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Gladstone Ports Corporation

Report for Western Basin Dredging and Disposal Project

Matters of National Environmental Significance

September 2009

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Figure Index

Appendices

1. Introduction

1.1 Project Background

The Project Area is situated in the Port of Gladstone 10 kilometres (km) north of Gladstone City. Gladstone is located on the eastern seaboard of Australia, approximately 525 km north of Brisbane and 100 km south of Rockhampton on the Capricorn Coast of Central Queensland (Figure 1).

Approval for dredging and dredged material disposal is sought to support the progressive development of the harbour through provision of access to port facilities, which will be a key component of the import and export chain and will assist in developing industries, specifically the Liquefied Natural Gas (LNG) industry that is to be located within the Gladstone region. In line with Draft Port of Gladstone Western Basin Master Plan (Coordinator General 2009), two areas of development are required for the long-term strategic development of the Port and are the subject of this EIS:

- The inner harbour dredging associated with deepening and widening of existing channels and swing basins, the creation of new channels, new swing basins and berth pockets; and
- The disposal of dredged material in the Western Basin Reclamation Area which is adjacent to the existing Fisherman's Landing Reclamation and the proposed Fisherman's Landing Northern Expansion.

By encompassing all predicted dredging and dredged material disposal requirements for the Port of Gladstone envisaged to enable the development of industries in the Port of Gladstone, the Western Basin Dredging and Disposal Project (this EIS) seeks to provide a cumulative impact assessment of these activities to a greater extent than would be possible should each individual development attempt this assessment independently.

1.1.1 Dredging Stages

Table 1 summarises the proposed dredging stages for the Western Basin Dredging and Disposal Project. These are shown on Figure 1. Each Dredging Stage is required to either support various LNG proponents (Stages 1A, 1B and 2) or future import or export facilities for as yet unidentified proponents and/or GPC (Stages 3 and 4). The current EIS addresses all dredging stages and overall footprint of development to provide a cumulative assessment of potential impacts.

Table 1 Proposed Dredging Stages for the Project

Dredging Stage	Description	Volume
Stage 1A	North China Bay Industry Precinct	16 million m^3
Stage 1B	Fisherman's Landing LNG	6.1 million m^3
Stage 2	Laird Point	4.5 million m^3
Stage 3	Fisherman's Landing Development	5.5 million m^3
Stage 4	Hamilton Point	3.9 million m^3

1.1.2 Western Basin Reclamation Area

Material dredged during the development of the Western Basin of the Port of Gladstone is proposed to be placed into a bunded Reclamation Area (Figure 1). The proposed Western Basin Reclamation Area is 10 km north of Gladstone City immediately adjacent to the existing Fisherman's Landing Reclamation and proposed Fisherman's Landing Northern Expansion, which is the subject of a separate EIS. The construction of the Western Basin Reclamation Area requires the construction of a bund wall, followed by progressive infilling with dredged material and stabilisation of the surface.

The reclamation areas and volumes are shown in Table 2 as follows:

Table 2 Reclamation Areas and Volumes

Reclamation Area	Footprint	Volume
Fisherman's Landing Northern Expansion (separate EIS)	173.5 ha	10 million m^3
Western Basin Reclamation Area	235 ha	45 million m^3
Total	408.5 ha	55 million m^3

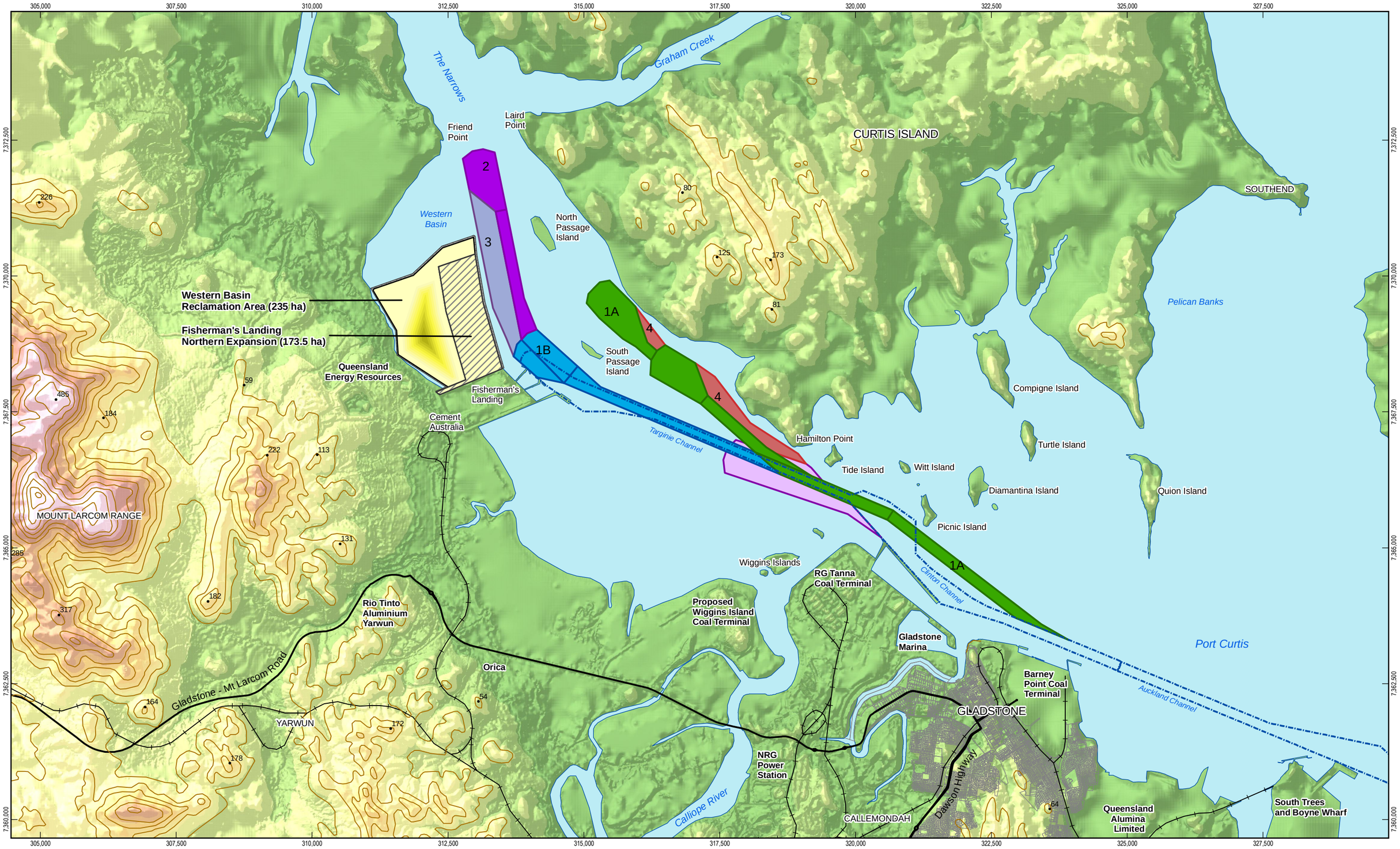
The volume available in the reclamation makes allowance for a substantial volume of maintenance dredging material over the life of the project.

1.2 Controlling Provisions

The Western Basin Dredging and Disposal Project was determined to be a controlled action under the under the EPBC Act on 18 June 2009 (EPBC 2009/4904, Appendix A). The controlling provisions for the Project under the Act are:

- Sections 12 and 15A (World heritage properties);
- Sections 15B and 15C (National heritage place);
- Sections 18 and 18A (Listed threatened species and communities); and
- Sections 20 and 20A (Listed migratory species).

How the project relates to each of these matters is described in this document.



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0 0.5 1 1.5 2 2.5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Elevation Spot Height (metres ASL)
- Elevation Contour (50m interval)
- Railway
- Major Road
- Western Basin Reclamation Area
- Fisherman's Landing Northern Expansion
- Built Up Area
- Existing Channels, Swing Basins and Berths
- Wiggins Island Coal Terminal (Approved)

Proposed Dredging Stages

- Stage 1A - North China Bay LNG Precinct
- Stage 1B - Fisherman's Landing LNG
- Stage 2 - Laird Point LNG
- Stage 3 - Fisherman's Landing
- Stage 4 - Hamilton Point

Port of Gladstone

Western Basin Dredging and Disposal Project

Location of the Proposed Dredging Stages and Reclamation for the Western Basin Dredging and Disposal Project

Job Number	42-15386
Revision	A
Date	30 Aug 2009

Figure 1

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2. Impacts on World Heritage Properties

World Heritage properties are those properties listed under UNESCO's "Convention Concerning the Protection of the World Cultural and Natural Heritage". They include areas of splendid natural and anthropogenic beauty, and are defined as being of outstanding value to humanity. Australia currently possesses 17 World Heritage properties. This includes the Great Barrier Reef World Heritage Area (GBRWHA), which extends to the mean low water mark along the coast. The Project will, therefore, occur within the GBRWHA.

The Project will consequently occur wholly within the Great Barrier Reef World Heritage Area (GBRWHA) which was inscribed on the World Heritage List in 1981 (DEWHA, 2008). The GBRWHA is protected under the International Treaty-Convention concerning the Protection of the World Cultural and National Heritage, adopted by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The GBRWHA is defined by the following four UNESCO criteria:

- (VII) Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
- (VIII) Outstanding example representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
- (IX) Outstanding example representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals; and
- (X) Contains 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.

Direct, indirect, permanent and temporary impacts on the benthic marine systems within the GBRWHA are anticipated from construction and operation of the Project. The majority of the impacts involve the permanent removal of an area (approximately 235 ha) of intertidal and subtidal habitat within the Western Basin Reclamation Area. In addition, a range of temporary impacts are expected as a result of construction activities, including dredge plume impacts, disturbance to the marine benthos and noise impacts.

Expected, probable and potential impacts have been assessed and described under the main EIS. Appropriate mitigation and management measures for identified impacts have also been developed. These include the use of offsets against permanent habitat removal as well as dredge management approaches to reduce water quality impacts and pollution potential. With identified mitigation measures in place the Project is expected to have an impact on the marine ecological values of the Gladstone region. Impacts to the natural beauty of the GBRMP are not expected as the development will blend within the existing industrial landscape of Gladstone. Detail regarding all potential impacts from the Project is described throughout this document. Specific impacts on the World Heritage Properties are described here.

2.1 Impact to Habitats

Ecology information of relevance to the Project across marine and terrestrial systems has been collated through a focussed desktop assessment of available information (including Government agencies databases) and from the results of baseline ecological surveys. The surveys were designed to collect information that enhanced the existing knowledge of systems occurring within and adjacent to the Project Study Area and the communities they support. A detailed description of the marine ecology of the region is provided in Section 9.3 and Appendix Q of the main EIS.

The Port of Gladstone has experienced ongoing development since the beginning of the twentieth century. Given the significance of industry to the Gladstone region, Port Curtis has experienced a history of coastal development for shipping and the waters of Port Curtis are subject to high volumes of vessel traffic and coastal infrastructure.

The marine environment within the Project Area is characterised by a heterogenous habitat matrix of soft-sediment, rocky reef, coral, seagrass and algae with highly variable water depths partitioned by islands, mud banks and channels. The Project Area of Western Basin is a relatively shallow embayment and is predominantly protected by Curtis and Facing Islands to the south east. To the north of the Project site, the marine environment contracts to form a system of creeks, mud flats and mangrove habitats, and is known as 'The Narrows'. The channels, adjacent to the Project Area, are relatively deep (to approximately 20 m) but narrow, being buffered by steep channel edges and shallow soft sediment habitats.

Despite the naturally high turbidity and sediment loads within the Project Area, seagrass occurs throughout most of Western Basin at densities that vary seasonally and between years (Rasheed *et al*. 2008, Chartrand *et al*. 2009). The extensive seagrass beds provide a direct and indirect foraging habitat for numerous key marine fauna species. The waters within Port Curtis provide a habitat that has been frequently observed to support a resident marine turtle population as well as dugong and dolphin species on a semi-permanent basis (I. Bell, pers. comm. 2009).

The existing seagrass meadows, and supported populations, currently occupy habitats in close proximity to port facilities demonstrating these assemblages persist under existing port operational conditions. However, as dredging and reclamation have both direct and indirect impacts on seagrass and benthic assemblages the implementation of this dredging and reclamation project in addition to current port practices will have a cumulative impact on these communities.

Construction of the Project will result in marked disturbance of the marine benthic habitats within the Project Area. The key impact on benthic habitats will be through reclamation of tidal seabed. A rock bund wall will be established prior to deposition of dredged material into the Reclamation Area. Geotextile fabric liner of the bund will be used to decrease potential leaching of material through the bund wall, thereby decreasing potential water quality impacts. Impacts to water quality are, however, expected. Cutter suction and trailer suction dredgers will place material into the Reclamation Area, with turbid plumes most likely to be associated with the trailer suction dredger works. Double handling of dredged material requiring bottom dumping of the material prior to placement within the Reclamation Area is also required. Plumes will be generated from this activity and may also eventuate from management of decant from the Reclamation Area.

The primary impacts identified for the project are the removal of benthic habitat (including seagrass meadows, algal beds and macroinvertebrates), declines in water quality associated with construction and dredging events, the flow on affects to the benthic habitats from declines in water quality and potential

impacts to marine megafauna from water quality impacts and vessel operations. The impacts on marine ecological values expected to result from the Project, either during construction and/or operation, therefore include:

The impacts on marine ecological values expected to result from the Project, either during construction and/or operation, include:

- Direct impacts (both potential and probable):
  - Removal or damage to the benthos and individual organisms from bund construction, dredging and pile driving works, including smothering of taxa;
  - Removal of foraging and/or inter-nesting habitat for marine turtle species, dugong and coastal dolphins;
  - Alteration of benthic habitat type from soft sediment to coarse/clay/hard substrate;
  - Alteration of benthic habitat type from intertidal to subtidal substrate;
  - Damage to individual organisms from direct contact related to construction activities, including trapping within bund when bund is closed;
  - Impact to fauna by boat strike from dredge and/or construction vessels;
  - Disturbance and displacement of marine fauna from increased noise and/or activity during construction and dredging on the local area;
  - Decreases in water quality from dredging, construction, spills of fuel or other hydrocarbons or other pollutants (animal wastes, paints, solvents and cleaners, etc.);
  - Increased rubbish that may be ingested or entangle marine fauna;
  - Introduction of marine pests to the Port and/or adjacent marine environment, including the GBRMP;
  - Alteration of sediment and water quality at the reclamation site by the introduction of contaminants or PASS;
  - Land use change resulting in loss of benthic primary producer habitat and fisheries resources; and
  - Interruption of recreational and other vessel traffic movement patterns.
- Indirect impacts (both potential and probable):
  - Decreased water quality from altered siltation/sedimentation regimes, alteration of stormwater input, and tailwater management, and an increase in pollutants as a result of construction waste or land use changes;
  - Conflict between commercial and recreational activities as a result of land use change leading to additive pressures on the adjacent marine systems;
  - Impact on subtidal and intertidal benthos (including mangrove communities) from changes in the hydrodynamic regime resulting in sedimentation, scouring, longer durations of wetting, increased/decreased flow rates; and
  - Noise, vibration and light impacts to marine reptiles and mammals from in-water construction or ongoing operational activities.

Seagrass communities are recognised as important ecosystems for maintenance of seabed stability, water quality and biodiversity (Collier and Waycott, 2009). In addition to their intrinsic value, seagrasses

are known to act as nursery grounds for juvenile fish, which may be targeted by commercial and recreational fishers, or be an important food source for other fish and megafauna species. Seagrasses are also an integral food for marine megafauna including turtles and dugongs. As such, the seagrass meadows, and the associated benthic macroinvertebrate communities that will be directly affected by the construction of the Project should be considered to be of high ecological value.

The proposed Project reclamation activities are directly adjacent to the proposed Fisherman's Landing Northern Expansion. This increases the cumulative impacts on the marine flora and fauna in the immediate area and could result in a decline in species diversity, removal of species or reduced use of the area by marine fauna. It is noted however; that there are extensive seagrass beds supporting the same or similar seagrass beds and benthic assemblages throughout the wider region as well as in close proximity to the Fisherman's Landing seagrass beds. Therefore, the loss of some or all of the Fisherman's Landing seagrass beds is not anticipated to affect the presence of these species. It may, however, reduce the prevalence of assemblages within Port Curtis as the carrying capacity of seagrass meadows in this area are not well understood and may be at their upper limits.

Mitigation measures proposed to manage potential impacts resulting from construction and operation of the Project have been assessed and established. These include:

- Minimisation of proposed project footprint (as represented in the current design);
- Creation of habitat to offset habitat losses (note that this does not include ability to create seagrass habitat);
- Use of fauna spotters, warning noises and equipment soft starts to minimise potential strike impacts to marine megafauna;
- Appropriate management of any reclamation decant through settlement ponds to minimise water quality impacts from reclamation activities;
- Adoption of lighting that minimises spill across the water to minimise impact upon marine fauna;
- Use of designated shipping channels with speed restrictions to minimise disturbance to marine fauna (including megafauna) and adjacent benthic habitats (to avoid continual seabed disturbance);
- Implementation of dredging, dredged material disposal and construction management plans considering avoidance of marine habitats used frequently by marine fauna and incorporating reactive dredge management plans that adjust dredging activities if impacts to sensitive ecosystem receptors are detected;
- Implementation of long-term monitoring of the presence and prevalence of seagrass meadows and the quality of adjacent water bodies to inform the success of reactive dredge management activities; and
- Implementation of appropriate onsite waste and pollution management practices to mitigate potential for offsite impacts on water and sediment quality and to avoid ingestion by marine fauna of waste products.

Under the identified mitigation measures significant impacts to the marine ecological habitat values of the World Heritage Area are reduced. Impacts to fishery and marine megafauna populations through reductions in available seagrass habitat are, however, of critical concern. Offsetting these habitat reductions with appropriate investment into these habitats and the communities they support should be considered. This could include developing understanding of the carrying capacity of the available

habitats and/or determining what light reduction threshold limits for the areas to be affected may be through experimental and research opportunities.

2.2 Impacts to Water and Sediment Quality

The construction and operation of the Project will result in a decline in water quality to varying degrees over different periods of development. This decline will have flow-on effects to the marine benthic community including smothering of benthos, reduction in photosynthetic activities, scouring and mobilisation of contaminants. Changes in water quality and resultant affects on the benthic communities have been considered as a contributory source of cumulative impact to those discussed above (relating to the direct removal of habitat), as well as in the context of other projects in the region.

Sediment composition of the habitats within the Project Area will be affected by construction dredging works related to the establishment of the Reclamation Area. Subtidal soft sediment marine habitat areas under the immediate footprint of the reclamation will be lost. Areas within the channel will be deepened and a change in the composition of the soft substrate from fine silty muds and sands to clays is expected in these environments.

Potential influences on water and sediment quality from the future industrial areas and Port operations include stormwater run off, accidental spills of hydrocarbons and other products and dust and spillage of bulk commodities that are imported and exported through the Port.

Marine flora and fauna may be impacted by increased turbidity in the water column that results from dredging and decant of tailwaters from placement of dredged material in reclamations. The modelling of dredge plumes, predicted to have the largest impact on water quality in the region, indicates that approximately 5,108 ha of benthic habitat outside the Project footprint has the potential to be impacted by the Project's dredging activities. Of this area, approximately 1,128 ha is comprised of known seagrass habitats (as identified in the 2002 DPI&F baseline survey; Rasheed *et al*. 2003 and the survey undertaken by GHD for this EIS).

A review of existing data and the collection of baseline water and sediment quality data was undertaken to provide a means of assessing the current state of the environment and to allow for the assessment of potential impacts from the development of the Project.

2.2.1 Water Quality

Turbidity

Results for turbidity (monthly and continuous data) and suspended solids indicate that the Project Area is a naturally turbid system. The continuous logger data indicates that turbidity is regularly elevated above the QWQG (2006) and ANZECC (2000) guidelines. A detailed review of existing water quality information was undertaken and is presented in Appendix K to the main EIS. Two environmental variables appear to influence sediment concentrations in the water column in the Project Area; tidal current speeds that induce resuspension of bottom sediments and wet season inflows from the catchment, both of which are natural events.

The review and analysis of existing water quality information, coupled with hydrodynamic modelling (Appendix J of main EIS), was utilised to establish water quality trigger values for the dredging operations at various sensitive locations. Full details of this analysis are provided in Appendix K to the main EIS, with the objectives presented in Table 3.

Table 3 Dredge Plume Total Suspended Solids Objectives

Location	TSS Objective (95th Percentile) mg/L	Alternate TSS Objective (80th Percentile) mg/L
Location: Middle Western Basin	77	29
Location: North Western Basin	169	55
Location: The Narrows (objective the same as WBM04)	77	29
Location: Wiggins Island	302	59

The results of monthly vessel based water quality monitoring indicated that anthropogenic contaminant inputs are minor, with one herbicide, one pesticide and one metal exceeding the limits of reporting in a small number of samples. Sampling also indicated that nitrogen regularly exceeds the adopted guidelines. These exceedences were across a range of sites and not restricted to any particular location, indicating the findings are not directly linked to any point source inoculation. The findings may indicate diffuse anthropogenic input of nitrogen and pesticides/herbicides from urban and agricultural sources (e.g. sewage effluent and fertilisers), but this may also result from naturally high levels in the Project Area.

With regards to elutriate analysis, concentrations of metals, metalloids and ammonia were generally much higher within sediments than those levels recorded in the water column or the relevant water quality guidelines. Accordingly, mobilisation of these parameters from the sediment into the water column needs to be assessed with regards to potential impacts during dredging works on the Project Area.

A summary of potential water quality impacts and mitigation measures are provided in Table 4.

Table 4 Overview of Potential Impacts of the Project on Water Quality and Mitigation Measures

Construction Aspect	Construction Process	Potential Impacts	Potential Mitigation Measures
Construction of Bund Wall	Construction of the bund will involve placement of core material and rock armour into the harbour by trucks.	The disturbance of soft seabed sediments will be limited to the first layer of rocks, after which subsequent any additional rock for that section will be placed on rock and not the soft seabed sediments.	Generation of turbid plumes during rock placement to be visually monitored and photographed daily during initial construction stages. Difficult to mitigate this plume as the large tidal range and strong tidal currents limit the practicality of silt curtains in this environment.
		There will be an increased risk of remobilisation of the mud wave during elevated wind and wave conditions, or during spring tides. There will also be the potential for waves to erode core material during storm (cyclone) conditions that may arise over the course of construction.	A stockpile of armour material will be held at the quarry, sufficient to cover any exposed core if a cyclone were to approach. Contingency planning for a storm will require the placement of the stockpiled armour material to cover exposed faces of the core material.
		There is the potential for spillage (either minor through drips or major through a leak/accident) of oils and fuels from construction equipment to impact on marine water quality.	No refuelling or maintenance of construction equipment will occur on the site, nor will equipment be parked at the site for a significant time, reducing the potential for significant spills of oils and fuels to occur. Spill kits for land and water based spills will be kept at the site and personnel trained in their use. Emergency response procedures will be established.
		Small reduction in flushing because of loss of inter-tidal storage and small changes to currents, water levels and tide phases.	No mitigation measures for flushing and hydrodynamic changes.

Construction Aspect	Construction Process	Potential Impacts	Potential Mitigation Measures
Filling of Bund Wall and Reclamation Decant	Dredged plume material will either be pumped from CSD locations or dumped by a TSHD adjacent to the Reclamation Area and rehandled by a medium-sized CSD into the Reclamation Area.	Placement of geotextile fabric will act to minimise the migration of fines through the bund wall and surrounding waters. Once a significant amount of dredged material is beached against the inner wall, this will also act as a filter layer to assist in preventing the migration of fine material through the bund wall into the receiving environment. TSS (turbidity) from the decant is expected to be within the natural range and variability that has been measured within the Western Basin inter-tidal and sub-tidal regions of the Project Area with elevated levels primarily along the northern boundary of the Reclamation Area, which is likely to the region of impacts to seagrass beds.	No mitigation required for migration of dredge plume material through the bund. To achieve water quality objectives multiple cells within the Reclamation Area will allow finer materials to settle out of suspension via weir boxes with adjustable gates so that water can be retained for longer periods if needed, and the final weir box at the outfall can be completely closed if water quality objective is exceeded. Floating booms will also be available on site and will be deployed into the reclamation cells should wind conditions result in waves stirring up deposited sediments within the reclamation cells. Prior to each dredging program, once the dredger, volume, production rate and time frame of the particular program is known, calculations will allow design of the number of reclamation cells and the area required to achieve the water quality objectives. Development of a Dredge Management Plan including daily monitoring of sites within the final reclamation cell, at the outfall and at the northern Western Basin seagrass bed that commences two weeks prior to dredging, and continues during decant discharge.

Construction Aspect	Construction Process	Potential Impacts	Potential Mitigation Measures
Channel Dredging	Material removed from seafloor by pumped CSD or TSHD rehandling with placement in Reclamation Area.	Increased turbidity in vicinity of CSD, TSHD overflow and TSHD dumping. Development of turbid plumes that impact seagrass beds in Western Basin (primarily during flood tides because of TSHD dumping), but less so for those in Narrows and Wiggins Island. Decrease in the light climate experienced by seagrass beds in shallow waters. Slight reductions in net circulation patterns and flushing.	Monitoring of water quality during dredging and comparison of results to site specific water quality objectives for turbidity. Sediment sampling undertaken for the EIS determined dredged material is suitable for reclamation material, therefore the risk of contaminants being mobilised into the water column is considered low. Where possible, reduce occurrence of TSHD dumping during selected periods (such as flood phase of large spring tides) through programming, as this is when much of the dredge plume material will be transported into the Western Basin seagrass beds, and to a lesser extent, beyond these beds. No mitigation for changes to circulation patterns and flushing.

2.2.2 Sediment Quality

A comprehensive sediment sampling undertaken for the Western Basin Dredging and Disposal Project has demonstrated the presence of minor concentrations of anthropogenic contaminants and naturally occurring compounds in individual samples across the areas to be dredged. A full assessment is provided in Chapter 7.2 and Appendix L of the main EIS. Individual results that were above either the NAGD (2009) and/or the EPA Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland (1998) – Environmental Investigation Levels included arsenic, cadmium, copper and manganese. Individual samples recorded concentrations of BTEX, total petroleum hydrocarbons and individual polycyclic aromatic hydrocarbons above the limits of reporting, but below the relevant guidelines.

The analysis of a large number of sediment samples from each of the dredge stages for an extensive suite of potential contaminants has revealed that the overall quality of the sediments in the Project Area are compliant to the NAGD (2009) and the QEPA EILs. The only exception to the compliance of the sediment quality with the adopted guideline values are the elevated manganese concentrations observed within the Stage 1B area. The occurrence of the three highest manganese concentrations within the Stage 1B area was within the upper 1 mBSB of sediment. However, across all the sediments to be dredged, the manganese concentration is compliant to the QEPA EIL.

Due to the comprehensive nature of the sediment sampling and analysis program the results are considered representative of the sediments to be dredged for the proposed Western Basin Dredging and Disposal Project. The results of the sediment chemical characteristics are also consistent with a number of other recently approved capital and maintenance dredging sampling programs within Port Curtis. It is therefore considered that the sediments proposed to be dredged are suitable for placement within the proposed Western Basin Reclamation Area, without the requirement for further sampling and analysis and no significant impacts relating to sediment quality are anticipated for the proposed dredging.

2.2.3 Potential Acid Sulphate Soils

A full assessment of acid sulphate soils is provided in Chapter 5 and Appendix I. The presence of acid sulphate compounds within marine sediments can result in the production of acid if those soils are exposed to air and allowed to oxidise. This is of environmental, social and economic concern. Based on the laboratory analysis and spatial distribution a number of locations within the dredge areas contain elevated amounts of net acidity and will require treatment. The occurrence of acid natural neutralising materials in most samples reduces the number of areas that may cause environmental harm if exposed to air, however the potential acidity is still considered as a potential impact. Based on the volume of sediment and the amount of acid neutralising capacity (ANC) in the samples, it is likely the majority of the sediments will self neutralise within the Reclamation Area, reducing the potential impact of the acid producing fraction. However it is possible that separation of the potential acid-producing fraction (pyritic material) and the neutralising fraction (calcium carbonate) may occur during dredged material placement, leading to accumulation of pockets with insufficient ANC to ensure neutralisation. As a number of samples did not recorded any potential acidity but did record excess amounts of ANC, it can be assumed there is a buffering capacity of more neutralising potential to acidity potential that will be available for neutralisation of the potentially acidic materials, further reducing the risk.

Management of the Potential Acid Sulphate Soil (PASS) and Actual Acid Sulphate soils (ASS) material during bund construction, dredging and dredged material placement within the reclamation will be guided by the preparation of a detailed Acid Sulphate Soil Management Plan.

Specific measures during bund construction, dredging and dredged material placement will include:

- Excavation of unconsolidated materials forming the 'mud wave' (caused by the weight of the rock forming the bund wall) when this material is above the mean high water neap level, ensuring that the remaining material is inundated for every tidal cycle;
- Neutralisation treatment of excavated mud wave materials as required, or storage of excavated mud wave material under water;
- Bottom dumping outside the reclamation area is not to occur when dredged material has titratable peroxide acidity, titratable sulphidic acidity or titratable actual acidity concentrations above the ASSMAC guidelines without appropriate turbidity/siltation control;
- During dredging, dredged material is to be kept in a saturated state to reduce the potential impact of oxidising PASS;
- Where possible, dredging of sediments identified as having high sulphur levels within the early stages of the project to allow strategic placement of sediments;
- Lime dosing of dredged sediments (as required) as they are pumped into the Reclamation Area to ensure sufficient neutralising agent is available;
- Validation testing of the sediments after placement to ensure sediments have sufficient buffering capacity; and
- Placement of a capping layer of at least 2 m of clean sand or the like over untreated PASS that has been placed above mean high water neap level to ensure materials stay near their optimum moisture content and do not dry out over time.

Ongoing management will include:

- Dewatering and lowering of the water table within the Reclamation Area will be avoided where possible, to allow the maximum volume of sediment to stay in a saturated state;
- Preparation of a water management strategy for the Reclamation Area, to mitigate the potential impacts of contaminated leachate and runoff entering the receiving environment; and
- Installation of groundwater monitoring bores at the reclamation site to allow early detection of any contamination plumes, fluctuations in groundwater levels and degradation of groundwater quality as a result of oxidation of PASS.

The implementation of these management measures will reduce the risk of oxidation of potential acid sulphate soils during dredging and reclamation and will allow the management of actual acid sulphate soils. Monitoring as outlined above will be required to allow proactive management of any residual risk from acid sulphate soils. Using these approaches significant impacts from PASS are considered to be mitigated.

2.3 Summary

The potential impacts of construction and operation of the Project on water quality are:

- The generation and migration of turbid plumes from dredging works;
- The mobilisation of contaminants into the water column (including nutrients, manganese and acid sulphate soils) during dredging works;
- The oxidation of PASS materials; and
- The introduction of contaminants from construction works into the aquatic environment of Port Curtis.

The results of numerical modelling suggest that it is likely that dredging will result in increases in turbidity above background levels throughout much of the Project Area, including some elevation at sites that are of ecological significance. However, the level of increase is generally insufficient to cause 95th percentile of background values to be reached. While turbidity objectives have been developed for the dredging and decant waters, there is a need to develop understanding of the resilience of these sensitive habitats to declines in water clarity from increased sediment loads. This could be achieved through experimental investigation of the resilience of seagrasses to varying light conditions in meadows that are expected to be impacted by dredge plumes. Determining thresholds of resilience to low light conditions will provide ability to develop a site specific reactive dredge management program that includes relevant water quality trigger levels to adjust dredging works before sensitive habitats are negatively affected.

The Project involves the reclamation of lands that may be developed into the future. Waste management plans for the reclamation works have been developed as part of this EIS and will be adhered to for mitigation against potential ongoing water quality degradation. Additional measures for the ongoing management of water quality impacts from operational activities of the reclamation site include:

- A condition of development for industry to gain the appropriate environmental approvals and comply with the permit conditions and other relevant guidelines, standards and codes of practice;
- Compliance with PASS and ASS management plans for the reclaimed lands; and
- A requirement for all owners/operators of activities and industries to prepare and implement an EMP for proposed activities and operations.

2.4 Impacts to Hydrodynamics and Coastal Processes

Numerical modelling has been undertaken in order to describe the existing hydrodynamic characteristics of Port Curtis, and in order to assess potential impacts associated with the construction of the reclamation and undertaking of the dredging works. This is described in Chapter 7 and Appendix J. The modelling exercise provides an understanding of general circulation patterns in Port Curtis (as driven by tide and waves) as well as informing details of circulation, sedimentation and flushing patterns across the Project works.

The proposed reclamation and dredging of channels and swing basins will have an affect on the hydrodynamics of the Western Basin Area, particularly in the immediate vicinity of the reclamation and within the footprint of the dredged channels. The proposed development also causes some changes in the tidal current velocities downstream as far as Auckland Point due to the reduction in the tidal prism taken up by the reclamation. Upstream of the Western Basin (in The Narrows) only minor changes in water levels and currents are predicted to occur. Modelling assessments indicate that affects on the hydrodynamics within the Study Area are not consistent across sites or tides, but can include:

- Changes in water velocity;
- Changes in water levels;
- Changes in bed shear stresses; and
- Changes in tidal flows.

These are described in detail in the Numerical Modelling Report (Appendix J). Information provided in the Coastal Processes Report (Appendix M) also provides understanding of potential impacts on the study area from the Project. In brief it is expected that:

- Areas to the north of the reclamation footprint and around the toe of the rock revetment walls will be subject to both increased bed shear stresses as well as increased deposition. The bed shear stresses are not expected to be significant enough to remobilise sediments except against the toe of the bund. There will also be a tendency for siltation, varying across parts of the Western Basin area, being greatest at the western shoreline and channel area;
- Areas to the west of the proposed reclamation footprint in the landward channel will be subject to decreased water flows, some pooling, decreased flushing on neap tidal cycles and, as noted above, will have an increased sedimentation potential;
- Where channels are deepened and swing basins are established tidal flows are expected to be marginally less than existing flow rates;
- Where water will move from the channels into shallower habitats there may be a small increase in flow rates compared to existing conditions. This is not expected to alter bed shear stresses to the point of having consequential effects on sedimentation rates / scouring potential;
- Within the Western Basin Project Area and upstream in The Narrows there is expected to be a very slight phase shift (minutes) in the tidal cycle;
- The northern side of the Reclamation Area will experience a slight increase in water levels (millimeters) while the south western corner will experience a phase change; and
- Within the landward channel and areas to the immediate north of the channel and reclamation there is expected to be a tens of minutes phase shift in the tidal cycle and a potential increase in water retention within the channel during low tide with fewer periods of drying.

In general terms the changes to the hydrodynamics are within the normal bounds of the processes that occur in the natural system as a result of the inherent variability of coastal and estuarine environments in a macro tidal area and it can be expected that the bed and foreshores of the harbour will adapt to the new regime.

The most significant impact is the increase in the potential level of sand and fine silt deposition in new channels, which will require a substantial increase in the maintenance dredging activity if the full potential of the predicted deposition is realised.

2.5 Introduced Marine Pests

The term marine pest may refer to a taxa that is introduced to an area but typically also relates to those introduced taxa that are posing a threat to the environment, economy or society of the area to which it has been introduced. Introduced or exotic species are those recognised as having been introduced to a region (usually via anthropomorphic vectors) that is beyond their normal geographic range but which are

not posing a threat to the area they have been introduced. In Australia, for management of marine invasives there are a recognised set of pests of concern. These pests have been agreed to through a formal process managed by the National Introduced Marine Pest Coordination Group (NIMPCG), which includes representatives from all states and territories.

Establishment of a marine pest in Port Curtis (Gladstone) waters poses a significant risk to the environment, the economy and society as it would likely impact upon aquatic resources and industries that rely on those resources (e.g. commercial and recreational fishing, aquaculture, port, tourism and shipping). Port Curtis is visited by a large number of commercial and recreational vessels from domestic and international locations. For instance, in 2008 imports were recorded from over 430 commercial vessels sourced from 13 international locations (Table 5). Each of these commercial vessels has the potential to introduce marine pests into the area via biofouling and/or ballast water transport vectors.

Table 5 Commercial Vessel Visitation Recorded for Port Curtis in 2008

	Vessel count		Vessel Count
Australia	296	China	24
Indonesia	9	Japan	41
Korea	18	Malaysia	2
New Zealand	1	Oman	4
Saudi Arabia	3	Qatar	5
Taiwan	8	Singapore	11
U.S.A. - West Coast	14	Trinidad	1

Source: http://www.cqpa.com.au/viewcontent/ShippingStatistics/CargoComparisonsSelection.aspx

Similarly, fishing trawlers, yachts and other non-commercial/non-trading vessels also have the potential of carrying a marine pest to the Gladstone region either via biofouling of their hull or vessel equipment (including fishing gear). The development of the Project provides opportunity for a future increase in vessel visitation to this area; this is most likely to be commercial traffic, a consequence of which will be a decrease in the recreational and fishing vessel traffic to the area. During construction a large number of vessels will be stationed in the area. This increases the chance of marine pest incursions to the local area which could then spread and have an impact in the wider Port Curtis environment. Understanding the potential marine pest risks related to the Project requires an understanding of existing marine pest concerns within the region and approaches for management of future introduction vectors.

A series of marine pest baseline surveys was undertaken in Australian ports prior to 2003 to assist in understanding the current state of marine pest incursions in Australia. Gladstone was included in this first set of baseline surveys with CQPA commissioning a port wide baseline survey for introduced marine pests. In 2000 samples were collected from over 20 sites within Gladstone Harbour, primarily focussing on areas likely to house marine pests including wharf piles and adjacent sediments. A range of macrobenthos and pelagic taxa were sampled with no marine pests, as recognised by the Australian Ballast Water Management Advisory Committee, were detected during the survey (Lewis et al., 2000).

Information from this original series of baseline surveys has been used to inform development of the *Australian Government's National System for the Prevention and Management of Marine Pest Incursions*

(the National System). The National System includes a range of measures to deal with all aspects of the prevention, management and control of marine pest introductions. Addressed under the National System are arrangements to reduce the risk of primary invasions via ballast water or biofouling, as well as measures to control the spread of existing introduced marine pests (IMP) as a result of secondary invasions.

Under the National System information collected during the first round of baseline surveys has been used to identify 18 locations in Australia to be targeted for ongoing monitoring for marine pests. Recognising the ongoing high risk of introduction to this area the Port of Gladstone is one of the 18 ports in Australia identified for ongoing monitoring for marine pests. The Port is to be monitored as part of the National System using new monitoring guidelines developed by Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF), in conjunction with other agencies and technical specialists. These guidelines seek to provide standardised approaches to the design, conduct and reporting of each of the marine pest monitoring events. The marine pests of concern to be monitored for using the guidelines focus on those previously identified by a range of ballast and biofouling and vector studies to be of risk to Australian waters.

Monitoring of marine pests within Gladstone under the National System has not yet been undertaken and an extensive period of time has elapsed since the previous pest surveys. Although no marine pests of concern have been detected or reported in the Gladstone none of the surveys undertaken in recent history (seagrass assessments, Santos EIS, PCIMP) have included marine pest assessments within their study frameworks. To manage the potential risks to the Project Area from the reclamation works it is appropriate to determine a current state of knowledge about marine pests within the Project area.

Accordingly, the marine baseline assessment completed for this study (refer Appendix Q – Marine Ecology Report), sought to identify any detected marine pest species of concern. Of the taxa sampled, only bivalves belonging to the familes Mytilidae and Corbulidae closely resembled potential marine pests of concern for the Gladstone region. These species were examined following the field work to enable further clarification of their status and all were determined to not be introduced marine pest taxa. Accordingly, no introduced marine pest taxa were detected during any phase of the benthic ecology sampling across the Port Curtis area.

Given that construction activities will require utilisation of dredgers among other construction vessels there is potential for introduction of marine pests to the Port and/or adjacent marine environment, including the GBRMP. Measures to reduce this impact potential include adherence to legislative requirements for border control and management of marine biofouling and ballast for marine pest introductions and confirmation that vessels entering the Project Area are of low risk of carrying invasive marine pests of concern for Australia during all phases of the project. The Western Basin Area is not expected to be a first port of call for quarantine clearance for incoming vessels, however, adoption of these mitigation measures is recommended to avoid potential for pest introduction and subsequent impacts to the habitat values of the World Heritage Area.

3. Impacts on National Heritage Places

Places that are of great significance to the national identity of Australia are listed under the National Heritage provisions of the EPBC Act. Such localities typically possess exceptional natural or cultural importance. In a cultural sense, National Heritage places are representative of important moments in Australia's history and development. Places may be listed as being of Natural Heritage if they are of outstanding natural significance. The GBRWHA classifies as a National Heritage Place of importance to the project given it's close proximity to the project area. Potential impacts to the GBRWHA as a consequence of this Project have been addressed under the previous section.

The Balaclava Island and The Narrows area adjacent to immediate north of the Project Area is one of only five tidal estuarine passages that separate continental islands from the Australian mainland. A 27,500 ha system of mangroves, saltmarsh and mud flats have been created as a result of two different hydrological systems. Five major alliances of mangroves occur with the communities reflecting variations in salinity and tidal inundation. The mangrove forests contain a mixture of tropical and temperate species such as *Avicennia marina* and *Rhizophora* spp. The saltmarsh areas are dominated by *Sporobolus virginicus* (saltwater couch) and occur between the mixed and landward mangrove communities. Balaclava Island and The Narrows support a diverse range of estuarine fauna including *Scylla serrata* (mud crab) and *Orcaella brevirostris* (irrawaddy dolphin). Balaclava Island and The Narrows are listed as a National Heritage place under the EPBC Act (DEWHA 1999). Impacts to the benthic habitats of The Narrows are expected as a consequence of construction works associated with this Project.

Dredging plumes and hydrodynamic impacts are expected to affect The Narrows. As a result of establishing a large reclamation area within Western Basin, impacts upon the hydrodynamics of the area are expected to produce a slight phase shift (minutes) in the tidal cycle up The Narrows. A slight increase in water levels on the western banks of The Narrows adjacent to the reclamation may also occur. As a consequence of dredging activities dredge plumes will extend up into The Narrows and this will result in a temporary decrease in water quality and altered siltation/sedimentation regimes. These impacts are likely to result in temporary displacement of marine taxa utilising these habitats, however, recovery is expected within 2 to 5 years following cessation of the impact.

Of greater concern is ongoing restriction of the migratory pathway from Port Curtis into The Narrows as a result of cumulative development potential. Under future multiple project scenarios with development from both the Western Basin and Curtis Island areas extending into the established shipping channels migratory pathways for marine animals to access The Narrows become highly restricted. The presence of berths, marine offloading facilities and shipping activities may even result in a restriction of migration into The Narrows for critical species including marine megafauna and other taxa sensitive to shipping activities. Future development applications for use of the established shipping channels should undertake a detailed assessment of the risk to these migratory pathways.

No terrestrial sites or places of Historic Heritage Significance were found to exist within the Project Area and, accordingly the Project will not have direct impacts upon any known sites of Historic Heritage Significance, (including Archaeological Places). Although no RAMSAR wetlands of international importance were noted to occur within the Project Area, a number of nationally important wetlands do occur. While not controlling provisions of this project, these wetlands are included here for completeness.

3.1 Port Curtis Wetland

Port Curtis wetland is a 31,232 ha wetland comprising a mixture of partially enclosed embayments, shallow estuaries, rocky islands, intertidal flats, estuarine islands and marine waters. The wetland includes extensive mangrove forests and shrublands dominated by *Avicennia*, *Rhizophora* and *Ceriops* species. The coastal saltpans include areas of bare claypan, low open halophytic shrubland and sand couch grassland. Seagrass beds of *Zostera capricornia*, *Halophila ovalis* (paddle weed) and *Halodule uninervis* (narrow-leaf seagrass) occur throughout the intertidal zone. The Port Curtis wetland provides habitat for a number of flora species at the limit of their distribution including: *Halophila tricostata*, *Acanthus ilicifolia*, *Avicennia eucalyptifolia* (black mangrove), *Xylocarpus australasicus* and *Bruguiera exaristata*. Notable fauna occurring within the wetland includes: *Dugong dugon* (dugong), *Chelonia mydas* (green turtle) and *Natator depressus* (flatback turtle) which are known to forage within the seagrass beds and colonies of *Pteropus scapulatus* (little red flying-fox), *Pteropus alecto* (black flying-fox) and *Pteropus poliocephalus* (grey-headed flying-fox) which inhabit the mangrove areas. The Port Curtis wetland provides forage and roosting habitat for a range of listed migratory and/or marine bird species and conservation significant species including *Esacus neglectus* (beach stone curlew), *Ephippiorhynchus asiaticus* (black-necked stork) and *Sterna albifrons* (little tern). Port Curtis wetland qualifies as a wetland of national importance under the DIWA (DEWHA 2004a). Potential impacts to species occurring within this wetland as a consequence of the Project are described in Sections 9.2 and 9.3 of the main EIS.

3.2 The Narrows Wetland

The Narrows is the 20,903 ha passage that separates Curtis Island from the mainland and is one of only five tidal passages within Australia. Habitat types within the wetland include saline coastal flats, mangrove forest, intertidal sand and mud flats, seagrass beds and open marine and estuarine waters. The seagrass beds provide important habitat for various fish and invertebrate species and act as a foraging ground for *Dugong dugon* (dugong) and four species of sea turtle. The Narrows also provides habitat for a number of listed marine and/or migratory bird species as well as the vulnerable *Crocodylus porosus* (estuarine crocodile), which is near its southern limit in this area. Current land use within The Narrows includes commercial and recreational fishing and crabbing, shipping transport, mineral exploration, grazing, industrial and urban development and transport. The Narrows qualifies as a wetland of national importance under the DIWA (DEWHA 2004b). Potential impacts to species occurring within this wetland as a consequence of the Project are described in Sections 9.2 and 9.3 of the main EIS.

4. Impacts on Listed Threatened Species and Communities and Listed Migratory Species

The EPBC Act provides legislative protection for all nationally threatened fauna and flora species, and ecological communities. The Act seeks to provide a standard by which species and communities can be listed as threatened, develop recovery actions and plans for such threatened species and communities, identify areas of critical habitat for threatened species, provide a list of key threatening processes, and provide plans by which threatening process can be abated.

The EPBC Act provides specific legislative protection for species that inhabit or naturally occur in Commonwealth Marine Areas. Such species are listed under the Act as Marine species. The legal protective status of listed marine species does not necessarily extend to State waters, unless there is a high likelihood that actions in State waters will significantly impact upon listed marine species of National Environmental Significance. Note, however, that all cetaceans (whales and dolphins) are covered by the EPBC Act, regardless of their conservation status.

Desktop assessments and field surveys were conducted to provide information on the listed threatened species and ecological communities that may be at risk as a consequence of the Project. Detailed assessments are provided in Section 9.2 and 9.3 and Appendices P, Q and R of the main EIS.

4.1 Threatened and Migratory Terrestrial Taxa Including Avifauna

Two threatened vegetation communities were indicated in the EPBC Protected Matters Search Tool results as potentially occurring within the footprint of the Project. 'Semi-evergreen vine thicket of the Brigalow Belt (North and South) and Nandewar bioregions' ('SEVT') is an endangered ecological community under the EPBC Act. The conservation advice for this community provides a list of Regional Ecosystems (Res) that are considered to define SEVT in Queensland (Threatened Species Scientific Committee 2001). None of these REs are present in the study area, and the characteristic vegetation of this ecological community is also absent from the project site and its vicinity, hence this Threatened Ecological Community (TEC) will not be impacted by the Project.

The second terrestrial ecological community nominated in the Protected Matters Search Tool results was the endangered community 'Weeping Myall Woodlands'. This community is dominated by myall (*Acacia pendula*) and in Queensland is restricted to the REs 11.3.2 and 11.3.28 (Threatened Species Scientific Committee 2008). Neither myall nor these REs were present in the project area or its immediate vicinity, and this Project will not impact on this ecological community.

Although it was not listed in the Protected Matters Search Tool results, the critically endangered ecological community 'Littoral rainforest and coastal vine thickets of Eastern Australia' is also present in the Curtis Coast region. In South East Queensland, this ecological community is considered to be wholly analogous with the RE 12.2.2 (Threatened Species Scientific Committee 2008). There are no REs from the Brigalow Belt listed for this ecological community. This RE does not occur in the project area or its immediate vicinity and the characteristic vegetation for this ecological community is also absent. Therefore, this project will not have an adverse impact on this ecological community.

4.1.1 Flora

A total of 16 flora species of conservation significance at State or Commonwealth level have been recorded within five kilometres of the study area. The majority of these species are found in closed forest/dry rainforest or vine thicket, and most records were from the slopes or peak of the nearby Mount Larcom. Only *Cycas megacarpa*, *Quassia bidwillii* (quassia) and *Indigofera baileyi* (Bailey's indigo) have habitat requirements that could be met in the study area. *Cycas megacarpa* is common on Mount Larcom but there are no records for this species in the lower lying areas in the vicinity of the study area. This species forms a conspicuous plant when mature. If present it is likely to have been observed. The project, is therefore, not expected to impact upon this species.

Herbrecs contains a single record for *Indigofera baileyi* (Bailey's indigo) from the southern coastline of Curtis Island (dated 1958). This is one of the northern most records for this species (Centre for Plant Biodiversity Research 2009) with the core populations of this plant are located south of Fraser Island. *Indigofera baileyi* (Bailey's indigo) is described as occurring in sclerophyll woodland and open forest on soils derived from granite and basalt (NSW Dept. Environment and Conservation 2009). Although the soils in the study area are either alluvium or derived from metamorphic rock or Tertiary sediments, the presence of this species cannot be ruled out. However, limited impacts to this species are expected given that the species was not detected.

Quassia bidwillii (quassia) is a shrub that is chiefly found in closed forests and vine thickets but which has been recorded from open forest and woodland, usually in association with riparian vegetation and freshwater (DEWHA 2008d). This species was not detected during targeted searches of riparian vegetation. However, its presence cannot be ruled out in association with the two creeks and two dams in the study area, although it is unlikely given the relatively poorly differentiated riparian vegetation in these areas.

4.1.2 Fauna

Of the 27 species identified during the desktop assessment, the following species were either recorded within the study area during field surveys or considered likely (≥ moderate likelihood) to occur within the study area:

- *Crocodylus porosus* (estuarine crocodile) – migratory and marine;
- *Chalinolobus dwyeri* (large-eared pied bat) – vulnerable;
- *Pteropus poliocephalus* (grey-headed flying fox) – vulnerable;
- *Epthianura crocea macgregori* (yellow chat - Dawson subspecies) – critically endangered;
- *Geophaps scripta scripta* (squatter pigeon) – vulnerable;
- *Nettapus coromandelianus* (cotton pygmy-goose) – migratory;
- *Numenius madagascariensis* (eastern curlew) - migratory; and
- *Sterna albifrons* (little tern) – migratory and marine.

The majority of these species are considered to inhabit the dryland/terrestrial environment of the study area. This environment is well connected to adjacent similar habitat. Furthermore, this habitat is not considered to be core habitat to any of these terrestrial species. The study area provides the characteristics suitable for breeding and foraging for many of those species however given the availability of similar habitat in the surrounds; this area is not considered of core importance.

4.1.3 Migratory and Marine Bird Species

A number of EPBC Act-listed migratory bird species either occur or are likely to occur within the study area. Woodland habitat within the study area is likely to be used for foraging and/or breeding by terrestrial migratory species listed under the EPBC Act including *Cuculus saturatus* (oriental cuckoo) and *Myiagra cyanoleuca* (satin flycatcher), both of which have been recorded near the study area. Areas of dense riparian vegetation and mangrove habitat within the study area could also be used by migratory *Monarcha trivirgatus* (spectacled monarch) and *Monarcha melanopsis* (black-faced monarch) for foraging, albeit on an infrequent/seasonal basis. Habitat for these terrestrial migratory species is limited within the study area and is unlikely to support significant numbers of the species and, with the exception of *Myiagra cyanoleuca* (satin flycatcher), is unlikely to be used for breeding. As such habitat within the study area is not considered important for these species.

Migratory *Chaetura caudacuta* (white-throated needletail) and *Apus pacificus* (fork-tailed swift) are also likely to forage over the study area when visiting eastern Australia in spring and summer. Habitat within the study area, however, is not considered important for these species.

Habitat within the study area is also likely to be used by a number of migratory shorebirds. *Limosa lapponica* (bar-tailed godwit), *Calidris ruficollis* (red-necked stint) and *Numenius madagascariensis* (eastern curlew) have all been recorded near the study area and are likely to utilise mudflats in the east of the study area for foraging and/or roosting during spring and summer. Other migratory shorebird species recorded from the Gladstone region (e.g. *Limosa limosa* (black-tailed godwit), *Calidris canutus* (red knot), *Tringa nebularia* (common greenshank), *Pluvialis squatarloa* (grey plover), *Xenus cinereus* (terek sandpiper), *Calidris acuminate* (sharp-tailed sandpiper), and *Calidris ferruginea* (curlew sandpiper) could similarly utilise habitat within the study area (mangroves and/or mudflats) for roosting and/or foraging. Reclamation paddocks south of the study area could also provide roosting habitat for some of these species.

The migratory and marine bird species recorded within the study area during the field survey are detailed in Table 6. This included one vulnerable species and six migratory species. Thirteen of the species recorded were utilising intertidal habitats. Habitat in the far north of the study area is locally important for feeding and roosting shorebirds (i.e., important within the Gladstone area). However, the Gladstone region is not recognised as an area of national or international significance for migratory shorebirds.

Table 6 Migratory and Marine Bird Species Recorded During Field Investigations

Family	Scientific Name	Common Name	EPBC Status	Habitat
Accipitridae	*Haliaeetus leucogaster*	white-bellied sea-eagle	MA/MI	WG/WV/IZ
Accipitridae	*Haliastur indus*	brahminy kite	MA	IZ
Accipitridae	*Haliastur sphenurus*	whistling kite	MA	WG/WV/IZ
Accipitridae	*Pandion cristatus*	osprey	MA/MI	IZ
Anseranatida	*Anseranas semipalmata*	magpie goose	MA	D
Ardeidae	*Ardea modesta*	great egret	MA/MI	IZ
Ardeidae	*Egretta garzetta*	little egret	MA	IZ

Family	Scientific Name	Common Name	EPBC Status	Habitat
Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike	MA	WG
Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike	MA	WG
Climacteridae	*Charadrius ruficapillus*	red-capped plover	MA	RA
Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)	V	WG/G
Cuculidae	*Chalcites minutillus minutillus*	little bronze-cuckoo	MA	WG/IZ
Dicruridae	*Dicrurus bracteatus*	spangled drongo	MA	WG
Halcyonidae	*Todiramphus sanctus*	sacred kingfisher	MA	WG/IZ
Laridae	*Gelochelidon nilotica*	gull-billed tern	MA	IZ
Laridae	*Hydroprogne caspia*	Caspian tern	MA/MI	IZ
Meropidae	*Merops ornatus*	rainbow bee-eater	MA/MI	WG
Pelecanidae	*Pelecanus conspicillatus*	Australian pelican	MA	IZ/RA/D
Recurvirostridae	*Recurvirostra novaehollandiae*	red-necked avocet	MA	RA
Scolopacidae	*Numenius phaeopus*	whimbrel	MA/MI	IZ
Threskiornithidae	*Threskiornis molucca*	Australian white ibis	MA	IZ

EPBC status:; E = Endangered; V = Vulnerable; MI = Migratory; MA = Marine. Habitat: WG = mixed open woodland with grassy understorey; WV = mixed open woodland with viney understorey; G = grassland; E = estuarine inlet; D = freshwater dam; IZ = intertidal zone; D = freshwater dam.

4.2 Threatened and Migratory Marine Taxa

A search of the Commonwealth EPBC Protected Matters online search tool revealed 75 listed marine fauna species (including ray-finned fishes) that occur or have the potential to occur in proximity to the Project Area (Appendix R). Table 7 lists key threatened marine, migratory marine species and listed cetaceans and their current conservation status with respect to National (EPBC) legislation and international status from the World Conservation Union (IUCN), and the likelihood of occurrence within the Project Area, as identified in the online search. These species are considered highly vulnerable to impacts as they are long-lived, slow-growing and have a low rate of fecundity. For each of these species, their ecology, distribution and population potentially affected by the Project is summarised in Appendix R. Table 7 does not suggest that species not identified to occur in this region by the online assessment do not occur within the immediate Project footprint or waters adjacent to the Project Area. Other key species not identified by the online searches have been observed whilst on survey and are discussed in Appendix R.

Table 7 Listed Marine Fauna Potentially Found within the Project Area

Scientific Name	Common Name	EPBC	IUCN (World Conservation Union)1	Likely Occurrence within the Project Area
Threatened marine species				
Megaptera novaeangliae	Humpback whale	Vulnerable, Migratory (Bonn), Cetacean	Least Concern	Possible
Balaenoptera musculus	Blue Whale	Endangered; Migratory (Bonn), Cetacean	Endangered	Unlikely
Threatened marine reptiles				
Natator depressus	Flatback turtle	Vulnerable, Migratory (Bonn), Marine	Data Deficient	Possible
Chelonia mydas	Green turtle	Vulnerable, Migratory (Bonn), Marine	Endangered	Possible
Caretta caretta	Loggerhead turtle	Endangered, Migratory (Bonn), Marine	Endangered	Possible
Lepidochelys olivacea	Olive ridley turtle	Endangered, Migratory (Bonn), Marine	Vulnerable	Possible
Dermochelys coriacea	Leatherback turtle	Vulnerable, Migratory (Bonn), Marine	Critically Endangered	Unlikely
Threatened sharks				
Pristis zijsron	Green sawfish	Vulnerable	Critically Endangered	Unlikely
Rhincodon typus	Whale shark	Vulnerable, Migratory (Bonn)	Vulnerable	Unlikely
Migratory marine mammals (not yet listed in this table)				
Balaenoptera edeni	Bryde's whale	Migratory (Bonn), Cetacean	Data Deficient	Unlikely

Scientific Name	Common Name	EPBC	IUCN (World Conservation Union)1	Likely Occurrence within the Project Area
Orcaella heinsohni	Australian snubfin dolphin	Migratory (Bonn), Cetacean	Near Threatened	Likely
Orcinus orca	Killer whale	Migratory (Bonn), Cetacean	Data Deficient	Unlikely
Dugong dugon	Dugong	Migratory, Marine	Vulnerable	Likely
Migratory Marine Reptiles				
Crocodylus porosus	Estuarine crocodile	Migratory (Bonn), Marine	Lower Risk/least concern	Possible
Listed Cetaceans				
Balaenoptera acutorostrata	Minke whale	Cetacean	Least Concern	Unlikely
Stenella attenuata	Spotted dolphin	Cetacean	Least Concern	Unlikely
Tursiops aduncus	Indian Ocean bottlenose dolphin	Cetacean	Data Deficient	Possible

[1] IUCN Red List categories: Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Lower Risk, Data Deficient (Source: 2002 IUCN Red List of Threatened Animals).

4.2.1 Marine Reptiles

The presence and potential impacts on crocodiles from this project are identified in the previous section. This section, therefore, describes impacts to marine turtles.

Curtis Island in Gladstone is recognised as a consistent medium density (Limpus *et al.* 2006) nesting area for flatback turtles along the Queensland coast and low density nesting occurs by green turtles. Gladstone Harbour and Rodds Bay are recognised as important foraging habitat for marine turtles (Dobbs 2007). In a regional context, the Capricorn Bunker Section of the Great Barrier Reef is an important feeding habitat where green turtles graze on the seagrass beds and flatback and loggerhead turtles forage for invertebrates (pers comm. I. Bell, EPA 2008). Green turtles primarily feed on seagrass and as such, they have a predicted high association with seagrass beds and prevalence in this region.

Given the urbanisation of the Gladstone coastline, marine turtles using the area are subject to numerous impacts such as habitat degradation and removal, vessel strike and marine pollution, among others. These are discussed in detail in earlier sections. Dredged channels also provide resting habitats for turtles (when they are not undergoing maintenance dredging). Of particular relevance to the Project is that medium density flatback turtle nesting occurs within the Gladstone region (Curtis, Wild Duck and Peak Islands) (Limpus 1971; Limpus *et al.* 1981, 1983b, Limpus *et al*. 2007). These islands are surveyed

annually by the Queensland Turtle Conservation Project, with support from the Gladstone Port Corporation and data exists dating back to the 1970s. Scattered periodic nesting for flatback turtles occurs on mainland and inshore islands between Townsville and Torres Strait.

The Southern end of Curtis Island is considered as a nesting index beach for monitoring. In the 2005 - 2006 nesting survey, a moderate sized population was recorded with 51 nesting females noted during a two week nesting peak in late November – early December.

These flatback turtle nesting populations continue to indicate that the eastern Australian flatback turtle stock has had a stable breeding population over the past 36 years – spanning about one generation for this species. The Curtis Island flatback turtle nesting population has maintained an approximately constant size for the females over the 35 years since monitoring of the nesting females began in 1969. This constancy in size of the nesting females is consistent with the wider population not being subjected to excessive differential mortality that skews the population structure towards either reduced recruitment of new adults to the population or reduced survivorship of adults.

Recent research on nesting flatback turtles on Curtis Island (Sperling 2007) suggests that inter-nesting females enter Gladstone harbour. These flatback turtles demonstrated dive periods up to 98 minutes with a mean dive time of 50 minutes. This mean dive time for flatback turtles is approximately twice as long as commonly seen in loggerheads and other large sea turtles, while comparable to the smaller olive ridley (*Lepidochelys olivacea)* and hawksbill turtle (*Eretmochelys imbricata*).

This Project identified a range of age classes of marine turtles using the Survey Area, suggesting that it is not only an important foraging area for adults but also for juvenile marine turtles. Of the six potential turtle species, only green turtles (*Chelonia mydas,* N = 522) were recorded.

The larger spatial scale survey identified areas within the Survey Area that are of high value to dugong and marine turtles, with numerous animals identified in the southern part of Port Curtis associated with known seagrass habitats.

Of notable importance to this Project is the value of habitat detected in the immediate Project footprint. The Rodds Bay DPA is approximately 515 km^2 in area, of which a minimum of 3 km^2 of known seagrass habitat will be directly reclaimed and or removed by the proposed Fisherman's Landing Northern Expansion Project and Western Basin Project. Further indirect impacts are possible. Given the model output, this loss of habitat will impact species distribution within this core area.

Potential impacts to marine megafauna, including turtles, are summarised following.

- Direct impacts (both potential and probable):
  - Removal of foraging and/or inter-nesting habitat for marine turtle species (three species observed on survey), dugong and coastal dolphins;
  - Damage/mortality to individual animals from direct contact related to construction activities;
  - Impact to fauna by boat strike associated with the construction;
  - Disturbance and displacement from increased noise and/or activity during construction and dredging on the local area;
  - Increased rubbish that may be ingested or entangle marine fauna; and
  - Decline in water quality from altered hydrology (in some areas reduced flushing), dredging, construction, spills of fuel or other hydrocarbons, paint, animal waste (feline pathogens) - feral or domestic, solvents and cleaners.

- Indirect impacts (both potential and probable):
  - Decreased water quality from construction disturbance of sediments around the Western Basin site, mobilisation of contaminated sediment;
  - An increase in sedimentation that may result in the smothering of adjacent benthic habitat communities;
  - Degradation of habitats through continual human usage (including inappropriate waste management, boat fuel spills);
  - Decreased water quality resulting from inappropriate waste management or an increase in sediments and pollutants as a result of construction waste or land use changes;
  - Noise and vibration impacts to marine fauna from in-water construction or ongoing operational activities; and
  - Reduced use of the area by mobile marine fauna may occur as a consequence of these potential impacts. This may have flow on effects for the value of the marine ecosystems within the Gladstone region.

Proposed mitigation strategies include:

- Monitor water quality turbidity levels against site specific objectives within relevant sensitive ecosystem receptors and adjacent habitats and respond as required by DMP. Objectives and monitoring sites to be determined during development of DMP. Processes to respond to trigger level exceedance to be defined in DMP and may include options for alteration of dredging program, temporary alternative to rehandling, or programmed movement of dredge between areas, in order to minimise sustained plume creation at any one area. Dredge activity alteration under DMP may include reducing duration of dredging at particular locations during spring tide, relocating dredge to different areas in accordance with dredge program, planned increase in period between dredging activity at any one location to reduce seabed impacts at that site;
- Offsets to be implemented for habitat losses. Consider implementation of 'like for like' offsets given importance as a foraging habitat;
- Implement speed restriction areas and for construction works and Project area. Educate construction workforce regarding risks to marine megafauna and requirement to avoid interaction with those species;
- Manually remove marine fauna prior to reclamation works from closed bund. Relocate megafauna species to adjacent open marine system. Adopt a strategy to decrease potential trapping of fauna during bund construction such as use of coarse netting to deter entry into bunded area.
- Dredge activities to be restricted to agreed footprint of channel works. Provide a dredging timescale to enable communities to be resilient and re-establish affected areas;
- Implement and adhere to appropriate waste, hazardous material and stormwater management to decrease impacts from potential pollution on marine communities;
- Use a tickler chain or turtle deflector head to avoid interaction with turtles resting on seabed. Maintain a fauna spotter and manage dredging operations to avoid interaction with megafauna. Maintain a fauna spotter and manage dredging operations to minimise interaction with megafauna. Consider marine turtle nesting (Nov – Feb) and inter-nesting behaviours in dredging schedule. Dredge head to be on the seabed prior to start-up;

- Use warning strikes or similar prior to commencement of pile driving (if found to be effective). Implement soft starts where possible to allow megafauna opportunity to leave area of impact. Avoid activity if breeding of megafauna noted in project area. Consider use of a megafauna spotter on vessel to manage conduct of activity to avoid interaction with megafauna when animals within close proximity to vessel; and
- Where possible implement lighting solutions to reduce potential attraction to site. Marine fauna currently co-exist with extensive lighting of construction and operational sites within Gladstone. Project site not within sight of adjacent nesting habitats.

The Project impacts, in combination with impacts likely from other proposed industrial developments in the Port Curtis area, will unquestionably impact marine megafauna identified to use the immediate Project Area. Adjacent (remaining) habitats will become increasingly important to support displaced megafauna species no longer able to continue feeding and resting in the Western Basin Area. Safe passage between The Narrows and other habitat patches by marine megafauna will be compromised by increased in-water infrastructure and vessel traffic from construction and operational activities. This consequently increases the risk of boatstrike to megafauna species or the potential for habitat displacement as a result of underwater noise disturbance. Of critical concern is the potential restriction of access to The Narrows, a listed habitat of importance and a significant area of use by marine fauna. Migratory pathways from Port Curtis into The Narrows may be restricted or removed by cumulative developments within and adjacent to the Western Basin Project Area.

If the additional industrial projects anticipated to proceed in Port Curtis all require lighting to manage their industry, lighting and response by nesting and hatchling turtles may develop into an issue of concern which will require further investigation and potential mitigation. The maintenance of acceptable water quality values, and flow regimes will also require monitoring from the relevant proponents.

Project timing and ongoing monitoring of the marine environment will be an important factor in determining potential cumulative impacts on turtles using the Project Area. Strategic assessment of all developments and resultant impacts is suggested to appropriately evaluate potential future impacts on habitat utilisation, carrying capacity of available habitats and migratory pathway interruption and to provide guidance for appropriate management and mitigation of long term impacts.

4.2.2 Marine Mammals

Terrestrial mammal species of concern for the Project Area are addressed in the previous section. This section, therefore, addresses marine mammal species.

A number of different whale species were recorded as potentially occurring in the Project Area (refer 4.2). The majority of these species generally occur in offshore areas. One whale was briefly observed during the survey in May around the northern tip of Curtis Island in relatively shallow coastal waters. This species was most likely the melon-headed whale *(Peponocephala electra),* determined by its shape and colouration. Given the inshore location of the Western Basin Project Area, the type of habitat and shallow nature of the area (<5m) it is unlikely that whale species would bypass other habitats to utilise the Western Basin and, as such, the project is not expected have any direct affect on these species. Water quality degradation impacts that extend into The Narrows or to the east of Curtis Island could result in habitat avoidance by any whale species using these areas. This may be a temporary affect, removed upon cessation of dredging activities.

The Project is located within the northern limits of the Rodds Bay Dugong Sanctuary, which is a Zone B (restricted use) Dugong Protection Area. Dugongs are confined to shallow and protected areas where their primary food source, seagrass, is found (Heinsohn *et al*. 1977; Anderson 1981). Gladstone and Rodds Bay DPA are recognised to be important habitat for dugong populations despite being within and closely associated to commercial port activities (Dobbs, 2007).

Coastal dolphin species, Indo-Pacific humpback dolphins (*Sousa chinensis*) and Australian snubfin dolphins (*Orcaella heinsohni*) share a similar coastal niche and have been identified in Stranding Database records from Gladstone (Greenland and Limpus 2007). Aerial and boat-based surveys indicate that Australian Snubfin Dolphins occur mostly in protected shallow waters close to the coast, and close to river and creek mouths (Parra 2006; Parra and Corkeron 2001; Parra *et al.* 2002a). Coastal dolphins are among the most threatened species of cetaceans due to their close proximity to anthropogenic activities (Thompson *et al*. 2000; DeMaster *et al*. 2001).

Dolphins and dugongs have life history characteristics that render them vulnerable to threatening processes. These include long life spans, late maturity, low reproduction rates, low fecundity, and long parental care. These characteristics result in slow rates of population growth and vulnerability to rapid population declines (Taylor 2002). Similar habitats to the shallow waters, seagrass beds, coral reefs and the creeks that characterise the Study Area have previously been identified for other regions as important habitats for these species (Parra *et al*. 2006).The potential loss or reduction in quality of these environments may, therefore, have a negative impact on local populations of these species.

Threatened marine mammal species identified on boat-based and aerial surveys include:

- Dugong (*Dugong dugon*); *N* = 81; and
- Dolphins (majority were Indo-Pacific humpback dolphins (*Sousa chinensis*) *N* = 163.

N= Total number of individuals recorded across all surveys (aerial or boat-based)

Potential impacts, and impact mitigation measures, as a consequence of the Project for dolphin and dugong species are the same as those listed under the Marine Reptiles section. As noted above, the Project impacts, in combination with impacts likely from other proposed industrial developments in the Port Curtis area, will unquestionably impact marine megafauna identified to use the immediate Project Area. Dugongs are at greater risk that dolphin species, given the loss of seagrass resource as a result of the project. However, increased pressure on adjacent habitats, risk of boat strike and interruption of migratory pathways are of concern for all megafauna species as a consequence of this Project. As noted above, strategic assessment of all developments and resultant impacts is suggested to appropriately evaluate potential future impacts on habitat utilisation, carrying capacity of available habitats and migratory pathway interruption and to provide guidance for appropriate management and mitigation of long term impacts.

4.2.3 Sharks

The whale shark (*Rhincodon typus*) and the green sawfish (*Pristis zijsron*) have been identified as potentially occurring within or adjacent to the Project site (4.2). No whale sharks have previously been recorded in the Port limits and their presence is highly unlikely. Whale sharks are filter feeders and generally prefer clearer, offshore waters. The project is unlikely to affect this species as they are widespread and migratory. Similarly, no green sawfish have been recorded within the project area. These sawfish are bottom dwelling rays, commonly found in near-shore coastal environments including

estuaries, river mouths, embankments and along sandy and muddy beaches. While there is potential for this species to occur in the Project Area, it is more likely to occupy The Narrows. Impacts could occur to this species as a result of habitat reduction or migratory pathway restriction. This taxa may also be at risk of being trapped within the bund and mitigation measures noted under the Marine Reptiles section regarding removal of any trapped species are applicable to this taxa to reduce likelihood of potential impact.

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Appendix A

EPBC Act Determination

Australian Government

Department of the Environment, Water, Heritage and the Arts

Notification of REFERRAL DECISION AND DESIGNATED PROPONENT – controlled action

Port of Gladstone Western Basin Strategic Dredging and Disposal Project, QLD (EPBC 2009/4904)

This decision is made under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed action	
proposed action	To undertaken the Port of Gladstone Western Basin Strategic Dredging and Disposal Project at the Port of Gladstone, QLD. The action is for dredging and the disposal of dredged material as described in the referral received on 18 May 2009.

Referral decision: Controlled action	
status of proposed action	The proposed action is a controlled action. *The project will require assessment and approval under the Environment Protection and Biodiversity Conservation Act 1999 before it can proceed.*
relevant controlling provisions	The project is likely to have a significant impact on: • World Heritage properties (section 12 & 15A) • National Heritage places (section 15B & 15C) • Listed threatened species and communities (sections 18 & 18A) • Listed migratory species (sections 20 & 20A)
designated proponent	Gladstone Ports Corporation Ltd

Decision on assessment approach	
assessment approach	This project will be assessed under the Bilateral Agreement with the Queensland Government.

Person authorised to make decision	
Name and position	Ms Vicki Middleton Assistant Secretary Environment Assessment Branch
signature	Vicki Middleton
date of decision	18 June 2009

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	Kerry Neil	Kerry Neil		Joanna Lee		20/10/09
1	Ross Fryar	Joanna Lee		Joanna Lee		5/11/09