Gladstone LNG Plant and Pipeline
Curtis Island

Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations

Report prepared for URS Australia

Biodiversity Assessment AND MANAGEMENT PTY LTD

FAUNA AND HABITAT SPECIALISTS

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Biodiversity Assessment and Management Pty Ltd

Managing Director

Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations

Gladstone LNG Plant and Pipeline, Curtis Island

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List of Abbreviations

BAAM	-	Biodiversity Assessment and Management Pty Ltd
BPA	-	Biodiversity Planning Assessment
DEWHA	-	Commonwealth Department of Environment, Water, Heritage and the Arts
DPIF	-	Queensland Department of Primary Industries and Fisheries
EPA	-	Queensland Environmental Protection Agency
EPBC Act	-	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EVR	-	Endangered, Vulnerable or Rare
IPA		Queensland *Integrated Planning Act 1997*
LP Act	-	Queensland *Lands Protection (Pest and Stock Route Management) Act 2002*
NC Act	-	Queensland *Nature Conservation Act 1992*
NRW	-	Queensland Department of Natural Resources and Water
RE	-	Regional Ecosystem
SEQ	-	South-east Queensland
VM Act	-	Queensland *Vegetation Management Act 1999*

1.0 INTRODUCTION

This report has been prepared for URS Australia for the purpose of providing an independent, targeted assessment of the potential occurrence of, and habitat values for, Powerful Owl *Ninox strenua*, Water Mouse *Xeromys myoides* and migratory wading birds of properties located on the south-west portion of Curtis Island.

It is understood that the assessment is to focus on all suitable coastal habitats within the study area for Water Mouse and wading birds, while assessment of Powerful Owl habitat values will focus on the area of the proposed construction of a 100 m pipeline easement.

The specific aims of the assessments are to provide:

- An evaluation and comment on the presence or absence of Water Mouse, Powerful Owl and migratory wader species within the study area and the implications of such for the proposed development;
- An assessment and comment on significant terrestrial faunal habitats suitable for Water Mouse, Powerful Owl and wading bird species within the study area and the implications of such for the proposed development; and
- Identification of potential impacts on Water Mouse, Powerful Owl and wading bird species and associated habitat, and recommendations for impact mitigation and management, including the need for further, more detailed assessments.

Nomenclature used in this report follows Clayton *et al.* (2006).

All following observations and recommendations are based on a review of available literature and site investigations undertaken by Adrian Caneris and Brett Taylor on 15 to 17 December 2008 (inclusive).

2.0 STUDY AREA DESCRIPTION

2.1 LOCATION

The study area is situated on Curtis Island, located adjacent to the coast 5 km to the north of Gladstone. The study area is centred on the south-western portion of the island (**Figure 2.1**) and comprises approximately 14 km^2 of freehold land contained in Lots 11DS220, 27DS220, 10DS220, 28DS220, 7DS220 (Mark J. Graving, Ross W. Graving and Colin G. Graving); 9DS220 (Santos P/L); 2RP602284 (Central Queensland Ports Authority); and 1RP602284 (Kemsip P/L).

2.2 LAND USE AND TERRESTRIAL FEATURES

The vegetation in the study area is dominated by older regrowth, having been cleared in the past. Open eucalypt forest dominates the study area with marine plains and mangrove communities along much of the shoreline. The site is situated on undulating land rising from sea level to a maximum of approximately 140 m elevation in the eastern extent of the study area. A number of ephemeral creeks/gullies drain the site, generally flowing west. The few man-made structures on the site are restricted to grazing infrastructure. The study area is bordered to the north by Graham Creek, a wide estuarine creek, and to the east by a low range. The south-west shoreline of the island borders the remainder of the study area.

Current landuse in the study area is restricted to low intensity cattle grazing. Much of the island north of Graham Creek is contained in conservation reserves. The Garden Island Conservation Park lies east of the southern tip of the study area. The closest settlement is South End, located on the south-east tip of the island.

2.3 PROPOSED ACTIVITIES

The proposed activities will involve the construction of a Liquefied Natural Gas (LNG) plant on the southern portion of the study area. A gas pipeline and road including a 100 m cleared corridor will extend approximately 8.2 km from Laird Point in the north-west to the site of the LNG plant in the south of the study area.

Base map courtesy of URS

Biodiversity Assessment AND MANAGEMENT PTY LTD

FIGURE 2.1

STUDY AREA LOCATION

Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations
Gladstone LNG Project

3.0 ECOLOGICAL PLANNING FRAMEWORK

The primary ecological planning framework for the study area incorporates legislation at the Commonwealth and State levels. In addition, planning for this area should have regard for the intent of regional and local statutory planning instruments.

3.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects the environment, particularly matters of National Environmental Significance (Protected Matters). It streamlines national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places.

The EPBC Act, administered by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA), is designed to provide for the conservation of biodiversity through the protection of threatened species and ecological communities, migratory, marine and other protected species listed under the Act.

In planning for the study area, there may be a requirement for a referral to DEWHA in accordance with the EPBC Act Policy Statement 1.1: Significant Impact Guidelines, Matters of National Environmental Significance (DEH 2006) for assessment against the EPBC Act. A requirement for Commonwealth referral in relation to terrestrial vertebrates will be dependant on the species of conservation significance and their associated habitats that are recorded in the study area, and the likelihood of those species and habitats being significantly impacted by the project.

3.2 QUEENSLAND NATURE CONSERVATION ACT 1992

Planning for the study area must address the guidelines and provisions of Queensland's *Nature Conservation Act 1992* (NC Act). The NC Act is the principal legislation for the conservation and management of the State's native flora and fauna and is administered by the Queensland Environmental Protection Agency (EPA). The key goal of the NC Act is the preservation of Endangered, Vulnerable and Rare (EVR) species of flora and fauna as listed under the *Nature Conservation (Wildlife) Regulation 1994*.

The NC Act (Section 68) states that:

> 'Protected wildlife is to be managed to—
>
> (a) conserve the wildlife and its values and, in particular to—
>
> (i) ensure the survival and natural development of the wildlife in the wild; and
>
> (ii) conserve the biological diversity of the wildlife to the greatest possible extent; and
>
> (iii) identify, and reduce or remove, the effects of threatening processes relating to the wildlife; and
>
> (iv) identify the wildlife's critical habitat and conserve it to the greatest possible extent; and …'.

Protected wildlife is linked to the Queensland *Vegetation Management Act 1999* through the mapping of Remnant Vegetation and associated Essential Habitat contained therein.

3.3 QUEENSLAND VEGETATION MANAGEMENT ACT 1999

The purpose of the *Vegetation Management Act 1999* (VM Act) is to regulate the clearing of native vegetation (i.e. Remnant Vegetation mapped as Regional Ecosystems (REs) that are: Endangered, Of Concern and Not of Concern) to maintain ecological processes, ensure there is no loss of biodiversity or increase in land degradation from vegetation clearing and manage the effects of clearing. In addition, some areas of remnant vegetation are further classified as Essential Habitat under the VM Act with specific reference to conservation significant species listed under the NC Act.

The VM Act is administered by the Queensland Department of Natural Resources and Water (NRW) certified mapping of Remnant Vegetation and Essential Habitat. Clearing of native vegetation mapped as REs and/or Essential Habitat is subject to assessment by the NRW against the Regional

Vegetation Management Code for Coastal Bioregions (NRW 2006).

3.4 QUEENSLAND LANDS PROTECTION (PEST AND STOCK ROUTE MANAGEMENT) ACT 2002

The main purpose of the *Lands Protection (Pest and Stock Route Management) Act 2002* (LP Act) legislation is to provide pest management for agricultural lands. The LP Act lists several species of flora and fauna that are considered Class 1, 2 or 3 pests under the Act.

In addition, there may be environmental weeds that are not listed under the LP Act may be present within the study area.

Future planning in the study area should incorporate appropriate weed and pest management.

3.5 QUEENSLAND COASTAL PROTECTION AND MANAGEMENT ACT 1995

The main objective of the State Coastal Management Plan as required under the Queensland *Coastal Protection and Management Act 1995* is to provide for coastal management policy direction and define how these directions should be implemented by government, industry and the community. The State Coastal Plan has the effect of a State planning policy under the Queensland *Integrated Planning Act 1997* (IPA) and is therefore a matter of State interest.

The State Coastal Plan is one of the matters that are coordinated and integrated into new planning schemes during their preparation, with regard to and for impact assessment applications, and considered in Ministerial community infrastructure designations.

In areas where a regional coastal management plan has not yet been prepared, erosion prone areas previously designated under the now repealed *Beach Protection Act 1968* are taken to be the default coastal management districts.

The erosion prone area is the width of the coast that is considered to be vulnerable to coastal erosion and tidal inundation over a 50-year planning period. Where no regional coastal management plan has been prepared, an area within a designated Erosion Prone Area is taken to be a coastal management district under Section 168 of the Coastal Act. Calculation of the erosion prone area is based on:

- a short-term erosion component from extreme storm events;
- a long-term erosion component where gradual erosion is occurring;
- a shoreline recession component due to sea level rise associated with climate change; and
- a dune scarp component, where slumping of the scarp face occurs following erosion.

3.6 QUEENSLAND FISHERIES ACT 1994

The Queensland *Fisheries Act 1994* states that its main purpose is to 'provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats …' in an ecologically sustainable manner.

Future planning for the study area must have regard for the presence of marine plants in terrestrial environments. There is a requirement for a permit from the Department of Primary Industries and Fisheries' Queensland Fisheries Service (QFS) prior to any disturbance to or removal of marine plants.

The *Fisheries Act 1994* (Section 8) defines marine plants as:

(1) Marine plant includes the following—

  (a) a plant (a tidal plant) that usually grows on, or adjacent to, tidal land, whether it is living, dead, standing or fallen;

  (b) material of a tidal plant, or other plant material on tidal land;

  (c) a plant, or material of a plant, prescribed under a regulation or management plan to be a marine plant.

(2) Marine plant does not include a plant that is a declared pest under the *Land Protection (Pest and Stock Route Management) Act 2002.*

QFS policy requires that works or activities associated with applications for marine plant permits or development approvals have zero or minimal adverse impact on marine plants or fish habitats. All such works or activities are assessed against criteria that aim to meet the objective of protection and enhancement of fish habitats, including marine plants. Unavoidable permitted impacts will require compensation.

3.7 BIODIVERSITY PLANNING ASSESSMENT

The EPA has prepared Biodiversity Planning Assessments (BPAs) for a number of Queensland Bioregions (as defined under the VM Act) in order to provide broadscale ecological data to advise a range of planning and decision-making processes.

The BPAs are based on the Biodiversity Assessment and Mapping Methodology (EPA 2002) using vegetation mapping data generated by the Queensland Herbarium. The methodology identifies areas with various levels of significance for biodiversity reasons, such as threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetland or other types of habitat important for the maintenance of biodiversity or ecological processes.

The BAMM assigns three levels of Biodiversity Significance:

State Significance – Areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales;

Regional Significance – Areas assessed as being significant for biodiversity at the sub-bioregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance; and

Local Significance and Other Values – Areas assessed as not being significant for biodiversity at State or Regional scales. Local values are of significance at the local government scale.

The methodology uses seven diagnostic criteria: Habitat for EVR taxa; Ecosystem value; Tract size; Relative size of Regional Ecosystem; Condition; Ecosystem diversity; and Context and connection, utilizing Queensland Herbarium RE mapping and buffered EVR flora and fauna records. Three supplementary criteria refine the mapped information by incorporating local knowledge and expert opinion. These are: Essential and general habitat for priority taxa; Special biodiversity values; and Corridors. Expert Panel Reports are compiled to document the decision-making process for assessing the supplementary criteria.

4.0 STUDY METHODOLOGY

4.1 DESK TOP

Prior to the field survey, public databases were searched in order to provide background information regarding the terrestrial vertebrate fauna known from the region and local area. Where deemed necessary, expert opinion was consulted regarding the target species involved.

Information gained from this phase of the study was used to:

- Ensure that survey methods were designed to detect the target species of significance known from the study area; and
- Determine the likelihood of the target species occurring if suitable habitat was located within the study area. Those species known from recent, nearby records are considered more likely to occur if suitable habitat is located.

4.2 FIELD SURVEY

4.2.1 Survey Effort and Site Selection

The field program involved a site investigation conducted over two days and two nights in order to assess the extent and quality of wildlife habitat and to determine the presence, or likely presence, of the target at-risk species known from, or predicted to occur, within the local area. This was undertaken in accordance with the EPA's Queensland Parks and Wildlife Service's Scientific Purposes Permit No. WISP02791605 and Queensland Department of Primary Industries and

Fisheries' (DPIF) Animal Ethics Committee Certification No. CA 2005/10/81.

The general survey approach was to visit and sample representative faunal habitats over the study area, recording the target fauna species by observations of actual animals, recognition of characteristic vocalisations, and/or identification of animal signs. Where no animal observations/signs were recorded, habitat was assessed for suitability of the target species occurrence. This involved the following specific techniques:

4.2.2 Survey Techniques

Diurnal Habitat Searches and Assessment

Active diurnal searches for traces of Water Mouse activity (nesting mounds and feeding areas) were undertaken in suitable habitat (mangroves with adjacent saltmarsh). In addition, wading birds were recorded in the area throughout the study period.

Searches of suitable habitat were conducted for traces of Powerful Owl activity (owl pellets) and suitable tree hollows for roosting.

Nocturnal Surveys

A combination of high-powered spotlights and head torches was used to search for Powerful Owl individuals as well as nocturnal mammals, an important prey item for the species.

During the spotlighting sessions, searches for Powerful Owl were assisted by the use of call playback.

Incidental (Opportunistic) Records

During the survey period, fauna observations were continuous and species records were obtained outside of the systematic methodology of the survey. All of the incidental vertebrate fauna species observed during the field survey are listed in **Appendix 1**.

5.0 RESULTS AND RECOMMENDATIONS

5.1 ESSENTIAL HABITAT MAPPING

The 'essential habitat' associated with RE mapping under the VM Act is shown in **Appendix 2**. Essential habitat, as mapped by the EPA, is vegetation in which a species has been known to occur, or is predicted to occur, that is Endangered, Vulnerable, Rare or threatened under the NC Act. The essential habitat mapped for the study area is for two species: Beach Stone-curlew *Esacus magnirostris* and Koala *Phascolarctos cinereus*.

Beach Stone-curlew

Under the VM Act, essential habitat for the Beach Stone-curlew (listed as Vulnerable) is described as:

> "All types of undisturbed beaches and littoral habitat, both surf and sheltered exposure on mainland and islands, especially near river mouths and mangrove-backed areas. Nest at back of beach/sandbank (occasionally among sparse grass or shingle with plant debris) or on coral ridge above high tide mark, often near creek or estuary"

Essential habitat for Beach Stone-curlew has been mapped under the VM Act in remnant habitat outside of the study area, in shoreline habitat along the south-eastern coastline. The essential habitat includes all REs along ecotones with beaches. Although the essential habitat mapping is based on a single record, it is likely the species would be found in suitable habitat along all coastal sections of the study area.

The Beach Stone-curlew generally occurs singularly or in pairs, and occasionally in small groups. The species inhabits sandy beaches, especially where sandflats, mudflats or reefs are exposed at low tide. Adult birds appear to be sedentary.

It should be noted that two adult birds were observed foraging along the coastline at South End during the field survey (**Section 5.2.3**).

Koala

Under the VM Act essential habitat for the Koala (listed as Vulnerable within the SEQ bioregion) is described as:

> "Open (structurally complex with mixture young/mature/old growth, especially 30-80 cm dbh), mixed (rich in number and species diversity of food trees) eucalypt forest and woodland at lower altitude in undulating country on relatively deep and usually high nutrient soil (main species - *Eucalyptus tereticornis, E. fibrosa, E. propinqua; E. umbra, E. grandis, E. microcorys, E. tindaliae, E. resinifera, E. populnea; E. robusta, E. nigra, E. signata*)."

Patches of essential habitat for Koala have been mapped under the VM Act throughout the northern and central portions of the study area. REs classified as essential habitat in the study area include: RE12.3.3; RE12.3.7; and RE12.3.11. There is no WildNet database record of this species in the study area or surrounds.

5.2 TARGET SPECIES

In general, there is little literature based in the region encompassing the study area and surrounds regarding the target species. The following sections on each target species present a summary of information obtained from a desktop review of available information, followed by the results of the field investigation and subsequent recommendations for further detailed assessment and mitigating potential impacts.

5.2.1 Water Mouse *Xeromys myoides*

General Profile

Status: NC Act Vulnerable; EPBC Act Vulnerable.

Historical occurrence within the study area: There is no database record for this species on the study area or surrounding area.

Ecology and Habitat: The Water Mouse (or False Water Rat) is a nocturnal, terrestrial carnivore and is one of Australia's most poorly known rodents. They require relatively large areas of intertidal flats over which to forage, together with suitable adjacent areas for nest sites. Home ranges of around 0.7 ha have been recorded and individuals are known to cover distances of up to 2.9 km within these areas. Food for this species primarily consists of marine crustaceans, bivalves and other invertebrates. Small amounts of plant material have been found in their stomachs, though this is thought to have originated from their ingested prey (Van Dyck 1996; Gynther and Janetzki 2008).

The species builds termitarium-like mounds up to 60 cm high and digs tunnels. The nests, regardless of type or structure, primarily serve as diurnal refuges and reproductive sites. Nests often occupy naturally elevated ground and utilise the bases of fallen trees or logs for support of the nest structure (Van Dyck 1996; Gynther and Janetzki 2008).

Distribution and Breeding: The Water Mouse is patchily distributed in the Northern Territory, and from the Gold Coast to Proserpine in Queensland (Menkhorst and Knight 2004).

Generally, there is only one sexually active male present in a nest and nests may be used by successive generations over a number of years. Once constructed, nests are continuously added to, with the larger mounds or nests having potential to provide significant historical information about populations and habitats over time (Van Dyck 1996).

Threats: The species is threatened by swamp and mangrove reclamation, feral predators, changes to water tables, and offshore pollution (Gynther and Janetzki 2008).

Field Survey Results

A total of 12 sites were assessed within the study area for Water Mouse suitability. A search of each site was conducted to look for signs of Water Mouse activity (nesting mounds, feeding middens) and general habitat suitability. The locations of habitat assessment sites are shown on **Figure 5.1**. GPS locations for each site and site habitat assessment results and recommendations for further assessment are listed in **Table 5.1**.

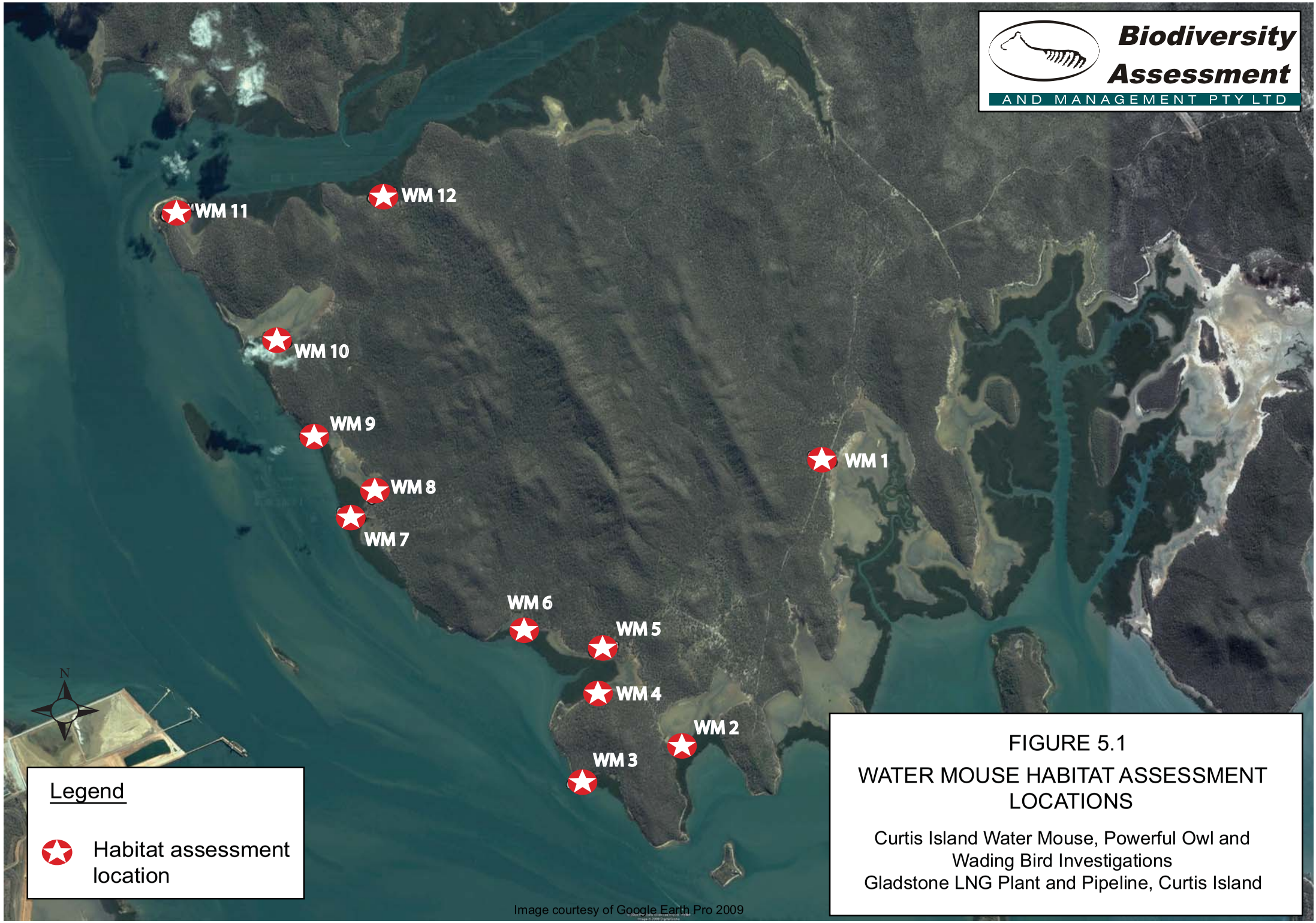

FIGURE 5.1

WATER MOUSE HABITAT ASSESSMENT LOCATIONS

Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations
Gladstone LNG Plant and Pipeline, Curtis Island

Table 5.1 Water Mouse Habitat Assessment Site Results

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM1	23.766015 S 151.239388 E	This site lies outside of the study area, although close to the current access road. Habitat is generally poor for Water Mouse at this location.	
WM2	23.790056 S 151.224626 E	There are good habitat values for Water Mouse within the mangrove community in this area. Suitable and abundant food resources (crustaceans) were observed during habitat assessment. Transitional areas along the mangrove edge are considered less suitable, with much evidence of feral animal disturbance (pig, horse, dog/fox) noted.	 
WM3	23.793449 S 151.215634 E	This area is a small bay that is comparatively exposed. The coarse substrate here is generally less suitable for Water Mouse nesting and foraging (low occurrence of crustaceans). Habitat values are generally low and it is considered unlikely that Water Mouse occurs in this area.	

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM4	23.785429 S 151.216038 E	This area has been subject to high levels of disturbance with abundant rubbish and feral animal disturbance. There are moderate habitat values for Water Mouse within the mangrove area.	
		An access track has disturbed the key transitional zone (marine couch/mangrove interface).	
WM5	23.782492 S 151.215740 E	Habitat less disturbed than WM4. Food resources outside of mangrove area are generally low. Moderate habitat values for Water Mouse within mangroves.	
		Two Eastern Curlews *Numenius madagascariensis* observed foraging in mudflat area.	

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM6	23.780124 S 151.209032 E	Habitat in transitional zone (marine couch/mangrove flat interface) has been recently disturbed by vehicles using access track. Low-moderate habitat values for Water Mouse in mangrove area, but low values outside.	
WM7	23.770879 S 151.192943 E	Largely undisturbed transition zone between mangrove and marine couch habitat. Excellent habitat values for Water Mouse.	
WM8	23.769301 S 151.193960 E	Adjacent to previous assessment site. Access track along marine couch area not affecting mangrove area at this stage. Excellent habitat values for Water Mouse. What may be a disused Water Mouse nest site was observed.	 

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM9	23.763815 S 151.189256 E	Mangrove area provides moderate values for Water Mouse.	
		Evidence of pig presence/damage on edges of mangroves. Coarse substrate in area adjacent to mangroves less suitable for Water Mouse.	
WM10	23.755714 S 151.185700 E	Wide claypan/mudflat area behind mangrove habitat. Food resources generally less abundant than in other areas. Generally low habitat values for Water Mouse at this location.	
		Wading birds including Eastern Reef Egret *Egretta sacra* observed foraging in area.	

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM11	23.744946 S 151.173784 E	Mangrove habitat at Laird Point in the north-western extent of study area. Mangroves along western edge of Laird Point restricted to thin strip adjacent to coastline with low habitat values for Water Mouse. Mangrove/marine couch transition zone east of Laird Point subject to some disturbance adjacent to existing access road. Moderate habitat values for Water Mouse in mangroves. Eastern Curlew and Whimbrel *Numenius phaeopus* observed foraging on sand flats at Point.	
WM12	23.743176S 151.193913E	Large areas of mangrove habitat. Abundant food resources observed during survey. Moderate habitat values for Water Mouse in mangroves.	

No distinctive signs of current Water Mouse activity were observed during the December 2008 survey. However, given the brief nature of the survey and the large size of the study area, the results are not considered conclusive. Portions of the marine habitats of the study area hold relatively large tracts of potential habitat and would provide suitable foraging resources.

No known targeted trapping surveys for Water Mouse have been conducted on Curtis Island or the adjacent mainland (Van Dyck, pers comm.). Water Mouse has been detected to the south of the study area on the Fraser Coast (Van Dyck, pers comm.) and targeted surveys have detected the species in North Queensland between Proserpine and Cape Palmerston (Ball 2004). Water Mouse captured near Proserpine were often in very similar habitat to that found in the study area and population densities were found to be low compared to populations further south. Ball (2004) states it is 'highly likely' the species range will be extended from its' known distribution with further targeted surveys.

Recommendations

It is recommended that intensive targeted trapping surveys be conducted to confirm the presence/absence of Water Mouse within suitable habitats proposed for disturbance by the project (**Table 5.1**).

A minimum survey effort should be 300 trap nights / site (i.e. 100 Elliott traps X 3 nights or 150 Elliott traps X 2 nights). Two nights is a minimum survey effort. The trapping should be conducted so as to coincide with tidal events where high tide is in later part of the afternoon to allow for extended trapping time during nocturnal period, prior to incoming tide requiring trap removal from site for animal ethics reasons.

It is also recommended that the project managers seek to ensure feral species

management planning and active control within any habitats found to support Water Mouse.

5.2.2 Powerful Owl *Ninox strenua*

General Profile

Status: NC Act Vulnerable.

Historical occurrence within the study area: There is one WildNet database record of this species from the general area, however this search was based on a 15 km radius centred on the study area and is therefore likely to have been from the mainland. A further seven records were shown with a wider search radius of 25 km. One individual Powerful Owl was observed in the study area by a URS Australia employee during a May 2008 fauna survey (GPS coordinates: 23.760062 S; 151.208312 E).

Ecology and Habitat: Pairs of Powerful Owls occupy large, probably permanent, home ranges of about 1,000 ha (Higgins 1999; Garnett and Crowley 2000), although in Victoria ranges larger than 4000 ha have been recorded (Soderquist and Gibbons 2007). Their principle prey is medium-sized mammals, particularly possums and gliders, which often represent more than 50% of their diet, but which also includes other birds, flying-foxes, rats and insects (Webster *et al.* 1999; Higgins 1999).

Adult birds roost in a variety of tree species, including exotics. Commonly, the roost tree has thick vegetation in which the owl can escape from the mobbing activities of smaller avian species. During breeding, adults usually roost in close proximity to the nest tree (Webster *et al.* 1999). The species occurs in mountain rainforests, gullies and forest margins, sparser hilly woodlands, coastal forests, woodlands, scrubs, exotic pine plantations and large trees in private/public gardens (Pizzey and Knight 2003). Powerful Owls are most likely observed at sites with mature dry forest, many live hollow-bearing trees, diverse habitats within 2 km, and not much pure regrowth within 5 km (Loyn *et al.* 2001).

Distribution and Breeding: This species is found in south-eastern Australia from Victoria north to Eungella, Queensland, and it is most common on the eastern slopes of the Great Dividing Range (Garnett and Crowley 2000).

Powerful Owls breed once per year from May to August. Nests are located in large tree hollows, usually at a considerable height above the ground (10-40 m) (Beruldsen 2003). Consequently, the presence of large hollow-bearing trees is important for breeding as well as smaller hollows for the persistence of its prey species.

Threats: Widespread clearing of Powerful Owl habitat has reduced the amount of available habitat by almost half. However the species is still persistent and stable in remaining habitats (Garnett and Crowley 2000). Forestry practices have the potential to impact this species through the removal of hollow bearing trees that provide suitable nesting locations or shelter for prey species. However, most logging on mainland Australia now occurs in a mosaic pattern consisting of logged and unlogged areas, and studies have suggested that the Powerful Owl can persist in such mosaics by nesting in unlogged areas and foraging in logged or regrowth areas (Kavanagh *et al.* 1995).

Field Survey Results

No Powerful Owl was detected during the December field survey, however given the brevity of the survey it cannot be concluded that the species does not occur in the study area. During two nights of spotlighting and call playback, only Southern Boobook *Ninox boobook* was recorded, the species being common across the study area. No arboreal mammals were detected (important prey for Powerful Owls).

As much of the study area has undergone logging in the past, particularly in the east and south, eucalypts of a suitable age with large hollows were not abundant. Larger trees with hollows capable of supporting nesting Powerful Owls and arboreal mammals were sparsely scattered throughout the eastern and southern sections of the study area. In the north-east and western edge of the study area larger hollow-bearing trees were more abundant. However, the brevity of this survey did not allow for a detailed assessment of this area, particularly the western portion of the study area that follows a low ridgeline and is relatively inaccessible.

Overall, habitat in the study area is considered to be marginal for the Powerful Owl. There is generally a lack of suitably sized hollow-bearing trees for nesting purposes or prey species (arboreal mammals). There are no records of arboreal mammal species from a WildNet database search for the area, although glider species were recorded by URS Australia employees during a May 2008 fauna survey. The study area may be used seasonally, or occasioned by individual Powerful Owls normally residing on the mainland, but the species is unlikely to be a permanent resident within the study area.

Recommendations

It is understood that much of the area considered by this survey to be more suitable for the species (i.e. the central, western and north-eastern sections of the study area) will be retained outside of the proposed works. The path of the proposed pipeline and road is likely to require the removal of some large trees suitable for Powerful Owl and its prey.

In order to minimise impacts on the Powerful Owl it is recommended:

- Wherever possible, the proposed width of the pipeline/road corridor should be minimised to reduce the amount of vegetation to be cleared.
- Wherever possible, the path of the pipeline/road corridor should be adjusted to avoid areas containing large hollow-bearing trees.
- In areas where large hollow-bearing trees cannot be avoided, suitable nest boxes should be deployed for both Powerful Owls and arboreal mammals to offset habitat loss.
- If any vegetation clearance is to be undertaken during the species' breeding season (May to August), those habitats should be thoroughly checked one day prior to the works through active searching in daytime hours and spotlighting and call playback during the evening prior. If breeding is identified within an area to be disturbed, this should be postponed until the young have left the nesting hollow.
- Wherever vegetation removal is required, all large trees should be checked for the presence of owls by registered fauna spotters.

Overall, there is only an extremely low likelihood of any direct impact and only low potential for secondary impacts (i.e. reduction in prey, loss of nest hollows) as a result of the project.

5.2.3 Wader and Shorebird Species

All wader and shorebird species recorded within or nearby the study area are included in this report, although a greater number of species would be likely to be recorded in a more extensive survey.

A total of 22 wader and shorebird species were identified within or near the study area during the December 2008 survey (**Table 5.2**). Eleven of these species are considered as Migratory species under the EPBC Act and three species are considered to be EVR under state legislation.

EVR species

Beach Stone-curlew *Esacus magnirostris*

Status: NC Act Vulnerable

The Beach Stone-curlew generally occurs singly or in pairs, and occasionally in small groups. The species inhabits sandy beaches, especially where sandflats, mudflats or reefs are exposed at low tide. Adult birds appear to be sedentary. The species feeds predominately on crabs and other marine invertebrates in the intertidal zone (Marchant and Higgins 1993).

A pair of Beach Stone-curlews was observed foraging along the beach near South End, approximately 10 km east of the study area. Essential habitat for this species has been mapped adjacent to the south-eastern boundary of the study area (EPA 2003). The species mainly shelters in beach scrub, but is likely to utilise much of the shoreline habitat periodically for foraging. It is considered unlikely the proposed works will significantly impact local populations in the study area given the area of suitable habitat.

However, a greater understanding of the species' utilisation of the island habitats and the location of breeding sites is required to fully assess actual and/or potential impacts on this species.

Table 5.2. Wader and shorebird species observed in or near the study area

Scientific Name	Common Name	NC Act Status	EPBC Act Status
Butorides striata	Striated Heron	Least Concern	
Egretta intermedia	Intermediate Egret	Least Concern	
Egretta sacra	Eastern Reef Egret	Special Least Concern	Migratory
Pelecanus conspicillatus	Australian Pelican	Least Concern	
Phalacrocorax melanoleucos	Little Pied Cormorant	Least Concern	
Phalacrocorax varius	Pied Cormorant	Least Concern	
Pandion haliaetus	Osprey	Special Least Concern	Migratory
Esacus magnirostris	Beach Stone-curlew	Vulnerable	
Haematopus longirostris	Pied Oystercatcher	Least Concern	
Haematopus fuliginosus	Sooty Oystercatcher	Rare	
Vanellus miles	Masked Lapwing	Least Concern	
Charadrius ruficapillus	Red-capped Plover	Least Concern	
Numenius phaeopus	Whimbrel	Special Least Concern	Migratory
Numenius madagascariensis	Eastern Curlew	Rare	Migratory
Tringa nebularia	Common Greenshank	Special Least Concern	Migratory
Xenus cinereus	Terek Sandpiper	Special Least Concern	Migratory
Actitis hypoleucos	Common Sandpiper	Special Least Concern	Migratory
Heteroscelus brevipes	Grey-tailed Tattler	Special Least Concern	Migratory
Calidris ruficollis	Red-necked Stint	Special Least Concern	Migratory
Larus novaehollandiae	Silver Gull	Least Concern	
Sterna bergii	Crested Tern	Special Least Concern	Migratory
Sterna hirundo	Common Tern	Special Least Concern	Migratory

Sooty Oystercatcher *Haematopus fuliginosus*

Status: NC Act Rare

This species is restricted to marine shoreline habitats, with a preference for rocky substrates, coral reefs, headlands and sandy beaches near intertidal mudflats and rocky areas (Marchant and Higgins 1993).

One individual was observed on a rocky islet near South End 10 km east of the study area. Sooty Oystercatcher generally prefers to forage on rocky substrates, but will occasion sand flats/salt pans. The habitats within the study area hold generally low value and potential and it is considered unlikely any significant detrimental impacts would result from proposed actions.

Eastern Curlew *Numenius madagascariensis*

Status: NC Act Rare; EPBC Act Migratory

Eastern Curlews occur on sheltered coasts, and are often recorded in saltmarsh and on mudflats within mangroves. They mainly forage on intertidal mudflats and sandflats, and roost on sandy spits and islets, in mangroves and saltmarsh, and along the high water mark on beaches (Higgins and Davies 1996).

The Eastern Curlew breeds in eastern Siberia during the northern hemisphere summer. Adults vacate breeding areas around June and migrate through Asia on their way to Australia and New Zealand, mostly arriving in eastern Australia by late August and September. The Australian Eastern Curlew population is

estimated at 19,000 and numbers have fallen significantly in some southern areas.

During the December 2008 survey this species was commonly observed at low tide on sandflats/mudflats at South End, 10 km east of the study area. Within the study area a pair of Eastern Curlews were observed foraging at WM5 (**Figure 5.1**) and another pair were observed on sandflats at Laird Point. The species is likely to periodically utilise much of the shoreline habitat, and nearby mudflats within the study area, during low tide periods. Impacts on populations of this species from the proposed works are considered to be minor and are restricted to reduction of foraging and possible roosting habitat within the study area. The preferred foraging habitat in the local area appeared to be low-tide marine plains adjacent to South End.

Other wader/shorebird species

Migratory species (EPBC Act)

Whimbrel and Eastern Reef Egret are species found in a variety of coastal habitats including tidal flats, estuaries and mangroves. Whimbrel was relatively common throughout the study area and was observed or heard calling in some of the mangrove sites during the Water Mouse survey and was observed foraging at Laird Point. An Eastern Reef Egret was observed foraging at Water Mouse survey site WM10. Impacts on populations of these species from the proposed works are considered to be minor and are restricted to reduction of foraging and roosting habitat within the study area.

Terek Sandpiper and Grey-tailed Tattler are known to forage on tidal mudflats, estuaries and mangroves. Both species were observed foraging on beach habitat near South End. Impacts on populations of either species from the proposed works are considered to be minor and are restricted to a reduction of foraging habitat within the study area.

Common Greenshank, Common Sandpiper and Red-necked Stint are listed as Migratory species. These are common species and all may be found in a variety of saline and freshwater habitats. These species are unlikely to be significantly impacted by the proposed works. Common Tern, Crested Tern and Osprey are wide-ranging species that are unlikely to be significantly impacted by the proposed works.

The remaining wader/shorebird species are not listed under legislation. Striated Heron and Pied Oystercatcher are essentially coastal species that will forage in a variety of habitats. The remaining species are all common and may be found in a variety of saline and freshwater habitats. None of these species are likely to be significantly impacted by the proposed works.

Recommendations

Wader/shorebird species were observed in relatively low numbers within the study area. Habitat values appeared to be low for many species due to low foraging potential. There is abundant existing habitat elsewhere on Curtis Island and surrounds. The majority of the observed waders, both in terms of species and number of individuals, were recorded foraging on more suitable habitat (sand/mudflats) 10 km to the east of the study area at South End. As such, recommendations are as follows:

- a more detailed study be conducted to ascertain the use of the study area by wader species, particularly in regards to use of the area for roosting at high tide;
- the proposed works should at all times minimise disturbance to the foreshore/intertidal zone within the study area; and
- it is considered that no referral under the EPBC Act is necessary in relation to these species in the areas investigated for this study.

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Appendix 1:
Terrestrial Vertebrate Species List

Curtis Island LNG plant study area: Species list derived from BAAM December 2008 survey

Status Abbreviations: EPBC Act: M = Migratory. **NC Act:** V = Vulnerable; R = Rare; S = Special Least Concern (Migratory); LC = Least Concern; I = Introduced. **BAMM (Biodiversity Assessment and Mapping Methodology):** X = Non-EVR priority species for the SEQ bioregion (EPA 2002).

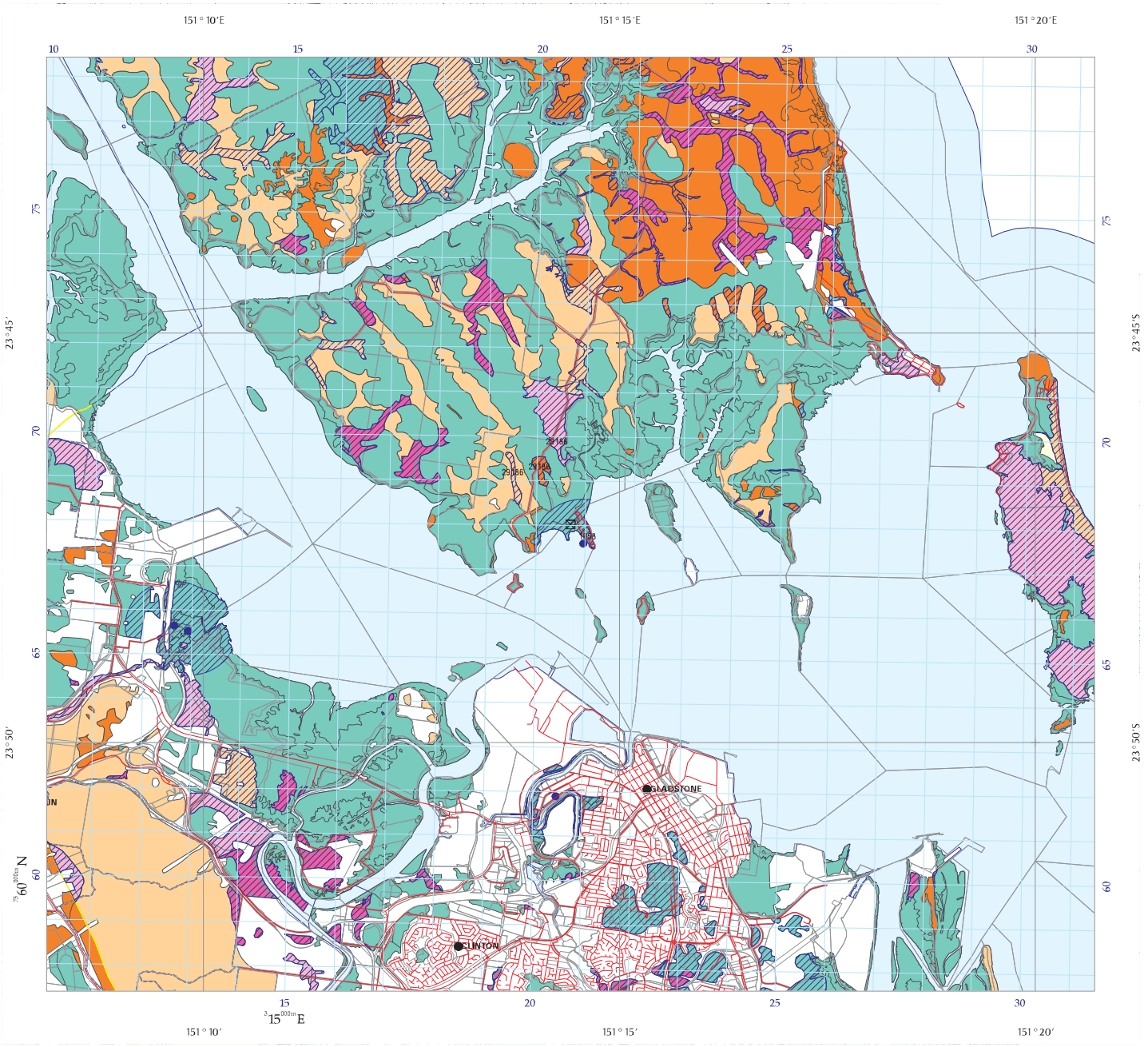
Unless otherwise noted, this table follows the nomenclature provided by the CSIRO List of Australian Vertebrates (Clayton *et al*. 2006) as it provides a single point of reference for all terrestrial vertebrate groups. Any notable variations in common and/or scientific names of conservation significant species are identified in the report text and as footnotes hereunder. With the exception of alterations due to subsequent taxonomic revision, species reported by sources other than BAAM are accepted at face value.

Family Genus Species	Common Name	NC Act	EPBC Act	BAMM
FROGS				
MYOBATRACHIDAE				
Crinia deserticola	Desert Froglet	LC		X
Uperoleia fusca	Dusky Toadlet	LC		
HYLIDAE				
Litoria caerulea	Green Tree Frog	LC		
Litoria fallax	Eastern Dwarf Tree Frog	LC		
Litoria gracilenta	Dainty Green Tree Frog	LC		
Litoria inermis	Peters' Frog	LC		X
Litoria latopalmata	Broad-palmed Frog	LC		
Litoria nasuta	Rocket Frog	LC		
Litoria rothii	Roth's Tree Frog	LC		X
Litoria rubella	Desert Tree Frog	LC		
BUFONIDAE				
Bufo marinus	Cane Toad	I		
REPTILES				
GEKKONIDAE				
Diplodactylus vittatus	Wood Gecko	LC		
Hemidactylus frenatus	House Gecko	I		
SCINCIDAE				
Carlia munda	Shaded-litter Rainbow-Skink	LC		
Cryptoblepharus litoralis	Supralittoral Shinning-Skink	LC		
Cryptoblepharus virgatus	Cream-striped Shinning-Skink	LC		
Ctenotus taeniolatus	Copper-tailed Skink	LC		
COLUBRIDAE				
Dendrelaphis punctulata	Common Tree Snake	LC		
Tropidonophis mairii	Freshwater Snake	LC		
BIRDS				
PHASIANIDAE				
Coturnix ypsilophora	Brown Quail	LC		
ANATIDAE				
Chenonetta jubata	Australian Wood Duck	LC		
PODICIPEDIDAE				
Tachybaptus novaehollandiae	Australasian Grebe	LC		
ARDEIDAE				
Butorides striata	Striated Heron	LC		
Egretta intermedia	Intermediate Egret	LC		
Egretta sacra	Eastern Reef Egret	S	M	
PELECANIDAE				
Pelecanus conspicillatus	Australian Pelican	LC		
PHALACROCORACIDAE				
Phalacrocorax melanoleucos	Little Pied Cormorant	LC		
Phalacrocorax varius	Pied Cormorant	LC		
ACCIPITRIDAE				
Pandion haliaetus	Osprey	S	M	

Haliastur sphenurus	Whistling Kite	LC		
Haliastur indus	Brahminy Kite	LC		
BURHINIDAE				
Burhinus grallarius	Bush Stone-curlew	LC		X
Esacus magnirostris	Beach Stone-curlew	V		
HAEMATOPODIDAE				
Haematopus longirostris	Pied Oystercatcher	LC		
Haematopus fuliginosus	Sooty Oystercatcher	R		
CHARADRIIDAE				
Vanellus miles	Masked Lapwing	LC		
Charadrius ruficapillus	Red-capped Plover	LC		
SCOLOPACIDAE				
Numenius phaeopus	Whimbrel	S	M	
Numenius madagascariensis	Eastern Curlew	R	M	
Tringa nebularia	Common Greenshank	S	M	
Heteroscelus brevipes	Grey-tailed Tattler	S	M	
Calidris ruficollis	Red-necked Stint	S	M	
LARIDAE				
Larus novaehollandiae	Silver Gull	LC		
Sterna bergii	Crested Tern	S	M	
Sterna hirundo	Common Tern	S	M	
COLUMBIDAE				
Phaps chalcoptera	Common Bronzewing	LC		
Geopelia placida	Peaceful Dove	LC		
Geopelia humeralis	Bar-shouldered Dove	LC		
CACATUIDAE				
Calyptorhynchus banksii	Red-tailed Black-Cockatoo	LC		
PSITTACIDAE				
Trichoglossus haematodus	Rainbow Lorikeet	LC		
Platycercus adscitus	Pale-headed Rosella	LC		
CUCULIDAE				
Eudynamys orientalis	Pacific Koel	LC		
Scythrops novaehollandiae	Channel-billed Cuckoo	LC		
CENTROPODIDAE				
Centropus phasianinus	Pheasant Coucal	LC		
STRIGIDAE				
Ninox boobook	Southern Boobook	LC		
PODARGIDAE				
Podargus strigoides	Tawny Frogmouth	LC		
CAPRIMULGIDAE				
Eurostopodus mystacalis	White-throated Nightjar	LC		
APODIDAE				
Hirundapus caudacutus	White-throated Needletail	S	M	
CORACIIDAE				
Eurystomus orientalis	Dollarbird	LC		
ALCEDINIDAE				
Dacelo novaeguineae	Laughing Kookaburra	LC		
Todiramphus macleayii	Forest Kingfisher	LC		
Todiramphus chloris	Collared Kingfisher	LC		
MEROPIDAE				
Merops ornatus	Rainbow Bee-eater	S	M	
MALURIDAE				
Malurus melanocephalus	Red-backed Fairy-wren	LC		
PARDALOTIDAE				
Pardalotus striatus	Striated Pardalote	LC		
ACANTHIZIDAE				
Gerygone levigaster	Mangrove Gerygone	LC		
MELIPHAGIDAE				
Lichenostomus fasciogularis	Mangrove Honeyeater	LC		

Melthreptus albogularis	White-throated Honeyeater	LC		
Philemon corniculatus	Noisy Friarbird	LC		
PACHYCEPHALIDAE				
Colluricincla harmonica	Grey Shrike-thrush	LC		
DICRURIDAE				
Dicrurus bracteata	Spangled Drongo	LC		
Myiagra rubecula	Leaden Flycatcher	LC		
ARTAMIDAE				
Cracticus nigrogularis	Pied Butcherbird	LC		
Gymnorhina tibicen	Australian Magpie	LC		
Artamus leucorhynchus	White-breasted Woodswallow	LC		
CAMPEPHAGIDAE				
Coracina novaehollandiae	Black-faced Cuckoo-shrike	LC		
Lalage leucomela	Varied Triller	LC		
ORIOLIDAE				
Sphecotheres vieilloti	Australasian Figbird	LC		
CORVIDAE				
Corvus orru	Torresian Crow	LC		
HIRUNDINIDAE				
Hirundo neoxena	Welcome Swallow	LC		
Petrochelidon nigricans	Tree Martin	LC		
DICAEIDAE				
Dicaeum hirundinaceum	Mistletoebird	LC		
NECTARINIIDAE				
Cinnyris jugularis	Olive-backed Sunbird	LC		X
MAMMALS				
MACROPODIDAE				
Macropus giganteus	Eastern Grey Kangaroo	LC		
EQUIDAE				
Equus caballus	Horse	I		
SUIDAE				
Sus scrofa	Pig	I		

Appendix 2:
Essential Habitat Mapping



VEGETATION MANAGEMENT ACT ESSENTIAL HABITAT MAP

Requested By: BRETT@BIODIVERSITY.TV
Date: 18 Dec 08 Time: 08.09.41

Centered on point position:
Latitude: -23.7889 Longitude: 151.2402 (decimal degrees)

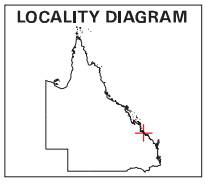
2003 Remnant endangered regional ecosystem
- Dominant
- Sub-dominant

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.*
- Vegetation Management Act Essential Habitat Species Records
- 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



2000 0 2000 m

Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)

Labels for Vegetation Management Act Essential Habitat are centred on the area of interest (1.1km surrounding and including a Lot on Plan or 2.2km around the selected coordinates). Labels relate to the attached species list.

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).

Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Natural Resources and Water, the Environmental Protection Agency and MapInfo Australia Pty Ltd, makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.

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

Species Name	Family	Common Name	Secondary Sites - Relative Abundances[1]					Quaternary Sites - Relative Abundances[1]		
			S1	S2	S3	S4	S5	Q1	Q2	Q3
Acacia leiocalyx	Mimosaceae	Black Hickory Wattle	C			R	C	U	U	C
Allocasuarina torulosa	Casuarinaceae	Forest She-oak								R
Alloteropsis semialata	Poaceae	Cockatoo Grass					I			U
Alphitonia excelsa	Rhamnaceae	Red Ash	C					U	U	
Altsonia constricta	Apocynaceae	Bitter Bark		I						
Aristida queenslandica var. dissimilis	Poaceae	Queensland Wiregrass								U
Avicennia marina	Verbenaceae	Grey Mangrove		I						
Breynia oblongifolia	Euphorbiaceae	Coffee Bush	U				U		U	
Bruguiera gymnorhiza	Rhizophraceae	Orange Mangrove		I						
Brunoniella australis	Acanthaceae	Blue Trumpet	R							
Cassytha filiformis	Lauraceae	Dodder Laurel								U
Ceriops tagal	Rhizophraceae	Yellow Mangrove		U	I					
Chloris divaricata	Poaceae	Slender Chloris				I				
Chloris inflata *	Poaceae	purpletop chloris	I							
Chrysopogon fallax	Poaceae	Golden Beard Grass					I			
Corymbia citriodora subsp. citriodora	Myrtaceae	Lemon-scented Gum	U							U
Corymbia tessellaris	Myrtaceae	Moreton Bay Ash						I		
Crotalaria montana var. angustifolia	Fabaceae	Rattlepod	R			R		U		
Cryptostegia grandiflora *	Asclepiadaceae	Rubber Vine	I							
Cupaniopsis anacardioides	Sapindaceae	Tuckeroo		I						
Cyanthillium cinereum	Asteraceae		O						U	
Cymbopogon refractus	Poaceae	Barbwire Grass	C					C		U
Cyperus gracilis	Cyperaceae	Graceful Sedge	U							
Desmodium heterocarpon var. strigosum	Fabaceae					R				
Dianella brevipeductulata	Phomeriaceae		R							
Dodonaea lanceolata var. subsessilifolia	Sapindaceae	Native Hop Bush	O							
Emilia sonchifolia var. sonchifolia *	Asteraceae	Emilia	I			C	C			
Enchylaena tomentosa	Chenopodiaceae	Ruby Saltbush			I		I			
Enneapogon robustissimus	Poaceae		I							
Epaltes australis	Asteraceae						R			
Eragrostis brownii	Poaceae	Brown's Lovegrass	O			U		U		U
Eremophila debilis	Myoporaceae	Winter Apple	I							

			S1	S2	S3	S4	S5	Q1	Q2	Q3
Eucalyptus crebra	Myrtaceae	Narrow-leaved Ironbark	U			I	U	U	U	
Eucalyptus exserta	Myrtaceae	Queensland Peppermint	I				I	I	I	
Eucalyptus tereticornis	Myrtaceae	Forest Red Gum				U	U	U	U	
Eustrephus latifolius	Smilacaceae	Wombat Berry	U						U	
Evolvulus alsinoides	Convolvulaceae	Blue periwinkle	I							
Fimbristylis polytrichoides	Cyperaceae				I					
Gahnia aspera	Cyperaceae	Sawsedge	R							
Glycine tabacina	Fabaceae	Glycine Pea	U							U
*Gomphocarpus physocarpus **	Asclepiadaceae	Balloon Cotton Bush				I				
Gomphrena celosioides	Amaranthaceae	Gomphrena Weed					I			
Heteropogon contortus	Poaceae	Giant Speargrass	U				A	C	A	
Hibiscus divaricatus	Malvaceae		R							
Imperata cylindrica	Poaceae	Blady Grass				C				
Indigofera hirsuta	Fabaceae	Hairy Indigo				I	R			
Jasminum simplicifolium subsp. australiense	Oleaceae	Native Jasmine	I							
*Lantana camara **	Verbenaceae	Lantana						I		
Leptochloa decipiens subsp. decipiens	Poaceae	slender cane grass	C							
Leptochloa digitata	Poaceae	umbrella cane grass				C	C			
Lomandra multiflora	Xanthorrhoeaceae	Many-flowered Mat Rush	R							
Lophostemon suaveolens	Myrtaceae	Swamp Box	I			U		U	I	I
Ludwigia octovalvis	Onagraceae	Willow Primrose				U				
Melaleuca quinquenervia	Myrtaceae	Paper Tea-tree				I	I			
Murdannia graminea	Commelinaceae	Slug Herb				R	R			
Myoporum acuminatum	Myoporaceae	Coastal Boobialla		I						
*Opuntia stricta **	Cactaceae	Common Prickly Pear	R							
*Oxalis corniculata var. corniculata **	Oxalidaceae	Creeping Oxalis					R			
Paspalidium distans	Poaceae					I				
*Passiflora suberosa **	Passifloraceae	Corky Passion Flower	R							
Phyllanthus virgatus	Euphorbiaceae		U							
Planchonia careya	Lecythidaceae	Cocky Apple	I			U		U		
Pogonolobus reticulatus	Rubiaceae	Medicine Bush	U				U		U	
Pseuderanthemum variabile	Acanthaceae					R				
Pterocaulon sphacelatum	Asteraceae					I				
Rhizophora stylosa	Rhizophraceae	Spotted Mangrove		A						
Rhynchosia minima	Fabaceae	Rhynchosia	R							

			S1	S2	S3	S4	S5	Q1	Q2	Q3
Sarcocornia quinqueflora	Chenopodiaceae	Bead Weed			I					
Scleria brownii	Cyperaceae		I							U
Sida hackettiana	Malvaceae		C			U				
Sida rhombifolia *	Malvaceae	Common Flannel Weed	U			O				
Sporobolus virginicus	Poaceae	Saltwater Couch			I					
Themeda triandra	Poaceae	Kangaroo Grass					R			
Vitex trifolia var. trifolia	Lamiaceae	Coastal Vitex		I						
Xanthorrhoea johnsonii	Xanthorrhoeaceae	Grass Tree								R

Key:

[1] Relative abundances: A – Abundant (>100 plants per transect); C – Common (50-100 plants); O – Occasional (20-49 plants);

U – Uncommon 5 – 20 plants; R – Rare (<5 plants); I – Incidental (recorded outside transect but within same RE).

* - denotes exotic species

***Sporobolus virginicus* grassland on marine clay plains (RE 12.1.2)**

Description: This Regional Ecosystem was identified at the east of the DMPF within the intertidal zone. This RE is generally found in close proximity to high water mark and was often devoid of vegetation. Where vegetation was present species included *Sporobolus virginicus* (saltwater couch), *Enchylaena tomentosa* (ruby saltbush) and *Sarcocornia quinqueflora* (bead weed).

Secondary Transect 3 **Curtis Island 15/04/09**	
Vegetation Community	Saltpan
R.E.	12.1.2
Transect Start	151.186625; -23.755802
Transect End (50m)	n/a
Bearing	0
Aspect	-
Slope	0°
Soil	Grey/brown. Fine grained marine sediments with small metamorphic rocks.
Weeds	-
Notes	-
Strata	**Dominant Species**
Ground (G): <1 m	*Enchylaena tomentosa*
FPC: 0%	*Sarcocornia quinqueflora*
Litter: 1%	*Fimbristylis polytrichoides*
Bare: 99%	*Sporobolus virginicus*

Mangrove shrubland to low closed forest on Quaternary estuarine deposits (RE 12.1.3)

Description: The mangrove communities lie adjacent to RE 12.1.2 in the far western section of the DMPF in the intertidal zone associated with Gladstone Harbour. This RE is characterised by a dense low canopy cover dominated by *Rhizophora stylosa* (spotted mangrove), *Avicennia marina* (grey mangrove) and *Ceriops tagal* (yellow mangrove) with the absence of any ground layer.

Secondary Transect 2 **Curtis Island 15/04/08**	
Vegetation Community	Mangroves
R.E	12.1.3
Transect Start	151.18431; -23.756437
Transect End (50m)	n/a
Bearing	-
Aspect	-

Secondary Transect 2 **Curtis Island 15/04/08**	
Slope	0°
Soil	Grey/brown marine sediments and sub-angular rocks
Weeds	-
Notes	-
Strata	**Dominant Species**
Shrub (S1): 2-3 m	*Avicennia marina*
FPC: 80%	*Ceriops tagal*
	Rhizophora stylosa
Ground (G):	No groundcover species present
FPC: 0%	
Litter: 10%	
Bare: 90%	

Eucalyptus tereticornis open forest to woodland on Cainozoic alluvial plains (R.E. 12.3.3)

Description: This vegetation community occurs on the alluvial plains present at the south and east of the DMPF site. The RE is characterised by *Eucalyptus tereticornis* (forest red gum) as the dominant canopy species with a mid-storey primarily comprised of *Lophostemon suaveolens* (swamp box). The shrub layer is relatively dense and supports *Acacia leiocalyx* (black wattle), *Planchonia careya* (cocky apple)*, Pogonolobus reticulatus* (medicine bush) and *Sida hackettiana.* The ground cover is dominated by native grass and herb species including *Eragrostis brownii* (Brown's lovegrass), and *Heteropogon contortus* (giant speargrass).

Secondary Transect 4 **Curtis Island 15/04/09**	
Vegetation Community	*E. tereticornis* grassy woodland on alluvium
R.E	12.3.3
Transect Start	151.189041; -23.755146
Transect End (50m)	151.188814; -23.755505
Bearing	SW
Aspect	-
Slope	Flat
Soil	Grey/ brown fine-grained alluvium with small pebbles.
Weeds	-
Notes	Melaleuca quinquenervia fringes this community on the mud-flat side.
Strata	**Dominant Species**

Secondary Transect 4 **Curtis Island 15/04/09**	
Canopy (T1): 14-18 m	*Eucalyptus tereticornis*
FPC: 16%	
Mid-Storey (T2): 6-8 m	*Lophostemon suaveolens*
	Eucalyptus tereticornis
Shrub (S1): 1-2 m	*Planchonia careya*
FPC: 5%	*Sida hackettiana*
Ground (G): <1 m	*Eragrostis brownii*
FPC: 44%	*Heteropogon contortus*
Litter: 45%	*Imperata cylindrica*
Bare: 11%	*Leptochloa digitata*

Corymbia citriodora, Eucalyptus crebra open forest on metamorphics ± interbedded volcanics (RE 12.11.6)

Description: This RE was recorded at the far south and east of the DMPF site where it occurs on the rocky slopes of the surrounding hills. This RE is characterised by the dominance of *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum) and *E. crebra* (narrow-leaved ironbark) in the canopy. Shrub layer species include *Alphitonia excelsa* (red ash), *Acacia leiocalyx (*black wattle) and *Sida hackettiana*. Ground cover species include *Cymbopogon refractus (*barbwire grass) and *Leptochloa decipiens* (slender cane grass).

Structural and floristic descriptions of the dominant species in each strata surveyed within this RE are described in the table below.

Secondary Transect 1 **Curtis Island 15/04/09**	
Vegetation Community	*C. citriodora* and *E. crebra* woodland on metamorphics
R.E.	12.11.6
Transect Start	151.185507; -23.757019
Transect End (50m)	151.185393; -23.757308
Bearing	SW
Aspect	NW
Slope	12°
Soil	Dark brown; fine clay with small metamorphic rocks.
Weeds	
Notes	On slope of hill- Entire hill is RE 12.11.6
Strata	**Dominant Species**

Secondary Transect 1 **Curtis Island 15/04/09**	
Canopy (T1): 12-16 m	*Corymbia citriodora subsp. citriodora*
FPC: 25%	*Eucalyptus crebra*
	Eucalyptus exserta
Mid-Storey (T2): 6-10 m	*Eucalyptus crebra*
	Corymbia citriodora subsp. citriodora
Shrub (S1): 1-4 m	*Acacia leiocalyx*
FPC: 40%	*Alphitonia excelsa*
	Pogonolobus reticulatus
	Sida hackettiana
Ground (G): <1 m	*Cyanthillium cinereum*
FPC: 46%	*Cymbopogon refractus*
Litter: 54%	*Heteropogon contortus*
Bare: 0%	*Leptochloa decipiens*

Eucalyptus crebra, E. tereticornis **grassy woodland on metamorphosed sediments and interbedded volcanics (RE 12.11.14)**

Description: This RE is present across the lower slopes at the north of the DMPF site and is characterised by a canopy of *Eucalyptus tereticornis* (forest red gum) and *E. crebra* (narrow-leaved ironbark). The shrub layer is dominated by *Pogonolobus reticulatus* (medicine bush), *Planchonia careya* (cocky apple) and *Acacia leiocalyx* (black wattle). Ground cover species include *Cymbopogon refractus (*barbwire grass) and *Leptochloa decipiens* (slender cane grass).

Structural and floristic descriptions of the dominant species in each strata surveyed within this RE are described in the table below.

Secondary Transect 5 **Curtis Island 15/04/09**	
Vegetation Community	*E. tereticornis* & *E. crebra* open woodland on metamorphics
R.E.	12.11.14
Transect Start	151.188355; -23.750094
Transect End (50m)	151.188654; -23.749966
Bearing	S
Aspect	-
Slope	flat
Soil	Dark brown; fine clay with small metamorphic rocks.
Weeds	
Notes	

Secondary Transect 5 **Curtis Island 15/04/09**	
Strata	**Dominant Species**
Canopy (T1): 8-14 m	*Eucalyptus crebra*
FPC: 17%	*Eucalyptus tereticornis*
Mid-Storey (T2): 6-8 m	*Eucalyptus crebra*
	Eucalyptus tereticornis
	Eucalyptus exserta
Shrub (S1):1-3 m	*Acacia leiocalyx*
FPC: 25%	*Breynia oblongifolia*
	Pogonolobus reticulatus
Ground (G):<1 m	*Cymbopogon refractus*
FPC: 67%	*Emilia sonchifolia var. sonchifolia* *
Litter: 32%	*Heteropogon contortus*
Bare: 1%	*Leptochloa decipiens*