Santos
GLNG

Operational
Shipping Activity Management Plan
Phases I and II

EPBC Approval 2008/4058

Document Number: 3310-GLNG-5-1.3-0012

Author:

Title	Name	Signature	Date
Senior Environmental Advisor	Brad Cartwright		16/10/15

Reviewed by:

Title	Name	Signature	Date
EHSS&T Manager	Deborah Hagenbruch		23.10.15

Approved by:

Title	Name	Signature	Date
General Manager Downstream Operations	Brenton Hawtin		28/10/15

Date	Rev	Reason For Issue	Author	Checked	Approved

Table of Contents

Abbreviations

AMSA	Australian Maritime Safety Authority
CSG	Coal Seam Gas
CSAMP	Construction Shipping Activity Management Plan
DEHP	Department of Environment and Heritage Protection
DPA	Dugong Protection Area
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPBC Approval	Approval issued under the EPBC Act for the LNG Marine Facilities (Referral No. 2008/4058)
ERMP	Ecosystem Research and Monitoring Program
GBRMP	Great Barrier Reef Marine Park
GLNG	Gladstone Liquefied Natural Gas
GPC	Gladstone Ports Corporation
IUCN	International Union for Conservation of Nature
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier (also referred to as 'LNG Tanker')
LNG Facility	The GLNG Facility on Curtis Island
LTTMP	Long Term Turtle Management Plan
MOF	Materials Offloading Facility
MSQ	Maritime Safety Queensland
Mtpa	Million tonnes per annum
OSAMP	Operational Shipping Activity Management Plan
OCIMF	Oil Companies International Marine Forum
PCIMP	Port Curtis Integrated Monitoring Program
PLF	Product Loading Facility
QMP	Quarantine Management Plan
REEFVTS	Great Barrier Reef and Torres Strait Vessel Traffic Service
ROPAX	Ro-Ro vessel built for freight vehicle transport along with passenger accommodation
Ro-Ro	Roll on Roll off
SAMP	Shipping Activity Management Plan
OSAMP	This Shipping Activity Management Plan, specific to Operational Shipping activities
SIRE	Ship Inspection Report Program
SOLAS	Safety of Life at Sea
VTS	Vessel Traffic Service

1. Introduction

1.1. Project Background

GLNG Operations Pty Ltd (GLNG) is developing an LNG export facility (LNG Facility) at Gladstone to commercialise its coal seam gas (CSG) resources located near Roma, Queensland. The project involves extraction of CSG that will be used as feed gas for an LNG Facility located on the south-west section of Curtis Island in the Port of Gladstone. The LNG Facility has a nameplate capacity of 7.8 Mtpa. The LNG will be loaded onto LNG Carrier ships (LNGCs) and exported internationally.

1.2. Purpose of the Operational Shipping Activity Management Plan

This Operational Shipping Activity Management Plan (OSAMP) has been prepared to meet the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* approval for the construction of the LNG Marine Facilities (Referral No. 2008/4058 - "the EPBC Approval").

A compliance matrix for the content of this plan against the requirements of the EPBC Approval is detailed in Table 1.

Table 1 – Compliance Matrix for OSAMP with Conditions of EPBC No 2008/4058

Condition EPBC No 2008/4058	Section Addressed within this Management Plan
13. The proponent must prepare a Shipping Activity Management Plan ('the Plan') (for shipping undertaken by or under the control of the proponent) which includes:	This Shipping Activity Management Plan covers Operational Shipping activities undertaken by or under the control of GLNG.
(a) provision for the protection of Dugongs (*Dugong dugon*); Green Turtles (*Chelonia mydas*); Loggerhead Turtles (*Caretta caretta*); Flatback Turtles (*Natator depressus*); and Water Mouse, (*Xeromys myoides*) and the seagrass species *Halodule uninervis*, *Halophila ovalis*, *Halophila decipens*, *Halophila minor*, *Halophila spinulosa*, and *Zostera capricorni*;	Section 6
(b) identification of the habitats, activities, and environmental tolerances in relation to the shipping activity associated with this referral for the species specified in condition 13(a);	Section 4
(c) to minimise environmental disturbance to the species mentioned in condition 13(a):	Section 6.1
(i) limits on vessel speeds, including speeds for particular vessel types;	
(ii) limits on vessel movements, including the use of thrusters; and	Section 6.5
(iii) limits on vessel light and sound.	Section 6.4

Condition EPBC No 2008/4058	Section Addressed within this Management Plan
(d) a comprehensive outline of mitigation measures and controls for each of the types of shipping activities to minimise their impact on the species mentioned in condition 13(a), including actions to: (i) prevent and respond to the impact of accidental fuel, oil or chemical spills;	Section 6.2
(ii) minimise the impact of marine discharges, including those associated with vessel cleaning, anti-fouling and waste disposal;	Section 6.3
(iii) minimise disturbance to the seagrass species mentioned in condition 13(a);	Section 6.8 and 4.4
(iv) minimise the impact of bow-wash on Water Mouse (***Xeromys myoides*****)** nesting sites; and	Section 6.8 and 4.3
(v) proposed remedial action in the event of any impacts directly attributable to the proponent's shipping activities on the species specified in condition 13(a), and the habitats identified in condition 13(b), including a feasible and beneficial offsets strategy.	Section 6.8 and 6.9
(e) a comprehensive outline of monitoring arrangements to determine the impact of shipping activity on the species specified in condition 13(a), which includes: (i) recommendations on the timing and frequency of species surveys; (ii) proposed monitoring arrangements; and (iii) the nature and frequency of proposed reporting arrangements.	Section 7
14. The plan required under condition 13 must be submitted for the approval of the Minister before commencement. The action must not commence until the plan has been approved. The approved plan must be implemented.	The OSAMP Phase I was approved by the Minister (approval granted on 12 March 2015), prior to commencement of LNGC activity. Operational passenger ferry services and operational service vessel will not occur until Phase II of the OSAMP is approved by the Minister. The OSAMP will be implemented once approved.
15. The plan required under condition 13 may be provided in two parts, to address: (a) Shipping associated with the construction of the LNG plant; and	Shipping associated with the construction of the LNG plant is addressed in the GLNG Plant Project,

Condition EPBC No 2008/4058	Section Addressed within this Management Plan
(b) LNG tanker operation and LNG tanker activities.	Shipping Activity Management Plan, Phase III, Rev 8 (GLNG 2014). This Plan was approved by the Department on 16 October 2014 and will continue to apply to construction associated shipping. Shipping associated with LNGC operation and activities is addressed in this OSAMP Phase I. Operational passenger ferry services and operational service vessels is addressed in this OSAMP Phase II
16. If the plan required under condition 13 is provided in two parts, each part must be provided before the commencement of the activity to which that part relates.	The approved GLNG Plant Project, Shipping Activity Management Plan, Phase III, Rev 8 (GLNG 2014) applies to ongoing construction associated shipping. The OSAMP Phase I addresses LNGC operations and activities which have not yet commenced. Operational passenger ferry services and operational vessel services are addressed in OSAMP Phase II and will not occur until approved by the Minister.

1.3. Objectives

The objectives of this OSAMP Phase I and II are to:

- specify the management and mitigation measures that will be implemented to minimise environmental impacts from
    - LNGC operations and associated activities;
    - Ferry and barge operations and associated activities during the operation of the LNG facility following construction and commissioning of each of Trains 1 and 2; and
- address the requirements of Condition 13 of the EPBC Approval.

1.4. Scope

A Shipping Activity Management Plan (SAMP; GLNG 2014*)* addressing shipping activity associated with the construction of the LNG Facility was approved by the Department of the Environment on 16 October 2014 to satisfy conditions 13, 14, 15(a) and 16 of EPBC Approval No. 2008/4058. The construction-phase SAMP considered the environmental impacts of shipping activities such as the use of passenger ferries to transport construction workers, barges to transport construction materials, and general construction support vessels.

For the purposes of this OSAMP, operational shipping activities are divided into two phases:

Operations Phase I included only LNGC operations and associated activities (e.g. use of tugs to assist with navigation) when conducting shipping activities to export LNG from the LNG Facility on Curtis Island. LNGC operations will commence during the commissioning of the LNG Facility and prior to the introduction of other operational services to Curtis Island;

Operations Phase II adds passenger ferry services and operational maintenance vessels associated with marine transport for the day-to-day operation of the LNG Facility.

This OSAMP addresses both Operational Phase I and Phase II activities. An overview of the layout of the LNG Facility, including the MOF and the marine facilities on the mainland are shown in Figure 1.

2. Project Description

2.1. Phase I

International LNGCs will move through the Great Barrier Reef Marine Park (GBRMP), Great Barrier Reef World Heritage Area and Port of Gladstone when in transit to and from the LNG Facility on Curtis Island. Loading of LNG onto LNGCs will take place at the Product Loading Facility (PLF), which has specialised LNG loading facilities and a single LNGC berth.

2.2. Phase II

Operational ferries and barges will operate within Gladstone Harbour between mainland facilities at Port Central (PC) and RG Tanna (RGT) and the Materials Offloading Facility (MOF) at the LNG Facility on Curtis Island.

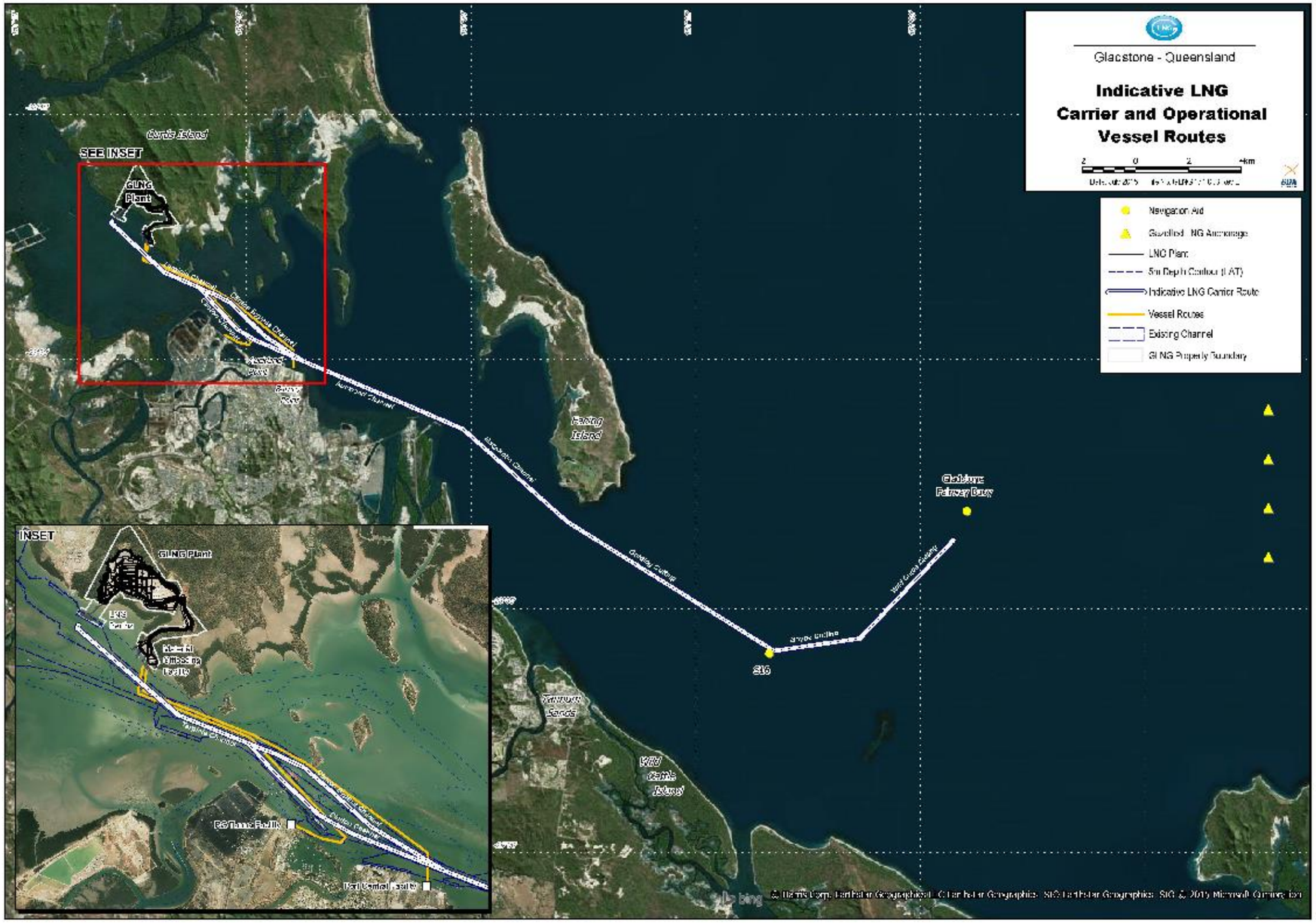

Figure 1 - Harbour Layout and Indicative LNG Carrier Route

3. Operational Shipping Activity

3.1. Phase 1 - LNGCs

LNGCs – Type and Size of Ships

The PLF is designed to handle LNGCs of both spherical and membrane containments, with a range of ship sizes and LNG capacities. LNGCs between 125,000 to 220,000 m^3 capacity range ('target ships') will be accommodated, which generally, have a design laden draft of 9.3 to 12.2 metres and a deadweight tonnage of between 67,000 to 110,000 tonnes. Simulations conducted by GLNG, in consultation with Port Operators and Regulators, has enabled the development of LNG vessel operating parameters established to ensure the safe transit of LNGCs in the Port of Gladstone.

Shipping Program

GLNG will trade LNG internationally from the Curtis Island facility. Assuming a nominal two-train LNG production rate of 7.8 Mtpa, up to 126 LNGCs of the 'target' ship class per year will be loaded. Loading of LNGCs commences with cool down of the loading arms and ship manifold and testing of emergency shutdown systems under both warm and cryogenic conditions. The LNG loading rate is increased in increments of 1 000 m^3/h to a maximum of 10,000 m^3/h. Loading of a LNGC with a 145,000 m^3 capacity is anticipated to take 16 hours with the total time to moor, cool down the loading arms and ship manifold, load, and unmoor the LNGC expected to take approximately 24 hours.

The first LNG (commissioning) cargo occurred during Quarter 4, 2015. Production is predicted to be approximately one LNG cargo per week during the commissioning stage of the LNG facility. Production rates may be inconsistent initially, and cargo frequency will gradually increase with improved production consistency. By commissioning of Train 2 in 2016, the frequency of LNG cargos is expected to have doubled from the initial commissioning stage to two LNGCs per week. The long-term production rate is expected to be 2.3 LNGC loadings per week from the latter half of 2016 onwards.

The indicative shipping forecast is summarised in Table 2 below.

Table 2 – Indicative LNGC Shipping Forecast

Year	Average Indicative Forecast Number of Vessels	Indicative Forecast of Average Vessels per Week
2015	12	1.1
2016	113	2.2
2017 onwards	120 per annum	2.3

LNGC Vessel Routes

LNGCs Travelling Through Port of Gladstone

Shipping routes within the Port of Gladstone to be used by LNGCs servicing the LNG Facility are shown in Figure 1.

Vessels Travelling Through the Great Barrier Reef Marine Park

All LNGC activities will comply with relevant State, Federal and International Legislative requirements.

LNGCs will navigate within the Designated Great Barrier Reef and Torres Strait Vessel Traffic Service (REEFVTS) VHF Channel established within the Great Barrier Reef Marine Park (Figure 2). Such measures have been established to minimise the impact of the shipping industry on the Great Barrier Reef while having regard for Australia's international obligations. The management approach takes into account past and forecast vessel usage patterns in the inner and outer shipping routes, existing recommended tracks and proposed new routes.

In addition, the Australian Maritime Safety Authority (AMSA) has prepared the Queensland Coastal Passage Plan (AMSA 2014) and the North-East Shipping Management Plan (AMSA 2014). Collectively, these plans provide for the protection of the environment of the Great Barrier Reef through cooperation between government agencies and the shipping industry. Each plan outlines measures currently in place to manage the safety of shipping in the sensitive marine environments of the Great Barrier Reef and proposes options to minimise the environmental impacts of shipping activities in the future. Pilotage, vessel tracking, vessel inspection, auditing and other requirements on LNGCs are outlined in Section 6. LNGCs will typically use the outer Great Barrier Reef navigational route except when meteorological conditions favour use of the inner route.

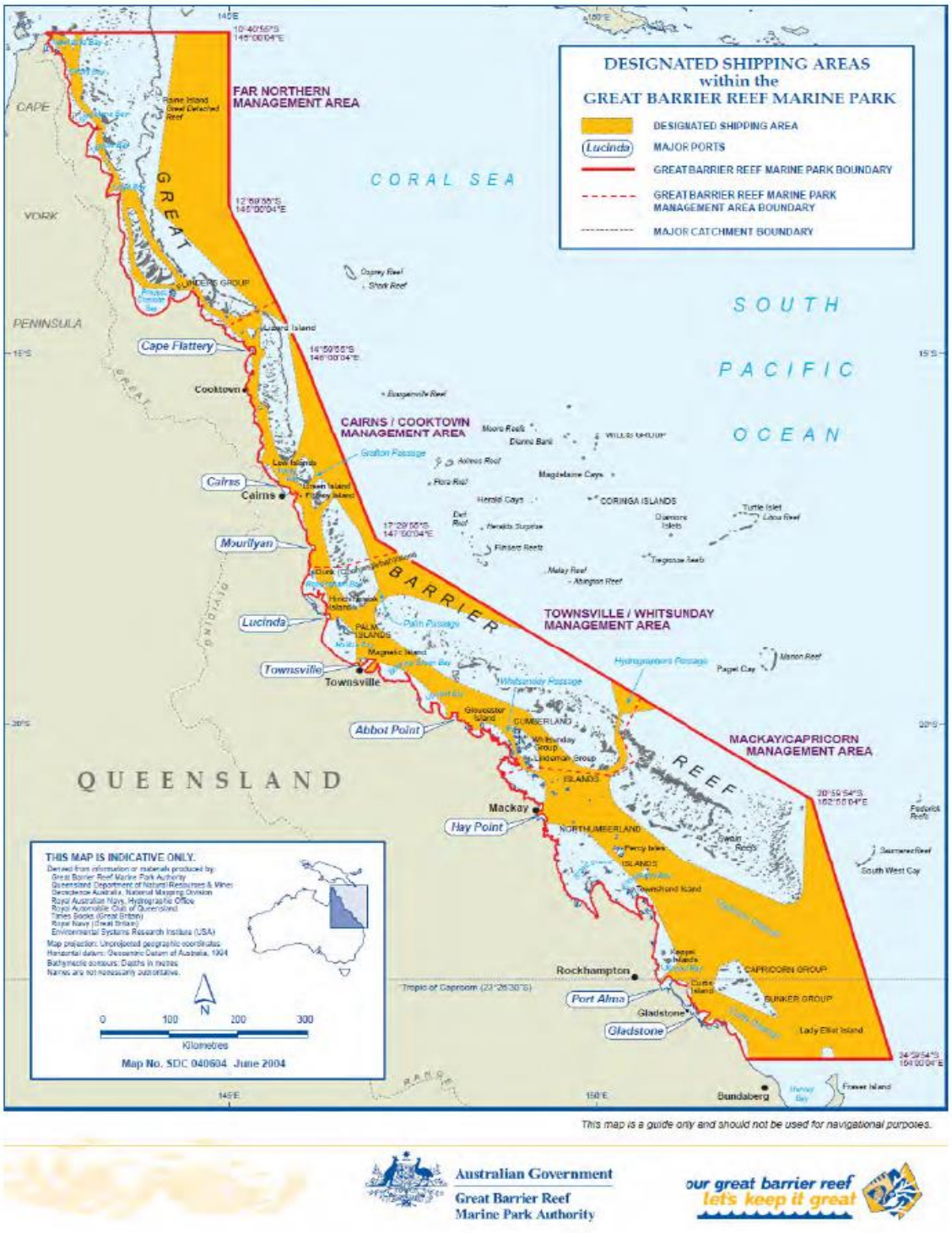

Figure 2 Great Barrier Reef Designated Shipping Area (Great Barrier Reef Marine Park Zoning Plan 2003)

These routes are indicative only and will vary depending on tidal fluctuations, meteorological conditions, the presence of other vessel traffic, the requirements of the Gladstone Harbour Master and the LNGC design.

LNGCs will be advised of their anchorage position by MSQ VTS upon arrival at the Port of Gladstone, LNGCs will discuss the vessels transit plan with the Gladstone Marine Pilot upon boarding at the Fairway Entry. Generally LNGCs will be given priority passage through the Port of Gladstone. Each LNGC will be met by a Gladstone Ports Corporation (GPC) pilot, to assist with navigation into Port Curtis.

The pilot and ship's master will exchange manoeuvring information about the LNGC and the anticipated transit. Permission to enter the channels will be confirmed through contact with Gladstone Vessel Traffic Service (VTS). Transit time is approximately three hours depending on the conditions at the time. Between the Fairway Buoy and Wild Cattle Cutting, two escort tugs operating under the Port of Gladstone exclusive Harbour Towage Licence will escort the LNGC. Once inside the harbour, two additional 70 tonne bollard pull harbour tug will assist the LNGC to berth.

Clinton Bypass Channel will be the normal route for LNGC movements. In exceptional circumstances, the Clinton Main Channel may be utilised, provided that precautions are taken to avoid interactions with any ships moored at the RG Tanna Wharf. Transit speed will be followed as per direction from the Gladstone Harbour Master. LNGC speed will be reduced to eight knots passing Barney Point Wharf (six knots if Barney Point Wharf is occupied). Transit speed will be reduced further to six knots upon entering Passage Islands Channel.

3.2. Phase II – Ferries and Barges

Types and Sizes of Vessels

GLNG will utilise either 36, 150 or 400 man capacity ferries to transport personnel between the mainland and Curtis Island of the same or similar type to those utilised during the construction phase of the Project.

Ropax vessels will be utilised to transport freight between the mainland and the LNG facility on Curtis Island.

Schedule

An indicative ferry timetable is shown in Table 3 below including expected passenger numbers. Three (3) return ferry trips are proposed at the start and end of each operational shift (i.e. 3 in the morning and 3 in the late afternoon). During the day, an additional two (2) ferry services shared with QCLNG using the smaller 36 man vessels are proposed. These smaller vessels will also serve as stand-by water taxis at other times (e.g. for LNG Carrier crew changes and for urgent, but not life-threatening, transfers of staff off the island to support sick partners/family members on the mainland).

Santos GLNG

Table 3 – Indicative LNGC Shipping Forecast

Indicative GLNG Ferry Timetable							
Depart Mainland	Arrive GLNG	Depart GLNG	Arrive Mainland	Mon - Fri	Sat - Sun	Public Hols 1	Public Hols 2
				Max Pax Over/Back	Max Pax	(exc Xmas,Boxing,Easter M&F)	(Xmas, Boxing, Easter Mon & Fri)
0545	0605			30/0	30/0	30/0	30/0
0605	0625	0645	0705	80/30	80/30	80/30	80/30
0645	0705	0715	0735	120/30	30/20	30/20	10/05
		1530	1550	0/120	0/20	0/20	0/05
		1700	1720	30	0	0	0
1745	1805	1845	1905	30/110	30/110	30/110	30/110

Indicative Shared Ferry Timetable									
Depart Mainland	Arrive GLNG	Depart GLNG	Arrive QGC	Depart QGC	Arrive Mainland	Mon - Fri	Sat - Sun	Public Hols 1	Public Hols 2
						Max Pax	Max Pax	(exc Xmas,Boxing,Easter M&F)	(Xmas, Boxing, Easter Mon & Fri)
1000	1020	1030	1040	1050	1115	30	30	30	30
1230	1250	1300	1310	1320	1345	30	30	30	30

Initially, operational ferries services will commence on a limited basis in conjunction with the construction ferries services still in place under the current Construction Shipping Activity Management Plan, reaching full services at a time when the construction ferry services are progressively withdrawn as construction and commissioning of the LNG Facility is completed.

A daily ROPAX service is proposed between the mainland and the LNG Facility on Curtis Island (i.e. Departing the mainland in the morning and returning from Curtis Island in the afternoon) during normal operations.

The number of ferry and ROPAX vessels movements per day may increase during shutdown periods.

Vessel Routes

Ferry and ROPAX vessel routes between the mainland and Curtis Island are shown on Figure 1.

All vessels are required to travel at safe speeds. Slower speeds will be enforced depending upon weather and harbour conditions at the time of the voyage. Within 30 meters of a jetty, wharf, boat ramp, pontoon or ship at anchor or made fast to the shore, a speed limit of six (6) knots applies as per the *Transport Operations (Marine Safety) Regulation 2001 (Qld).* Additionally, speed restrictions will apply as per condition 13 of EPBC No. 2008/4058 which specifies a maximum speed limit of six (6) knots within the shallow water sections of the shipping route, defined as waters with a five (5) metre depth contour or less.

Several purpose built ferries for use by GLNG have engineered design features such as water jet propulsion systems, shallow draughts and have forward looking infra-red cameras installed to minimise the potential impact of the ferries on sensitive environmental receptors. Circumstances may require the use of additional or replacement ferries which are not purpose built for GLNG from time to time (e.g. replacement of a regular ferry requiring repairs and/or maintenance).

4. Sensitive Environmental Receptors and Potential Impacts

The purpose of the OSAMP Phases I and II is to manage the potential environmental impacts on the following sensitive environmental receptors from LNGC, ferry and barge/ROPAX shipping operations and associated activities.

- Dugong (*Dugong dugon);*
- Green Turtles (*Chelonia mydas);*
- Loggerhead Turtles *(Caretta caretta);*
- Flatback Turtles *(Natator depressus);*
- Water Mouse *(Xeromys myoides); and*
- Seagrass species *(Halodule uninervis, Halophila ovalis, Halophila decipens, Halophila minor, Halophila spinulosa, and Zostera capricorni*).

This section outlines the conservation status and background information on each of the sensitive environmental receptors specified in EPBC Approval 2008/4058, and identifies potential modes of impact from GLNG shipping activities.

4.1. Dugongs

The dugong (*Dugong dugon*) is listed as Vulnerable under the *Nature Conservation (Wildlife) Regulation 2006*, Migratory under the EPBC Act, and is recorded to occur within the waters of Port Curtis where LNGC operations will occur (Marsh and Lawler 2006). Dugongs prefer shallow and sheltered areas where their primary food source, seagrass, occurs. Seagrass meadows in the Gladstone area are of regional significance as they are the only known major seagrass habitats between Shoalwater Bay and Hervey Bay (Thomas *et al.* 2010). Seagrass areas are therefore likely to provide an important connecting habitat along the southern Queensland coast (Sobtzick *et al.* 2013).

The LNG Facility is located within the Rodds Bay Dugong Sanctuary, which is a Zone B (restricted use) Dugong Protected Area (DPA) declared under the *Fisheries Act 1994* (Figure 3). Such management arrangements recognise that parts of the Gladstone coastline are important habitat for dugong, despite being closely associated with commercial port activities.

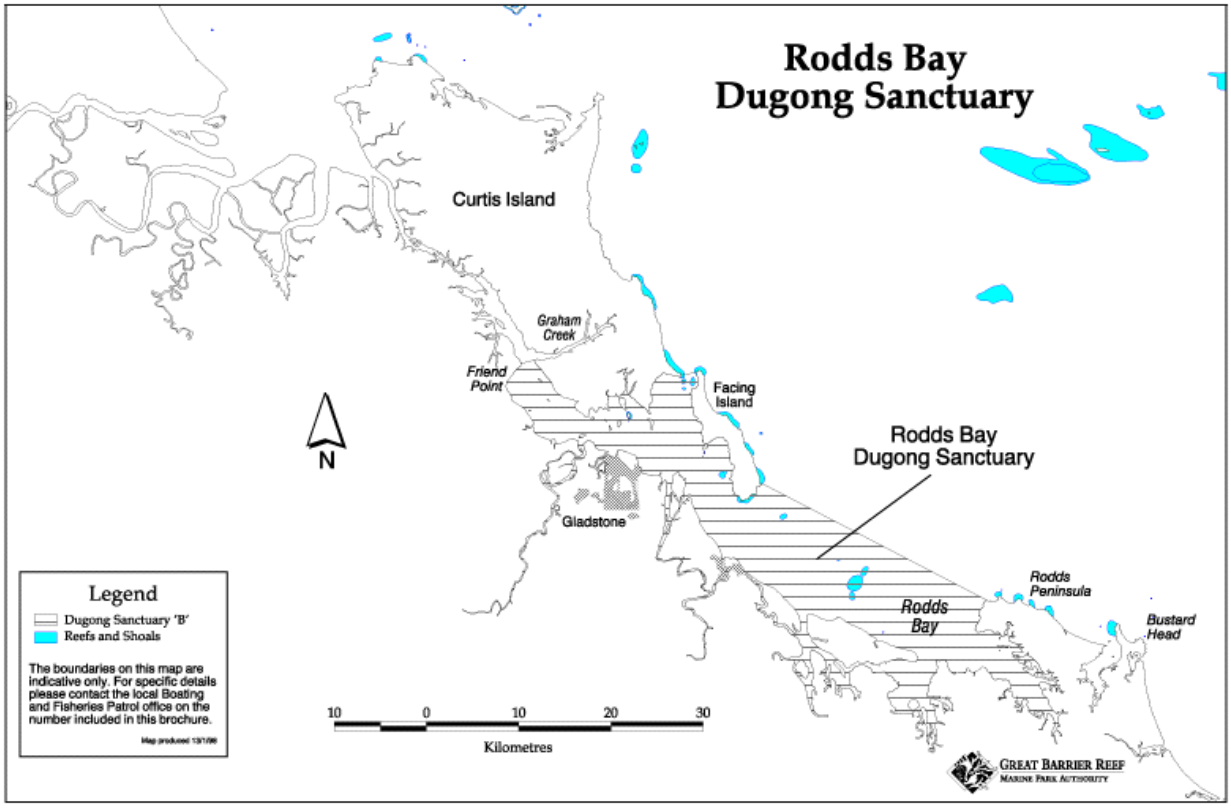

Figure 3 Rodds Bay Protection Area (Figure sourced from Great Barrier Reef Marine Park Authority http://www.gbrmpa.gov.au/zoning-permits-and-plans/special-management-areas)

A survey conducted in 2005 (Marsh and Lawler 2006) estimated that there were 183 (±66) dugongs in the Port of Gladstone area, with dugong feeding activity observed on the majority of intertidal seagrass meadows surveyed during a study of benthic habitats in the port. However, Grech and Marsh (2007) classed the area around Gladstone as low to medium conservation status on the basis of relative density of dugongs estimated from spatial modelling and frequency analysis of time-series data over 19 years of aerial surveys. A recent review by Sobtzick *et al.* (2013) concluded that the size of the dugong population at Gladstone is likely to be "in the low hundreds at the most".

Seagrass meadows in the Port Curtis area serve as a primary foraging habitat for dugongs. The degradation and/or destruction of such seagrass meadows may reduce feeding opportunities for dugongs within Port Curtis. Seagrass habitats were affected by a severe flood event in the Gladstone area in 2011, with a reduction in the area and quality of seagrass (Sankey *et al*. 2012). The decline in seagrass coincided with an increase in dugong strandings (DEHP 2014).

Potential impacts of shipping activity on dugongs include mortality, sub-lethal injury and/or behavioural changes (e.g. avoidance of preferred feeding grounds) resulting from:

- Disturbance to seagrass foraging habitats from sediment resuspension
- Disturbance associated with noise and vibration from vessels;

- Vessel strike;
- Impacts arising from fuel, oil or chemical spills, or other marine discharges; and
- Light from vessels.

4.2. Turtles

Marine turtles are recognised internationally as species of conservation concern and are listed in the 2000 IUCN (World Conservation Union) Red List of Threatened Animals. All marine turtle species occurring in Australian waters are listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora. In addition, all marine turtle species occurring in the Indo-Pacific region are a priority for conservation under the Convention on the Conservation of Migratory Species of Wild Animals. Australia recognises these agreements in the EPBC Act.

Green turtles (*Chelonia mydas*) are listed as vulnerable in Queensland (*Nature Conservation Act 1992*) and Australia (EPBC Act), and endangered by the IUCN. The Gladstone area contains important foraging habitat for green turtles, particularly within Port Curtis. Nesting occurs on the Capricorn Group of islands offshore from Gladstone and very occasionally on the eastern side of southern Curtis Island and Facing Island (Limpus 1999; 2008).

Loggerhead turtles (*Caretta caretta*) are listed as endangered in Queensland (*Nature Conservation Act 1992*), Australia (EPBC Act) and by the IUCN. The Gladstone area provides a diverse foraging ground for loggerhead turtles, with nesting rookeries also occurring on several islands (e.g. Tryon Island, Wreck Island and Erskine Island). Loggerhead turtles have occasionally nested on the eastern side of southern Curtis Island and Facing Island (Limpus, 1999).

Flatback turtles (*Natator depressus*) are listed as vulnerable in Queensland (*Nature Conservation Act 1992*) and Australia (EPBC Act), and data-deficient by the IUCN. Flatback turtles nest at major rookeries located on Curtis and Facing Islands, as well as the nearby Peak and Wild Duck Islands. Approximately 50 breeding females nest at Curtis Island each season (Hodge *et al*. 2006). Inter-nesting flatback turtles are likely to enter Port Curtis from time to time, but are unlikely to feed in the region (Sperling *et al*. 2010) and, based on tag recoveries, have foraging habitats further afield in the Great Barrier Reef lagoon (Limpus *et al*. 2002).

According to a study conducted by Queensland Department of Environment and Heritage & Gladstone Ports Authority (1994), the loggerhead turtle and flatback turtle utilise habitats in the outer harbour and occasionally move northward through Port Curtis into The Narrows.

There are no recognised marine turtle nesting beaches inside Port Curtis, with the closest sites being used by flatback (and occasionally green) turtles at North Cliff Beach (Facing Island) and the main beach at South End (Curtis Island) (QCLNG 2014) refer to Figure 4.

Figure 4 - Turtle Nesting Locations

Potential impacts of shipping activities on turtles include mortality, sub-lethal injury and behavioural changes (e.g. avoidance of preferred feeding grounds) resulting from:

- Vessel strike;
- Disturbance associated with noise and vibration from vessels;
- Disturbance of seagrass foraging habitats from sediment resuspension;
- Impacts arising from fuel, oil or chemical spills, or other marine discharges; and
- Light from vessels (which can disorient nesting turtles and emerging hatchlings).

4.3. Water Mouse

The water mouse (*Xeromys myoides*) is a small native rodent and is listed as Vulnerable under the EPBC Act. The water mouse occurs in three discrete populations in Australia: the coastline of the Northern Territory, central south Queensland and south-east Queensland. The central south Queensland population is relevant to the LNG Facility, as this population extends from Cannonvale (Whitsunday Coast) in the north to Agnes Water in the south (incorporating Gladstone).

Habitat mapping indicates that the water mouse is likely to occur throughout the Gladstone area (DEWHA 2009). As part of the LNG Proponents' Monte Christo offset proposal, described further in section 6.8, an RE-based model of suitable water mouse habitat on Curtis Island was developed to give an indication of "core", "essential" and "general" habitat, Figure 5. (Ecofund 2013).Several recent surveys (GHD 2011, GHD 2012, Queensland Museum 2012, Aurecon 2012, Worley Parsons 2011) have confirmed the presence of the water mouse in the Gladstone area. GLNG has undertaken extensive trapping programs in the vicinity of the LNG Facility and the water mouse has not been detected (BAMM 2012). Although the occurrence of water mouse in the GLNG project area cannot be discounted completely, the available habitat is likely to be marginal at best for this species.

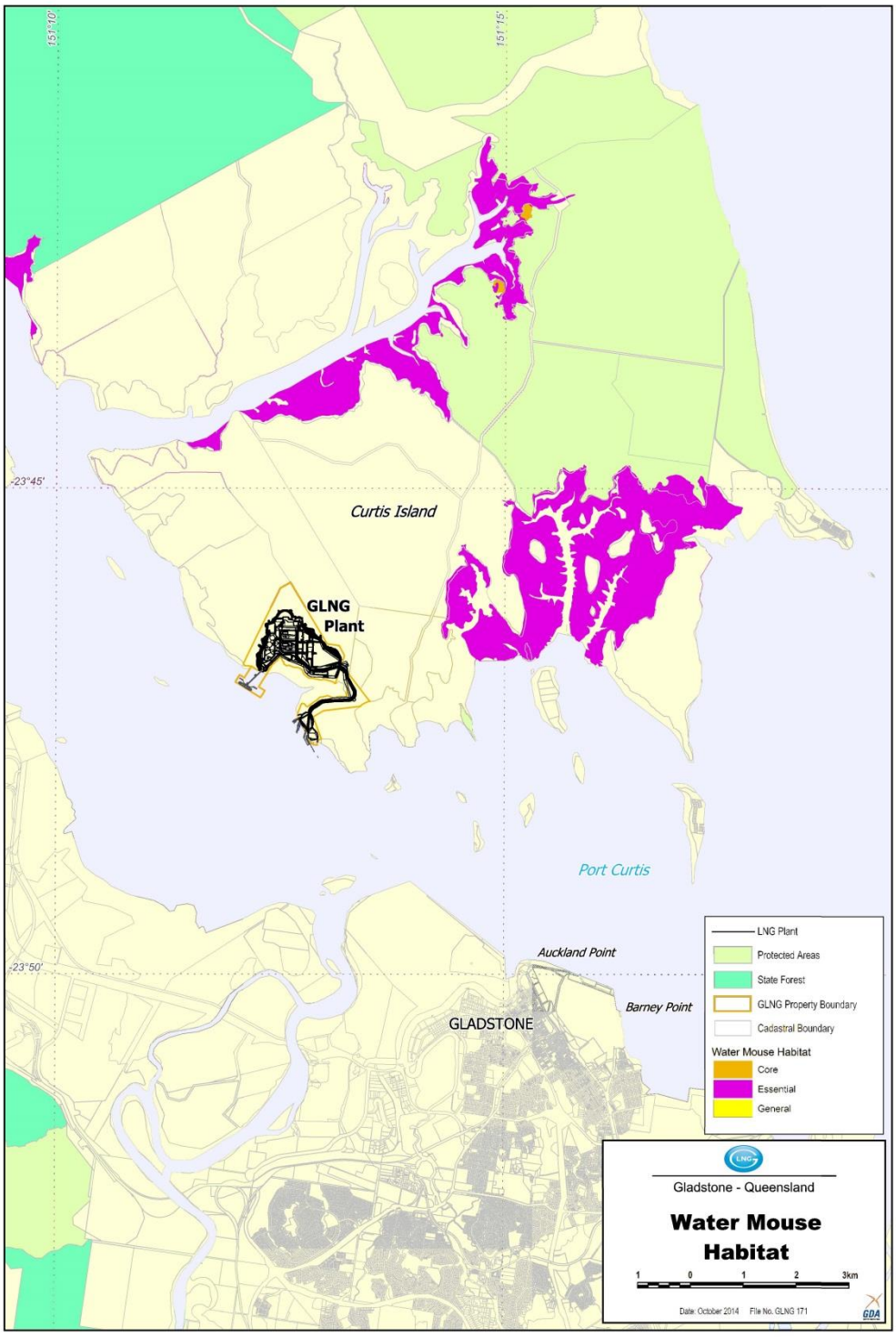

Figure 5 - Water Mouse Habitat

4.4. Seagrass

Seagrass meadows in Queensland are known to provide an important food resource for dugongs and green turtles with both species observed within Port Curtis (Rasheed *et al*. 2003). Annual seagrass monitoring has been ongoing in the Port Curtis area since 2004 under the Port Curtis Integrated Monitoring Program (PCIMP), which was established in 2001. The aim of PCIMP is to manage a coordinated and integrated monitoring program to determine the ecosystem health of Port Curtis. Within the Port of Gladstone, the following seven seagrass species have been identified (McKenzie *et al*. 2012; Thomas *et al*. 2010; Chatrand *et al*. 2009; Rasheed *et al*. 2008; Taylor *et al*. 2007; Taylor *et al*. 2006; Rasheed *et al*. 2003; Lee Long *et al*. 1993):

- *Halodule uninervis;*
- *Halophila ovalis;*
- *Halophila decipens;*
- *Halophila minor;*
- *Cymodocea rotundata*
- *Halophila spinulosa;* and
- *Zostera capricorni.*

A total of 7,246 ha of intertidal (coastal) seagrass beds has been identified within the Port of Gladstone – Rodds Bay Dugong Protection Area (DPA), with an additional 6,332 ha in deep-water areas (>5 m Mean Sea Level) identified to the east and south of Facing Island (Rasheed *et al*. 2003; Rasheed *et al*. 2005) (see Figure 6). No deep-water seagrass communities have been reported within the inner-port area.

Seagrass distribution and per cent cover has varied significantly within Port Curtis since 2011, following some severe flood events. While some recovery was observed in 2012, a flow event in the Calliope River caused a reversal of much of that recovery (Bryant *et al.* 2013). Seasonal influences on temperature, riverine discharges and light intensity are also factors affecting seagrass growth at Port Curtis over periods of months. A small area of *Halophila ovalis* has been identified near the LNG Facility jetty, with the inshore channels leading to the LNG Facility only having small areas of sparse seagrass (Bryant *et al*. 2013).

There is a limited extent of seagrass in proximity to the proposed vessel routes within the Port of Gladstone (Figure 6). The LNGCs will be operating within designated shipping channels only, in deep water with average depths of between 13 and16 m. The proposed vessel routes do not traverse key seagrass areas (Figure 6).

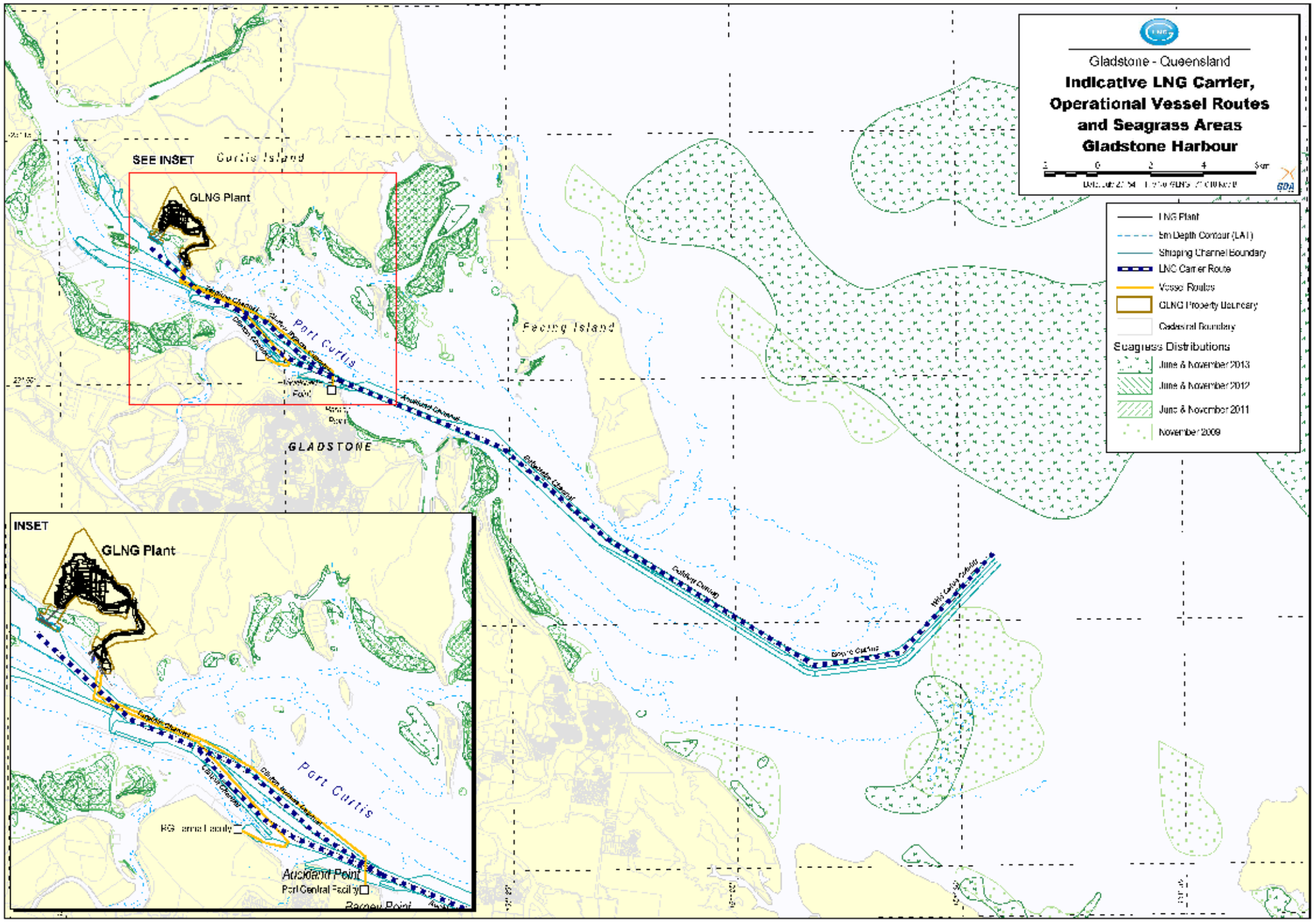

Figure 6 Seagrass Areas Gladstone Harbour

Potential impacts of shipping activity on seagrass include destruction and degradation resulting from:

- Vessel wash and sediment resuspension;
- Vessel grounding or anchoring in seagrass areas; and
- Impacts arising from fuel, oil or chemical spills, or other marine discharges.

4.5. Summary of potential impacts

The following aspects of GLNG's shipping activities have the potential to result in adverse impacts on sensitive environmental receptors:

- Vessel wash and sediment resuspension;
- Vessel grounding or anchoring in seagrass areas;
- Impacts arising from fuel, oil or chemical spills, or other marine discharges;
- Noise, vibration and light from vessels; and
- Vessel strike.

These potential modes of impact have been assessed through a risk assessment process to identify environmental risk and assist in developing mitigation measures to reduce risk on sensitive environmental receptors. The results of the risk assessment, as applied to EPBC listed fauna and seagrass species specified in condition 13(a), are presented in Section 5. A program of mitigation and monitoring measures to minimise the risk of environmental impacts is described in Sections 6 and 7.

5. Risk Assessment

5.1. Method and Results

GLNG has undertaken a comprehensive risk assessment of the potential impacts of shipping related activities (OSAMP Phases I and II) on the species specified in Condition 13 (a) of the EPBC Approval. The risk assessment has been completed to determine the likelihood and consequence of potential impacts on those species.

The risk assessment approach has been modified from the Great Barrier Reef Marine Park Authority Environmental Assessment and Management (EAM) Risk Management Framework (GBRMPA 2009) which involves assessing risk both before and after the implementation of mitigation actions. The criteria used to determine the likelihood and consequence of each potential impact are described in Table 3. The potential for recovery of impacted species and habitats is described in the consequence rating of Table 3 in the context of new mitigation measures being applied that reduce the impact of unmitigated activities. The likelihood rating is the probability of a defined impact occurring at a population level.

Table 4 Risk assessment matrix

	Consequence Rating				
Likelihood (probability of occurring)	Insignificant – Little to no impact on the overall ecosystem, or on EPBC listed species and their habitats.	Minor – Impacts are present, but not to the extent that the overall condition of populations of EPBC listed species or their habitats are impaired in the long term (decades). Some low levels of mortality may occur very infrequently, with recovery occurring within a period of years.	Moderate – Populations of EPBC listed species and their habitats are affected, either through elevated mortality, habitat disturbance or a minor disruption to a population over a widespread geographic area. Recovery at habitat level would take at least a decade, with recovery of listed species taking several decades.	Major – Significant impact on populations of EPBC listed species and their habitats, with high levels of mortality. Recovery of habitats would take a few decades, with populations taking several decades for populations of long-lived species.	Catastrophic – EPBC listed species and their habitats irretrievably compromised. Mass mortality of species and/local extinction. Recovery over several decades for habitat values and centuries for populations of long-lived species.
Almost Certain (95-100%)	Medium	Medium	High	Extreme	Extreme
Likely (71-95%)	Medium	Medium	High	High	Extreme
Possible (31-70%)	Low	Medium	High	High	Extreme
Unlikely (5-30%)	Low	Low	Medium	Medium	High
Rare (0-5%)	Low	Low	Medium	Medium	Medium

The risks associated with shipping activities have been considered in three geographic areas, as the potential mode of impact on the listed species differs across these areas:

- Inshore habitats located adjacent to the LNG Facility and their associated dredged channels located west of Auckland Point, which are surrounded by tidal and sub-tidal flats. Ferry and ROPAX activities are confined to this area. LNGC activities in this area are confined to the final approach to the LNG Facility jetty or initial stages of departure following the completion of loading. Transit of LNGCs through the area is under assistance from a pilot and tugs and generally at low speeds (six to eight knots).

- Estuarine habitats of Port Curtis, located inside the barrier islands of Curtis and Facing Islands east of Auckland Point. In this area, LNGCs are in transit under assistance from a pilot through partially sheltered waters of Port Curtis.

- Offshore habitats of the Great Barrier Reef, located east of the barrier islands of Curtis and Facing Islands. In this area, LNGCs are in transit through open waters of the Great Barrier Reef Marine Park. Anchoring may also be carried out very infrequently within this area at designated anchorage sites.

The results of the risk assessment are presented in Table 5, Table 6 and Table 7, identifying inherent (unmitigated) risks and the residual risks to EPBC Act listed species and their habitats following the implementation of mitigation and management strategies. Risks have been assessed by considering the likelihood of an impact occurring on an EPBC Act listed species at the population level or its habitat, rather than the risk of a single incident occurring. The consequence rating is based upon the most probable consequence for populations of EPBC Act listed species and their habitats given the nature of the activity.

Results of the three risk assessments are discussed in further detail below in relation to EPBC listed species identified in Condition 13(a) of the EPBC Approval 2008/4058.

Santos GLNG

Table 5 Risk assessment of impacts of LNGC (Phase I), Ferry and ROPAX vessel activities (Phase II) within inshore areas of Gladstone Harbour (L=likelihood, C=consequence)

Hazards and potential impacts	L	C	Inherent Risk	Mitigation measures	L	C	Residual risk
Use of bow thrusters to manoeuvre LNGCs to and from LNG jetty, creating turbidity plumes (potentially disturbing seagrass), wake from ships (potentially causing erosion on the shoreline) and increasing noise (disturbing water mouse, turtles and dugong).	Possible	Minor	Medium	LNGC activity limited to an average of 120 ships per year (2.3 ships per week). Ships confined to channels only under direction of pilot. Tugs used to improve the precision of navigation, maximising the clearance between LNGC hull and seabed and minimising turbidity plumes. Direct environmental offsets secured by GLNG will protect water mouse habitat at Curtis Island.	Rare	Minor	Low
Manoeuvring of ferry and ROPAX vessels at the mainland marine facilities (PC and RGT) and at the MOF at the LNG facility creating turbidity plumes (potentially disturbing seagrass), wake from vessels (potentially causing erosion on the shoreline) and increasing noise (disturbing water mouse, turtles and dugong).	Possible	Minor	Medium	Ferry and ROPAX vessel activities are expected usually to be limited to a total of nine (9) return movements per day during normal operations. This is significantly less returns (~80% reduction) compared to ferry and ROPX activities during the construction phase of the project. Ferry design – jet propulsion, shallow draught. ROPAX – slow speed, shallow draught.	Rare	Minor	Low
Use of navigation channels by ferries, ROPAX vessels and LNGCs creating a risk of boat strike for turtles and dugong, a risk of introduced marine species and causing indirect disturbance of natural behaviours (avoidance of foraging areas).	Unlikely	Minor	Low	All vessels will abide by the Port of Gladstone published speed restrictions and exclusion zones set out by all relevant authorities at all times. There will usually be a low frequency of vessel trips (average of 2.3 LNGC ships per week, 8 return ferry trips per day and 1 ROPAX vessel return trip per day). Utilise only designated shipping channels, where water is deepest and clearance between the vessel hull and seabed is greatest. LNGC ballast water exchange to comply with international guidelines (generally occurring offshore).	Unlikely	Minor	Low
Lighting of LNGC ships at night while in transit or berthed at the PLF (contributing to sky glow-associated disturbance of turtles and disturbing local water mouse habitat).	Unlikely	Minor	Low	PLF is not in direct line of sight to turtle nesting beaches. Light spill from LNGCs will be minimised while maintaining safety. Use of low pressure sodium and directional lights at PLF. Shipping channels are located several hundred metres from potential water mouse habitat. Direct environmental offsets secured by GLNG will protect significant areas of water mouse habitat on Curtis Island.	Rare	Insignificant	Low

Hazards and potential impacts	L	C	Inherent Risk	Mitigation measures	L	C	Residual risk
Lighting of ferries and ROPAX vessels in the early hours of the morning or early evening while in transit or berthed at the MOF (contributing to sky glow-associated disturbance of turtles and disturbing local water mouse habitat).	Unlikely	Minor	Low	MOF is not in direct line of sight to turtle nesting beaches. Light spill from ferries and ROPAX vessels will be low due to their low profile. Use of low pressure sodium and directional lights at the MOF. Direct environmental offsets secured by GLNG will protect significant areas of water mouse habitat on Curtis Island.	Rare	Insignificant	Low
Spill of LNG or other product (e.g. oil) from LNG facility or LNGC, ferry or ROPAX vessel into the water, causing contamination of habitat (including seagrass) for water mouse, turtles and dugong.	Unlikely	Moderate	Medium	LNG will vaporise if spilled and is non-toxic. Minimal oils or other potential pollutants kept on board vessels. LNGCs are dual fuel in design. Spill prevention and response plans in place through GPC and MSQ. Pilot on LNG ships to reduce risk of collision or grounding. The LNG Industry's Indirect Offset Program improves managing agencies' response capabilities for a ship grounding event on the Great Barrier Reef. Disposal of wastes to comply with Queensland guidelines.	Unlikely	Minor	Low

Table 6 Risk assessment of impacts of LNGC activities within sheltered waters of Port Curtis (L=likelihood, C=consequence)

Hazards and potential impacts	L	C	Inherent Risk	Mitigation measures	L	C	Residual risk
Use of designated shipping channels by LNGCs, creating a risk of boat strike for turtles and dugong. Indirect impact from increase in underwater noise and displacement of fauna from foraging grounds.	Possible	Minor	Medium	Low frequency of vessel trips (average of 2.3 ship movements per week), with low incremental increase in ship movements. All vessels will abide by the Port of Gladstone published speed restrictions and exclusion zones set out by all relevant authorities at all times. Ships confined to channel under direction of pilot and assistance of tugs.	Unlikely	Minor	Low
Lighting of ships at night while in transit and adding to sky glow of Gladstone area (disturbing nesting turtles and hatchlings).	Unlikely	Minor	Low	Ships will be constantly moving into or out of port, and thus the duration of any disturbance will be very small. Very infrequent anchoring. Light spill from LNGCs will be minimised while maintaining safety.	Rare	Minor	Low

Hazards and potential impacts	L	C	Inherent Risk	Mitigation measures	L	C	Residual risk
Spill of LNG or other product from ship into the water, causing contamination of habitat (including seagrass) for turtles and dugong. Risk of grounding or collision with another ship within Port Curtis.	Unlikely	Moderate	Medium	LNG will vaporise if spilled and is non-toxic. Minimal oils or other potential pollutants kept on board vessels, as LNG vessels are dual fuel in design. Spill prevention and response plans in place through GPC and MSQ. Disposal of wastes to comply with Queensland guidelines. Pilot on LNGCs to reduce risk of collision or grounding. The LNG Industry Indirect Offset Program improves managing agencies' response capabilities for a ship grounding event on the Great Barrier Reef.	Unlikely	Minor	Low

Table 7 Risk assessment of impacts of LNGC activities within the Great Barrier Reef lagoon (L=likelihood, C=consequence)

Hazards and potential impacts	L	C	Inherent Risk	Mitigation measures	L	C	Residual risk
Transit of LNG ships through the Great Barrier Reef Marine Park, creating a risk of boat strike for turtles or dugong.	Possible	Minor	Medium	Low frequency of vessel trips. Ships confined to Designated Shipping Area and General Use Zone under the Great Barrier Reef Marine Park Zoning Plan.	Rare	Minor	Low
Anchoring of ships at designated anchoring area offshore from Port Curtis, possibly disturbing deep water seagrass and other benthic habitats for EPBC listed species.	Unlikely	Minor	Low	Anchoring only within designated anchoring areas established at the port for LNGCs, minimising disturbance to a localised area. LNGCs will generally move straight into port and, other than during the commissioning phase, will only anchor infrequently.	Rare	Minor	Low
Lighting of ships at night while in transit (disturbing nesting turtles or hatchlings) or while anchored.	Unlikely	Minor	Low	LNGCs will be constantly moving into or out of port, and thus the duration of any disturbance will be very small. Other than during the commissioning phase, very infrequent anchoring offshore.	Rare	Minor	Low

Hazards and potential impacts	L	C	Inherent Risk	Mitigation measures	L	C	Residual risk
Spill of LNG or other product from ship into the water, causing contamination of habitat (including seagrass) for turtles and dugong. Risk of grounding or collision (physical disturbance to habitat of EPBC listed species).	Unlikely	Moderate	Medium	LNG will vaporise if spilled and is non-toxic. Minimal oils or other potential pollutants kept on board vessels, as LNG vessels are dual fuel in design. Spill prevention and response plans in place through GPC and MSQ. Disposal of wastes to comply with Queensland, Australian and international guidelines. Ships under Pilotage through some sections of the Great Barrier Reef, reducing risk of grounding or collision. The LNG Industry Environmental Offset Program improves managing agencies' response capabilities for a ship grounding event on the Great Barrier Reef.	Unlikely	Minor	Low

5.2. Discussion of risks to EPBC Act listed species

The risk assessment identified that prior to the implementation of mitigation measures, shipping related risks from LNGCs, ferry and ROPAX vessel activities to selected EPBC Act listed species and their habitats (as specified in the EPBC Approval) are highest within the inshore areas of Port Curtis, located between Auckland Point and the PLF and MOF at the LNG facility on Curtis Island. This is because shipping activities in the area are:

- adjacent to water depths which are shallow (generally <10 m), increasing the risk of boat strike and the proximity of shipping activities to seagrass habitats and foraging habitat for turtles and dugong;
- adjacent to small patches of water mouse habitat, most of which are located outside of the LNG Facility; and
- more likely to act cumulatively with other commercial and recreational vessels (e.g. passenger ferries, recreational boats and barges).

In the estuarine sections of Port Curtis located east of Auckland Point, water depths are greater and the distance between shipping channels and seagrass and water mouse habitats are larger. The use of pilots on board LNGCs in this area significantly reduces the risk of a grounding or collision.

Offshore from Port Curtis within the Great Barrier Reef lagoon, LNGCs are either leaving the port or arriving at port through the designated shipping channels of the GBRMP. Oceanic waters in these sections are generally much deeper than within Port Curtis, with no estuarine habitats supporting seagrass or water mouse. A designated anchoring area has been established east of Facing Island, which will be used infrequently by LNGCs as they will be given priority entry into Port Curtis upon arrival. Benthic habitats such as deep-water seagrass or soft-bottom communities may be disturbed during any period of infrequent anchoring. Lighting of ships at night while in transit may be directly visible at turtle nesting beaches. Ships will generally be constantly moving into and out of port, and thus the duration of any disturbance will be very small.

Following the implementation of mitigation measures, all environmental risks of GLNG's shipping activities in all three areas are reduced to low. This reflects the low frequency of LNGC activity at the LNG facility (approximately 2.3 LNG cargoes per week once Train 2 is operational), the slow speeds at which LNGCs, ferries and ROPAX vessels will operate adjacent to the most sensitive habitats located at inshore areas (vessels to abide by the Port of Gladstone published speed restrictions and exclusion zones), and the Environmental Management Plans that are already in place to address risks associated with lighting, noise and incident response at the LNG Facility. Further discussion of the specific measures to minimise disturbance to EPBC Act listed species is provided below.

Dugong

Dugongs are an important feature of the marine environmental values of Port Curtis and are highly reliant upon seagrass habitats for foraging. Dugongs have persisted within Port Curtis in numbers of a few hundred, despite the ongoing industrialisation across a range of industries over several decades. There is potential for dugongs to forage near the LNG Facility due to the presence of seagrass meadows nearby.

Hodgson (2004) showed that dugongs were particularly susceptible to interactions with large high speed vessels due to their delayed avoidance response. However, it is expected that dugongs will avoid areas of intense shipping activity within the existing shipping channels. As described in Section 3.1, LNGC's will be towed by tugs typically operating at speeds of six to eight knots in close proximity to inshore areas containing seagrass. Figure 7 illustrates indicative vessel routes in relation to water depths and known seagrass areas. Maintaining a regular watch and adhering to reporting requirements will be implemented to further reduce the potential risk of vessel strike.

When vessels are operating in shallow water close to seagrass beds and within 30 metres of a jetty, wharf, boat ramp or pontoon, a speed limit of six knots applies. Vessels moving at these speeds have a low risk of striking dugongs. Additionally, the small increase in LNGC shipping activity (2.3 LNGs per week on average) will be provide for only a minor incremental increase in the risk of boat strikes. The risk of impacts on dugongs and their habitats is therefore assessed to be low. This is offset by the significant reduction (generally ~80%) in ferry and ROPAX during the operational phase of the LNG facility compared to vessels movements during the construction phase.

The Port of Gladstone is the second largest commercial port in QLD. It is likely that dugongs will therefore be accustomed to noise, vibration and light from a wide variety of vessel types, and the movements of LNGCs, ferries and ROPAX vessels are not anticipated to have any significant incremental impacts on dugongs. As stated above, vessels operating in shallow waters close to seagrass beds will be limited to a speed of six knots which will reduce noise and vibration emanating from vessels in areas where dugongs may be foraging.

Lighting requirements on vessels will be designed to minimise light spill into the water during hours of darkness. However, for safety reasons all vessels will be required to comply with the relevant regulations and MSQ requirements with regards to lighting. No long-term impacts from the LNG Facility on the distribution of dugongs within the area are predicted (GHD 2009).

Turtles

The Gladstone area contains regionally-significant turtle nesting sites and important foraging habitats for a variety of turtle species. As for dugong, the additional risk of boat strike from LNGCs in waters of Port Curtis and offshore within the Great Barrier Reef lagoon is low. While LNGCs will be lit at night for safety, they will only briefly be in the direct line of sight of turtle nesting beaches while in transit through the Great Barrier Reef lagoon. There is potential for marine turtles to be present near the LNG Facility. However, it is expected that turtles will avoid areas of intensive shipping activity. Controlled vessel speeds and adhering to reporting requirements will be implemented to reduce the risk of vessel strikes. Impacts on marine turtle behaviour and breeding are not likely to be significant as the nearest recorded turtle nesting locations are approximately six km to the east on Curtis and Facing Islands. There is no direct line of sight between the LNG Facility and turtle nesting beaches. Lighting at the LNG Facility and from LNGCs, ferries and ROPAX vessels may contribute a small amount of light to the overall sky glow. LNGCs will be lit at night, but will generally move through the area within a few hours, unless anchored, which will occur infrequently.

As described in Section 3, except when in close proximity to terminals or barge facilities, vessels will operate in deep water and will not traverse seagrass areas. When vessels are operating in shallower water where turtles are most likely to be present, vessel speed will generally be limited to between six and eight knots under the assistance of tugs. Vessels moving at these speeds are unlikely to increase the risk of boat strikes on turtles.

The Port of Gladstone is a busy operational waterway, so it is likely that turtles there are accustomed to noise, vibration and light from a wide variety of vessel types. Vessels operating in shallow waters (i.e. within 30 metres of a jetty, wharf, boat ramp or pontoon) will be limited to a speed of six knots, which will reduce noise and vibration emanating from vessels in areas where turtles may be present. Lighting requirements on vessels will be designed to minimise excessive light spill into water during hours of darkness. However, for safety reasons all vessels will be required to comply with the relevant regulation and MSQ requirements with regards to lighting.

A comprehensive Long Term Turtle Management Plan (LTTMP) has been developed by the LNG industry in Gladstone, and provides for detailed monitoring of the potential impacts associated with the construction and operation of the LNG Facility and reporting across a variety of turtle indicators at various life cycle stages. Monitoring initiatives include monitoring night time sky glow, turtle nesting activity, hatchling orientation, flatback turtle inter-nesting habitat utilisation and necropsies to determine the cause of death for carcasses recovered from the area. A control monitoring site at Wild Duck Island has also been established.

Water Mouse
While the water mouse is known to be present in the Curtis Island environment, areas immediately adjacent to the GLNG LNG facility have been intensively surveyed and assessed to provide only marginal habitat suitable for this species. While the water mouse may occasionally use such areas, none have been sighted during dedicated surveys and trapping (BAMM 2012)The potential modes of impact from shipping activities on the water mouse include increased disturbance from noise and lighting during the berthing process, and the creation of wake from vessels, causing disturbance and erosion of foraging and nesting habitats.

When vessels are operating in the vicinity of potential water mouse habitat close to the LNG Facility, speed will be limited to six to eight knots. At this speed vessels will generate minimal wash and therefore no adverse impacts on water mouse habitat are predicted. For LNGCs, bow thrusters will be used to provide sufficient manoeuvrability to safely berth the vessel. Marine infrastructure has been designed to be located away from potential water mouse habitat areas.

The existing controls in place at the LNG Facility under Environmental Management Plans will reduce the impact of light and noise to a minimum. Additional disturbance from noise and lighting produced by LNGCs, ferries and ROPAX vessels will be low in frequency, intensity and geographic scale, and is necessary to maintain the safe navigation of vessels within the inshore Port Curtis environment (in the case of lighting).

Once LNGCs and operational vessels have moved away from the inshore environments where water mouse habitat may occur, the potential impacts are insignificant. GLNG has secured direct offsets on Curtis Island that will provide protection and improved management of higher quality water mouse habitats, resulting in positive environmental outcomes for the species.

Seagrass
Seagrass habitats are an important environmental value of the Port Curtis region, supporting primary production and providing a food and habitat resource for a variety of fauna. Monitoring in recent years has identified that local seagrass assemblages vary in their extent and condition in response to changes in water quality, driven primarily by rainfall. Healthy seagrass assemblages underpin the resilience of the Port Curtis marine environment and contribute to the maintenance of World Heritage values.

LNGCs, ferries and ROPAX vessels will navigate only within the designated shipping channels within the port, where water depths are sufficient to provide a safe clearance between the vessel hull and seabed. Most seagrass habitats of Port Curtis occur in waters much shallower than found within such channels. Sparse patches of seagrass can be expected to appear and disappear in coastal waters immediately adjacent to the LNG Facility, driven by regional trends in water quality arising from varying rainfall and riverine flows. When vessels are operating in shallower water and potentially close to seagrass beds, a vessel speed of six to eight knots will generally apply. At this speed vessels will generate minimal wash and therefore the risk of adverse impacts of wash on seagrass is expected to be low.

On their final approach to and departure from the LNG Facility jetty, navigation of LNGCs will be assisted by tugs . Under such circumstances, particularly at low tide, some resuspension of sediments within the navigation channel can be expected, causing a temporary and localised increase in turbidity. The scale of such effects is likely to be insignificant, both spatially and temporally.

Spill prevention and response procedures are common for all marine vessels and will minimise the likelihood and severity of a spill event, which could cause local contamination of seagrass habitats. When compared with the existing shipping traffic within the Port Curtis region, an additional 2.3 LNGs per week represents a minor incremental increase in the risk of a spill event offset by the reduction in the number of other operational vessels compared to the construction phase of the LNG Facility.

To minimise risk of grounding within seagrass areas, LNGCs will use existing navigation channels and be under Pilotage while in restricted waters. In order to minimise the impact of anchoring in seagrass areas, LNGCs will be restricted to designated anchorages specified by GPC.

6. Mitigation Measures and Controls

This section describes the mitigation measures and controls that will be implemented to minimise the impacts of shipping activities, associated with the operation of the LNG facility (i.e. OSAMP Phases I and II), on the sensitive environmental receptors identified in Section 4, based on the results of the Risk Assessment in Section 5.

Mitigation measures and controls for shipping activities during the construction phase of the LNG Facility are outlined in the construction-phase SAMP (GLNG 2013). These management measures have been approved by the Department. The following sections provide a description of mitigation and control measures directly applicable to operational phase shipping activities.

6.1. Vessel Strike

All LNGCs will be towed by tugs and use approved navigation channels. The risk of boat strike on turtles and dugong is likely to be low within the existing deep channels specified for LNGC activity. Navigation routes within specified channels will be selected based on the location and dimension of the shipping channel, dimensions of the vessel, tide, weather conditions, other marine activities in the area and navigational hazards. Safety is the key factor influencing selection of the route by the pilots. The selection of routes that have the maximum clearance from the bottom of the vessel to achieve navigational safety is generally best for minimising interaction with marine fauna.

All vessels (LNGCs, ferries and ROPAXs) will abide by the Port of Gladstone published speed restrictions and exclusion zones set out by all relevant authorities at all times. GLNG will contribute to any process to assess improvements to speed management of vessels in Gladstone Harbour. LNGCs will be travelling at slow speeds (six to eight knots) through inshore areas where the risk of boat strike is likely to be highest. When vessels are operating in shallow water sections of the shipping route and within 30 metres of a jetty, wharf, boat ramp or pontoon, a speed limit of six knots applies to all vessels.

Several purpose built ferries have engineered design such as water jet propulsion systems, shallow draughts and have forward looking infra-red cameras installed to minimise the potential impact of the ferries on sensitive environmental receptors. All ROPAX vessels are shallow draught and are relatively slow moving (12 knots or less).

Procedures for monitoring of fauna and reporting of incidents will be implemented. If a LNGC, ferry or ROPAX accidentally injures or kills a dugong or turtle, the Master or another appropriate representative must report it as soon as practicable to the Department of Environment and Heritage Protection Hotline (1300 130 372) and to the GLNG Downstream Operations Manager who will ensure formal notification is undertaken for EPBC Act listed species to the Department of the Environment within five business days.

6.2. Fuel, Oil or Chemical Spill

In general, Maritime Safety Queensland (MSQ) is the statutory and combat agency for all ship-sourced spills in Queensland Waters. Initial response to fuel, oil or chemical spills will be undertaken by GPC in accordance with *Section 12: Emergency - pollution - marine incidents of Maritime Safety Queensland's Port Procedures for Gladstone*, the First Strike Oil Spill Response Plan (MSQ 2014) and as subsequently directed by the Port of Gladstone Harbour Master. An incident control team will be assembled by the responsible agencies and scaled up or down as required in response to the scale of the incident.

If LNG is spilled into the ocean, it will quickly reach ambient temperature and form a gas. The environmental consequences of any spill are therefore very minor. Individual vessel operators are required to have a spill avoidance and response plan for operating in Gladstone Harbour and all spill plans are subject to review and approval by the GPC.
In the event of a spill associated with an LNGC, the following procedures will be initiated:

- Marine Superintendent immediately notifies by radio the Vessel Traffic Service (VTS) which is operated by MSQ.
- VTS notifies the Harbour Master.
- Marine Superintendent notifies GPC First Strike Oil Response if required. If the spill is LNG, it will simply vaporise as it approaches ambient temperature on contact with the water. However, in the event that the scenario involves loss of containment of other contaminants, a GPC First Strike Oil Response team will be initiated. GLNG will also have spill containment capabilities at its marine facilities to be implemented following consultation with the GPC First Strike Oil Response.
- At the same time the Central Control Room is notified.

- From this point all communications are channelled through Central Control Room, which coordinates the response. All stakeholders will be in communication via the Central Control Room.
- Pressure sensors automatically shut off the loading operation if required.
- In the unlikely event that this system fails, the process can be shut down from the Central Control Room.
- A standby tug will be present in close proximity to the LNGC with fire-fighting capability.
- An exclusion zone around the spill will be maintained.

There will be regular checks of the LNG loading pipeline for leaks, testing of emergency and shutdown systems, inspection and maintenance of hydraulic hoses, as well as permanent concrete bunding around areas susceptible to spills from the loading arms and standby generator.

In the event of a spill associated with a ferry or ROPAX vessel, the following procedures will be initiated:

- Marine Superintendent immediately notifies by radio the Vessel Traffic Service (VTS) which is operated by MSQ.
- VTS notifies the Harbour Master.
- Marine Superintendent notifies GPC First Strike Oil Response if required. A GPC First Strike Oil Response team will be initiated. GLNG will also have spill containment capabilities at its marine facilities to be implemented following consultation with the GPC First Strike Oil Response.
- At the same time the Central Control Room is notified.
- From this point all communications are channelled through Central Control Room, which coordinates the response. All stakeholders will be in communication via the Central Control Room.
- An exclusion zone around the spill will be maintained.

6.3. Marine Discharges

Marine discharges will be managed in accordance with applicable international conventions, Australian and Queensland legislation and regulations, and Port of Gladstone procedures, including but not limited to:

- *Quarantine Act 1908;*
- *International Convention for the Prevention of Pollution from Ships 1973 and the 1978 Protocol;*
- *(MARPOL 73/78) (see Management actions applied to shipping in the Great Barrier Reef);*
- *Protection of the Sea (Prevention of Pollution) from Ships Act 1983;*
- *Protection of the Sea (Powers of Intervention) Act 1981;*
- *Protection of the Sea (Civil Liability) Act 1981;*
- *Great Barrier Reef Marine Park Act 1975;*
- *Great Barrier Reef Marine Park Regulations 1983;*
- *Transport Operations (Marine Pollution) Act 1995;*
- *Environment Protection and Biodiversity Conservation Act 1999;* and
- *Environment Protection (Sea Dumping) Act 1981.*

All foreign vessels coming from international waters must comply with Australia's ballast water management requirements enforced under the *Quarantine Act 1908*. An effective program for the safe removal and disposal of sewage will be implemented. Vessels will not be allowed to discharge treated or untreated sewage into the water. Anchoring of vessels will be restricted to designated anchorages specified by Gladstone Ports Corporation.

6.4. Light and Sound from Vessels

For safety reasons all vessels will be required to comply with relevant regulations and MSQ requirements with regard to lighting. Lighting of vessels while at the PLF or MOF will be the minimum required to meet safety and operational requirements. Excessive lighting will be avoided.

A marine flare will dispose of any flashed LNG vapours generated from the LNG storage tanks and during the LNGC loading process. This may create additional sources of light at the LNG facility, if flaring activity occurs at night.

Similarly, noise sources associated with shipping activities are not qualitatively different from existing noise sources from any large scale commercial port facility. The increase over the existing noise levels in Port Curtis as a result of the increase in LNGC numbers is a minor and offset by the reduction in ferry and ROPX vessel movements. LNGC loading operations will occur 24 hours a day. The loading schedule is dependent on many variables such as LNG production rate, shipping schedules and weather conditions. Operating in deep-water channels and reducing vessel speeds will reduce noise emissions from LNGCs, ferries and RPOX vessels.

6.5. Vessel Movements Including the Use of Thrusters

LNGC and operational ferry and ROPAX vessel movements will typically occur along the routes outlined in Figure 1. These routes are indicative only and may vary due to factors including but not limited to tidal or meteorological conditions, the presence of other harbour traffic, the requirements of the Gladstone Harbour Master, vessel type, and further refinement of Project planning.

Given the limited extent of seagrass in proximity to the proposed vessel routes within Port of Gladstone, and the absence of confirmed water mouse presence along the foreshore in the immediate vicinity of the LNG Facility, no limits on use of bow thrusters, if available, are proposed other than standard requirements of MSQ and the Gladstone Harbour Master.

A small area of *Halophila ovalis* seagrass has recently been identified near the PLF (Bryant *et al*. 2013). *H. ovalis* is an early colonising species that often inhabits inshore waters which are subject to regular disturbance (Birch and Birch 1984). The inshore channels leading to the LNG Facility have small areas of sparse seagrass (PCIMP, 2013), which can be expected to disappear and re-establish in response to changes in water quality conditions. The slow speeds at which all vessels will operate in close proximity to the jetty at either the PLF or MOF, in conjunction with the deep water within dredged channels, will minimise any impacts on seagrass meadows on adjacent tidal and sub-tidal soft-bottom habitats.

6.6. Great Barrier Reef and Torres Strait Vessel Traffic Service (REEFVTS)

The Queensland and Australian Governments established the Great Barrier Reef and Torres Strait Vessel Traffic Service (REEFVTS) to:

- Enhance navigational safety in Torres Strait and the inner route of the Great Barrier Reef by interacting with shipping to provide information on potential traffic conflicts and other navigational information;
- Minimise the risk of a maritime accident and consequential ship-sourced pollution and damage to the marine environment in the Torres Strait and Great Barrier Reef region; and
- Provide an ability to respond more quickly in the event of any safety or pollution incident.

REEFVTS is operated under joint Australian and Queensland Government arrangements between the AMSA and MSQ. Vessel Traffic Services are recognised internationally as a navigational safety measure through the International Convention on the Safety of Life at Sea 74/78 (SOLAS Convention). LNGCs will report through REEFVTS while in the REEFVTS Area. The REEFVTS service will reduce the likelihood of a ship grounding or marine incident.

6.7. Ship Vetting and Auditing

GLNG is committed to ensuring that all LNG cargoes which are loaded at its terminal are carried safely, and with the minimum risk to people, infrastructure, and the environment. GLNG has employed or contracted a group of specialized experienced mariners to provide marine assurance for all GLNG marine activities.

GLNG will utilise the Oil Companies International Marine Forum (OCIMF) Ship Inspection Report Program (SIRE) risk assessment system to complete ship vetting assessments to assess suitability of vessels to load at the GLNG Terminal. This auditing process will provide an additional measure to reduce the risk of a marine grounding or incident.

The service provider engaged for the provision of ferry and ROPAX services is required to operate in accordance with this Operational Shipping Activities Management Plan and in accordance with GLNG's environmental approval requirements.

6.8. Environmental Offsets

The LNG Proponents (GLNG, QCLNG and APLNG) have committed to a range of environmental offsets which satisfy requirements of their respective approval conditions at both a State and Commonwealth level. Collaborative delivery and funding of the environmental offsets has been agreed by the three LNG proponents to simplify the offsets process and maximise environmental outcomes that can be achieved. Details of the projects which are relevant to the offsetting of low levels of environmental impact associated with shipping activities for the LNG Facility are described in the following sections.

Monte Christo Offset Proposal
The LNG proponents have acquired and propose to surrender to the State legal interests over a significant area of Curtis Island known as the Monte Christo property as well as grazing permits within the Curtis Island State Forest. The Montel Christo property is located approximately 15 km north of the LNG Facility and is located wholly within the Great Barrier Reef World Heritage Area.

The Monte Christo property is expected to be dedicated as Regional Park by the Queensland Government, while the nearby Regional Park is expected to be upgraded to National Park following the removal of grazing. Sections of the Curtis Island Environmental Management Precinct will also be dedicated as National Park and Regional Park, and funding has been arranged for management of the new protected area estate (and others already existing on Curtis Island).

Areas affected by the proposed offset and their adjacent intertidal lands contain approximately 10,100 ha of habitat suitable for the water mouse (Ecofund 2013). The offset will result in the indirect protection of water mouse habitat and allow such areas to be managed by the Department of National Parks, Recreation, Sport and Racing under an island wide management program. Such benefits will significantly outweigh the impacts on water mouse (assessed as low risk) that may result from shipping activities associated with the LNG Facility.

LNG Industry Indirect Offset Program
GLNG and the other LNG proponents on Curtis Island have developed an LNG Industry Indirect Offset Program to offset the increased risks to biodiversity values of the World Heritage Area from the LNG Facility, including increased shipping activity and water quality impacts. The program is required under Condition 15 (c) of EPBC Approval 2008/4057 and involves financial contributions to the Great Barrier Reef Marine Park Authority (through the Australian Government Reef Trust) to address the environmental risks associated with the increased shipping activities associated with the construction and operation of the LNG Facility.

Projects and initiatives that will be funded under the Indirect Offset Program and are relevant to offsetting the potential impacts of shipping activities associated with the LNG Facility include:

- Appoint an Environmental Incident Coordinator within the Great Barrier Reef Field Management Program to build the capacity of the Great Barrier Reef Field Management team to respond to potential shipping incidents in the Mackay/Capricorn region. While actions will concentrate on shipping activities connected to Curtis Island LNG developments, funding will also be made available for response to an emergency anywhere within the Great Barrier Reef Marine Park.
- Maintain and improve turtle nesting sites within the Capricorn Bunker Group of islands, Swain Reef and Gladstone coastal areas.

6.9. Remedial Action in Event of Impacts

Apart from the response to marine spills as outlined above, remedial action in the event of incidents will be determined on a case by case basis subject to the nature and extent of impact. Additionally, if monitoring measures, as outlined in section 7 below, indicate impact to species specified in condition 13(a) and the habitats identified in condition 13 (b) from shipping activities remedial actions will be determined and undertaken subject to the nature and extent of the impact identified. Examples of potential remedial actions include a review of existing mitigation measures and implementation of additional monitoring activities to determine the effectiveness of enhanced measures.

7. Monitoring Measures

This section summarises the monitoring activities associated with dugong, seagrass and turtles, as required under Condition 13(e) of EPBC Act Approval 2008/4058. This OSAMP (Phases I and II) does not propose any monitoring measures specific to the potential impact of shipping activities on the water mouse, as there are no predicted mechanisms for impact on this species.

GLNG currently provides funding for several long term ecosystem research and monitoring programs within Port Curtis that are relevant to this OSAMP. These include:

- GPC's Ecosystem Research and Monitoring Program (ERMP); and
- LNG Industry LTTMP.

The ERMP and LTTMP are long-term plans that include monitoring of marine megafauna and seagrass health in Port Curtis and surrounding environs. Details of monitoring methodology and frequency are located at:

http://www.westernbasinportdevelopment.com.au/ermp/section/environmental; and

http://www.santosglng.com/media/pdf4699/long_term_turtle_management_plan.pdf

A summary of long-term monitoring activities for seagrass, dugong and marine turtles of particular relevance to shipping activities is as follows:

- Ongoing examination of turtle carcasses to determine cause of death, with a particular focus on boat strike for a period of up to 10 years (LTTMP);
- Monitoring of nesting turtles annually, night time sky glow every two years and at milestones in the project and hatchling dispersion behaviour annually in response to LNG activities (LTTMP and ERMP);
- Annual satellite tracking of inter-nesting flatback turtles for five years to determine habitat use in relation to shipping channels (LTTMP);
- Tracking of foraging turtles within Port Curtis for a minimum of three years to determine home ranges for foraging (LTTMP)
- Seagrass monitoring, including updating of existing data, selection of new sites and establishing a meta-population model, incorporating stress indicators (ERMP, LTTMP and PCIMP); and
- Dugong satellite and acoustic tagging (ERMP).

Collectively, these monitoring initiatives provide a comprehensive basis to verify the conclusions of the risk assessment and if necessary, identify any additional impacts requiring new mitigation measures for implementation. The ERMP and LTTMP involve regular reporting to the Department, and technical oversight by qualified scientific experts.

7.1. Reporting

The results of monitoring activities for the LTTMP will be summarised and reported each year in accordance with EPBC Approval 2008/4057 (development of a LNG liquefaction park). GPC is responsible for reporting the results of the ERMP.

In accordance with EPBC Approval 2008/4058, an Annual Return will be prepared each year reporting on non-compliances (including in relation to the implementation of this plan), records of any unavoidable adverse impacts on MNES, mitigation measures applied to avoid adverse impacts on MNES and any rehabilitation work undertaken in connection with any unavoidable adverse impact on MNES.

References

AMSA (2014). North East Shipping Management Plan. Australian Maritime Safety Authority.

AMSA (2014). Queensland Coastal Passage Plan. Australian Maritime Safety Authority.

Aurecon (2012) Human and Wildlife Interaction Report - 6 month progress report to DERM for the WICET Project. Report prepared for WICET Pty Ltd.

BAAM (2012). Water Mouse Survey – GLNG Facility Curtis Island. Report prepared for URS Australia, 15 pp.
http://www.santosglng.com/media/pdf1853/water_mouse_management_plan.pdf

Birch WR, Birch M (1984). Succession and pattern of tropical intertidal seagrasses in Cockle Bay, Queensland, Australia: a decade of observations. Aquatic Botany 19: 343-367.

Bryant CV, Davies JD, Jarvis, JC, Tol, S, Rasheed MA (2013). Seagrasses in Port Curtis and Rodds Bay 2013 - Annual Long Term Monitoring, Biannual Western Basin Surveys and Updated Baseline Survey. Report 14/23.

Chartrand, KM, Rasheed, MA and Unsworth, RKF. (2009), "Long Term Seagrass Monitoring in Port Curtis and Rodds Bay, November 2008", DEEDI Publication PRO9-4407.

DEHP (2014). Marine Strandings Update 2013. Department of Environment and Heritage Protection. https://www.ehp.qld.gov.au/wildlife/caring-for-wildlife/marine-strandings-update2013.html Accessed 24/9/14.

DEWHA (2009) "Background paper to EPBC Act Policy Statement 3.20 – Significant impact guidelines for the vulnerable water mouse *Xeromys myoides"*, Department of Sustainability, Environment, Water, Population and Communities.

Ecofund (2013). Monte Christo Offset Proposal. Prepared on behalf of Santos GLNG, APLNG and QCLNG, 290 pp.
http://www.santosglng.com/media/pdf4700/monte_christo_report_-_copy.pdf

GHD (2009). Western Basin Dredging and Disposal Project, Environmental Impact Statement. GHD, Gladstone.

GHD (2011) Report for QCLNG The Narrows Crossing Project - Pre clearance Survey Report. Report prepared for Queensland Gas Company

GHD (2012) Yarwun Coal Terminal Project - Initial Advice Statement (April 2012). Report prepared for Tenement to Terminal Ltd.

GLNG (2013) Shipping Activity Management Plan Phase III - GLNG Plant Project. Revision 7 dated 31 July 2013, 34 pp.

Grech A Marsh H (2007), “Prioritising areas for dugong conservation in marine protected area using a spatially explicit population model”, Applied GIS 3(2):1 – 14.

Hodgson AJ (2004), “Dugong behaviour and responses to human influences”, PhD thesis, School of Tropical Environment Studies and Geography, James Cook University, Townsville, Australia.

Hudson L (2009), “Underwater noise impact assessment – Gladstone LNG Project”, L Hudson & Associates Pty Ltd.

Lee Long WJ, Mellors JE & Coles RG (1993). ‘Seagrasses between Cape York and Hervey Bay’, Queensland Australia’, Australian Journal of Marine and Freshwater Research, 44(1): 19-31.

Lewis S, Hewitt . & Melzer A (2001), “Port survey for introduced pests – Port Curtis, Final Report”, Centre of Environmental Management, Central Queensland University.

Limpus CJ (1999), “Distribution of Flatback Turtle nesting in Central-southern Queensland: 1998-1999 Breeding Season”, Unpublished report to the Gladstone Port Authority and Queensland Parks and Wildlife Service.

Limpus CJ (2007), “A biological review of Australian marine turtle species. 5. Flatback Turtle (*Natator depressus*) (Garman)”, Queensland Environmental Protection Agency.

Limpus CJ (2008). A biological review of Australian marine turtles. 2. Green turtle, Chelonia mydas (Linnaeus). Brisbane: Queensland Environmental Protection Agency.

Limpus CJ, Parmenter CJ, Limpus DJ (2002). The status of flatback turtle in Eastern Australia. Proceedings of the 20th Annual Symposium on Sea Turtle Biology and Conservation. Orlando Florida: NOAA Technical Memo NMFS-SEFSC 477:140-142.Marsh HD & Lawler IR (2006), “Dugong distribution and abundance on the urban coast of Queensland: a basis for management”, James Cook University, Vic, 27 Aug-1 Sept 2006.

McKenzie L, Collier C, Waycott M, Unsworth R, Yoshida R & Smith N (2012). Monitoring inshore seagrasses of the Great Barrier Reef and responses to water quality. Proceedings of the 12th International Coral Reef Symposium, Cairns, Australia, 9-13 July 2012. 15B Seagrasses and seagrass ecosystems.

MSQ (2014). Port of Gladstone First Strike Oil Spill Response Plan, Maritime Safety Queensland, 11 pp.

QCLNG (2014), “Long-Term Turtle Management Plan, LNG Facilities – Curtis Island, Gladstone”, Revision 3 dated May 2014

Queensland Department of Environment and Heritage & Gladstone Ports Authority (1994), “Curtis Coast Study Resource Report”, Queensland Department of Environment and Heritage, Rockhampton.

Queensland Museum (2012) Recent Xeromys myoides records for Gladstone region communicated in email to Sandra Walters (Aurecon) (June 21 2012).

Rasheed MA, Thomas R, Roelofs AJ, Neil KM & Kerville SP (2003), "Port Curtis and Rodds Bay Seagrass and Benthic Macro Invertebrate Community Baseline Survey, November/December 2022", DPI Information Series QI03058 Department of Primary Industries and Fisheries, Queensland.

Rasheed MA, McKenna SA, Taylor HA & Sankey TL (2008). 'Long term seagrass monitoring in Port Curtis and Rodds Bay', Gladstone – October 2007, DPI&F Publication PR07- 3271 (DPI&F, Cairns), 32 pp.

Sankey TL, McCormack CV and Rasheed MA (2012). Gladstone permanent transect seagrass monitoring. Department of Agriculture, Fisheries and Forestry, 13 pp.

Schell C (2013), "GLNG Gas Transmission Pipeline Significant Species Management Plan", document Number: 3380-GLNG-4-1.3-0104 (Rev T), Auecon.

Sobtzick S, Grech A, Coles R, Cagnazzi D, Marsh H (2013). Status of the dugong population in the Gladstone area. Project CA 120017: Monitoring of Dugongs. Report 13/07, April 2013.

Sperling JB, Grigg GC, Limpus CJ (2010). Diving behaviour in two distinct populations of gravid flatback turtles, *Natator depressus*. Australian Zoologist 35: 291-306.

Taylor B & Abbott A (2010). "Water mouse survey and habitat assessment – Santos GLNG Curtis Inland LNG Facility", Biodiversity Assessment and Management Pty Ltd.

Taylor HA, Rasheed MA & Thomas R (2006). 'Port Curtis post oil spill seagrass assessment, Gladstone - February 2006', DPI&F Information Series QI06046 (DPI&F, Cairns), 19 pp.

Taylor HA, Rasheed MA, Dew K & Sankey TL (2007). 'Long term seagrass monitoring in Port Curtis and Rodds Bay, Gladstone – November 2006'. DPI&F Publication PR07- 2774 (DPI&F, Cairns), 30 pp.

Thomas R, Unsworth RKF and Rasheed MA (2010). Seagrasses of Port Curtis and Rodds Bay and long term seagrass monitoring, November 2009. (DEEDI, Cairns).

Transport and Main Roads (2012), "Port Procedures and Information for Shipping Port of Gladstone", http://www.msq.qld.gov.au/Shipping/Port-procedures/Port-procedures-gladstone.aspx

Worley Parsons (2011) SEWPaC Pre-Clearance Survey Report Curtis Island LNG Facility Site (18 May 2011). Report prepared for APLNG