



Gladstone Ports Corporation
Growth, Prosperity, Community.

Executive Summary





Executive Summary

Introduction

The Port of Gladstone Western Basin Dredging and Disposal Project (the Project) is seeking approval for dredging and dredged material disposal to accommodate the progressive development of the Port. This Environmental Impact Statement (EIS) has been prepared in accordance with the Terms of Reference (ToR) for the project provided by the Coordinator General.

The Gladstone Ports Corporation (GPC) is the Project Proponent. GPC is a Government Owned Corporation under the *Government Owned Corporation Act 1993*, which manages the Port of Gladstone.

The Queensland Department of Infrastructure and Planning (DIP) and the Coordinator General (CG) have prepared the Draft Port of Gladstone Western Basin Master Plan (Master Plan) (Coordinator General, 2009). The Master Plan sets the direction for the Port of Gladstone, in particular the development of its Western Basin, for the next 30 years. The Master Plan aims to provide certainty to industry that the area will be developed, and this development will be in a coordinated manner for mutual benefit and a net reduction in potential cumulative environmental impacts. There are currently two key projects being developed by GPC to assist in meeting the Master Plan's strategic objective of developing the inner harbour:

- ▶ Fisherman's Landing Northern Expansion Project (undergoing a separate EIS); and
- ▶ Port of Gladstone Western Basin Dredging and Disposal Project (this Project).

Project Description

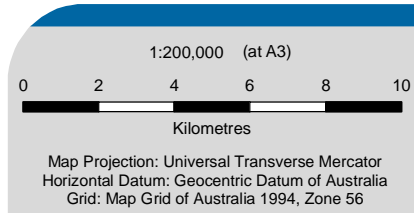
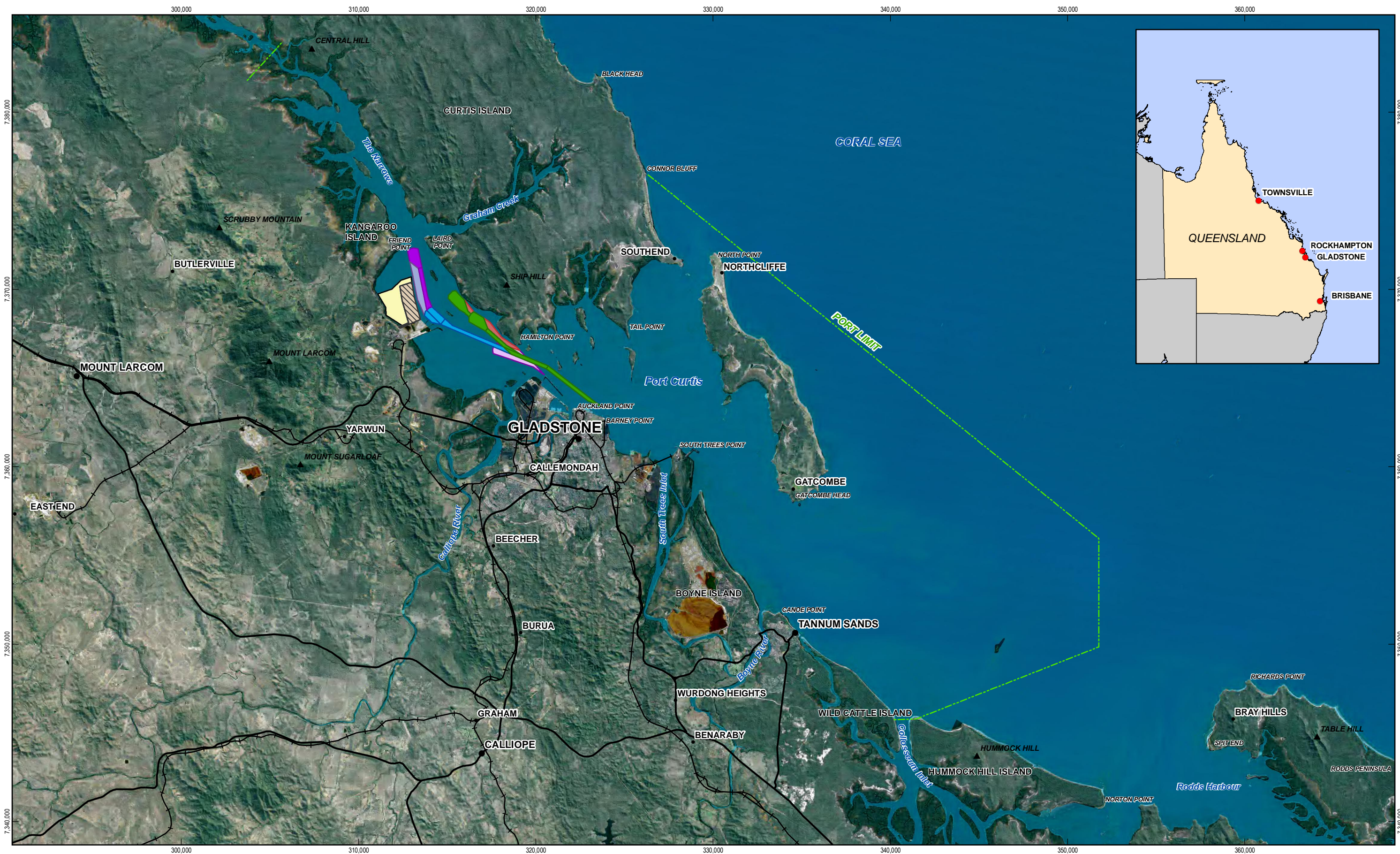
The Project Area is situated in the Port of Gladstone, 10 kilometres (km) north of Gladstone. Gladstone is located on the eastern seaboard of Australia, approximately 525 km north of Brisbane and 100 km south of Rockhampton on the Capricorn Coast of Central Queensland (Figure E-1).

Approval for dredging and dredged material disposal is sought to support the progressive development of the harbour through provision of access to port facilities. Two areas of development are the subject of this EIS:

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

Specifically, this EIS addresses the following activities:

- ▶ Construction of the outer bund wall from bluestone material sourced from the GPC owned quarry;
- ▶ Capital and maintenance dredging from the nominated dredging footprint, including access channels, swing basins, shipping berths and marine offload facilities on Curtis Island;
- ▶ Placement of dredged material into the Reclamation Area and management of decant waters; and
- ▶ Final capping, surface stabilisation and stormwater management upon completion of the reclamation.



- LEGEND**
- Town or Locality
 - Major Road
 - +— Railway
 - Port Limit
 - Western Basin Reclamation Area
 - Fisherman's Landing Northern Expansion
 - 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 Port of Gladstone,
Central Queensland

Job Number	42-15386
Revision	A
Date	22 Oct 2009

Figure E-1



The Terms of Reference for this project does not require this EIS to address dredging associated with the LNG pipelines. This is being addressed by the LNG proponents in association with the State Government.

By encompassing all of the dredging and dredged material disposal that is envisaged to enable the development of industries in the Port of Gladstone, the Western Basin Dredging and Disposal Project 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.

The following summarises the maximum proposed dredging volumes for the Western Basin Dredging and Disposal Project (should each project proceed).

Dredging Stage	Description	Volume
Stage 1A	North China Bay LNG 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
Total		36 million m³

Material dredged during the development of the Western Basin of the Port of Gladstone is proposed to be placed into a bunded Reclamation Area. The volume available in the reclamation makes allowance for a substantial volume of maintenance dredging material over the life of the project. The reclamation areas and volumes are as follows:

Reclamation Area	Footprint	Volume Accommodated
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 m³

Project Context and Objectives

The Commonwealth and Queensland governments have identified Gladstone as a port with the potential to service future large scale export oriented, resource processing and value adding industries. The close proximity of Gladstone's international port facilities is an essential component of the economic viability of the Gladstone State Development Area (GSDA). The GSDA is an approximately 28,000 hectare declared land bank to the north east of Gladstone. A Materials Transportation Services Corridor (MTSC) links the GSDA to the Port.

The GSDA aims to attract industries by offering internationally competitive operating costs and has the capacity to accommodate significant future industrial growth. GPC is responsible for the provision of and



maintenance of declared depths of shipping channels, swing basins and berth pockets in the Port. The Port of Gladstone Western Basin Dredging and Disposal Project encompasses all the dredging and disposal of dredged material that is currently outlined in the Coordinator General's Draft Port of Gladstone Western Basin Master Plan (Coordinator General, 2009).

The objectives of the Project are:

- ▶ To accommodate the long term dredging and dredged material disposal that is required to provide safe and efficient access to the existing and proposed port facilities in the harbour; and
- ▶ The provision of a location for the disposal of dredged material from capital and maintenance dredging in the Port.

Project Alternatives

The GPC 50 Year Strategic Plan and the Draft Port of Gladstone Western Basin Master Plan nominate the Western Basin of the Port as an area that will undergo significant development over the coming years (GPC 2008a and Coordinator General 2009). The EIS considered the alternatives available to meet the needs of the Port and associated industries and the social, economic and environmental benefits and disadvantages of the proposed alternatives. Alternatives were considered for industry locations (in particular LNG), alternative dredging footprints and alternative dredged material disposal locations.

The alternatives for the location of industry indicated that Gladstone has been nominated by the Queensland Government as a location suitable for industrial development, which is supported by the declaration of the GSDA. In particular, the establishment of the Curtis Island LNG Precinct within the GSDA and the preparation of the Draft Western Basin Master Plan support the development of the LNG industry in Gladstone. The LNG proponents have undertaken options assessments for other export locations along the Queensland coast in their individual EISs.

The Western Basin Dredging and Disposal Project dredging footprint is largely driven by shipping safety and operational protocols and the location of the sites that are available for development in the Port.

The main focus of the alternatives assessment was the dredged material disposal location, with the EIS exploring options such as reclamation, land based disposal, unconfined subtidal disposal within the Port and offshore disposal. Consistent with the Draft Western Basin Master Plan, the options assessment concluded that reclamation in the vicinity of the existing Fisherman's Landing Reclamation was the most suitable disposal option. An options assessment was then undertaken on five reclamation configurations, to arrive at the option that was assessed in the EIS.

Environmental Impact Statement Process

The Project was declared by the Queensland Coordinator-General (CG) as a "significant project for which an EIS is required" under Section 26 of the *State Development and Public Works Organisation Act 1971* (SDPWO Act) on 9 April 2009. The proponent was notified that an EIS was required and draft Terms of Reference (ToR) released for public comment. Comments were considered and the ToR were finalised by the Coordinator-General on 10 September 2009, with a copy provided to GPC on 21 August 2009. This EIS has been prepared in accordance with the ToR.

On 18 June 2009, the Australian Government Minister for Environment, Water, Heritage and the Arts (DEWHA) determined that the Project is a 'controlled action' (2009/4904), which requires assessment



and approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The controlling provisions are:

- ▶ World Heritage properties (section 12 & 15A);
- ▶ National Heritage places (section 15B & 15C);
- ▶ Listed threatened species and communities (sections 18 & 18A); and
- ▶ Listed migratory species (sections 20 & 20A).

The statutory impact assessment process under the SDPWO Act is also the subject of a bilateral agreement between the Queensland and the Commonwealth Governments in relation to environmental assessment under the EPBC Act. Pursuant to the bilateral agreement, this EIS addresses the requirements of both State and Commonwealth legislation.

Following the Coordinator General's acceptance of the EIS, the document is subject to a public exhibition period. Submissions on the EIS must be made in writing and forwarded to the Coordinator-General c/- EIS Project Manager shown below and be received by 5 pm, 18 December 2009. Submissions must state the grounds of the submission and the facts and circumstances relied upon to support the grounds. Properly made submissions must be signed by each person who made the submission and include their name and address. A pro-forma submission form is available for download from the Port of Gladstone Western Basin Dredging and Disposal Project page on the DIP website at <http://www.dip.qld.gov.au/projects.html>. Submissions will be treated as public documents unless confidentiality is requested. Copies of all submissions will be forwarded to GPC.

For further inquiries about the EIS process for this project, please contact:

EIS Project Manager – Western Basin Dredging Project
Significant Projects Coordination
Department of Infrastructure and Planning
PO Box 15009
Brisbane City East QLD 4002
Tel (07) 3224 2748
Fax (07) 3225 8282
wbdp@dip.qld.gov.au
www.dip.qld.gov.au

Outline of the EIS

The EIS has been prepared in accordance with the ToR. Individual chapters discuss the existing environment, potential impacts and mitigation measures / monitoring required for each aspect of the receiving environment. A risk assessment was also conducted, with both the 'raw' (unmitigated) risks and 'residual' risks (the level of risk remaining following mitigation) presented. The EIS covers the following broad topics:

- ▶ Climate and Climate Change;
- ▶ Acid Sulphate Soils;
- ▶ Hydrodynamic Modelling;
- ▶ Coastal Processes;



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Western Basin Dredging and Disposal Project

- ▶ Water Quality;
- ▶ Sediment Quality;
- ▶ Stormwater Management;
- ▶ Groundwater Resources;
- ▶ Terrestrial Ecology;
- ▶ Marine Ecology;
- ▶ Marine Megafauna;
- ▶ Air Quality, Noise and Vibration;
- ▶ Greenhouse Gases;
- ▶ Traffic and Transport;
- ▶ Cultural Heritage;
- ▶ Social Impact;
- ▶ Stakeholder and Community Consultation;
- ▶ Landscape and Visual Character; and
- ▶ Economic.

Project Approvals

The compliance of the Project to the relevant Acts, State Government Policies, Local Government planning controls, local laws and policies was undertaken and is presented in the EIS. The approvals required are summarised in the following table.

This Project has been determined to be a controlled action under the Commonwealth EPBC Act and a significant project under the SDPWO Act. In this regard, the Australian Government has accredited the Queensland EIS process for the purposes of the Australian Government assessment under Part 8 of the EPBC Act. A stand-alone report addressing the matters of national environmental significance has been prepared that exclusively addresses the issues relevant to the controlling provisions.

Legislation	Administering Authority	Trigger	Project Response
<i>Aboriginal Cultural Heritage Act 2003</i>	Department of Environment and Resource Management	Fact that development requires an EIS	A Cultural Heritage Management Plan will be developed for the Project.
<i>Coastal Protection and Management Act 1995</i>	Department of Environment and Resource Management	Land Reclamation Impact on Stuart Oil Shale Deposits	If the DERM is not the assessment manager for the proposed development, the proposed development will be referred to the agency as a concurrence agency. The DERM will assess the proposed dredging and disposal of dredge spoil against the provisions of the Coastal Plan. The DERM will refer the development to the Department of Employment, Economic Development and Innovation for advice.



Western Basin Dredging and Disposal Project

Legislation	Administering Authority	Trigger	Project Response
<i>Environmental Protection Act 1994</i>	Department of Environment and Resource Management	Possible noise, air and water pollution and waste management	Approval for ERA 16 will be required. When considering the development, the DERM will also assess the proposal against the relevant policies under the Act. These policies would include noise, air, water and waste management.
<i>Fisheries Act 1994</i>	Department of Efficiency, Economic Development and Innovation	Marine plant clearing	Authorisation to clear marine plants will be considered during the referral and assessment process.
<i>Integrated Planning Act 1997</i>	Department of Infrastructure and Planning	Tidal Works	The Assessment Manager for an application for Tidal Works is Gladstone Ports Corporation. The application will cover the work for dredging as well as the disposal of material in tidal water. The application will require referral to the following agencies: <ul style="list-style-type: none"> ▶ DERM as concurrence agency; ▶ DEEDI as concurrence agency; and ▶ DIP as advice agency.
<i>Land Act 1994</i>	Department of Environment and Resource Management	Tenure	Prior to application being made for Resource Allocation for the Reclamation Area, application must be made to lease the unallocated State land. Once the land is reclaimed, the GPC can apply for ownership of the land. However, in terms of section 127(3), if the reclaimed land is held under lease, that lease must be surrendered before a deed of grant can be issued.
<i>Native Title Act 1993</i>	Department of Environment and Resource Management	Native Title Notification	The Assessment Manager is responsible for undertaking Native Title Notification. Notification is done at the time when an application for a development permit (in this case application for tidal works) is lodged. The process runs concurrently with the IDAS process.
<i>Nature Conservation Act 1994</i>	Department of Environment and Resource Management	Possible effect of project on endangered, vulnerable, or rare wildlife, or the habitat on which that wildlife depends	Will be assessed as part of the referral and assessment process.



Legislation	Administering Authority	Trigger	Project Response
<i>Transport Infrastructure Act 1994</i>	Queensland Transport	Creation of land (land reclamation)	The GPC Land Use Plan has to be amended to include the reclaimed area in the plan in order to make development on the reclaimed land assessable development. This process can only be started after completion of the reclamation.
<i>Vegetation Management Act 1999</i>	Department of Environment and Resource Management	Possible vegetation clearing	Authorisation to clear vegetation (if required) will be acquired as part of the referral and assessment process.

Climate and Climate Change

Existing Environment

Climate Factors

- ▶ The average annual rainfall for Gladstone over a 51 year period from December 1957 to July 2009 is 880 mm. The wet season occurs during the summer months, with December, January and February accounting for 47.4% of the annual average rainfall.
- ▶ On average, the highest average minimum and maximum temperatures are in January (22.5°C to 31.2°C) whilst the lowest average minimum and maximum temperatures occur in July (13.3°C to 22.8°C). The long-term annual average range for this site was reported as 18°C to 27.2°C.
- ▶ Annually, the 9 am and 3 pm relative humidity averages are 64 % and 54 % respectively.
- ▶ On average, at 9 am, wind speeds between 20 and 30 km/h are from the south-easterly direction. At 3 pm, wind speeds between 20 and 30 km/h are mostly from the east and north-easterly direction and wind speeds between 30 and 40 km/h were from the easterly direction.

Extremes of Climate

Drought has occurred in the Gladstone area due to high temperatures and low rainfall over the past decade. Ten tropical cyclones passed within 100 km of Gladstone between 1940 and 2006 and in March 2009, Tropical Cyclone Hamish passed along the coastline near Gladstone causing the temporary closure of the Gladstone Port. Numerous flood events have been recorded for Calliope River, the closest river to the Project Area, since the installation of a gauging station on the in 1938. Storm tides were recorded in the Gladstone region in 1974 and 1980, with a 0.4 m surge.

Potential Impacts and Mitigation Measures

Vulnerability of Area to Natural or Induced Hazards

Tropical cyclones and the associated extreme wind, rain and wave conditions may result in some level of damage to the rock armouring of the bund wall. As the proposed Western Basin Reclamation Area is not adjacent to any major river or creek, it is not expected that flooding following large rainfall events will result in inundation or scouring of the reclamation. The reclamation will be vulnerable to the impacts of storm tides, however, the rock armour protection is based on a dynamic design and therefore, will move to create a stable profile over its lifetime. Bushfires and landslides do not pose a risk to this project.



Climate Change Adaptation

An assessment of climate change vulnerability of the Project was undertaken, with a focus on the construction of the Western Basin Reclamation Area. The main climate change variables that were flagged as having the most significant potential impact on this project were sea level rise and associated increase in storm surge. The sea level rise adopted for the design of the rock armour is as recommended by the DERM Building and Engineering Standards for Tidal Works and corresponds with the approximate 'high level' mean sea level rise projections for a 50 yr period. If a design storm event occurs during the lifetime of the structure, some maintenance and possibly replenishment of the rock armour may be required in places.

It is expected that the potential impacts of climatic factors, extreme climatic events, natural or induced hazards and climate change on the construction and operation of facilities that may be constructed on the reclamation in the future will be considered by the future proponents.

Land

Existing Environment

Bathymetry

The seabed in the vicinity of the proposed Western Basin Reclamation Area ranges from around 0 m LAT in the east to around +2 m LAT in the west of the proposed reclamation area. The central and eastern parts of the proposed Reclamation Area will be underwater at the mean low water neap tide level prior to filling. The bathymetry in the areas to be dredged varies across the dredging stages. A few areas are very shallow, requiring the removal of up to 13.0 m of material to achieve the required declared depths in shipping channels and swing basins, while some areas are already deeper than the required depths (e.g. adjacent to Hamilton Point). In general, the current depths in the areas to be dredged are between -5 m and -10 m LAT.

Land Use and Land Tenure

There are a variety of land uses surrounding the proposed dredging footprint and Reclamation Area. These include industrial sites such as Cement Australia and Queensland Energy Resources Limited, port facilities such as RG Tanna Coal Terminal and the existing Fisherman's Landing Northern Expansion (which supports facilities for Orica and Rio Tinto Alcan Yarwun) and undeveloped industrial land in the Gladstone State Development Area, including the Curtis Island LNG Precinct. The Project Area is also used for marine based recreational activities and there are residents located on some of the islands located in the centre of the harbour.

There is a Native Title Claim (QC01/29) over the Gladstone region. Port Curtis Coral Coast Aboriginal Corporation (PCCCAC) is the Claimant. The portion of the project area comprising the waters of the Gladstone Harbour is not subject to a current native title claim or Aboriginal Cultural Heritage Body.

Soils and Quarry Materials

The materials to be used in the construction of the bund wall, filling and capping of the Western Basin Reclamation Area will consist of, respectively:

- ▶ Hard rock (approximately 1,800,000 m³ of bluestone) from a GPC owned quarry situated at Guerassimoff Road Yarwun;



- ▶ Up to 55 million m³ of dredged material (capital and maintenance dredging); and
- ▶ Capping material sourced from quarry overburden.

Acid Sulphate Soils

An assessment of acid sulphate soils (ASS) has been completed to define areas of the Project Area that contain actual ASS (AASS) or potential ASS (PASS) and to characterise the dredged material in terms of the potential for ASS. A total of 189 locations were sampled for the Dredging Area and 100 locations sampled for the Reclamation Area.

A number of locations within the Dredging Area have been identified as containing elevated amounts of Net Acidity if they become oxidised and will require management. The occurrence of natural neutralising capacity in most samples analysed means it is likely that 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 and hence the potential for acid generation.

The majority of the sediments underlying the proposed Western Basin Reclamation Area contain excess sulphur acidity and net acidity at varying depths. It has been assumed that a maximum of 2 m may be disturbed during the construction of the bund wall. Based on laboratory testing the majority of the samples from the Reclamation Area do not appear to contain enough buffering capacity to self-neutralise.

Potential Impacts and Mitigation Measures

Land Use and Land Tenure

The construction of the Western Basin Reclamation Area will result in a change of land use from marine waters to potential industrial land. This change in land use will prevent the current uses of the area, which are marine habitat and recreational and commercial fishing. The construction of the Reclamation Area allows for an expansion of port facilities for import and export of bulk commodities and resources, and as such, is compatible with adjacent land uses.

The dredging activities for the Project will promote shipping access to Curtis Island, which will impact on its land use. However, the Curtis Island LNG Precinct has been established specifically to cater for industrial development. It is also possible that the dredging activities may impact upon recreational uses in the area, however, this impact will be transient.

Soils and Quarry Material

It is possible that erosion of the surface of the Reclamation Area may occur during or after construction due to wind and rainfall. The following mitigation measures will be implemented to minimise this:

- ▶ A stormwater drainage system will be constructed on the final Reclamation Area, which will direct runoff and discharge stormwater from the area. This will reduce soil erosion from water; and
- ▶ Vegetation of the final reclamation area to prevent wind erosion of the surface of the area.

All rock of resource value in the quarry was categorised as bluestone, which is not expected to result in impacts on water quality when placed in the marine environment. The fine fraction (<20 mm) will be removed from the rock to reduce the potential for generation of turbid plumes through the introduction of fines into the harbour.



Acid Sulphate Soils

Potential impacts from ASS during the construction of the bund wall, dredging and filling of the reclamation relate principally to the potential for oxidation of PASS materials should they become unsaturated. This could occur if any PASS is displaced above the mean high water neap level as a result of the creation of a 'mud wave' from lateral movement of soft material due to the weight of rock being placed for the bund wall. Oxidation of PASS could occur during dredging if sediments don't remain saturated. Oxidation of PASS could also occur during placement in the reclamation should adequate acid neutralising capacity not be available within the sediments, or if the finer sediments where the acid generating capacity is highest become separated from the coarser sediments that contain the ANC during placement within the Reclamation Area. Some PASS may also be released and redistributed into the harbour during the dredging operations from the dredge overflow.

If PASS is allowed to oxidise, there is the potential for acidic groundwater to be released into the harbour from the reclamation and this groundwater could potentially contain elevated concentrations of metals. Also, metals such as iron, arsenic and manganese may precipitate out of solution if PASS materials are placed at the surface and allowed to oxidise, causing staining at ground surface within the Reclamation Area. There are also potential health issues for workers that handle and work around PASS, any leachate or impacted groundwater.

Mitigation measures to be implemented during bund construction, dredging and filling of the reclamation are detailed in the EIS and include:

- ▶ Excavation of unconsolidated materials forming the 'mud wave' above the mean high water neap level, ensuring that the remaining material is inundated each tidal cycle;
- ▶ Excavation of disturbed, trapped, unconsolidated materials from the western side of the Reclamation Area which are no longer inundated by the mean high water neap tide and placement of this excavated material permanently below the water table within the bunded area;
- ▶ Temporary rehandling adjacent to the Reclamation Area is not to occur with any dredged material that has TPA, TSA or TAA concentrations above the ASSMAC guidelines without appropriate turbidity/siltation control;
- ▶ During dredging, dredged material is to be kept in a saturated state;
- ▶ Management during placement of the dredged material within the reclamation will be required;
- ▶ Verification sampling will be conducted to indicate separation of the neutralising fraction and the acid producing fraction does not occur and the sediments do not produce acidity in high enough concentrations to cause environmental harm;
- ▶ A detailed ASS Management Plan will be required outlining the recommended strategy during placement, after completion and any other excavation works for future developments within the Reclamation Area. The EIS details the measures that are to be included in the ASSMP.

Hydrodynamic Modelling

Hydrodynamic models, and linked models addressing waves, sediment and water quality, form one of the key components of any impact assessment in the ocean environment. Typically, models are developed over a wide regional extent, such that a much wider understanding can be obtained of processes (e.g. tidal characteristics) within that extent than could be provided through monitoring alone. Effectively, models allow two key advantages over monitoring:



- ▶ The ability to consider characteristics and impacts anywhere within the model extent; and
- ▶ The ability to predict how characteristics might change in response to actions within the extent. Such actions could include the dredging of a channel, the construction of a Reclamation Area, or the creation of a plume.

Hydrodynamic modelling of the entire Port Curtis region, encompassing the Western Basin Project Area, has been undertaken using the TuFlow –FV software. The purpose of this modelling is provide a tool to quantify key physical processes acting within the waters of the port, with the model capable of informing engineering design, and the assessment of environmental impacts. In particular, the model has been used to establish baseline conditions across the entire area of interest, and to then quantify the potential impacts of proposed dredging and reclamation works on key characteristics including:

- ▶ Tidal water levels;
- ▶ Currents (velocities) and bed shear stresses;
- ▶ Flushing characteristics (an indicator of potential impacts on water quality);
- ▶ Suspended sediment concentrations (arising from the proposed dredging process); and
- ▶ Sediment deposition.

The modelling therefore addresses tidal hydrodynamics and flushing characteristics, turbid dredge plume dispersion, wave conditions and sedimentation processes. A detailed report on the modelling software, establishment, calibration and validation are provided as an appendix to the EIS.

Modelling results were utilised throughout the EIS to assess the potential impacts of the Project on water quality, coastal processes and marine ecology.

Coastal Environment

Marine Water Quality

Existing Environment

A comprehensive review of existing data was undertaken, with a focus on turbidity, which is the main water quality variable impacted by dredging. A data collection program was undertaken for this EIS, comprising long term continuous logger data at 4 locations and monthly *in situ* sampling at 12 locations throughout the Project Area. A summary of the water quality data from the baseline monitoring data for this EIS and other available recent turbidity logger data within the Project Area follows.

Turbidity

Turbidity and suspended solids data confirm 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. Turbidity logger data indicates the following characterisation of the Project Area:

- ▶ The median and 95th percentile turbidity ranges during the dry season in deep waters (approximately >2 m LAT) of the Project Area are 3 – 9 NTU and 11 – 35 NTU, respectively;
- ▶ The median and 95th percentile turbidity ranges during the dry season in shallow waters (approximately <2 m LAT) of the Project Area are 9 NTU and 30 – 90 NTU, respectively;



- ▶ The median and 95th percentile turbidity ranges during the wet season in shallow waters of the Project Area are 10 – 23 NTU and 127 – 176 NTU, respectively; and
- ▶ During the dry season, the turbidity during spring tide conditions is 2 –4 times those in neap tide conditions.

Two environmental variables appear to influence sediment concentrations in the water column in the Project Area; tidal state current speeds that induce resuspension of bottom sediments and wet season inflows from the catchment, both of which are natural events.

Water Quality

The majority of water quality parameters analysed from monthly vessel-based samples over a 6 month period were below the limit of reporting except for:

- ▶ One herbicide, metolachlor, exceeded the limit of reporting on six out of 36 recordings;
- ▶ One organophosphorus pesticide, chlorpyrifos, exceeded the limit of reporting on six out of 36 recordings;
- ▶ Of the dissolved metals, aluminium, arsenic, barium, cadmium, chromium (III+VI), copper, iron, manganese, nickel, silver and vanadium had some measurements above their respective limit of reporting. Only cadmium exceeded the ANZECC (2000) trigger value on two occasions;
- ▶ All nitrogen nutrient species exceeded the QWQG (2006) and/or ANZECC (2000) guidelines on at least one occasion over the monitoring period. The most regularly exceeded guideline levels were:
 - Total oxidised nitrogen with a median of 0.004 mg/L above the QWQG (2006) guideline level of 0.003 mg/L;
 - Total nitrogen with a median of 0.135 mg/L exceeded the ANZECC (2000) guideline level of 0.1 mg/L on 37 occasions;
- ▶ Both reactive and total phosphorus were always lower than the QWQG (2006) guideline levels. Reactive phosphorus exceeded the ANZECC (2000) guideline level of 0.005 mg/L on six occasions;
- ▶ Chlorophyll *a* exceeded both the QWQG (2006) and ANZECC (2000) guideline levels on eight and 13 occasions, respectively, out of a total of 48 samples over the monitoring period;
- ▶ Laboratory and *in situ* pH tended to be below the lower limit specified in both the QWQG (2006) and ANZECC (2000) guidelines, but not above the upper limit;
- ▶ Total Suspended Solids exceeded the QWQG (2006) guideline level of 15 mg/L on 28 occasions out of the 48 measurements with a median TSS of 18 mg/L;
- ▶ *In situ* turbidity tended to be near the upper limit of the ANZECC (2000) guideline range of 20 NTU and above the QWQG (2006) guideline of 6 NTU; and
- ▶ *In situ* dissolved oxygen saturation tended to be within the QWQG (2006) guideline range of 90-100% with occasional measurements above or below this range.

The results indicate that anthropogenic contaminant inputs are minor (one herbicide, one pesticide, one metal) and that nitrogen regularly exceeds the adopted guidelines. This may indicate anthropogenic input of nitrogen from urban and agricultural sources (e.g. sewage effluent and fertilisers), but this may also result from naturally high levels in the Project Area.



Potential Impacts and Mitigation Measures

Water quality impacts of bund wall construction, dredging and filling of the reclamation were assessed using the results of hydrodynamic modelling. The impacts were assessed for a range of dredging scenarios and included the plume generated by the decant from the Reclamation Area. A combination of trailer suction hopper dredgers (TSHD), which operate using overflow and rehandling methods, and cutter suction dredgers (CSD), which pump directly into the reclamation using pipelines, will be utilised, with a backhoe dredger possibly required.

Water quality monitoring for this EIS, coupled with the use of past data relevant to the Project Area has characterised the locality as a turbid environment with relatively good water quality. Most of the physico-chemical and chemical parameters were within adopted guidelines.

As the Project involves reclamation of approximately 235 ha of seabed, there is a minor impact on tidal currents, water levels and flushing efficiency with diminishing effects with distance from the Reclamation Area. The hydrodynamic and flushing impacts of the proposed capital dredging areas are less than those associated with the loss of the tidal volume from the Reclamation Area.

The main potential construction impacts, including potential cumulative impacts, which may result during the reclamation and channel dredging works are, therefore:

- ▶ Decant discharge during filling of the Reclamation Area is predicted to generate elevated turbidity in the region of the outfall and particularly along the northern bund wall. However, the effects of the decant discharge on the northern Western Basin inter-tidal and sub-tidal regions are greatly diminished relative to the northern bund wall area. Representative locations of sensitive seagrass beds (i.e. Wiggins Island and the Narrows) are not significantly impacted by elevating the decant discharge;
- ▶ CSD plants are predicted to have a low impact on turbidity and water quality, as most of the dredged material will be pumped directly to the Reclamation Area;
- ▶ TSHD plants are predicted to have greater impacts in terms of areal extent during dredging works. Regions of persistent elevated turbidity are predicted as a consequence of overflows during active dredging and emptying of the hopper adjacent to the eastern bund wall with subsequent rehandling by a dedicated CSD plant with dredge material pumped into the Reclamation Area. In particular, hopper dumping coincident with flood tides will have an impact on the turbidity climate of the Western Basin and to a lesser degree on the Narrows. Increased turbidity reduces the light intensity at the seabed, thereby impacting seagrass beds. Seagrass beds in the vicinity of Wiggins Island are not greatly impacted during ebb tides as the dredge material plumes are primarily confined to the deep water channels with elevated velocities; and
- ▶ The sediments of the Project Area are predominately of good quality, hence other than increases in turbidity, persistent degradation to other physico-chemical and chemical parameters is not anticipated. However, elutriate analyses indicate manganese and ammonia that can be readily released from the sediments and/or are contained within the pore waters, however ammonia concentrations are compliant to the ANZECC (2000) toxicant guidelines. For TSHD overflow and rehandling activities, elevated levels of ammonia were conservatively estimated to range from a 3-4 fold increase over QWQG (2006) guidelines during low slack tide. However, the impact is likely to be substantially less when a number of physical, chemical and biological processes that would decrease ammonia values in the water column are taken into account and the NAGD (2009) initial dilution over a 4 hour period is applied.



All of these potential impacts on water quality are temporary, and water quality should therefore return to levels similar to the current status in between various capital dredging works stages and at the end of the project. Small changes to the overall water quality may occur because of minor changes to flushing efficiency of certain regions in the Project Area.

In addressing the potential risks to the marine system from the Project proposed mitigation measures were examined, where opportunities to mitigate impacts are available. These were detailed above and, in brief, include:

- ▶ Development and implementation of a reactive dredge management plan to mitigate against impacts on water quality from dredging activities;
- ▶ Implementation of waste management plans;
- ▶ Appropriate design of the Reclamation Area facility to reduce water quality impacts from leaching of material through the bund wall, decant waters and storm-water run-off; and
- ▶ Practicable scheduling of TSHD hopper dumps to not occur during some flood tide periods to reduce turbidity and light climate impacts to Western Basin shallow waters.

A number of direct impacts are not able to be mitigated such as modifications to hydrodynamics and flushing efficiency.

Marine Sediment Quality

Existing Environment

A review of the results of previous sediment sampling programs was undertaken, along with a comprehensive sampling program to characterise the sediments to be dredged. Compliance of the sediments to be dredged to the National Assessment Guidelines for Dredging (NAGD 2009) and EPA Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland 1998 – Environmental Investigation Levels (EIL) was determined.

The sediment sampling undertaken for the Western Basin Dredging and Disposal Project demonstrated the presence of minor concentrations of anthropogenic contaminants and naturally occurring compounds in individual samples across the areas to be dredged. Individual results that were above either the NAGD (2009) and/or the QEPA EILs 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. 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. The exception would be any dredging stages not dredged within the next 5 years, which is the maximum time samples can be treated as current, or the introduction of a new contaminant source into the Harbour in the vicinity of the areas to be dredged.

Potential Impacts and Mitigation Measures

The main potential impact of the Project with respect to sediment quality is the resuspension of sediments subsequent contaminant resuspension and/or desorption and re-entry into the water column. This may occur through overflow during trailer suction hopper dredging, bottom dumping and rehandling, disturbance of bottom sediments during rock placement during bund wall construction and during filling of the reclamation. Sampling of surface sediments underlying the proposed Reclamation Area indicated that the concentrations of contaminants are compliant to relevant guidelines. The material to be dredged was also analysed and the sediments were assessed as suitable for placement within the proposed Western Basin Reclamation Area.

Therefore, it is not expected that mobilisation of sediments into the water column will result in the introduction of contaminants into the water column. Monitoring of water quality will be undertaken during dredging and management measures implemented if trigger levels relevant to background water quality levels within Port Curtis are exceeded. Management measures may include alteration of dredging activities (frequency, duration, intervals, timing with respect to tidal run) to enable water quality levels to return to background conditions. The inner face of the bund wall will be lined with geotextile fabric and internal decant ponds will be established to manage the quality of tailwaters discharged from the reclamation.

Coastal Processes

Existing Environment

Within Port Curtis the principal drivers of sediment movement are tidal currents and locally generated waves. Important but infrequent drivers are extreme events like cyclones which can generate high waves and water levels that can have major effects on the environment and affect areas that would not normally be affected under prevailing conditions.

Surface sediments in Port Curtis range from unconsolidated silts and clays in the shallow tidal flats north and west of the Reclamation Area to coarse sands and gravel in the deeper areas. The processes that transport sediment around the area are dominated by tidal currents driven by the relatively large spring tides, coupled with a mild wave climate that stirs up sediments in the shallower areas at times of low tide.

Port Curtis is subject to a relatively high tidal range and has a large tidal compartment, being the area of waterway into which the tide propagates. This produces tidal currents up to 1.5 m/s in the main channels and up to 0.35 m/s on some of the shallower areas. These velocities are capable of moving large amounts of sediment depending on the water depth and wave action. In deep areas, tidal currents are the dominant motive force for sediment movement, and in shallower areas, where tidal currents are smaller, it is the combination of wave action and tidal currents that are important.

Tides in this area go through a neap-spring cycle over a period of approximately 14 days, with ranges of around 4m at the spring and 1m during the neap. The estuary has extensive intertidal banks, mangrove, and saltpan areas that are inundated to various degrees, depending on the tidal range. The large tide range and associated high tidal currents means that the estuary waters are well mixed.



The area is protected from ocean-generated sea and swell waves by Curtis Island and Facing Islands to the east and hence the wave action at the site is relatively mild, although there is a substantial fetch for the generation of waves to the east south-east. The site is subject to locally generated waves under the influence of local wind conditions and to higher waves, principally from the east south-east, during cyclonic conditions.

Potential Impacts and Mitigation Measures

Hydrodynamic modelling was used to examine the impact of the proposed Reclamation Area in the Western Basin and the various dredging scenarios on the coastal processes in the harbour and adjacent areas through an assessment of the changes to water levels, tidal currents, ambient and extreme wave climates, and transport of sand and silts as a result of the Project.

The Reclamation Area affects the hydrodynamics of the harbour through a reduction in the tidal prism and, on a local scale, obstructs flows that previously flowed across its footprint area. This leads to a reduction in flows downstream of the Reclamation Area and an increase in flows adjacent to the Reclamation Area from the reduction in the cross sectional area leading up to The Narrows. The Reclamation Area also produces quite different flow conditions within its immediate vicinity, particularly in the shallow areas to the north and west.

The dredged channels reduce tidal flows within their footprint due to the increased cross sectional area available for the flow. However, the increased capacity of the dredged channel (albeit at a lower velocity) leads to increased flows in the undredged areas upstream, increasing the sand transport potential into the newly dredged channels / swing basins. The quantity of sand sized material is relatively small and is likely to be concentrated at the northern end of the newly dredged areas at the toe of the dredged batter, but will nevertheless, need to be removed when it limits shipping draft.

The dredged channels will provide increased regions within the Western Basin that are in a relatively low energy hydrodynamic regime and hence, are likely to experience significant silt deposition (255,000 m³/yr) that will require regular maintenance dredging to maintain the design depth of the channels / swing basins / berth pockets. The expected level of maintenance dredging represents a significant increase compared to the current maintenance dredging commitment.

From a physical coastal processes viewpoint, the potential impacts of the proposed development consisting of a large scale reclamation of part of the tidal waterway and extensive new dredged channels, swing basins and berths are summarised as follows:

1. The changes in flow and water level conditions adjacent to the Reclamation Area to the north and west, and potentially, the changes to the rate at which the ebb tide level drops, reducing the time that the tidal flats are dry during the lower parts of the tidal cycle;
2. The initial scour of fine silts from the north-eastern corner of the Reclamation Area;
3. An increase in maintenance dredging of sand sized sediment in the new dredged channels and swing basins that is commensurate with the existing maintenance commitment; and
4. Potentially, a large increase in maintenance dredging to remove fine silts from the new channels and swing basins adjacent to the Western Basin Reclamation and in the turning basins adjacent to Curtis Island.

It is not necessary to mitigate the changes to the tidal flows and water levels in themselves as the changes are within the normal bounds of the processes that occur in the natural system (representing



the inherent variability of coastal and estuarine environments in a macro tidal area). However, it may be necessary to mitigate against or manage some of the effects that these changes bring about, such as increased sedimentation.

The most practical management measure for the increased potential for sedimentation in the dredged channels is to monitor the actual deposition rates and devise a maintenance dredging plan to arrange its removal to the reclamation so that there is no interruption to future ship movements. This rate of siltation of fine silts could be accommodated by an over-dredging allowance to extend the time between maintenance dredging campaigns.

Water Resources

Surface Water and Watercourses

Existing Environment

Two unnamed creeks (referred to as Creeks A and B) and several small overland flow paths presently discharge into the area to the north of the existing Fisherman's Landing Reclamation. Six catchments were identified as discharging into the intertidal channel that will be created behind the proposed Reclamation Area. These catchments are relatively small and do not contain significant potential pollutant sources.

Two existing industrial developments, Cement Australia and Queensland Energy Resources Ltd, also discharge into the area adjacent to the proposed Reclamation Area. These stormwater discharges are required to meet Development Approval conditions, therefore the quality of these discharges is managed before it leaves the site from which it is generated.

Potential Impacts and Mitigation Measures

As a result of the proposed Western Basin Reclamation Area, Creek A, the several small overland flow paths and the two existing industrial developments will all discharge into the intertidal channel. Creek B will discharge beyond the northern extremity of the proposed Reclamation Area and is therefore not impacted. Estimated peak discharges within the intertidal channel were determined to assess the impact of the construction of the Reclamation Area on surface water and industrial discharges. Afflux resulting from stormwater conveyance within the intertidal channel, under HAT conditions, is negligible. Therefore, the effect on Creek A is considered negligible. Furthermore, the stormwater outlets of the two industrial developments should not be adversely affected.

Predicted velocities resulting from stormwater conveyance within the intertidal channel were calculated for LAT and HAT. Predicted velocities within portions of the intertidal channel, under LAT conditions, could be sufficiently high (approximately 0.7 m/s) to result in the resuspension of benthic sediments, potentially causing scour adjacent to the proposed bund wall. Predicted peak velocities at the outlet of the intertidal channel during low tailwater conditions are considered high (>1.5 m/s). The proposed temporary at-grade construction access road that is to traverse the intertidal channel to gain access for construction of the western bund wall is considered to have negligible impacts provided that the road elevation matches that of the channel invert.

Mitigation measures include rock armouring of the outlet of the intertidal channel rock, monitoring of the intertidal channel to determine if significant deposition or scour are occurring and removal of the temporary at-grade construction access road at the earliest opportunity practicable.



Following filling of the Reclamation Area, the final surface will be capped with suitable material and/or revegetated. However, there remains the potential for sediments to be entrained in the stormwater runoff and released to the harbour. This stormwater is unlikely to be contaminated with nutrients, organics, hydrocarbons or metals as there will be no activities occurring on the undeveloped Reclamation Area that would result in the introduction of contaminants into the stormwater runoff. A conceptual design of a stormwater management system (including drainage system and stormwater treatment measures) for the proposed Reclamation Area was undertaken to demonstrate that a functional stormwater management system that can manage stormwater runoff and minimise the discharge of sediment-laden and turbid waters to Port Curtis is practicable. Grass lined channels have been recommended for stormwater drainage and a Type D wet sediment basin recommended as the final stormwater treatment measure.

Groundwater

Existing Environment

A review of the existing groundwater environment in the vicinity of the proposed Reclamation Area was undertaken through a census of existing bores, installation of six additional groundwater monitoring bores, groundwater monitoring at existing and new bores, description of existing hydrogeological conditions and preparation of a groundwater flow model, in order to quantify the potential impacts of the proposed development on groundwater levels. Model development was carried out using the MODFLOW suite of modelling code and modules.

The geological/hydrogeological units identified in the vicinity of the Reclamation Area through the desktop review and field investigations are:

- ▶ Fill, including marine dredge and quarried material;
- ▶ Coastal/estuarine sediments (Qhe/m, Holocene –age);
- ▶ Alluvium (Qa and TQa, Quaternary-age) and colluvium (TQr, Quaternary-age); and
- ▶ Bedrock of varying age.

Forty eight existing groundwater bores were identified within a 5 km radius of the Project Area. Groundwater in the alluvium/colluvium within a 5 km radius of the Project Area does not appear to be used for water supply. It appears that groundwater in bedrock is used locally for water supply, however the nearest groundwater abstraction to the proposed Reclamation Area appears to be approximately 4.4 km west.

Historic groundwater level data (for 2001 – 2009) suggest typical seasonal level fluctuations of 0.4 to 1 m in shallow groundwater (<15 m bgl) within natural strata. Groundwater levels close to the coastline are also likely to fluctuate on a sub-daily and monthly basis in response to tidal movements. Measured groundwater levels for the coastal strip immediately west of the Project Area (July to September) ranged between 0.7 mBGL (m below ground level) and 2.8 mBGL. Groundwater levels approximately 500 m further inland ranged from 4.5 mBGL to 7.4 mBGL. Automatically recorded groundwater level data confirm small sub-daily and monthly groundwater level fluctuations in response to tidal movements of between 0.02 and 0.075 m. Groundwater elevations for the 15 monitored bores indicate groundwater flow in the alluvial/colluvial deposits is from south west to north east, towards the coast and the proposed Reclamation Area.

Analysis of the major ion groundwater chemistry data indicates that the groundwater is of sodium-chloride type, which is not unexpected given the proximity of the monitoring bores to the coast.



Laboratory testing results indicate that the groundwater contains concentrations of dissolved metals (chromium, copper, cobalt, lead, nickel and zinc) and nutrients (ammonia as N) above the ANZECC (2000) guideline values for marine aquatic ecosystems (at the 95% level of protection) at one or more monitoring locations. Groundwater immediately west (alluvial/colluvial deposits) and south (Fisherman's Landing) of the proposed Reclamation Area is brackish to saline with a neutral to slightly acidic pH. Total dissolved solids concentrations and electrical conductivity indicates that the groundwater in the alluvial/colluvial material in the coastal strip of land immediately adjacent to the proposed Reclamation Area and in the deposits of Fisherman's Landing is unsuitable for drinking, stock watering and irrigation. Based on limited data available, the groundwater in bedrock is considered not to be good drinking water, but could potentially be used for irrigation and stock watering.

Potential Impacts and Mitigation Measures

Based on the design of the Project, which includes the maintenance of an intertidal channel between the existing coastline and the Reclamation Area, no significant impacts on groundwater resources and/or groundwater quality are anticipated. Nevertheless, potential sources of groundwater impacts during construction and/or post construction are:

- ▶ Groundwater modelling results indicate that groundwater levels in the coastal strip adjacent to the Reclamation Area may increase by up to 0.8 m due to revised groundwater flow patterns post development. However, model predictions also suggest that for the most part groundwater levels will remain more than 1 m below surface and hence risks of water logging and/or soil salinisation will only be increased in isolated areas totalling around 0.175 km²;
- ▶ Degradation of groundwater quality adjacent to the Project Area as a result of any leaks and spills originating from construction activities on the landward side of the proposed Reclamation Area; and
- ▶ Acidification and degradation in quality of the surrounding marine waters if any acid sulphate soil material used in the reclamation is not managed appropriately. This could lead to the mobilisation of metals in the fill material, such as aluminium and iron, and subsequent discharge to the receiving environment.

The following measures are proposed to monitor and mitigate the potential impacts identified:

- ▶ Groundwater monitoring (levels and quality), for a minimum 12 month period prior to the start of construction both in the alluvial/colluvial deposits and fill material and the coastal areas adjacent to the proposed Reclamation Area;
- ▶ Regular assessment of groundwater monitoring results against baseline groundwater conditions during construction;
- ▶ The installation of inlets and/or drainage channels at sea level within the proposed Reclamation Area, thereby minimising groundwater level mounding within the area itself and hence, reducing the potential for increased groundwater levels in onshore areas;
- ▶ If impacts on groundwater levels are identified, an assessment of potential mitigation measures will be conducted, which will include the use of the groundwater flow model to help assess the effectiveness of proposed mitigation measures; and
- ▶ Storage areas for vehicles, machinery, equipment, chemicals etc., whether on land or within the Reclamation Area, during construction will require appropriate facilities to contain spills, leaks and surface water runoff to reduce the potential for contamination of groundwater through infiltration.



Nature Conservation

Sensitive Environmental Areas

The Project is located within or adjacent to the following sensitive environmental areas:

Significance Classification	Sensitive Environmental Area
Commonwealth	
EPBC Act 1999	
World Heritage properties	Great Barrier Reef World Heritage Area, QLD
National Heritage places	Great Barrier Reef, QLD Balaclava Island and The Narrows, QLD
Wetlands of International Importance (Ramsar Wetlands)	None present
Threatened species and ecological communities	7 potential threatened flora species 13 potential threatened fauna species 2 threatened ecological communities
Migratory species	86 potential migratory species
Commonwealth Marine Areas	None present
Nuclear actions	Not applicable to this Project
DEWHA's Directory of Important Wetlands Database	
	Port Curtis, QLD
	The Narrows, QLD
Great Barrier Reef Marine Park Authority	
	Great Barrier Reef Marine Park
	Rodds Bay Dugong Protection Area, QLD
State	
Vegetation Management Act 1999	
Regional Ecosystems	1 Endangered RE
Moratorium mapping	Extensive areas present
Essential Habitat	Essential Habitat for one species (<i>Phascolarctos cinereus</i> - koala)
Nature Conservation Act 1992	
Threatened flora species	14 potential threatened flora species
Threatened fauna species	26 potential threatened fauna species
Protected areas	Rodds Bay Dugong Protection Area, QLD Targinie State Forest
Marine Parks Act 2004	
Protected areas	Great Barrier Reef Coast MP
Fisheries Act 1994	



Significance Classification	Sensitive Environmental Area
Protected areas	Rodds Bay Dugong Protection Area, QLD Colosseum Inlet (level A and B – Fish Habitat Area 037) 30 km south of the Project Area The Calliope River mouth is currently under consideration as a Fish Habitat Area
Marine plants	12 marine plant species
EPA Biodiversity Planning Assessment	
Significant areas	Areas of State significance
Local	
EPA Gladstone Harbour Protection and Enhancement Strategy	
Significant areas	Major shorebird roost and feeding sites

The potential impacts of the Project on these sensitive environmental areas was considered in the marine and terrestrial ecology sections of the EIS.

Terrestrial Flora and Fauna

Existing Environment

The ecological values of the study area were established through a combination of literature reviews and field surveys and potential impacts and mitigation measures for terrestrial flora, fauna and sensitive areas were identified. The study area lies at the northern extent of the South East Queensland bioregion and eastern extent of the Brigalow Belt bioregion, both of which support a diverse range of flora and fauna.

The Regional Ecosystem (RE) mapping over the study area is generally correct and identifies nine REs (eight Not of Concern and one Endangered listed under the VM Act). The mapping of the endangered RE 12.3.3 (Queensland blue gum woodland to open-forest on broad alluvial plains) is incorrect. High quality regrowth for this RE type exists (i.e. vegetation in a non-remnant state), however other areas mapped as containing this RE actually contain RE 11.3.29 (VMA Status: Not of Concern).

The vegetation communities range from eucalypt woodland and open-forest communities to tidally influenced mudflats and mangroves. Condition assessments identified that the majority of the vegetation communities were in good condition. Seven fauna habitat types are represented in the study area and these generally correspond to the delineated vegetation communities. In general, the habitats identified within the study area provide a range of resources for fauna. Variation in the complexity of the vegetation strata provides for differences in habitat values. The woodland areas demonstrate increased complexity relative to the grasslands and are considered to support a greater number of fauna species. Disturbed areas, mainly the grassland habitats, exhibited reduced species richness though retain important foraging habitat values for a range of fauna species.

The intertidal and coastline habitats, such as those with tidal influences or estuarine vegetation complexes, provide a distinctly different fauna assemblage, as do the freshwater areas. The exposure to coastal processes (winds, saline water, tides and wave action) result in an ecotone between estuarine



and inland habitats. This ecotone displays characteristics of both marine and terrestrial landscapes and is similarly expected to provide habitat for species common to both landscapes.

Desktop assessments indicated that 16 flora species of conservation significance occur or had the potential to occur within the study area. Of these 14 species are listed under the Queensland NC Act and seven listed under the EPBC Act. Fourteen of these species do not have their specific habitat requirements met in the study area and its immediate vicinity. Three species may possibly occur in the study area: *Cycas megacarpa*, *Indigofera baileyi* (Bailey's indigo) and *Quassia bidwillii* (quassia). However, none of these species were recorded during the field investigation.

Based on desktop assessments and field surveys, 27 fauna species of conservation significance are considered likely to occur in the study area. The majority of these species are considered to inhabit the dryland terrestrial environment adjacent to the reclamation footprint. This area has potential for indirect impacts only. In addition, the reclamation footprint boundary includes marine tidal flats used for foraging and roosting by a number of EPBC Act-listed migratory shorebirds. Mudflats in the north of the study area are considered important habitat for shorebirds within the Gladstone region.

Potential Impacts and Mitigation Measures

Impacts and risks associated with the project to the terrestrial ecosystems are generally linked to the loss and potential degradation of marine plant communities and intertidal habitats. The change in coastal processes as a result of the reclamation is likely to reduce the extent and suitability of foraging habitat for shorebirds in the area. How shorebirds will respond to these changes is uncertain. For some shorebird species the predicted changes in hydrology may be beneficial, at least in the short term. For others (and perhaps the majority of species currently utilising habitat in this area) these changes are more likely to be detrimental. Impacts on the marine plant vegetation communities in the intertidal area may also occur as a result of changes in coastal processes. As a result, marine plant offsets will be negotiated in accordance with relevant legislation including the EPBC Act and Queensland Government offset policies. In addition to expected offset requirements, mitigation measures proposed include: minimising construction of the northern bund wall during critical bird migratory periods if possible, widening the retained channel entrance, establishing speed limits on access roads, installing rubbish disposal facilities and managing tailwater decant. Monitoring of marine plant and migratory shorebird communities will also be undertaken to allow for adaptive management of impacts during the construction and operation of the Project.

Marine Ecology

Existing Environment

A benthic survey of multiple sites within and adjacent to the proposed dredging area and a Reference Location was undertaken, along with a review of previous studies, to characterise the marine communities of the Study Area. The Project Area supports a number of key marine benthic habitats, some of which are unique to those areas with regard to the species compositional mix they support, the majority of which are, however, well represented within the Study Area.

Survey sites in the Western Basin and Fisherman's Landing area were dominated by soft silty, muddy benthic habitats supporting communities that were similar in their composition. Sites in the Reference Area, The Narrows and the Passage Islands all supported a mixture of sediment types across the different sites and the community composition at each site was reflective of this. Survey sites in the



channels had the most diverse sediments on a site by site basis with no silty sediments and a dominance of coarse sand, rubble and some rock.

The taxonomic composition of the macroinvertebrate benthic communities were fairly similar to one another at Western Basin, Fisherman's Landing and the Reference Area where around half of all the organisms present were molluscs and crustaceans with seagrass and algae the other dominant benthos. These communities differed from those at The Narrows, Channel and Passage Islands where a more diverse, greater proportion of different types of animals were observed, specifically, there were more echinoderms, corals and anemones, bryozoans, ascidians and sponges. Western Basin and Fisherman's Landing had the least diverse communities of all locations surveyed.

Marine fauna surveys for key species such as marine turtles, dugong and dolphins were also undertaken. Literature on previous studies within the region was reviewed prior to conducting field work to provide information on seasonal habitat distribution and species presence to assist in designing the survey to meet local conditions and anticipated marine fauna. A survey program over nine months was implemented and included aerial and boat-based surveys for marine megafauna at a regional and finer spatial scale. Habitat utilisation of these areas by key marine fauna species was recorded and interpreted in the context of the proposed development.

Surveys recorded marine megafauna within the footprint of the development and throughout the Study Area. Megafauna identified on boat-based and aerial surveys include marine turtles, dugong and dolphins (majority were Indo-Pacific humpback dolphins).

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 (Tannum Sands) associated with known seagrass habitats. The dugong spatial model applied to the Project aerial survey data highlights the importance of three core regions in the Study Area at high tide.

The marine megafauna study supported a number of key findings:

- ▶ Dugong distribution recorded in the current survey supports previous aerial survey observations by Marsh *et al.* 2005 and a close association with seagrass habitats. The habitat utilisation by dugongs was notably different at a high tide compared with low tide distributions, suggesting the importance of inter tidal seagrass habitats to dugongs in this area.
- ▶ Marine megafauna species are widely distributed throughout Port Curtis and the Gladstone region with observed high habitat utilisation, recognising the importance of Rodds Bay DPA habitat area for these coastal species, particularly on a high tide;
- ▶ The environment of Western Basin and adjacent waters represent important habitat for Indo-Pacific humpback dolphins of various age classes as numerous calves were observed on survey;
- ▶ Nesting habitats for marine turtles do not occur within the immediate footprint of the Project though inter-nesting habitat is identified within the Project Area; and
- ▶ Good quality foraging habitats exist for green turtles and habitat of high conservation value to dugongs is recognised throughout much of the Project Area and Port Curtis.

Potential Impacts and Mitigation Measures

As the Project involves reclamation of approximately 235 ha of seabed within the Western Basin footprint the marine benthic habitats in this area will be directly impacted. Areas to be dredged in proposed channels will also be directly impacted. The primary direct impact will involve removal of all seabed



environment under the direct footprint of the Reclamation Area and channel dredging areas, which totals approximately 902 ha including habitat that is already dredged and will be deepened. Areas within the channel are expected to be recolonised post dredging within two to five years, but probably with different species composition.

The major indirect impacts expected include degradation of water quality during dredging and disposal activities resulting in displacement of mobile fauna and potential die back of benthic fauna and alteration of the hydrodynamic regime in the Project Area. This is expected to increase sedimentation in some locations, such as along the eastern face of the reclamation footprint, but is also expected to increase scouring potential around the bund and will impact on low water levels and therefore drying time in the area to the north of the reclamation.

The main potential construction impacts which may result during the reclamation and channel dredging works are, therefore:

- ▶ Removal of benthic habitat, particularly benthic primary producer communities that support fisheries taxa and protected and threatened marine megafauna;
- ▶ Declines in water quality associated with construction events, particularly from the combined effect of dredge plumes; and
- ▶ Potential impacts to fauna, particularly turtles and dugongs, from vessel operations and noise during dredging.

The main potential operational impacts include:

- ▶ Continuous disturbance to benthic systems or mobile species transit routes from an altered hydrodynamic regime;
- ▶ Ongoing impacts to water quality from reclamation decant operations;
- ▶ Increased potential of pollution to the marine environment as a result of land use change.

In addressing the potential risks to the marine system from the Project proposed mitigation measures were examined, where opportunities to mitigate impacts are available. These were detailed above and, in brief, include:

- ▶ Development and implementation of a reactive dredge management plan to mitigate against impacts on water quality from dredging activities;
- ▶ Dredge activities to be restricted to agreed footprint of channel works;
- ▶ Development and implementation of a reactive sensitive habitat monitoring program to inform dredging activities and mitigate against potential impacts to these systems from declines in water or sediment quality. This may include development of tolerance limits of sensitive systems prior to dredging commencing;
- ▶ Implementation of waste management plans;
- ▶ Appropriate design of the reclamation facility to reduce water quality impacts from leaching of material through the bund wall, decant waters and stormwater run-off and to reduce benthic habitat scouring potential around the bund;
- ▶ Removal of marine fauna from the Reclamation Area prior to bund closure to avoid fatalities of the animals that previously occupied this footprint;



- ▶ Dredge management strategies to avoid impacts upon marine megafauna including use of spotters and turtle exclusion devices;
- ▶ Use of soft starts during pile driving activities to minimise potential impacts upon nearby marine fauna; and
- ▶ Considered use of speed restricted areas and education of workforce regarding potential for vessel impacts upon marine megafauna to reduce potential for damaging or fatal interactions.

A number of direct impacts are not able to be mitigated. These primarily relate to loss of habitat as a consequence of the Project activities. Offsets will be implemented for these habitat losses. Some benthic marine habitat will be created by the Project and an estimate of the areas to be lost and gained as a result of the Project activities has been provided in the EIS.

Air Quality, Noise, Vibration and Greenhouse Gas Emissions

Air Quality

Existing Environment

In 2007 the EPA released an air monitoring report for Queensland, in accordance with the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM). The results published in this report showed that carbon monoxide, lead and ozone measurements were not required in Gladstone as pollutants were reasonably expected to be consistently below the relevant AAQ NEPM standard. For nitrogen dioxide, sulphur dioxide and PM₁₀ (particulates of 10 microns or less) the monitoring results demonstrated that the performance standards and goals of the AAQ NEPM were met during 2007 in Gladstone.

Potential Impacts

The likelihood of significant air emissions from either the construction or operation of the Project is low as the major construction activities are to be undertaken at a maximum height of RL 7 (construction of the bund wall for the Reclamation Area), but will mostly be completed below the high water mark (dredging).

Potential sources of air emissions from the Project include:

- ▶ Dust emissions from mechanical disturbance during the placement of rock in the bund once it is above the high water mark;
- ▶ Vehicle exhaust emissions from construction traffic, including trucks delivering quarry materials and the movement and operation of construction machinery on the bund wall;
- ▶ Dust emissions from mechanical disturbance during the placement of capping material on the final reclamation surface;
- ▶ Dust from the completed surface of the reclamation; and
- ▶ Exhaust emissions from dredge vessels.

Vehicle exhaust emissions during construction have the potential to impact on air quality; however the impact is likely to be very low due to the number of vehicles and short-term period of construction. Dust emissions have the potential to affect health and amenity, however due to the short-term nature of construction, the limited amount of construction activity being undertaken above water and the distance



from sensitive receptors, there is a very low likelihood of dust emissions impacting on either health or amenity.

The mitigation of the impacts identified above is proposed through the following measures:

- ▶ Dust suppression trucks to be used on the Reclamation Area, as required;
- ▶ All construction vehicles including dredging vessels to be properly maintained and standard emission reduction devices are to remain on vehicles; and
- ▶ Progressive revegetation of the reclamation area in stages as construction is complete.

Greenhouse Gas Emissions

Existing Environment

A greenhouse gas (GHG) assessment was completed to provide a qualitative investigation of potential greenhouse gas emissions associated with the Project. Where sufficient information was available regarding emission sources likely to be significant for the Project, a quantitative assessment of these emissions has been undertaken. Sources of GHG emissions identified for the Project are:

- ▶ Transportation of the bund armour and core material from the quarry to the Reclamation Area;
- ▶ Embodied emissions from the manufacturing of the geotextile material;
- ▶ Diesel fuel consumption of the on-site machinery; and
- ▶ Fuel required for capital dredging programs that will fill the Reclamation Area with dredged material.

The total GHG emissions from the construction phase of the Western Basin Dredging and Disposal project are estimated at approximately 300,500 tonnes of carbon dioxide equivalent (tCO₂-e). The use of fuel for the capital dredging operations will be the most significant source of GHG emissions for this project.

Potential Impacts and Mitigation Measures

When compared with the annual baseline emissions for the State of Queensland, the GHG emissions potentially being generated from the main sources during the construction phase of this project could be expected to be approximately 0.17% of Queensland's annual emissions.

A number of potential mitigation options were identified for the project to reduce the quantity of GHG emissions arising from the Project;

- ▶ Design of the dredging operation to reduce overall fuel use;
- ▶ Scheduling the dredging programs so that the same dredgers can be used for multiple dredging stages;
- ▶ Selecting newer dredges with more efficient engines, if possible;
- ▶ Implementation of efficient driving methods by the drivers operating the trucks transporting the quarried materials to the site;
- ▶ Reduction of possible congestion associated with the filling and emptying of the trucks at the quarry and Reclamation Area should be implemented to avoid trucks spending more time on each trip than is necessary;
- ▶ The potential to use bio-fuels for the transport vehicles should be investigated;



- ▶ Investigating the potential to source polyester geotextile manufactured from recycled PET;
- ▶ Use of the most suitable site equipment that can carry out the required tasks with the most efficient fuel consumption rates; and
- ▶ Carrying out any additional fuel and energy savings measures identified in the Gladstone Port Corporation Energy Efficiency Opportunity assessments, such as the implementation of a system for analysing energy usage, as well as working to ensure that energy efficiency clauses are included in all equipment tender specifications.

Noise and Vibration

Existing Environment

The baseline noise environment of the Project Area was established through monitoring. A review of sensitive receptors for both dredging and bund construction operations was undertaken and noise goals were established for the Project.

The nearest sensitive receptor (residential) to the Reclamation Area is 5.5 km away and the nearest sensitive receptor (residential) to the areas to be dredged is 450 m away. The area surrounding the Project Area has been noted to experience elevated evening and night-time noise levels due to existing industrial noise. This includes rail shunting, existing annual maintenance dredging in the Clinton Channel, industrial noise from Port Central and road traffic noise in the area. Residents in Gladstone are also located within 200 m of road, rail and industrial activities that operate 24 hours a day.

Noise modelling was undertaken to assess the impacts of the proposed dredging and reclamation activities using Computer Aided Noise Abatement software (CadnaA).

Potential Impacts and Mitigation Measures

Noise sources that were modelled are from the following activities:

- ▶ Construction of the reclamation area, including tip trucks, earthmoving machinery, vibratory rollers and other smaller construction vehicles;
- ▶ Dredging activities including the operation of large and medium trailing suction hopper dredgers, large and medium cutter suction dredgers, backhoe dredger and workboats, survey boats and tug boats; and
- ▶ Pile driving for the 19 beacons and channel markers to be installed.

It was assumed that construction activities will be undertaken in the Reclamation Area between the hours of 6.30 am and 6.30 pm, Monday to Saturday. No construction activities will be undertaken on Sundays or public holidays. It was assumed that dredging activities will occur seven days a week, 24 hours a day. Worst-case noise modelling was undertaken and modelled sources were assumed to operate under full load at all times.

The results of the modelling show that the predicted noise levels from construction activities are below the ambient and background noise levels and comply with the worst case night time site specific criteria of 45 dB(A) for the receiver on Fisherman's Road and 25 dB(A) for the receivers on Targinie Road.

Noise from dredging activities has the potential to exceed the project noise goals by 3 dB during the night time period at one receiver (Tide Island) during neutral weather conditions and three receivers (Tide Island, Endeavour Parade/Flinders Parade/Auckland Street/Oaka Lane and the State Marine Park



boundary at Friend and Laird Points) by 1 dB during noise enhancing weather conditions. Any exceedance of noise goals is likely to be temporary as the dredging vessels will be constantly moving, therefore the location of the noise source will not be in any one location for an extended period of time.

The results of the assessment suggest that construction activities associated with the Project will not significantly impact on:

- ▶ The health and biodiversity of ecosystems;
- ▶ Human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to sleep, study and be involved in recreation, including relaxation and conversation; and
- ▶ The amenity of the community.

To further minimise noise emissions the following management and mitigation measures will be implemented:

- ▶ All combustion engine plant, such as generators and compressors, will be checked to ensure they produce minimal noise and machines found to produce excessive noise compared to industry best practice will be removed from the site or stood down until repairs or modifications can be made;
- ▶ Where practical, all vehicular movements to and from the dredging site will be made only during normal working hours;
- ▶ Where practical, machines will be operated at low speed or power and be switched off when not being used rather than left idling for prolonged periods;
- ▶ Activities that cause excessive noise (such as pile driving) will be limited to business days or Saturdays between 6:30 am and 6:30 pm and pile driving will, where possible, be undertaken during a low tide;
- ▶ Community consultation will be undertaken at the sensitive receivers prior to works;
- ▶ Where possible, dredging in areas close to sensitive receivers will be avoided during the night time period; and
- ▶ Vehicles, dredgers and tugs will be kept properly serviced and fitted with appropriate mufflers.

It is possible that the sensitive receivers will observe vibrations from construction activities at times. The nearest sensitive receivers will be located further than 500m of the construction activities, and as such, no appreciable impact is expected and no mitigation measures are required to manage impacts.

Transport

Existing Environment

A former quarry situated at Guerassimoff Road, Yarwun is being re-established by GPC to provide a source for hard rock quarry materials for the construction of the Reclamation Area bund wall. This quarry is located approximately 4 km from the proposed Western Basin Reclamation Area. The trucks used to haul rock from the quarry to the Reclamation Area will be based at the quarry. An off-road haul route will be established should off-road mining trucks be required to achieve a higher construction rate. If a lower construction rate, and smaller vehicles are utilised, a road route will be established, with loaded vehicles journeying via Serrant Road and return unloaded via Landing Road.



Equipment and plant for construction of the Reclamation Area and small volumes of construction waste will be transported on the existing road network, accessing the Western Basin Reclamation Area along Landing Road. No hazardous material will be transported, except for fuel for the reclamation construction traffic, which will be provided by dedicated fuel trucks or at a licensed fuel storage facility at the quarry site.

The existing road network that is likely to be utilised by construction specific workforce traffic is predominantly rural. The intersection between Gladstone – Mt Larcom Road (operated by the Department of Transport and Main Roads) and Landing Road (operated by Gladstone Regional Council) was analysed to assess the effects caused by the additional traffic from the construction of the Reclamation Area.

Waterborne traffic within the Port may be classified as shipping and port vessels and small craft. The proposed Reclamation Area and proposed new channels is located in an area that is currently used for various recreational activities. Existing channels that will be deepened for this Project are utilised by commercial vessels accessing the existing Fisherman's Landing facility. Non-fishing boating activity includes smaller vessels and yachts that use the adjacent channel to access in and out of the Narrows.

Potential Impacts and Mitigation Measures

Workforce Traffic and Pavement Impacts

It is expected that a total workforce of 225 people will be used during the peak dredging period. The workforce during the construction of the Reclamation Area will be substantially lower than during dredging operations, with a workforce of 30 – 40 people anticipated. The traffic analysis was performed using the dredging workforce commuting to the Western Basin Reclamation Area as this is considered to represent the worst case scenario for workforce traffic for this Project. The intersection analysis was conducted using SIDRA Intersection 3.2. Three scenarios were modelled, these being existing traffic (2009), future traffic (2011) without construction traffic and future traffic (2012) with construction traffic. These follow the planning guidelines stipulated in Section 13.4.4 of the DTMR *Road Planning and Design Manual*. It is anticipated that the construction activities will be most intensive in 2011 and thus, have the greatest impact on the road network.

The performance of the intersection between Gladstone – Mt Larcom Road and Landing Road remains at a Level of Service (LOS) A (highest level of service) for all traffic movements for the peak workforce scenario. Therefore, the intersection can be considered adequate for both future year scenarios. The intersection has spare capacity and will not require any upgrades. As the Landing Road / Gladstone – Mt Larcom Road intersection operates at a LOS A with a key right turn movement without right of way, other intersections along the Gladstone – Mt Larcom Road should be operating at similar levels of service with the predicted traffic levels.

The majority of vehicles used by workers to commute to and from the Western Basin Reclamation Area along Gladstone – Mt Larcom Road during construction of the Reclamation Area and dredging will be cars and light trucks that will have a minimal impact on the pavement of the roads used.

The pavement and traffic impacts of the preferred transport routes for the haulage of rock from the quarry at Guerassimoff Road to the Reclamation Area were assessed in a separate options study and approvals process. Some repairs may be required to Landing Road and maintenance will be required to be undertaken on Serrant Road at the completion of haulage if the road route is utilised.



Rail and Airport Impacts

There is a rail line that runs into Cement Australia and there are two level crossings along Serrant Road that cross the rail loop. Commuter traffic for the construction of the Reclamation Area will be instructed to use the route consisting of Landing Road to the end curving around onto the Strategic Port Land. This will not impact on the local rail infrastructure. The road haulage route will use Serrant Road. Adequate signage has been provided at the rail crossings to minimise potential collisions between haulage vehicles and trains.

Review of the Airport Overlay Code map in the “Gladstone Plan”, indicates that the Obstacle Limitation Surface (OLS) for the Gladstone Airport will not be impacted by the construction of the Western Basin Reclamation Area.

The Gladstone Calliope Aerodrome Board had a long-term proposal to construct a future Airport on Kangaroo Island. Given the current upgrade of the Gladstone Airport and the annexure of the Kangaroo Island Reserve into the Gladstone State Development Area as a “Restricted Development Precinct”, it is considered unlikely that the Airport will proceed on the Kangaroo Island site. It is therefore concluded that the proposed Western Basin Dredging and Disposal Project will not have an impact on the use of the Kangaroo Island site as an airport.

Marine Traffic

The proposed Western Basin Reclamation Area is west of the current port facilities, therefore no impacts to the existing commercial shipping traffic and facilities are anticipated during construction of the Reclamation Area. There may be an exclusion zone around the bund wall itself, which may place restrictions on recreational and commercial fishing activities in this area.

Prior to the commencement of bund construction and dredging operations, the Regional Harbour Master will issue a “Notice to Mariners” as the means of advising the masters of all vessels using the port of the specifics of the dredging and bund construction works, including any restrictions to draft, the presence of floating and sunken pipelines, exclusion zones around the dredging and reclamation construction areas and the presence of the Material Discharge Area adjacent to the Reclamation Area.

All dredgers, pipelines, support vessels and the Reclamation Area will be marked and lit as per the requirements of the relevant legislation and guidelines to maintain marine safety. Dredgers will be required to exit existing shipping channels when commercial shipping vessels are committed to sailing the channel reach.

Dredgers will be required to carry a spill response kit in case fuel is spilt. GPC also has a contingency plan in place for petroleum spills associated with shipping operations within the Port that will be implemented should a major incident occur. Dredgers and other support vessels will also be required to operate under the requirements of the *Transport Operations (Marine Pollution) Act 1995* with respect to the management of ships waste.



Cultural Heritage

Existing Environment

Indigenous Cultural Heritage

Section 87 of the *Aboriginal Cultural Heritage Act 2003* (the Act) states that, as the Project requires an EIS, the development of a Cultural Heritage Management Plan (CHMP) is the process through which management and protection of Aboriginal cultural heritage will be formally managed.

Only a small portion of the Project Area is situated within the external boundaries of the registered Port Curtis Coral Coast (PCCC) native title claim. The applicants for the PCCC native title claimant group were endorsed as the Aboriginal Parties with whom a CHMP can be developed for those portions of the Project falling within the PCCC native title claim boundaries.

The remaining portion of the Project Area lying outside the external boundaries of the PCCC native title claim area (namely the marine portion of the Project area comprising the waters of Gladstone Harbour) is not subject to a current native title claim or Aboriginal Cultural Heritage Body. Formal public notification of the Project was therefore required and occurred between 10th August 2009 and 10th September 2009. Formal responses were received within the required timeframes, and these respondents have subsequently been endorsed by the Project as Aboriginal parties for the purpose of developing a CHMP for those areas lying outside the PCCC native title claim boundaries. The Project is committed to working with all of the endorsed parties for the Project and it is expected that the development of a CHMP or CHMPs for the Project will be completed pursuant to Part 7 of the Act.

A formal cultural heritage survey has been undertaken by representatives of the PCCC claimant group and their archaeologist over those portions of the Project lying within the PCCC native title claim's external boundaries (report not yet finalised).

No Aboriginal cultural heritage was listed on these registers within the Project Area at the time of conducting these searches, however three sites were listed on the DERM register and database within close proximity to the Project Area (i.e. within a 1 kilometre radius of the outer proposed extent of the Project Area), these being 2 artefacts and a tree.

Non-indigenous Cultural Heritage

A desktop search of heritage registers and studies (for previously identified places) with historical contextual research to identify places of potential cultural heritage and archaeological significance was undertaken for the Project Area. A visual inspection of the Project Area was also undertaken, in an attempt to identify sites and places which might be of previously unidentified historic cultural heritage significance.

A review of contextual and thematic historical research and searches of all relevant registers and databases indicates that no known historical heritage sites or places are located within or in close proximity (a radius of at least 3 km) to the Project Area.

The site survey resulted in no sites of Historical Heritage Significance being defined and seven places of Historical Interest being identified within the study area. Places of Historical Interest are not considered significant and do not require further assessment or specific mitigation strategies. Additionally, the potential for currently unknown historic heritage sites or places being present is regarded as nil to low. The potential for a sub-surface historical archaeological record being present is regarded as low.



Potential Impacts and Mitigation Measures

Indigenous Cultural Heritage

The assessment of potential Project impacts on Aboriginal cultural heritage will be carried out as part of the CHMP development and implementation process that is expected to be finalised by the end of 2009. Protection, management and mitigation measures will be discussed by the parties following the completion of the assessment program incorporating cultural heritage surveys and related consultation.

Non-indigenous Cultural Heritage

The Project does not impact on any known sites of Historic Heritage Significance. The seven places of Historic Interest that may potentially be impacted by the Project are not considered significant, and therefore do not warrant specific mitigation measures.

General recommendations for managing potential impact on unknown sites of Historic Heritage significance and places of Historic Interest located or potentially located within the Project Area include:

- ▶ If, during construction, an item or object that may be considered to be historic heritage appears, the following measures will be undertaken:
 - All work at the location of the potential find must cease and the Site Manager should be notified. They will then notify the Historical Archaeologist appointed to the Project; and
 - The Historical Archaeologist will provide a management recommendation to the Site Manager and will undertake appropriate actions.
- ▶ Where possible, Historic Interest places should be retained
- ▶ Management strategies to mitigate potential impact to unexpected cultural heritage material or sites should be employed, including training in the identification of cultural heritage sites or objects and report any findings to the Site Environmental Officer and requiring permits for undertaking clearing or excavations activities.

Social

Existing Environment

A review of existing information relating to the social environment in Gladstone and the surrounding region was undertaken, in combination with a stakeholder consultation program. While there was a large number of differing social values expressed in the documents reviewed and raised through the Project's stakeholder consultation activities, there are some reoccurring value themes. In summary, three overarching themes can be identified: economic growth and employment, equitable social outcomes and natural assets and recreation.

Economic Growth and Employment

Much of the local community is employed by large private industrial groups, Queensland Government agencies associated with heavy industry or small/medium businesses providing support and services to industry. The local community appears to place strong value on the industrial development and the benefit it brings to the community in terms of employment and standards of living.



Equitable Social Outcomes

There are recurring concerns about some of the adverse social effects of strong growth. Issues such as provision of social services, housing affordability and income inequality appear to be pertinent to at least parts of the community. The value expressed is essentially one of equity in social outcomes, ensuring that the less well-off also benefit from economic growth and prosperity.

Natural Assets and Recreation

The Project's consultation activities identified that strong community value is placed on the local area's natural assets. This value is also reflected in the promotion of the area as an attractive lifestyle choice and desirable tourist destination.

The popularity of various recreational activities, particularly fishing, also reflect the community value placed on the area's natural assets. Gladstone has one of the highest proportional boat registration levels in Queensland, with registrations increasing by over 110% between 1985 and 2005.

Potential Impacts and Mitigation Measures

For each social impact identified for the Project, a significance assessment has been carried out and impacted stakeholders were identified. Where the likelihood/consequence rating was determined to be negligible, no further analysis has been made. The social impact identification was based on a review and analysis of the local area profile, technical data from the project proponent and other sections of this EIS, and input from stakeholder consultations. A summary of potential social impacts and mitigation measures follows:

Potential Social Impact	Relevant Stakeholder Group	Recommended mitigation measures/management responses
Health and Social Wellbeing		
Reduced safety on land	Road users	GPC and contractor OH&S procedures.
	Workers in nearby businesses	Implement appropriate signage near project site, quarry and along haul route.
	Recreational users of area	Communicate updates to bund construction activities through GPC communication channels and local media.
Reduced marine safety	Recreational and commercial fishers	GPC and contractor OH&S procedures.
	Other users of Western Basin	Establishment of appropriate marine exclusion zones, and other measures such as navigational markers. Erect signage with project information at Auckland Creek and Calliope river boat ramps.
		Communicate update to dredging activities through GPC communication channels and local media, with particular attention to notification of mariners.
Economic Impacts and Material Wellbeing		
Employment	Gladstone community	Prioritise local employment in recruitment where possible.
	Project workers and their families	Include appropriate levels of local recruitment as a condition for engaging contractors, where possible.
Business opportunities	Local businesses	Include appropriate local spend targets as a condition for engaging contractors.
	Gladstone community	



Western Basin Dredging and Disposal Project

Potential Social Impact	Relevant Stakeholder Group	Recommended mitigation measures/management responses
Impact on commercial fishing	Commercial fishers	Commercial fishing offsets are not directly addressed in this EIS. Should monitoring establish a loss of fish catch directly linked to the Project, a coordinated approach involving local commercial fishers, representative bodies (such as the Queensland Seafood Industry Association) and relevant State Government agencies (such as the Queensland Primary Industries and Fisheries section of DEEDI) may be established to review direct and cumulative impacts. GPC will participate in the fore mentioned process and in any future negotiations lead by the Queensland State Government as part of the management of commercial fishing impacts in the Western Basin of the Port.
Property values and marketability	Current and aspiring property owners	No significant impacts expected.
Quality of the Living Environment		
Noise, dust and vibration	Gladstone community	Establishment of appropriate exclusion zones. Noise, dust and vibration mitigations measures to be included as part of the project's EMP.
Visual amenity/aesthetic quality	Gladstone community Recreational users of western basin	Landscaping and planting of reclamation area and mound.
Loss of natural and recreational areas	Recreational users of the area Environmental groups Indigenous groups Gladstone Community	Provide access points for safe recreation areas during the construction and communicate the location of these access points and areas to user groups and potential visitors. This could be through signage at public access points. Signage should also describe the project, project timeline and what the reclamation site will look like after construction. GPC may consider measures that help to offset/minimise impacts on recreational fishers based on the likely loss of recreational fishing sites associated with the Project. This would require a coordinated approach involving local recreational fishers, representative bodies and relevant State Government agencies; and may consider broader cumulative recreational fishing impacts. GPC will participate in any future negotiations lead by the Queensland State Government as part of the management of recreational fishing impacts in the Western Basin of the Port.
Increased demand for housing	Gladstone Community	Collaborate with LNG proponents about workforce accommodation management.
Increased demand for services	Gladstone Regional Council Government departments	Communicate workforce numbers to GRC and service providers in advance.



Western Basin Dredging and Disposal Project

Potential Social Impact	Relevant Stakeholder Group	Recommended mitigation measures/management responses
Cultural impacts		
Reduced access to culturally important areas and landscapes	Local Indigenous groups	<p>Identify culturally important areas, and work in conjunction with the PCCC and individuals to maintain or develop alternative access where possible.</p> <p>Proponent to continue to develop their relationship with the PCCC and explore opportunities to further build the capacity and role of this group.</p>
Impacts on community values and aspirations	Community expressing employment and development values	Public information program, including onsite signage, describing the project and highlighting proposed benefits (including employment and local development).
	Community expressing conservation values	<p>Identify areas that can be used for environmental education in collaboration with local environmental groups.</p> <p>(These measures should address environmental values and communicate the purpose and benefits of the project, to help improve the public perception of the project).</p>
Family and community impacts		
Change in demographic structure of the local community	Gladstone Community	Impact is likely to be minor.
Reduced community cohesion	Gladstone Community	Impact is likely to be minor.
Institutional, legal, political and equity impacts		
Formation of opinions and attitudes about the project	GPC	<p>Communicate project updates regularly to general community.</p> <p>Keep Community Working Group updated.</p>

Landscape and Visual Character

Existing Environment

The Project Area is located within Port Curtis, with the landform immediately surrounding the site largely low-lying mangrove and tidal flats of the mainland and The Narrows. In these areas, the mangroves are the predominant landscape feature. The foothills and peak of Mt Larcom provide the backdrop to the west while Curtis Island has an undulating landform that provides a vegetated backdrop to the visual landscape to the east. The main vegetation in these areas includes *Eucalyptus crebra* and *Corymbia citriodora* woodlands, and mixed eucalypt forests.

The existing industrial development extending north from the Gladstone urban area is a major feature of the visual landscape. These industrial complexes include Cement Australia, Orica, Rio Tinto Alcan Yarwun (RTAY), RG Tanna Coal Terminal and NRG Power Station. In addition to the existing



developments, there are also industrial developments proposed for the Gladstone region that will result in changes to the visual character and landscape of the area. These developments include the Wiggins Island Coal Terminal, the proposed Gladstone Pacific Nickel plant, the proposed Fisherman’s Landing Northern Expansion, and the LNG facilities proposed for Curtis Island.

The visual catchment of the Project extends over the ridges and high points of the city and incorporates both residential and commercial development, recreation areas and lookouts, as well as views from boats using Port Curtis. The visual catchment for the Project includes Port Curtis waters, Mt Larcom and adjacent ranges, Friend Point and Auckland Point, Round Hill and the elevated sections of the Gladstone urban area.

Potential Impacts and Mitigation Measures

The landscape and visual impacts of the Project are assessed as being of moderate adverse significance. Due to the nature of the Project, there will be a permanent impact on the visual landscape and amenity of the area, particularly when viewed from the water in the vicinity of the Reclamation Area. A summary of the outcomes of this assessment are detailed in the following table:

Viewpoint	Landscape Impact	Visual Sensitivity	Significance of Impact
Viewpoint 1 – Port Curtis – Western Basin	●	●	*
Viewpoint 2 - Port Curtis – Clinton Bypass Channel	○	○	○
Viewpoint 3 – Port Curtis – Targinie Channel	◐	◐	○
Viewpoint 4 – Friend Point	●	●	*
Viewpoint 5 – Mt Larcom	◐	◐	◐
Viewpoint 6 – Auckland Point Lookout	○	◐	○
Viewpoint 7 – Round Hill	◐	◐	◐
Viewpoint 8 - Gladstone Urban Area	◐	◐	◐

- Negligible Landscape Impact / Negligible Visual Sensitivity / Not Significant Impact
- ◐ Small landscape Impact / Low Visual Sensitivity / Minor Significance of Impact
- ◑ Moderate Landscape Impact / Medium Visual Sensitivity / Moderate Significance of Impact
- Large Landscape Impact / High Visual Sensitivity / High Significance of Impact
- * Major Significance of Impact



The Project aims to achieve construction without causing undue visual disruption to receptors. The following mitigation measures will be undertaken for this Project:

- ▶ Avoid loss or damage to landscape features, including minimisation of clearance of mangroves. Where possible, protect trees prior to construction and/or trim vegetation to avoid total removal. This includes vegetation that makes a significant and positive contribution to landscape character and/or has significant value in terms of biodiversity;
- ▶ Temporary hoardings, barriers, traffic management and signage will be removed when no longer required;
- ▶ Materials and machinery to be stored tidily during the works;
- ▶ Roads providing access to the site and work areas to be maintained free of dust and mud as far as reasonably practicable;
- ▶ Measures implemented to minimise sedimentation created by dredging activity; and
- ▶ At the completion of the dredging operations, stabilisation of the reclamation mound will be required which will also assist in achieving an improved visual outcome. GPC will undertake progressive planting of native vegetation, including trees, shrubs and groundcovers on the mound.

Economic Impact

Existing Environment

Gladstone is an expanding region with strong population growth, high labour force participation and low unemployment, albeit marginally higher than the Queensland average. There are also a number of projects underway, committed or under investigation within the region. The Western Basin Dredging and Disposal Project will facilitate a range of major industrial projects within the Port of Gladstone.

Potential Impacts and Mitigation Measures

The Western Basin Dredging and Disposal Project is anticipated to support between approximately 890 and 1,500 full time equivalent positions annually throughout the first ten years of Project works. The labour market has slackened over the past few months resulting in the availability of qualified employees. For positions that are unable to be filled by workers within the region, the existing commercial accommodation appears to have sufficient capacity to accommodate the new workers. In the housing and rental market, housing costs have increased, but no more than in Queensland generally. The median weekly rents for two bedroom units and three bedroom houses are traditionally below the state average. As such, the Project is unlikely to place significant pressure on the housing market.

At the target discount rate of 6%, the Project has a positive net present value and is economically viable. For the main case of the cost benefit analysis, the Project remains economically viable across a spread of discount rates, having an internal rate of return of 12.33%. The Project remains economically viable at the test discount rate of 6% in both sensitivity tests. In the first test, the extent of environmental disbenefits is assumed to significantly increase, and in the second test the willingness to pay for Western Basin harbour services is assumed to fall from \$2.75/tonne to only \$1.00/tonne.

The Project aims to increase the efficiency and expand the capacity of the Port of Gladstone, which is one of the region's most significant pieces of transport infrastructure. Although the Western Basin Dredging and Disposal Project will be a significant Project within the region, the change to the Gladstone economy would be marginal, rather than general.



Health and Safety

There are potential risks to health and safety of the workforce and community from the dredging and disposal activity including dust and odour, noise, mosquitos and biting midges and construction safety. A qualitative assessment of potential health and safety hazards to personnel on site and the general public during the dredging and disposal activities was prepared for the Project. The implementation of workplace health and safety procedures and preparation of an Health and Safety Management Plan and a Mosquito and Biting Midge Management Plan for the Project will minimise the potential risks to acceptable levels.

Hazard and Risk

The identification of the major hazards and risks from the construction and operation phase of the Project was undertaken in a workshop format, utilising the GPC likelihood and consequence rating tables. The Hazard and Risk assessment identified the nature and scale of hazards for this project. The study identified a total of 41 hazards that resulted in 16 high risks, 22 medium risks, two low and one very low risk hazards before the implementation of mitigation measures. After mitigation measures, there were no high risks, 28 medium risks, eight low risks and five very low risks hazards. A number of risk reduction recommendations were developed, including management plans for dredging, construction safety, construction environmental management, oil spill response plan, fire emergency response plan, natural hazard emergency response plan.

The proposed Project will not significantly impact on the amenity of sensitive receptors, providing appropriate management procedures are implemented as identified in the assessment studies. The controls identified, when in place, will adequately safeguard against safety, asset and environmental consequences from hazards associated with the project. The risk assessment carried out in this study assumed that the assessment process will continue throughout the project life to refine and update the outcome of the development approval/ environmental risk process.

Environmental Management Plan

Based on the outcomes of the technical studies and risk assessments, a Draft Environmental Management Plan was prepared for the Western Basin Dredging and Disposal Project which provides plans for a number of elements including marine water quality, marine and terrestrial flora and fauna, sediment quality, acid sulphate soils, coastal processes, groundwater, hydrology and stormwater, social impact, noise and vibration, air quality, visual and amenity, traffic and site access, health and safety, mosquito and biting midge, environmental emergency procedures and cultural heritage.