodiversity and maintains ecological processes – areas of remnant vegetation are – a) of sufficient size and configured in a way to maintain ecosystem functioning; and b) of sufficient size and configured in a way to remain in the landscape in spite of any threatening processes; and c) located on the lot(s) that are the subject of the application to maintain connectivity to remnant vegetation on adjacent properties.	**AS S.4** S.4.1 Where clearing is less than – a) 10 metres wide; or b) 2 hectares Clearing does not i) reduce the width of remnant vegetation to less than 200 metres; and ii) occur where the width of remnant vegetation is less than 200 metres; OR S.4.2 Clearing does not – a) reduce areas of contiguous remnant vegetation to less than 10 hectares; and b) occur in areas of contiguous remnant vegetation that are less than 10 hectares; and c) reduce the width of remnant vegetation to less than 200 metres; and d) occur where the width of remnant remnant vegetation is less than 200 metres; and e) reduce the total extent of remnant vegetation to less than 30%; and f) occur where the total extent of remnant vegetation is less than 30%.	Following certification of the revised RE mapping, the Concept Masterplan will be revised to ensure that it complies with the acceptable solutions, or that acceptable alternative solutions are achieved to meet the performance requirements.
PR S.5: Soil erosion To regulate the clearing of vegetation in a way that does not cause land degradation and maintains ecological processes – the effect of clearing does not result in – a) mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion or scalding; and b) any associated loss of chemical, physical or biological fertility – including, but not limited to water holding capacity, soil structure, organic matter, soil biology, and nutrients	**AS S.5** S.5.1 Mechanical clearing only occurs on – a) stable soils on a slope less than 30%; and b) unstable soils on a slope less than 10%; and c) very unstable soils on a slope less than 1%.	Geotechnical and soils studies will guide the infrastructure plan, which will address the performance requirement. An approved Erosion and Sedimentation Control Plan will be prepared and implemented to protect soil characteristics and downstream ecological processes.

within and/or outside the lot(s) that are the subject of the application.		
PR S.6: Salinity To regulate the clearing of vegetation in a way that does not cause land degradation and maintains ecological processes – clearing does not contribute to – a) waterlogging; or b) the salinisation of groundwater, surface water or soil.	**AS S.6** S.6.1 Where clearing is less than – a) 2 hectares; or b) 10 metres wide; Clearing does not occur in any discharge area. OR S.6.2 Where clearing is less than a) 5 hectares; or b) 50 metres wide – Clearing does not occur – i) in any discharge area; and ii) within 200 metres of any discharge area.	The area proposed for clearing does not occur within a discharge area, or within 200 metres of a discharge area.
PR S.7: Conserving remnant *endangered* regional ecosystems and *of concern* regional ecosystems To regulate the clearing of vegetation in a way that conserves remnant endangered regional ecosystems and remnant of concern regional ecosystems – maintain the current extent of *endangered* regional ecosystems and *of concern* regional ecosystems.	**AS S.7** Clearing only occurs in *endangered* regional ecosystems or *of concern* regional ecosystems that are not listed in Table 2 and where the clearing within those regional ecosystems is less than – a) 10 metres wide; or b) 0.5 hectares.	The certified RE mapping (NRW 2005) shows the *of concern* RE subject to a proposal for clearing of an area greater than 10 metres wide as RE 7.11.25. The revised RE mapping (3D Environmental 2006a) shows the *of concern* RE subject to a proposal for clearing as 7.11.8b. Both REs are listed in Table 2. While taking into account the performance requirement in the Infrastructure Plan as far as possible, the proponent intends to negotiate an alternative solution to allow the proposed clearing.
PR S.8: Essential Habitat To regulate the clearing of vegetation in a way that prevents the loss of biodiversity – maintain the current extent of essential habitat.	**AS S.8** S.8.1 Clearing does not occur in an area shown as essential habitat on the essential habitat map.	The areas proposed for clearing are mapped under the VMA as essential habitat for the Southern Cassowary (*Casuarius casuarius johnsonii*). While taking into account the performance requirement in the

		Infrastructure Plan as far as possible, the proponent intends to negotiate an alternative solution to allow the proposed clearing.
PR S.9: Conservation Status Thresholds To regulate the clearing of vegetation in a way that prevents the loss of biodiversity and conserves remnant regional ecosystems – maintain the current extent of regional ecosystems listed in Table 3.	**AS S.9** S.9.1 Clearing in a regional ecosystem listed in Table 3, does not occur unless the clearing is less than – a) 10 metres wide; or b) 2 hectares.	The vegetation proposed for clearing areas greater than 10m wide are not listed in Table 3.
PR S.10: Acid sulfate soils To regulate the clearing of vegetation in a way that does not cause land degradation and maintains ecological processes – clearing activities do not result in disturbance of acid sulphate soils or changes to the hydrology of the location that will either – a) aerate horizons containing iron sulfides; or b) mobilise acid and/or metals.	**AS S.10** S.10.1 Clearing in land zone 1, land zone 3 or land zone 3 in areas below 5 metres Australian Height Datum – a) is carried out in accordance with an acid sulphate soils environmental management plan as outlined in the State Planning Policy 2/02 Guideline: Planning and Managing Development involving Acid Sulfate Soils; and b) follows management principles in accordance with the Soil Management Guidelines in the Queensland Acid Sulphate Soil Technical Manual.	The area proposed for clearing for residential development in the south-east is not within land zones 1, 2 or 3. The areas proposed for clearing for road and pedestrian access on the eastern edge of the site are within landzones 2 and 3. The Acceptable Solutions as recommended will be applied to construction.