Dredge Management Plan

Queensland Curtis LNG

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Revision Record

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ACRONYMS AND ABBREVIATIONS

AASS	Actual Acid Sulphate Soils
AHD	Australian Height Datum
ASS	Acid Sulphate Soils
BPPH	Benthic Primary Producer Habitat
BHD	Back Hoe Dredge
CSD	Cutter Suction Dredge
CSG	Coal Seam Gas
DEWHA	Department of Environment, Water, Heritage and the Arts
DGPS	Differential Global Positioning System
DMP	Dredge Management Plan
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
FL	Fishermans Landing
GBRWHA	Great Barrier Reef World Heritage Area
GPC	Gladstone Ports Corporation
HAT	Highest astronomical tide
IMCRA	Integrated Marine and Coastal Regionalisation for Australia
LAC	Light Attenuation Coefficient
LAT	Lowest astronomical tide
LNG	Liquefied Natural Gas
MLR	Minimum Light Requirement (of seagrass)
MOF	Materials Offloading Facility
NTU	Nephelometric Turbidity Units
PASS	Potential Acid Sulphate Soils
PAH	Polycyclic aromatic hydrocarbons
SDP	Sea Dumping Permit
SDMDP	Strategic Dredge and Material Disposal Plan
SHB	Split Hopper Barge
TSS	Total Suspended Solids
TSM	Total Suspended Matter
TTA	Total Titratable Acidity
PAR	Photosynthetically active radiation
QCLNG	Queensland Curtis Liquefied Natural Gas
QGC	Queensland Gas Corporation

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1.0 INTRODUCTION

1.1. Queensland Curtis LNG Project

The Queensland Curtis Liquefied Natural Gas (QCLNG) Project comprises the following components:

- Coal Seam Gas (CSG) field development and supporting infrastructure in the Surat Basin of southern Queensland including management of associated water produced
- A network of underground pipelines, including gas and water collection pipelines and an underground gas transmission pipeline (the Export Pipeline) from the Gas Field to a Liquefied Natural Gas (LNG) Facility
- An LNG facility on Curtis Island, initially comprising two processing units, or "trains", to be followed by a third train. This component also includes an export jetty and other supporting infrastructure
- LNG shipping operations to load the LNG cargo ships for export to global markets.

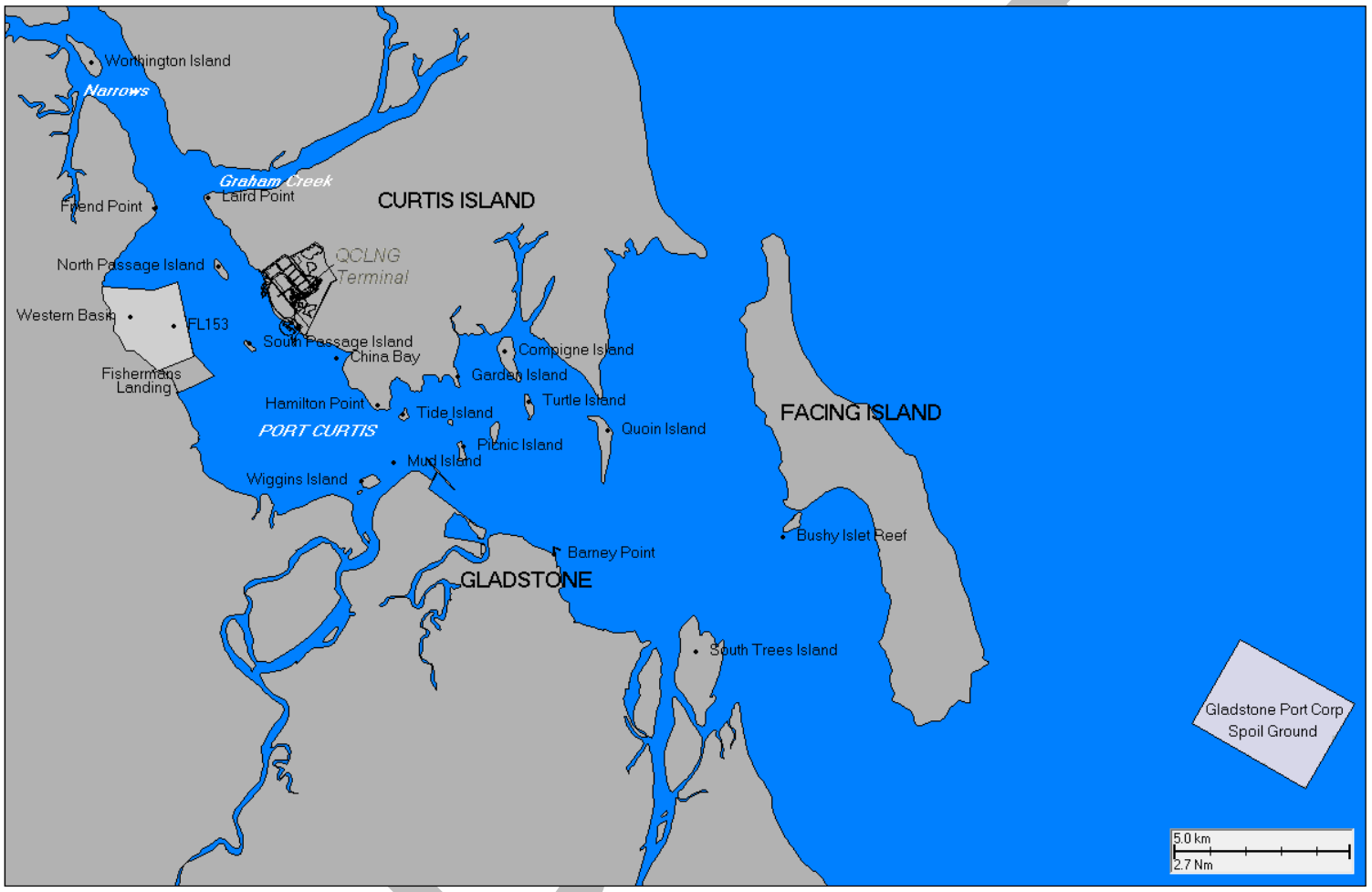
A new shipping channel from the existing channels in the Port of Gladstone and a swing basin at the export jetty will be developed to provide access for the shipping operations. The dredging works required for this will be undertaken as part of a larger shipping channel development program being proposed by Gladstone Ports Corporation (GPC).

As part of the early construction works, dredging for the development of a Materials Offloading Facility (MOF) and Construction Dock will be required. Dredging will also be required for the construction of the LNG pipeline crossing over The Narrows, and several minor marine works associated with transfer facilities on the mainland.

For a description of the existing marine environment, please refer *Volume 5, Chapter 8* of the Draft Environmental Impact Statement (EIS) and Supplementary EIS for the QCLNG Project.

The location of the Project is shown in *Figure 1.1*.

Figure 1.1 Location of QCLNG Facility



1.2. Purpose and Objectives

The purpose of this Draft Dredge Management Plan (DMP) is to provide a framework for the environmental management and monitoring of the dredging and spoil management for the early works associated with the QCLNG Project.

To achieve this, the Draft DMP includes the following:

- Scope of the dredging and spoil management works
- Overview of the existing marine environment and the result of the environmental impact assessment applicable to the dredging and spoil management works
- Results of sediment plume modelling undertaken as part of the impact assessment process
- Overview of the environmental risk assessment
- Proposed management strategies for the mitigation of the key environmental risks
- Proposed environmental monitoring programs
- Overview of the proposed environmental project management structure.

The DMP will require approval from regulatory agencies and the GPC prior to commencement of any dredging and material disposal works. This Draft DMP will continue to be refined as the primary operational management tool for mitigating the environmental effects of the Project's dredging activities.

1.3. Port Curtis Strategic Dredge and Dredge Material Management Plan

GPC is currently undertaking two environmental assessments related to dredging and dredged material placement within Port Curtis. These assessments require approvals from State and Commonwealth regulators before implementation.

As the timing for approvals for GPC's Western Basin Strategic Dredging and Disposal (WBSDD) Project did not align with that of the early works dredging program for the QCLNG Project, the potential impacts of the dredging and material disposal requirements for early works activities as well as management of these activities, is discussed in the Supplementary EIS for the QCLNG Project, dated January 2010.

1.4. Scope of this Dredge Management Plan

The scope of this Draft DMP includes all the dredging and spoil disposal activities associated with QCLNG early works. These activities include dredging and spoil disposal for the construction of the:

- Construction Dock
- Materials Offloading Facility (MOF)
- Narrows Pipeline Crossing.

The scope of this DMP does not include dredging for construction of GPC's Curtis LNG Precinct channels or swing basins, or minor works to be conducted elsewhere in the port by GPC in support of land-based transfer facilities. These works will be undertaken by GPC, and are described in GPC's Fisherman's Landing Northern Expansion EIS (released October 2009) and WBSDD Project EIS (released November 2009), or other minor works approvals processes. For the same reason, impacts caused by construction of Fishermans Landing reclamation areas are not covered by this plan.

This DMP will be implemented subject to approval from the Queensland and Commonwealth Ministers for the Environment.

This plan will be reviewed if there is a significant change in the duration or intensity of QGC's planned dredging works. The review will include a reassessment of the environmental risks presented by the works and the corresponding management strategies being implemented. The revised plan will be provided to the State and Commonwealth regulators.

1.5. Conventions and Guidelines

The Queensland Department of Environment and Resource Management (DERM) have released a guideline with respect to the approval of DMPs entitled 'Approval of Dredge Management Plan Guideline" (*http://www.derm.qld.gov.au/register/p00935aa.pdf*). This document details the requirements of a DMP with respect to addressing key coastal plan policies.

The dredging and spoil disposal activities will be conducted in a manner consistent with the following international conventions:

- International Convention for the Prevention of Pollution from Ships, 1973, as modified by the protocol of 1978 relating thereto (MARPOL 73/78)
- London Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972, as modified by the 1996 Protocol relating thereto (the 'London Convention')
- International Convention for the Control and Management of Ship's Ballast Water and Sediments (note: subject to ratification by the International Maritime Organisation (IMO).

The following guidelines were also considered in the development of this DMP:

- National Assessment Guidelines for Dredging 2009 (DEWHA, 2009)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000)
- Queensland Water Quality Guidelines (2009)
- Port Curtis Integrated Monitoring Program (2001)
- OSPAR Guidelines for the Management of Dredged Material (OSPAR 1998).

2.0 DREDGING WORKS

This DMP is applicable to dredging and spoil disposal associated with early works, specifically the construction of:

- Construction Dock (including the initial site access)
- MOF Stage 1 and MOF Stage 2
- Pipeline crossings of The Narrows as well as Targinie and Humpy Creeks.

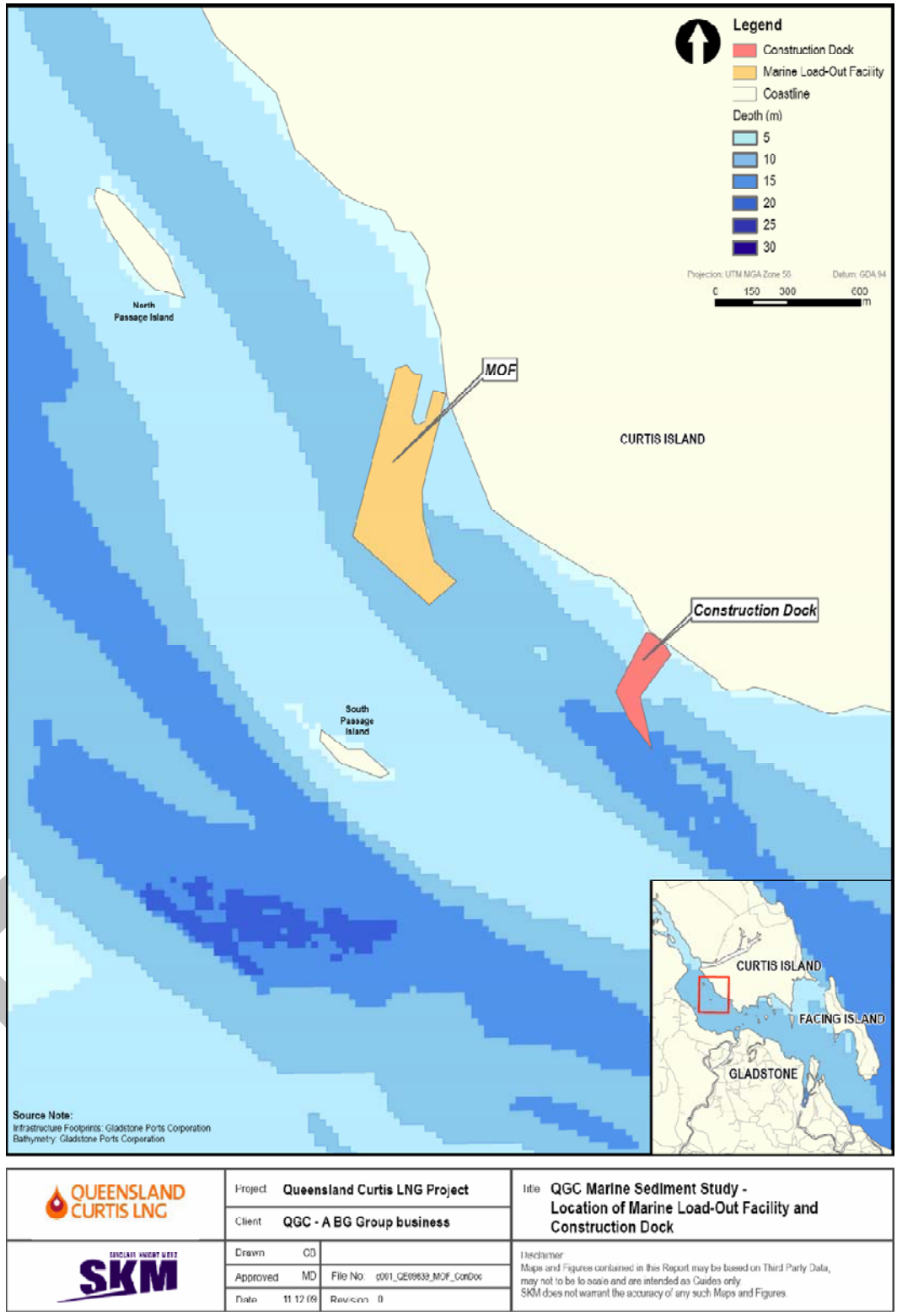
Dredging for construction of the QCLNG Project swing basin and channel extension from Targinie Channel to the QCLNG Project will be undertaken by GPC, as described in GPC's WBSDD Project EIS. Similarly, impacts caused by construction of reclamation areas at Fishermans Landing are not covered by this plan.

2.1. MOF and Construction Dock Dredging Works

The development of the QCLNG Project will require the import onto the island of construction materials and labour to construct, and later to operate the facility.

Figure 2.1 shows the proposed location of the Construction Dock and MOF and the associated dredging areas. The locations were selected to minimise impact on mangroves and other marine plants as far as practicable.

Figure 2.1 Location of MOF and Construction Dock Dredge Areas



Dredging is required to provide an access channel for support of construction of the MOF as well as to allow access to the MOF. QGC may undertake construction of the MOF in two stages (MOF I and MOF II). Stage I will involve an initial first dredge cut for the MOF channel of -2.8 m (LAT) to accommodate shallow barges required for the construction phase, plus a dredge cut of -5.0 m (LAT) for the Construction Dock. Stage II will involve a second dredge cut to -7.8m LAT to accommodate deeper draft vessels. Due to the nature of the bathymetry adjacent the MOF site and in the area of proposed marine works, the MOF channel extends a considerable distance from the MOF in order to reach the naturally occurring bathymetric contour. The length of the MOF channel will be shorter (and volume of dredging required will be smaller) if GPC's planned port development dredging occurs promptly. In this case the swing basin and shipping channel would be constructed first and deeper portions of the MOF channel will be dredged in that program.

Preliminary estimates of dredge material volume for construction of the MOF channel and Construction Dock are 2.14 million cubic metres (m^3). This includes:

- 300,000 m^3 for the Construction Dock
- 340,000 m^3 for MOF Stage I
- 1,500,000 m^3 to a maximum of 1,800,000 m^3 for MOF Stage II.

2.2. The Narrows, Targinie and Humpy Creek Pipeline Crossing Dredging Requirements

Delivery of coal seam gas from the Condamine fields to Curtis Island will be via a 380 km pipeline. This will include a submarine pipeline crossing at The Narrows and the upper reaches of Targinie and Humpy Creeks. Dredging (jetting or backhoe) will be required in order to trench this pipeline. This will involve removal of approximately 167,000 m^3 of material, depending on the method finally selected.

2.3. Total Volume to be dredged

Total *in situ* dredged volume for MOF (Stages I & II, and assuming this is required before GPC completes the access channel), Construction Dock, and pipeline crossing of The Narrows, ranges from 2,240,000m^3 to 3,040,000m^3.

2.4. Dredging Methodology

Preliminary engineering, geomorphology and geochemical studies suggest that a Cutter Suction Dredge (CSD) is most suited (subject to availability of equipment and availability of a Fishermans Landing disposal area at that time) to undertake the majority of dredging works for the MOF and Construction Dock. If a CSD is not available at the required time, or the Fishermans Landing disposal area is not available at that time, dredging will need to be performed with one or two Backhoe Dredges (BHD). Trenching at The Narrows will employ one or two Backhoe Dredges (BHD) or a single jetting barge. Any BHD(s) will be supported by a number of Split Hopper Barges (SHB) to facilitate transfer of material to the disposal site. Blasting is unlikely based on findings of preliminary investigations.

2.5. Spoil Management Options

QGC has identified several disposal options for material resulting from dredging. Of these options, the following are the most likely, in order of preference:

- Disposal in GPC's existing Fisherman Landing (FL) site
- Disposal in the proposed Fishermans Landing Northern Expansion reclamation area or the proposed Western Basin Reclamation area (see *Figure 1.1*) subject to capacity and timing of approvals and initial construction of the bund wall
- Disposal to any other nearby approved spoil disposal area, noting that the GLNG Project (Santos) is currently proposing a Laird Point reclamation area which, if constructed, would have sufficient capacity for QGC's required early works dredge disposal material
- Disposal in GPC's existing approved Offshore Spoil Ground, located at the mouth of Port Curtis.

Fishermans Landing Reclamation

The most feasible option for disposal of material resulting from dredging of the MOF is reclamation at Fishermans Landing. The three potential sites (existing Fishermans Landing cells, Northern Expansion and Western Basin Reclamation) have the capacity to easily accommodate the estimated 3,040,000 m^3 of material from MOF, Construction Dock and pipeline crossing dredging. For disposal of material at Fishermans Landing, the CSD will be attached to booster pumps which will propel the material through delivery pipelines to the reclamation area.

The availability of Fishermans Landing reclamation areas will depend on timing of approvals and construction of the bund walls.

GPC Offshore Spoil Ground

Under provisions of the *Sea Dumping Act 1998* (Commonwealth) (*Sea Dumping Act*) GPC has an approved Sea Dumping Permit for marine disposal of capital and maintenance dredging material at a designated site located within the outer limits of the Port boundaries.. This site is known as the East Banks disposal site. QGC has requested that GPC consider placing dredged material from the Project's early works dredging in its East Banks site if Fishermans Landing is unavailable when required.

If Fishermans Landing is unavailable, and consent is granted to use the GPC spoil ground, barges will be employed for transfer of the dredged material.

3.0 MANAGEMENT STRATEGIES

3.1. Overview

This section will be revised post-EIS approval to ensure consistency with any conditions set by the regulators.

The development of this Draft DMP provides the basis for managing potential impacts relating to the dredging, land reclamation and spoil disposal works. The following potential impacts of these activities were identified in the EIS and the Supplementary EIS (*Volume 5, Chapter 8* and *Volume 6*):

- Impacts to water quality and benthic primary producers, particularly seagrasses, in and adjacent to the project area due to reduced light availability and increases in sedimentation
- Impacts to marine fauna (directly due to dredging operations and indirectly due to accidental release of solid, hazardous or sewage wastes generated during the dredging and disposal activities)
- Disturbance of acid sulphate soils during dredging and disposal activities, particularly for land reclamation activities, potentially leading to the generation of acidity and potential mobilisation of contaminants
- Introduction of marine pests via the dredging vessels and equipment.

Six key management strategies have been developed to manage these potential impacts. Each strategy includes a tiered approach to impact management.

“Impact Zones”, defined in the Draft and Supplementary EIS, are areas where permanent or temporary impacts will occur. Impact mitigation for these areas has been applied through the project planning and impact assessment phase. This will be combined with reasonable and practical operational controls to ensure that impacts do not exceed those described in the EIS.

“Management Zones”, also defined in the EIS, are areas where significant impacts are predicted not to occur, but which have been defined as ‘at risk’. These areas are to be subject to a higher level of construction-phase monitoring, and will have surveillance and response programs in place to ensure that these ‘at risk’ areas remain unaffected.

The extent of “Impact Zones” and “Management Zones” is different for the different dredging activities and for different sensitive receptors.

The six key management strategies are:

- Management Strategy 1 –Seagrasses
- Management Strategy 2 – Corals
- Management Strategy 3 – Marine Fauna Interaction: Marine Mammals
- Management Strategy 4 – Marine Fauna Interaction: Marine Turtles
- Management Strategy 5 – Introduced Marine Pests
- Management Strategy 6 – PASS Material

Other potential environmental impacts that fall outside the DMP implementation requirements shall be managed under other Project Environmental Management Plans (EMP) that have been prepared for the Project. This includes the management of waste, hydrocarbons, vegetation clearing (including mangroves), chemicals, noise and lighting.

3.2. Management Strategy 1 – Seagrasses

Whilst macroalgae, corals and other benthic primary producers (BPP) occur within potentially impacted portions of Port Curtis, the impact assessment process identified seagrass meadows as the key environmental feature to be protected in those areas where dredging plumes may occur at ecologically significant levels.

Seagrass occurrence is largely influenced by light availability and the overall stability of the substratum. The most recent seagrass survey conducted in the Gladstone region identified six (6) species of seagrass including Halodule uninervis, *Halophila ovalis, Halophila decipiens, Halophila minor, Halophila spinulosa and Zostera capricorni*.

Indirect impacts are predicted to occur to seagrasses due to altered water quality (including increased turbidity and sedimentation) (refer to *Volume 5, Chapter 8* of the *Supplementary EIS for a detailed discussion of impacts*). Specifically, a 'Seagrass Impact Area' encompassing 244.3 ha to 304.5 ha of seagrass meadows (depending on the dredging scenario) will be indirectly and temporarily impacted. A 'Seagrass Management Area 1' (SMA1) encompasses a further 118.9 ha to 132.5 ha of seagrass meadows where there is a potential for indirect impacts, and where the greatest dredge management effort will be directed. A 'Seagrass Management Area 2' (SMA2) encompasses areas outside of SMA1, and is predicted to serve as an unaffected reference zone for environmental monitoring comparisons. As such, three management areas have been defined referencing the extent and the nature of the impact predicted to occur to seagrasses (e.g. reduction in surface area; reduction in shoot density). A summary of the process by which these areas were defined is provided in *Volume 5, Chapter 8 of the Supplementary EIS*.

A dual approach to management of potential impacts to seagrasses will be implemented comprising preventative, and contingency and responsive management measures.

Management of Impacts to Seagrasses	
Environmental Objective:	• To minimise losses of seagrasses due to dredging, land reclamation and disposal activities
Key Performance Indicators:	• No loss of seagrasses beyond the Seagrass Impact Zone predicted in the EIS and Supplementary EIS • The number of exceedances of seagrass trigger levels at 'Seagrass Management Area 1' monitoring sites • The number of SMA1 sites where seagrass cover declines as a result of dredging • The percentage of net detectable seagrass loss within SMA1 areas
Management:	**General Management Strategies** • Disposal vessels will use a Global Positioning System (GPS) immediately prior to disposal episodes to ensure that the vessel is within the proposed spoil disposal area boundaries; • Accurate bathymetric surveys will be carried out on the proposed spoil disposal area prior to and after the Project completion to confirm proper spoil placement;

Management of Impacts to Seagrasses	
	• Hopper doors / compartments on the SHB will be completely closed prior to leaving the disposal ground at the end of each spoil disposal event to reduce discharge of material outside the spoil disposal area boundary; • Accurate bathymetric survey will be carried out of the dredging areas; • Differential GPS (DGPS) will be used on dredges to ensure direct impact is restricted to the approved dredging areas. **Preventative Measures:** The following management strategies will be implemented throughout the dredging and spoil disposal program. ***Dredging and Offshore Spoil Disposal*** • Hopper door seals will be maintained in good condition to ensure minimum loss of sediment during transport • Sailing routes will be selected to minimise the generation of propeller wash • Well maintained and properly calibrated dredging vessels will be used. Vessels will include features such as real-time bathymetric charts, production statistics and vessel positioning systems. ***Reclamation:*** • The design and operation of the reclamation area (including internal bund walls) will be used as the main management measure to reduce TSS being discharged into the marine environment • A suitable control (e.g. weir box) will be used at the discharge point to control the water level and the rate and timing of discharge. ***Pipeline:*** • Well maintained floating pipelines will be used to minimise leakage of turbid water during pumping of material to the reclamation area • Pipeline flow controls and inline monitoring will be utilised • Regular observation and inspection of floating pipelines will be undertaken • Any observed or detected leaks will be repaired as soon as practicable • Pumping will stop as soon as any major ruptures are identified (within the operational constraints of the equipment). **Responsive Measures:** **Water Quality Triggers and Management Responses** Water quality monitoring and management response triggers provide an early warning of potential impacts to seagrasses. Three management zones are proposed, these are: 1. Seagrass Impact Areas , the outer boundaries of these areas approximately coincide with the 50th percentile 25mg/L TSS contour line. No BPP management responses are proposed to be undertaken in the area of predicted impact. Monitoring of seagrass in this area will be have the purpose of validating impact predictions and improving modelling capacity. 2. Seagrass Management Area 1 (SMA1), seagrass meadows within areas bounded by the 50th percentile 25mg/L TSS contour line and the 95th percentile 25 mg/L TSS contour line. This is the zone of potential impact within which most management efforts will be directed. 3. Seagrass Management Area 2 (SMA2), seagrass meadows immediately adjacent to but outside of the zone of potential impact. Monitoring sites will be established in seagrass meadows within Seagrass Management Areas 1 and 2. Once the exact depth of each of the monitoring locations is known, specific trigger values will be assigned for each location.

Management of Impacts to Seagrasses

Note: Spatial definition of the management areas, response levels and triggers are to be finalised following approval of EIS

Management Response Level	Trigger	
	SMA 1	SMA 2
No Exceedance	LAC<trigger	LAC<trigger
Level 1	LAC>trigger	LAC>trigger
Level 2	LAC>trigger for ≥XX time	LAC XX% higher than trigger
Level 3	LAC>trigger for ≥XX time	LAC XX% higher than trigger

Breaches of water quality triggers will in the first instance be investigated to determine whether the dredging and spoil disposal activities were responsible (wholly or in part) for observed elevations of turbidity.

Investigations of possible causes will examine:

- Whether any similar trends were observed at reference sites;
- The location of the dredging and spoil disposal activities in relation to the affected site(s);
- The extent and position of the visible dredge plume in relation to the affected site(s);
- The weather conditions, sea state and tides at the time of the exceedance; and
- The spatial distribution of affected sites in relation to unaffected sites and the position of the dredge.

The investigation will allow a decision to be made with respect to the potential role of the dredging and spoil disposal program in the observed exceedance(s) and whether the activities continue to pose a threat to further or continued exceedances.

In the event that it is considered that dredging or spoil disposal has contributed to the exceedance, the following management and monitoring strategies will be implemented, related to each level of exceedance and response:

Level 1 Management Response:

- Report the exceedance in fortnightly reporting;
- Investigate the exceedance and develop management strategies to be implemented if water quality does not improve;
- Inform seagrass monitoring teams of exceedance and potential need for upcoming monitoring.

Level 2 Management Response:

- Investigate the exceedance and develop management strategies to be implemented if water quality does not improve;
- Inform regulatory authority of the exceedance and proposed management strategies within 72 hours of detection of the exceedance;
- Implement management strategies as soon as practically possible;
- Continue monitoring water quality and dredge and disposal activities;
- Inform seagrass monitoring team of exceedance and potential for upcoming monitoring.

Level 3 Management Response:

- Immediately commence a re-evaluation of agreed seagrass health indicators in the region of the water quality exceedance;
- Investigate the exceedance and implement appropriate management strategies;
- Inform regulatory authority of the water quality exceedance and proposed management strategies within 48 hours of detection of the exceedance;
- Continue monitoring water quality.

Management of Impacts to Seagrasses

Seagrass Health Triggers and Management Responses

Seagrass health monitoring will be undertaken at set times pre-dredging, during and post-dredging. However, if a Level 2 or Level 3 Water Quality trigger is exceeded, and the cause of this exceedance can be attributed in part or in whole to dredging or disposal activities, then a response seagrass monitoring event will be triggered.

Seagrass health triggers will be based on shoot density counts *(Note: trigger level parameters to be confirmed post approval of the EIS)*. While other seagrass health parameters will also be measured in the pre-determined dredging surveys (leaves per shoot, aboveground biomass, epiphyte and epifaunal biomass, dead rhizomes and benthic cover), these data will be used to support management decisions based around shoot density triggers. The trigger levels for seagrass health monitoring within the management areas are presented in ***Table 3.1***.

Table 3.1 Seagrass health triggers associated with each management response level for the management areas

Management Response Level	Trigger	
	SMA 1	SMA 2
No Exceedance[1]	SD decreases by ≤XX%	SD decreases by ≤XX%
Level 1	SD decreases by ≤XX%	SD decreases by ≤XX%
Level 2	SD decreases by ≤XX%	SD decreases by ≤XX%
Level 3	SD decreases by ≤XX%	SD decreases by ≤XX%

No Exceedance

If water quality triggers prompt the implementation of seagrass health monitoring, but changes to shoot density counts do not exceed any Level 1–3 triggers, the following procedures will be followed:

- Continuance of water quality monitoring;
- If water quality does not improve, seagrass health monitoring should be repeated *(Note: frequency and duration to be determined)* after water quality returns to below the trigger levels or at the end of the dredging program, whichever comes first.

Similar to water quality triggers, any exceedance of seagrass health triggers (Level 1–3 exceedance) will, in the first instance, be investigated to determine whether the dredging and spoil disposal activities were responsible (wholly or in part) for observed reductions in seagrass health.

Investigations of possible causes will examine:

- Whether similar trends were observed at reference sites;
- Whether trends in other seagrass health parameters supports findings of exceedance;
- Correlations between seagrass health and water quality parameters including examination of significant environmental factors and events, (e.g. storms) to elucidate the cause of exceedance;
- The location of the dredging and spoil disposal activities in relation to the affected site(s);
- The extent, position and duration of the visible dredge plume in relation to the affected site(s); and
- The spatial distribution of the affected site(s) in relation to unaffected sites and the position of the dredge.

Any exceedance of seagrass health triggers that can be attributed in whole or in part to

Management of Impacts to Seagrasses	
	dredging or disposal activities would elicit management responses outlined below: <u>Level 1 Management Response:</u> • Inform the regulatory authority within 24 hours of the detection of the exceedance; • Investigate the cause of the exceedance and develop management strategies to reduce the impacts; • Inform the regulatory authority of proposed management strategies and implement management strategies within 48 hours of detection of the exceedance; • Repeat seagrass health monitoring within (Note: frequency to be determined) or at the end of the dredging program, whichever comes first. <u>Level 2 Management Response:</u> • Inform the regulatory authority within 24 hours of the detection of the exceedance; • If the dredging or disposal activity causing the exceedance can be determined, and is still deemed to be a threat, stop any dredging or disposal activities in the locations where the exceedance was deemed to be caused within 48 hours; • Develop management strategies in consultation with the regulatory authorities and implement upon resumption of dredging and disposal activities in the affected area; • Repeat seagrass health monitoring within (Note: timeframe to be determined) or at the end of the dredging program, whichever comes first. <u>Level 3 Management Response:</u> • Inform the regulatory authority within 24 hours of the detection of the exceedance; • Immediately stop dredging and spoil disposal activities in areas that are contributing to the impact; • No recommencement of dredging or disposal activities in areas that are contributing to the impact until it can be demonstrated to the satisfaction of the regulatory authority that resuming activity will not cause any additional impacts. **<u>Contingency Measures:</u>** In the event that exceedances of triggers can be attributed to dredging and/or spoil disposal activities, a range of contingency management procedures will be considered to reduce observed impacts. The adoption of management procedures will take into account the location and nature of the exceedance, as well as the influence of external factors, such as environmental conditions. Proposed procedures that may be considered and applied include: • Temporary relocation of dredging activities; • Optimisation of disposal locations and schedule, based on met-ocean conditions; • A reduction in dredging to a single shift; and/or • Temporary cessation of dredging activities.
Monitoring:	• Bathymetric surveys will be carried out within dredging and disposal areas upon completion of dredging and disposal programs as per Sea Dumping Permit (SDP) requirements; and • Seagrass health monitoring program will be extended out to assess seagrass loss on completion of project (SIA, SMA 1 & SMA 2). • Water quality monitoring program; and • Seagrass health monitoring program.
Reporting Requirements:	• Water quality and seagrass health monitoring reports • Regulatory reporting

3.3. Management Strategy 2 – Corals

Coral communities within Port Curtis are dominated by hard corals to the east and south, and by soft corals in the north-west. Whilst high hard coral cover exists at a number of sites on the eastern side of the bay, these are well outside of the areas where dredge plumes are predicted to pose a risk. The distribution of soft coral dominated seabed communities overlaps areas where dredge plumes are predicted to occur.

Corals (soft and hard) are also influenced by suspended sediments and sedimentation rates. However, they are much more susceptible to sedimentation than seagrasses, with ecological effects noted for depositional rates of only 2 g/m^2/day. This criterion has been used to define impact and 'at risk' areas.

No significant soft coral communities have been identified within the "Coral Impact Area" defined by the 50th percentile 2 g/m^2/day sedimentation contours. Some of the soft coral communities on Hamilton Point occur within the 95% percentile (5% exceedance) contours, and are therefore within the proposed Coral Management Area 1 (CMA 1). The outer-most zone (Coral Management Area 2, CMA 2) will be defined to encompass other similar soft-coral dominated reefs which fall outside of CMA 1. Management measures to be implemented to minimise the risk of impacts to corals beyond the levels/areas described in the EIS (in CMA 1) are presented below.

Management of Impacts to Corals	
Environmental Objective:	• To minimise corals of seagrasses due to dredging, land reclamation and disposal activities
Key Performance Indicators:	• No loss of corals beyond the Coral Impact Zone predicted in the EIS and Supplementary EIS • The number of exceedances of coral trigger levels at 'Coral Management Area 1' monitoring sites • The number of CMA1 sites where coral cover declines as a result of dredging • The percentage of net detectable coral loss within CMA1 areas
Management:	**<u>General Management Strategies</u>** • Disposal vessels will use a Global Positioning System (GPS) immediately prior to disposal episodes to ensure that the vessel is within the proposed spoil disposal area boundaries; • Accurate bathymetric surveys will be carried out on the proposed spoil disposal area prior to and after the Project completion to confirm proper spoil placement; • Hopper doors / compartments on the SHB will be completely closed prior to leaving the disposal ground at the end of each spoil disposal event to reduce discharge of material outside the spoil disposal area boundary; • Accurate bathymetric survey will be carried out of the dredging areas; • Differential GPS (DGPS) will be used on dredges to ensure direct impact is restricted to the approved dredging areas. **<u>Preventative Measures:</u>** The following management strategies will be implemented throughout the dredging and spoil disposal program. ***Dredging and Offshore Spoil Disposal*** • Hopper door seals will be maintained in good condition to ensure minimum loss of sediment during transport

Management of Impacts to Corals

- Sailing routes will be selected to minimise the generation of propeller wash
- Well maintained and properly calibrated dredging vessels will be used. Vessels will include features such as real-time bathymetric charts, production statistics and vessel positioning systems.

Reclamation:

- The design and operation of the reclamation area (including internal bund walls) will be used as the main management measure to reduce TSS being discharged into the marine environment
- A suitable control (e.g. weir box) will be used at the discharge point to control the water level and the rate and timing of discharge.

Pipeline:

- Well maintained floating pipelines will be used to minimise leakage of turbid water during pumping of material to the reclamation area
- Pipeline flow controls and inline monitoring will be utilised
- Regular observation and inspection of floating pipelines will be undertaken
- Any observed or detected leaks will be repaired as soon as practicable
- Pumping will stop as soon as any major ruptures are identified (within the operational constraints of the equipment).

Responsive Measures:

Water Quality Triggers and Management Responses

Water quality monitoring and management response triggers provide an early warning of potential impacts to corals.

Three management zones are proposed, these are:

- Coral Impact Areas (CIA), the outer boundaries of these areas approximately coincide with the 50th percentile 2 g/m^2/d sedimentation contour line. No BPP management responses are proposed to be undertaken in the area of predicted impact. Monitoring of corals in this area will be have the purpose of validating impact predictions and improving modelling capacity.
- Coral Management Area 1 (CMA1), Sublittoral reefs comprising at least 10% soft coral cover within areas bounded by the 50th percentile 2 g/m2/day sedimentation contour line and the 95th percentile 2 g/m^2/day sedimentation contour line. This is the zone of potential impact within which most management efforts will be directed.
- Coral Management Area 2 (CMA2), coral reefs immediately adjacent to but outside of the zone of potential impact, having at least 10% soft coral cover.

Monitoring sites will be established in reefal areas within Coral Management Areas 1 and 2. Once the exact depth of each of the monitoring locations is known, specific trigger values will be assigned for each location.

(Note: Spatial definition of the management areas, response levels and triggers are to be finalised following approval of EIS)

Management Response Level	Trigger	
	CMA 1	CMA 2
No Exceedance	LAC<trigger	LAC<trigger
Level 1	LAC>trigger	LAC>trigger
Level 2	LAC>trigger for ≥XX time	LAC XX% higher than trigger
Level 3	LAC>trigger for ≥XX time	LAC XX% higher than trigger

Management of Impacts to Corals	
	Breaches of water quality triggers will in the first instance be investigated to determine whether the dredging and spoil disposal activities were responsible (wholly or in part) for observed elevations of turbidity. Investigations of possible causes will examine: • Whether any similar trends were observed at reference sites; • The location of the dredging and spoil disposal activities in relation to the affected site(s); • The extent and position of the visible dredge plume in relation to the affected site(s); • The weather conditions, sea state and tides at the time of the exceedance; and • The spatial distribution of affected sites in relation to unaffected sites and the position of the dredge. The investigation will allow a decision to be made with respect to the potential role of the dredging and spoil disposal program in the observed exceedance(s) and whether the activities continue to pose a threat to further or continued exceedances. In the event that it is considered that dredging or spoil disposal has contributed to the exceedance, the following management and monitoring strategies will be implemented, related to each level of exceedance and response: <u>Level 1 Management Response:</u> • Report the exceedance in fortnightly reporting; • Investigate the exceedance and develop management strategies to be implemented if water quality does not improve; • Inform coral monitoring teams of exceedance and potential need for upcoming monitoring. <u>Level 2 Management Response:</u> • Investigate the exceedance and develop management strategies to be implemented if water quality does not improve; • Inform regulatory authority of the exceedance and proposed management strategies within 72 hours of detection of the exceedance; • Implement management strategies as soon as practically possible; • Continue monitoring water quality and dredge and disposal activities; • Inform coral monitoring team of exceedance and potential for upcoming monitoring. <u>Level 3 Management Response:</u> • Immediately commence a re-evaluation of agreed coral health indicators in the region of the water quality exceedance; • Investigate the exceedance and implement appropriate management strategies; • Inform regulatory authority of the water quality exceedance and proposed management strategies within 48 hours of detection of the exceedance; • Continue monitoring water quality. **Coral Health Triggers and Management Responses** Coral health monitoring will be undertaken at set times pre-dredging, during and post-dredging. However, if a Level 2 or Level 3 Water Quality trigger is exceeded, and the cause of this exceedance can be attributed in part or in whole to dredging or disposal activities, then a response coral monitoring event will be triggered. Coral health triggers will be based on observable sediment deposits on coral surfaces, and coral bleaching patterns *(Note: trigger level parameters to be confirmed post approval of the EIS)*. While other coral health parameters will also be measured in the pre-determined dredging surveys (benthic cover, tentacular motion and extension, etc), these data will be used to support management decisions based around surficial deposits. The trigger levels for coral health monitoring within the management areas are presented in ***Table 3.1***.

Management of Impacts to Corals

Table 3.2 ***Coral health triggers associated with each management response level for the management areas***

Management Response Level	Trigger	
	CMA 1	CMA 2
No Exceedance[1]	SD decreases by ≤XX%	SD decreases by ≤XX%
Level 1	SD decreases by ≤XX%	SD decreases by ≤XX%
Level 2	SD decreases by ≤XX%	SD decreases by ≤XX%
Level 3	SD decreases by ≤XX%	SD decreases by ≤XX%

No Exceedance

If water quality triggers prompt the implementation of coral health monitoring, but changes to surface sediment accumulations do not exceed any Level 1–3 triggers, the following procedures will be followed:

- Continuance of water quality monitoring;
- If water quality does not improve, coral health monitoring should be repeated *(Note: frequency and duration to be determined)* after water quality returns to below the trigger levels or at the end of the dredging program, whichever comes first.

Similar to water quality triggers, any exceedance of coral health triggers (Level 1–3 exceedance) will, in the first instance, be investigated to determine whether the dredging and spoil disposal activities were responsible (wholly or in part) for observed reductions in coral health.

Investigations of possible causes will examine:

- Whether similar trends were observed at reference sites;
- Whether trends in other coral health parameters supports findings of exceedance;
- Correlations between coral health and water quality parameters including examination of significant environmental factors and events, (e.g. storms) to elucidate the cause of exceedance;
- The location of the dredging and spoil disposal activities in relation to the affected site(s);
- The extent, position and duration of the visible dredge plume in relation to the affected site(s); and
- The spatial distribution of the affected site(s) in relation to unaffected sites and the position of the dredge.

Any exceedance of coral health triggers that can be attributed in whole or in part to dredging or disposal activities would elicit management responses outlined below:

Level 1 Management Response:

- Inform the regulatory authority within 24 hours of the detection of the exceedance;
- Investigate the cause of the exceedance and develop management strategies to reduce the impacts;
- Inform the regulatory authority of proposed management strategies and implement management strategies within 48 hours of detection of the exceedance;
- Repeat coral health monitoring within *(Note: timeframe to be determined)* or at the end of the dredging program, whichever comes first.

Level 2 Management Response:

- Inform the regulatory authority within 24 hours of the detection of the exceedance;

Management of Impacts to Corals	
	• If the dredging or disposal activity causing the exceedance can be determined, and is still deemed to be a threat, stop any dredging or disposal activities in the locations where the exceedance was deemed to be caused within 48 hours; • Develop management strategies in consultation with the regulatory authorities and implement upon resumption of dredging and disposal activities in the affected area; • Repeat coral health monitoring within *(Note: timeframe to be determined)* or at the end of the dredging program, whichever comes first. <u>Level 3 Management Response:</u> • Inform the regulatory authority within 24 hours of the detection of the exceedance; • Immediately stop dredging and spoil disposal activities in areas that are contributing to the impact; • No recommencement of dredging or disposal activities in areas that are contributing to the impact until it can be demonstrated to the satisfaction of the regulatory authority that resuming activity will not cause any additional impacts. **<u>Contingency Measures:</u>** In the event that exceedances of triggers can be attributed to dredging and/or spoil disposal activities, a range of contingency management procedures will be considered to reduce observed impacts. The adoption of management procedures will take into account the location and nature of the exceedance, as well as the influence of external factors, such as environmental conditions. Proposed procedures that may be considered and applied include: • Temporary relocation of dredging activities; • Optimisation of disposal locations and schedule, based on met-ocean conditions; • A reduction in dredging to a single shift; and/or • Temporary cessation of dredging activities.
Monitoring:	Bathymetric surveys will be carried out within dredging and disposal areas upon completion of dredging and disposal programs as per Sea Dumping Permit (SDP) requirements; and • Coral health monitoring program will be extended out to assess coral loss on completion of project (CIA, CMA 1 & CMA 2). • Water quality monitoring program; and • Coral health monitoring program
Reporting Requirements:	• Water quality and coral health monitoring reports • Regulatory reporting

3.4. Management Strategy 3 – Marine Fauna Interaction: Marine Mammals

The interaction between marine mammals (cetaceans and dugongs) with dredging equipment has the potential to cause injury or mortality to individual animals via direct striking or entrapment/entrainment. Refer to *Volume 5, Chapter 8* of the Draft EIS and Supplementary EIS for details on potential impacts to marine mammals present in the project area.

Marine Mammal Management	
Environmental Objective:	• To detect and mitigate risks of injury/mortality to marine mammals as a result of the dredging and spoil management activities.
Key Performance Indicator:	• Zero reported incidents of injury or mortality to marine mammals as a result of dredging and spoil management activities.
Management:	• The requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth), the Australian National Guidelines for Whale and Dolphin Watching will be complied with. • Vessel speed limits will be applied to vessels operating within the construction area to reduce the risk of vessel strikes on marine mammals. • During barge transport of dredged material, a lookout for marine mammals will be maintained as per the requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth). In the event that a marine mammal is sighted, the vessel speed and direction will be altered as necessary to avoid impact with the marine mammal (within safety constraints). • Where practicable, barges will use consistent routes during offshore disposal. • Adopt 'slow start' procedure for dredges to alert marine mammals and potentially deter them before the cutter head is started. • At times where the cutter head of the CSD is raised while the dredge pumps are still running (for example, during the pipeline flushing as part of normal operations), the cutter head will remain operational (that is, this continue to rotate) to act as a deterrent to any marine mammals in the vicinity of the dredge and reduce the risk of entrainment within the dredging equipment. • In the event that the dredging or spoil disposal activities result in injury or mortality to two or more marine mammals, a review of the current management measures will be undertaken in consultation with a marine mammal specialist to identify potential additional management measures NOTE 1: There is not considered to be a significant risk of impacts to marine mammals as a result of the deterioration in water quality (elevated turbidity). Potential impacts of increase turbidity on marine mammals will be managed via the water quality management measures presented in *Section 3.2*. NOTE 2: In line with recent practice in the management of impacts to marine mammals on large scale dredging project in Australia, the above management measure will not apply to dolphin sightings. The speed and intelligence of dolphins means that there is a low risk of impacts to dolphins via vessel strike.
Monitoring:	• Not applicable
Reporting:	• All incidents resulting in marine mammal injury or mortality will be reported to DERM and DEWHA. • All marine mammal sightings resulting in the application of management measures will be recorded.

3.5. Management Strategy 4 – Marine Fauna Interaction: Marine Turtles

The interaction between marine turtle and the dredging equipment has the potential to cause injury or mortality to individual animals via direct striking or entrapment/entrainment. Refer to *Volume 5, Chapter 8* of the Draft EIS and Supplementary EIS for details on potential impacts to marine turtles present in the project area.

Marine Turtle Management	
Environmental Objective:	• To detect and mitigate risks of injury/mortality to marine turtles as a result of the dredging and spoil management activities.
Key Performance Indicator:	• Zero reported incidents of injury or mortality to marine turtles as a result of dredging and spoil management activities.
Management:	<u>Vessel Interaction</u> • Vessel speed limits will be applied to vessels operating within the construction area to reduce the risk of vessel strikes on marine mammals. • During barge transport of dredged material, a lookout for marine turtles will be maintained by dredge crew. In the event that a marine turtle is sighted, the vessel speed and direction will be altered as necessary to avoid impact with the marine turtle (within safety constraints). • Where practicable, barges will use consistent routes during offshore disposal. • Adopt 'slow start' procedure for dredges to alert turtles and potentially deter them before the cutter head is started. • At times where the cutter head of the CSD is raised while the dredge pumps are still running (for example, during the pipeline flushing as part of normal operations), the cutter head will remain operational (that is, this continue to rotate) to act as a deterrent to any marine turtles in the vicinity of the dredge and reduce the risk of entrainment within the dredging equipment. • In the event that the dredging or spoil disposal activities result in injury or mortality to two or more marine turtles, a review of the current management measures will be undertaken in consultation with a marine turtle specialist to identify potential additional management measures <u>Lighting</u> • Lighting onboard dredging and support vessels will be limited to a level required for safe and efficient operations. NOTE 1: There is not considered to be a significant risk of impacts to marine turtles as a result of the deterioration in water quality (elevated turbidity). Potential impacts of increase turbidity on marine turtles will be managed via the water quality management measures presented in *Section 3.2*.
Monitoring:	• Not applicable
Reporting:	• All incidents resulting in marine turtle injury or mortality will be reported to DERM and DEWHA • All marine turtle sightings resulting in the application of management measures will be recorded.

3.6. Management Strategy 5 – Introduced Marine Pests

Introduced Marine Species Management	
Environmental Objective:	• To prevent the establishment of introduced Marine Species into the waters surrounding the project area as a results of the dredging and spoil disposal activities
Key Performance Indicator:	• Zero establishment of introduced marine species as a result of the dredging and spoil disposal activities.
Management:	**Vessels Mobilising From Within Bioregion Encompassing Port Curtis** • No specific management measure required **Vessels Mobilising from within Australia but outside of Bioregion Encompassing Port Curtis** • All dredging vessels and dredging support vessels (e.g. barged) to be subjected to vessel risk assessment (prior to mobilisation) based on vessel history, last cleaning, last application of anti-fouling and vessel location. • Dredging vessels determined to be low risk, can be mobilised to site (direct sail/tow) and begin operations • Vessels determined to be medium to high risk, require a pre-mobilisation inspection with full cleaning prior to mobilisation to site in the event that marine species listed on the priority species of concern list are found. • Once classified as clean, vessel to undertake direct sail/tow to site. **Vessels Mobilising from outside of Australian Waters** • All dredging vessels and dredging support vessels (e.g. barged) to be subjected to vessel risk assessment (prior to mobilisation) based on vessel history, last cleaning, last application of anti-fouling and vessel location. • Dredging vessels require a pre-mobilisation inspection with full cleaning prior to mobilisation in the event that marine species listed on the priority list are found. • Once classified as clean, vessel to undertake direct sail/tow to site. • A pre-start vessel inspection to be undertaken within 48 hours of arrival on site **Introduced Marine Species Response Measures** In the event that marine species on the priority species of concern list, are identified on dredging vessels while at the project site, the following measures will be taken: • The relevant regulatory authorities will be notified immediately • An introduced marine species monitoring and response program will be developed in conjunction with the regulatory authorities. The aim of this program will be to detect and control the establishment of any introduced marine species.
Monitoring:	• Introduced marine species monitoring and response program
Reporting:	• The results of all vessel inspection will be provided to the relevant regulatory authorities within 72 hours of the inspection. • Reporting requirements relating to the introduced marine species monitoring and response program will be developed in the event that the plan is required.

3.7. Management Strategy 6 – PASS Material

An activity specific Acid Sulphate Soils Management Plan will be developed, consistent with the over-arching Project-wide Framework Acid Sulphate Soils Management Plan, prior to commencement of dredging activity and as part of this DMP.

4.0 MONITORING AND INSPECTION PROGRAMS

4.1. Overview

The objective of the monitoring program is to implement a combination of baseline and triggered reactive monitoring to guide dredge and disposal management and ensure that any potential impacts to water quality, seagrasses and corals are avoided or minimised.

The monitoring program will monitor sensitive values and provide an early warning of the potential risk of impacts due to dredging, spoil disposal and land reclamation activities. This reactive approach will provide time to mitigate potential impacts in the event they arise. This reactive monitoring programme is characterised by the frequency of data collection and review.

4.2. Monitoring Activities

The monitoring and inspection programs that will be undertaken to support the management strategies are detailed in the following sections. The programs and surveys to be implemented include:

- Water quality monitoring
- Seagrass health monitoring
- Mangrove monitoring
- Invasive marine pest surveys

4.3. Monitoring Regimes

The monitoring activities will occur as follows:

(1) Pre-dredging and disposal activities;

(2) Baseline seagrass health assessment survey at all reference and impact sites; and

(3) Baseline mangrove mapping survey.

(4) During Dredging

- Weekly water quality monitoring at impact and reference sites;
- In the event Water Quality (LAC) trigger values are exceeded, intermediate seagrass health surveys will be undertaken at the relevant sites;

(5) Post Dredging and Disposal

- Undertake seagrass health assessment survey at all reference and impact sites within two months of completion of activities;
- In the event that results of monitoring activities under #4 indicate impacts are greater than were predicted, undertake further survey at relevant impact and reference sites within 12 months of completion, and each 12 months thereafter until recovery is evident;

- Undertake a survey of offshore spoil ground within two months of completion of spoil disposal activities and each 12 months thereafter for two years after completion of spoil disposal activities; and
- Undertake an additional survey of offshore spoil ground within two months of a severe storm event exceeding a 1 in 5 year ARI.

4.4. Monitoring Sites

(To be determined)

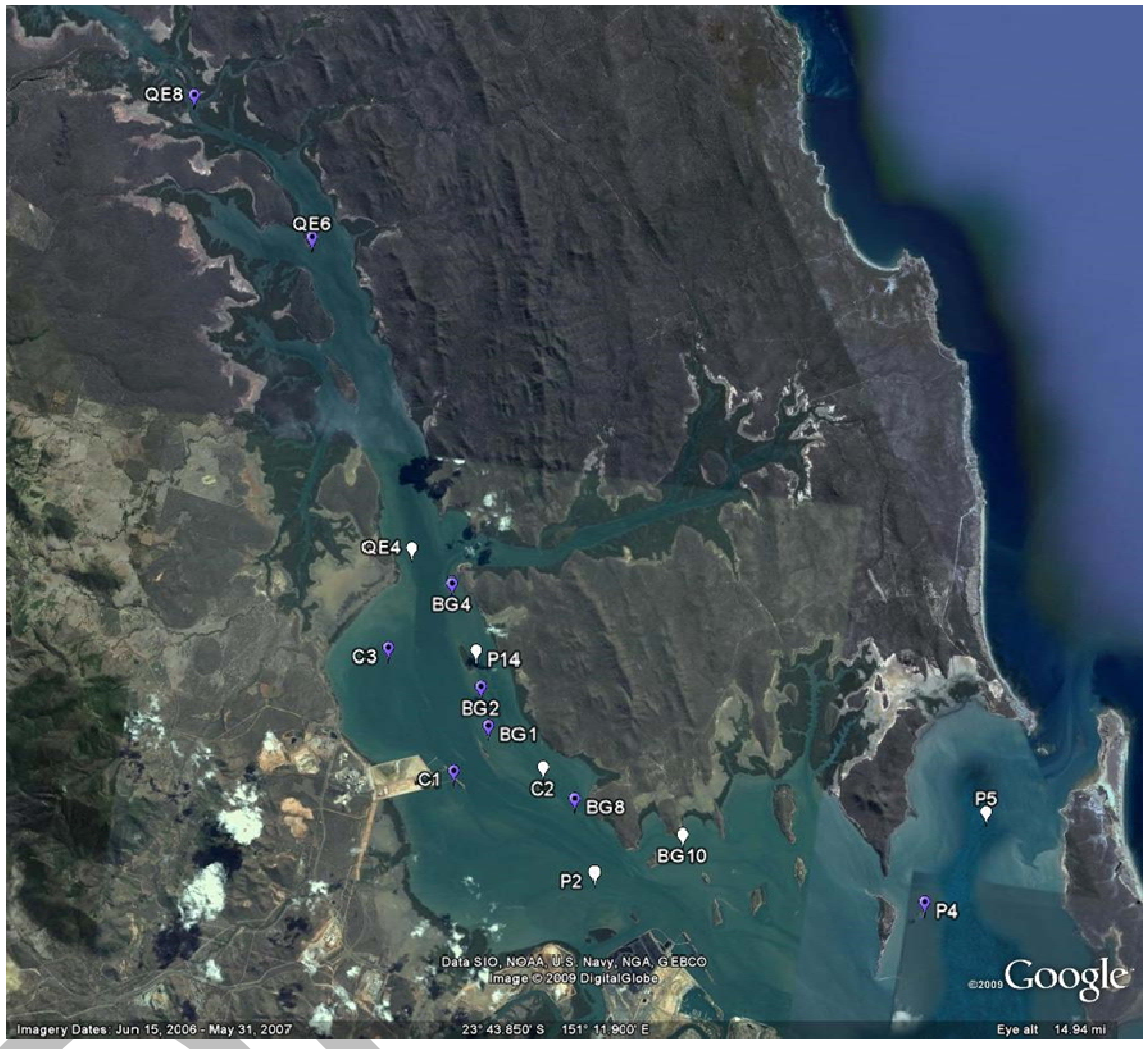
4.5. Water Quality Monitoring

(To be determined)

4.5.1. Baseline monitoring

The Port Curtis Integrated Monitoring Plan (PCIMP) has been collecting baseline water quality data for the Port Curtis region for a considerable period. This routine water quality monitoring program has continually measured light, turbidity and temperature, using bed-mounted nephelometers. This program is to be expanded post-2009 such that water quality monitoring will be undertaken at 15 sites, chosen according to their proximity to established seagrass meadows and the proposed dredging and land reclamation activities (see *Figure 4.1*). An additional three reference sites have been selected in Rodds Bay.

Figure 4.1 Location of continuously logging nephelometers (white) and other water quality monitoring sites (purple) in Port Curtis



A summary of the baseline water quality monitoring program is provided in *Table 4.1* below.

Table 4.1 Summary of baseline water quality monitoring program

Analysis	Parameters	Frequency	Sites
Physico-chemistry	Depth profiling (temperature, conductivity, dissolved oxygen, pH, turbidity, ORP)	Monthly	18 water sites
	Nephelometer (temperature, conductivity, dissolved oxygen, pH, turbidity, ORP)	Continual (monthly download)	7 water sites
	Temperature loggers	Continual (monthly download)	20 seagrass sites
Light	Water Column Light attenuation	Monthly	18 water sites
	PAR readers	Continual (monthly download)	20 seagrass sites
Water Analysis	Nutrients (total phosphorus, orthophosphate, total nitrogen, total Kjeldahl nitrogen, ammonium-N, nitrate and nitrite)	Quarterly	18 water sites
	Chlorophyll	Quarterly	18 water sites
	Total Suspended Solids (TSS)	Monthly	18 water sites

4.5.2. Elements of reactive monitoring

Using the baseline environmental information that has been collated, an investigation of the data was undertaken to establish relationships between water quality parameters (e.g. TSS>NTU>SI). The reactive water quality monitoring program will have the following elements:

- Parameter(s) allowing continuous monitoring and quick response times;
- Parameter(s) that will be indicative of seagrass health;
- Statistically defensible trigger values that can be used to either precipitate further environmental investigation or management action; and
- A spatial and temporal complexity that is achievable within any response times required.

4.6. Seagrass Health Monitoring

(To be confirmed through consultation with DEEDI)

4.6.1. Seagrass Baseline

The seagrass shading experiments currently being conducted will allow the derivation of minimum light requirements for local seagrass species which will be directly interpretable with water quality conditions due to the parallel baseline water quality monitoring program. It will be possible to develop reactive seagrass triggers directly from the MLR experimental data, with the

likelihood that tiered triggers can be proposed, allowing a hierarchy of monitoring or management responses that the regulatory authority can be confident in.

4.6.2. Elements of reactive monitoring

As for the reactive water quality monitoring program, it is anticipated that the reactive seagrass health monitoring program will have the following elements:

- Parameter(s) allowing continuous monitoring and quick response times;
- Parameter(s) that will be indicative of seagrass health;
- Statistically defensible trigger values that can be used to either precipitate further environmental investigation or management action; and
- A spatial and temporal complexity that is achievable within any response times required.

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