7 TERRESTRIAL ECOLOGY

This chapter assesses terrestrial ecology impacts associated with construction, operation and decommissioning of the LNG Facility and associated facilities on Curtis Island (the LNG Facility), and the construction of the export pipeline on Curtis Island. The chapter also assesses impacts associated with the construction of the Curtis Island Road and Mainland Road and Bridge Approach, although QGC would not be the proponent if these project elements are constructed.

For the purposes of this chapter, "study area" refers to the footprint of the structures (refer to *Figure 5.7.1*).

This chapter identifies the ecological attributes of the terrestrial environment in relation to Queensland and national legislation and the significance of these attributes from a local, regional and state perspective. Where Commonwealth-listed threatened species or ecological communities are concerned, impacts from the LNG Facility, Pipeline and Ancillary Infrastructure are also considered at a national level. The chapter outlines the likely impacts on local ecological values of the study area, considers cumulative impacts from a regional perspective, mitigation measures for the protection of existing ecological values, and viable alternative strategies to proposed actions where these actions impact on terrestrial species or ecological communities of significance.

7.1 DESCRIPTION OF PROJECT ENVIRONMENTAL OBJECTIVES

The Project environmental objective for terrestrial ecology is: to undertake Project activities such that impacts on abundance and distribution of terrestrial flora, fauna and ecological communities are minimised.

7.2 PROJECT COMPONENTS AND ANCILLARY INFRASTRUCTURE ASSESSED

This chapter assesses terrestrial ecological impacts associated with the following:

LNG Facility and Pipeline Corridor on Curtis Island

This includes the LNG Facility site on Curtis Island and the proposed corridor for the pipeline from Laird Point to the LNG Facility.

Roads and Infrastructure

QGC does not intend to construct a bridge to cross The Narrows or associated roads on the mainland or Curtis Island outside the LNG Facility boundary. Similarly, the Project does not require road access to the LNG Facility for construction or operations.

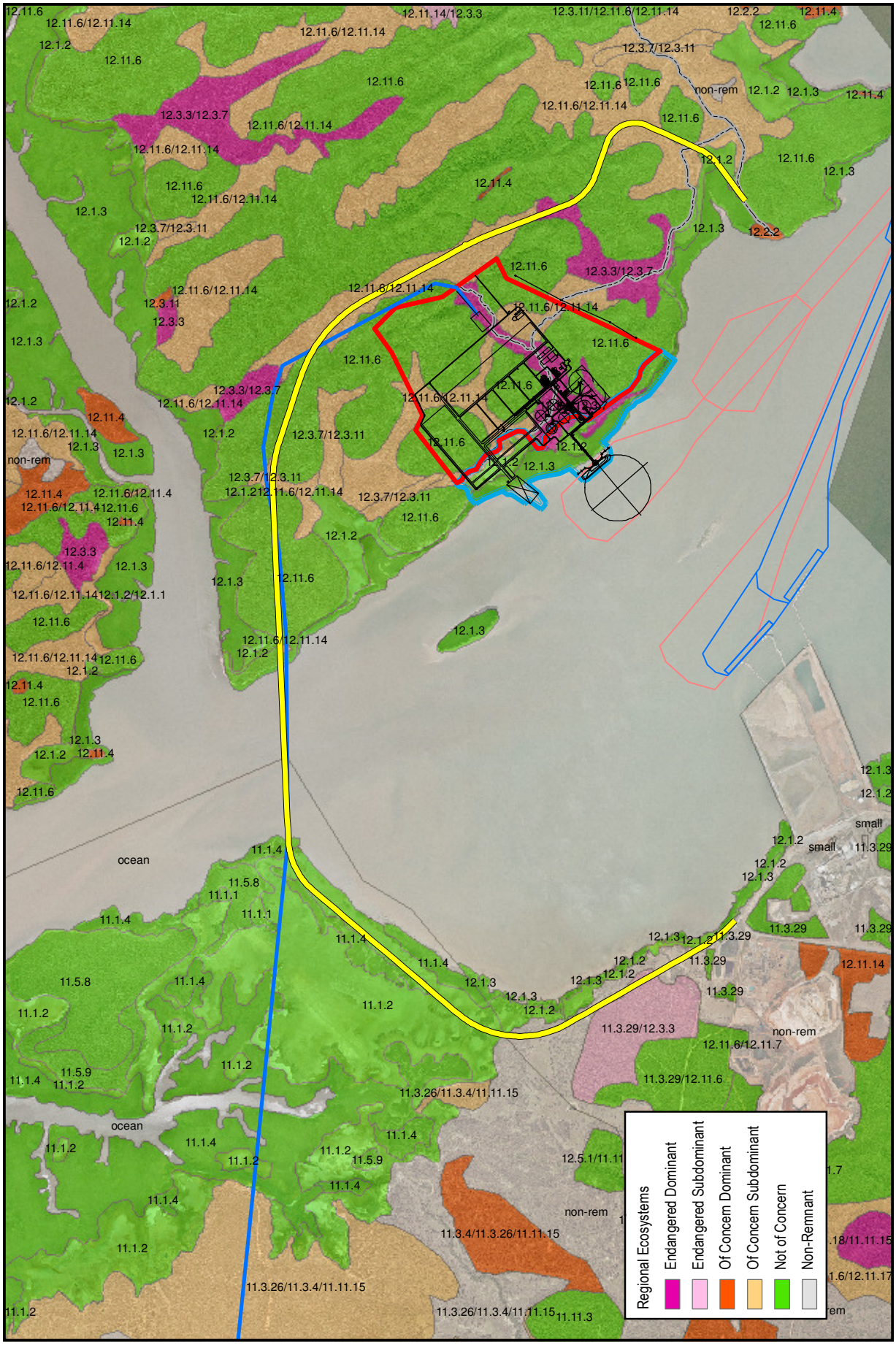
QGC will not be the proponent should these components be constructed. However, for completeness, the bridge and associated roads have been assessed as part of this Environmental Impact Statement (EIS). Components include:

- *Mainland Road and Bridge Approach*: This infrastructure comprises the proposed Mainland Road and Bridge Approach connecting with the proposed Curtis Island Bridge on Kangaroo Island at the northern end of the Port of Gladstone, north of Fisherman's Landing and east of the Calliope River-Targinie Road. .

- The road will extend north along the foreshore for approximately 2.5 km before turning north-east across the tidal mudflats for approximately 2.5 km towards the southern end of Kangaroo Island at Friend Point. The proposed alignment runs between two linear mangrove communities.
- *Curtis Island Road*: The proposed road alignment on Curtis Island would extend approximately 8.5 km from the eastern bridge abutment at Laird Point to the LNG Facility site.
- *Curtis Island Bridge*: The proposed Curtis Island Bridge would extend 1.5 km to 2.0 km from Friend Point across The Narrows to Laird Point on Curtis Island. Marine ecological impacts of the bridge development and construction are addressed in *Volume 5, Chapter 8*.

7.3 EXISTING ENVIRONMENT

This section describes the existing environment of Curtis Island and the local, regional and state context of the terrestrial ecological attributes of the study area.



QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: Proposed LNG Facility, Pipeline Corridor, Ancillary Infrastructure and Regional Ecosystems (EPA 2008)
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JB	Volume 5 Figure 5.7.1	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: MB	File No: 0086165b_EIS_TE_GIS001_F5.7.1	
	Date: 19.05.09	Revision: 2	

The study area, located south of Graham Creek, is subject to grazing predominantly by free-ranging cattle (*Bos taurus*), feral horse (*Equus caballus*) and some small populations of feral pig (*Sus suscrofa*). The area is undeveloped and displays a history of disturbance as a product of livestock grazing and altered fire regimes.

The inter-tidal zone of the study area is characterised by mudflats dominated by mangroves and in some areas by salt pan. Beyond this zone, the land is gently undulating and is covered with eucalypt woodland. A number of small, incised seasonal drainage lines flow into Port of Gladstone from the study area.

7.3.1.1 Soils

The dominant underlying geology of the study area is the Wandilla Formation of the Curtis Island Group consisting of mudstone, quartz greywacke, and pale grey chert. The estuary environments associated with Graham Creek and Port of Gladstone consist of Holocene sediments of gravel, silt and clay alluvium and associated mangrove swamps, mud flats and salt pans[1].

No parts of the study area have been listed on either the Queensland Environmental Management Register (EMR) or Contaminated Land Register (CLR) (refer *Volume 5, Chapter 6*).

Further detail on site geology, including acid sulfate soils (ASS), is provided in *Volume 5, Chapter 4*.

7.3.1.2 Terrestrial Vegetation

Regional ecosystem (RE) mapping of the study area and surrounds on Curtis Island, provided in 2008 by the Environment Protection Agency (EPA)[2], shows remnant vegetation communities which have the status of Not Of Concern, Of Concern and Endangered under the provisions of the Queensland *Vegetation Management Act 1999* (*VM Act*) (*Figure 5.7.1*). The following RE units have been identified on RE maps:

- Endangered
  - 12.3.3: *Eucalyptus tereticornis* woodland to open forest on alluvial plains
- Of Concern
  - 12.3.11: Eucalyptus siderophloia, E. tereticornis, Corymbia intermedia open forest on alluvial plains usually near coast
  - 12.11.14: *Eucalyptus crebra, E. tereticornis* woodland on metamorphics ± interbedded volcanics

1 ASRIS online (2008) Australian Soils Resource Informatino System

2 Now incorporated within the Department of Environment and Resources Management (DERM)

- Not Of Concern
  - 12.1.2: Salt pan vegetation including grassland and herbland on marine clay plains
  - 12.1.3: Mangrove shrubland to low closed forest on marine clay plains and estuaries;
  - 12.3.7: Eucalyptus tereticornis, Melaleuca viminalis, Casuarina cunninghamiana fringing forest; and
  - 12.11.6: *Corymbia citriodora, Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics.

The RE mapping of the LNG Facility area shows the occurrence of both mixed and uniform RE units classified as Endangered dominant: 12.3.3/12.3.7 (60/40); Of Concern sub-dominant: 12.3.7/12.3.11 (70/30); 12.11.6/12.11.14 (85/15); and Not Of Concern: 12.1.2; 12.1.3; and 12.11.6.

7.3.1.3 Freshwater Hydrology

No permanent freshwater bodies are known to be present within the study area. Surface hydrology on Curtis Island is characterised by annual stream flow as a product of sub-tropical seasonal rainfall. Further detail is provided in *Volume 5, Chapter 9*.

7.3.1.4 Marine Environments

Marine areas of the island support a range of vegetated and non-vegetated habitats such as mangroves, intertidal mudflats, seagrass meadows and salt marshes. Deep water benthic regions in Port Curtis and Rodds Bay have been mapped as comprising open, rubble and reef substrates[3]. Marine areas are considered in comprehensive detail within the marine assessment undertaken as part of this EIS (See *Volume 5*, *Chapter 8*).

Wetlands

The Directory of Important Wetlands in Australia[4] lists Port Curtis, The Narrows, and Northeast Curtis Island as Wetlands of National Importance.

3 Rasheed, M.A, Thomas, R, Roelofs, A.J, Neil, K.M. and Kerville, S.P., (2003). ***Port Curtis and Rodds Bay Seagrass and Benthic Macro-invertebrate community baseline survey***

4 Environment Australia (2001) ***A Directory of Important Wetlands in Australia*** *(Third Edition)*

Mangroves

Nearly 7,000 ha of mangroves have been mapped in the Port Curtis area, the majority of which is *Rhizophora* closed forest[5]. Mangroves fringe the entire coastline of the proposed LNG Facility site on Curtis Island.

Seagrass and Dugongs

Seagrasses are protected under section 124 of the *Fisheries Act 1994* (Qld) as marine plants and areas that support dugongs (*Dugong dugon*). Extensive seagrass mapping has been undertaken by the former Queensland Department of Primary Industry and Fisheries (DPI&F), now Department of Employment, Economic Development and Innovation (DEEPI), in the Port Curtis and Rodds Bay area. Dugongs are considered vulnerable to extinction globally, according to International Union for the Conservation of Nature (IUCN) criteria[6] and are listed as marine and migratory marine under the *Environmental Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) and as Vulnerable under the Queensland *Nature Conservation Act 1992* (*NC Act*). Part of the study area falls within a declared Dugong Protection Area (DPA).

Intertidal Mudflats and Benthic Fauna

Intertidal mudflats support high biodiversity and biomass of benthic invertebrates. These habitats surround the study area and provide feeding habitat for waders listed as migratory under the *EPBC Act* and protected under international migratory bird agreements (i.e. Japan-Australia Migratory Birds Agreement (JAMBA) and/or the China-Australia Migratory Birds Agreement (CAMBA) and/or the Republic of Korea Migratory Bird Agreement (ROKAMBA).

Declared Fish Habitat

Fish Habitat Areas (FHA) are declared under Section 118 of the Queensland *Fisheries Act 1994* to protect fisheries resources. The closest FHA is east of Curtis Island, in the Curtis Channel.

Turtles

Important turtle nesting beaches for the Flatback Turtle (*Natator depressus*) have been identified on the east coast of Curtis Island and Facing Island and further south at Tannum Sands[7]. The Green Turtle (*Chelonia mydas*) also nests in these locations, but in smaller numbers. There are no known turtle nesting beaches within close proximity to the study area.

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5 Danaher K F, Rasheed M A and Thomas R (2005) ***The intertidal Wetlands of Port Curtis***

6 IUCN (2008) ***2001 Categories and Criteria (version 3.1)***

7 Limpus C J, McLaren M, McLaren G and Knuckey B (2006) ***Queensland Turtle Conservation Project: Curtis Island and Woongarra Coast Flatback Turtle Studies, 2005-2006***

7.4 LEGISLATIVE CONTEXT

The local planning objectives pertaining to the protection of terrestrial ecology in the Gladstone region and Curtis Island are outlined below and relevant legislation is listed in this section with detailed discussion presented in *Volume 1.*

7.4.1 Local Context

7.4.1.1 *Curtis Coast Regional Coastal Management Plan*

The *Curtis Coast Regional Coastal Management Plan* (Curtis Coastal Plan), developed under the *Coastal Protection and Management Act 1995* (Qld) (*Coastal Act*), describes how the coastal zone of the Curtis Coast region is to be managed. Key initiatives in the Curtis Coastal Plan include:

- recognition of the economic importance of the Port of Gladstone
- recognition of the Gladstone State Development Area (GSDA) as an area of state and national significance that has been established by Government for large-scale industry development
- recognition of the valuable resource of the Stuart and Rundle oil shale deposits
- increased protection of significant coastal wetlands in the region such as The Narrows, the marine plain on Curtis Island and Colosseum Inlet
- increased protection for the Calliope River and its fisheries habitat value
- improved criteria for development on the coastal islands to ensure significant coastal resources and their values are protected
- identification and protection of significant scenic coastal landscapes in the region
- identification and protection of habitat for significant species such as shorebirds, dugong and turtles.

7.4.1.2 *Fitzroy Basin 'Back on Track' Biodiversity Action Plan (Draft) 2008 (FBBAP)*

The Fitzroy Basin Biodiversity Plan (FBBAP) was developed by a partnership between the Queensland EPA and the Fitzroy Basin Association to provide a framework to direct management and research, as well as a strategic approach to address threats to species recovery. Priority rankings are given to those species that are of significance from a regional perspective to assist in targeting effective regional conservation and management efforts for species that are not necessarily listed under State or Commonwealth legislation. The FBBAP is intended as a strategic tool to guide planning and investment within the region on regional biodiversity issues and in particular priority species[8].

8 EPA (2008) ***Draft Fitzroy Basin "Back on Track" Biodiversity Action Plan***

7.4.2 Queensland Legislation

The relevant legislation in Queensland that regulates matters pertaining to terrestrial ecology and its management are:

- *Vegetation Management Act 1999 (VM Act)*
- *Nature Conservation Act 1992 (NC Act)*
- *Coastal Protection and Management Act 1995 (Coastal Act)*
- *Environment Protection Act 1994*
- *Fisheries Act 1994*
- *Land Protection (Pest and Stock Route Management) Act 2002*
- *Water Act 2000*
- *Integrated Planning Act 1997*
- *Forestry Act 1959*
- *Marine Parks Act 1982*
- *Queensland Heritage Act 1992*
- *Recreation Areas Management Act 1988*.

7.4.3 Features of State and National Environmental Significance

Several features of State and National Environmental Significance are present within the Gladstone region in proximity to the LNG Facility, pipeline corridor on Curtis Island and Ancillary Infrastructure. These include:

- the Great Barrier Reef World Heritage Area (GBRWHA), which extends seaward from the low water mark on the Queensland coast, covering the waters and islands within the Port of Gladstone including Curtis Island
- the Queensland State Great Barrier Reef Coast Marine Park (GBRCMP) which extends down The Narrows to a line between Friend Point on the mainland and Laird Point on Curtis Island. The proposed LNG Facility is located approximately 2 km south of the southern boundary of the GBRCMP
- Curtis Island National Park extends northward on Curtis Island from Graham Creek. The proposed LNG Facility is located approximately 2 km south of the southern boundary of this park
- the Directory of Important Wetlands in Australia[9] lists Port Curtis, The Narrows, and Northeast Curtis Island as Nationally Important Wetlands
- Dugong Protection Area (DPA) - The Narrows south of Graham Creek and east to Facing Island, encompassing the majority of Southern Curtis Island waters comprise the Rodds Bay DPA.

9 Environment Australia (2001) ***A Directory of Important Wetlands in Australia*** *(Third Edition)*

- Register of the National Estate (RNE) - Registered places can be protected under the *EPBC Act* if they are also included in another Commonwealth statutory heritage list or are owned or leased by the Commonwealth. The following locations in proximity to the study area are listed under the RNE:
  - Balaclava Island and The Narrows
  - Curtis Island (part)
  - Garden Island Environmental Park.

7.5 METHODOLOGY

This section outlines the methods used during the desktop and field ecology assessments carried out for the ecological impact assessment.

7.5.1 Overview

Prior to field investigations, desktop assessments and literature reviews were undertaken to ensure that field surveys were appropriate to the proposed developments and the study area. Two field surveys were carried out (spring and summer) from 28th September 2008 to 15th October 2008 and 12th to 24th February 2009 (a total of five weeks). An earlier site inspection to identify key issues was also carried out in June 2008.

Detailed assessment studies and reports for birds, reptiles and amphibians and vegetation were undertaken by specialist consultants. Specialist technical reports are summarised within this chapter, with the full technical reports provided as *Appendix 5.5*[10], *Appendix 5.6*[11], *Appendix 5.7*[12] *and Appendix 5.8*[13].

Following this, these reports were then analysed and the impact assessment process outlined in *Volume 1* was applied.

7.5.1.1 Study Area

Figure 5.7.2 shows the location of survey transects, spotlight routes, Anabat units and trap lines for mammals on Curtis Island. Similar maps showing the location of transects and survey points are provided for vegetation (*Appendix 5.5 Figure 1*), reptiles and amphibians (*Appendix 5.6, Map 1*), and birds (*Appendix 5.7, Figures 3, 3a* and *4*; and *Appendix 5.8, Figures 3a* and *3b*).

10 Unidel (2009) *QC LNG – Curtis Island Components: Flora Report*.

11 Unidel (2009) *QC LNG – Curtis Island Components: Reptiles and Amphibians Report*

12 Rohweder, Dr D, and Charley D (2008) *QGC Queensland Curtis LNG Project, Curtis Island: Targeted Bird Survey*. .

13 Rohweder, Dr D, and Charley D (2009) *QGC Queensland Curtis LNG Project, Curtis Island: Supplementary Targeted Bird Survey*..

7.5.1.2 *Defining Conservation Significance*

"Significant" species (or ecological communities) referred to in this document include all those listed as:

- Endangered, Vulnerable or Rare under the Queensland *NC Act*
- Critically Endangered, Endangered or Vulnerable under the *EPBC Act*
- migratory under the *EPBC Act* and those listed on international agreements such as the JAMBA, CAMBA and ROKAMBA
- regionally or locally significant species that are recognised as such in the literature (eg. FBBAP)
- rare or threatened Australian plants (ROTAPs) in Briggs and Leigh (1996)[14].

7.5.1.3 *Desktop Assessments*

State and Commonwealth agency database searches were undertaken to identify the potential occurrence (or recorded occurrence) of significant fauna and flora species within the study area and within the locality (within a 10 km radius of the study area). The following resources were accessed in August 2008:

- Queensland Environmental Protection Agency (EPA) Wildlife Online:http://www.epa.qld.gov.au/nature_conservation/wildlife/wildlife_online/
- Commonwealth *EPBC Act* protected matters search:http://www.environment.gov.au/cgibin/sprat/public/publicthreatenedlist.pl
- Queensland EPA Regional Ecosystem (RE) Description Database and RE mapping:http://www.epa.qld.gov.au/nature_conservation/biodiversity/regional_ecosystems/.

Literature reviews undertaken by specialist consultants are referenced in the reports provided in *Appendix 5.5* to *Appendix 5.8*.

14 Briggs J D and Leigh J H (1996) ***Rare or Threatened Australian Plants*** *(Revised Edition)*

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Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business
Drawn	JB
Approved	MB
Date	19.03.09
Volume 5	Figure 5.7.2
File No:	0086165b_EIS_TE_GIS002_F5.7.2
Revision	2

Title **Mammal Transect and Survey Locations**

7.5.2 Terrestrial Flora

7.5.2.1 Flora Desktop Assessment

The flora desktop assessment included:

- review of the Queensland Wildlife Online database, Queensland Herbarium Records data and the Department of Environment, Water, Heritage and the Arts (Commonwealth) Protected Matters flora data
- review of the Queensland Herbarium RE mapping (Version 5.0 2005) to establish those vegetation communities mapped by the Queensland Herbarium at a scale of 1:100 000
- examination of satellite imagery to gain an appreciation of the proximity of the LNG Facility, pipeline corridor on Curtis Island and Ancillary Infrastructure to sensitive areas, assess vegetation patterns and identify target areas for field investigations.

It is recognised that there are caveats attached to information gained from databases, in particular regarding the robustness or completeness of the information. Wildlife Online data is based almost exclusively on plant specimens actually recorded as present in the given locations. The absence of any specimen records for a particular species from an area does not imply that that species does not occur in the area.

Data from the DEWHA website is based on a combination of actual records, primarily from Queensland Government databases, combined with modelled distributions of species according to their ecological characteristics.

7.5.2.2 Flora Field Survey

The field survey was designed to:

- confirm the presence/absence of those REs mapped by the Queensland Herbarium and listed as Endangered and Of Concern REs under Queensland legislation
- confirm the presence/absence of coastal wetlands as mapped by the former Department of Primary Industries (now Department of Employment, Economic Development and Innovation)
- determine the structure and condition of vegetation communities on the site
- identify any plant species afforded additional protection under Commonwealth or Queensland legislation
- gain an understanding of the wider environment of the LNG Facility site, road and pipeline corridors so that potential impacts associated with proposed clearing could be discussed in local and regional contexts.

The site survey was conducted in accordance with the Queensland Herbarium vegetation survey methods described in Nelder *et al.* (1999)[15]. A total of 35 sites were surveyed (see *Appendix 5.5, Figure 1*), with the following data collected:

- confirmation of mapped RE
- general description of vegetation
- structural characteristics of vegetation (based on life forms, height and canopy cover)
- groundcover characteristics
- vegetation condition (integrity) (as either pristine, excellent, very good, good, degraded or completely degraded)
- occurrence of weed species.

7.5.3 Reptiles and Amphibians

Surveys for reptiles and amphibians were undertaken within the study area and in other habitats on Curtis Island.

Pit-fall traps, spotlighting and day-searching for amphibians and reptiles were conducted on-site between 6th and 16th October 2008. Eight pit-fall lines were established. Four of these lines were established on 6th October, another three on the 8th October with a final line added on 11th October. All traps were removed 16th October, with pit-fall trapping effort equated to 69 trap-days.

Traps were placed across the study area in order to sample a representative range of habitats. These included *Corymbia citriodora* forest, *Eucalyptus crebra* woodlands and the saline margins of mangroves fringing The Narrows (see,*Appendix 5.6, Map 1*).

In addition to trapping, the study area was traversed during the day on foot and via vehicle, and records of opportunistic sightings or hand-capture by survey teams were made during all site visits.

The study area was also surveyed for additional frog species by traversing the site at night and assessing several dams adjacent to the site. The dams were located in similar habitat to the study area. Therefore, species identified at these dams would potentially have a high likelihood of occurrence across the whole area.

15 Nelder V J, Thompson E J, Bean A R and Dillewaard H A (1999) ***Methodology for survey and mapping of vegetation communities and regional ecosystems in Queensland (draft working copy)***

7.5.4 Birds

Prior to the commencement of field surveys, aerial photographs and RE mapping were reviewed to identify major fauna habitats. A foot-based traverse of the study area was conducted on 29th September 2008 to further verify the type and distribution of bird habitat. Sample sites were allocated to each RE and habitat type. To ensure that sample sites did not overlap, sites within a habitat or ecosystem were located a minimum of 400 m apart where possible. Field surveys were conducted over a total of 19 days, from 29th September to 3rd October 2008, 6th to 9th October 2008, 26th to 28th January 2009, and 16th to 22nd February 2009. Further detail on survey methodology is provided in *Appendix 5.7 and Appendix 5.8.*

7.5.4.1 *Area Searches*

A total of 62 two-hectare sample plots were established throughout the study area with replicate plots situated in each of the major vegetated habitats. Each plot was sampled on two occasions with 20 minutes spent recording bird species during each survey. All area-searches were conducted between 0600 hrs and 0930 hrs.

7.5.4.2 *Dusk Surveys*

Dusk surveys were conducted at ten sites between 1700 hrs and 1845 hrs by two observers for between 30 minutes and 60 minutes. During the survey all species and the number of individuals, calling or sighted, were recorded.

7.5.4.3 *Fauna Features Traverse*

The study area was traversed on foot during each day of the survey. Surveys were undertaken using the random meander traverse method to search for specific fauna features, such as roost or nest trees, raptor nests, button-quail feeding sites, additional bird habitats and additional bird species.

7.5.4.4 *General Species List*

Birds within the study area were sampled opportunistically during a random meander and habitat assessment. During these surveys all potential bird habitats were sampled and a general bird species list for each was developed.

7.5.4.5 *High And Low Tide Surveys*

Intertidal habitat was sampled during high and low tide to assess use of the site by estuarine birds, particularly shorebirds (*Order Charadriiformes*). Surveys were undertaken on ten occasions assessing high, spring and neap tide conditions. The time of high and low tide was determined through visual observation of water level on-site and with reference to National Tidal Centre

tide predictions and local tide variations. Sites are shown in *Appendix 5.7, Figure 3*, and *Appendix 5.8, Figure 3*.

At high tide, transects were established parallel to and on the landward side of the mangrove fringe and traversed by two observers. At low tide the study area was divided into two areas and each area was traversed on foot by two observers. Low tide surveys were also conducted in the vicinity of the mainland access road corridor and along the southern coastline of Curtis Island in the vicinity of, and adjacent to, the LNG Facility. A known high tide shorebird roost in the vicinity of South End on Curtis Island was surveyed on 3rd October 2008 to compare shorebird roosts within the study area to regional assemblages.

During each survey all species were identified and the number of individuals per species was recorded. To avoid double counting each site was approached systematically and the direction of flight for birds that were flushed was recorded.

7.5.4.6 Call Broadcast

Selective call broadcast was undertaken during the day to illicit a response from species that were expected to be common in the subject site, namely Shining Flycatcher (*Myiagra alecto*) and Mangrove Honeyeater (*Lichenostomus fasciogularis*). Dusk call broadcast was conducted for Black Bittern (*Ixobrychus flavicollis*) on two nights at three sites along the mangrove fringe. Nocturnal call broadcast was conducted on eight nights between 1830 and 2100hrs at eight sites. Sites are shown in *Appendix 5.7, Figure 3a* and *Appendix 5.8, Figure 3b*.

Early evening call broadcasts was undertaken to maximise the opportunity of detecting owls that were roosting on, or in close proximity to, the site. Calls of five species, Eastern Barn Owl (*Tyto javanica*), Masked Owl (*Tyto novaehollandiae*), Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*) and Bush Stone-curlew (*Burhinus grallarius*), were broadcast at all sites, unless a species was detected during the preceding dusk census. Calls were broadcast for five minutes with a three to five minute gap between calls. Ten minutes was spent listening for calls prior to and after broadcast and a brief spotlight survey of the playback site was conducted at the completion of the final 10 minute listening period.

Nocturnal call broadcast was conducted by two personnel in conjunction with spotlight surveys, for a maximum period of two hours per night. Call broadcasting was only undertaken in habitats that were likely to support the target species.

7.5.4.7 Waterhole Surveys

In October, due to the absence of freshwater in the study area, observations were conducted at two small stock watering dams (*Figure 3a, 5.8*). This

survey aimed to identify additional species that may utilise the study area but were absent during the survey due to the lack of freshwater. Each waterhole survey extended for 60 minutes and surveys were conducted during the mid morning, midday and late afternoon.

7.5.4.8 Shoreline (Chat) Survey

Targeted Yellow Chat (*Ethianura crocea macgregori*) surveys were conducted in saltmarsh and other wetland habitats along the shoreline adjacent to the study area and within the vicinity. The EPA (since incorporated within DERM) states that on Curtis Island Yellow Chat occurs in swampy grassland and saline herbland, in which it probably feeds on insects. In winter the species has been recorded in only a few small areas of sedge on the island.

Shorelines within the study area are heavily degraded by feral ungulates (hoofed animals) and support few patches of grassland and saline herbland. Potential saline herbfield, saltmarsh and other degraded habitats were targeted during the Yellow Chat surveys (See *Appendix 5.7, Figure 3a* and *Appendix 5.8, Figure 3a & 3b*). Shoreline surveys were conducted on four occasions between 6th and 9th October 2008, with two ecologists traversing the area on foot. During each traverse the shoreline was scanned using binoculars for any signs of Yellow Chat, and records were made of any suitable habitat features that the species may utilise at each site.

7.5.4.9 Habitat Assessment

Habitat was assessed within a 25 m by 25 m quadrant within a majority of the 2 ha (area search) plots. The aim of the survey was to categorise the habitat types occurring within the study area and to determine their suitability for threatened and rare avifauna species. A standard habitat assessment proforma was used to collect information on fauna habitat features, including, disturbance history, vegetation structure and floristics, density of arboreal hollows, foraging resources and ground layer attributes.

7.5.4.10 Targeted Surveys for Threatened Species

Bird species listed on the Queensland *NC Act* and/or the Commonwealth *EPBC Act* with the potential to occur within the locality was targeted during field surveys. Targeted searches were incorporated in call playback methodology for nocturnal species, high and low-tide surveys for shorebirds, shoreline counts for Yellow Chat, fauna feature traverses and habitat assessments. Any indications of threatened species occurring within the study area, including suitable habitat features, animal remains, faecal and regurgitate pellets, bird calls and opportunistic sightings was recorded.

7.5.5 Butterflies

Butterflies were recorded opportunistically while conducting other activities. Particular attention was focused on recording butterflies around flowers in mangrove and woodland habitat, where species listed on the *NC Act* and/or the *EPBC Act* were most likely to occur. Observations were made in the early and mid-morning, while conducting morning bird surveys and habitat assessments.

7.5.6 Mammals

Mammal surveys were designed to gain an understanding of the types of native mammal species that may use the study area, as well as to target threatened species considered to have the potential to occur there. The potential occurrence of a species was assessed based on the results of the desktop assessment and the habitat types that occur within the study area. Mammal species survey methods are described in the following sections.

7.5.6.1 General Habitat Assessments

Notes on the habitat attributes of the study area were made during targeted fauna and vegetation surveys and during previous inspections of the study area in June 2008. In particular, any occurrence of the following habitats of significance was noted:

- hollow-bearing trees (an important resource for a variety of arboreal fauna and bird species)
- termite mounds
- riparian areas and drainage lines
- rocky outcrops or caves
- areas containing significant structural diversity.

7.5.6.2 Hollow-bearing Tree Assessments

The purpose of the hollow-bearing tree assessments was to estimate the density of this habitat resource within the study area. Six strip transects of 20 m x 250 m were used to record the size, distribution and abundance of tree hollows to assess habitat quality for arboreal mammals roosts and nests at the study area. Within each transect hollow-bearing trees were recorded with a Global Positioning System (GPS). Transects were distributed across a range of habitats to account for spatial variation in habitat type across the site.

7.5.6.3 Evidence Based Searches

Searches were undertaken for scats, tracks, traces, scratches on trees, feeding scars on trees, signs of burrowing in soil or foraging in leaf litter,

mammal runs or nests in ground cover vegetation and possum drays. Any scats that were unable to be identified in the field were sent to identification specialist for analysis. Searches were conducted on foot using the random meander technique and were generally undertaken in conjunction with habitat assessments, hollow-bearing tree searches and trap setting and recovery.

7.5.6.4 *Mammal Trapping*

Mammal trapping was undertaken to assess the types of ground-dwelling mammals inhabiting the study area. Seventy A+ size Elliott traps were laid out in seven transects of 10 traps each. Transects were distributed across a variety of vegetation types and aspects to account for biophysical site variation and to enhance the likelihood of detecting a range of species within the study area. Transect locations are shown on *Figure 5.7.2.*

Mammal trapping was undertaken over four nights from 29th September to 2nd October 2008 and again over three nights from 13th to 15th October 2008, giving a total of 490 trap nights. Traps were baited with peanut butter, rolled oats and honey (mix) or with sardines, depending on the trap location and the target species. All traps were checked before 9 am each morning, after which they were closed, before being reopened at dusk. This method was employed to prevent any non-target species (such as skinks) entering the traps during the day.

7.5.6.5 *Hair-funnel Survey*

During the spring survey period, 20 Faunatech hair funnels were deployed in two ten-funnel transects from 13th October and collected on 3rd November 2008 (21 days). One hundred hair funnels were deployed in summer for 14 days from 12th to 26th February 2009 (see *Figure 5.7.2* for locations), for a combined total of 1820 funnel nights.

Funnels were baited with either a mix of rolled oats, peanut butter and honey, or with sardines. Sardines were used to attract carnivorous mammals, in particular Dasyurids. For all transects, funnels were placed on the ground and spaced at 25 m intervals along the length of a 250 m transect. The 100 funnels used in the summer survey were deployed in two, 10-trap transects using the oat mix only, and four, 20-trap transects each with paired oat and sardine baited funnels.

7.5.6.6 *Spotlighting*

Spotlighting was undertaken on foot throughout the study area for four nights from 29th September to 2nd October 2008; three nights from 13th to 15th October 2008; and four nights from 13th to 17th February 2009. A total of 108 person hours of spotlighting was conducted in the study area.

Spotlighting commenced at sunset and continued for a period of approximately three hours using handheld spotlights of 55 W to 100 W. All habitat types were investigated and quiet listening was undertaken for periods of up to 10 minutes during each of the spotlighting sessions. All vertebrate species observed and heard were recorded. The locations of spotlighting surveys are shown on *Figure 5.7.2*.

7.5.6.7 Call Broadcast

Targeted call broadcasting was undertaken in the aim of detecting Yellow bellied Glider (*Petaurus australis australis*), and Squirrel Glider (*Petaurus norfolcensis*). For each species the call broadcast was preceded by three minutes of listening at a given site. A series of calls for a single species was then broadcast for three minutes, followed again by three minutes listening. This process was repeated a total of three times, or until a response was detected. Spotlighting commenced again after the call playback procedure was undertaken. Call broadcasting was undertaken at 10 sites for Yellow-bellied Glider over four nights and at three sites for Squirrel Glider over two nights.

7.5.6.8 Anabat Detection

Ultrasonic bat call detection was undertaken at four sites in the study area. Two Anabat units were each deployed at two separate sites for two nights over a four night period between 13th and 17th February 2009. Sites selected were those where the detection of microchiropteran bats was probable, such as flyways, over waterbodies, open areas and close to shorelines (see *Figure 5.7.2* Anabats were time-delayed to commence recording at 5 pm and to cease at 7 am.

7.5.6.9 Flying-fox Camp Assessment

Anecdotal evidence of a flying-fox camp was investigated on 17th February 2009. The site was investigated for signs of activity, particularly for the presence of Grey-Headed Flying-fox (*Pteropus poliocephalus*). The target area was traversed on foot during daylight hours and an evening emergence count was undertaken by four personnel for one hour over dusk. All calls and observations of animals emerging from the location were recorded. The survey was undertaken from a small boat with a clear perspective of the potential camp site, at a distance of approximately 80 m from the shore.

7.6 RESULTS

7.6.1 Desktop Assessment

Wildnet database searches found a total of six threatened flora species and 18 threatened fauna species within a 10 km radius of the study area. A protected matters search (*EPBC Act*) revealed a number of threatened flora and fauna species considered to have the potential to occur within the study area.

A consideration of whether threatened species identified in desktop assessments are likely to occur within the study area, or to be impacted by the proposed Project, is provided in *Appendix 5.5, Table 3*; *Appendix 5.8, Table 3;* and *Annex 5.2, Table 1* and *Table 2*.

7.6.1.1 Threatened Flora Species

A protected matters search (*EPBC Act*) revealed eight threatened flora species considered to have the potential to occur with the study area (refer *Table 5.7.1*). A search of the Queensland EPA Wildlife Online database and records from the Queensland herbarium revealed a total of six threatened or rare flora species (*NC* Act) previously recorded within the locality (refer *Table 5.7.2*).

Table 5.7.1 Threatened flora species within the locality – EPBC search

Species	*EPBC Act* Status
Atalaya collina	E
Bosistoa selwynii (Heart-leaved Bosistoa)	V
Bosistoa transversa (Three-leaved Bosistoa)	V
Bulbophyllum globuliforme (Miniature Moss-orchid)	V
Cupaniopsis shirleyana (Wedge-leaf Tuckeroo)	V
Parsonsia larcomensis	V
Quassia bidwillii (Quassia)	V
Taeniophyllum muelleri (Minute Orchid, Ribbon-root Orchid)	V

1. From Online Protected Matters Search undertaken August 2008
2. The values of *EPBC Act* are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V)

Table 5.7.2 Threatened and rare flora species within the locality – Wildlife Online

Species	*NC Act* Status	*EPBC Act* Status
Alyxia magnifolia	R	-
Asplenium pellucidum	V	V
Atalaya rigida	R	-
Bosistoa transversa (Three-leaved Bosistoa)	C	V
Cupaniopsis shirleyana (Wedge-leaf Tuckeroo)	V	V
Hernandia bivalvis	R	-

1. Under the *NC Act*: The codes are Presumed Extinct (PE), Endangered (E), Vulnerable (V), Rare (R), Common (C) or Not Protected (NP)
2. The values of *EPBC Act* are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V)

7.6.1.2 *Threatened Fauna Species*

A protected matters search (*EPBC Act*) found 20 threatened fauna species considered to have the potential to occur within the study area (*Table 5.7.3*). A search of the Queensland EPA Wildlife Online database revealed a total of 19 threatened or rare terrestrial fauna species previously recorded within the locality (refer *Table 5.7.4*).

Table 5.7.3 Threatened fauna species within the locality – EPBC search

Species	*EPBC Act* Status
Birds	
Erythrotriorchis radiatus (Red Goshawk)	V, M
Geophaps scripta scripta (Squatter Pigeon - southern)	V
Macronectes giganteus (Southern Giant-Petrel)	E, M
Pterodroma neglecta neglecta (Kermadec Petrel - western)	V,
Rostratula australis (Australian Painted Snipe)	V
Turnix melanogaster (Black-breasted Button-quail)	V
Mammals	
Balaenoptera musculus (Blue Whale)^	E, M
Chalinolobus dwyeri (Large-eared Pied Bat)	V
Dasyurus hallucatus (Northern Quoll)	E
Megaptera novaeangliae (Humpback Whale)^	V, M
Xeromys myoides (Water Mouse, False Water Rat)	V
Reptiles	
Caretta caretta (Loggerhead Turtle)#	E, M
Chelonia mydas (Green Turtle)#	V, M
Denisonia maculata (Ornamental Snake)	V
Dermochelys coriacea (Leatherback Turtle)#	V, M
Egernia rugosa (Yakka Skink)	V
Eretmochelys imbricata (Hawksbill Turtle)#	V, M
Lepidochelys olivacea (Pacific Ridley, Olive Ridley)#	E, M
Natator depressus (Flatback Turtle)#	V, M
Paradelma orientalis (Brigalow Scaly-foot)	V

1. From Online Protected Matters Search undertaken August 2008
2. ^ = Entirely marine species
3. # = Marine species dependant upon terrestrial environments for breeding

Table 5.7.4 Threatened and rare fauna species within the locality – Wildlife Online

Species	*NC Act* Status	*EPBC Act* Status	Sighting Records (EPA)
Birds			
Accipiter novaehollandiae (Grey Goshawk)	R	M	1
Ephippiorhynchus asiaticus (Black-necked Stork)	R		1
Esacus magnirostris (Beach Stone-curlew)	V		2
Epthianura croceri macgregori (Yellow Chat)	E	CE	2
Geophaps scripta scripta (Squatter pigeon)	V	V	6
Haematopus fuliginosus (Sooty Oystercatcher)	R		1

Lewinia pectoralis (Lewin's Rail)	R		1
Lophoictinia isura (Square-tailed Kite)	R	M	2
Melithreptus gularis (Black-chinned Honeyeater)	R		1
Nettapus coromandelianus (Cotton Pygmy-goose)	R	M	2
Ninox strenua (Powerful Owl)	V		1
Numenius madagascariensis (Eastern Curlew)	R	M	13
Tadorna radjah (Radjah Shelduck)	R	M	2
Mammals			
Chalinolobus picatus (Little Pied Bat)	R		2
Taphozous australis (Coastal Sheathtail Bat)	V		4
Reptiles			
Caretta caretta (Loggerhead Turtle) #	E	E, M	1
Chelonia mydas (Green Turtle) #	V	V, M	3
Natator depresus (Flat-backed Turtle) #	V	V, M	1
Varanus semiremex (Rusty Monitor)	R		1

1. Under the *NC Act*: The codes are Presumed Extinct (PE), Endangered (E), Vulnerable (V), Rare (R), Common (C) or Not Protected (NP)
2. The values of *EPBC Act* are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V)
3. Records: indicates the total number of records of the taxon on the database
4. # = Marine species that is reliant on the terrestrial environment for breeding

7.6.2 Field Survey Results

7.6.2.1 Terrestrial Flora and REs

Vegetation within the site was found to be in average to good condition. In certain areas shrub and ground layer vegetation was dominated by *Acacia* species and herbaceous weeds, apparently as a product of historic land use and previous fire events.

EPBC Act Endangered Ecological Communities

A field survey confirmed that no vegetation communities listed under the *EPBC Act* occur within, or within the vicinity of, the study area.

VM Act 'Endangered' Regional Ecosystems

Endangered RE 12.3.3 (Blue Gum open woodland on alluvial plains) was verified at eight locations within the study area. The field surveys found that all areas mapped as the mixed community RE 12.3.3/12.3.7 showed only characteristics of the RE 12.3.3.

The principal occurrence of the RE 12.3.3 within the southern third of the LNG Facility site included an area of approximately 37.05 ha. This RE was generally found to be in good condition. There was some evidence of erosion and herbaceous weeds that were found to be prevalent due to high water and nutrient availability.

The pipeline on Curtis Island transects the edge of a remnant of RE 12.3.3. The area of RE 12.3.3 estimated to fall within the proposed pipeline corridor is 0.44 ha. Field surveys of this area found it to be in an average condition as a result of historic land use and previous fires. The shrub and ground layers in places were dominated by a number of *Acacia* species and herbaceous weeds.

RE 12.3.3 also occurs near the southern end of the proposed Curtis Island Road and (as a subdominant component of a 90/10 mosaic) near the southern end of the Mainland Road and Bridge Approach corridor. The total area of these communities within the footprint of these roads is approximately 2.15 ha. However RE areas of the proposed roads and bridge approach have been provided for informative purposes only.

The total area of Endangered RE within the proposed LNG Facility and pipeline corridor is approximately 37.49 ha.

***VM Act* 'Of Concern' Regional Ecosystems**

Areas of Of Concern Dominant RE 12.3.11 (Grey Ironbark open woodland on alluvial plains) and Of Concern Subdominant RE 12.11.14 (ironbark woodlands on metamorphics ± interbedded volcanics) were identified within the study area.

The field survey found RE 12.3.11 to be present at the most northern point of the pipeline corridor and the Curtis Island Road corridor and a small area of the LNG Facility. The remnant that occurred over the pipeline and road corridor was generally found to be in average condition due to regular fires and weed infestations. However, the small area of RE 12.3.11 (1.5 ha) that occurred within the LNG Facility site was found to be in good condition due to low weed density and was considered high-quality fauna habitat. The total area of RE 12.3.11 that occurs within the LNG Facility and pipeline corridor is approximately 2.35 ha.

A portion of the proposed Curtis Island Road corridor to the east of the LNG Facility site and a smaller area to the south of the LNG Facility site cross a mixed forest of RE 12.11.6/12.11.14 (mosaic ratio of 85:15).

Field survey confirms that the subdominant Of Concern community RE 12.11.6/12.11.14 occurs as belts of vegetation crisscrossing the LNG Facility site. Field surveys found this community to be in average condition as a result of regular fires in the area.

Two remnants of RE 12.11.6/12.11.14, additional to those identified in the existing Queensland Herbarium RE mapping were identified during the field survey. In total, approximately 6.74 ha of RE 12.11.14 occurs within the LNG Facility site [as part of a total of approximately 44.95 ha of mixed 12.11.6/12.11.14 shown on *Figure 5.7.6*]. Due to the openness of the native vegetation and high weed density, these remnants were considered to be in poor condition. The total area of RE 12.11.14 within the area to be cleared of the proposed LNG facility site and pipeline corridor is approximately 8.28 ha.

The total area of RE Of Concern (dominant and subdominant) within the area to be cleared of the proposed LNG Facility site and pipeline corridor on Curtis Island is approximately 10.63 ha.

***VM Act* 'Not Of Concern' Regional Ecosystems**

According to the Queensland Herbarium RE mapping, REs 12.1.2, 12.1.3, 12.3.7 and 12.11.6 occur within the LNG Facility site. The field survey found this to be generally accurate with the notable exception that the area mapped as RE 12.3.3/12.3.7 was in fact RE 12.3.3, with no RE 12.3.7 observed on the entire site.

RE 12.1.2 (saltpan vegetation) was found to be in generally very poor condition with only a few clumps of vegetation present. This low density of vegetation was likely to be due to trampling and grazing by cattle and feral horses.

RE 12.1.3 (mangroves) adjacent to the LNG Facility site showed evidence of significant dieback and was found to be in a degraded state. However, the mangrove areas to the north and the south of the LNG Facility site were generally observed to be in a good condition. Laird Point was an exception where mangroves were found to be in a degraded condition due to the accumulation of organic matter around mangrove roots.

RE 12.11.6 (Open forest of Lemon-scented Gum and Narrow Leaf Ironbark on metamorphics ± interbedded volcanics) present within the LNG Facility site were generally found to be in average condition with evidence of regular fire damage. These regular fires were likely to be a contributing factor to the limited shrub layer observed in some areas.

Not Of Concern REs that occurred in the proposed Curtis Island Road, Mainland Road and Bridge Approach and pipeline corridors were RE 11.1.2, 11.1.4, 12.1.2 and 12.11.6, while RE 11.3.29 occurred in the road corridor only. A significant portion of the road corridor to the east of the LNG Facility site and a smaller area to the south of the LNG Facility site occurred in a mixed woodland of RE 12.11.6/12.11.14. This area was found to be in average condition due to frequent fire damage and a high weed density in the area.

The proposed road corridor on Curtis Island crossed very small areas of RE 12.1.2 where it crossed the coast near each end of the road. A significant portion of the road corridor on the mainland crossed RE 11.1.2 and 11.1.4. As the saltpan vegetation and mangrove communities were not able to be inspected due to access constraints they were assumed to be in good condition. The southern portions of the proposed road corridor on the mainland crossed a mosaic RE which is dominated by RE 11.3.29. Site surveys at two locations within this RE observed that the condition was degraded due to frequent fire damage and a high weed density in the area.

The total area of Not Of Concern REs within the area to be cleared of the proposed LNG Facility and pipeline corridor is approximately 101 ha.

Findings of Assessment In Relation to Coastal Wetlands

Wetlands mapped by Department of Natural Resources and Water as coastal wetlands were observed to consist of tidal mud/salt flats. These areas were predominantly bare with only one or two small clumps of saltmarsh species present, and were considered to be in degraded condition.

The mangrove and wetland areas crossed by the road corridor on the mainland were not inspected in the field and were assumed to be in good condition (for the purposes of this assessment).

A summary of the Terrestrial Flora and REs described in the above sections is provided in *Table 5.7.5*.

Revised RE mapping of the study area based on the findings of this assessment is provided in *Figure 5.7.3*.

A detailed summary of the survey results for each site is provided in *Appendix 5.5, Attachment 3*. A complete list of all flora species recorded in the study area is provided in *Appendix 5.5, Attachment 4*.

Scheduled Flora Species

Four scheduled flora species were indentified as having preferred habitat within the study area (*Table 5.7.6*), and were specifically targeted during the field survey. However, none of the scheduled flora species were recorded within the study area during the field survey. Therefore, based on the survey effort and the existing level of disturbance, scheduled flora species are not expected to occur within the study area.

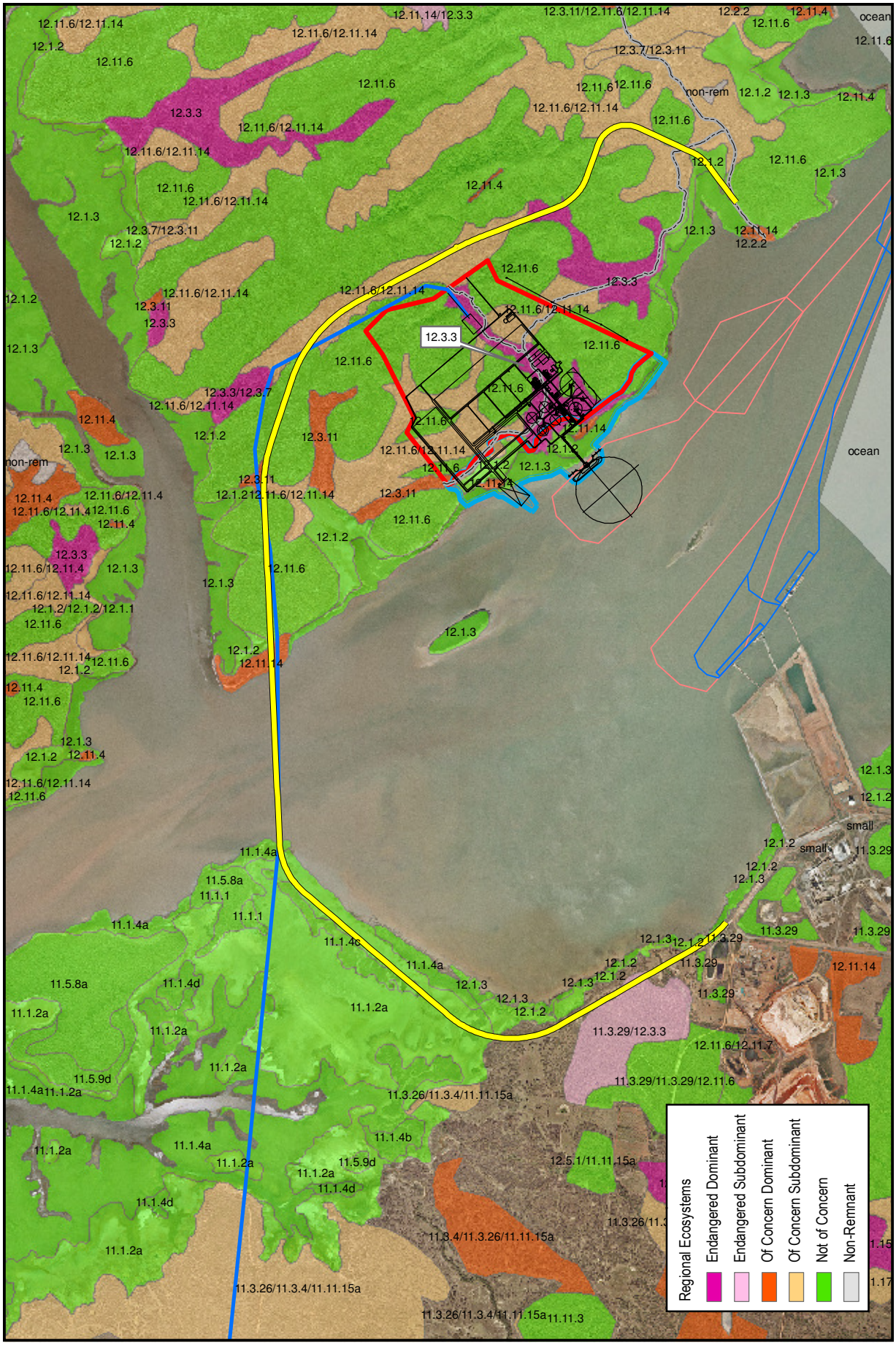
Declared Weeds

Three declared species were recorded within the study area during the field surveys. These were:

- *Cryptostegia grandiflora* (Rubber Vine) Class 2
- *Opuntia* sp. (Prickly Pear) Class 2
- *Lantana camara* (Lantana) Class 3.

The most abundant of these was Prickly Pear, which was found to be most prevalent around the marine fringes.

C. grandiflora and *L. camara* are listed on the Weeds of National Significance list, which was developed in 1999 in an attempt to classify Australia's most prominent weed threats and to prioritise regional, state and national actions.



Projection: UTM MGA Zone 56 Datum: GDA 94

0 250 500 1,000 m

N

Source Note:
Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
Curtis Island Road/Bridge Corridor - Connell Wagner
Disclaimer: Positional Accuracy of RE Data mapped at a scale of 1:100,000 is 100 metres.
Survey and Mapping of 2003 Remnant Vegetation Communities and Regional Ecosystems of Queensland, Version 5.0, EPA (Dec 2005), Certified Regional Ecosystem Map Amendments under the Vegetation Management Act (1999), EPA, 20/08/2008.
Field Assessments undertaken by Unidel as reported in "Revised Regional Ecosystem Mapping"

Legend

- Possible Curtis Island Road/Bridge Corridor
- Existing Access Track
- Indicative Wet Lease Area
- Proposed QCLNG Site Boundary
- Proposed Swing Basin & Shipping Channel
- Existing Shipping Channel
- Proposed Export Pipeline

QUEENSLAND CURTIS LNG
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Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business

Title Revised RE Mapping of the Study Area (Based on Field Assessments)

Drawn	JB	Volume 5	Figure 5.7.3
Approved	MB	File No:	0086165b_EIS_TE_GIS003_F5.7.3
Date	19.05.09	Revision	2

Disclaimer:
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ERM does not warrant the accuracy of any such Maps and Figures.

Table 5.7.5 RE's occurring in the study area, status, and indicative area to be cleared under the proposal

Vegetation Community/RE		Status*			Estimated Area to be Cleared (ha)[4]			Total Area Cleared (ha)	% cleared in 10 km buffer
RE code	RE Description	*EPBC Act*	*VM Act*	Biodiversity	LNG Facility	Pipeline (Curtis Island)	Road Corridor		
11.1.2	Samphire forbland on marine clay plains		NOC	NOC			10.21	10.21	1.39
11.1.4	Mangrove forest/woodland on marine clay plains		NOC	NOC			3.54	3.54	0.33
11.3.29	*Eucalyptus crebra*, *E. exserta*, *Melaleuca* spp. woodland on alluvial plains		NOC	NOC			3.35	3.35	0.63
12.1.2	Saltpan vegetation including grassland and herbland on marine clay plains		NOC	NOC	3.5		0.43	3.93	0.19
12.1.3	Mangrove shrubland to low closed forest on marine clay plains and estuaries		NOC	NOC	8			8	0.07
12.3.3	*Eucalyptus tereticornis* woodland to open forest on alluvial plains		E	E	37.05	0.44	2.15	39.64	4.62
12.3.7	*Eucalyptus tereticornis, Melaleuca viminalis, Casuarina cunninghamiana* fringing forest		NOC	NOC		0.28		0.28	0.05
12.3.11	*Eucalyptus siderophloia, E. tereticornis, Corymbia intermedia* open forest on alluvial plains usually near coast		OC	OC	1.5	0.85	1.01	3.36	0.64
12.11.6	*Corymbia citriodora, Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics		NOC	NOC	70.15	19.15	29.88	119.18	1.21
12.11.14	*Eucalyptus crebra, E. tereticornis* woodland on metamorphics ± interbedded volcanics tree species.		OC	OC	6.74	1.54	3.49	11.77	2.04

1. Under the *VM Act*: The codes are Endangered (E), Of Concern (OC), and Not Of Concern (NOC)
2. The values of *EPBC Act* are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V)
3. Road refers to Curtis Island Road and Mainland Road and Bridge Approach.
4. The estimated area to be cleared shown here differs slightly from that shown in Appendix 5.5. Appendix 5.5 includes total area within the LNG Facility Boundary, while Table 5.7.5 addressed only that area within the LNG Facility boundary that will be cleared.

Table 5.7.6 Scheduled flora species with the potential to occur within the study area

Species	*EPBC Act* Status	*VM Act* Status	Habitat
Atalaya collina	E	E	Grows on hillsides, in remnant dry scrubs, together with *A. salicifolia,* but is not as common as that species (Reynolds, 1991).
Atalaya rigida		R	Restricted to eastern Qld from Mt Aberdeen near Bowen, south to Mt Glastonbury south west of Gympie. Occurs in vine thicket and *Araucarian microphyll notophyll* vineforest on red clay soil or black clay loam (DNR, 1999).
Hernandia bivalvis (Cudgerie)		R	Vine forests on rocks with shallow soils (DNR, 1999).
Quassia bidwillii (Quassia)	V	V	Below 650m in rainforests, open forest, woodland and mangroves (DNR,1999).

1. Under the *VM Act*: The codes are Presumed Extinct (PE), Endangered (E), Vulnerable (V), Rare (R), Common (C) or Not Protected (NP)
2. The values of *EPBC Act* are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V)

The non-declared weed *Praxelis clematidea* (Praxelis) was also observed within the study area. This weed is rapidly spreading throughout parts of Northern Queensland and is currently listed on the Alert List for Environmental Weeds collated by DEWHA (A weed profile for this species is provided as, *Appendix 5.5, Attachment 5*).

Generally, weeds were found to be in low abundance within the study area. The weeds that were most commonly observed were generally found to be herbaceous non-problematic species.

7.6.2.2 Reptiles and Amphibians

The field surveys identified 20 reptile species, 11 native frog species and one introduced toad species. Numbers of individuals and results per capture/observation technique are presented in *Appendix 5.6, Table 1.* Observations of species encountered in the field have been included in *Appendix 5.6, Maps 2 – 6*.

The species recorded are typical of those found in the Gladstone region and none are listed as threatened species under Commonwealth or Queensland legislation.

Cane toad (*Bufo marinus*) was abundant across the study area. Densities of up to one individual per two square metres were commonly encountered on vehicle tracks at night.

The grassy and shrubby understorey of the forests and woodlands within the study area support an abundance of small skinks (*Carlia*, *Menetia* and *Cryptoblepharus* sp.). Larger reptiles were rare. Curtis Island residents reported that a number of larger reptile species (e.g. goannas and pythons) occur on the Island but they were not seen during the survey.

A full species list is included as *Appendix 5.6, Table 1*. Species anecdotally reported by residents are provided as *Appendix 5.6, Table 2*.

The eastern, seaward-facing beaches of Curtis Island are used as breeding sites by a number of sea turtles including the Flatback and Loggerhead. These species are listed threatened species under both Commonwealth and Queensland legislation. Discussions with residents prior to field assessments suggested that these species do not occur in the study area. Site inspections confirmed that there is no suitable turtle breeding habitat for these species within the study area.

Past records also indicate the presence of salt water or estuarine crocodile (*Crocodylus porosus*). Local sources report that crocodiles have not been recorded in the area during the past several decades. While the potential for crocodiles to occur in the area cannot be ruled out, no signs (slides or footprints) were detected in the study area during the course of the survey.

7.6.2.3 Birds

A combined total of 140 bird species was recorded during the 2008 and 2009 surveys. The level of survey effort and the attention focused on assessing bird habitat provided a good gauge of species richness with which to assess the likelihood of occurrence of threatened species. A full species list including scientific nomenclature for each species recorded within the study area is provided in *Appendix 5.8, Table A3*.

Species Richness

The richness of bird species within the study area is regarded as typical given the floristic and structural diversity of habitats within the study area and the distribution of flowering and fruiting plants.

Diurnal Birds

Spring Surveys

The diurnal species recorded in 2008 were typical of a late spring early summer survey. The highest species diversity and abundance was recorded in the Endangered RE 12.3.3/12.3.7 Forest Red Gum Narrow-leaf Ironbark (42 species) and in the RE 12.11.6 Lemon-scented Gum Narrow-leaf Ironbark Peppermint (54 species). Bird species diversity in the saltmarsh and mangrove communities (RE 12.1.3) was relatively low, with 17 and 28 species respectively.

During the first week of the survey, White-naped and White-throated Honeyeaters and Noisy Friarbirds were relatively common in the Forest Red Gum woodlands where both the Forest Red Gums and Ironbarks were flowering. This flowering event had almost finished by the completion of the survey. Honeyeater numbers declined significantly once flowering had ceased.

Seasonal migrants, such as the Forest Kingfisher and Leaden Flycatcher were common, with both of these species breeding at the time of survey.

The larger cuckoos including the Eastern Koel, Channel-billed Cuckoo and Pheasant Coucal were common in all habitats other than the saltpan and mangrove shrublands. The Brush Cuckoo and Horsfield's Bronze-cuckoo were also recorded in low numbers.

No introduced bird species were recorded during the surveys (refer *Appendix 5.7*, *Section 3*).

Summer surveys

The diurnal species recorded in 2009 were typical of a summer survey. Species diversity and abundance were highest in the Endangered RE 12.3.3/12.3.7 – Queensland Blue Gum (*Eucalyptus tereticornis*) – Grey Ironbark (*Eucalyptus crebra*) (59 species) and in the RE 12.11.6, -

Lemon-scented Gum (*Corymbia citriodora*)/Grey Ironbark (*Eucalyptus crebra*)/Queensland Peppermint (*Eucalyptus exerta)* (71 species).

Bird species diversity in the saltmarsh/claypan and mangrove communities (REs – 12.1.2 and 12.1.3) was relatively low, with 30 and 39 species respectively.

In 2009, the mainland mangrove habitats and associated estuarine wetlands were notable for their higher bird activity and abundance when compared with similar habitats on Curtis Island. Mangrove Honeyeaters, Collared Kingfisher, Mangrove Gerygone and Shining Flycatchers were frequently encountered on the mainland but were relatively rare in similar habitat on Curtis Island.

Squatter Pigeons were observed at four locations on the mainland but were not observed on Curtis Island. All of the mainland observations were within 150 m of a dam or creekline containing permanent fresh water. A number of immature birds were observed.

Detailed results are provided in *Appendix 5.8*, *Section 3*.

Nocturnal Birds

Seven species of nocturnal bird were recorded, including Barking Owl, Powerful Owl, Eastern Barn Owl, Southern Boobook, White-throated Nightjar, Australian Owlet-nightjar and the Bush Stone-curlew.

Survey results suggest that there are at least seven pairs of Barking Owl, one resident pair of Powerful Owl and a number of Southern Boobook pairs within the study area. The Barking Owl was recorded at five locations during the 2009 survey including pairs at three roost sites. These were in addition to the five locations, including a nest site and three roosts, located during the 2008 survey. The Barking Owl and Southern Boobook were relatively abundant and were recorded in a majority of the major REs within the study area. Both species were often recorded by unsolicited calls or located during foot traverses of the site.

A single Powerful Owl responded to call broadcast. An adult male was observed at close quarters after it responded to calls broadcast from a location at the eastern edge of the study area. It was observed within three minutes of the calls being broadcast and appeared to have come from a location close to the broadcast site. This observation is consistent with the results obtained during the 2008 surveys when a response to call broadcast was recorded from the same area.

During the 2008 survey a number of Sugar Glider (*Petaurus breviceps*) tails (three) were found during fauna feature traverses of the proposed LNG Facility site. The tails of this prey-species are typically removed by Powerful Owls following capture and their occurrence suggests that the Powerful Owl forages widely across the subject site. However, Barking Owls are also known to take Sugar Gliders and these prey remains may be the result of predation by Barking Owl rather than Powerful Owl.

The Bush Stone-curlew was recorded at a number of sites. Two pairs responded to call playback adjacent to the extensive mudflats of North China Bay and a pair was flushed from woodland habitat on the southern coastline of Curtis Island immediately south of the proposed road corridor within the study area. These were in addition to the birds recorded during the 2008 survey when seven birds were recorded. This species was not recorded on the mainland despite suitable habitat being present.

The White-throated Nightjar and Australian Owlet-nightjar were recorded at a number of nocturnal call broadcast locations and were also recorded opportunistically.

The Eastern Barn Owl was recorded at one location. One bird responded to calls broadcast from Nocturnal Call Playback Site 2 in the vicinity of Laird Point. The Masked Owl was not recorded.

Estuarine Birds

Six shorebird surveys were conducted on the most northerly claypan on the mainland site which is bisected by the proposed pipeline easement (*Appendix 5.8, Figure 3b*). Species diversity and abundance at these mainland sites was high. A total of 17 (estuarine) species was recorded: Bar-tailed Godwit, Whimbrel, Eastern Curlew, Common Greenshank, Grey-tailed Tattler, Terek Sandpiper, Great Knot, Red-necked Stint, Sharp-tailed Sandpiper, Pied Oystercatcher, Red-capped Plover, Pacific Golden Plover, Lesser Sand Plover, Beach Stone-curlew, Caspian Tern, Gull-billed Tern and Little Egret.

Shorebird populations within the Curtis Island study area were significantly lower than on the mainland and included: Bar-tailed Godwit, Whimbrel, Eastern Curlew, Pied Oystercatcher, Red-capped Plover, Beach Stone-curlew, Striated Heron, Masked Lapwing and Little Egret.

By way of comparison, high tide counts conducted at a roost site immediately to the west of South End on south-east Curtis Island recorded a minimum of 1,600 individuals of 16 species, including large flocks of Eastern Curlew, Whimbrel and Grey-tailed Tattler. Smaller flocks of Bar-tailed Godwit and Great Knot were also recorded.

A large number of Terek Sandpiper (105), 19 Grey-tailed Tattler and 35 Little Egret were recorded roosting in the mangroves and on a small sandspit at the southern end of South Passage Island. The numbers occupying this roost suggest that this site is of some significance. Two Buff-banded Rails and two Striated Herons were also recorded at this site.

Bird Habitat

Six broad bird habitats were recorded in the study area (See *Appendix 5.8, Figure 2b)*. The majority of habitats had been previously cleared or significantly disturbed. Previous land uses include cropping, dairy, grazing and horticultural activities. The structure and development of the vegetation

reflects these previous land uses. There was no freshwater recorded within the study area during spring surveys. However, surface water and freshwater runoff was abundant in the summer surveys. Further detail is provided in *Appendix 5.8, Section 3* and *Appendix 5.8, Section 3*.

Threatened and Migratory Species

Four species listed on the Queensland *NC Act* were recorded during the survey. These were: Squatter Pigeon, Powerful Owl, Beach Stone-curlew (all listed as Vulnerable); and Eastern Curlew (listed as Rare). Sighting records are provided in *Appendix 5.8, Table A5*.

The Squatter Pigeon is listed as vulnerable on the *EPBC Act*. Twenty-eight migratory species, listed on the *EPBC Act* were also recorded (*Table 5.7.7*).

The Beach Stone-curlew was observed at a number of locations in the study area: on the shoreline near the south western end of the Mainland Road and Bridge Approach corridor; on the shoreline approximately midway along the proposed Mainland Road and Bridge Approach corridor; in the vicinity of Friend Point; near Laird Point at the mouth of Graham's Creek on Curtis Island; and on the southern shoreline of Curtis Island immediately south of the proposed road corridor within the study area.

The Squatter Pigeon was observed on four occasions in the vicinity of the Mainland Road and Bridge Approach corridor. The habitat at these locations was typically open grassy woodland in close proximity to a number of permanent freshwater dams and lagoons. The Squatter Pigeon was not recorded on Curtis Island.

7.6.2.4 Butterflies

Twenty species of butterfly were recorded during the spring survey and 19 species were recorded during the summer survey. The highest abundance and species richness was recorded in Mangrove Shrubland and Forest Red Gum Woodland/Open Forest. No species listed as either Endangered or Vulnerable on the *NC Act* or the *EPBC Act* were recorded. A full species list is provided in *Appendix 5.8, Table A6*.

7.6.2.5 Mammals

A total of 20 native mammal species were recorded within the study area (See *Table 5.7.8* and *Table 5.7.9*). One species of bat that was not identifiable to species level may be a species that is listed as Vulnerable under the *EPBC Act* and *NC Act* as shown in *Table 5.7.9*.

Table 5.7.7 Migratory species listed on the EPBC Act recorded in the study area

Species	Region Supports Ecologically Significant Proportion of Population	Limit of the Species Range	Area where a species is declining
Wandering Whistling Duck (*Dendrocygna arcutata*)	No	No	No
Magpie Goose (*Anseranas semipalmata*)	No	No	No
Black Swan (*Cygnus atratus*)	No	No	No
Pacific Black Duck (*Anus superciliosa*)	No	No	No
Great Egret (*Ardea alba*)	No	No	No
Pacific Baza (*Aviceda subcristata*)	No	No	No
Whistling Kite (*Haliastur sphenura*)	No	No	No
Brown Goshawk (*Acciptera fasciatus*)	No	No	No
Brahminy Kite (*Haliastur indus*)	No	No	No
Eastern Osprey (*Pandion cristatus*)	No	No	No
White-bellied Sea-eagle (*Haliaeetus leucogaster*)	No	No	No
Australian Hobby (*Falco longipennis*)	No	No	No
Bar-tailed Godwit (*Limosa lapponica*)	**Yes**	No	No
Eastern Curlew (*Numenius madagascariensis*)	**Yes**	No	**Yes**
Whimbrel (*Numenius phaeopus*)	**Yes**	No	No
Common Greenshank (*Tringa nebularia*)	**Yes**	No	No
Great Knot (*Calidris tenuirostris*)	No	No	No
Grey-tailed Tattler (*Tringa brevipes*)	No	No	No
Terek Sandpiper (*Xenus cinereus*)	No	No	No
Red-necked Stint (*Calidris ruficollis*)	**Yes**	No	No
Sharp-tailed Sandpiper (*Calidris acuminata*)	No	No	No
Pacific Golden Plover (*Pluvialis fulva*)	No	No	No
Lesser Sand Plover (*Charadrius mongolus*)	No	No	No
Masked Lapwing (*Vanellus miles*)	No	No	No
Caspian Tern (*Hydroprogne caspia*)	No	No	No
Fork-tailed Swift (*Apus pacificus*)	No	No	No
White-throated Needletail (*Hirundapus caudacutus*)	No	No	No
Rainbow Bee-eater (*Merops ornatus*)	No	No	No

Table 5.7.8 Native terrestrial mammals recorded in the study area (excluding bats)

Species	Observed	Heard	Callback response	Hair sample	Scat
Sugar Glider (*Petaurus breviceps*)	2	2			
Squirrel Glider (*Petaurus norfolcensis*)	1		1		
Yellow-bellied Glider (*Petaurus australis australis*)	2				
Brushtail possum (*Trichosurus vulpecula*)	12	2		8	2
Swamp Wallaby (*Wallabia bicolor*)				1	
Eastern Grey Kangaroo (*Macropus giganteus*)	4				6

1. Columns indicate the abundance of each species recorded using each survey method.

Table 5.7.9 Bat species recorded in the study area

Species	Anabat	Harp trap	Observed	
Gould's Wattled Bat *(Chalinolobus gouldii)*	✓			
Chocolate Wattled Bat (*Chalinolobus morio*)		✓		
Hoary Wattled Bat *(Chalinolobus nigrogriseus)*	✓			
Little Bent-wing Bat *(Miniopterus australis)*	✓	✓		
Eastern Bent-wing Bat *(Miniopterus schreibersii oceanensis)*	✓			
Beccaris Freetail Bat *(Mormopterus beccarii)*	✓			
East Coast Freetail Bat *(Mormopterus norfolkensis)*	✓			
Southern Freetail Bat (*Mormopterus planiceps*)	✓			
Unidentified Long-eared Bat *(Nyctophilus* sp.*)* *	✓			
Yellow-bellied Sheathtail Bat *(Saccolaimus flaviventris)*	✓			
Eastern Broad-nosed Bat *(Scotorepens orion)*	✓			
Northern Broad-nosed Bat *(Scotorepens sanborni)*	✓	✓		
Eastern Cave Bat *(Vespadelus troughtoni)*	✓		✓	
Black Flying-fox (*Pteropus alecto*)			✓	

1. ✓ indicates the means by which each species was detected
2. * indicates the species is possibly listed as Vulnerable under the NC Act and EPBC Act.

No other listed mammal species were recorded. The Yellow-bellied Glider (southern subspecies) was recorded on two occasions directly along the proposed road route on the mainland as shown in *Table 5.7.9*. This species is listed as a High Priority Species on the FBBAP[16].

Bat Species

Thirteen microchiropteran and one megachiropteran species were recorded. Anabat units detected 12 species, harp trapping detected three species and two species were observed while spotlighting in the study area. Calls were recorded for one species of genus *Nyctophilus* that was not identifiable to species level.

16 EPA (2008) ***Draft Fitzroy Basin "Back on Track" Biodiversity Action Plan***

Mammal Trapping

A total of 490 trap nights using Elliot traps resulted in no captures of ground dwelling mammals at the study area during spring surveys. This methodology was abandoned for subsequent survey periods.

Hair Funnels

Brushtail Possum hairs were recorded at eight of the 120 hair funnels deployed in the study area. One macropod species, suspected to be Swamp Wallaby (*Wallabia bicolour*), was recorded from one hair funnel at the site. Feral Cat hair was detected from one other sample.

Introduced Species

Introduced mammal species recorded through direct observations, scats or other signs included:

- Black Rat (*Rattus rattus*) was recorded from within fox scat material
- cattle were observed frequently
- European Red Fox (*Vulpes vulpes*) was observed on two occasions and scats were also recorded
- feral dog (*Canis lupis*) scats were collected on one occasion
- feral pig were inadvertently flushed and diggings and scats were observed at many localities
- feral horse were frequently observed, particularly near Laird Point
- feral cat (*Felis catus*) was detected from a hair funnel sample, scats and tracks.

Conservation Significance

An unidentified species of genus *Nyctophilus* was recorded using Anabat units on three separate days during the February survey period. Three species of *Nyctophilus* have distributions that are consistent with the study area[17,18]. These are: *N. timoriensis* (Eastern Long-eared Bat, listed as Vulnerable under NC Act and EPBC Act), *N. gouldi* (Gould's Long-eared Bat) and *N. bifax* (Northern Long-eared Bat). Neither of the latter two species is listed under Commonwealth or Queensland legislation.

Habitat preferences of the three species indicate that the species detected in the study area is likely to be *N. gouldi.* In Queensland the distribution of *N. gouldi* is associated with open eucalypt woodland habitat, which is common in the study area. Although poorly understood, *N. timoriensis* favours arid and semi arid environments[19] and these habitat types do not occur in the study

17 Churchill S (1998) ***Australian Bats*** *Reed New Holland, Sydney*

18 Menkhorst P and Knight F (2001) ***A field guide to the mammals of Australia***

19 Environment Australia (1999) ***The Action Plan for Australian Bats***

area, or within the locality. *N. bifax* tends to inhabit wet forest, rainforest and riparian gullies, and is therefore unlikely to occur in the study area due to a lack of suitable habitat. The unidentified species is therefore considered to be *N. gouldi*.

The Yellow-bellied Glider (southern subspecies) was recorded in two instances while spotlighting along the proposed road corridor route on the mainland as shown in *Figure 5.7.5.*The Yellow-bellied Glider is listed as a High Priority species under the Fitzroy Basin Biodiversity Plan (FBBAP). Despite repeated call broadcast attempts and extensive spotlighting throughout the study area the species was not recorded at the proposed LNG Facility or road corridor on Curtis Island. However, suitable habitat is available in the study area and it is therefore assumed that the species could occur within the proposed LNG Facility site on Curtis Island.

General Habitat Assessments

A diversity of habitat features was recorded within the study area. The habitats recorded included grassy woodland, tall open woodland, forest communities, drainage lines, hollow-bearing trees, mudflats and saltpan, hilltops and ridgelines, and mangroves. The study area is considered to provide habitat and resources suitable for macropods, arboreal marsupials, rodents and bats.

Habitats found to be limited across the study area included native ground cover, native shrubs, permanent fresh water, and structurally complex vegetation. Evidence of fauna that was limited or absent from the study area included:

- nests within vegetation ground cover
- fauna runs (that provide evidence of use by ground-dwelling mammals)
- scratches on trees (that provide evidence of use by arboreal fauna)
- scats of native mammals
- signs of burrowing or foraging.

Tree Hollows

A summary of tree hollow assessment results is shown in *Table 5.7.10*. The area comprising Endangered RE 12.3.3 along the proposed road route on Curtis Island had a greater density of hollows than the other sites assessed on the island (*Figure 5.7.4*). Fallen large woody debris was common at all sites. This resource could provide important habitat for ground-dwelling mammals, reptiles and amphibians. Large hollows suitable for large owls, gliders and possums were infrequently encountered, except at transects 4 and 6.

Table 5.7.10 Tree hollow density at six sites in the study area

Transect	Regional Ecosystem	Hollow-bearing tree density (per ha)	Total hollows	Mean hollows per tree
1	12.11.6	20	46	5
2	12.11.6/12.11.4	30	50	3
3	12.11.6	34	40	2
4	12.3.7/12.3.11	24	41	3
5	12.11.6/12.11.14	34	51	3
6	12.3.3	76	104	3

7.7 DISCUSSION

7.7.1 Disturbance History

The Curtis Island LNG Facility study area has experienced previous disturbances including land clearing, pastoral development, cultivation, grazing of domestic stock and feral animals. Ongoing disturbances include the presence of introduced weeds, predation and physical disturbance from introduced animal species and frequent fire disturbance.

Evidence of this ongoing disturbance is present in the structure and formation of the remnant vegetation at the site. Such disturbances are likely to have resulted in the moderate diversity of native fauna recorded within the study area.

7.7.2 Fauna

The surveys found no evidence of carnivorous marsupials. The Northern Quoll (*Dasyurus hallucatus*) is predicted to occur within the region of the study area. However, this species is recognised as the native species that is most threatened by the introduction of cane toads. Populations are in decline across northern Australia primarily due to the presence and spread of cane toads across the region[20]. Therefore, it is considered unlikely that the Northern Quoll occurs in the study area, given the high abundance of cane toad at the site and the lack of evidence of the species.

20 Rankmore B R, Griffiths A D, Woinarski J C Z, Ganambarr B L, Taylor R, Brennan K, Firestone K and Cardoso M (2005) **Island translocation of the northern quoll Dasyurus hallucatus as a conservation response to the spread of the cane toad Chaunus (Bufo) marinus in the Northern Territory, Australia.** Natural Heritage Trust Strategic Reserve Program, as a component of project *2005/162: Monitoring & Management of Cane Toad Impact in the Northern Territory*.

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Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business
Drawn	JB
Approved	MB
Date	19.05.09
Volume 5	Figure 5.7.4
File No:	0086165b_EIS_TE_GIS004_F5.7.4
Revision	2

Title: **Hollow Bearing Trees within Survey Transects**

Disclaimer:
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ERM does not warrant the accuracy of any such Maps and Figures.

Projection: UTM MGA Zone 56 Datum: GDA 94

0 250 500 1,000 m

N

Source Note:
Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
Curtis Island Road/Bridge Corridor - Connell Wagner

Disclaimer: Positional Accuracy of RE Data mapped at a scale of 1:100,000 is 100 metres.
Survey and Mapping of 2003 Remnant Vegetation Communities and Regional Ecosystems of Queensland, Version 5.0, EPA (Dec 2005). Certified Regional Ecosystem Map Amendments under the Vegetation Management Act (1999), EPA, 20/08/2008.

Legend

- Proposed QCLNG Site Boundary
- Proposed Swing Basin & Shipping Channel
- Existing Shipping Channel
- Possible Curtis Island Road/Bridge Corridor
- Proposed Export Pipeline
- Indicative Wetlease Area
- Yellow-Bellied Glider Waypoints
- Indicative Vegetation Removed Area

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Client	QGC - A BG Group business

Drawn	JB	Volume 5	Figure 5.7.5
Approved	MB	File No:	0086165b_EIS_TE_GIS005_F5.7.5
Date	19.05.09	Revision	2

Title **Priority Mainland Fauna Sites**

Cane toads could also be influencing the species richness of reptile and amphibian communities in the study area. The ecological assessment revealed a paucity of large reptiles and a moderate diversity of skinks and frogs. Cane toads are known to cause death in large reptiles and are documented as being responsible for the decline of Varanid (goanna/monitor lizard) populations in northern Australia[21]. There is evidence that cane toads are also responsible for the decline of native frog and small reptile populations through competition and predation[18].

Significant effort was invested in trapping to identify ground dwelling mammals in the study area. No captures were made using Elliot traps, and only eight individual hair funnels (of a total of 120) were successful in collecting hair samples. A low diversity and abundance of mammals at the site was also indicated by the lack of "runs" or nests, signs of burrowing, scratching or foraging. It is suspected that poor mammal richness and diversity was attributable to the historical clearance and fire disturbance in the study area and the presence of introduced predators including European Red Fox. European Red Fox and feral dog are also likely to be partially responsible for the relatively low abundance of macropods (two species) encountered during the ecological assessments.

The lack of permanent freshwater in the study area is a primary determinant of the distribution and abundance of native mammals, reptiles and birds. No permanent freshwater sources were found throughout the ecological assessments. During the spring surveys there was a lack of freshwater availability, which would negatively influence the diversity of bird species present in the area.

In summer of 2009 high rainfall across the region and at the study area caused significant runoff, localised flooding and wetland bogs to develop within the study area. Annual precipitation events such as these are a feature of the sub-tropical environment and can cause fluctuations in faunal activity.

7.7.3 Significance of the Study Area

7.7.3.1 Local and Regional Significance of the Study Area

The Gladstone locality is heavily developed for industrial purposes and where habitats have not been directly impacted by development, they are subject to a variety of indirect impacts including exposure to increased traffic, habitat fragmentation, interruption of habitat corridors, exposure to increased light and noise levels and altered surface hydrology.

Therefore, areas maintaining habitat continuity and containing priority species are considered to be of significance to the Gladstone locality. Within the local

21 van Dam R A, Walden D J and Begg G W (2002) ***A preliminary risk assessment of cane toads in Kakadu National Park***, *Supervising Scientist Report 164*

area, these attributes would be vulnerable to the cumulative effects of development.

Habitat continuity

The native habitats recorded on Curtis Island are of local and regional significance in that that they are:

- part of an intact native landscape
- part of a diverse landscape mosaic including marine, intertidal, lowland and upland forest communities
- not subject to edge effects, habitat fragmentation or corridor discontinuity
- not subject to industrial or urban interference
- afforded a low level of habitat protection by the island isolation.

An important aspect of the study area on Curtis Island is the continuity of vegetation and habitats. The lack of developed roads and cleared areas means that habitat units are not yet fragmented. This habitat connectivity enables dispersal of terrestrial fauna across the study area and the greater Curtis Island. This scenario is not consistent across the regional landscape, as much of the adjacent region on the mainland is developed for industrial and agricultural developments.

Priority Species

The FBBAP lists eighty species of regional conservation significance for the Fitzroy Basin. Of these species, one mammal and one bird were recorded within the study area. Both are listed as High Priority species under the plan, which identifies them as species that are of local conservation concern:

- Yellow-bellied Glider (Southern subspecies) – recorded on two occasions along the proposed Mainland Road and Bridge Approach corridor between Landing Road and Friend Point. This species is listed on the regional FBBAP as a High Priority species
- Beach Stone-curlew – recorded at a number of salt-pan sites within, and adjacent to, the study area. It is suspected that up to three pairs occur within the study area, each occupying separate territories consisting of significant isolated salt-pans.

None of the species recorded during the ecological assessments is at the limit of their distributional range within the study area.

Vulnerability to Cumulative Effects

Currently, Curtis Island is isolated from the mainland and is subject to limited disturbance from vehicles, noise pollution, light pollution and waste. The study area also represents an unfragmented landscape connecting marine, intertidal, lowland and upland environments. Cumulative effects of the QCLNG Project, other proposed LNG projects on Curtis Island and Ancillary Infrastructure are likely to expose the local environment to increased

fragmentation, edge effects, pest plant and animal species, increased light pollution and noise pollution, industrial traffic and industrial waste.

Cumulative effects associated with these projects occurring within the local area and within the region could result in a decrease in dispersal opportunities for small mammal and reptile species.

Summary of Local and Regional Significance of the Study Area

In a regional context the Curtis Island components of the study area are relatively unique in providing an unfragmented landscape. This is partly a product of the protection afforded by the island environment. However, the condition of the site is compromised by the presence of a number of abundant feral species and the historical impacts of grazing and altered fire regimes that have occurred there. Therefore, while Curtis Island has value within the local and regional context, the local study area is in degraded condition as a product of historic management and ongoing disturbance.

7.7.3.2 State Significance of the Study Area

The following ecological attributes identified within the study area are of state significance:

- Endangered RE 12.3.3
- habitat for threatened and rare species including Squatter Pigeon, Powerful Owl, Eastern Curlew, and Beach Stone-curlew.

Vegetation

The vegetation of the study area is considered of low state significance. The area was generally in a moderate to poor condition due to prolonged degradation from free-ranging cattle and poor management of local fire regimes. No threatened flora species were recorded within the study area, and therefore the study area is not significant with respect to threatened flora.

One RE that occurs within the study area is considered significant at a state level, RE 12.3.3 (Blue Gum open woodland on alluvial plains). This RE principally occurs within the southern third of the LNG Facility site, an area of approximately 37 ha (See *Figure 5.7.6*). This RE was generally found to be in good condition. The reserved area of this RE is low in Queensland and less than 10 per cent remains of an estimated pre-clearing extent of 694 000 ha.

Habitat for Threatened Species

Four bird species listed as threatened on the Queensland *NC Act* were recorded during the surveys. These were: Squatter Pigeon, Powerful Owl, Beach Stone-curlew, (each listed as Vulnerable) and Eastern Curlew (listed as Rare). The ecological assessments did not record any terrestrial reptiles, amphibians or mammals of state significance in the study area.

Salt pans and mud flats of the study area have the potential to provide significant habitat for the Beach Stone-curlew at a state level and mitigation recommendations are provided in *Section 7.9*.

The LNG Facility site is unlikely to represent a significant habitat for the Eastern Curlew, whereas other areas on Curtis Island such as the mud flats near South End may represent important feeding habitats for the species.

The study area occupies part of a home range for one pair of Powerful Owls, and is likely to support a roost for the pair. This species could be negatively impacted by the proposed developments. Proposed mitigation measures are provided in *Section 7.9*.

Squatter Pigeons were recorded adjacent to the proposed Mainland Road and Bridge Approach, and are expected to inhabit the surrounding grasslands. Habitat removed to construct the Mainland Road and Bridge Approach would not have direct impacts to Squatter Pigeons, though the proposed road would pose a risk of vehicle strike to pigeons at the site.

7.7.3.3 Commonwealth Significance of the Study Area

Ground truthing of vegetation communities of the study area confirmed that no threatened ecological communities listed under the Commonwealth *EPBC Act* occur within the study area (*Table 5.7.6).* Two *EPBC Act* listed plant species were considered to have suitable habitat within the study area. These species were specifically targeted in the on-ground assessments, and were not detected. Therefore the flora of the study area is not considered to be of conservation significance from a national perspective.

No amphibians of Commonwealth significance were detected, or are predicted to occur within the study area.

No terrestrial reptiles of Commonwealth significance were detected within the study area. Three Commonwealth-listed species were predicted to occur within the study area (*Table 5.7.3*). Of these, only *Egernia rugosa* (Vulnerable) was considered to have suitable habitat within the area. Given the difficulty in detecting this species[22], it is possible that *E. rugosa* occurs within the study area. Mitigation measures to reduce impacts to reptiles are provided in *Section 7.9.*

No terrestrial mammals of Commonwealth significance were detected within the study area. It is unlikely that any of the three Commonwealth-listed terrestrial mammal species considered to have the potential to occur within the study area (*Table 5.7.3*) actually occur there due to their specific habitat requirements (see *Annex 5.2*).

22 DEWHA (2009) ***Egernia rugosa in Species Profile and Threats Database***

One bird species listed as threatened under the *EPBC Act* occurs within the study area. In addition, 28 listed Migratory species (*Table 5.7.7*) are known to use the study area. None of these species are at the limit of their range in the study area and only one species, Eastern Curlew, is declining within the region. An area Of Concern for the Eastern Curlew and other migratory species is located on the mud flats along the proposed Mainland Road and Bridge Approach corridor near Kangaroo Island (*Table 5.7.7*). The area is considered to be an important shorebird foraging site. Proposed mitigation measures are provided in *Section 7.9*, although as QGC would not be the proponent for construction of the mainland road these mitigation measures are provided as options only and are not commitments made by QGC.

7.8 IMPACT ASSESSMENT

7.8.1 Vegetation

Impacts on vegetation are likely to be primarily associated with the physical clearing of vegetation for infrastructure development. *Table 5.7.5* provides details on the area of each RE to be cleared as a result of the LNG Facility, pipeline on Curtis Island and ancillary infrastructure.

Other potential impacts on vegetation are:

- introduction and further spread of invasive weeds
- introduction or proliferation of pest animals
- leaching of pollutants into adjoining mangrove and wetland areas
- release of silt into adjoining mangrove and wetland areas
- air emission impacts on adjoining areas.

Edge effects and fragmentation of vegetation are likely to increase the prevalence of weed species in the surrounding vegetation due to canopy clearance, altered runoff patterns and increased exposure to foreign material brought to the study area on machinery and equipment.

it should be noted that the specialist reports included as *Appendices 5.5 to 5.8* discuss total coverage of RE within the LNG Facility boundary, as well as the clearing required if the mainland road and bridge were to proceed. The discussion below addresses how much RE will actually be cleared within the Facility boundary. This difference in approach explains the discrepancy between the numbers stated in the Appendices and those indicated in *Table 5.7.5.*

7.8.1.1 Regional Ecosystems

Endangered RE

The LNG Facility site, Curtis Island Road, Mainland Road and Bridge Approach and pipeline corridor on Curtis Island are proposed to be located within areas of Endangered RE 12.3.3 (Blue Gum open woodland on alluvial plains) at four locations.

Field surveys of these communities that occur within the LNG Facility site found that these remnants were generally in good condition. However, there was some evidence of erosion and weeds were common within these localities. The sites along the pipeline corridor on Curtis Island were in average condition and the site on the Mainland Road and Bridge Approach was degraded due to frequent fires and weeds.

The amount of RE 12.3.3 that will require removal as a result of these developments will be approximately 39.6 ha. This equates to less than 5 per cent of that which occurs within a 10 km buffer of the study area (*Table 5.7.5*). The proposed clearing has been assessed as constituting a significant impact on this RE given that less than 10 per cent of the pre-clearing extent remains and that it represents a significant proportion of the RE which occurs within the local area.

Of Concern REs

RE 12.3.11 (Grey Ironbark open woodland on alluvial plains) occurs within the proposed LNG Facility site, pipeline corridor and Curtis Island Road at two locations. This would require the removal of a total of approximately 3.4 ha of this RE, which equates to less than 1 per cent of this RE type which occurs within a 10 km buffer of the study area (*Table 5.7.5*).

The remnant that occurs in the area of the proposed pipeline corridor on Curtis Island and Curtis Island Road is in average condition due to regular fires and weed infestations. The small area (1.5 ha) that is present within the LNG Facility site is in good condition due to low weed density.

The proposed clearing of RE 12.3.11 is a relatively small area and represents a relatively small proportion of that found within the vicinity. As such, it is considered that impacts on this RE are not likely to be significant, provided mitigation measures recommended in *Section 7.9* are implemented.

RE 12.11.14 (Ironbark woodlands on metamorphics ± interbedded volcanics) falls within the proposed LNG Facility site, pipeline corridor and Curtis Island Road at several locations. The total area of RE 12.11.14 that will require removal is approximately 11.8 ha. This equates to approximately 2 per cent of this RE type found within a 10 km buffer of the study area. Generally the remnants of this community were found to be in poor condition due to regular fires in the area and a high weed density.

Not Of Concern REs

The total amount of RE 11.1.2 (Saltpan vegetation) that will be required to be cleared is approximately 10.2 ha. This makes up approximately 1.4 per cent of the total amount of this RE type within 10 km of the study area (*Table* 5.7.5).

The total amount of RE 11.1.4 (Mangroves) that will be required to be cleared is approximately 3.1 ha. This makes up less than 0.4 per cent of the total amount of this RE type within 10 km of the study area.

Both RE 11.1.2 and 11.1.4 areas were not inspected in the field due to site access constraints and are assumed to be in good condition for the purposes of this study. Both contain plants which are Marine Plants under the Queensland *Fisheries Act 1994* and permits for clearing of these plants will be required.

There is potential for significant impacts to both of these community types if the construction of the Mainland Road and Bridge Approach were to proceed. It is recommended that detailed field investigations be conducted to confirm the location, health and options for avoiding these REs. Potentially significant impacts may be caused by altered hydrological conditions and sedimentation as a result of the construction of the Mainland Road and Bridge Approach. This was one of the key reasons that QGC decided not to proceed with this option.

The total amount of RE 11.3.29 (*Eucalyptus crebra, E. exserta, Melaleuca spp.* woodland on alluvial plains) that will be required to be cleared is approximately 3.4 ha. This makes up less than 1 per cent of the total amount of this RE type within 10 km of the study area. This remnant was in degraded condition and the potential impact on this community is not considered significant.

The total amount of RE 12.1.2 (Saltpan vegetation) that will be required to be cleared is approximately 3.9 ha. This makes up less than 0.2 per cent of the total amount of this RE type within 10 km of the study area. This remnant is in poor condition and was sparsely vegetated as a result of trampling by cattle and feral horse.

The RE 12.1.3 (Mangroves) also occurs within the area of the LNG Facility site. The total amount of this community that will be required to be removed for the construction of the LNG Facility site is approximately 8 ha. This makes up less than 0.1 per cent of the total amount of this RE type within 10 km of the study area. The field survey found these areas to be in a degraded with evidence of significant dieback.

Because of their poor condition and the small proportion to be removed, the impact of removing these areas is not deemed to be significant. As for RE 11.1.2 and RE 11.1.4, plants within RE 12.1.2 and RE 12.1.3 are Marine Plants under the Queensland *Fisheries Act 1994* and permits for clearing of these plants will be required. In order to minimise impacts and protect the

healthy mangroves further north and south, mitigation measures are presented in *Section 7.9*.

RE 12.11.6 (Open forest of Lemon-scented Gum and Narrow Leaf Ironbark on metamorphics ± interbedded volcanics) occurs within the LNG Facility site pipeline corridor on Curtis Island. The amount of this community that will be required to be removed will be approximately 89.3 ha. This equates to approximately 1.2 per cent of the total amount of this RE within 10 km of the study area. These areas were generally found to be in average condition as a result of regular fires in the area and weed infestations.

Provided that the mitigation measures recommended in *Section 7.9* are implemented, the potential for the construction and operation of the LNG Facility site, Curtis Island Road and pipeline on Curtis Island to impact on the Not Of Concern REs which occur on Curtis Island is not significant.

7.8.1.2 Scheduled Flora Species

The LNG Facility site, Curtis Island Road and Mainland Road and Bridge Approach corridors and pipeline corridor on Curtis Island contain potential habitat for four listed flora species. As no protected flora species were recorded or expected to occur within the study area, there is limited potential for construction to have any impact on these species. However, mitigation measures are provided in *Section 7.9* which will further reduce any potential to impact Endangered, Vulnerable or Rare (EVR) flora species.

7.8.1.3 Declared Weed Species

The construction and operation of the LNG Facility, Curtis Island Road, Mainland Road and Bridge Approach and pipeline on Curtis Island could potentially spread existing and introduce new weeds to the study area. Declared weeds that were not observed in the study area during field studies but nevertheless have preferred habitat within the study areas include:

- Giant Rat-tail Grass (*Sporobolus* sp.), a declared weed commonly found in the Gladstone area
- Groundsel Bush (*Baccharis halimifolia*), which has the potential to occur on the site, particularly within areas of RE 12.3.3 (Blue Gum open woodland on alluvial plains), which is a preferred habitat
- Singapore Daisy (*Sphagneticola trilobata*), a common garden plant that was observed during field studies in gardens and rocky headlands on the eastern side of Curtis Island.

The introduction of these and other new weed species could potentially render neighbouring lands less productive and in some cases could have adverse impacts on livestock health. Mitigation measures aimed at reducing the risk of introducing and spreading weeds on Curtis Island are provided in *Section 7.9* and *Volume 11.*

7.8.2 Fauna

7.8.2.1 Mammals

The primary impact of the proposed developments on mammal species is associated with habitat loss, degradation and fragmentation. Associated impacts include increased prevalence of introduced species, reduced foraging range due to noise and light pollution, disturbance of foraging areas due to road corridors, and vehicle-induced fatalities.

Habitat Loss and degradation

The proposed LNG Facility, the road and the pipeline corridor will require the removal of approximately 149 ha of vegetation, including approximately 48 ha of woodland and open woodland habitat (see *Figure 5.7.3* and *Figure 5.7.6*). This will remove foraging and roosting habitat for Eastern Grey Kangaroo, Swamp Wallaby, Brushtail Possum, Sugar Glider, Squirrel Glider, microbats, and foraging habitat for Black Flying-fox. The removal of habitat has the potential to increase pressure on resources in adjacent areas. However, given the low diversity and abundance of mammals in the study area, this is unlikely to significantly impact on species in adjacent areas.

Habitat for native mammals within the study area is considered to be relative to condition and structure to other available habitat in southern parts of Curtis Island. The quality of the habitat has been influenced by historic fire regimes, a long history of grazing, and introduced predators including feral Dog and European Red Fox.

Habitat Fragmentation

Given the position of the proposed LNG Facility on the coastal plains and western ranges of Curtis Island, fragmentation of species habitat is more likely to be associated with the road and associated infrastructure, than with the LNG Facility itself.

In isolation, the proposed Curtis Island Road is not considered likely to significantly impact habitat linkages and dispersal of species. However, when coupled with the proposed pipeline route and infrastructure facilities that may be commissioned as part of the Curtis Island Infrastructure Corridor, localised fragmentation of populations of smaller species such as Sugar Glider, Squirrel Glider and Yellow-bellied Glider may occur. Glider species are documented as being susceptible to habitat fragmentation, and occur in greater densities within larger fragments i.e. 100-200 ha than smaller fragments 10-20 ha[23].

To reduce the impact of habitat fragmentation on these species, the Curtis Island Road and pipeline would be coupled together where practical, corridor

23 Rowston C, Catterall C P and Hurst C (2002) ***Habitat preferences of squirrel gliders, Petaurus norfolcensis, in the fragmented landscape of southeast Queensland*** *Forest Ecology and Management Volume 164(1-3), p197-209*

width will be reduced wherever possible, and fauna crossing options would be considered and implemented where practicable.

7.8.2.2 *Reptiles and Amphibians*

The LNG Facility, pipeline on Curtis Island, Curtis Island Road and Mainland Road and Bridge Approach are likely to affect reptiles and amphibians within the study area through removal of habitat and ongoing disturbance. Fragmentation of habitat and increased traffic also pose a threat to reptilian and amphibian fauna within the study area.

Paved access roads attract reptiles and are likely to result in reptilian road deaths. The road corridor from the LNG Facility to Laird Point is also likely to increase habitat fragmentation and decrease habitat connectivity as fewer individuals are able to disperse between habitat fragments.

Silt and foreign materials entering the waterways from the LNG Facility may alter the water quality at the site, reducing habitat availability for amphibian species, altering their distribution in the area. Runoff and pollution controls will be implemented to protect amphibian diversity surrounding the LNG Facility and proposed road route.

The development may result in an increased prevalence of rodents, foxes and feral cats at the site if not managed appropriately. There is the potential for positive impacts on reptiles and amphibians if an adequate feral pest species control program is implemented successfully.

7.8.2.3 *Birds*

The LNG Facility, pipeline on Curtis Island, Curtis Island Road and Mainland Road and Bridge Approach could affect birds in several ways, including: removal of habitat, dispersal barrier effects, edge effects, habitat fragmentation, isolation of habitat and altered hydrology. Impacts would vary between the different Project components and the Ancillary Infrastructure. Potential impacts are summarised here and discussed in full in *Appendix 5.7 and Appendix 5.8.*

Linear developments such as the proposed roads and pipeline corridor have the potential to impact birds in a number of ways. These include:

- creation of a large area subject to edge effects
- habitat fragmentation along an extended area
- creation of dispersal barriers
- direct habitat loss
- increased disturbance from traffic and human activity
- disruption to tidal movement (mainland)
- increased risk of vehicle strike.

7.8.3 Threatened Species

7.8.3.1 NC Act

Four threatened species listed under the *NC Act* were recorded within the study area. Two additional species were considered to have a high likelihood of occurrence. The potential impacts to these species are discussed in this section.

Impact on the Local Population[24] of a Threatened Species

Squatter Pigeon – Small numbers of Squatter Pigeons were recorded at four sites near the proposed Mainland Road and Bridge Approach and were associated with existing vehicle tracks or small areas with sparse ground cover. Understorey vegetation through most of the study area is unsuitable for Squatter Pigeons as it consists of dense grass cover. No potential Squatter Pigeon habitat was recorded within the study area on Curtis Island. Habitat removed to construct the Mainland Road and Bridge Approach would not have direct impacts on Squatter Pigeons as most of the existing track network would remain unaffected. The proposed Mainland Road and Bridge Approach would pose a risk of vehicle strike to pigeons.

Beach Stone-curlew – Several breeding pairs of Beach Stone-curlews utilise habitat within and immediately adjacent to the study area along the Mainland Road and Bridge Approach at Laird Point. This species is capable of moving substantial distances including between the mainland and Curtis Island. The Mainland Road and Bridge Approach and Curtis Island Road would have direct impacts on Beach Stone-curlews through habitat removal, increased disturbance and potentially decreased breeding success as a result.

Given the broad distribution of Beach Stone-curlews, potential habitat in the locality and the localised nature of impacts it is unlikely that the Mainland Road and Bridge Approach and Curtis Island Road would have a significant impact on the local population.

Eastern Curlew – Eastern Curlews were widely distributed throughout the study area. Curlews forage on intertidal habitat along the mainland and island coasts and small flocks roost in areas along the Curtis Island coastline to the north and south of the LNG Facility site, as well as at Laird Point. Larger numbers of individuals (often up to 50) use the neap tide roost near Friend Point. The proposed mainland road route would render the neap tide roost unsuitable for Eastern Curlews and reduce the suitability of the nearby spring tide roost.

Impacts on Curtis Island are either minor or can be controlled by managing vehicle access to Lairds Point. Impacts on the mainland resulting from the Mainland Road and Bridge Approach would be more severe as they would

24 *Local Population* is the population that occurs within a 10km radius of the subject site.

affect an important roost site for Eastern Curlew and other migratory shorebirds.

Powerful Owl – The study area represents part of a foraging home range used by one or possibly two Powerful Owls. It is possible that Powerful Owls roost on or in close proximity to the proposed LNG Facility. It is likely that Powerful Owls forage over most of the study area, increasing the species' exposure to impact of the proposed developments. The study area is situated at the northern distributional limit for this species and impacts on roost and/or nest sites have a high likelihood of causing detrimental effects on breeding pairs.

The cumulative effect of this and other adjoining proposed LNG projects would remove a substantial area of potential foraging habitat and potential nest and roost sites. Based on available evidence it is likely that the development of the LNG Facility, Curtis Island Road and pipeline on Curtis Island would remove one pair of owls from Curtis Island. The impact on the local population is unknown.

Square-tailed Kite – Square-tailed Kites are known to occur in the Gladstone area and habitat within the study area is suitable for foraging and nesting[25]. Use of the area by kites would be influenced by the abundance of small birds and may be greatest during peak flowering periods when honeyeaters are most abundant. Given the large area of similar quality foraging habitat on Curtis Island and the adjoining mainland it is unlikely that habitat removal associated with the LNG Facility, pipeline on Curtis Island, Curtis Island Road and Mainland Road and Bridge Approach would affect the viability of a local Square-tailed Kite population.

Black-chinned Honeyeater - If present, the Black-chinned Honeyeater is likely to be an uncommon visitor to the study area and would most likely occur during peak flowering periods of Grey Ironbark and Queensland Blue Gum[26]. Given their scattered distribution in eastern Queensland and the abundance of similar habitat in the locality, detrimental impacts on the viability of the local Black-chinned Honeyeater population are unlikely.

Impact on the Habitat of a Threatened Species

Habitat removal from the study area could directly affect Powerful Owl, Squatter Pigeon, Eastern Curlew and Beach Stone-curlew, while habitat of the latter two species (and other migratory shorebirds) would be affected by disturbance. The development of the LNG Facility, pipeline on Curtis Island, Curtis Island Road and Mainland Road and Bridge Approach would remove potential habitat for the Black-chinned Honeyeater and Square-tailed Kite.

In a broad context woodland habitat similar to that affected by the LNG Facility, pipeline on Curtis Island, Curtis Island Road and Mainland Road and

25 Marchant S and and Higgins P J (Eds) (1993) ***Handbook of Australian, New Zealand and Antarctic Birds Volume 2: Raptors to Lapwings***

26 Higgins P J (Ed) (1999). *Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbird*

Bridge Approach is common and widespread in the Curtis Coast region and the proportion of this habitat removed is minor in a local context.

However, the woodland habitat provides resources for Powerful Owl, and the Endangered RE 12.3.3 Queensland Blue Gum Woodland/Open Forest that dominates the alluvial flats may also provide foraging habitat for the Black-chinned Honeyeater and Square-tailed Kite. This habitat is of particular significance having a large number of large hollow-bearing trees, arboreal termitaria (termite nests) and seasonally important flowering gums.

Impacts on intertidal and Saltpan habitats are more severe as they affect habitats that are restricted in distribution (i.e. roosts) and used for nesting or roosting by flocks of threatened (and migratory) species. The Mainland Road and Bridge Approach would remove the mainland neap tide roost and reduce the suitability of the nearby Saltpan spring tide roost. Although intertidal habitat is widespread in Port Curtis, roost sites require a specific suite of characteristics and are more restricted in distribution.

The proposed pipeline and road corridors would fragment woodland habitat particularly on Curtis Island where the two corridors are often separated by a narrow strip of vegetation. Narrow strips of vegetation retained between the pipeline and road corridors would have limited habitat value for threatened species and often become favoured sites for exotic and edge tolerant species.

Do the Proposed Developments Constitute a Threatening Process

Native vegetation removal is recognised as a threatening process under Commonwealth legislation and would therefore constitute a threatening process under the *EPBC Act* and the *NC Act*.

The LNG Facility, pipeline on Curtis Island, Curtis Island Road and Mainland Road and Bridge Approach will result in the removal of several hundred hectares of Open Woodland in several locations within the study area that could result in reduced available habitat for a range of common and some threatened bird species to varying degrees.

Summary

Potential impacts on threatened and rare species can be summarised as follows:

LNG Facility, Pipeline Corridor on Curtis Island and Curtis Island Road

- removal of a substantial area of foraging habitat used by Powerful Owl
- removal of potential Powerful Owl roosting and nesting habitat
- removal of potential Beach Stone-curlew nesting habitat and disturbance of shelter and foraging habitat at Laird Point.

Mainland Road and Bridge Approach

- removal of neap tide roosting habitat used by Eastern Curlew and increased disturbance at three roost sites
- removal or modification of a substantial area of foraging habitat used by Eastern Curlew
- hydrological impacts on a spring tide roost used by Eastern Curlews and possible disruption of movement paths between the neap and spring tide roost
- removal of potential Beach Stone-curlew nesting habitat and disturbance of shelter and foraging habitat near Friend Point
- removal of a small area of known Squatter Pigeon foraging habitat and increased risk of mortality through road strike.

7.8.3.2 *EPBC Act*

Twenty-eight migratory bird species and one threatened bird species protected under the *EPBC Act* were recorded within the study area. A summary of significance of impacts to these species is provided below:

Vulnerable Species

An action is likely to have a significant impact on a Vulnerable species listed under the *EPBC Act* if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species (an "important population" is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are key source populations either for breeding or dispersal, populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species range)
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of an important population
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- introduce disease that may cause the species to decline
- interfere substantially with the recovery of the species.

Significant impacts to the Squatter Pigeon using the *EPBC Act* assessment criteria are unlikely, because:

- the area is not considered to support an important population as defined under the Act
- the area of habitat to be affected (mainland) is very small
- areas of known habitat are available in areas immediately adjacent to the study area.

Migratory Species

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

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species (important habitat is defined as habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or habitat utilised by a migratory species which is at the limit of the species range, and/or habitat that is of critical importance to the species at particular life-cycle stages; and/or habitat within an area where the species is declining)
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Using these criteria, the study area (mainland) was identified as representing important habitat to five migratory species; Bar-tailed Godwit, Eastern Curlew, Red-necked Stint, Whimbrel and Common Greenshank. An assessment of significance was undertaken to assess the impacts of the Mainland Road and Bridge Approach to these species (see *Appendix 5.5* and *Appendix 5.7*). The assessment of significance concluded that the proposed Mainland Road and Bridge Approach has the potential to have a significant impact on these migratory species due to:

- direct impacts (i.e. habitat removal and disturbance); and
- indirect impacts (hydrology and visual barrier).

Mitigation measures are detailed in *Section 7.9* to reduce impacts on the migratory and threatened species recorded within the study are:

- direct impacts (i.e. habitat removal and disturbance) on a neap tide roost that is used by a species whose population is decline
- indirect impacts (hydrology and visual barrier) on a nearby spring tide roost for the species.

Mitigation measures to reduce impacts on the Eastern Curlew and the other migratory and threatened species recorded within the study area are detailed in *Section 7.9*. Potential impacts on these species was a key reason for QGC excluding the Curtis Island Bridge and associated road works from the Project base case for both construction and operations.

7.9 MANAGEMENT MEASURES

The following management and mitigation measures are proposed to ensure that impacts on terrestrial ecology arising from Project activities are minimised. While certain measures are specific to certain infrastructure components, it should be noted that mitigation measures proposed for the bridge and associated mainland and Curtis Island roads are outside the control of QGC, given that QGC will not be the proponent of these items of infrastructure. Mitigation measures for the bridge and roads should, therefore, be taken as recommendations only.

7.9.1 General Measures

General measures applicable across all proposed works will include:

- clearing of native vegetation will be monitored by appropriately qualified personnel
- vehicle access to sensitive areas, specifically saltmarsh, mudflats, mangroves and riparian zones will be restricted
- sediment management plans will be prepared and implemented for construction and operations
- rehabilitation and revegetation plans for areas that are disturbed for access during construction phases, will be developed prior to commencement of construction
- a monitoring program of significant target species (Powerful Owl, Squatter Pigeon, Eastern Curlew, Beach-stone Curlew, and Yellow-bellied Glider) will be considered, where practicable, to inform future management actions
- ongoing management for the duration of all phases of the QCLNG Project will include implementation of revegetation and rehabilitation plans, sediment management plans; weed management plans; and pollution and storm water runoff management plans
- vegetation offsets, for significant residual impacts or where mitigation of impacts is not practicable (refer *Section 7.9.3*).

7.9.1.1 *LNG Facility*

Within the LNG Facility boundary clearing will be undertaken: across the LNG plant footprint; in areas where disposal of topsoil or other site strip material will

be undertaken; for construction of sediment and control structures; and for fire breaks, access roads, and fencelines. Clearing outside these areas will be kept to the minimum practicable.

7.9.1.2 Bridge and Roads

Recommended measures:

- minimise road corridor width wherever possible
- realign the corridor within existing access tracks and cleared areas wherever possible
- reduce, wherever possible the width of the proposed pipeline corridors (proposed as 40 m each) to minimise fragmentation and dispersal barriers effects
- align the pipeline and road corridors together wherever possible to reduce the need for additional access tracks and construction clearing
- taking into account the range of factors that determine road alignments (e.g. presence of acid sulfate soils, geotechnical characteristics, cultural heritage sites) investigate the feasibility of realigning the road corridor to avoid areas of significant habitat value including hollow-bearing tree clusters, specifically focussing on potential:
  - realignment of the Curtis Island Road corridor uphill to the northwest of RE 12.3.3 at the easternmost road alignment
  - realignment of the southern sections of the Mainland Road and Bridge Approach closer to the shoreline near Landing Road to avoid identified habitat of the Yellow-bellied Glider
  - continuation of the road northwards along the salt flats before bearing east where it meets the pipeline at the northern boundary of the salt flats to minimise impacts on migratory shorebird habitat.

7.9.2 Specific Management Measures

This section outlines specific measures to reduce impacts to key flora and fauna of the study area. These measures aim to avoid impacts where possible and mitigate the impact of unavoidable actions.

7.9.2.1 Vegetation

Mitigation measures to avoid or minimise impacts on flora values at the study area include:

General

- clearing of Endangered RE 12.3.3 will be kept to a practical minimum given the constraints of the Project footprint

- clearing of mangrove vegetation (RE 12.1.3) will be kept to a practical minimum given the constraints of the Project footprint
- where clearing of vegetation is unavoidable, consideration will be given (where practicable) to establishing environmental offsets as outlined in *Section 7.9.3*
- quarantine measures will be implemented to prevent introduction of weeds and other exotic species to Curtis Island (refer Volume 11). Vehicles and equipment will be certified as weed free prior to their initial commencement of works on Curtis Island.

Bridge and Roads

Additional measures recommended for the proponent of the bridge and associated roads on Curtis Island and the mainland include:

- investigate realigning the southern portions of the Mainland Road and Bridge Approach further east by approximately 100 m into more open and lightly vegetated areas.

Revegetation

It is recognised that the much of the vegetation clearance across the LNG Facility site will be for the duration of operations. However, where the pipeline alignment or site periphery areas are to be revegetated the following measures will be undertaken:

- vegetation will be monitored for re-establishment
- monitoring for weed infestations will be undertaken quarterly for a period of two years following construction and appropriate control measures implemented.

7.9.2.2 Reptiles and Amphibians

The following measures will be implemented to avoid and mitigate impacts to reptiles and amphibians:

- preclearance surveys to assess and potentially relocate animals (as appropriate) inhabiting the study area prior to vegetation clearance
- ecologists (or other appropriate specialist animal handlers) will be utilised during tree felling to safely remove frogs, snakes (and other animals) inhabiting trees, as appropriate.

7.9.2.3 Birds

The following measures will be implemented to avoid and mitigate impacts on birds:

- vegetation clearing outside the LNG plant footprint and spoil areas will be kept to a practical minimum, and, where possible, large hollow-bearing habitat trees will be retained

- additional targeted surveys for Powerful Owl will be undertaken prior to commencement of construction to obtain further definition of their distribution on Curtis Island
- undertake seasonal field surveys of EPBC listed migratory species, prior to commencing construction, to further define distribution along the Curtis Island shoreline
- prohibit vehicles and machinery from crossing saltmarsh, except along designated access tracks or for specified construction purposes
- protect recorded roost and nest sites of Powerful Owl and Barking Owl outside the LNG plant footprint and spoil areas.

Bridge and Roads

Additional measures recommended for the proponent of the bridge and associated roads on Curtis Island and the mainland include:

- investigate realigning the northern section of the Mainland Road and Bridge Approach to reduce impacts on neap and spring tide roosts
- undertake additional surveys of EPBC listed migratory shorebirds that may be affected by the mainland road alignment
- investigate the potential and viability of rehabilitating shorebird roost areas by reclaiming land near the existing neap tide roost near Friend Point
- ensure that natural tidal flux is maintained for saltmarsh, mangrove and saltpan habitat as much as practical
- limit access to Laird Point during construction
- limit speed on the proposed access road to 80 km/h to reduce bird deaths from road-strike.

7.9.2.4 Mammals

The following measures will be implemented to avoid and mitigate impacts on native mammal species:

- vegetation clearing outside the LNG plant footprint and spoil areas will be kept to a practical minimum, and, where possible, large hollow-bearing habitat trees will be retained
- a vegetation clearance strategy which includes protocols for hollow bearing tree (HBT) removal aiming to minimise or avoid injury to arboreal fauna will be developed prior to construction
- restrict movement of vehicles to designated access tracks and roads throughout the construction and operation of the proposed developments, except for authorised purposes
- a site induction presentation and tool box meeting will be implemented during construction to ensure all personnel are educated on the measures to protect native fauna.

7.9.3 *Offsets*

A vegetation management offset is a legal arrangement by which development applicants seeking to clear vegetation can meet the relevant performance criteria for vegetation management under the *VM Act*. Offsets are governed by the Policy for Vegetation Management Offsets (Offsets Policy) which outlines the criteria for suitable development offsets and is administered by the Queensland Department of Environment and Resources Management.

An environmental offsets strategy will be developed prior to the commencement of the Project. Although no threatened ecological communities or plant species listed under the EPBC Act were detected in the study area, the offsets strategy will consider EPBC Act offset requirements, as outlined in the Draft Policy Statement of August 2007[27]. The strategy will identify the environmental offset activities which will be established to compensate for the unavoidable clearing of ecologically significant areas. QGC will not be responsible for offsets of RE within the proposed road corridor as the roads and bridge approach are not part of the proposed Project.

The proposed LNG Facility and pipeline corridor on Curtis Island will require the clearing of approximately 37.49 ha of Endangered RE 12.3.3: *Eucalyptus tereticornis* woodland to open forest on alluvial plains. This RE is listed under the *VM Act*, and is therefore subject to the Offsets Policy if the area to be cleared constitutes a significant impact. The proposed clearing has been assessed as constituting a significant impact on this RE given that less than 10 000 ha of the RE remains and less than 10 per cent of the pre-clearing extent remains.

While it would be preferable that any vegetation offset is on Curtis Island, or at least within the Gladstone region, and that the vegetation to be offset is RE 12.3.3, this is not an essential requirement as the existing vegetation concerned is not listed as essential habitat and is not listed as having critically low coverage under the Offsets Policy[28]. It is a requirement that the vegetation to be offset is in equivalent condition to the existing vegetation, and that it is managed effectively for the purposes of rehabilitation of revegetation.

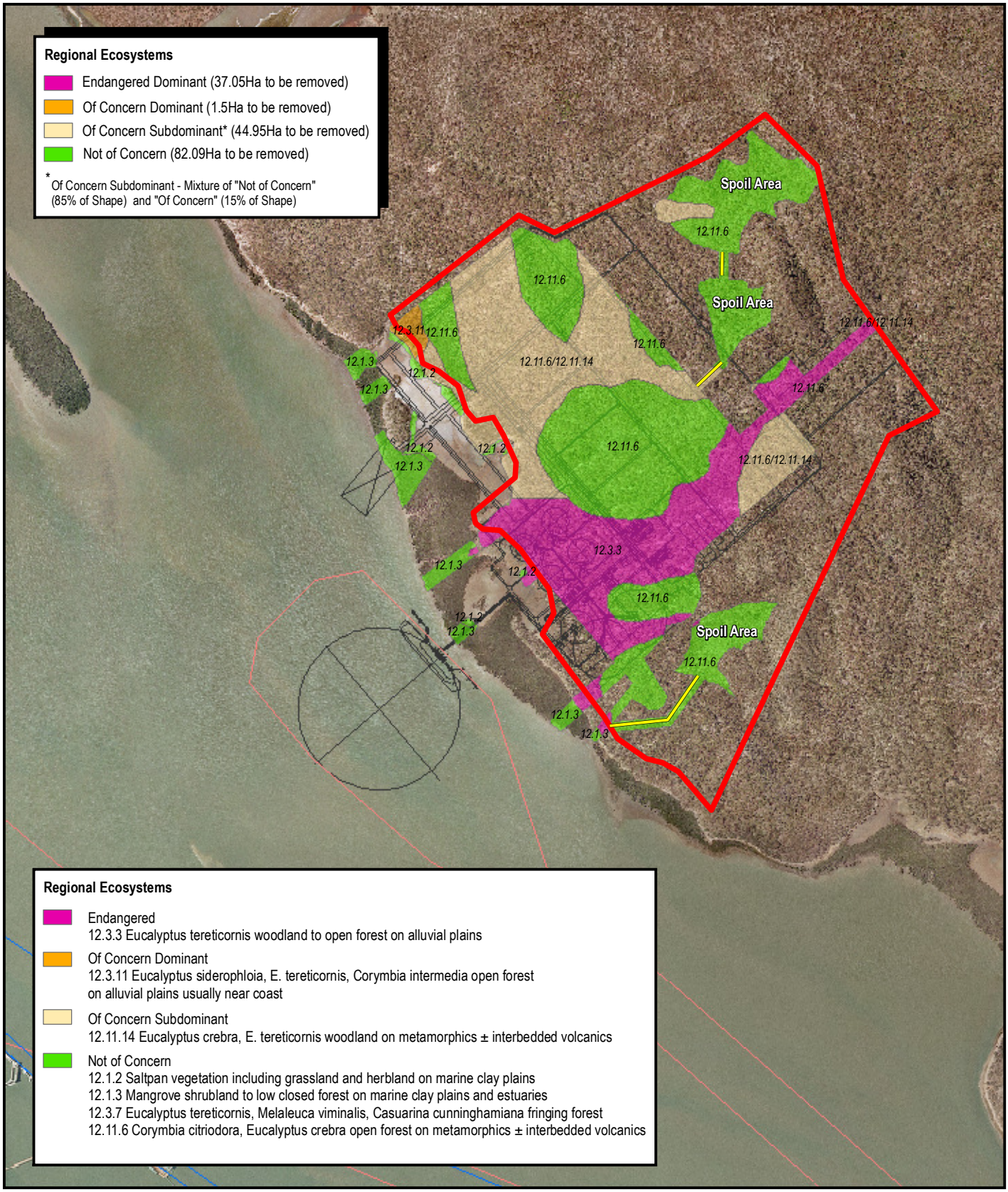
The area to be offset must not be currently protected by existing offsets, private conservation agreements or government conservation policies. An offset of a minimum size of 57 ha with similar shape, connectivity and ecological value as the existing vegetation would be necessary to compensate for the loss of RE from the LNG Facility and pipeline corridor on Curtis Island.

Approximately 8 ha of Of Concern REs is to be cleared for the LNG Facility and pipeline on Curtis Island comprising 12.3.11 (*Eucalyptus siderophloia, E. tereticornis*, *Corymbia intermedia* open forest on alluvial plains usually near coast) and 12.11.14 (*Eucalyptus crebra, E. tereticornis* woodland on metamorphics ± interbedded volcanics tree species).

27 DEWHA (2007) Draft Policy Statement: Use of environmental offsets under the EPBC Act 1999

28 DNRW (2007) ***Policy for Vegetation Management Offsets***

Although the impacts on these REs has been determined as not significant based on the area occurring within a 10 km radius, an equivalent area of 12 ha or greater would be necessary to account for the vegetation clearing to be undertaken in the proposed LNG Facility site and pipeline corridor. The estimated areas of RE clearing for the LNG Facility only are presented in *Figure 5.7.6*.



Legend

- Proposed QCLNG Site Boundary
- QCLNG Footprint Plant Layout
- Indicative Access to Spoil Area
- Proposed Swing Basin & Shipping Channel
- Existing Shipping Channel

Source Note:

Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
Disclamer: Positional Accuracy of RE Data mapped at a scale of 1:100,000 is 100 metres.
Survey and Mapping of 2003 Remnant Vegetation Communities and Regional Ecosystems of Queensland, Version 5.0, EPA (Dec 2005), Certified Regional Ecosystem Map Amendments under the Vegetation Management Act (1999), EPA, 20/08/2008.
Field Assessments undertaken by Unidel as reported in "Revised Regional Ecosystem Mapping"

Projection: UTM MGA Zone 56 Datum: GDA 94

0 125 250 500 m

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Project	Queensland Curtis LNG Project	Title	LNG Facility Layout and RE (Regional Ecosystems) Vegetation Clearing
Client	QGC - A BG Group business		
Drawn JB	Volume 5	Figure 5.7.6	
Approved KR	File No: 0086165b_EIS_TE_GIS006_F5.7.6		
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7.10 CONCLUDING STATEMENT

The study area for the terrestrial ecology study included the LNG Facility site, the pipeline corridor on Curtis Island, the Curtis Island Road, Mainland Road and Bridge Approach and areas of RE to the north and south of the LNG Facility Site along the Curtis Island coastline .

The study area contains a biodiversity assemblage that is typical of coastal Queensland environments. Due to ongoing disturbance, the presence of feral species and historic land-use, habitat condition is considered to be degraded and contains few native species of conservation significance.

No terrestrial plants, amphibians, reptiles or mammals of state or national conservation significance are expected to occur within the study area. However, the LNG Facility, pipeline and ancillary infrastructure are likely to affect reptiles, amphibians and mammals that exist within the area by habitat removal and ongoing disturbance.

Two fauna species of regional significance (Yellow-bellied Glider and Beach-stone Curlew), four bird species of state significance (Squatter Pigeon, Beach Stone-curlew, Eastern Curlew and Powerful Owl) and five migratory bird species of national significance (Red-necked Stint, Bar-tailed Godwit, Eastern Curlew, Whimbrel and Common Greenshank) were recorded within the study area and could be impacted by the proposed LNG Facility, pipeline and ancillary infrastructure.

The cumulative effect of the LNG Facility, pipeline and ancillary infrastructure and other adjoining proposed LNG projects would remove a substantial area of potential foraging habitat and potential nest and roost sites for the Powerful Owl. Several breeding pairs of Beach Stone-curlews use habitat within and immediately adjacent to the study area. Small numbers of Squatter Pigeons were recorded along the proposed mainland access road, although no potential Squatter Pigeon habitat was recorded within the study area on Curtis Island. Recommendations to minimise the impacts of the proposal on these species is provided in *Section 7.9*.

Management measures have been designed to provide strategies for minimising the impact of the LNG Facility, pipeline and Ancillary Infrastructure on the terrestrial ecology of the area, and to limit adverse impacts on significant species. Provided that the specific management measures are implemented, offsets are established and maintained appropriately, and ongoing environmental management is a key component of the development, impacts should remain limited to the vicinity of the study area.

QGC will need to apply for a permit to clear Marine Plants under the Queensland *Fisheries Act 1994* where marine plants cannot be avoided.

The following sub-sections summarise the site specific impacts associated with the LNG Facility, pipeline and the Ancillary Infrastructure to terrestrial ecology.

LNG Facility and Pipeline on Curtis Island

Regional ecosystems occurring within the study area that are considered likely to be impacted by the LNG Facility and pipeline corridor on Curtis Island include one Endangered RE (12.3.3) and two Of Concern REs (12.3.11 and 12.11.14).

The Endangered RE (12.3.3) that occurs within the LNG Facility site was generally in good condition. Approximately 37.5 ha of this RE is proposed to be removed from the LNG Facility site and pipeline corridor on Curtis Island. The proposed clearing has been assessed as constituting a significant impact on this RE. An offset with a minimum size of 57 ha similar vegetation has been proposed to account for unavoidable impacts to the RE.

Approximately 8 ha of Of Concern REs (12.3.11) and (12.11.14) are proposed to be cleared for the LNG Facility and pipeline corridor on Curtis Island. Although the impacts on these REs has been determined as not significant based on the proportionate area occurring within a 10 km radius, offset recommendations have been made to account for an equivalent of 12 ha or greater of Of Concern RE.

One of the primary concerns for the existing fauna in the study area and vicinity is the impact of habitat fragmentation and dispersal barrier effects from the proposed pipeline corridor on Curtis Island. Specific measures will be implemented to minimise unnecessary impacts and ameliorate unavoidable disturbance effects.

Threats to migratory bird species in the study area are associated with the pipeline alignment at Kangaroo Island and Laird Point. Management measures will be implemented to minimise unnecessary impacts and ameliorate unavoidable disturbance effects on shorebirds in the vicinity of the study area. A summary of the impacts relating to LNG Facility and Pipeline on Curtis Island outlined in this Chapter is provided in *Table 5.7.11* below.

Table 5.7.11 Summary of impacts for Terrestrial Ecology - LNG Facility and Pipeline on Curtis Island

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct and cumulative
Impact duration	Permanent for RE and dependent on additional data regarding Powerful Owl use of the site and distribution across Curtis Island.
Impact extent	Local
Impact likelihood	Highly likely

Overall assessment of impact significance: Moderate to major, for permanent impacts to Endangered RE and impacts to Powerful Owl and migratory birds.

Curtis Island Road and Mainland Road and Bridge Approach

Regional ecosystems occurring within the study area that are considered likely to be impacted by the Curtis Island Road as well as the Mainland Road and Bridge Approach include one Endangered RE (12.3.3) and two Of Concern REs (12.3.11 and 12.11.14).

Approximately 2 ha of Endangered RE is proposed to be removed from the road corridor for the Curtis Island Road and Mainland Road and Bridge Approach. The offset for this is included in the 50 ha offset recommended for this RE type for the LNG Facility and pipeline corridor on Curtis Island. Specific recommendations have also been provided to avoid impacts to smaller remnants of this vegetation community by realignment of the Curtis Island Road and Mainland Road and Bridge Approach where possible. However, as QGC will not be the proponent for the bridge and roads these are recommendations only and their implementation is not under the control of QGC.

Approximately 4.5 ha of Of Concern RE 12.3.11 and 12.11.14 are proposed to be cleared for the Curtis Island Road and Mainland Road and Bridge Approach. The offset for this is included in the 18 ha or greater offset recommended for Of Concern RE type for the LNG Facility and pipeline corridor on Curtis Island.

One of the primary concerns for the existing fauna in the study area and vicinity is the impact of habitat fragmentation and dispersal barrier effects due to the proposed Curtis Island Road and Mainland Road and Bridge Approach. Specific recommendations have been provided to minimise unnecessary impacts and ameliorate unavoidable disturbance effects.

Primary threats to migratory bird species in the study area are associated with the road alignment at Kangaroo Island and Lairds Point. Management recommendations have been provided to avoid and where necessary manage the impacts of these activities on shorebirds in the vicinity of the study area. A summary of impacts relating to Curtis Island Road and Mainland Road and Bridge Approach outlined in this Chapter is provided in *Table 5.7.12* below.

Table 5.7.12 Summary of impacts for Terrestrial Ecology - Curtis Island Road and Mainland Road and Bridge Approach

Impact assessment criteria	Assessment outcome
Impact assessment	Negative
Impact type	Direct
Impact duration	Permanent
Impact extent	Local to regional
Impact likelihood	Highly likely

Overall assessment of impact significance: Moderate to major, for loss of Endangered RE, impacts to breeding and roosting habitat for species protected under the *EPBC Act* and for general impacts associated with fragmentation due to the linear corridor.