Annex 13-3

Matters of National Environmental Significance (MNES) Report for the LNG Facility, Pipeline Crossing, Ancillary Infrastructure and Shipping Operations

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13-3 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (MNES) REPORT FOR THE LNG FACILITY, PIPELINE CROSSING, ANCILLARY INFRASTRUCTURE AND SHIPPING OPERATIONS

13-3.1 INTRODUCTION

This report identifies and describes Matters of National Environmental Significance (MNES) that are present within, or could be affected by, the development of the LNG Facility and Ancillary Infrastructure, as well as associated Shipping Operations.

This annex also covers the MNES that are affected by the section of the QCLNG Project Export Pipeline that crosses The Narrows between Friend Point (Kangaroo Island) to Laird Point on Curtis Island and up to the LNG Facility, as this overlaps with the study area for the other controlled actions. MNES that are affected by the remaining pipeline network are addressed in detail in *Annex 13.2*.

This Annex is relevant to the following referrals:

- EPBC 2008/4399 – Pipeline Network (from The Narrows crossing to the LNG Facility)
- EPBC 2008/4400 – Curtis Island Bridge
- EPBC 2008/4401 – LNG Marine Facilities
- EPBC 2008/4402 – LNG Plant and Associated Onshore Facilities
- EPBC 2008/4403 – Mainland Road and Bridge Approach
- EPBC 2008/4404 – Curtis Island Road
- EPBC 2008/4405 – Shipping Activities
- EPBC 2008/4406 – Swing Basin and Channel Dredging

QGC is in the process of withdrawing the following referrals:

- EPBC 2008/4400 – Curtis Island Bridge
- EPBC 2008/4403 – Mainland Road and Bridge Approach
- EPBC 2008/4404 – Curtis Island Road

These EPBC referral activities are not part of the QCLNG Project as the Marine Transportation Operations option is the preferred strategy for access to and from the LNG Facility on Curtis Island.

13-3.2 DESCRIPTION OF THE AFFECTED ENVIRONMENT RELEVANT TO THE CONTROLLING PROVISIONS

This section identifies and describes the MNES that could potentially be affected by the controlled actions identified in *Section C-1*. The information is drawn from specialist studies undertaken for the QCLNG EIS. The methodology used during the desktop and field surveys for these studies are described in the original specialist study reports. The referrals covered by the scope of these specialist studies is summarised in *Table 13-3.1.*

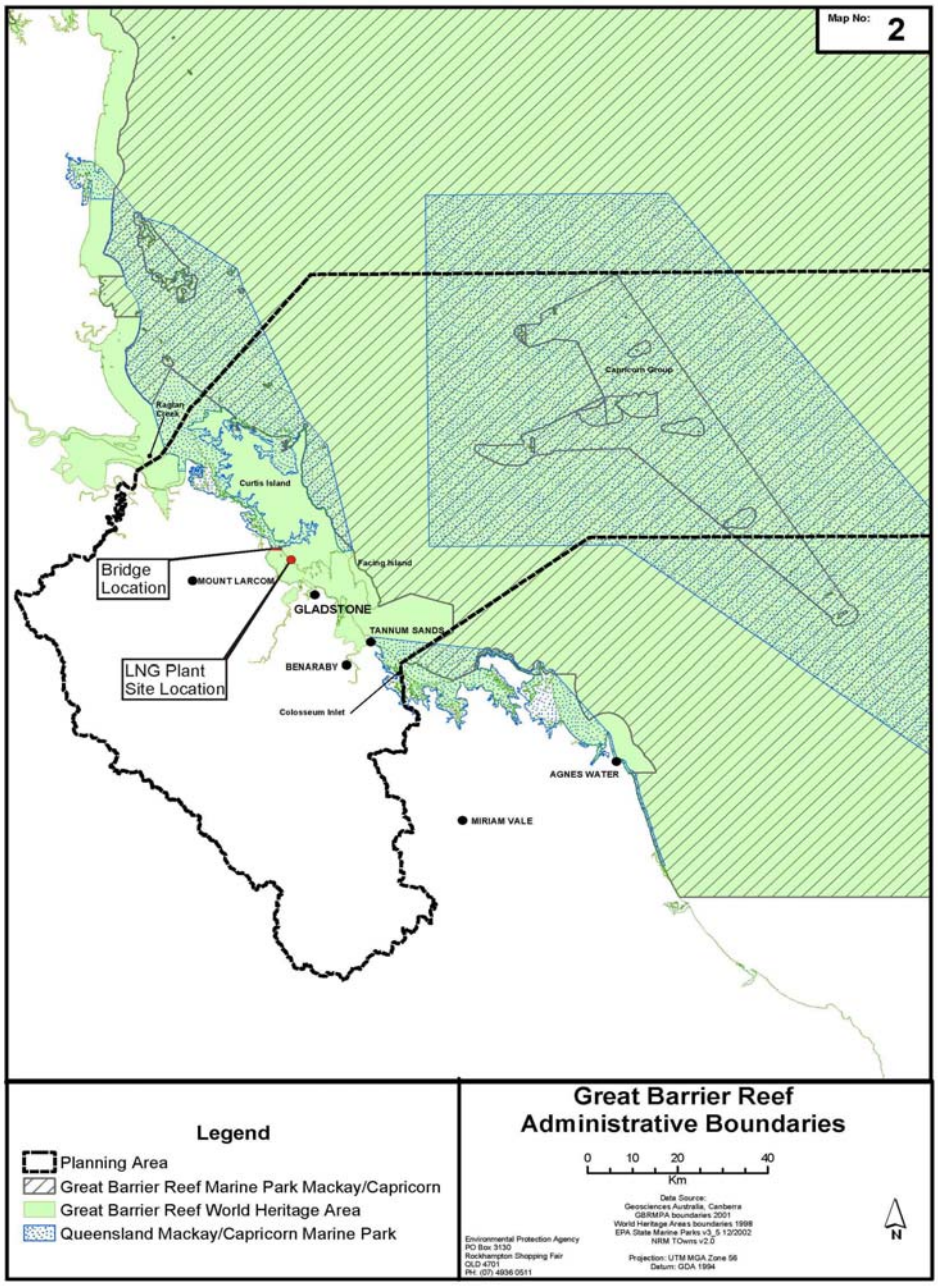
Table 13-3.1 Scope of Specialist Studies

Specialist Study	EIS Reference	Controlled actions Covered within the Scope of the Study
Landscape and Visual Impact Assessment (ERM)	Volume 5, Chapter 16 and Appendix 5.18	EPBC 2008/4400 – Curtis Island Bridge EPBC 2008/4401 – LNG Marine Facilities EPBC 2008/4402 – LNG Plant and Associated Onshore Facilities
Terrestrial Ecology (ERM)	Volume 5, Chapter 7 Appendices 5.5, 5.6, 5.7 and 5.8	EPBC 2008/4399 – Pipeline Network (from The Narrows crossing to the LNG Facility) EPBC 2008/4400 – Curtis Island Bridge EPBC 2008/4401 – LNG Marine Facilities EPBC 2008/4402 – LNG Plant and Associated Onshore Facilities EPBC 2008/4403 – Mainland Road and Bridge Approach EPBC 2008/4404 – Curtis Island Road
Marine Ecology (ERM)	Volume 5, Chapter 8	EPBC 2008/4399 – Pipeline Network (from The Narrows crossing to the LNG Facility) EPBC 2008/4400 – Curtis Island Bridge EPBC 2008/4401 – LNG Marine Facilities EPBC 2008/4402 – LNG Plant and Associated Onshore Facilities EPBC 2008/4403 – Mainland Road and Bridge Approach EPBC 2008/4405 – Shipping Activities EPBC 2008/4406 – Swing Basin and Channel Dredging

13-3.2.1 World Heritage and National Heritage Places

All of the controlled actions listed in *Section C-1* are proposed within the Great Barrier Reef World Heritage Area (GBRWHA) (refer to *Figure 13-3.1).* The GBRWHA is administered by the Great Barrier Reef Marine Park Authority (GBRMPA) in association with the Queensland Environmental Protection Agency (EPA). The proposed Curtis Island Bridge and Pipeline across The Narrows is located on the administrative boundary of the Great Barrier Reef Marine Park Mackay Capricorn Management Area.

Figure 13-3.1 Location of the LNG Facility and Curtis Island Bridge within the Great Barrier Reef Administrative Boundaries[1]



As gazetted in 2007, World Heritage properties are included in the National Heritage List as a National Heritage Place[2]. The GBRWHA is therefore also a National Heritage Place and these two MNES are dealt with simultaneously.

1 EPA (2001) Curtis Coast Regional Coastal Management Plan.

2 Australian Government Department of Environment and Water Resources (2007) Determination regarding including World Heritage Places in the National Heritage List. Special Gazette No. S 99, 21 May 2007. Commonwealth of Australia.

The GBRWHA was accepted for inclusion in the World Heritage List in 1981 having met all four of the natural heritage criteria:

- to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance (i.e. aesthetics and natural beauty)
- to be an outstanding example representing major stages of Earth's history, including the record of life, significant ongoing geological processes in the development of landforms or significant geomorphic or physiographic features (i.e. geological phenomenon)
- to be an outstanding example representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals (i.e. ecological and biological processes)
- to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation (i.e. biodiversity and threatened species)[3].

The following sub-sections comment on the "aesthetics and natural beauty", "geological phenomenon" and "ecological and biological processes" that may be directly or indirectly affected by components of the QCLNG Project and Ancillary Infrastructure. "Biodiversity and threatened species" are addressed in *Section 13-3.2.2,* which identifies "listed threatened species and communities and migratory species" within the study area.

Aesthetics and Natural Beauty

The GBRWHA extends 2,000 km along the coast of Queensland, covering approximately 35 million hectares. It extends seaward from the low water mark covering the waters and the islands within the Port of Gladstone, including Curtis Island.

The great diversity of landscape types across the GBRWHA is part of its recognised value. This includes passage landscape systems such as The Narrows and coastal islands such as Curtis Island, with fringing mangroves. The landscape sensitivity of the estuarine landscapes and waterways of The Narrows are rated as high in the Landscape and Visual Impact Assessment (LVIA) undertaken for the LNG Facility and Curtis Island Bridge (*Volume 5, Chapter 16 and Appendix 5.18*.

While the aesthetic importance of the GBRWHA is largely dependent on naturalness, its "exceptional natural beauty" is punctuated by nodes of development, including the two large industrialised ports of Gladstone and Townsville[4]. Within these urban/industrialised nodes, the aesthetic values ascribed to the GBRWHA do not apply directly, however, the interface between natural undeveloped areas and urban areas is critical to the overall protection of World Heritage Area values.

3 Operational Guidelines for the Implementation of the World Heritage Convention, United Nations Educational, Scientific and Cultural Organisation (UNESCO)

4 Environmental Resources Management Australia (2009) **Queensland Curtis LNG Project Landscape and Visual Impact Assessment**.

The Curtis Coast Regional Coastal Management Plan was developed to establish the management framework for this interface in the Gladstone area. The regional context section (*Section 2.7.1*) of the Curtis Coast Regional Coastal Management Plan describes these areas as follows:

- *"Areas of State Significance (Scenic Coastal Landscapes) in the Curtis Coast region include the landscape features identified on Map 10. Incompatible development within these areas can adversely impact on their scenic landscape values, particularly in relation to the coastal islands, Mt Larcom and the coastal ranges and remote natural areas such as The Narrows."*
- *"The Gladstone Region is identified to be of 'High Scenic Management Priority', with Curtis Island and the Capricorn Group being of Level 1 Scenic Quality."*

The *"desired coastal outcomes"* for Curtis Island as described in the Curtis Coast Regional Coastal Management Plan include:

- *"Maintenance of Curtis Island in a generally natural or non-urban state outside existing residential and tourist areas at South End, Black Head, Seal Hill and Station Point while providing opportunities for future development in appropriate locations."*
- *"Development is sited and designed to protect the island's significant coastal resources and their values including protection of the island's scenic coastal landscapes."*

Future development pressures on Curtis Island are acknowledged, including the intent to develop future industry, port facilities and a proposed bridge to the mainland. Such future development is required to *"recognise the interconnectedness of coastal management issues on the island to ensure coastal resources and their values are not degraded."*

The *"desired coastal outcomes"* specific to the proposed LNG locality (south-west Curtis Island) include the requirement that future development: *"considers the design and location of development ensuring any impacts on the coastal landscape values associated with the island are minimised".*

The significant landscape values attributed to The Narrows are further detailed in the Curtis Coast Regional Coastal Management Plan, with the area *"given the highest level of protection in recognition of its pristine state and significant coastal resources and values."* In particular, the "*maintenance of World Heritage values associated with the area's outstanding coastal landscape values, including its scientific values as an indicator of past geomorphic processes and its scenic amenity values."*

The Areas of State Significance (Scenic Coastal Landscapes) relevant to the proposed project site are detailed in an extracted section of *Schedule 1* of the Curtis Coast Regional Coastal Management Plan in *Table 13-3.2.*

Table 13-3.2 Schedule 1 - Areas of State Significance (Scenic Coastal Landscapes) Described in Policy 2.7.1

Landscape	Sites	Description	Desired coastal outcomes	Measures
Islands and offshore features	Curtis Island	Large identifiable coastal islands close to shore and visually prominent from the mainland and harbour. These islands provide a strong structural element to the landscape and define the seaward edge of the coastal viewshed. They provide a high degree of contrast and visual diversity between intertidal and upland areas.	The landscape values of the islands and their contribution to the landscape values of the Curtis Coast region are protected and maintained. Views from the mainland and viewpoints to the island are maintained and enhanced.	Ensure the development remains unobtrusive and compatible with landscape values.
Coastal wetlands	The Narrows	Coastal wetlands in the Curtis Coast region comprise a range of mainly tidal wetlands such as mangroves, salt marsh and claypan, with some freshwater wetlands. Coastal wetlands contribute significantly to scenic quality in terms of vegetation, wildlife and naturalness. The landscape qualities of the tidal wetlands are generally appreciated from boats, access points such as boat ramps and elevated lookouts.	The landscape values and ecological integrity of coastal wetlands are maintained. The edges of mangrove vegetation in areas of high scenic quality are managed to maintain or restore their visual continuity. Degraded wetland areas are rehabilitated.	Minimise visual breaks in areas of continuous mangrove vegetation. Maintain existing vegetation along waterways to a maximum extent to form natural landscape edge and screen.
Estuaries and inlets	The Narrows	The landscape qualities of estuaries and waterways are generally appreciated from boats and access points such as jetties and boat ramps, the shoreline and	The landscape values and ecological integrity of mangroves, inlets and waterways are maintained. The edges of mangrove vegetation in areas of high	Minimise visual breaks in areas of continuous vegetation. Maintain existing vegetation along waterways to a maximum extent to form a natural landscape edge and

Landscape	Sites	Description	Desired coastal outcomes	Measures
		elevated lookouts. Estuarine and freshwater systems are dominant in the lower reaches by mangroves, claypans and salt marsh. Many areas have a high degree of naturalness and offer a "remote" experience.	scenic quality are managed to maintain or restore their visual continuity.	screen. Ensure infrastructure in areas of high visual quality does not obscure views to water or intrude on waterways.

The interface between The Narrows and the Port of Gladstone, the "entrance" to The Narrows, is the cadastral boundary of the Great Barrier Reef Coast Marine Park, which runs between Lairds Point on Curtis Island and Friend Point/ Kangaroo Island adjoining the mainland. The significant aesthetic values of this "uncommon" passage landscape are not limited to this administrative area, however, and continue along the natural coastal landscape of Curtis Island fringing the northern end of the Port of Gladstone.

Future expansion of the Port of Gladstone either side of the Targinie Passage has been secured through the designation of the Gladstone State Development Area (GSDA), in particular the Curtis Island Industrial Precinct and the Targinie Precinct, as well as the Restricted Development Precinct on Kangaroo Island.

The proposed QCLNG Facility and Curtis Island Road is located within the Curtis Island Industrial Precinct, which allows for *"High Impact Industry limited to natural gas (liquefaction and storage), Infrastructure Facility, Local Infrastructure and Materials Transport Infrastructure, with the potential for Extractive Industry and Forestry".*

The Curtis Island Bridge and Pipeline crossing of The Narrows fall within the scope of activities envisaged for the Restricted Development Precinct. This allows for "*Local Infrastructure, Materials Transport Infrastructure and Special Use, with the potential for development of an Infrastructure Facility*".

While this GSDA designation allows for high impact industrial and infrastructure development there remains the requirement for development to address the 'interconnectedness of coastal management issues including impacts on State Significant (Scenic Coastal Landscapes). In particular, the landscape and visual impact of a "controlled action" on designated values needs to be considered and impacts that may degrade these landscape values must be minimised.

Geological Phenomenon

Within the GBRWHA the channel between Curtis Island and the mainland known as The Narrows is listed on the Australian Heritage Commission Register of National Estate. The Statement of Significance as detailed on the Heritage database is as follows:

> *"The Narrows represent an uncommon passage landscape and are one of only five narrow tidal passages separating large continental islands from the mainland in Australia. Of the five passages, Pumicestone Passage and Great Sandy Strait separate large sand islands from the mainland, leaving only Hinchinbrook Channel and Howard Island (NT) as geologically comparable to The Narrows. In contrast to the sub-tropical Narrows, Hinchinbrook Channel and the Howard Passage are wide tropical estuaries at a much earlier stage of development.*
>
> *The Narrows are also an important indicator of past geomorphological processes, as many of Queensland's headlands and coastal ranges have been joined to the mainland by sedimentation processes identical with those operating within The Narrows. The geomorphological system includes the distinctive features of Balaclava Island, Kangaroo Island, Targinie Creek, Graham Creek and The Narrows.*
>
> *Balaclava Island and The Narrows are in a zone of overlap and transition between tropical and temperate littoral vegetation communities. Importantly, this determines a switch in the competitive balance between southern mangrove communities dominated by the temperate/sub-tropical species Avicennia marina and northern mangroves dominated by the tropical species of Rhizophora. Three mangrove species are at, or near, their southern limit in the area.*
>
> *The intertidal environments of Balaclava Island and The Narrows are influenced by two different hydrological systems, which interface at a tidal null point at Ramsays Crossing. The origin of the sedimentary environment of The Narrows from these two different hydrological systems has created a complex system of intertidal habitats.*
>
> *The mangroves, saltmarsh and mud flats within the area are important to the maintenance of regional fish and crustacean populations. Targinie Creek is fringed by a well-developed mangrove forest and is an excellent example of a tidal channel within The Narrows. Graham Creek joins the southern end of The Narrows and channels a significant portion of the freshwater run-off from the southern half of Curtis Island into The Narrows. The beach ridges at the southern end of Kangaroo Island contain a diverse assemblage of mangrove species".*

Ecological and Biological Processes

The Great Barrier Reef is the largest coral reef system in the world, its high productivity and topographic complexity supporting a wide diversity of marine life including more than 1,500 fish species, 5,000 mollusc species, six turtle species and 400 coral species[5].

5 CRC Reef Research Centre (2008) **Reef Facts: Plants and Animals on the Great Barrier Reef.**

In contrast to its name, only a small percentage of the GBRWHA is taken up by coral reefs, with most of the area comprised of seabed and benthic (bottom dwelling) communities. The "significant on-going ecological and biological processes" for which it is recognised are underpinned by the diversity of habitat types, which harbour very different communities of plants and animals and a wide diversity of species. This network of habitats makes up the Great Barrier Reef ecosystem. The interconnectivity between habitat types is vital to the lifecycles of many marine animals and to the healthy functioning of the Great Barrier Reef ecosystem as a whole[6].

The extent and location of the different intertidal and subtidal habitats that make up the ecological and biological environment in the Port of Gladstone are summarised in *Table 13-3.3* and are described in the text below.

Table 13-3.3 Summary of Intertidal and Subtidal Habitat in the Port of Gladstone Area[7,8]

Habitat Type		Area (ha)	% Area of Total	Prominent Location(s)
Exposed mud and sandbanks		5,144	9	Eastern side of Curtis Island Western side of Facing Island
Exposed rocky substrate		297	0.52	Curtis, Facing, Tide and Picnic islands
Seagrass (coastal)		7,246	12.7	Pelican Banks/Quoin Island Fisherman's Landing area
Seagrass (deepwater)		6,332	11.1	Facing Island Seal Rocks West and East Banks
Benthic macro-invertebrate communities (including coral)	Open substrate, occasional individual	9,876	17.3	Outside Facing Island from Curtis Island to East Bank North-west of Seal Rocks Entrance to Rodds Bay
	Low density	8,606	15	Throughout the Port of Gladstone/Rodds Bay area
	Medium Density	4,099	7.2	Southern and northern side of Seal Rocks Deep channel area from mouth of the narrows at Graham Creek to Fisherman's Landing
	High	4,189	7.3	Narrow strip in channel from

6 Great Barrier Reef Marine Park Authority (GBRMPA) (2003) The State of the Great Barrier Reef Report - Environmental Status: Inter-reefal and Lagoonal Benthos.

7 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, November/December 2002**. DPI Information Series Q103058

8 Danaher K, Rasheed M A and Thomas R (2005) **The Intertidal Wetlands of Port Curtis.** Department of Primary Industries and Fisheries Information Series QI05031

Habitat Type	Area (ha)	% Area of Total	Prominent Location(s)
Density			Fisherman's Landing to inside Facing Island and East Bank
Saltmarsh	4,572	8	Throughout the Port of Gladstone/ Rodds Bay area
Mangroves	6,736	11.8	Curtis Island coastline from Grahams creek to Hamilton point
Total	**57,097**	**100**	

Mudflats/Sandbanks: Intertidal mudflats constitute an important habitat that supports a high biodiversity and biomass of benthic invertebrates, sustains productive fisheries and likely provides important feeding grounds for Migratory shorebirds listed under the *EPBC Act*[9]. While mudflats and sandbanks are often considered relatively unproductive compared to fish habitats such as seagrass meadows or mangroves, these "bare" fish habitats support microalgae on and below the surface.

Exposed mud and sandbanks are the most common intertidal habitat within the Port of Gladstone area, totalling approximately 5,144 ha. These areas may be non-vegetated sand or mud or colonised by seagrass or algal beds. These banks are primarily a feature of the outer harbour and extend through much of the waters to the east of the eastern entrance. They present a significant natural barrier to prevailing south-easterly swells and provide a degree of protection for inshore waters and coastal mangroves on the mainland side of the entrance to the port. Large areas of exposed mud and sand are found, for example, on the eastern side of Curtis Island (Pelican Banks) and the western side of Facing Island (Shoal Bay).

Rocky Substrate: Rocky foreshores provide a hard substrate for the attachment of algal flora, as well as the long-term attachment of sedentary invertebrates (e.g. barnacles, oysters, tube worms). Exposed rocky substrate totalling approximately 297 ha are found in the Port of Gladstone area. They occur along the seaward edge of the intertidal zone and are inundated every tide[10]. Rocky substrate in subtidal areas are restricted to small headlands and drop-offs of Curtis and Facing islands, as well as some of the smaller islands south of Curtis Island including Tide and Picnic. Brown algae have been reported as the predominant Macro-algae on these substrates.

Saltmarsh: Although biodiversity within saltmarsh habitats is generally low compared to other wetland types, these communities support a range of invertebrates that are an important food source for a wide range of fish

9 Erftemeijer P L A and Lewis R R (1999) **Planting mangroves in intertidal mudflats: habitat restoration or habitat conversion?** Paper presented at the ECOTONE-VIII Seminar 'Enhancing coastal ecosystem restoration for the 21st century. Ranong and Phuket, 23–28 May 1999.

10 Danaher K, Rasheed M A and Thomas R (2005) **The Intertidal Wetlands of Port Curtis.** Department of Primary Industries and Fisheries Information Series QI05031.

species, waterbirds and shorebirds. These areas also provide critical nursery areas for many fish and crustaceans, as well as acting as filters to land run-off.

Within the Port of Gladstone/Curtis Coast region there are saltpans which are largely bare, but contain patches of saltmarsh species such as *Sueda* spp., *Sarcocornia quinqueflora* and *Sporobolus virginicus*. Approximately 40 saltmarsh species have been recorded[11]. Saltmarsh habitat comprises 4,572ha within the Port of Gladstone area and occurs along the landward edge of the intertidal zone in a saline environment that is only inundated by the spring tides (see *Figure 13-3.2*). Areas of saltmarsh are found along the coastline of Curtis Island in close proximity to the LNG Marine Facilities and also adjacent, south and north.

Mangroves: Mangroves are ecologically important habitats that link the marine and terrestrial environments and provide habitat for both marine and terrestrial organisms. Mangrove ecosystems are vital to the biological productivity and food webs of coastal waters and provide critical nursery areas for many fish and crustaceans, including commercially and recreationally important species. They provide an important buffer between land and reef, as they filter land run-off and thus improve the quality of water entering the marine environment. They also buffer the coastline from storms and cyclones.

Most of the mangrove habitats are on the border of the GBRWHA and not actually inside it, however, they form a critical part of the Great Barrier Reef ecosystem[12].

At a regional scale, the distribution of mangrove species is determined by a number of factors, including temperature, rainfall, catchment area and tidal inundation. In Queensland, mangrove species diversity generally decreases with increasing latitude. For example, 36 species have been recorded from Cape York, 14 from the Curtis Coast region and only nine species from south-east Queensland[13].

11 Saenger P (1996) **Ecology of mangroves of Port Curtis: regional biogeography, productivity and demography. In: Mangroves – a resource under threat?** (eds D Hopley & L Warner). Australasian Marine Science Consortium, James Cook University, Townsville (pp. 23-36).

12 Great Barrier Reef Marine Park Authority (GBRMPA) (no date) The State of the Great Barrier Reef Report - Environmental Status: Mangroves and Saltmarshes.

13 Duke N C (1992) **Mangrove floristics and biogeography**. In: Robertson A I and Alongi D M (eds) Tropical Mangrove Ecosystems. American Geophysical Union, Washington DC, pp. 63–100.

Legend

- Proposed QCLNG Site Boundary
- QCLNG Footprint Plant Layout

Source Note:

Aerial - Department of Infrastructure and Planning for QCLNG Project
Vegetation data: Regional Ecosystem v5.0 QLD Herbarium

Projection: UTM MGA Zone 56 Datum: GDA 94

0 0.5 1 2 km

N

QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: Coastal Wetland Vegetation (Mangroves and Saltmarsh)
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JF/JB	Annex 13.3 Figure 13.2	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: JC	File No: 0086165b_ANX_GIS024_F13.C.2	
	Date: 24.06.09	Revision: 1	

Fourteen species of mangroves are reported from the Port of Gladstone region and three species (*Acanthus ilicifolius, Bruguiera exaristata* and *Xylocarpus moluccensis*) are at the southern limit of their distribution. The mangrove assemblage is dominated by *Rhizophora stylosa,* with lesser amounts of *Ceriops tagal* and *Avicennia marina* present, generally on the landward edge of the assemblage. The mangrove assemblage is considered to be in a healthy state.

Mangroves are dominant in the mid-to-upper intertidal zones, fringing much of the mainland and Curtis Island coasts between Mean Sea Level and Mean High Water Springs. Extensive mangroves extend along the Curtis Island coastline from Grahams Creek to Hamilton Point to the south beyond the Project area[14]. Intertidal mangrove habitat comprises 31.7per cent of all habitat types in the Port of Gladstone, covering an area of 6,736ha (see *Figure 13-3.2*). Areas of mangrove (*Rhizophora* closed forest) are found along the coastline of Curtis Island close to the proposed LNG Marine Facilities and also adjacent, south and north and on Passage Islands.

Recent monitoring of mangroves in the Port of Gladstone for the Port Curtis Integrated Monitoring Program (PCIMP)[15] identified five mangrove species among the surveyed sites: *Rhizophora stylosa, Avicennia marina, Aegiceras corniculatum, Ceriops tagal* and *Osbornia octodonta*. The highest number of species found in any one sampling zone was four, with The Narrows, Boat Creek, Auckland Creek, South Trees South and Oceanic Reference zones containing the highest diversity. Species diversity was found to be similar across two years of monitoring (2006 and 2007). *Rhizophora stylosa* was the dominant mangrove species, with the Grahams Creek, Wiggins Island, Inner Harbour and South Trees North zones containing only this species. Total tree density varied significantly among the zones, with density at Grahams Creek (0.2 trees/m² in 2007) significantly lower than in the Calliope River (0.9 trees/m² in 2007) and Auckland Creek (1.5 trees/m² in 2007). In addition, density at Auckland Creek was significantly higher than the Mid-Harbour, Fisherman's Landing and Boat Creek zones (0.3 to 0.4 trees/m² in 2007).

Seagrass: Seagrasses are true flowering plants found between intertidal and subtidal habitats. Seagrasses are highly productive and form the basis for many complex grazing and detrital food webs, which host essential sources for a variety of marine and estuarine organisms including Dugong, turtles, fish and macro-invertebrates[16]. Seagrasses fall within the category of Benthic Primary Producer Habitat (BPPH), which plays a major role in marine ecosystem functioning including as a substrate, nursery area and providing shelter and food for organisms as well as physical stability of the coastline and seafloor.

14 Danaher K, Rasheed M A and Thomas R (2005) **The Intertidal Wetlands of Port Curtis.** Department of Primary Industries and Fisheries Information Series QI05031

15 Melville F and Anderson L (2008) **PCIMP Intertidal Monitoring 2007: North Harbour Zones.** Centre for Environmental Management, Central Queensland University.

16 Alquezar R, Small K and Hendr R (2007) **Port Curtis Biomonitoring programme: macroinvertebrate, mangrove and seagrass surveys November 2006.**

Within the Port or Gladstone region, seagrass has been regularly monitored by the Department of Primary Industries and Fisheries (DPIF) Marine Ecology Group in collaboration with Central Queensland Ports Authority. This monitoring expands on a baseline study conducted in 2002, and in 2007 was included as an annual monitoring theme in the Port Curtis Integrated Monitoring Program (PCIMP)[17].

Within Queensland waters, 15 species of seagrass have been recorded. Within the Port of Gladstone, the following six species were identified:

- *Halodule uninervis*
- *Halophila ovalis*
- *Halophila decipiens*
- *Halophila minor*
- *Halophila spinulosa*
- *Zostera capricormi.*

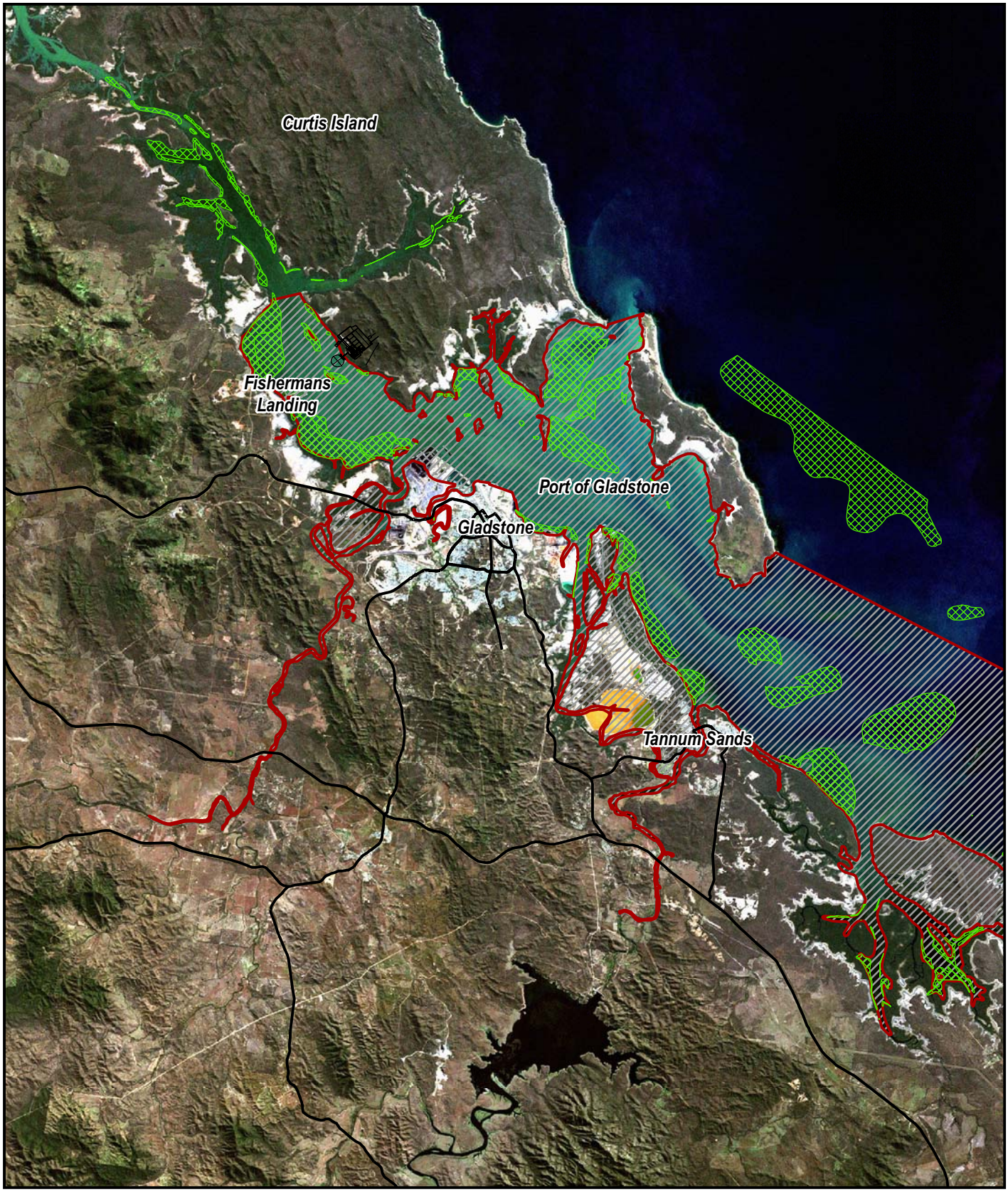
The 2002 baseline study determined that the Port of Gladstone-Rodds Bay seagrass communities (shown in *Figure 13-3.3*) are of regional significance, as the next nearest meadows are at Hervey Bay 170 km to the south and Shoalwater Bay 170 km to the north. The extensive seagrass distribution within the area is considered in part to be as a result of sheltered conditions, with much of the Port of Gladstone-Rodds Bay area well protected from south-easterly winds by Rodds Peninsula and from northerly winds by Curtis and Facing islands.

A total of 7, 246 ha of intertidal (coastal) seagrass beds were identified within the Port of Gladstone-Rodds Bay Dugong Protection Area (DPA), with an additional 6,332 ha in deepwater areas (>5 m Mean Sea Level) identified to the east and south of Facing Island[18].

Within the port, the majority of the seagrass communities were located in the Pelican Banks/Quoin Island area between The Narrows and the Calliope River mouth and southern port limits. These communities are close to a number of industrial activities within the port, including shipping channels, the RG Tanna Coal Terminal (RGTCT), Queensland Alumina Limited and Fisherman's Landing. No deepwater seagrass (>5m below Mean Sea Level) communities occurred within the inner-port area.

17 Storey A W, Andersen L E, Lynas J, and Melville F (2007). **Port Curtis Ecosystem Health Report Card.** Port Curtis Integrated Monitoring Program (PCIMP), Centre for Environmental Management, Central Queensland University.

18 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**, November/December 2002. DPI Information Series Q103058



Legend

- QCLNG Footprint Plant Layout
- Seagrass
- Dugong Protection Areas

Source Note:

Dugong Protection Areas and Gladstone November 2002
Seagrass distribution produced by Queensland Department of Primary Industries and Fisheries.
Landsat ETM+ Image source: USGS 2009. Aquired May 2000.

Projection: UTM MGA Zone 56 Datum: GDA 94

0 2 4 8 km

N

QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: Dugong Protection Area and Areas of Seagrass in the Port of Gladstone Region
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JF/JB	Annex 13.3 Figure 13.3	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: JT	File No: 0086165b_ANX_GIS025_F13.3	
	Date: 20.07.09	Revision: 1	

It is noted that the studies have not been focused in the intertidal/subtidal areas to the west of Curtis Island, therefore limited information is available about the proposed area of the LNG Marine Facilities, including the Materials Offloading Facility (MOF). There is significant data about seagrass meadows to the north and south of the Fisherman's Landing area,

Seagrass meadows most commonly occur on intertidal mud and sand substrates. Only 12 coastal seagrass meadows were completely subtidal, generally small *Halophila*-dominated meadows immediately adjacent to mud and sand banks[19].

A recent long-term seagrass monitoring program (2002-2007) found shifts in the community structure and composition were not uncommon. Seagrass meadows varied significantly in per cent cover, biomass and species composition among sampling sites and over years[20].

In 2007, seagrasses in the Port of Gladstone were in their healthiest condition recorded since monitoring began[21]. Most of the meadows were at or near their highest recorded density and area. The changes observed during the monitoring program appear to be largely linked to a combination of climate factors and tidal exposure, as well as the natural resilience and capacity for recovery in individual seagrass meadows. The changes were consistent with those at reference sites in nearby Rodds Bay and other Queensland locations. The healthy *Zostera capricorni* communities identified in the 2007 monitoring program will likely provide an important refuge for fish and crustacean species, and are recognised as key nursery areas for many commercial species.

Evidence of Dugong activity in the Port of Gladstone seagrass meadows has been consistently observed throughout the monitoring program. The seagrass meadows around Wiggins Island, in particular, appear to be heavily utilised by Dugong. Feeding trails were found at most sites sampled in 2007 and have been recorded in all previous surveys. Further evidence of feeding activity was observed at South Trees, Quoin Island and Fisherman's Landing. Green sea Turtles were also regularly observed within the seagrass meadows, particularly on Pelican Banks, where they were often "stranded" at low tide.

The presence of seagrass meadows and Dugong activity in intertidal areas adjacent to port facilities and infrastructure has implications for port management. Some of the most utilised seagrass meadows also appear to be those closest to major port infrastructure and proposed areas of expansion.

Macro-algae are only a minor component of the benthic communities in the Port of Gladstone region. Macro-algae cover is generally low and does not

19 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, November/December 2002.** DPI Information Series Q103058

20 Alquezar R, Small K,, Hendry R (2007) **Port Curtis Biomonitoring programme: macroinvertebrate, mangrove and seagrass surveys November 2006.** A report to Queensland Energy Resource Limited (QERL). Centre for Environmental Management, Central Queensland University, Gladstone Queensland.

21 Rasheed M A, McKenna S A, Taylor H.A. and Sankey T L (2008). **Long term seagrass monitoring in Port Curtis and Rodds Bay, Gladstone – October 2007.** DPI&F Publication PR07- 3271.

form distinctive community regions. However, while significant areas of macro-algae in coastal areas are absent, coastal seagrass meadows have been observed with a relatively high percentage cover of filamentous green algae[22]. Micro-algae live within the sediment and form part of the local and regional fish production cycle. In the Port of Gladstone area, micro-algae occur in lagoons, estuaries, sandbanks, mudbanks, saltmarshes and soft seabeds.

Benthic Macro-invertebrate Communities (Including Coral): The nearest coral reefs of significance to the Project area are associated with the offshore islands of the Capricorn and Bunker groups, approximately 60 km north-east of Gladstone. In this region, the reefs consist of a series of isolated platform reefs, many of which surround small vegetated islands. A total of 244 species of hard corals have been recorded from the Capricorn Group reefs and the reefs of the Bunker Group to the south[23].

Deepwater benthic macro-invertebrate communities previously identified in the Port of Gladstone were divided into regions based on density of individuals and community composition[24]. Two regions (98 ha and 158 ha) of low coral reef bommies[25] and associated mixed coral reef invertebrate community, interspersed with bare substrate, were identified on the seaward side of Facing Island. Hard and soft corals were also associated with a number of benthic communities throughout the survey area (see *Figure 13-3.4*).

Developed hard-coral assemblages are supported on the rocky reef substrate sites between Facing and Curtis islands[26,27] and north of Targinie Creek in rocky parts of The Narrows channel[28]. Reefal benthos on the south side of Picnic Island is comprised primarily of soft corals, anemones, fan worms, sponges and tunicates[29]. A few small, isolated hard corals occur (mostly *Favidae* and *Goniopora*), but these do not combine or provide adequate structure (height and extent) to form significant reef habitat for reef-associated species[30].

22 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, November/December 2002**. Q103058

23 Great Barrier Reef Marine Park Authority (GBRMPA) (2004) The Status of the Great Barrier Reef Report: Corals.

24 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, November/December 2002**.

25 A shallow isolated piece of reef located a distance offshore.

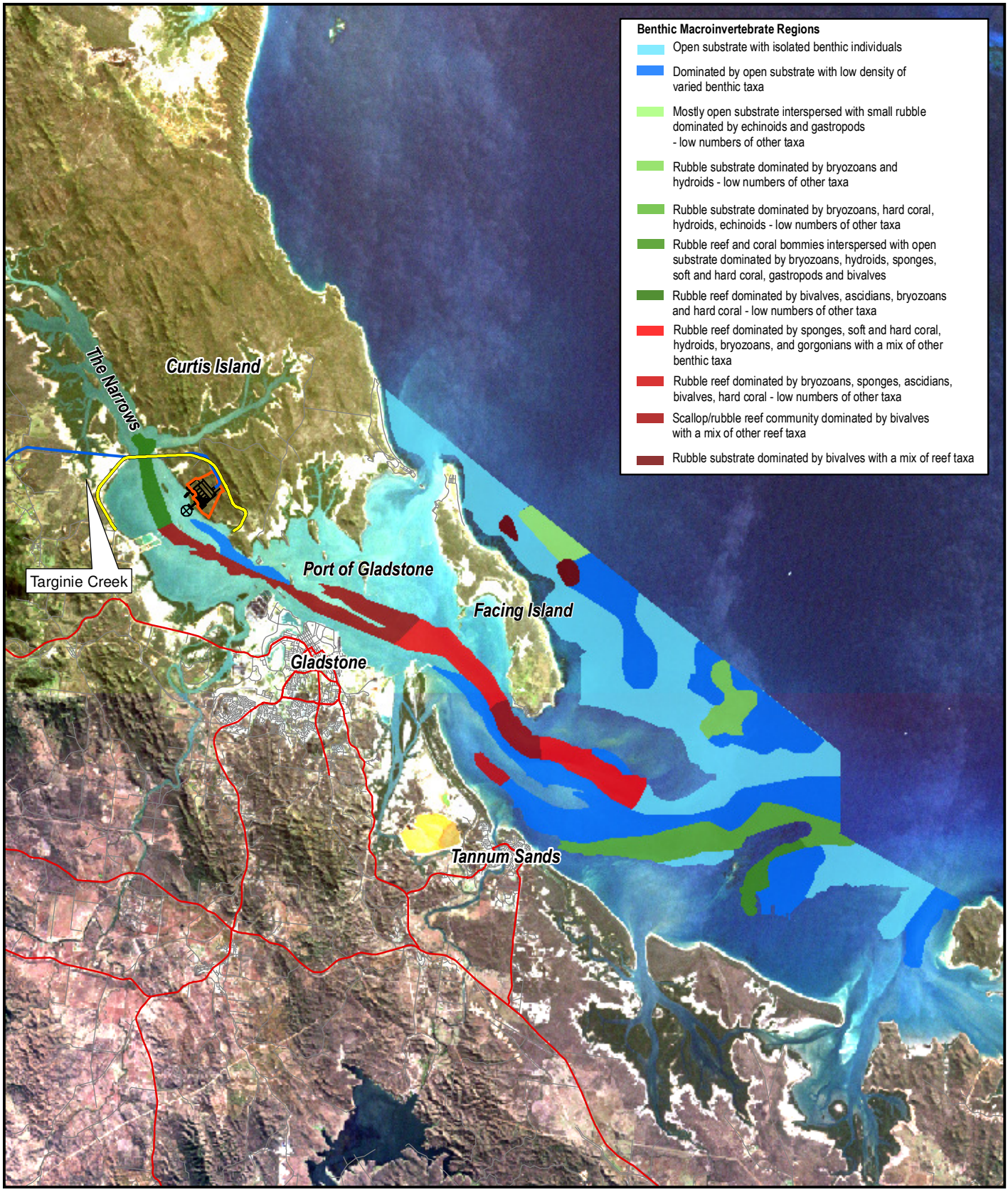
26 URS (2007) **Gladstone Nickel Project Environmental Impact Statement.** Public EIS report prepared on behalf of Gladstone Pacific Nickel by URS Australia Pty Ltd, Brisbane, Queensland.

27 Dames and Moore (1998) **Comalco Alumina Project Gladstone: Impact Assessment Study – Environmental Impact Statement.** Public EIS report produced by Dames and Brisbane (now URS Australia Pty Ltd), Brisbane, Queensland.

28 URS (2007) **Gladstone Nickel Project Environmental Impact Statement.** Public EIS report prepared on behalf of Gladstone Pacific Nickel by URS Australia Pty Ltd, Brisbane, Queensland.

29 URS (2007) **Gladstone Nickel Project Environmental Impact Statement.** Public EIS report prepared on behalf of Gladstone Pacific Nickel by URS Australia Pty Ltd, Brisbane, Queensland.

30 URS (2007) **Gladstone Nickel Project Environmental Impact Statement.** Public EIS report prepared on behalf of Gladstone Pacific Nickel by URS Australia Pty Ltd, Brisbane, Queensland.



Legend

- Proposed QCLNG Site Boundary
- QCLNG Footprint Plant Layout
- Possible Curtis Island Road/ Bridge Corridor
- Proposed Export Pipeline
- Major Roads
- Local Roads

Source Note:
Benthic macro-invertebrate data adapted from Rasheed et al 2003.
Landsat ETM+ Image source: USGS 2009. Aquired May 2000.
Curtis Island Road/bridge Corridor - Connell Wagner
StreetPro Australia - Pitney Bowes MapInfo

Projection: UTM MGA Zone 56 Datum: GDA 94

0 2 4 8 km

N

QUEENSLAND CURTIS LNG
A BG Group business

ERM
Environmental Resources Management Australia Pty Ltd

Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business
Drawn	JF/JB
Approved	JC
Date	20.07.09
Annex 13.3	Figure 13.4
File No:	0086165b_ANX_GIS026_F13.4
Revision	1

Title: **Deep Water Benthic Macro - Invertebrate Regions in Port of Gladstone and Rodds Bay, November/December 2002**

The strong tidal regime in the Port of Gladstone gives rise to naturally high turbidity levels and, as such, the species found within this location are well adapted to high sediment loads and scour within/from the water column. Because of their dynamic physical nature, the faunal composition of an estuary may vary considerably at spatial scales of metres to kilometres, and temporal scales of days to years[31, 32].

Infaunal communities inhabiting the soft sediments of the Port of Gladstone are well studied, both spatially and temporally. It has been found that filter-feeding organisms dominate the infaunal communities and account for more than 50 per cent of the total abundance and nearly 30 per cent of total species richness[33]. Deposit-feeding organisms were also common (>25 per cent of total abundance and nearly 35 per cent of total species diversity). Polychaete worms, molluscs and crustaceans together accounted for more than 86 per cent of the individuals and 83 per cent of the species collected. Other less common taxa identified included echinoderms, cnidarians, sea spiders and ribbon, round, peanut and flat worms. The bivalve mollusc (*Carditella torresi*) was the most abundant species and accounted for more than 14 per cent of total infaunal abundance, principally within subtidal sites. Few other species could be considered numerically dominant.

Species abundance data revealed strong ecological gradients that were principally driven by depth and sediment grain size. Depth-related differences in infaunal species assemblages were most pronounced between the subtidal and intertidal zones, and total abundance and richness were both significantly lower in the intertidal zones. Total abundance and richness were also found to be significantly lower in sediments that were either extremely coarse or extremely fine. This broad ecological gradient was retained throughout the duration of the study period, despite apparent seasonal and other changes in species dominance.

A diverse range of benthic macro-invertebrate communities have been previously identified[34]. Benthic macro-invertebrates occurred throughout the areas surveyed (see *Figure 13-3.4*). Communities identified in the survey were divided into regions based on density of individuals and community composition. Communities were dominated by filter-feeding species such as sponges, gorgonians and bivalves, which tend to thrive in high-current environments.

High-density benthic communities were mostly located in a narrow strip running in the channel from Fisherman's Landing to inside Facing Island and East Bank. The high-density communities generally consisted of rubble reef

31 Morrisey D J, Howitt L, Underwood A J, Stark J S, (1992a) **Spatial variation in soft-sediment benthos.** Marine Ecology Progress Series 81, 197-204.

32 Morrisey D J, Underwood A J, Howitt L, Stark J S, (1992b) **Temporal variation in soft-sediment benthos.** Journal of Experimental Marine Biology and Ecology 164, 233-245.

33 Currie D R and Small K J (2005) **Macrobenthic community responses to long-term environmental change in an east Australian sub-tropical estuary.** Estuarine, Coastal and Shelf Science, 63: 315-331.

34 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, November/December 2002.** DPI Information Series Q103058 (DPI, Cairns), 47pp.

dominated either by sponges, soft coral, hard coral, hydroids, bryozoans and gorgonians with a mix of other benthic taxa or by large numbers of scallops, but otherwise with a similar mix of reef taxa.

Medium-density benthic communities in the deep-channel area from the mouth of The Narrows at Graham Creek to Fisherman's Landing consisted of rubble reef dominated by bivalves, ascidians, bryozoans and hard corals with low numbers of other taxa.

A 2006 survey of benthic invertebrates in 17 arbitrary zones in the Port of Gladstone (see *Figure 13-3.4*) similarly found molluscs and crustaceans dominate in most zones[35]. Polychaetes were the next most abundant organism. The highest total macro-invertebrate abundance was found at Fisherman's Landing (279 organisms/m^3) while the lowest was at the Anabranch (54 organisms/m^3). Polychaetes provided the highest proportion of individual species in the majority of zones, while mollusc and crustacean species richness was also high. Highest species richness was found at Fisherman's Landing (31 species/m^3) while the lowest was at the Estuarine Reference (13 species/m^3).

Spatial variation in intertidal macro-invertebrate abundance, species richness, species diversity and evenness across the zones, however, was not found to be significant. This is primarily due to the large amount of variation within each zone. This indicates that a range of diverse macro-invertebrate communities are found throughout the intertidal areas of the Port of Gladstone.

Macro-invertebrate parameters did not appear to be impacted by sediment-contaminant concentrations, but seemed to be more dependent on sediment physical properties such as particle size.

Biodiversity and Threatened Species

The biodiversity associated with the different habitat types found within the Gladstone region of the GBRWHA were described in the previous section on "ecological and biological processes". Threatened species that could be affected by the controlled actions are described in Section C.2.2.

13-3.2.2 Listed Threatened Species and Communities and Listed Migratory Species

Terrestrial Species and Communities

Searches of the Commonwealth *EPBC Act* Protected Matters database and Queensland Environmental Protection Agency (EPA) Wildlife Online searches conducted in August 2008 identified a number of threatened terrestrial flora and fauna species that had the potential to occur within the study area. This included nine Threatened flora species (*Table 13-3.4*) and 10 Threatened terrestrial fauna species (*Table 13-3.5*).

35 Melville F and Anderson L (2008). **PCIMP Intertidal Monitoring 2007: North Harbour Zones.** Centre for Environmental Management, Central Queensland University.

Table 13-3.4 Threatened Flora Species Identified in the EPBC Protected Matters Search

Species	*EPBC Act* Status
Atalaya collina	E [1]
Asplenium pellucidum	V [2]
Bosistoa selwynii (Heart-Leaved Bosistoa)	V [1]
Bosistoa transversa (Three-Leaved Bosistoa)	V [1,2]
Bulbophyllum globuliforme (Miniature Moss-Orchid)	V [1]
Cupaniopsis shirleyana (Wedge-Leaf Tuckeroo)	V [1,2]
Parsonsia larcomensis	V [1]
Quassia bidwillii (Quassia)	V [1]
Taeniophyllum muelleri (Minute Orchid, Ribbon-Root Orchid)	V [1]

1. From Commonwealth Online Protected Matters search (August 2008)

2. From EPA Wildlife Online search (August 2008)

***** The values of *EPBC Act* are: Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V)

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. The methods used during the desktop and field ecology assessments carried out for the ecological impact assessment are summarised in *Volume 5 Chapter 7, section 7.5*.

Detailed assessment studies and reports for birds, reptiles and amphibians and vegetation were undertaken by specialist consultants. Specialist technical reports are summarised within Volume 5 Chapter 7, with the full technical reports provided as *Appendix 5.5*[36]*, Appendix 5.6*[37]*, Appendix 5.7*[38] *and Appendix 5.8*[39].

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

Terrestrial Flora: Two of the *EPBC Act* listed plant species were considered to have suitable habitat within the study area (i.e. *Quassia bidwillii* and *Atalaya collina*). These species were specifically targeted in the on-ground assessments, and were not detected. Therefore, the flora of the study area

36 Unidel (2009) *QCLNG – Curtis Island Components: Flora Report*.

37 Unidel (2009) *QCLNG – Curtis Island Components: Reptiles and Amphibians Report.*

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

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

(refer *Appendix 5.5*[40]) is not considered to be of conservation significance from a national perspective.

Table 13-3.5 Threatened Terrestrial Fauna Species Identified in the EPBC Protected Matters Search

Species	*EPBC Act* Status	Sighting Records (EPA)
Terrestrial Birds #		
Erythrotriorchis radiatus (Red Goshawk)	V, M [1]	
Geophaps scripta scripta (Squatter Pigeon -southern)	V [1,2]	6
Turnix melanogaster (Black-Breasted Button-Quail)	V [1]	
Epthianura croceri macgregori (Yellow Chat)	CE [2]	2
Terrestrial Mammals #		
Chalinolobus dwyeri (Large-Eared Pied Bat)	V [1]	
Dasyurus hallucatus (Northern Quoll)	E [1]	
Xeromys myoides (Water Mouse, False Water Rat)	V [1]	
Terrestrial Reptiles #		
Denisonia maculata (Ornamental Snake)	V [1]	
Egernia rugosa (Yakka Skink)	V [1]	
Paradelma orientalis (Brigalow Scaly-Foot)	V [1]	

1. From Commonwealth Online Protected Matters search undertaken August 2008, excluding Migratory species.
2. From EPA Wildlife Online search (August 2008), excluding Migratory species.

= Excludes marine and wetland bird species, marine mammals and marine reptiles that are dependent upon terrestrial environments for breeding.

The values of *EPBC Act* are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) Vulnerable (V) and Migratory (M)

Records indicates the total number of records of the taxa on the database.

Terrestrial Birds: During field surveys (refer *Appendix 5.7*[41] *and Appendix 5.8*[42]) the only *EPBC Act* listed Threatened bird species recorded was the Squatter Pigeon (*Geophaps scripta scripta*). Squatter Pigeons (Vulnerable) were observed at four locations on the mainland, but not on Curtis Island. All of the mainland observations were within 150 m of a permanent freshwater dam or creekline. A number of immature birds were observed.

Targeted searches for the Endangered Yellow Chat were undertaken during the terrestrial ecology field surveys in 2008 and 2009 and focused on the saltpan habitats, particularly the Saltwater Couch vegetation. No Yellow Chats were recorded. Apart from a small area in the vicinity of Friend Point, saltmarsh was highly degraded and its extent limited.

40 Unidel (2009) *QCLNG – Curtis Island Components: Flora Report*.

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

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

The bird surveys undertaken for the terrestrial ecology study did record sightings of 25 *EPBC Act* listed Migratory birds (refer *Table 13-3.6*). For all of these the study determined that the area is not at the limit of the species' range. It was found that the region supports an ecologically significant proportion of the population of Bar-Tailed Godwit (*Limosa lapponica*), Eastern Curlew (*Numenius madagascariensis*), Whimbrel (*Numenius phaeopus*) and Common Greenshank (*Tringa nebularia*).

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 on the mainland. 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 Laird Point. Impacts on the mainland resulting from the Mainland Road and Bridge Approach would be more severe as they would affect an important roost site for Eastern Curlew and other migratory shorebirds.

The proposed Mainland Road and Bridge Approach has the potential to have a significant impact on the Eastern Curlew, due to:

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

The following potential impacts of the Mainland Road and Bridge Approach on birds and associated habitat are summarised:

- 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.

Terrestrial Mammals: No terrestrial mammals of Commonwealth significance were detected within the study area. It is unlikely that any of the three Commonwealth listed Threatened terrestrial mammal species considered to have the potential to occur at the site are actually within the study area, due to their specific habitat requirements.

One species of Long-Eared Bat (*Nyctophilus* sp.) that was not identifiable to species level was recorded using Anabat units on three separate days during the February 2009 terrestrial ecology field survey period. This bat may be a species that is listed as Vulnerable under the *EPBC Act*.

Three species of *Nyctophilus* have distributions that are consistent with the study area[43,44]. These are Eastern Long-Eared Bat (*N. timoriensis)*, listed as Vulnerable, Gould's Long-Eared Bat (*N. gouldi*) and the Northern Long-Eared Bat (*N. bifax*). Neither of the latter two species is listed under State or Commonwealth legislation. Habitat preferences indicate that the species detected in the study area is likely to be *N. gouldi* and is therefore not of Commonwealth significance.

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[45] and these habitat types do not occur in the study 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 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[46]. Therefore, it is considered unlikely that the Northern Quoll occurs in the study area, given the abundance of cane toads at the site and the lack of evidence of the species.

The lack of permanent freshwater in the study area is a primary determinant of the distribution and abundance of mammal species. Water Mouse, False Water Rat (*Xeromys myoides*) was not recorded during the field survey.

Terrestrial Reptiles and Amphibians: No *EPBC Act* listed Threatened reptiles or amphibians were found during the field surveys (refer *Appendix 5.6*[47]).

Of the three Commonwealth listed Threatened species predicted to occur within the study area, only the Yakka Skink (*Egernia rugosa),* listed as Vulnerable, was considered to have suitable habitat. Given the difficulty in detecting this species[48], it is possible that *E. rugosa* occurs within the study area.

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

44 Menkhorst P and Knight F (2001) **A field guide to the mammals of Australia** Oxford University Press, Melbourne

45 Environment Australia (1999) **The Action Plan for Australian Bats** Environment Australia, Canberra

46 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.

47 Unidel (2009) *QCLNG – Curtis Island Components: Reptiles and Amphibians Report.*

48 DEWHA (2009) ***Egernia rugosa* in Species Profile and Threats Database** Department of the Environment, Water, Heritage and the Arts, Canberra

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 populations in northern Australia[49]. There is evidence that they are also responsible for the decline of native frog and small reptile populations through competition and predation[50].

Butterflies: No *EPBC Act* listed Threatened butterfly species were identified in the EPBC Protected Matters database or EPA Wildlife Online search and none were recorded during the terrestrial ecology field surveys.

Table 13-3.6 Terrestrial Migratory Bird 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
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
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
White-throated Needletail (*Hirundapus caudacutus*)	no	no	no
Rainbow Bee-eater (*Merops ornatus*)	no	no	no

49 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, Supervising Scientist, Darwin

50 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, Supervising Scientist, Darwin

Marine Species

An area search of the *EPBC Act* Protected Matters database (on February 19, 2009) for species of National Environmental Significance identified a total of 12 Threatened and 24 Migratory Marine species.

Fish: Two threatened fish species, Whale Shark (*Rhincodon typus*) and the Green Sawfish (*Pristis zijsron*), are listed as Vulnerable under the *EPBC Act* and have the potential to occur within or migrate through the area.

Green Sawfish are a northern Australian species with a preference for muddy, soft-bottom habitats such as the upper reaches of estuaries and turbid river systems[51]. In Australian waters, Green Sawfish have historically been recorded in the coastal waters off Broome in Western Australia, around northern Australia and down the east coast as far as Jervis Bay in New South Wales. On the east coast, however, Green Sawfish are now only found north of Cairns, most commonly in the Gulf of Carpentaria[52]. It is therefore highly unlikely that the Port of Gladstone will provide important habitat for Green Sawfish.

The Whale Shark (*Rhincodon typus*) is also listed as Migratory under the *EPBC Act,* as well as being classified as Vulnerable on the International Union for Conservation of Nature (IUCN) Red List (2008). It may utilise the region for migration and foraging. However, this species is typically an offshore species and not expected to utilise the Port of Gladstone or areas immediately adjacent to the Project.

Marine Mammals: One species of marine mammal, the Humpback Whale (*Megaptera novaeangliae*), is listed as Vulnerable and Migratory under the *EPBC Act* and may potentially occur in or around the Project area. A further five Migratory Marine mammal species are listed under the *EPBC Act* and potentially occur in the region (*Table 13-3.7*).

Table 13-3.7 EPBC Act and Nature Conservation Act (Qld) Threatened and Migratory Listed Marine Mammal Species

Species name	Status	Type of Presence (EPBC definition)	Likelihood of presence in the Port of Gladstone
Humpback whale *(Megaptera novaeangliae)*	*EPBC Act*: Vulnerable and Migratory *NC Act*: Vulnerable *IUCN Category*: Least Concern.	Breeding known to occur within area.	Unlikely (known to aggregate offshore from the Port of Gladstone).
Bryde's Whale *(Balaenoptera edeni)*	*EPBC Act*: Migratory *NC Act*: No Listing *IUCN Category*: Data Deficient.	Species or species habitat may occur within area.	Unlikely (may migrate occasionally through the area).

51 Department of Environment Water Heritage and the Arts (DEWHA) (2008) http://www.environment.gov.au/index.html

52 Stevens,J D, Pillans R D and Salini J (2005). **Conservation assessment of Glyphis sp. A (speartooth shark), Glyphis sp. C (northern river shark), Pristis microdon (freshwater sawfish) and Pritis zijsron (green sawfish).** CSIRO Marine Research

Species name	Status	Type of Presence (EPBC definition)	Likelihood of presence in the Port of Gladstone
Dugong *(Dugong dugon)*	*EPBC Act*: Migratory *NC Act*: Vulnerable *IUCN Category*: Vulnerable.	Species or species habitat likely to occur within area.	Highly likely (dugong protection area in the Port of Gladstone).
Snubfin Dolphin (*Orcaella heinsohni*) (previously listed as Irrawaddy Dolphin, *Orcaella brevirostris)*	*EPBC Act*: Migratory *NC Act*: Rare *IUCN Category*: Vulnerable.	Species or species habitat may occur within area.	Likely (may migrate through the area).
Killer Whale, Orca *(Orcinus orca)*	*EPBC Act*: Migratory *NC Act*: No Listing *IUCN Category*: Data Deficient.	Species or species habitat may occur within area.	Highly unlikely (oceanic species - may migrate occasionally through the area).
Indo – Pacific Humpback Dolphin *(Sousa chinensis)*	*EPBC Act*: Migratory *NC Act*: Rare. *IUCN Category*: Near Threatened.	Species or species habitat may occur within area.	Likely (may migrate through the area)

Source: Area search of the EPBC Protected Matters database on 19 February 2009.

There are known to be two populations of Migratory Humpback Whales in Australia, a west coast and an east coast population. The population estimate for the Humpback Whale on the east coast of Australia was around 8,000 in 2006[53]. Every year the whales migrate north to the sub-tropical calving grounds, from June to August, with peak migration in July. From September to November, they head south to the feeding grounds of the Southern Ocean.

The northward migration is generally offshore and the majority of whales probably pass (as close as 50 km off the coast) to the east of Stradbroke and Moreton islands, which are approximately 600 km from the Port of Gladstone. The closest aggregation area to the Port of Gladstone is approximately 400 km south in the area surrounding Hervey Bay[54]. The Great Barrier Reef is a critical habitat used as calving (between 14°S and 27°S) and resting grounds during the annual migration. Given the offshore nature of this species and the known distances from the Port of Gladstone area, it is not expected to be a key sensitive receptor for the QCLNG Project.

Further, due to the inshore nature of the site it is considered that Bryde's Whale (*Balaenoptera edeni*) and the Killer Whale (*Orcinus orca*) do not occur at or adjacent to the Port of Gladstone itself, as they are principally oceanic species.

53 Department of Environment and Water Resources (DEWR) (2007). **The Humpback Whales of Eastern Australia.** [Accessed: 03-Feb-2009].

54 Chaloupka M., Osmond M. and Kaufman G. (1999) **Estimating seasonal abundance trends and survival rates of humback whales in Hervey Bay (east coast of Australia).** Marine Ecology Progress Series, 184, 291-301

Two dolphin species may occur in the Port of Gladstone region, the Snubfin Dolphin (*Orcaella heinsohni*) – previously listed as Irrawaddy Dolphin, *Orcaella brevirostris*) – and the Indo-Pacific Humpback Dolphin (*Sousa chinensis*). The Indo-Pacific Humpback Dolphin usually inhabits shallow coastal waters of less than 20 m depth and is often associated with rivers and estuarine systems, enclosed bays and coastal lagoons[55]. Previous studies have shown that the Indo-Pacific Humpback Dolphin co-exist with coastal development such as in Cleveland Bay, Townsville[56]. The Snubfin Dolphin (*Orcaella heinsohni*) is endemic to Australia and is known to occur close to river mouths[57]. Their preference for near-shore, estuarine waters is likely related to the productivity of these tropical coastal areas[58]. There is no published information available for either species in the Port of Gladstone region.

The Australian population of Dugong (*Dugong dugon*) comprises two apparently genetically distinct groups. One ranges from Moreton Bay in southern Queensland to Western Australia, the other has a more restricted distribution, ranging from Moreton Bay to the Northern Territory[59]. Although Dugong are not considered to be under threat in most parts of Australia, their number has declined along the Queensland coast[60]. The IUCN has listed Dugong as Vulnerable to Extinction due to the global decline of populations.

Dugongs feed predominately on seagrass but supplement their diet with invertebrates such as polychaete worms, seasquirts and shellfish. The value of the large seagrass meadows identified in the coastal areas within the Port of Gladstone[61] to the Dugong population has resulted in declaration of the Rodds Bay Dugong Protected Area (DPA) (refer *Figure 13-3.3*). Rodds Bay DPA comprises The Narrows south of Graham Creek and east to Facing Island, encompassing the majority of Southern Curtis Island waters. The area has been classified as Zone B, which represents habitat that is less significant than Zone A but still important. Within this protection area, boat speed is restricted and, while mesh-netting is practices are permitted, they are subject to more restrictions than for outside the DPA.

Recent studies suggest that Dugong numbers are now stable, at the scale of the whole urban coast and over a timeframe of two decades[62]. However,

55 Parra G J (2006) **Resource partitioning in sympatric delphinids: Space use and habitat preferences of Australian Snubfin and Indo-Pacific humpback dolphins.** Journal of Animal Ecology 75:862-874.

56 Parra G J (2006) **Resource partitioning in sympatric delphinids: Space use and habitat preferences of Australian Snubfin and Indo-Pacific humpback dolphins.** Journal of Animal Ecology 75:862-874.

57 Parra G J, Azuma C, Preen A R, Corkeron P J and Marsh H (2002) **Distribution of Irrawaddy Dolphins, *Orcaella brevirostris*, in Australian waters.** Raffles Bulletin of Zoology, Supplement10, pp 141-154.

58 Parra G J (2006) **Resource partitioning in sympatric delphinids: Space use and habitat preferences of Australian Snubfin and Indo-Pacific humpback dolphins**. Journal of Animal Ecology 75:862-874.

59 Lawler I, Marsh H, McDonald B and Stokes T. (2002) **Current State of Knowledge: Dugongs in the Great Barrier Reef.** CRC Reef Research Centre, Townsville.

60 Lawler I, Marsh H, McDonald B and Stokes T. (2002) Current State of Knowledge: Dugongs in the Great Barrier Reef. CRC Reef Research Centre, Townsville.

61 Coles R G, Lee Long W J, Squire B A, Squire L C and Bibby J M (1987) **Distribution of seagrasses and associated juvenile commercial penaeid prawns in north-eastern Queensland waters.** Aust J Mar Freshwater Res, 38: 103–119.

62 Marsh H and Lawler I R (2006) **Dugong distribution and abundance on the urban coast of Queensland: a basis**

populations fluctuate at the level of individual bays and over shorter time periods, probably largely due to natural changes in seagrass habitats. From a November 2005 survey, it was estimated that there were 183 (±66) Dugong in the Port of Gladstone area.

Figure 13-3.5 shows the aerial survey transects with location and sizes of Dugong groups sighted[63]. In a long-term monitoring program of seagrass in the Port of Gladstone, Dugong were consistently observed feeding, especially around Wiggins Island (approximately 6 km south-east of the Project site)[64].

Dugong feeding activity was also observed on the majority of intertidal seagrass meadows surveyed during a study of benthic habitats in the Port [65]. The highest density of Dugong feeding trails was observed at Wiggins Island West, with feeding trails recorded at 58 per cent of sampling sites. Dugong feeding trails were also observed at Quoin Island, Pelican Banks, South Trees and the intertidal meadows to the north and south of Fisherman's Landing[66].

Marine Reptiles: A search of the *EPBC Act* Protected Matters database on February 19, 2009, found that two species of marine turtle that are listed as Endangered and Migratory and four species listed as Vulnerable and Migratory may potentially occur in or around the Project area (*Table 13-3.8*). The database also indicated that two of the turtle species (the Loggerhead and Flatback) are known to breed in the area.

The Estuarine Crocodile is listed as Migratory under the *EPBC Act* and also potentially occurs within the area.

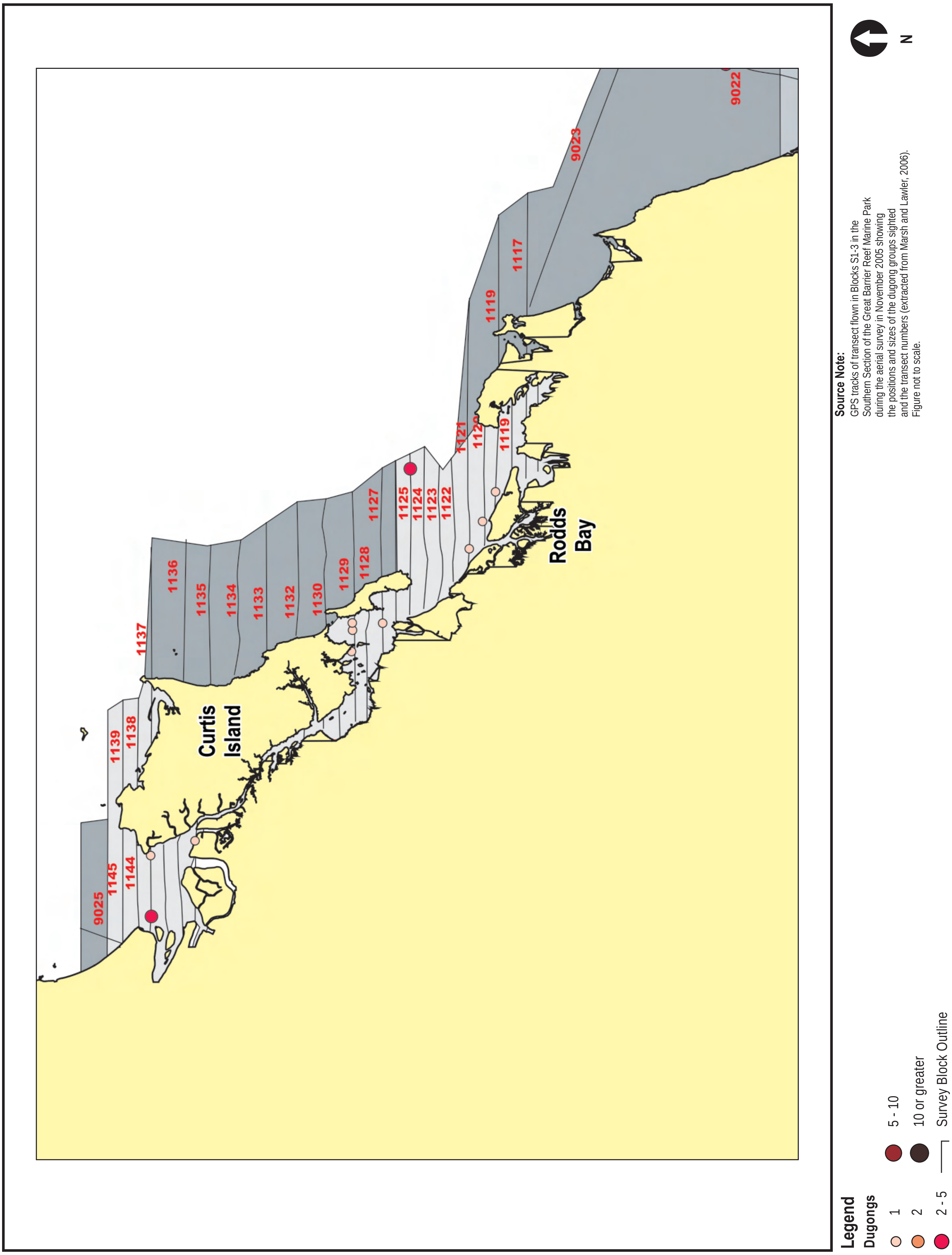
for management. Marine and Tropical Science Research Facility Interim Projects 2005-06 FINAL Report Project 2.

63 Marsh H and Lawler I R (2006) **Dugong distribution and abundance on the urban coast of Queensland: a basis for management.** Marine and Tropical Science Research Facility Interim Projects 2005-06 FINAL Report Project 2.

64 Taylor H, Rasheed M, Dew K. and Sankey T. (2007) **Long Term Seagrass Monitoring in Port Curtis and Rodds Bay, Gladstone, November 2006.** Queensland: Queensland Department of Primary Industries and Fisheries Publication PR07-2774.

65 Rasheed M A, McKenna S A, Taylor H A and Sankey T L (2008) **Long term seagrass monitoring in Port Curtis and Rodds Bay, Gladstone – October 2007**. DPI&F Publication PR07- 3271 (DPI&F, Cairns), 32 pp.

66 Rasheed M A, McKenna S A, Taylor H A and Sankey T L (2008) **Long term seagrass monitoring in Port Curtis and Rodds Bay, Gladstone – October 2007**. DPI&F Publication PR07- 3271 (DPI&F, Cairns), 32 pp.



QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: **GPS Tracks of Transects Flown in Blocks S1-3**
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JF/JB	Annex 13.3 — Figure 13.5	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: GB	File No: 0086165b_ANX_CDR027_F13.5	
	Date: 24/06/09	Revision: 1	

Table 13-3.8 EPBC Act and Nature Conservation Act (Qld) Listed Threatened and Migratory Marine Reptiles

Species name	Status	Type of Presence (EPBC definition)	Likelihood of presence in the Port of Gladstone
Green Turtle *(Chelonia mydas)*	*EPBC Act*: Vulnerable/ Migratory *NC Act*: Vulnerable *IUCN Category*: Endangered	Species or species habitat may occur within the area	Likely (occasionally breed in the area)
Loggerhead Turtle *(Caretta caretta)*	*EPBC Act*: Endangered/ Migratory *NC Act*: Endangered *IUCN Category*: Endangered	Breeding known to occur within the area	Likely (occasionally breed in the area)
Leatherback Turtle *(Dermochelys coriacea)*	*EPBC Act*: Vulnerable/ Migratory *NC Act*: Endangered *IUCN Category*: Critically Endangered	Species or species habitat may occur within the area	Highly unlikely (oceanic species - may migrate occasionally through the area)
Pacific Ridley Turtle (*Lepidochelys olivacea)*	*EPBC Act*: Endangered/ Migratory *NC Act*: Endangered *IUCN Category*: Vulnerable	Species or species habitat may occur within area	Unlikely (may migrate occasionally through the area)
Hawksbill Turtle *(Eretmochelys imbricata)*	*EPBC Act*: Vulnerable/ Migratory *NC Act*: Vulnerable *IUCN Category*: Critically Endangered	Species or species habitat may occur within area	Unlikely (may migrate occasionally through the area)
Flatback Turtle *(Natator depressus)*	*EPBC Act*: Vulnerable/ Migratory *NC Act*: Vulnerable *IUCN Category*: Data Deficient	Breeding known to occur within area	Highly likely (breed in the area)
Estuarine/ Saltwater Crocodile *(Crocodylus porosus)*	*EPBC Act*: Migratory *NC Act*: Vulnerable *IUCN Category*: Least Concern	Species or species habitat likely to occur within area	Unlikely (may migrate occasionally through the area)

Source: Area search of the EPBC Protected Matters database on 19 February 2009.

Figure 13-3.6 illustrates major turtle nesting sites in Queensland and in the Curtis Coast region respectively. Important turtle nesting beaches for Flatback Turtles (*Natator depressus*) have been identified on the east coast of Curtis Island and Facing Island and further south at Tannum Sands (approximately

15 km South of Gladstone)[67,68]. The majority of turtle nesting for Curtis Island occurs on South End Beach[69]. Discussions with residents prior to the terrestrial ecology field assessments suggested that these species do not occur in the study area. There are no known turtle nesting beaches within close proximity (5 km) to the proposed LNG Marine Facilities, and site inspections by terrestrial ecologists confirmed that there is no suitable turtle breeding habitat within the study area. Green Turtles (*Chelonia mydas*) have been regularly observed within the seagrass meadows, particularly on Pelican Banks (eastern side of Curtis Island)[70].

Table 13-3.9 illustrates the key periods of annual turtle nesting activity in the Port of Gladstone. Flatback Turtle nesting in eastern Queensland commences mid-October, peaks late-November/early-December and ends in late-January. Hatchlings emerge from nests from early-December until late-March, with a peak in February[71]. Most females return to the same beach within a nesting season and over successive nesting seasons[72,73].

Curtis Island has been used as an index beach for monitoring population dynamics of Flatback Turtles within the eastern Australian stock. Mid-season nightly census studies at Curtis Island since 1970 have shown no obvious trend in the size of the annual nesting population, with a range from approximately 35-80 individuals per season recorded[74]. The Curtis Island Flatback Turtle nesting population has maintained an approximate constant size over the 35 years since monitoring began[75].

In southern Queensland, Green Turtle nesting commences mid-to-late October, peaks late-December/early-January and ends between late-March to early-April[76]. Hatchlings emerge from nests from late-December until around May, peaking in February and March. Loggerhead Turtle (*Caretta caretta*)

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67 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**. Queensland Environmental Protection Agency, ISSN 1449–194X. 13pp.

68 Queensland Environmental Protection Agency (QEPA) (2003) **Curtis Coast Regional Coastal Management Plan.** Environmental Protection Agency and Queensland Parks and Wildlife Service, ISBN 0-9751106-2-4. 184pp.

69 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**. Queensland Environmental Protection Agency, ISSN 1449–194X. 13pp.

70 Taylor H, Rasheed M, Dew K. and Sankey T. (2007) **Long Term Seagrass Monitoring in Port Curtis and Rodds Bay, Gladstone, November 2006.** Queensland: Queensland Department of Primary Industries and Fisheries Publication PR07-2774.

71 Limpus C J (2007a) **A biological review of Australian Marine Turtles. 5: Flatback Turtle *Natator depressus* (Garman).** Queensland Environmental Protection Agency, ISBN 978-0-9803613-1-5. 53pp.

72 Limpus C J, Fleay A and Baker V. (1984) **The Flatback Turtle, *Natator depressa*, in Queensland: reproductive periodicity, philopatry and recruitment.** Australian Wildlife Research 11: 579-587.

73 Limpus C J, Miller J D, Parmenter C J, Reimer D, McLachlan N and Webb, R (1992) **Migration of Green (*Chelonia mydas*) and Loggerhead (*Caretta caretta*) turtles to and from eastern Australian rookeries.** Wildlife Research 19: 347-358.

74 Limpus C J, Parmenter J and Limpus D J (2002). **The status of the Flatback Turtle, *Natator depressus*, in Eastern Australia.** NOAA Technical Memorandum NMFS-SEFSC 477: 140-142.

75 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.** Queensland Environmental Protection Agency, ISSN 1449–194X. 13pp.

76 Limpus C J (2007b) **A biological review of Australian Marine Turtles. 2: Green Turtle *Chelonia Mydas* (Linnaeus).** Queensland Environmental Protection Agency, ISBN 978-0-9803613-1-5. 102pp.

nesting commences late-October, peaks in December and ends in early-March. Hatchlings emerge from nests from late-December through to April[77].

Green and Loggerhead turtles nest occasionally on the beaches of Curtis Island and Facing Island. However, the Capricorn Group of islands (60 km from Gladstone) provide internationally significant rookeries for both[78].

- Tryon Island and Reef is of international importance for Loggerhead Turtles, with the flat an important feeding area for young turtles, and is also of regional significance for Green Turtle nesting.
- North-west Island and Reef is a regionally important rookery for Loggerhead Turtles and internationally significant rookery for Green Turtles.
- Wreck Island and reef has a Green Turtle rookery of international importance and has the most important offshore rookery for Loggerhead Turtles in eastern Australia.

Leatherback Turtles (*Dermochelys coriacea*), Hawksbill Turtles (*Eretmochelys imbricata*) and Olive Ridley Turtles (*Lepidochelys olivacea*) are not known to nest in the Port of Gladstone area. Individuals may migrate through the area, however, there are unlikely to be significant numbers in the vicinity of the Project.

The Estuarine Crocodile (*Crocodylus porosus*) is listed as a Migratory species under the *EPBC Act*. Crocodiles occur in mangrove wetlands, estuaries and associated wetlands (fresh and saline). In Australia, Estuarine Crocodiles are distributed throughout the Northern Territory, northern Western Australia and in Queensland from the Northern Territory border to Gladstone in the south[79]. The key area for Estuarine Crocodile populations in Queensland is the north-western Cape York Peninsula, particularly the Wenlock River and Lakefield National Park[80]. Gladstone lies at the southernmost boundary of the breeding distribution of the Estuarine Crocodile in eastern Australia[81] and, accordingly, the occurrence of crocodiles in this region is rare[82]. Local sources consulted during the terrestrial ecology study report that crocodiles have not been recorded in the area for several decades. While the potential for crocodiles to utilise the area cannot be ruled out, no signs (slides or footprints) were detected in the study area.

77 Department of Environment and Heritage (2005) **Draft Turtle Recovery Plan, Issues Paper: For six species of marine turtles found in Australian waters that are listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999.** 39pp.

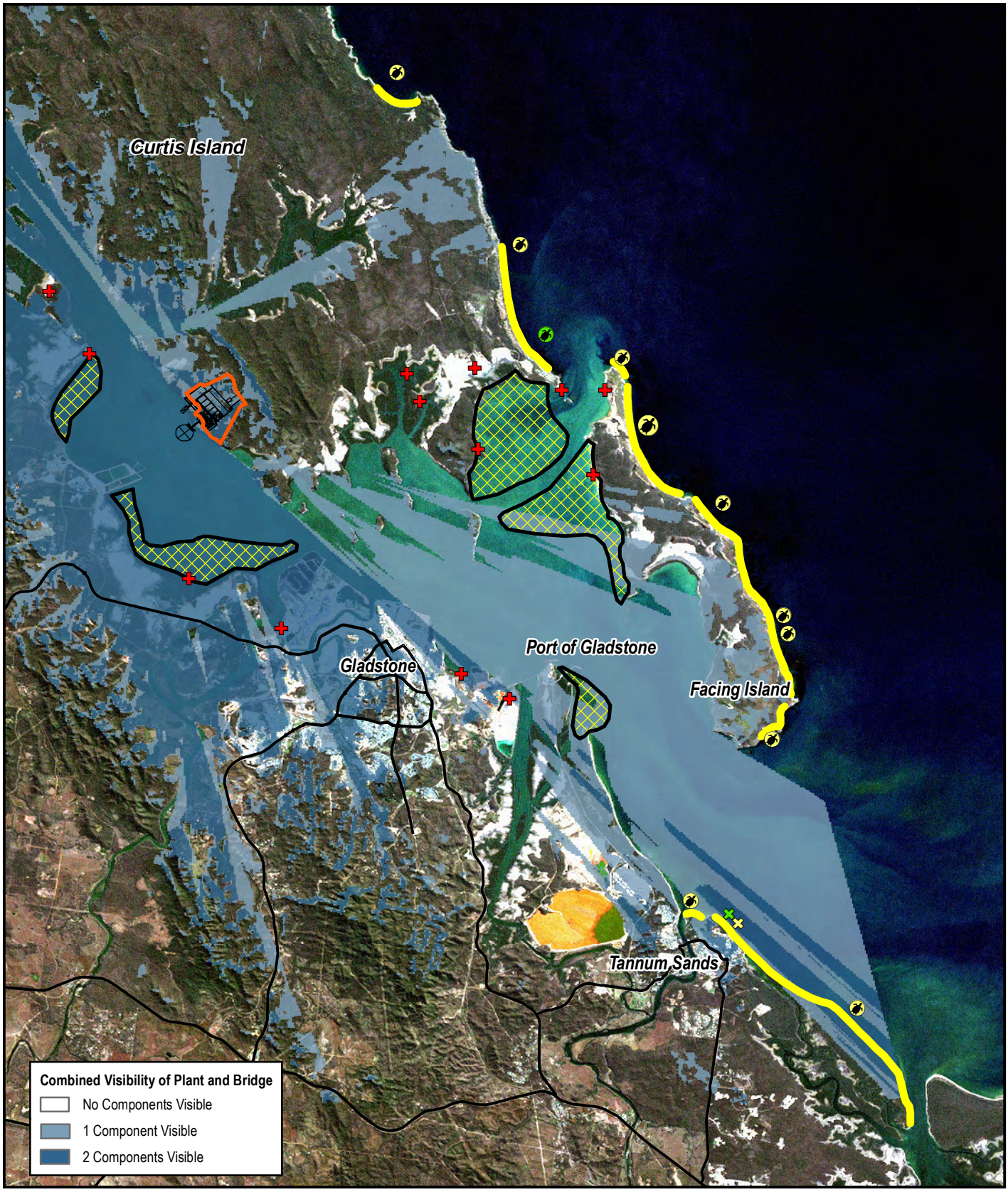
78 Department of Environment and Heritage (2005) **Draft Turtle Recovery Plan, Issues Paper: For six species of marine turtles found in Australian waters that are listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999**. 39pp.

79 Read M A, Miller J D, Bell I P, and Felton A. (2004) **The distribution and abundance of the Estuarine Crocodile, *Crocodylus porosus*, in Queensland.** Wildlife Research 31: 527–534.

80 Read M A, Miller J D, Bell I P, and Felton A. (2004) **The distribution and abundance of the Estuarine Crocodile, *Crocodylus porosus*, in Queensland.** Wildlife Research 31: 527–534.

81 Taplin L E (1987) The management of crocodiles in Queensland, Australia, pp. 129–140 in **Wildlife Management: Crocodiles and Alligators**, G.J.W. Webb, S.C. Manolis and P.J. Whitehead (eds). Surrey Beatty, Sydney.

82 Read M A, Miller J D, Bell I P, and Felton A. (2004) **The distribution and abundance of the Estuarine Crocodile, *Crocodylus porosus*, in Queensland.** Wildlife Research 31: 527–534.



Legend

- QCLNG Footprint Plant Layout
- Major Shorebird Roost Sites
- Major Shorebird Feed Sites
- Turtle Nesting Beaches
- Flatback Turtle
- Green Turtle

Turtle Nest Rates

- Not Quantified
- 1-10 females/year
- 10-100 females/year

Source Note:
Turtle and shorebird data adapted from QEPA 2003.
Landsat ETM+ Image source: USGS 2009. Aquired May 2000.

Projection: UTM MGA Zone 56 Datum: GDA 94

0 1.25 2.5 5 km

N

QUEENSLAND CURTIS LNG
A BG Group business

Project: Queensland Curtis LNG Project

Client: QGC - A BG Group business

Title: **Key Areas for Turtle Nesting and Shorebird Feeding/Roosting in Port of Gladstone Region**

ERM
Environmental Resources Management Australia Pty Ltd

Drawn	JF/JB	Annex 13.3	Figure 13.6
Approved	JC	File No:	0086165b_ANX_GIS028_F13.6
Date	20.07.09	Revision	1

Table 13-3.9 Key Periods of Annual Turtle Nesting Activity in the Port of Gladstone

Species/Activity		June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Flatback Turtles	Nesting												
	Hatching												
Green Turtles	Nesting												
	Hatching												
Loggerhead Turtles	Nesting												
	Hatching												

Seabirds and Shorebirds: A search of the *EPBC Act* Protected Matters database on February 19, 2009, by marine ecologists found that 10 marine and wetland Migratory bird species listed under the *EPBC Act* potentially occur within the area. Of these, one species listed as Endangered and one as Vulnerable may potentially occur in or around the Project area (*Table 13-3.10*). One further species was listed as Vulnerable but not Migratory.

Table 13-3.10 EPBC Act and Nature Conservation Act (QLD) Listed Threatened and Migratory Marine and Wetland Bird Species

Species name	Status	Type of Presence (EPBC definition)
Southern Giant Petrel (*Macronectes giganteus*)	*EPBC Act:* Endangered/ Migratory *NC Act:* Migratory	Species or species habitat likely to occur within area
Kermadec Petrel (western) (*Pterodroma neglecta*)	*EPBC Act:* Vulnerable	Species or species habitat may occur within the area
Painted Snipe (*Rostratula australis*)	*EPBC Act:* Vulnerable/ Migratory *NC Act:* Vulnerable *CAMBA* (as *Rostratula benghalensis*)	Species or species habitat may occur within the area
Fork-tailed Swift *(Apus pacificus)*	*EPBC Act:* Migratory *CAMBA/JAMBA/ROKAMBA*	Species or species habitat may occur within area.
Great Egret/White Egret (*Ardea alba*)	*EPBC Act:* Migratory *CAMBA/JAMBA*	Species or species habitat may occur within the area.
Cattle Egret (*Ardea ibis*)	*EPBC Act:* Migratory *CAMBA/JAMBA*	Species or species habitat may occur within the area.
Latham's Snipe/ Japanese Snipe (*Gallinago hardwickii*)	*EPBC Act:* Migratory *CAMBA/JAMBA/ROKAMBA*	Species or species habitat may occur within the area.
Cotton Pygmy-goose (*Nettapus coromandelianus albipennis*)	*EPBC Act:* Migratory *NC Act:* Vulnerable	Species or species habitat may occur within area.
Little Curlew/Little Whimbrel (*Numenius minutus*)	*EPBC Act:* Migratory *CAMBA/JAMBA/ROKAMBA*	Species or species habitat may occur within the area.
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	*EPBC Act:* Migratory *CAMBA*	Species or species habitat likely to occur within area.
Little Tern (*Sterna albifrons*)	*EPBC Act*: Migratory *NC Act*: Endangered *CAMBA/JAMBA/ROKAMBA*	Species or species habitat may occur within the area.

Source: Area search of the EPBC Protected Matters database on 19 February 2009.

The Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) and Republic of Korea Australia Migratory Bird Agreement (ROKAMBA) are treaties to minimise harm to the major areas used by birds that migrate between Australia and the respective countries. A large proportion of shorebird species that inhabit the Port of Gladstone region are internationally significant and listed under these agreements.

A recent review of Migratory shorebirds has drawn together population estimates and identified internationally important sites of the East Asian-Australasian Flyway[83]. Some 119 internationally important sites were recognised in Australia, with Moreton Bay/Great Sandy Strait (about 250 km south of the Port of Gladstone) having importance for more than 10 species of Migratory shorebird.

The Port of Gladstone region is recognised as an important staging area for a number of Migratory bird species. Two habitats are especially important:

- low-tide feeding areas comprising exposed tidal flats
- high-tide roosting areas comprising coastal saltflats, sand-spits and the mangrove fringe.

Intertidal mudflats with saltmarsh and mangrove vegetation in the Project area support a high biodiversity and biomass of benthic invertebrates and provide important feeding habitat for listed Migratory waders protected under JAMBA, CAMBA and ROKAMBA (refer *Figure 13-3.2).*The mud flats along the proposed road route corridor on the mainland near Kangaroo Island are considered to be an important shorebird foraging site.

When they are not feeding, shorebirds roost generally at or above the high-tide mark. Shorebirds select roost sites that are likely to be free from disturbance. They also select roost sites that are close to feeding areas, usually within 2 km, for energy conservation[84]. *Figure 13-3.6* provides an indication of important feeding and roosting sites for shorebirds in the Port of Gladstone region[85].

The Painted Snipe (*Rostratula australis*), listed as Vulnerable under the *EPBC Act,* has a scattered distribution throughout many parts of Australia and may occur in small numbers in the Port of Gladstone region. The species is found in coastal regions and generally inhabits coastal grass-sedge wetlands in both freshwater and saline environments, as well as lakes and saltmarshes. Recent surveys of waterbirds on marine plains in central Queensland have revealed small numbers of Painted Snipe. There is no robust estimate of the population size of this species, but a decline in numbers across Australia has been

83 Bamford M, Watkins D, Bancroft W, Tischler G and Wahl J (2008**) Migratory Shorebirds of the East Asian - Australasian Flyway; Population Estimates and Internationally Important Sites** Wetlands International - Oceania. Canberra, Australia.

84 Queensland Environmental Protection Agency (QEPA) (2003) **Curtis Coast Regional Coastal Management Plan**. Environmental Protection Agency and Queensland Parks and Wildlife Service, ISBN 0-9751106-2-4. 184pp.

85 Queensland Environmental Protection Agency (QEPA) (2003) **Curtis Coast Regional Coastal Management Plan**. Environmental Protection Agency and Queensland Parks and Wildlife Service, ISBN 0-9751106-2-4. 184pp.

documented[86]. Painted Snipe was not recorded during the bird surveys undertaken for the Terrestrial Ecology Study.

The Southern Giant Petrel (*Macronectes giganteus*) and Kermadec Petrel (*Pterodroma neglecta*) are listed as Endangered and Vulnerable respectively under the *EPBC Act*, and may occur in the Port of Gladstone region. The petrels are pelagic species, feeding in the open ocean and generally nesting on remote islands. The waters off south-east Australia are considered to be potentially important wintering grounds for the Southern Giant Petrel[87]. However, due to its near-shore location, there are no significant petrel breeding or feeding habitats in the Port of Gladstone area and these species are therefore unlikely to occur in any substantial numbers. They were not recorded during the bird surveys undertaken for the study.

The bird surveys did record sightings of the Great Egret (*Ardea alba*), White-Bellied Sea-eagle (*Haliaeetus leucogaster*) and Fork-Tailed Swift (*Apus pacificus*) within the study area. For all of these species, the study determined that the region does not support an ecologically significant proportion of the population nor is the species in decline in the area or at the limit of its range.

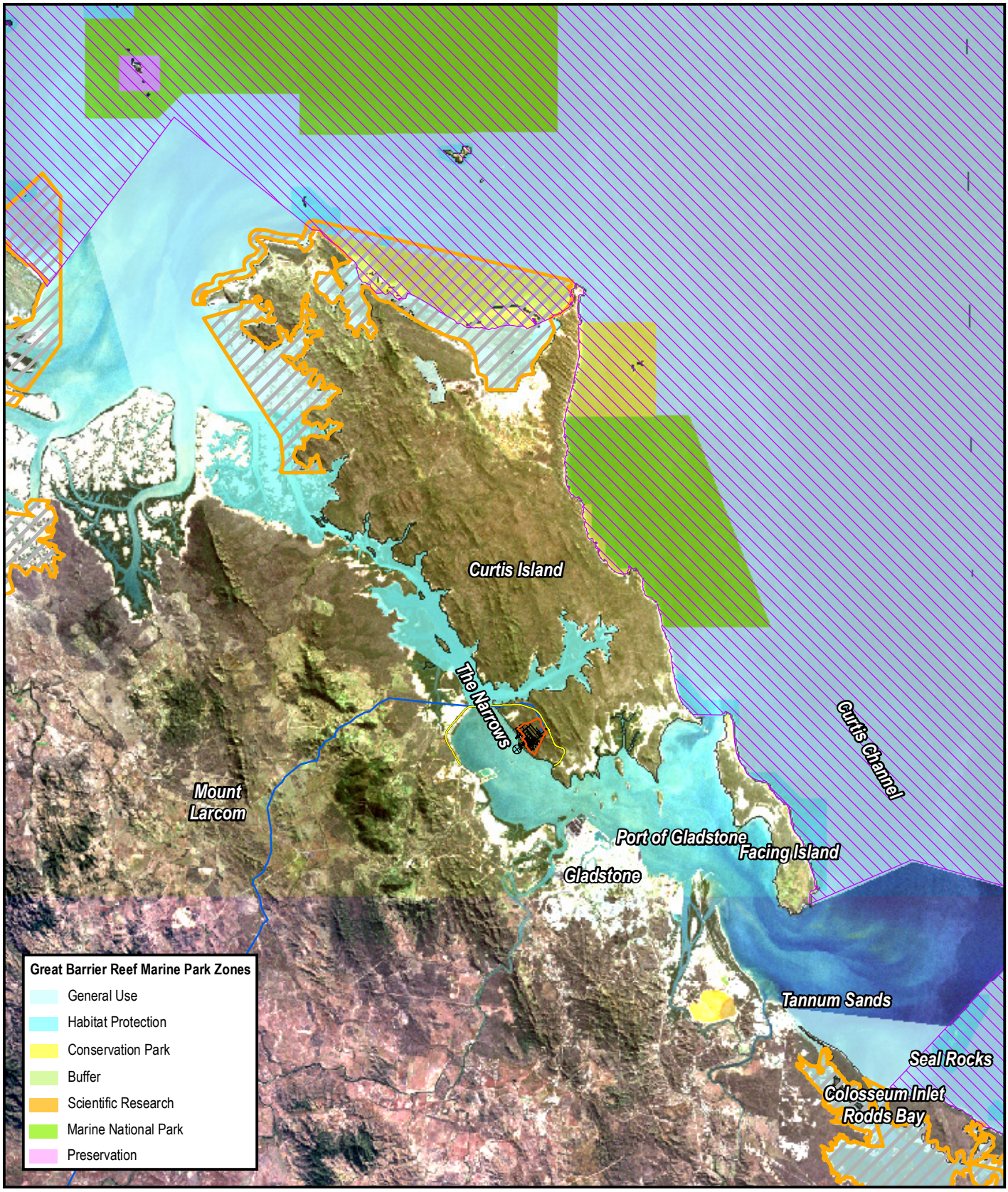
13-3.2.3 Other Features of State and National Environmental Significance

Several features of State and National Environmental Significance are present within proximity to the LNG Component of the Project. These include:

- A number of Habitat Protection Zones (HPZ) located within the Port of Gladstone (*Figure 13-3.7*). These are administered and managed by GBRMPA. The HPZs are:
  - seal rocks on the southern boundary of the Port of Gladstone shipping channel
  - the eastern side of Facing Island
  - The Narrows between Curtis Island and the mainland.
- The Commonwealth Great Barrier Reef Marine Park (GBRMP) and the Queensland State Great Barrier Reef Coast Marine Park (GBRCMP) reach their southernmost point at The Narrows between Friend Point on the mainland and Laird Point on Curtis Island. The proposed LNG Facility is located approximately 2 km outside the southern boundary of these parks.
- 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.

86 Jaensch and Joyce (2006). **Wetland Management Profile: Coastal Grass-Sedge Wetland. Ecosystem Conservation Branch, EPA.** Available at: http://www.epa.qld.gov.au/publications/p01781aa.pdf/Coastal_grasssedge_wetlands.pdf [last accessed 18/02/2009].

87 Environment Australia (2001) **A directory of important wetlands in Australia, Third Edition**. Environment Australia, Commonwealth Government, Canberra.



Legend

- Proposed QCLNG Site Boundary
- QCLNG Footprint Plant Layout
- Possible Curtis Island Road/ Bridge Corridor
- Proposed Export Pipeline
- Fish Habitat Area, Management 'A'
- Great Barrier Reef Marine Park

Source Note:
Landsat ETM Image: USGS 2009, Aquired 2002.
Marine Park Boundaries: Great Barrier Reef Marine Parks Authority
Data extracted from MPZ17 - Gladstone

Projection: UTM MGA Zone 56 Datum: GDA 94

0 2.5 5 10 km

N

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Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business
Drawn	JF/JB
Approved	JC
Date	20/07/09
Volume 13	Figure 13.7
File No:	0086165b_ANX_GIS028_F13.7
Revision	1

Title **Great Barrier Reef Marine Park Zoning Plan**

- The Directory of Important Wetlands in Australia lists Port Curtis, The Narrows and north-east Curtis Island as nationally important.
- 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 (*refer Figure 13-3.3).* This is classified as Zone B DPA, which represents habitat that is less significant than Zone A but is still important.
- 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.

The LNG Facility and Ancillary Infrastructure are not located within a Commonwealth Marine Area. Shipping Operations will, however, pass through the area, which begins at 3 nm from the coast out to 200 nm.

There are no Ramsar wetlands in the vicinity. The closest Ramsar wetland sites are the Shoalwater and Corio Bay areas, approximately 140 km north-west of the proposed site.

There are no declared Fish Habitat Areas (FHAs) within the Port of Gladstone. The closest FHA is east of Curtis Island in the Curtis Channel.

13-3.3 ASSESSMENT OF IMPACTS ON MNES AND MITIGATION MEASURES

This section identifies and assesses impacts to MNES and proposed mitigation measures for the following referrals:

- EPBC 2008/4399 – Pipeline Network (from The Narrows crossing to the LNG Facility)
- EPBC 2008/4400 – Curtis Island Bridge
- EPBC 2008/4401 – LNG Marine Facilities
- EPBC 2008/4402 – LNG Plant and Associated Onshore Facilities
- EPBC 2008/4403 – Mainland Road and Bridge Approach
- EPBC 2008/4404 – Curtis Island Road
- EPBC 2008/4405 – Shipping Activities
- EPBC 2008/4406 – Swing Basin and Channel Dredging

The assessment of impacts to World Heritage and National Heritage Places applied the criteria established by the Commonwealth Department of Environment and Heritage (now DEWHA)[88]. An action is likely to have a

88 Department of the Environment and Heritage (2006) Matters of National Environmental Significance EPBC Act Policy Statement 1.1: Significant Impact Guidelines. Australian Government.

significant impact on the World Heritage and National Heritage values (and of a declared World Heritage or National Heritage property) if there is a real chance or possibility that it will cause:

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

13-3.3.1 World Heritage and National Heritage Places

This section summarises the impacts of relevant controlled actions on the applicable World Heritage Area values.

Aesthetics and Natural Beauty

EPBC 2008/4400 – Curtis Island Bridge: The pristine natural "wilderness" area of The Narrows passage landscape as recognised at international, national and State level would be impacted by the proposed bridge and approach road resulting in an adverse effect on landscape values of major to critical significance. However, the visual influence of the bridge on the passage landscape is likely to affect only the "entrance" to the channels and will not be visually significant beyond the 3.2 km sphere of influence. The distance at which the proposed Curtis Island Bridge has the potential to become evident and dominate views is within 2 km of the bridge.

The visual impact of the proposed bridge and approach road is summarised as:

- Views of the proposed Curtis Island Bridge from Gladstone and surrounding areas are expected to have low or negligible visual impact, largely owing to distance.
- No locations on the mainland are expected to be impacted to a major or critical level.
- Targinie foreshore is the only location on the mainland which would have uninterrupted views of the bridge, and as such it will have a moderate to major impact.
- There would be no significant difference in the visual impact of the bridge during the Construction and Operation phases when viewed from the mainland, however, impact of the approach roads would decrease assuming landscape treatment of the road easement is implemented.
- Views of the Curtis Island Bridge from the adjoining waterway within 2 km of the bridge are expected to have a major to critical visual impact significance when viewed from the south against the backdrop of The Narrows.
- Views of the proposed bridge from the north of The Narrows against the background of the Port of Gladstone were found to have moderate to major visual impact significance

- Views of the proposed bridge from 5 km north of The Narrows entrance are expected to have minor visual impact.
- There would be no views of the bridge from the waters adjoining Turtle, Witt and Tide islands.
- The bridge is expected to have no visual impact on residential properties.
- The bridge would substantially alter the current lighting levels of the immediate areas, which are currently natural landscapes.

In summary, the proposed Curtis Island Bridge is likely to have a significant impact on the landscape character and visual quality within 2 km of the development. This area is within both the Port of Gladstone and the GBRWHA designation. However, the impact on the "aesthetics and natural beauty" of the GBRWHA area is already attenuated by the presence of Port of Gladstone industrial elements in the viewshed. Therefore, this area is not 'pristine' or representative of the "exceptional natural beauty" assigned to the World Heritage and National Heritage values. In addition, the GSDA designation of the Restricted Development Precinct on Kangaroo Island indicates a planning intention to develop the area for "Local Infrastructure, Materials Transport Infrastructure and Special Use, with the potential for development of an Infrastructure Facility". In these circumstances, the landscape and visual impact of the Curtis Island Bridge would be consistent with the proposed development of an infrastructure corridor to link the mainland with the Curtis Island Industry Precinct of the GSDA.

Mitigation Measures

The scale and function of the proposed Curtis Island Bridge precludes significant modification for the purpose of mitigating visual impact. The preliminary stage of the Curtis Island Bridge design, however, does enable some principles to be established for the reduction of visual impact.

The following measures describe how the proposed management and mitigation measures meet, or partially meet, the desired outcomes for the protection of Areas of State Significant (Coastal Landscape) values as detailed in the Curtis Coast Regional Coastal Management Plan.

The desired outcomes to protect and maintain the landscape values of Curtis Island and *"ensure the development remains unobtrusive and compatible with landscape values"* will partially be met through:

- screening of the approach roads and abutment to the proposed bridge with endemic planting on embankments and disturbed areas
- detailed design of abutments to minimise visual impact, such as the use of riprap rock and planting
- retention of the mangroves shoreline, where possible, by limiting the extent of disturbance during construction and reinstatement as part of the landscape rehabilitation process

- use of recessive materials, colours and textures on the bridge to reduce light reflection and increase compatibility with the landscape.

The measures outlined for Curtis Island also apply to the reduction of visual impact on the landscape values of The Narrows. While the requirement to *"ensure infrastructure in areas of high visual quality does not obscure views to water or intrude on waterways*" is difficult to achieve with a structure that crosses the waterway, minor reductions in visual intrusion can be achieved through design of the support structures, which should be as slender and few as possible within the parameters of the construction requirements.

EPBC 2008/4401 – LNG Marine Facilities and EPBC 2008/4402 – LNG Plant and Associated Onshore Facilities: The impact of the LNG Facility (including the LNG Plant, Associated Onshore Facilities and Marine Facilities) on visual quality is such that:

- The level of visual impact of the LNG Facility on views from residential areas in Gladstone would be of negligible to minor adverse significance, mainly owing to the attenuating effects of distance and intermediate topography.

- The level of visual impact on views from the Targinie foreshore would be of moderate to major adverse significance. This viewpoint was the only location on the mainland affected at this level of significance.

- No locations on the mainland are expected to be affected to a major to critical level by the proposed LNG Facility.

- There would be no significant difference in the visual impact of the LNG Facility during the construction and operational stages when viewed from the mainland.

- The level of visual impact on views from the waterways of the Port of Gladstone and The Narrows would increase in significance within approximately 4.2 km of the LNG Facility site, as at this distance the project becomes potentially visually dominant in the view.

- Views of the LNG Facility, within approximately 4.2 km of the site, are expected to have a level of visual impact which would be rated as moderate to major adverse significance.

- Views of the LNG Facility from the adjoining waterway, within approximately 1.4 km of the site, are expected to have the highest identified level of visual impact which would be rated as major adverse significance.

- The level of visual impact on views of the LNG Facility from within The Narrows and 1 km north of the entrance are expected to be of moderate to major adverse significance.

- The level of visual impact on views of the LNG Facility from 5 km north of The Narrows entrance are expected to be of negligible significance.

- The level of visual impact on views of the LNG Facility from the waterways adjoining Turtle, Witt and Tide islands is expected to be of negligible significance during construction and moderate significance during operation. The visual impact during operation is expected to be higher owing to the height and occasional operation of the flare stacks.

- The LNG Facility is expected to have negligible visual impact on views from residential properties within the viewshed.

In summary, the LNG Facility, Associated Onshore Facilities and Marine Facilities are likely to have a significant impact on the landscape character and visual quality within 4.2 km of the development. This area is within the Port of Gladstone and is within the GBRWHA designation. However, the impact on the "aesthetics and natural beauty" of the GBRWHA area is already attenuated by the presence of Port of Gladstone industrial elements in the viewshed. Therefore, this area is not 'pristine' or representative of the "exceptional natural beauty" assigned to the World Heritage and National Heritage values. In addition, the GSDA designation of Curtis Island indicates a planning intention to develop the area into an industrial precinct. In these circumstances, the landscape and visual impact of the LNG Facility, Associated Onshore Facilities and Marine Facilities would be consistent with the proposed expansion of industry around the Port of Gladstone.

Mitigation Measures

The scale and function of any LNG Facility precludes significant modification to the design for the purpose of mitigating visual impact. However, the preliminary stage of the QCLNG Project enables some design principles to be established as parameters for further development of the engineering.

The desired outcomes to protect and maintain the landscape values of Curtis Island and "ensure the development remains unobtrusive and compatible with landscape values" will partially be met through the following management and mitigation measures:

- Screening of the LNG Facility from the vast majority of Curtis Island, and in particular the adjoining Environmental Management Precinct, has been achieved through the location of the facility in relation to the Ship Hill linear ridgeline to the north. Vegetation along these ridgelines is to be retained and protected.
- Retaining the vegetated ridges and hills on the skyline will assist in reducing the visual impact by retaining the natural landscape horizon.
- The landscape values of Curtis Island as viewed from Gladstone are largely maintained due to the retention of the minor ridgeline to the south-east of the site. Vegetation along these hills and ridgelines are to be managed and maintained to ensure their long-term integrity as important screening elements.
- Views of Curtis Island from Targinie and the waters of the Port of Gladstone opposite the site do not have the benefit of the screening potential of topography or vegetation. Retention of the mangroves along the shoreline, where possible, will contribute to reducing the visual impact by maintaining a continuity of the natural shoreline on Curtis Island and "softening" the

interface between the constructed edge of the LNG Facility and the water's edge

The desired outcomes to protect and maintain the landscape values of The Narrows will be partially met through the following management and mitigation measures:

- The main bulk of the LNG Facility has been located behind the mangrove line, with only the Marine Facilities extending beyond the shoreline. This retains the edges of mangrove vegetation and visual continuity of the shoreline and achieves the desired outcome to *"maintain existing vegetation along waterways to a maximum extent to form a natural landscape edge and screen."* While the screening potential of the mangroves is low due to their height (approx 5 m), their importance lies in retaining continuity of the natural shoreline.
- The requirement to *"ensure infrastructure in areas of high visual quality does not obscure views to water or intrude on waterways"* is partially achieved through setting the main LNG Facility back from the shoreline.

There is no single solution to light impacts on sensitive receptors. As such the implementation of a range of management strategies should be considered to provide sufficient management and mitigation of the potential impacts.

As there is no singular solution to light impacts on sensitive receptors, detailed lighting design for the LNG Facility will be undertaken consistent with the safety of the plant operators, and to meet the requirements to minimise light spill and reduce light glow.

The lighting design will be undertaken using software that permits the use of efficient floodlights aimed to establish lux goals for each unique location. The software enables an iterative design process to be undertaken to establish lighting levels while minimising light visible from outside the plant.

Where possible, lighting will not be installed where it can be avoided. For example, almost no perimeter fence illumination will be installed, with use of infrared-sensing cameras and motion-detection software resident in the security system computer instead.

Micrositing should be undertaken for luminaires to ensure conformation with existing site conditions.

Geological Phenomenon

EPBC 2008/4400 – Curtis Island Bridge: A preliminary hydrodynamic assessment was undertaken to determine the impact of the Curtis Island Bridge on the hydraulics in the Port of Gladstone[89]. The preferred bridge alignment and structure was assessed to have minimal impact on tidal flows through The Narrows, with respect to both range and velocities.

89 Connell Wagner (2008a) **Executive Summary. Curtis Island Road / Bridge Concept Design.** Reference 36914-001, Revision 0. Prepared for the Department of the Coordinator-General. 12 December 2008.

These findings were supported by further hydrodynamic modelling undertaken for the QCLNG Project EIS, results of which are incorporated into the marine ecology study in *Volume 5, Chapter 8.*

The Curtis Island Bridge is therefore unlikely to have a significant impact on Wold Heritage and National Heritage values.

EPBC 2008/4403 – Mainland Road and Bridge Approach: A preliminary hydrodynamic assessment was undertaken to determine the impact of the Mainland Road and Bridge Approach on the hydraulics in the Port of Gladstone[90]. The road embankment proposed across the tidal mudflats from the mainland to the western abutment of the Curtis Island Bridge was also assessed to have minimal impact, due to the fact that the tide does not actually flow across this area, rather it is inundated by flows from both directions and the water is essentially still[91].

These findings were supported by further hydrodynamic modelling undertaken for the QCLNG Project EIS, results of which are incorporated into the marine ecology study in *Volume 5, Chapter 8.*

The Mainland Road and Bridge Approach is therefore unlikely to have a significant impact on Wold Heritage and National Heritage values.

Mitigation Measures

Based on the outcomes of further hydrodynamic modelling, provision for tidal cross-flows may need to be incorporated into the design of the embankment across tidal areas for the Mainland Road and Bridge Approach.

EPBC 2008/4406 – Swing Basin and Channel Dredging: The origin of the sedimentary environment of The Narrows from two different hydrological systems has created a complex system of intertidal habitats. Inherently associated with dredging activities are changes to local bathymetry and the currents/tidal flows through the project area. Based on the findings of the Marine Ecology Study (*Volume 5, Chapter 8*), these changes have not been identified as likely to have significant impacts on sensitive marine receptors. Dredging impacts are also discussed further in *Volume 6.*

Ecological and Biological Processes

The Pipeline Crossing, Curtis Island Bridge, Mainland Road and Bridge Approach, LNG Facility, LNG Marine Facilities, Swing Basin and Channel Dredging and Shipping Operations will involve a variety of activities that have the potential to impact on the following aspects listed as important to maintaining the characteristics and functioning of ecological and biological processes. These are in turn are of importance to maintaining biodiversity and viable habitats for listed Threatened and Migratory species) within the Port of

90 Connell Wagner (2008a) **Executive Summary. Curtis Island Road / Bridge Concept Design.** Reference 36914-001, Revision 0. Prepared for the Department of the Coordinator-General. 12 December 2008.

91 Connell Wagner (2008a) **Executive Summary. Curtis Island Road / Bridge Concept Design.** Reference 36914-001, Revision 0. Prepared for the Department of the Coordinator-General. 12 December 2008.

Gladstone and The Narrows:

- bathymetry and seabed features
- hydrodynamic regime
- water quality
- seagrass and algae
- mangroves
- other benthic habitats.

A detailed assessment of impacts is included in *Volume 5, Chapter 8* (Marine Ecology).

The most important impacts anticipated to occur during the Construction phase arise as a result of the dredging and reclamation required to prepare and install infrastructure. These include direct impacts on habitats such as seagrasses and mangroves from the footprint of structures and the reclamation area, as well as secondary impacts on water quality and behavioural changes from mobile marine species temporarily disturbed by the increased turbidity or noise.

Inherently associated with dredging activities are the changes to local bathymetry and the currents/tidal flows through the Project area. However, these changes have not been identified as likely to have significant impacts on sensitive marine receptors. Dredging impacts are also discussed in *Volume 6.*

The increased presence of vessels and frequency of vessel movements during both the Construction and Operation phases pose a risk to marine fauna, and will have some localised impact on water quality from standard discharges, the deployment and retrieval of anchors and chains and the use of propellers and thrusters.

Vessel movements themselves pose a risk to the marine life such as turtles and marine mammals. It is, however, acknowledged that the controlled actions are within the limits of the Port of Gladstone and, as such, all vessel movements and activities will be undertaken in accordance with the requirements and procedures of the port. Given that the port is already very active, the existing species that use the waters for feeding, breeding and transiting already do so within the disturbed conditions.

In relation to marine mammals, the incremental increase in noise and light emissions from Project associated vessels will be small in comparison to the current level of activity in the Port of Gladstone, however noise generated from active dredge heads is considered to be relatively greater than existing background conditions. Noise and light impacts are expected to be low due to the temporal extent and ability of sensitive receptors to avoid areas where noise levels are higher than baseline levels.

With regard to migratory birds, the incremental increase in noise and light emissions from Project associated vessels will be small in comparison to the current level of activity in the Port of Gladstone. Noise and light impacts are therefore expected to be low.

Light impacts have been evaluated (refer *Volume 5 Chapter 8, section 8.4.1.4*) and, given the absence of the most sensitive receptors (nesting adults and turtle hatchlings) from within the identified impact zone, this warrants no further mitigation

The implementation of industry standard management practices will minimise the impact of solid wastes generated by the different controlled actions. The largest marine discharge associated with the LNG Facility occurs during the Construction phase and is associated with the sewage and sullage from the onshore construction site and the desalination plant. These liquids will be treated prior to discharge, and the design of the diffuser at the end of the pipeline will further promote mixing. Discharges will be subject to conditions (including monitoring) set as part of an Environmental Authority or an Environmentally Relevant Activity by the Queensland Government.

Other discharges with the potential to impact the marine environment include stormwater, deck drainage and anti-fouling leachate. These will be managed to ensure no unacceptable risk through the implementation of standard management plans and procedures.

There is the potential for unplanned events, specifically hydrocarbon or chemical spills. During the Construction phase, there is a greater risk of small spills as a result of the increased number of vessels and activities occurring at any one time. Vessels and onshore construction activities in the vicinity of the marine environment will have emergency response procedures (refer to *Volume 5 Chapter 18, section 18.6*) in place in the event of an incident.

The consequence of a spill is related to the nature of the material, the prevailing conditions, the sensitivity of the environment and the response measures. All vessel activities will be under the jurisdiction and approved protocols of the Port of Gladstone, as well as international maritime law, when transporting the LNG to market. In the event that an incident occurs within the port, but beyond the vessel's mitigation capabilities, the Port of Gladstone response plans will be triggered. In this instance, all QGC resources and vessels would be available to support the Port's response.

Shipping Operations can increase the risk of introducing marine species to the Port of Gladstone, due to the number of vessels from other countries. National and international requirements specifically target the management of risk from introduced marine species. These protocols include the exchange of ballast water at sea and the inspection of hulls and cavities likely to host species potentially harmful to the environment (and ultimately the economy). All vessels will be screened before entering the port, with sufficient measures implemented to ensure the risk of any vessel bringing introduced marine species into the Project area is minimised. There will be full collaboration with the procedures and protocols of the Port of Gladstone on this issue.

The Pipeline Crossing (EPBC 2008/4399), Curtis Island Bridge (EPBC 2008/4400), LNG Marine Facilities (EPBC 2008/4401), LNG Facility (EPBC 2008/4402), Mainland Road and Bridge Approach (EPBC 2008/4403), Shipping Activities (EPBC 2008/4405) and Swing Basin and Channel

Dredging (EPBC 2008/4406) are therefore unlikely to have a significant impact on the ecological and biological processes that are of World Heritage and National Heritage value.

Mitigation Measures

Measures for mitigating impacts to the ecological and biological processes within the Port of Gladstone marine environment are summarised in *Table 13-3.15* for the Construction phase and *Table 13-3.16* for the Operation phase.

As the design progresses, mitigation measures will be identified and incorporated into the Environmental Management Plan and broader environmental management system. These will focus on:

- minimising the direct footprint of infrastructure on sensitive habitats
- optimising installation techniques and schedules to reduce both the direct footprint and secondary impacts on water quality and marine receptors during construction
- ensuring routine operational impacts associated with the LNG plant are managed to minimise the impact on marine receptors
- ensuring adequate response capabilities should an unplanned event occur that has the potential to impact on marine receptors.

Biodiversity and Threatened Species

The controlled actions are unlikely to have a significant impact on biodiversity and threatened species. Impacts to threatened species and proposed mitigation measures are discussed in more detail in *Section 13-3.2.*

The four criteria developed as the basis for the listing as a World Heritage Area, together with a summary assessment of potential impact from the Project is contained in *Table 13-3.11*.

Table 13-3.11 World Heritage Criteria

Criterion	Project impact and Conclusions
Outstanding example representing a major stage of the earth's evolutionary history	Examples given of the values of the Great Barrier Reef which relate to this criterion include: its coral reefs; coral cays; geological processes linking reefs, cays, islands, sand barriers and dunes; and its record of sea level changes and climatic history. The following sections of the EIS assess the interaction of the Project with the evolutionary history of the WHA: *Volume 1 Chapter 5 sections 5.1, 5.3, 5.4* and *5.8; Volume 2 Chapter 4 section 4.3, Chapter 10,* and *Chapter 14 sections 14.1-14.8; Volume 5 Chapter 7 sections 7.2-7.10, Chapter 8 sections 8.2-8.6, Chapter 11 sections 11.2-11.8,* and *Chapter 16 sections 16.3-16.8; Volume 6;* and *Volume 13 Annex 13.3* (LNG

Criterion	Project impact and Conclusions
	Component and Shipping Operations). Parts of Port Curtis may exhibit geological processes linking the various elements of the coastal environment (e.g. estuaries, intertidal flats, coral reefs, mangroves and embayments). However, the hydrodynamic and coastal process investigations have demonstrated that the construction and operation of marine facilities (i.e. loading jetty and MOF) within the WHA will not have a detrimental impact on the coastal environment. The placement of dredged material generated from the development of the QCLNG swing basin and shipping channel (if the QCLNG Project proceeds ahead of any other mooted project) will result in permanent disturbance to a limited area of intertidal flats in the vicinity of Fishermans Landing within the Port Curtis area. In the event that GPC's FL153 or Western Basin Strategic Dredging Disposal Project proceed, reclamation associated with the QCLNG Project will have no incremental effect on coastal geomorphological values. There will be no other Project components which will interfere with the listed examples of the earth's evolutionary history.
An outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment.	Examples given of the values of the Great Barrier Reef which relate to this criterion include: its size and morphological diversity; the process of accretion and erosion of coral reefs; extensive Halimeda beds; dispersion and evolution of hard corals; diversity of flora and fauna; coral colonies and communities; floristic regions; and morphological and genetic changes in mangroves and seagrass. The Project is to be located within the designated industrial precinct of the GSDA associated with the Port of Gladstone (Port Curtis). The Port handles over 30 products, which are transported to more than 30 countries. Major products include coal, alumina, aluminium and cement. In addition, the Port also caters to all forms of containerised and general cargoes. The Queensland government has identified the Port of Gladstone and adjacent lands as one of Australia's major ports and industrial centres. The following sections of the EIS assess the interaction of the Project with the geological processes and biological environment: *Volume 1 Chapter 5 sections 5.1, 5.3, 5.4* and *5.8; Volume 2 Chapter 4 section 4.3, Chapter 10,* and *Chapter 14 sections 14.1-14.8; Volume 5 Chapter 7 sections 7.2-7.10, Chapter 8 sections 8.2-8.6, Chapter 11 sections 11.2-11.8*, and *Chapter 16 sections 16.3-16.8; Volume 6;* and *Volume 13 Annex 13.3* (LNG Component and Shipping Operations). The QCLNG Project is entirely consistent with the future plans for the Port of Gladstone. The swing basin and channel development associated with the Project is also consistent with the Gladstone Port Corporation's 50 year Strategic Plan. As discussed above, the hydrodynamic and coastal process investigations have demonstrated

Criterion	Project impact and Conclusions
	that the construction and operation of marine facilities associated with the Project (i.e. loading jetty and MOF) within the WHA will not have a detrimental impact on the geomorphological environment. In addition, the predicted increased turbidity associated with the dredging for construction of the pipeline crossing of The Narrows and the QCLNG swing basin and channel development will have potential short term effects on elements of the WHA such as sea grass meadows and coral reefs within the Port Curtis area. The placement of dredged material generated from the development of the QCLNG swing basin and shipping channel will result in permanent disturbance to a limited area of intertidal flats in the vicinity of Fishermans Landing within the Port Curtis area.
Contains unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty.	Examples given of the values of the Great Barrier Reef which relate to this criterion include: its vast extent and variety of reefs and islands; coastal mangrove systems of exceptional beauty; rich variety of landscapes and seascapes; spectacular breeding colonies of seabirds and butterflies; and migrating mammals. The project location within the Port of Gladstone means the “aesthetics and natural beauty” of the GBRWHA in this area is already attenuated by the presence of Port of Gladstone industrial elements in the viewshed. The Project does not interfere with the natural beauty of any reefs or coral islands. The proposed LNG Facilities will result in a local impact of major adverse significance within approximately 4.2 km of the site. The landscape values within the affected viewshed are not representative of the WHA criterion of ‘areas of exceptional natural beauty’. The limited extent of visual impact of the Project and the existing degradation of landscape values within the Port of Gladstone results in the Project not significantly altering or modifying the WHA values.
Provides habitats where populations of rare and endangered plants and animals still survive	Examples given of the values of the Great Barrier Reef which relate to this criterion include: structurally and ecologically complex coral reefs; large number of islands providing extensive habitats; mangroves and seagrass beds; inter-reefal and lagoonal benthos; and plants and animals of conservation significance. Potential impacts to MNES from the marine facilities, dredging and increase in shipping activities associated with the development include the following (refer to *Volume 5, Chapter 8* and *Volume 6* for full impact assessment): • Short term effects on seagrass, coral reefs and other benthic communities due to increased turbidity • injury and fatality of a small number of marine fauna through vessel strikes • disturbance from vessel & dredge noise • disturbance from vessel lighting

Criterion	Project impact and Conclusions
	• potential injury of fauna and contamination of habitats from accidental spills of hydrocarbons or chemicals Impacts to "biodiversity and threatened species" may be possible but these are likely to be insignificant, temporary and/or highly localised when considered in a regional context (refer *Volume 5, Chapters 8, 11* and *15; Volume 6; Appendix 5.18* and *Annex 13.3*). If the QCLNG Project were the first project to utilise the GPC's FL153 and Western Basin Strategic Dredging and Disposal reclamation area the impacts would include the loss of a significant area of intertidal flat habitat due to the placement of dredge material in the vicinity of Fishermans Landing

Table 13-3.11 does not consider the impact of the Curtis Island Bridge; Mainland Road and Bridge Approach; or Curtis Island Road, as QGC is in the process of withdrawing these referrals. These EPBC referral activities are not part of the QCLNG Project as the Marine Transportation Operations option is the preferred strategy for access to and from the LNG Facility on Curtis Island.

13-3.3.2 *Listed Threatened Species and Communities and Listed Migratory Species*

The assessment of impacts to *EPBC Act* listed Threatened species and communities applied criteria established by the Commonwealth Department of Environment and Heritage (now DEWHA)[92].

For critically endangered or endangered species listed under the *EPBC Act,* an action is likely to have a significant impact if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population
- reduce the area of occupancy of the species
- fragment an existing population into two or more
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of a population
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

92 Department of the Environment and Heritage (2006) **Matters of National Environmental Significance EPBC Act Policy Statement 1.1: Significant Impact Guidelines**. Australian Government.

- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species habitat
- introduce disease that may cause the species to decline
- interfere with the recovery of the species.

For Vulnerable species, an action is likely to have a significant impact 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 one 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 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.

For Migratory species, an action is likely to have a significant impact if there is a real chance or possibility that it will:

- substantially modify (including as a result of fragmenting or altering of fire regimes, nutrient or hydrological cycles), destroy or isolate an area of important habitat for Migratory species. An important habitat is defined as that 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 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 lifecyle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a Migratory species.

Terrestrial Species and Communities

Impacts on vegetation are likely to be primarily associated with the physical clearing of vegetation for infrastructure development. Other potential impacts 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 are likely to increase the prevalence of weed species in the surrounding vegetation due to canopy clearance, altered run-off patterns and increased exposure to foreign material carried to the study area on machinery and equipment.

Impacts to fauna are primarily associated with habitat loss, degradation, fragmentation and creation of dispersal barriers. Associated impacts include increased prevalence of introduced species and predators, reduced foraging range due to noise and light pollution, disturbance of foraging areas due to road corridors and vehicle-induced fatalities.

Detailed assessment studies and reports for birds, reptiles and amphibians and vegetation were undertaken by specialist consultants. Specialist technical reports are summarised within Volume 5 Chapter 7, with the full technical reports provided as *Appendix 5.5*[93]*, Appendix 5.6*[94]*, Appendix 5.7*[95] *and Appendix 5.8*[96].

The findings of the terrestrial ecology assessment (refer *Volume 5, Chapter 7*) of impacts to *EPBC Act* listed Threatened and Migratory terrestrial species and communities are summarised below.

Ecological Communities: No Threatened vegetation communities listed under the *EPBC Act* occur within or within the vicinity of the study area therefore the controlled actions will not impact on these.

Terrestrial Flora: Based on the results from the EPBC Protected Matters database, eight Threatened flora species were predicted to occur within the study area (refer *Appendix 5.5*[97]*Attachment 2*). None of these were identified during the field survey (refer *Appendix 5.5*[98]). The flora of the study area is not considered to be of conservation significance from a national perspective. The controlled actions are unlikely to have a significant impact on Threatened terrestrial flora species.

93 Unidel (2009) *QCLNG – Curtis Island Components: Flora Report*.

94 Unidel (2009) *QCLNG – Curtis Island Components: Reptiles and Amphibians Report.*

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

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

97 Unidel (2009) *QCLNG – Curtis Island Components: Flora Report*.

98 Unidel (2009) *QCLNG – Curtis Island Components: Flora Report*.

Terrestrial Birds: Eight *EPBC Act* listed Threatened terrestrial bird species were predicted to occur within the study area (refer *Appendix 5.7*[99] *Table 3*), based on the results of the EPBC Protected Matters database and EPA Wildlife Online search. During the field surveys (refer *Appendix 5.7*[100] *and Appendix 5.8*[101]), the only Threatened bird species recorded was the Squatter Pigeon (*Geophaps scripta scripta*), which is listed as Vulnerable. The Squatter Pigeon was recorded only on the mainland and not on Curtis Island.

Habitat removed to construct the Mainland Road and Bridge Approach (EPBC 2008/2008/4403) would not have direct impacts on Squatter Pigeons, though the road would pose a risk of vehicle strike. Using the *EPBC Act* assessment criteria, significant impacts to Squatter Pigeon are unlikely because:

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

Twenty-eight terrestrial *EPBC Act* listed Migratory birds were recorded during the field surveys. Areas within the tidal mudflats on the mainland were identified as representing important habitat to one Migratory species, the Eastern Curlew (*Numenius madagascariensis*). An assessment concluded that the proposed Mainland Road and Bridge Approach (EPBC 2008/4403) has the potential to significantly impact on the Eastern Curlew due to:

- 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.

Impacts on the Eastern Curlew (and other migratory birds) can be reduced through implementing the following mitigation measures. 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 on the mainland.

Recommended measures:

- 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 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

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

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

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

- 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.
- 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.

Terrestrial Mammals: Based on the EPBC Protected Matters database and EPA Wildlife Online search, three Threatened terrestrial mammals were predicted to occur within the study area (refer *Volume 5, Chapter 7 Table 5.7.3*). None of these species were detected during the field surveys. The controlled actions are therefore unlikely to have a significant impact.

Terrestrial Reptiles and Amphibians: Based on the EPBC Protected Matters database and EPA Wildlife Online search, three Threatened terrestrial reptiles and amphibians were predicted to occur within the study area (refer *Volume 5, Chapter 7 Table 5.7.3*). None of these species were detected during the field surveys (refer *Appendix 5.6*[102]). The controlled actions are therefore unlikely to have a significant impact.

Terrestrial Butterflies: No Threatened butterfly species were identified in the EPBC Protected Matters database or EPA Wildlife Online search, and none were recorded during the terrestrial ecology field surveys.

Marine Species

The range and sources of impacts associated with the construction and operation of the LNG Facility, Ancillary Infrastructure and Shipping Operations that have the potential to affect *EPBC Act* listed Threatened Marine and Migratory species due to changes to the marine environment are summarised in *Table 13-3.12* below and in more detail in *Volume 5, Chapter 8.*

Table 13-3.12Types and Sources of Impacts to the Marine Environment

Type/Source of Impact	Description
Physical Presence – Permanent	Impacts to receptors that arise as a result of the installation and presence of "permanent" infrastructure, such as bridge, pipeline or jetty.
Physical Presence – Temporary	"Temporary" or "short duration" impacts that arise from the physical presence of vessels during the Construction, Installation and Operation phases.
Underwater noise	Impacts associated with the generation of noise, and the subsequent propagation of that noise through the air and marine environment during each of the phase of the Project.
Light	Impacts to receptors that arise as a result of the introduction of artificial light sources.
Food scraps and putrescible	Impacts arising from the generation of food scraps and other putrescibles during construction, installation and operation that have a potential to enter the marine

102 Unidel (2009) *QCLNG – Curtis Island Components: Reptiles and Amphibians Report.*

Type/Source of Impact	Description
	environment.
General non-hazardous wastes	Impacts associated with the generation of non-hazardous wastes such as scrap metal, timber, packaging material and empty containers.
General hazardous wastes	Impacts that have the potential to arise as a result of the generation of hazardous wastes such as batteries, oils, chemicals and otherwise contaminated materials that cannot be disposed of as non-hazardous waste.
Sewage and sullage	Impacts arising as a result of the discharge of sewage and sullage from vessels and onshore sources such as construction camp and proposed LNG Facility (once operational).
Saline discharges	Impacts to the marine environment from the discharge of saline water produced by the desalination plant, which forms part of the proposed LNG Facility and will produce the necessary potable water for the Construction phase of the Project.
Stormwater runoff	Impacts arising from the potential entry of stormwater run-off (treated and untreated) from the proposed LNG Facility and associated infrastructure during all phases of the Project.
Deck Drainage	Impacts associated with deck drainage entering the marine environment from vessels during both the Construction, Installation and Operation phases.
Antifouling leachate	Impacts to marine receptors as a result of leachate from anti-fouling paints entering the marine environment.
Introduced marine species	Impacts as a result of marine species or marine pests being introduced to the Port of Gladstone after having been transported from their natural habitat vessel fouling and ballast water discharge.
Hydrocarbon spills	Impacts as a result of either small or large-scale hydrocarbon releases to the marine environment. The risk profile for unplanned hydrocarbon spills changes over the lifetime of the Project and is related to factors such as number of vessels mobilised, size of hydrocarbon inventories at risk and the prevailing environmental conditions at the time of the unplanned event
Chemical spills	Similar to the risk profile of hydrocarbon spills, the potential impacts on the marine environment from chemical spills is related to the type and volume of chemical, the sensitivity of the receiving environment and the level of response initiated in the event of an unplanned event.

Prediction of impacts is essentially an objective exercise. A risk based approach based on recent Oil and Gas Industry documents including the APPEA Code of Environmental Practice was used as a guideline for the impact assessment methodology employed. To determine the level of risk an evaluation of each key Project activity was made based on two intersecting criteria being: Impact Severity; and, Impact Probability. Impact Severity assessments were based on definitions provided under the *EPBC Act* while probability assessments were based on industry experience and statistics. The level of risk was therefore defined as being “High”, “Medium” “Low” or “Insignificant” depending on the intersection of severity and probability scores.

Table 13-3.13 summarises which impact applies to each of the controlled actions. A summary of the predicted environmental risk to each of the Threatened Marine and Migratory species is provided in *Table 13-3.14*. Predicted risks are discussed and explained in *Volume 5, Chapter 8.*

Based on the results reflected in *Table 13-3.14* no impacts are assessed to be of high risk to the listed Threatened and Migratory Marine species and in most cases risks are rated as insignificant or low.

The temporary increase in vessel movements within the Port of Gladstone as a result of the QCLNG Project was assessed to be a medium risk to Dugong. During construction, interaction between vessels and Dugong is likely. Behavioural changes are possible and collisions and boat strikes are recorded in other areas[103]. Any fatalities are likely to impact the population locally[104]. During operations, the probability of strike is reduced due to fewer vessels than in the Construction phase.

The controlled actions are unlikely to have a significant impact on Threatened and Migratory Marine species due to:

- the small number of individuals that utilise the site
- the likelihood that small numbers of marine fauna would continue to utilise parts of the site during the Construction and Operation phases of the Curtis Island Bridge.

Table 13-3.15 and *Table 13-3.16* summarise the management measures and residual level or risk for the Construction and Operation phases of the applicable referrals.

The proposed management measures aim to maintain ecological structure and function and protect the biodiversity and integrity of populations listed under the *EPBC Act* that naturally inhabit the marine environs of the area.

103 Hodgson A J, Marsh H (2007) **Response of dugong to boat traffic: the risk of disturbance and displacement.** Journal of Experimental Marine Biology and Ecology 340:50–61.

104 www.unep.org

Table 13-3.13 Summary of Predicted Marine Related Environmental Risks that are Applicable to EPBC Referrals Associated with the LNG Facility, Pipeline Crossing, Ancillary Infrastructure and Shipping Operations

Referral to Which Risks are Applicable	Physical Presence - Permanent	Physical Presence – Temporary	Underwater Noise	Light	Food Scraps & Putrescible	General non-hazardous solid waste	General hazardous solid waste	Sewage & Sullage	Saline Discharge	Stormwater run-off	Deck Drainage	Anti-fouling leachate	Introduced Marine Species	Hydrocarbon spills	Chemical Spills
EPBC 2008/4399: Pipeline Network	X	X *	X *		X *	X *	X *					X		X *	X *
EPBC 2008/4400:Curtis Island Bridge	X	X *	X *	X	X *	X *	X *			X				X *	X *
EPBC 2008/4401: LNG Marine Facilities	X	X *	X *	X	X	X	X			X		X		X	X
EPBC 2008/4402: LNG Plant and Associated Onshore Facilities				X	X	X	X	X	X	X				X	X
EPBC 2008/4403: Mainland Road and Bridge Approach	X			X		X *	X *			X				X *	X *
EPBC 2008/4404: Curtis Island Road										X					
EPBC 2008/4405: Shipping Activities		X	X	X	X	X	X				X	X	X	X	X
EPBC 2008/4406: Swing Basin and Channel Dredging	X	X *	X	X	X *	X *	X *				X	X *	X *	X *	X *

Notes: * During construction/dredging

Table 13-3.14 Summary of Predicted Marine Related Environmental Risks to EPBC Act Listed Threatened and Migratory Marine Species

Protected Species	Physical Presence - Permanent	Physical Presence - Temporary	Underwater Noise	Light	Food Scraps & Putrescible	General hazardous non-solid waste	General hazardous solid waste	Sewage & Sullage	Saline Discharge	Stormwater runoff	Deck Drainage	Anti-fouling leachate	Introduced Marine Species	Hydrocarbon spills	Chemical Spills
Birds (Wetland and Marine)															
Southern Giant petrel	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Yellow chat	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
White-bellied sea eagle	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Fork-tailed swift	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Great egret, White egret	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Cattle egret	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Latham's snipe, Japanese snipe	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Australian Cotton Pygmy-goose	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Little curlew, Little whimbrel	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Kermadec petrel	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Little tern	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Australian Painted snipe	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Eastern curlew	M	L	I	L	I	L	I	L	L	L	I	I	I	L	L
Red goshawk	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Squatter pigeon	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Great knot	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Grey-tailed tattler	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Terek sandpiper	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Red-necked stint	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Sharp-tailed sandpiper	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Pacific Golden plover	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Lesser Sand plover	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Masked lapwing	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Caspian tern	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
White-throated needletail	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Rainbow bee-eater	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L

Protected Species	Physical Presence - Permanent	Physical Presence - Temporary	Underwater Noise	Light	Food Scraps & Putrescible	General hazardous non-solid waste	General hazardous solid waste	Sewage & Sullage	Saline Discharge	Stormwater runoff	Deck Drainage	Anti-fouling leachate	Introduced Marine Species	Hydrocarbon spills	Chemical Spills
Whistling kite	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Brown goshawk	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Brahminy kite	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Eastern osprey	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Australian hobby	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Whimbrel	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Common greenshank	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Beach Stone-curlew	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Radjah shelduck	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Square-tailed kite	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Grey goshawk	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Black-necked stork	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Sooty oystercatcher	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Lewin's rail	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Black-chinned honeyeater	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Wandering Whistling duck	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Magpie goose	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Black swan	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Pacific Black duck	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Pacific baza	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Whistling kite	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Brown goshawk	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Brahminy kite	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Eastern osprey	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Australian hobby	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Whimbrel	L	I	I	L	I	L	I	L	L	L	I	I	I	L	L
Marine Mammals															
Bryde's whale	I	L	L	L	I	I	I	L	L	I	I	I	I	I	I
Dugong	L	M	L	L	I	I	I	L	L	I	L	I	I	L	I
Humpback whale	I	L	L	L	I	I	I	L	L	I	I	I	I	I	I

Protected Species	Physical Presence - Permanent	Physical Presence - Temporary	Underwater Noise	Light	Food Scraps & Putrescible	General hazardous non-solid waste	General hazardous solid waste	Sewage & Sullage	Saline Discharge	Stormwater runoff	Deck Drainage	Anti-fouling leachate	Introduced Marine Species	Hydrocarbon spills	Chemical Spills
Snubfin dolphin	I	L	L	L	I	I	I	L	L	I	L	I	I	L	I
Killer whale, orca	I	L	L	L	I	I	I	L	L	I	I	I	I	I	I
Indo-Pacific Humpback dolphin	I	L	L	L	I	I	I	L	L	I	L	I	I	L	I
Reptiles															
Loggerhead turtle	I	L	L	L	I	I	I	L	L	I	L	I	I	L	I
Green turtle	I	L	L	L	I	I	I	L	L	I	L	I	I	L	I
Estuarine crocodile, Salt-water crocodile	I	I	L	L	I	I	I	L	L	I	L	I	I	L	I
Leathery turtle, Leatherback turtle	I	L	L	L	I	I	I	L	L	I	L	I	I	L	I
Hawksbill turtle	I	L	L	L	I	I	I	L	L	I	L	I	I	L	I
Pacific Ridley turtle, Olive Ridley turtle	I	L	L	L	I	I	I	L	L	I	L	I	I	L	I
Flatback turtle	I	L	L	L	I	I	I	L	L	I	L	I	I	L	I
Fish															
Whale shark	I	L	I	I	I	I	I	I	I	I	I	I	I	I	I
Green sawfish	I	L	L	L	I	L	I	L	L	I	L	I	I	I	I

Risk Level: I – Insignificant L – Low M - Medium H - High

Table 13-3.15 Summary of Project Management Measures and Residual Level of Risk for the Construction Phase

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
Physical presence (permanent)	EPBC 2008/4399: Pipeline Network EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4403: Mainland Road and Bridge Approach	Design infrastructure and apply construction methods to minimise direct footprint on sensitive habitats and reduce potential impacts on water quality.	Regulatory compliance Best practice	Medium
	EPBC 2008/4406: Swing Basin and Channel Dredging	Design and manage land reclamation activities to reduce the impact to benthic habitats and marine flora and fauna	Regulatory compliance Best practice	
		Develop a Dredging Management Plan that includes the timing, duration and location of activities to minimise the overall impact on marine receptors.	Regulatory compliance Best practice	
Physical presence (temporary)	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Vessels will abide by Port of Gladstone vessel speed restrictions and exclusion zones, in particular within Dugong Protected Areas (DPA).	Regulatory compliance	Medium
		Navigation permitting, vessels to take the most direct route and avoid approaching observed Vulnerable or Migratory species.	Best practice Education	
Underwater noise	EPBC 2008/4399: Pipeline Network EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Construction activities (e.g. dredging, HDD, pile driving) will be undertaken in as short a timeframe as practicable to minimise disturbance. The requirement for an exclusion zone for marine mammals during percussive piling activities and the use of bubble jackets/walls to dampen noise will be evaluated when more information on construction methods is available.	Best practice	Low
		Navigation permitting, vessels will take the most direct route	Best practice	
		Vessels will abide by Port of Gladstone speed restrictions.	Regulatory compliance	
		Vessels will avoid or minimise the use of thrusters to maintain position where possible.	Best practice	
Light	EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities	Develop and implement a Lighting Management Plan to reduce impact from design and minimise where possible.	Regulatory compliance Best practice	Low

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
	EPBC 2008/4402: LNG Plant and Associated Onshore Facilities EPBC 2008/4403: Mainland Road and Bridge Approach EPBC 2008/4405: Shipping Activities	Design lighting to meet relevant industry standards to reduce light spill, including non- or low-reflecting materials.	Regulatory compliance Best practice	
Solid waste	EPBC 2008/4399: Pipeline Network EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities EPBC 2008/4403: Mainland Road and Bridge Approach EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Food scraps and putrescible wastes from the LNG Facility will be disposed of onshore and will not therefore be discharged to the marine environment.	Regulatory compliance Best practice	Insignificant
		Food scraps and other putrescible wastes from vessels will be disposed of in accordance with *MARPOL 73/78 Annex V*.	Regulatory compliance	
		Collection of oils and greases will be collected for onshore disposal	Regulatory compliance	
		Avoid or minimise waste to be generated by procuring services which provide alternative disposal.	Best practice	
		Develop and implement waste management plans for all solid wastes for the life of the Project.	Best practice Regulatory compliance	
		Non-hazardous waste will be segregated into recyclable and non-recyclable waste and disposed of onshore at government-approved facilities.	Best practice Regulatory compliance	
		Hazardous waste will be avoided or minimised during construction by procuring services that use alternate materials wherever practicable.	Best practice Regulatory compliance	
		If hazardous wastes are required (and no alternative available) they will be labelled, stored and transported in accordance with appropriate standards and disposed of onshore at an approved facility.	Best practice Regulatory compliance	
Marine discharges	EPBC 2008/4402: LNG Plant and Associated Onshore Facilities	Design and locate the diffuser discharge point to maximise mixing and dilution of the wastewater through the marine discharge outfall.	Regulatory compliance Best practice	Low
		Design and manage the production of potable water to be minimised where possible to reduce the requirement to discharge saline waste water.	Best practice	
	EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities	Surface water runoff during high rainfall events will be managed through the design of detention basins other sediment control structures, and cleared surfaces will be stabilised to further reduce erosion of fine sediments.		
	EPBC 2008/4401: LNG Marine Facilities	Cleared surfaces will be stabilised to further reduce erosion	Best practice	

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
	EPBC 2008/4402: LNG Plant and Associated Onshore Facilities EPBC 2008/4403: Mainland Road and Bridge Approach EPBC 2008/4404: Curtis Island Road	of fine sediments.		
	EPBC 2008/4399: Pipeline Network EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities EPBC 2008/4403: Mainland Road and Bridge Approach EPBC 2008/4404: Curtis Island Road EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Fuel and chemical storage areas, as well as refuelling areas, will be adequately bunded to ensure no oil or chemical contaminated water is discharged to the marine environment.	Regulatory compliance Best practice	
	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	No contaminated waste will be intentionally discharged via deck wash-down activities.	Best practice	Insignificant
	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Anti-fouling products to be used on vessels will be procured to ensure least impact to receiving marine environment; this includes no use of tributyltin (TBT) on new vessels.	Regulatory compliance Best practice	Low
Introduced marine species	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Develop and implement a ballast water management plan in accordance with relevant legislation and standards, which will include segregation of ballast water tankers and exchange of ballast water in deep ocean areas.	Regulatory compliance	Low
		Vessels at risk of bringing introduced marine species to the Project area will be inspected prior to entry into either Australian waters or the Port of Gladstone. Vessels will be vetted and approved for in collaboration with the Port of Gladstone.	Regulatory compliance	
Hydrocarbon spill	EPBC 2008/4399: Pipeline Network EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities	In accordance with the requirements of the Port of Gladstone, develop and implement emergency response plans for spills, which will include the use of absorbent materials and disposing of these in an approved facility onshore.	Regulatory compliance Best practice	Medium
	EPBC 2008/4403: Mainland Road and Bridge Approach	Oil and chemical usage area shall be contained with appropriate bunding and sumps.	Regulatory compliance Best practice	

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Adhere to industry standards for fuel and hydrocarbon storage, handling and operation, as well as vessel and equipment inspections to identify any potential leaks.	Regulatory compliance Best practice	
		Each vessel will have a Ship Board Oil Pollution Emergency Plan (SOPEP) and carry an oil pollution kit.	Regulatory compliance Best practice	
Chemical spill	EPBC 2008/4399: Pipeline Network EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities EPBC 2008/4403: Mainland Road and Bridge Approach EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	If required, purchasing of chemicals will be assessed and chosen based on their safety, technical, environmental and commercial performance.	Best practice	Insignificant
		Chemicals will be stored safely in approved, labelled containers.	Regulatory compliance	

Table 13-3.16 Summary of Project Management Measures and Residual Level of Risk for the Operations Phase

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
Physical presence (permanent)	EPBC 2008/4399: Pipeline Network EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4403: Mainland Road and Bridge Approach EPBC 2008/4406: Swing Basin	In conjunction with the Port of Gladstone, support the broader programs established to monitor environmental changes in the marine environment.	Best practice	Low
		Comply with all applicable laws, regulations and industry standards and obtain relevant licences or permits during operation of the Project.	Regulatory compliance Best practice	

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
	and Channel Dredging			
Physical presence (temporary)	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Vessels will abide by the Port of Gladstone vessel speed restrictions and exclusion zones, in particular within Dugong Protected Areas (DPA).	Regulatory compliance	Medium
		Navigation permitting, vessels to take the most direct route and avoid approaching observed Vulnerable or Migratory species.	Best practice	
		Vessels to minimise unnecessary vessel movements, such as propeller thrusting, to avoid sediment disturbance	Best practice	
Underwater noise	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Navigation permitting, vessels will take the most direct route and avoid approaching observed marine mammals or turtles.	Best practice	Low
		Vessels will abide by Port of Gladstone speed restrictions.	Regulatory compliance	
		Vessels will avoid or minimise the use of thrusters to maintain position where possible.	Best practice	
Light	EPBC 2008/4400: Curtis Island Bridge EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities EPBC 2008/4403: Mainland Road and Bridge Approach EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin	Implement a lighting management plan, including flaring, to reduce the impact from light sources during operations.	Best practice	Low.
		Implement a lighting audit program to monitor, report and adapt lighting to reduce impact to the environment	Best practice	

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
	and Channel Dredging			
Solid waste	EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Disposal of food scraps and putrescibles from vessels will meet relevant standards to reduce impact to marine environment, including discharge to open ocean only (>22km from land)	Regulatory compliance	Insignificant
		Collection of oils and greases for onshore disposal	Regulatory compliance	
		Implement waste management plans for all solid wastes for the life of the project.	Best practice Regulatory compliance	
		Non-hazardous waste will be segregated into recyclable and non-recyclable waste and disposed of onshore at government-approved facilities.	Best practice Regulatory compliance	
		If hazardous wastes are required (and no alternative available) they will be labelled, stored and transported in accordance with appropriate standards and disposed of onshore at an approved facility.	Best practice Regulatory compliance	
Marine discharges	EPBC 2008/4402: LNG Plant and Associated Onshore Facilities	Desalination brine produced will be discharged to the ocean using a rapid dispersion method.	Best practice	Low
	EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities	Fuel and chemical storage areas, as well as refuelling areas, will be adequately bunded to ensure no oil or chemical contaminated water is discharged to the marine environment.	Best practice Regulatory compliance	
		Operate and manage stormwater systems to accommodate erosion and sediment control structures, including regular inspections and removal of sediment, especially after heavy rainfall.	Best practice	
	EPBC 2008/4405: Shipping	No contaminated waste will be intentionally discharged via deck wash-	Best practice	Insignificant

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
	Activities EPBC 2008/4406: Swing Basin and Channel Dredging	down activities.		
		Anti-fouling products to be used on vessels will be procured to ensure least impact to the marine environment. This includes no use of tributyltin (TBT) on new vessels.	Regulatory compliance Best practice	Low
Introduced species	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	Implement a ballast water management plan in accordance with relevant legislation and standards, which will include segregation of ballast water tankers and sequential exchange of ballast water in deep ocean areas.	Regulatory compliance	Low
		Vessels at risk of bringing introduced marine species to the Project area will be inspected prior to entry into either Australian waters or the Port of Gladstone. Vessels will be vetted and approved for entry into the Port, in collaboration with the Port of Gladstone.	Regulatory compliance	
Hydrocarbon Spills	EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities	In accordance with the requirements of the Port of Gladstone, develop and implement emergency response plans to spills, which will include the use of absorbent materials and disposing of them at an approved facility onshore.	Regulatory compliance Best practice	Medium
		Oil and chemical usage area shall be contained with appropriate bunding and sumps.	Regulatory compliance Best practice	
		Adhere to industry standards for fuel and hydrocarbon storage, handling and operation, as well as vessel and equipment inspections to identify any potential leaks.	Regulatory compliance Best practice	
	EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin	Each vessel will have a Ship Board Oil Pollution Emergency Plan (SOPEP) and carry an oil pollution kit.	Regulatory compliance Best practice	

Aspect	Applicable Referral	Management Action	Driver	Residual Level of Risk
	and Channel Dredging			
Chemical Spill	EPBC 2008/4401: LNG Marine Facilities EPBC 2008/4402: LNG Plant and Associated Onshore Facilities EPBC 2008/4405: Shipping Activities EPBC 2008/4406: Swing Basin and Channel Dredging	If required, chemicals will be assessed and chosen based on their safety, technical, environmental and commercial performance. Chemicals will be stored safely in approved, labelled containers.	Best practice Regulatory compliance	Insignificant

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