Advisian
WorleyParsons Group

Queensland Government

Abbot Point Growth Gateway Project

Outline Dredging Management Plan

23 July 2015

Advisian
WorleyParsons Group

Queensland Government

Disclaimer

This report has been prepared on behalf of and for the exclusive use of the Queensland Department of State Development, and is subject to and issued in accordance with the agreement between the Queensland Department of State Development and Advisian. Advisian accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this report by any third party.

REPORT NO 301001-01956-00-EN-REP-0004-017

ABBOT POINT GROWTH GATEWAY PROJECT: OUTLINE DREDGING MANAGEMENT PLAN

Rev	Description	Author	Review	Advisian Approval	Date
Rev 0	Issued for Use	S Neale	T Graham	A Hanly	23 July 2015

Table of Contents

List of Figures

List of Tables

1 Introduction

1.1 Background

The existing Terminal 1 (T1) at the Port of Abbot Point commenced operations in 1984, with infrastructure developed to support the export of coal from the Bowen Basin. In 2011, T1 was expanded to increase export capacity to 50 million tonnes per annum (Mtpa).

Terminal development at the Port of Abbot Point is proposed in the coming years. To support the development of Terminal 0 (T0) it is necessary to undertake capital dredging for new berth pockets and ship apron areas.

The Abbot Point Growth Gateway Project (the Project) is proposed by the Queensland Government Department of State Development (DSD) to support the development of the already approved T0 project at the Port of Abbot Point through undertaking capital dredging to provide sea access for this terminal. The Project includes:

- Construction of onshore dredged material containment ponds (DMCPs) within the area previously allocated for the development of Terminal 2 (T2) and adjoining industrial land
- Capital dredging of approximately 1.1 million m^3 *in situ* (Mm^3) of previously undisturbed seabed for new berth pockets and ship apron areas required to support the development of T0
- Relocation of the dredged material to the DMCPs and offshore discharge of return water
- Ongoing management of the dredged material including its removal, treatment and beneficial reuse within the port area and the Abbot Point State Development Area (APSDA), where appropriate.

1.2 Scope

The Project is currently undergoing assessment for approval under Queensland and Australian Government legislation (described in Section 2.1).

This Outline Dredging Management Plan (Outline DMP) has been prepared with regard to the ISO14001 specification for an environmental management system. The Plan is designed to ensure the planning and delivery of the Project is responsibly and effectively managed with respect to the protection of environmental values (including Matters of National Environmental Significance - MNES).

This Outline DMP provides for the management and monitoring of:

- Dredging
- Placement of dredged material in the DMCPs
- Return of water from the placement operation to sea.

As an Outline DMP, the document should be read in conjunction with the relevant impact assessment documentation for the Project and the Outline Environmental Management Plan (EMP). The Outline EMP provides for the management and monitoring of the:

- The design and construction of the DMCPs
- The management of the DMCPs before and after completion of placement of dredged material

- The reuse (including any treatment that may be required) of dredged material, post-placement in the DMCPs.

It is assumed that submission of the final DMP to Queensland and Australian Government regulatory authorities prior to commencement of dredging will be required as a condition of approval of the Project. In development of the final DMP further engagement will be undertaken with regulatory authorities. The final DMP will reflect relevant conditions of approval and provide further detail regarding environmental management and monitoring proposed as the Project's design and execution methodology are progressed.

1.3 Objectives

The DMP describes approval conditions, monitoring and management response arrangements for capital dredging and dredged material management to be undertaken for the Project. The DMP supports the implementation of Australian and Queensland Government requirements for dredging, onshore management of marine sediments and discharge of return water to the sea.

Core operational objectives of the DMP for the Project include:

- Providing a platform for delivering legislated approval conditions for the development as evidenced by practical and achievable action plans
- Implementation of an adaptive management and monitoring strategy which provides data for management at suitable spatial and temporal scales to enable effective environmental management outcomes
- Establishment of an agreed outline for the management of dredging and dredged material placement which is transparent to stakeholders
- Provision of guidance to the approval holder and the dredging contractor with regards to dredging and management activities, including environmental management criteria and response requirements.

This DMP is a living document that may be reviewed and updated as necessary during the works period if considered necessary, and where approved by regulatory authorities, to achieve its objectives.

2 Management Outline

2.1 Legislative framework and approvals

The Project falls under the management jurisdictions of both Queensland and Australian Governments. The following defines key regulatory instruments affecting the conduct of the Project.

2.1.1 Australian Government

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) prescribes the Australian Government's role in environmental assessment, biodiversity conservation and the management of protected matters. The EPBC Act identifies MNES and makes it an offence to take any action that has, or is likely to have, a significant impact on any of those matters, unless it is approved by the Minister. Such an action is a 'controlled action'. It is an offence to undertake a controlled action without the approval of the Australian Government Minister responsible for the EPBC Act.

The Project was determined to be a controlled action and is being assessed by preliminary documentation with the relevant controlling provisions (MNES) being:

- World Heritage properties
- National Heritage places
- Listed threatened species and communities
- Listed migratory species
- Great Barrier Reef Marine Park (GBRMP)
- Commonwealth marine areas.

2.1.2 Queensland Government

The Project triggers a number of Queensland Government approvals under the *Sustainable Planning Act 2009* (SP Act), the APSDA Development Scheme and other legislation. The following key approvals are triggered by the Project:

- Development Approval by North Queensland Bulk Ports (NQBP) as Assessment Manager for Operational Work within Strategic Port Land and by the Department of Infrastructure Local Government and Planning (DILGP) (as State Assessment and Referral Agency - SARA) as concurrence agency supported by technical advice agencies. This approval includes:
  - Operational work that is tidal works: the proposed dredging and land placement activities are considered tidal works under the SP Act because they occur in tidal waters.
  - Operational work that is the removal, damage or destruction of marine plants: the proposed dredging will cause removal of seagrass, which is classed as marine plants under the *Fisheries Act 1994*.
  - Approval from Maritime Safety Queensland (MSQ), ensuring the proposed works are carried out safely, without undue restrictions on maritime traffic, professional and recreational fishing activities.

  - Environmental Authority to carry out an Environmentally Relevant Activity (ERA) 16(1)(b), being dredging more than 1,000,000t in a year, and associated Material Change of Use (MCU) for an ERA.

- Development Approval by DILGP as Assessment Manager for Operational Work in coastal waters outside Strategic Port Land, supported by the Department of Agriculture and Fisheries. This approval covers operational work that is the removal, damage or destruction of marine plants (i.e. seagrass).
- MCU under the APSDA Development Scheme, including approval for self-assessable operational work, which is granted by the Coordinator-General, as follows:
  - Assessment against the APSDA Development Scheme assessment criteria.
  - Clearing of remnant vegetation. The dredged material transport and return water pipelines intersect an area of mapped remnant vegetation. This section of the MCU application is assessed by the Department of Natural Resources and Mines (DNRM) as referral entity.
  - Approved Traffic Impact Assessment covering the Bruce Highway/Abbot Point Road intersection and rail crossings. The road traffic generated by the Project may generate increased traffic and increased risks that must be assessed and managed. This section of the MCU application is assessed by the Department of Transport and Main Roads (DTMR) as referral entity.
  - Use of Aurizon railway crossings. The road traffic generated by the Project may have some impacts on three railway crossings managed by Aurizon.
  - Approval of development by NQBP on land owned in freehold.
  - High impacts earthworks in a Wetland Protection Area. Small sections of the DMCP embankment southern wall encroach on the Caley Valley Wetland Protection Area and must therefore be assessed for their potential impacts on the wetland. This section of the MCU application is assessed by the Department of Environment and Heritage Protection (DEHP) as referral entity.
- Permit to tamper with animal breeding places. The land disturbance caused by the construction of the ponds may remove fauna breeding places as defined under the *Nature Conservation (Wildlife Management) Regulation 2006*. This permit application is assessed by DEHP.

3 Context of Dredging and Placement

3.1 Port of Abbot Point

The Port of Abbot Point is located approximately 25km north-west of Bowen on the North Queensland coast, and is Australia's most northerly coal export port. It is centrally located between Mackay and Townsville.

The Queensland Government has declared the Port of Abbot as one of the five Priority Port Development Areas (PPDAs) in Queensland. The Queensland Government has recognised the significant strategic value of this port as a gateway to export Queensland resources to the global market for a number of reasons:

- There are very few locations along Queensland's seaboard with water deeper than 15m so close inshore, with the deep water of the Port allowing for safe port facilities requiring minimal dredging to accommodate large tonnage vessels
- The Port is located in close proximity to the Bowen Basin (coal resource), Galilee Basin (coal resource) and North West Minerals Province, and efficient export of product through the port from these areas is critical to an economically viable supply chain to the global market.

Abbot Point is the Queensland Government's preferred port for developing the specialist coal handling infrastructure required to export coal from the Galilee Basin.

NQBP is the Port Authority for the Port of Abbot Point under the *Transport Infrastructure Act 1994.*

3.2 Abbot Point State Development Area

Directly adjacent to the Port of Abbot Point is the APSDA. Declared in 2008, the area was established to facilitate large-scale industrial development of regional, State and national significance.

Land use and infrastructure planning and development in the SDA are controlled by the APSDA Development Scheme.

3.3 Great Barrier Reef World Heritage Area and Marine Park

The Great Barrier Reef is one of Australia's most significant environmental assets. It is recognised internationally for its 'Outstanding Universal Value' and was listed as a World Heritage Property in 1981 under the World Heritage Convention 1972. The declaration was made at approximately the same time that the original coal terminal at Abbot Point was approved for development.

The Great Barrier Reef World Heritage Area (GBRWHA) extends to the low water mark on the mainland coast, including marine waters at Abbot Point. Marine infrastructure development, shipping, dredging and dredged material management occur within the GBRWHA. The GBRWHA was listed for the following four natural criteria, whereby it was considered to:

- Contain outstanding examples representing the major stages of the earth's evolutionary history
- Contain outstanding examples representing significant ongoing geological processes, biological evolution and humankinds interaction with the natural environment
- Contain unique, rare or superlative natural phenomena, formations or features or areas of exceptional natural beauty, such as superlative examples of the most important ecosystems to man
- Comprise habitats where populations of rare or endangered species of plants and animals still survive.

A detailed study was undertaken to understand how the iconic GBR World Heritage attributes are expressed at Abbot Point, as part of the Abbot Point Cumulative Impact Assessment (CIA) (EcoLogical Australia and Open Lines, 2013). Based on this analysis, three natural heritage attributes were identified as being relevant to Abbot Point, including:

- Aesthetics
- Birds
- Marine mammals.

While a number of other natural heritage attributes are present within the vicinity of the proposed action area (e.g. marine turtles, seagrass and mangroves), the CIA considered that they were not present at a scale or value that was relevant to the GBRWHA as a whole. For instance, while a number of marine turtle species are present within the vicinity of the proposed action area, the numbers are very low when compared to important breeding areas within the wider GBRWHA.

The GBRMP was established under the *Great Barrier Reef Marine Park Act 1975* (Cth) to provide for the long-term protection and conservation of the environment, biodiversity and heritage values of the GBR region. The jurisdictional boundary of the GBRMP ends at the low water mark on the mainland coast but does not include the Abbot Point port area.

The GBRMP is a multiple-use area, supporting a wide range of activities including tourism, fishing, recreation, traditional uses, research, defence, shipping and port uses. Activities within the marine park are managed through the application of management zones. All port infrastructure lies outside the GBRMP. The dredging footprint is outside the boundary of the marine park. The plume from the dredging activity will enter the marine park. The return water pipeline's discharge location is outside the marine park and its plume is not predicted to enter the marine park. Vessel movements associated with the works may enter within the marine park boundary. Shipping activities are allowable uses within the 'general use' zone of the marine park.

The Commonwealth marine area is any part of the sea, including the waters, seabed and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State waters. It is generally defined as the area extending from 3 to 200 nautical miles from the mainland coastline.

Within Queensland, the Commonwealth marine area overlaps with the boundaries of the GBRMP and the GBRWHA. All port existing infrastructure lies outside the Commonwealth marine area. The Project's dredging area and return pipeline is located outside the Commonwealth marine area. Direct impacts (actual impacts) on the Commonwealth marine

area will not occur, whilst indirect predicted impacts could occur as a result of plume migration associated with the dredging only.

3.4 Environmental values and sensitive areas

The current state of the environmental values at the T2 site reflects both its proximity to some ecologically important areas, as well as adjacent uses to an existing industrial port. Prior to the development of T1 in the 1980s, Abbot Point was used for agriculture. Consequently, vegetation across much of the land area is regrowth vegetation.

The marine environment at Abbot Point is typical of a near shore coastal environment of the central GBR region. Marine waters in the surrounds of Abbot Point waters support a number of marine ecosystems and communities, including seagrass, mangrove and intertidal soft sediment and rocky habitats, rocky reefs and algal communities. Studies have demonstrated that the waters in the vicinity of Abbot Point provide transient habitat for a range of species including the Dugong, Humpback Whale, the Australian Snubfin Dolphin, Indo-Pacific Humpback Dolphin, Loggerhead Turtle, Green Turtle, Flatback Turtle and other marine organisms.

The dredged area and temporary offshore pipeline infrastructure will occur within the GBRWHA and will be located adjacent to but not within the GBRMP.

Construction of the DMCP will occur within the area previously allocated for the development of Terminal 2 (T2) and adjoining industrial land. The onshore DMCP is adjacent to the Caley Valley Wetlands which is listed on the Directory of Nationally Important Wetlands. This wetland is a largely ephemeral wetland that is important for a number of bird species (including listed threatened and migratory species). The wetland covers 5,154 ha and is one of the largest intact wetland systems between Townsville and Bowen (BMT WBM, 2012).

Coastal areas at Abbot Point contain remnant areas of semi-evergreen vine thicket which is listed as an endangered ecological community. The Project is designed to avoid clearing of this vegetation.

3.5 History of dredging and placement

The port commenced operations in 1984, with infrastructure developed to support the transfer of coal from the Newlands and Collinsville mines onto ships from trains that enter the port area. Major expansion of the port and the existing coal terminal, T1, to increase capacity to 50Mtpa was completed in 2011, which included increasing the number of berths from one to two.

Abbot Point is a naturally deep water port, which, unlike many other Australian ports, does not require regular maintenance dredging (NQBP, 2010). Only two maintenance dredging activities have occurred at the port since its construction in 1984. The first event occurred in 1986 shortly after the initial capital dredging. The second event occurred in August 2008, when capital and maintenance dredging were undertaken for the new Berth 2 and existing Berth 1, respectively (NQBP, 2010). The 2008 capital and maintenance dredging campaign was approved by the (now) DoE and Great Barrier Reef Marine Park Authority (GBRMPA) via a Sea Dumping Permit and a Marine Parks Permit. These authorities permitted the

relocation of up to 295,000m^3 of dredged material, less than 20,000m^3 of which was dredged for maintenance purposes.

4 Project Description

4.1 Overview

The Project is proposed by the Queensland Government DSD to support the development of the already approved T0 project at the Port of Abbot Point through undertaking capital dredging to provide sea access for this terminal.

The Project includes:

- Construction of onshore DMCPs within the area previously allocated for the development of T2 and adjoining industrial land
- Capital dredging of approximately 1.1Mm^3 *in situ* of previously undisturbed seabed for new berth pockets and ship apron areas required to support the development of T0
- Relocation of the dredged material to the DMCPs and offshore discharge of return water
- Ongoing management of the dredged material including its removal, treatment and beneficial reuse within the port area and the APSDA, where appropriate.

An overview of the layout for dredging, pipelines and placement area is provided in Figure 4-1.

610000
615000
7805000
7800000

LEGEND

- Dredged material pipeline (indicative)
- Return water pipeline (indicative)
- Dredging footprint
- Dredging study area
- Dredged material containment pond
- Dredged material containment pond study area
- Existing rail network
- Abbot Point Rd (Private road)
- Existing Terminal T1

Dredging study area

ABBOT POINT

Existing T1 terminal

MOUNT LUCE

Dredged material containment pond study area

Abbot Point Road (Private road)

CALEY VALLEY WETLANDS

0 0.5 1
Kilometres
SCALE: 1 : 35,000 (at A3)
GDA 1994 MGA Zone 55

N
W E
S

PROJECT LOCALITY

Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

Source information:
Dredging study area
Setout points derived from coordinates on NQBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NQBP
Dredged material and return water pipelines
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Department of State Development, Infrastructure and Planning, (DSDIP)
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Existing Terminal T1
Digitised from 2013 imagery and cadastral boundaries

REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
0	20/07/2015	Issued for information	KM	RA			

Queensland Government

QUEENSLAND GOVERNMENT

ABBOT POINT GROWTH GATEWAY PROJECT

Figure 4-1
Project components

Figure: 301001-01956-00-GM-SKT-0013 | Rev: 0

Compiled by BRISBANE GEOMATICS

\\aubriwpdfs02v\brisbane\Projects\301001\01956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0013-0 (Project components).mxd

4.2 Dredging methodology

A medium to large CSD will be used to dredge all materials, as is typical practice for projects involving onshore placement of dredged material.

A CSD is a stationary or self-propelled vessel that uses a rotating cutter head to loosen the material in the bed ('cutting'). A suction inlet located beneath the cutter head (known as the suction mouth) is connected by a suction tube directly to one or more centrifugal pumps. The vacuum force at the suction inlet sucks up the loosened material. The suction tube and cutter head are attached to a ladder. The ladder with cutter head is positioned at the fore of the vessel. On the aft side, the cutter generally has two spud poles. One spud pole (the auxiliary spud) passes straight through the vessel, while the other is mounted on a movable spud carriage, which can be moved lengthwise along the vessel or pontoon. Steel cables are used to move the ladder or cutter head back and forth, with the spud in the spud carriage as the centre of each concentric circle that it describes. Moving the spud carriage causes the CSD to move as well ('stepping').

A sea bed levelling device may be used to assist in the completion of dredging to ensure required depths of dredging are uniformly achieved. A bed leveller is used to flatten any peaks in the dredged area, which minimises the need for 'over dredging' to achieve design depths.

4.3 Pipeline establishment

The dredged material will then be pumped onshore by a part floating and part submerged pipeline. The pipeline for delivery of dredged material and return of tail water would be approximately 1m diameter. The dredged material and seawater will be pumped through the delivery pipeline and into the DMCP.

Pipe for the pipeline may be delivered to Abbot Point either by road or sea and transported to an onsite laydown area.

Welding of offshore pipe strings would be undertaken at a convenient laydown area and/or the Abbot Point Material Offloading Facility (MOF). Marine support vessels would be used to pull string length offshore as they are fabricated until the desired length is achieved. The sections of the pipe will be floated into position using a workboat and/or tug. A crane barge would then be used to join and position the pipe strings on the required alignment.

Flanged pipes will be placed along the required alignment on site using a crane. A crane and installation crew will assemble the onshore dredging pipeline in place. The onshore pipes will be connected up to pre-installed pipes at the interface of the separately constructed DMCP pond.

The final routing of the pipelines will consider (amongst other things) avoidance or minimisation of impact to sensitive marine and terrestrial flora and fauna. On land, where appropriate, the dredged material and return water pipelines will be co-located to minimise disturbance (BMT WBM, 2015).

Consideration has been given to the risk of failure of the delivery and return pipelines, with this to be further addressed in the development of the execution approach for pipelines and relevant management measures incorporated into the final DMP.

4.4 Placement methodology

The dredged material delivery pipeline will deliver the dredged material into the Primary DMCP, whereupon it will connect to a floating and moveable pipeline system. The Primary DMCP will be filled over the duration of the Project in a stepping process where one area (step) is filled before the delivery pipe's discharge point is relocated or extended to the next area.

The dredged material is classified as 60% coarse sands and 40% fines. The primary DMCP has been designed to retain coarse sands, gravels and clay balls (approximately 75% of the total dredged material solids including all of the coarse sands and gravels and one-third of the fines material).

Return waters containing suspended fine sediments will flow in a controlled manner through the inner bund to the secondary DMCP, which has been designed to retain the remaining fines material (approximately 25% of total dredged material). The secondary DMCP will also serve to manage the water quality prior to discharge to the return water pipelines at the designated final outlet location.

Dredged material at the entry point to the DMCP is typically controlled using conventional earthmoving equipment (dozers and excavators). The sediments in the discharge are retained in the DMCP whilst draining off the excess water, as it flows through the internal weir to the secondary DMCP. This may be assisted through the construction of baffle walls if considered necessary.

An adjustable height weir (e.g. drop-board weir box) would be located within the internal embankment separating the primary and secondary DMCPs, to enable controlled flow of dredged materials between these two ponds. The weir boxes are typically prefabricated steel boxes with timber drop-boards across the inlet and short lengths of large diameter pipe at the outlet. The drop-boards can be inserted or removed as necessary to control the height of the upstream water level, and this operation is carried out manually and safely from the embankment crest. By maintaining the water level in the pond as high as possible the dwelling time of any suspended sediment is maximised. The water then flows into the internal cell of the box where the flow energy is dissipated before exiting through the downstream outlet comprised of multiple large diameter pipes connected to the base of the weir box. The adjustable height weir boxes form an important function both during dredging and in the long-term, enabling control of water levels within each DMCP and retention of return water until water quality has been confirmed to be within discharge approval limits.

A pump would be installed to transfer return water from the south-east (tail end) of the secondary DMCP through return water pipelines to deliver the return water back into the ocean. It is proposed that the return pipeline outlet would be positioned on the seabed in the inshore area. The pump for the return water pipeline will operate continuously, subject to the return water quality meeting discharge approval limits.

4.5 Duration, timing and staging

Project stages include:

- DMCP construction, including construction contractor mobilisation and demobilisation

- Dredging operations, including pipeline installation and dredging contractor mobilisation and demobilisation
- Decommissioning and rehabilitation of the DMCP site.

Timing of the decommissioning and rehabilitation of the DMCP will be dependent on port beneficial reuse requirements, and is subject to discussions with other port users. The indicative schedule has assumed that works will commence in early 2016. If approvals are gained and timeframes permit, site preparation and construction activities may commence in late 2015.

It is anticipated to complete all works associated with the DMCPs and dredging in the 2016 dry season, with some activities such as mobilisation and demobilisation occurring in the fringes of the wet season. DMCP construction will occur over a four to five month timeframe. Mobilisation of the dredge, supply and installation of dredging pipelines will also occur over a four to five month timeframe. DMCP construction, dredging pipe supply and transport to site, and dredger mobilisation may occur concurrently.

Capital dredging will commence as soon as practical post completion of the DMCP. Dredging and dredged material deposition will take place over a 5 to 13 week timeframe in a single dredging campaign, after which a period of stabilisation (dewatering and consolidation of dredged material) within the DMCPs will occur.

DMCP construction activity is planned to take place on a continuous basis during the dry season on a 12 hours per day, 7 days per week cycle. However, if required to meet project timeframes, working hours may need to increase to 24 hours per day, 7 days per week.

It is anticipated that the dredger would operate on a 24 hours per day, 7 days per week cycle to limit the length of the dredging campaign.

Monitoring activities will continue in accordance with the monitoring program requirements.

5 Dredged Material Description

5.1 Physical characteristics

Marine sediment studies at the Port of Abbot Point have essentially identified four material types, described in descending order to the seabed as:

- Silty clayey sand, very loose to loose
- Silty clayey sand, loose to medium dense
- Sandy clayey silt, stiff
- Clayey sand with silt, medium dense.

The four material types identified each exist as a soil matrix of sand, silt, clay and some gravel. The sand, silt, clay and gravel particles forming these soil matrices are not expected to separate significantly during the dredging process (i.e. the sands will not be separated from the cohesive silt and clay particles), but rather the dredged materials would retain much of their *in-situ* matrix composition until placed in the DMCP. No discrete layers of pure sand or other soil types have been identified. No rock material has been identified within the depth of the proposed dredging.

5.2 Chemical contaminant characteristics

All sediments have been screened and tested in accordance with the *National Assessment Guidelines for Dredging* (Commonwealth of Australia, 2009) as part of the Abbot Point Growth Gateway Project and reported in *Terminals 0, 2 and 3, Abbot Point, Queensland, Capital Dredging Sediment Sampling and Analysis Plan Implementation Report* prepared by GHD (2012). Overall, the contaminants of concern assessed in the sediments to be dredged were found to be not a risk to human or environmental health.

Although the dredged material will be placed onshore, the material is considered suitable for unconfined placement at sea in an approved offshore relocation area, on the basis that the 95% UCLs of analysed contaminant substances are less than their respective *National Assessment Guidelines for Dredging 2009* (NAGD) screening levels. Tributyltin (TBT) and arsenic (As) exceeded the NAGD screening levels for sea placement in a few isolated samples. However, the 95% UCL of TBT was less than the minimum detected and the arsenic concentration recorded was less than the NAGD sediment quality high value.

Analysis of the contaminant substance concentrations against National Environment Protection Measure (NEPM) Environment Investigation Levels (EILs) and Health Investigation Levels (HILs) identified that the material is suitable for unrestricted use on land.

5.3 Acid Sulfate Soils

Acid sulphate soils (ASS) assessments have targeted the T0 dredging area and the DMCPs.

A sediment study, undertaken for the Abbot Point T0, T2 and T3 capital dredging project in 2012 by GHD identified that marine sediments are potential acid sulphate soils (PASS) containing a natural neutralising capacity greater than the acid generating capacity. However, settling processes within the DMCP will change the composition of the dredged material and

may reduce the neutralising capacity of the fine grained material. Additional investigations are currently being undertaken to further assess this risk, in consultation with DEHP.

Golder and Associates was commissioned to undertake an ASS investigation of the DMCP footprint (Golder, 2015a). The field and laboratory results on soil samples do not indicate the presence of AASS and PASS within the upper 5m across the proposed DMCP site. Excavation below this depth is not proposed. Limited groundwater sampling conducted during the ASS investigations generally indicates a relatively stable and neutral environment with a high buffering capacity. Test results do not indicate that groundwater has been affected by historical oxidation of sulfides although; relatively high levels of aluminium and iron have been detected in some groundwater samples. Groundwater dewatering outside of the DMCPs will not be required to construct the DMCPs and therefore monitoring and possible treatment of groundwater is not required.

Potential impacts associated with ASS have been considered in the development of this document. These potential impacts, along with potential mitigation measures are described in further detail in the Preliminary ASS Management Plan (ASSMP) Golder (2015b).

6 Existing Environment

The existing environment relevant to the Project is described in detail in the *Abbot Point Growth Gateway Project Marine Ecology Technical Report* (WorleyParsons, 2015). This information will be summarised into the final DMP, when it is later developed into a stand-alone document for implementation.

7 Risk Assessment Approach

This outline DMP is developed based on the requirements of the international standard AS/NZS ISO14001:2004 Environmental Management Systems.

A risk-based approach has been applied to assess potential environmental impacts associated with the Project. The development of this DMP is closely linked with the Risk Assessment that was undertaken for the Project.

As part of the overall risk process (based on ISO 31000:2009: Risk Management – Principles and Guidelines), management and ongoing monitoring of the potential impacts and effectiveness of the proposed mitigation measures shall be undertaken throughout all phases of the Project. Potential environmental impacts were systematically identified and classified by linking them to project phases, project activities, technical assessment areas and controlling provisions (MNES) and collated in a Risk Register.

Mitigation measures were identified to reduce the potential for consequences to occur and/or to reduce their severity if they do occur. These mitigation measures align with those presented in this DMP.

8 Potential Impacts

The potential impacts to the marine environment relevant to the Project are described in detail in the *Abbot Point Gateway Growth Project Marine Ecology Technical Report* (WorleyParsons, 2015). This information will be summarised this DMP as the document is developed to a final DMP.

In summary, the potential impacts associated with dredging and onshore placement are outlined in Table 8-1.

Table 8-1 Activities and potential impacts associated with the Project specifically addressed in this DMP.

Activity	Potential Impact
Pipeline establishment and placement	Loss of flora (seagrass) and fauna (benthic communicates),
Marine dredging and return water discharge	Loss of flora (seagrass) and fauna (benthic communicates), increased turbidity in World Heritage Area, increase in bio-availability of contaminants, mobilisation of sediments
Construction vessels	Vessels associated with pipeline establishment and placement, dredging and construction may strike or cause disturbance to marine animals. Vessels associated with the Project may introduce marine pest species. Vessels associated with the Project may introduce wastes (oil, fuel, general waste) into the marine environment.
Underwater construction noise	Dredging activity underwater noise may cause local nuisance or disturbance to marine animals

8.1 Risk assessment results

The results of the risk assessment are provided in the project risk register. All activities associated with the pipeline establishment and placement, return water discharges (which include: construction vessel activity and underwater noise) were assessed as having an initial risk of low.

The risk of the mobilisation of sediment from marine dredging resulting in turbidity plumes potentially affecting light dependent species, filter feeders and having potential flow on effects to higher trophic groups was classified as moderate prior to mitigation measures. Once mitigation measures were applied to this risk, the residual risk was classified as low.

9 Management Strategies and Procedures

Management strategies and procedures described in this section are draft only. These will be updated prior to finalisation to reflect relevant conditions of approval and to provide further detail regarding environmental management and monitoring proposed as the project design and execution methodology are progressed.

9.1 Responsibility and implementation

The responsibilities of parties relevant to this Outline DMP are outlined in Table 9-1.

Table 9-1 Responsibilities and reporting

Responsible Party	Responsibilities	Reporting
APPROVAL HOLDER	Accountable for ensuring compliance with the requirements of project approvals which are supported by this this DMP May appoint a PRINCIPAL'S REPRESENTATIVE responsible for managing the project on the APPROVAL HOLDER's behalf.	Reports compliance to Environmental Agencies Liaises with PRINCIPAL'S REPRESENTATIVE
PRINCIPAL'S REPRESENTATIVE	Appoints Site Supervisor and ensures compliance on behalf of the APPROVAL HOLDER.	Reports To APPROVAL HOLDER Liaises with SITE SUPERVISOR
SITE SUPERVISOR	Oversee the execution of the dredging contract.	Reports to PRINCIPAL'S REPRESENTATIVE Liaises with DREDGING CONTRACTOR
DREDGING CONTRACTOR (including Environmental Officer)	Carry out works in accordance with the contract, relevant legislation, statutory approvals and this DMP.	Reports to the SITE SUPERVISOR Liaises with ENVIRONMENTAL MONITORING CONSULTANT
ENVIRONMENTAL MONITORING CONSULTANT	Carry out water quality monitoring and ASS testing (when required) Undertake pre and post environmental monitoring surveys.	Reports to the SITE SUPERVISOR Liaises with DREDGING CONTRACTOR

Table 9-2 outlines the primary day-to-day responsibilities of each of the responsible parties in implementing this DMP.

Table 9-2 Responsibilities for implementing the DMP

Responsible Party	Primary Responsibilities
PRINCIPAL'S REPRESENTATIVE (on behalf of the APPROVAL HOLDER)	Auditing and amendments to the DMP.
	Liaison with regulators, including all compliance reporting.
	Contractual control of the Dredging Contractor.
	Ensuring all reporting requirements are being met by the management team. Making these available to the audit process (internal and external).
	Review of routine and reactive monitoring reports from the monitoring consultants.
SITE SUPERVISOR	Day-to-day oversight of the DMP implementation.
	Management of safety and security standards for the Project.
	Handling of complaints from community/regulators.
	Ensuring corrective actions are followed through where appropriate.
	Maintain reporting requirements and registers to ensure compliance to the DMP.
	Provide rapid response reporting to the Approval Holder / Principal's Representative.
DREDGING CONTRACTOR (including Environmental Officer)	Implementing the requirements of the DMP with respect to dredging management (operation scheduling, vessel specifications, liaison with monitoring team, marine mammal interaction, marine turtle interaction, noise, air quality, waste and water quality management, hydrocarbons and hazardous material management).
	Providing a central point of contact for the integration of environmental management requirements into the dredging operations.
	Providing timely access and support of sampling requirements throughout the dredging campaign.
	Providing regular (weekly) reports to the Site Supervisor.
	Ensuring dredging equipment and service vessels are maintained in appropriate running order to prevent issues with operational pollution (noise, air and water quality).
	Ensure all staff are trained and inducted into the requirements of this DMP.
	Ensuring safety and security plans are implemented and followed.
ENVIRONMENTAL MONITORING CONSULTANT	Implement the routine monitoring and reporting programs to the Dredging Contractor and the Principal's Representative.
	Install and maintain the monitoring equipment and staffing requirements.
	Conduct post dredging monitoring as described.

Responsible Party	Primary Responsibilities
	Provide emergency response reporting to the Dredging Contractor and Site Supervisor.

9.2 Environmental management strategies

9.2.1 Marine water quality

Key marine water quality issues relevant to the Project relate to dredging and return water causing suspension of fine sediments in the water column and associated impacts – turbid plumes, reduced photosynthetic capabilities and smothering. Suspension of material may occur at both the dredger head, at the discharge of return water to the sea, and through accidental release should a pipeline leak.

The strategy for management of marine water quality is provided in Table 9-3.

Table 9-3 Marine water quality management plan

Objectives	To minimise the impact of proposed works on marine water quality at the dredge, along the offshore pipeline length and at the discharge location.
Control Measures	Assemble pipeline with appropriate seals between sections. Maintain pipeline and fittings. Undertake all dredging with a CSD which limits the extent of turbidity generation. Develop relationship between turbidity and TSS. Ensure rolling seven day average 100mg/L TSS (or corresponding level for turbidity in units of NTU) discharge limit are met. Undertake all dredging within approved areas and apply adaptive management to the dredging operation as described in the draft marine water quality and seagrass monitoring plan (refer Section 12). *As described at Section 1.2, the monitoring plan will be updated in consultation with regulators.*
Monitoring – Environmental Monitoring Consultant	Develop relationship between TSS and turbidity in the first week of discharging as per the following: On day 3, 5 and 7 of discharging collect one 10L sample from the discharging waters (immediately before the water enters the return water pipeline) every 30mins over a period of 2 hours (4 samples total per day). Test each sample immediately after collection as follows: ▪ Ensure the sample is well mixed, then immediately measure the turbidity (as NTU) of the sample using a hand held nephelometer and note down the value, the date/time and sample number for the day ▪ Ensure the sample is well mixed, then immediately transfer 2L of the

	discharge water into an appropriate clean container ▪ Label the container with the date/time and sample number for the day ▪ At the end of the day dispatch all four labelled samples from that day via overnight courier to a laboratory for analysis of TSS. As the laboratory results are available, compare (by way of a graph) the turbidity values for each sample against each of the corresponding laboratory derived TSS values to establish a relationship between TSS and turbidity. Based on this relationship calculate turbidity value in NTU which is equivalent to a TSS value of 100mg/L. Repeat the sampling once every week of discharging to ensure relationship between TSS and turbidity is stable. Sampling for turbidity (once the relationship between TSS and turbidity is established) will be undertaken at the DMCP weir-box daily until dredging ceases. Dissolved oxygen and pH testing of waters will be undertaken during discharge at the DMCP weir-box daily until dredging ceases, then daily until return water discharge ceases. Undertake receiving environment monitoring in accordance with the draft marine water quality and seagrass monitoring plan (refer Section 12). As described at Section 1.2, the monitoring plan will be updated in consultation with regulators.
Monitoring – Dredging Contractor	Daily visual inspection of waters for turbidity plumes (including plume direction). Daily visual inspection of waters for any turbidity plumes in the vicinity of the offshore section of dredged material pipeline (for integrity checking). Daily visual inspection of waters for oil, grease, floating scum and litter.
Performance Indicators	No dredging outside approved areas. No leaks at joins between pipe components. No breaks in the pipeline. Full compliance with discharge criteria for water quality parameters.
Response	In the event compliance with discharge criteria is not met, a review of the receiving environment monitoring results is to be undertaken in consultation with regulators. To discuss appropriate actions. In the event of a pipeline rupture cease dredging, inform Principal's Representative, identify the impacted area and undertake repairs.

9.2.2 Marine and terrestrial flora

The key issues regarding impacts to flora, both terrestrial and marine, relate to unauthorised clearing or removal of vegetation and / or plants. Potential also exists for pest or exotic plant materials to be introduced to the area through the import of plant, vehicles and pipes to the site.

Minimal if any clearing of vegetation is proposed to be undertaken for the Project. The strategy for management of marine and terrestrial flora is provided in Table 9-4.

Table 9-4 Marine and terrestrial flora management plan

Objectives	To minimise impacts on terrestrial and marine flora as a result of dredging and pipeline installation, maintenance and operation.
Control Measures	Pipeline corridor to be developed in existing cleared areas or degraded or less sensitive environmental areas where possible. The indicative pipeline locations will be selected and micro aligned to avoid SEVT and potential bird habitats where practicable. Only clear vegetation that is directly in the path of the pipeline, where there is no practical alternative.. Pre-clearance survey will be undertaken if it is determined that protected vegetation requires removal. Areas to be cleared will be surveyed in advance, marked-out and authorised by an appropriate person prior to clearing, to ensure no significant areas are inadvertently disturbed and no excessive clearing occurs. Trim terrestrial vegetation where possible rather than removing them. Restrict dredging and placement to locations specified on approved drawings. Clean all plant and equipment of mud, seeds and vegetation prior to use on the site. Controlling of weeds will be undertaken in areas where vegetation has been removed. Prevention of fire ignition and uncontrollable fires through appropriate measures, including fire arrestors on all earth-moving equipment. Overarching management strategies for weed and fire management will be incorporated to the DMP as relevant.
Monitoring	Identify any clearing or damage outside approved areas. Periodic monitoring of weeds will be undertaken in areas where vegetation has been removed. Undertake seagrass monitoring in accordance with the marine water quality and seagrass monitoring plan (refer to Section 12). *As described at Section 1.2, the monitoring plan will be updated in consultation with regulators.*
Performance Indicators	No clearing outside approved areas. Dredging footprint is contained to the approved footprint. Seagrass monitoring completed in accordance with marine water quality and seagrass monitoring plan (refer to Section 12). *As described at Section 1.2, the monitoring plan will be updated in consultation with regulators.*

Response	Unauthorised clearing – report to Principal's Representative. Undertake actions as directed by the Site Supervisor. Management response will to be applied according to the marine water quality and seagrass monitoring plan (refer to Section 12). *As described at Section 1.2, the monitoring plan will be updated in consultation with regulators.*

9.2.3 Marine and terrestrial fauna

The pipeline establishment, dredging, placement and management of dredged material and discharge of return water are not likely to result in mortality or injury to marine or terrestrial fauna. Construction of the DMCP will occur as part of the Abbot Point Growth Gateway Project.

Some localised disturbance to fauna may occur through this Project. The strategy for management of marine and terrestrial fauna, including management of risk of introduced marine species, is provided in Table 9-5.

Table 9-5 Fauna management plan

Objectives	To minimise habitat disturbance and prevent physical injury or mortality of fauna as a result of the works. To minimise potential for pest incursions associated with execution of the Project.
Control Measures	Restrict dredging to locations specified on approved drawings to minimise additional habitat disturbance. Restrict pipeline establishment onshore to areas that have been previously cleared as far as practicable. Visual observations for marine fauna during pipeline establishment. Visual observations of marine fauna in immediate vicinity of dredger. Locations of observed aggregations of marine fauna to be communicated to all vessels in the project area. Avoidance of aggregations of marine fauna where practicable. Vessels are to proceed with caution in areas where aggregations of marine fauna are observed. Maintain site speed limits to minimise likelihood of animal strike when driving

on-site.

Planing hull work vessels[1] may be speed limited in the operational port area of the Port of Abbot Point, i.e. the area outside of the GBRMP.

Implement a Vessel Traffic Management Plan.

A detailed risk assessment procedure consistent with the *National System for the Prevention and Management of Marine Pest Incursions* Guidelines will be implemented to deal with the risk associated with introduction of introduced marine species (IMS). This procedure will be applied to all vessels and immersible equipment used for the dredging campaign to assess the risk of IMS introduction. The risk assessment will be undertaken prior to the identified vessel and/or immersible equipment engaging in dredging and dredged material placement activities. The objective of the risk assessment is to identify the individual level of IMS threat a contracted vessel or its immersible equipment poses. This allows selection of the most appropriate vessels and immersible equipment and establishment of management measures to mitigate identified threats to an acceptable low level.

The three risk categories used in the risk assessment are:

1. Low: low likelihood of IMS – no additional management measures required
2. Uncertain: likelihood of IMS is not apparent – precautionary approach adopted, additional management measures required
3. High: identified as a potential risk – additional management measures required.

The key factors to be considered in the risk assessment include:

1. Vessel type
2. Inspection history
3. Presence and age of fouling control coating
4. Presence or absence of internal treatment systems
5. Internal treatment history
6. Previous climatic region(s) of operation
7. Stationary or slow periods of operation and climatic region;
8. Type of vessel activity
9. Vessel desiccation period during mobilisation
10. Adherence to Australian Quarantine and Inspection Service (AQIS) ballast water requirements.

The outcomes of the risk assessment will determine whether or not an IMS

[1] Planing vessels: Planing is defined by operation of a waterborne craft in which its weight is predominantly supported by hydraulic lift, rather than hydrostatic lift (buoyancy). Typically, a planing vessel is identifiable when it travels 'on top' of the water (planning mode) instead of 'in' the water (displacement modes. Examples of vessels capable of planing may include, a speed boat, personal water craft (PWC), aluminum dingy with outboard, and other high speed craft.

	vessel inspection is required prior to the vessel or immersible equipment mobilisation to site. Traffic related measures from the overarching EMP will be incorporated into this management plan including: ▪ Appropriate speed limits will be sign-posted, included in staff inductions and enforced ▪ Vehicles to be limited to traversing approved roads and tracks ▪ No unauthorised access by vehicles. Personnel working on site will be made aware of the potential for Squatter Pigeons and other threatened and migratory species to be encountered on site, including on vehicle tracks. Directional lighting will be used which is directly away from sensitive habitat. Overarching management strategies for feral animal management will be incorporated into the dredging management plan as relevant.
Monitoring	Be alert for fauna movements in the areas of dredging and pipeline installation and operation. The vessel operator will record all marine fauna observed during pipeline installation.
Performance Indicators	No fauna injuries or mortality. No pest incursions associated with the project.
Response	Fauna injuries or deaths (dugong, turtles, whales and dolphins) will be reported to the Site Supervisor for referral to DEHP and DoE according to approval requirements.

9.2.4 Acid Sulfate Soils

ASS assessments have targeted the T0 dredging area and the DMCPs.

A sediment study, undertaken for the Abbot Point T0, T2 and T3 capital dredging project in 2012 by GHD identified that marine sediments are potential acid sulphate soils (PASS) containing a natural neutralising capacity greater than the acid generating capacity, i.e. the sediments are self-neutralising. However, settling processes within the DMCP may change the composition of the dredged material and may reduce the neutralising capacity of the material.

Golder and Associates was commissioned to undertake an ASS investigation of the DMCP footprint (Golder, 2015a). The field and laboratory results do not indicate the presence of Actual ASS (AASS) and PASS within the upper 5m across the proposed DMCP site. Excavation below 5m is not proposed. Limited groundwater sampling conducted during the ASS investigations generally indicates a relatively stable and neutral environment with a high buffering capacity. Test results do not indicate that groundwater has been affected by historical oxidation of sulfides although; relatively high levels of aluminium and iron have

been detected in some groundwater samples. Groundwater dewatering outside of the DMCPs will not be required to construct the DMCPs and therefore monitoring and possible treatment of groundwater is not proposed.

Potential impacts associated with ASS have been considered in the development of this document. These potential impacts, along with potential mitigation measures are described in further detail in the Preliminary Acid Sulfate Soils Management Plan (Preliminary ASSMP) for the DMCPs (Golder, 2015b), provided in Volume 3 Appendix M of the EIS.

The strategy for management of ASS is provided in Table 9-6.

Table 9-6 Acid Sulfate Soil management

Objectives	To manage ASS appropriately to ensure the environmental values of the receiving environment are protected through all phases of the Project.
Control Measures	Implementation of the Preliminary ASSMP (Golder, 2015b). Control measures outlined in the plan have been divided into four phases namely, DMCP construction, placement of dredged material in the DCMP and returning water back to the ocean, management of dredged material in the DMCP after dredging and management for reuse. The first two phases are pertinent to the outline dredging management plan; control measures for these two phases are summarised below. DMCP Construction: ▪ The inclusions of ASS identification training in construction inductions ▪ Testing of possible ASS materials observed during construction ▪ Contingency measures for lime neutralisation treatment of any confirmed ASS. Dredged material placement in DMCP and return water back to the ocean: ▪ Laboratory testing of historical vibrocore samples from the Multi Cargo Facility offshore investigations ▪ Strategies to be reviewed and updated if self-neutralising ASS is not confirmed ▪ Lime guard layer to be placed over the base of the secondary pond ▪ Phased characterisation/verification testing of dredged materials during placement by visual identification, field screening and subsequent laboratory testing, if warranted ▪ Groundwater quality monitoring surrounding the ponds ▪ Return water monitoring and management.
Monitoring – Environmental Monitoring Consultant	Implementation of groundwater monitoring as described in Section 12. Refer to marine water quality environmental management strategies (Section 9.2.1). Refer to marine water quality and seagrass monitoring plan for pH monitoring

	of marine water (Section 12). During DCMP construction, complete an ASS assessment on sediments during placement as per Procedure CP-A in the ASSMP (Golder,2015b). During dredged material placement in DMCP complete an ASS assessment as per Procedure DS-A in the ASSMP (Golder, 2015b).
Performance Indicators	No generation of acidic soil conditions during the construction of the DMCPs or placement of the dredged material No impacts from ASS to environmental receptors Implementation of all ASS management measures
Response	If suspected ASS is encountered during the construction of the DMCPs follow procedure CP-B as outlined in the ASSMP. If the presence of ASS is confirmed treatment and verification is required refer to Procedure CP-B in the ASSMP. If during placement the dredged material is found to contain ASS follow Procedure DS-A as outlined in the ASSMP. If treatment is required refer to procedure PD-A in the ASSMP Additional advice can be obtained from the ASS group (QASSIT) and DEHP.

9.2.5 Surface water

Stormwater that falls within the DMCPs (during the operation of the DMCPs) will be managed through the DMCPs and discharged to the marine environment with return water as described at Section 12.

Surface water that is generated external to the pond will be managed by diversion drains and bunds to be constructed around the perimeter of the external DMCP bund adjacent to the downstream embankment toe.

The strategy for management of surface water is provided in Table 9-7.

Table 9-7 Surface water management plan

Objectives	To minimise the impact of proposed works on surface water.
Control Measures	Limit impact to DMCP from erosive flow velocities within the catchment diversion drains or diversion bunds. Limit the ponding of water against the DMCP embankment from local catchment drainage, regional flood levels, storm surge, and mean sea level rise. Intercept and divert local drainage catchments around the DMCP embankment. Maintain positive catchment drainage and flow regime as close to natural as

	possible. Implement a reactive surface water quality monitoring program to manage any surface water quality impacts Implementation of the ASSMP including relevant control measures described at Table 9-6. Implementation of waste and hazardous materials management measures as described at Table 9-9 and Table 9-12 respectively.
Monitoring – Environmental Monitoring Consultant	Visually monitor drainage infrastructure for signs of erosion and effective working. A reactive surface water quality monitoring program will be developed and implemented to manage any surface water quality impacts. Undertake ASS related monitoring as described in Table 9-6. Undertake waste and hazardous materials related monitoring as described in Table 9-9 and Table 9-12 respectively.
Performance Indicators	Minimal impacts to catchment drainage and flow regime or to water quality of the receiving environment. Full compliance with discharge criteria for water quality parameters
Response	Implementation of erosion and sediment control measures as relevant. Maintenance of drainage infrastructure to ensure appropriate functioning. Implementation of response measures for ASS as identified in Table 9-6. Implementation of response measures for waste and hazardous materials as identified in Table 9-9 and Table 9-12 respectively.

9.2.6 Groundwater

Information about geochemical characteristics of the material to be dredged and the water quality of seawater at the dredging location indicates that dredged material (as a bulk material) is expected to be non-acid forming, contain low concentrations of metals and metalloids and low concentrations of organic compounds (AGE 2015). The dredged material pumped into the DMCP will be saline, with a salinity approximating seawater concentration (~35,400 mg/L). The wetland receiving environment is already saline to hypersaline, with a highly saline shallow groundwater system, which is recharged periodically by seawater inundation (from king tides and storm surges).Therefore, from an environmental geochemical perspective, the dredged material and resultant seepage would be expected to have a low to negligible impact on the currently saline to hypersaline wetland areas south and west of the DMCP area.

There is also some potential for mobilisation of waste or hazardous material (such as oil and lubricants) to groundwater if not managed appropriately.

The strategy for management of groundwater is provided in Table 9-8.

Table 9-8 Groundwater management plan

Objectives	To minimise the impact of proposed works on groundwater.
Control Measures	Implementation of the ASSMP including relevant control measures described at Table 9-6. Implementation of waste and hazardous materials management measures as described at Table 9-9 and Table 9-12 respectively. Implementation of a ground water monitoring and management plan.
Monitoring – Environmental Monitoring Consultant	A groundwater monitoring and management plan will be implemented including water level and water quality monitoring. This will be instigated prior to commencement of construction. The recording of groundwater levels from existing monitoring bores will continue from pre to post dredging: ▪ To enable natural water level fluctuations (such as responses to rainfall and wetland flows) to be distinguished from potential water level impacts due to the placement of dredged materials in the DMCPs ▪ To assist with determination of groundwater trigger levels ▪ Be used to validate and update model predictions if this is identified as a requirement. The groundwater monitoring and management plan will define the parameters, frequency and time frame for the ground water monitoring program. Monitoring bores should strategically located for early detection and monitoring of changes. These may be equipped with electronic loggers to record water levels at regular intervals to assist with the collection of background groundwater level data. In addition to the maintenance of groundwater level loggers, groundwater levels will be manually measured at intervals as described in the groundwater monitoring and management plan Groundwater quality sampling of existing monitoring bores should continue to: ▪ Establish a baseline groundwater quality dataset ▪ Assess groundwater quality impacts during and post dredging. The groundwater analytical water quality suite will include the following laboratory analysis: ▪ Physical parameters – pH, electrical conductivity, total dissolved solids, alkalinity ▪ Major anions – carbonate, bicarbonate, chloride, sulfate ▪ Major cations – calcium, magnesium, potassium, sodium ▪ Dissolved and total metals – aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc ▪ Nutrients – ammonia, nitrate, nitrite, total Keldahl nitrogen, total phosphorus.

	In addition to the laboratory analysis, pH and electrical conductivity will be measured in the field during sampling.
Performance Indicators	Extent of impact of dredged material placement to groundwater levels restricted to the area of modelled impact. No significant impacts to groundwater quality identified.
Response	Implementation of response measures for ASS as identified in Table 9-6.

9.2.7 Waste

The works to be undertaken can potentially release waste substances into surrounding environment. The strategy for managing these is provided in Table 9-9.

Table 9-9 Waste management plan

Objectives	To prevent the release of waste and other inappropriate substances as a result of the works.
Control Measures	No open or ground garbage mounds are permitted. Provide appropriate receptacles for each waste stream (recycling/general litter/waste). The Dredging Contractor will endeavour to minimise waste generation from equipment consumables, packaging, and the like. The Dredging Contractor will ensure that adequate toilet facilities are provided on the dredger and other vessels. All vessel related wastes, including grey water, will be legally disposed of. If there is a sewage treatment plant on board the dredger or any other vessels, it must comply with the *Transport Operations (Marine Pollution) Act 1995* (QLD). Solid waste will be transported to approved facilities outside the project area. Waste is to be minimised and segregated during mobilisation, installation, execution and demobilisation stages of the project. Fix all receptacles on the dredger and support vessels securely to the deck. Train staff on waste management requirements and instruct staff to use such receptacles. Empty receptacles at appropriate regular intervals and dispose of litter and waste offsite in accordance with approved guidelines. No burning of waste or other materials on site. All domestic, toxic, and hazardous wastes, oils and petroleum hydrocarbons, empty drums and other containers, and any other waste materials will be collected, handled, stored, and disposed of in accordance with existing Port of

	Abbot Point waste management policies and procedures.
Monitoring	Daily visual inspections of the works and storage areas. Daily visual inspection of pipeline and pumps for leakages and/or spills.
Performance Indicators	No unapproved release of substances. All waste materials are handled and disposed of in a safe and environmentally sound manner. With the exception of return water, no wastes from dredging plant and facilities are disposed of to the marine environment.
Response	Collect and dispose of litter.

9.2.8 Air quality

There are no sensitive human receptors in the vicinity of the works; however the works will occur in the vicinity of wetland habitats and coastal marine habitat, and the existing T1 operation. The Air Quality assessment (Katestone 2015) found that there is some potential for elevated dust levels to occur in close proximity to construction activities. The construction emissions and the potential for impact will vary according to the construction activities underway, and will be temporary in nature. No air quality monitoring is proposed.

The strategy for management of air quality is provided in Table 9-10.

Table 9-10 Air quality management plan

Objectives	To minimise the impact of proposed works on air quality
Control Measures	Ensure all machinery is fitted with exhaust systems as per manufacturer's specifications. No burning of waste or other materials on site. Maintain all vessels and plant in good condition to minimise exhaust emissions. Shut down engines when not in operation. Designating, signposting, and enforcement of appropriate maximum speed limits, and ensuring unconsolidated loads (e.g. fill) are covered. Ensure that all significant earthworks are avoided where practicable during unfavourable meteorological conditions (high winds etc.).
Monitoring	Undertake pre-start checks on all plant and vessels.
Performance Indicators	No observations of excessive dust or air emissions noted by Dredging Contractor Environment Officer or Environment Monitoring Consultant.
Response	Excessive emissions noted in daily inspections – maintenance and/or replacement of faulty equipment.

9.2.9 Noise

There are no sensitive human receptors in the vicinity of the works; however, the works will occur in the vicinity of wetland habitats and coastal marine habitat, and the existing T1 operation. It is prudent to apply good practice to the management of noise which may locally modify animal behaviour. The results of the Terrestrial Noise Impact Assessment (SLR 2015a) and the Underwater Noise Impact Assessment SLR (2015b) found the project activities will cause minimal impacts to identified terrestrial and marine sensitive receptors. Based on these assessments, no noise monitoring (terrestrial or marine) is proposed.

The strategy for management of noise is provided in Table 9-11. The strategy for management of dust and other airborne emissions is provided in Table 9-10.

Table 9-11 Noise management plan

Objectives	To minimise the impact of proposed works on noise levels to fauna.
Control Measures	Maintain all vessels and plant in good condition. Shut down engines when not in operation. Exhaust mufflers are to be as per manufacturer's specifications. Adjustment of reversing alarms on plant to limit the acoustic range to the

	immediate danger area.
Monitoring	Undertake pre-start checks on all plant and vessels. No noise monitoring is proposed.
Performance Indicators	No excessive noise noted by Dredging Contractor Environment Officer or Environment Monitoring Consultant.
Response	Excessive noise noted in daily inspection – maintenance and/or replacement of faulty equipment.

9.2.10 Hazardous materials management and emergency preparedness

The works to be undertaken can potentially release hazardous substance into surrounding environment.

The strategy for management of release prevention and response to significant spills of these substances is provided in Table 9-12.

Table 9-12 Hazardous materials management and emergency management

Objectives	To prevent the release of hazardous substances as a result of the works.
Control Measures	**Hazardous Substances Management** Compliance with Port of Abbot Point Emergency Continuity Plan. Onshore refuelling will be conducted by licensed fuel suppliers in accordance with their Standard Operating Procedures. Implementation of the contractors Occupational Health and Safety strategy. Emergency Response Procedures will be implemented by the contractor with training provided in the procedure provided to all crew and personnel. An Emergency Contact List will be maintained with an up to date copy retained. Storage of fuel, lubricants and oil in discrete containers on board vessels will be minimised. When required they will be stored in a secure area and any spills will be cleaned immediately. Any visible or reasonably suspected fuel, lubricant or hydraulic fluid loss will be treated as an 'incident' and reported appropriately. A register of Materials Safety Data Sheets (MSDS) relating to all hazardous substances on board will be maintained. Supply and maintain a spill control kit containing at a minimum – floating booms to a minimum length of 12ms and absorbent pads and materials to handle a spill of up to 80L in the marine environment.

	Note the location of additional oil spill kits at the Abbot Point Coal Terminal in case of larger spills. A significant spill is defined as: ▪ A spill to land greater than: – 200 L for hydrocarbons – 100 L for chemicals – 10,000 L for untreated sewage ▪ A spill to receiving waters greater than: – 20 L for hydrocarbons – 20 L for chemicals – 500 L for untreated sewage **Spill Response** In the event of a significant spill to the marine environment, the dredging contractor is to undertake the following: ▪ Stop the source of the spill ▪ Prevent the oil/chemical from entering the water and mop up with spill with appropriate absorbent material from an on-board spill kit. The absorbent material is to be stored on-board until it can be appropriately disposed of to a licensed facility ▪ Notify the following personnel immediately: – Dredging Contractor to notify the Site Supervisor – In the event of a fire or other emergency, the Dredging Contractor is to immediately call 000 and inform the relevant marine authority (MSQ) then advise as soon as possible, the Site Supervisor. Dispose of any material that has been used from the kit off-site and replace the contents before recommencing works. Supply and maintain personal protection equipment and appropriate training in relation to the use of spill kits. Isolate any booster pumps with bunds. No unregulated dumping of waste oil burying in landfill, by pouring on the ground or any drainage channels.
Monitoring	Vessel crew to regularly check equipment for evidence of leaks and fitness of hydraulic hoses and seals. Daily visual inspections of the works and storage areas. Daily visual inspection of pipeline and pumps for leakages and/or spills.
Performance Indicators	No unapproved release of substances.

	Rapid response clean-up for any spill.
Response	Contain any significant spills, isolate the area and clean up immediately. Cease operation of any equipment leaking fuel or oil to the environment until leaks are repaired. Record any spillage, maintenance requirements or incorrect usage. Report any significant spill immediately to the Site Supervisor. In the event of a fire or other emergency, the Dredging Contractor is to immediately call 000 and inform the relevant marine authority (MSQ) then advise the Site Supervisor as soon as possible. Where necessary the Site Supervisor will coordinate the on-site response to environmental incidents.

10 Environmental Management Plan Procedures

10.1 Training

Training of dredging contractor's personnel will assist in ensuring that the implementation of this DMP are understood, and followed during operations. Appropriate training will ensure that all staff and contractors are adequately trained prior to undertaking activities associated with pipeline establishment, dredging and placement. Key measures will include:

- All personnel will be required to attend a site-specific induction that includes training in relevant environmental management plans and procedures. Key elements to be covered include:
  - Marine fauna interaction
  - Waste management
  - Storage, handling and spill response involving hydrocarbons and other hazardous materials
  - Environmental incidents and response requirements
- Relevant staff and crew will be trained in procedures for handling and storage of hydrocarbons and other hazardous materials
- Copies of relevant approvals, permits and licences and this DMP will be available on-site and on all work vessels
- Tool-box meetings will include review of environmental management requirements relevant to the tasks to be undertaken.

10.2 Complaint management

A register of all complaints received will be maintained.

Any justified complaint received, or referred by a government agency, will be accurately recorded on an Environmental Complaints Form which will includes provision for the following information:

- The date and time of the complaint received
- The date and time of the event or nuisance forming the subject matter of the complaint
- The detail of the subject matter of the complaint
- The identity and address of the complainant (if provided)
- Any action taken in response to the complaint.

An Environmental Complaints Register summarising the complaints received and the actions taken, is to be maintained by the Dredging Contractor at the project site office. This register will be made available upon request to the Site Supervisor and Principal's Representative, and to regulatory authorities upon request.

10.3 Incident reporting

All responsible parties involved in the works have the responsibility to report any significant incidents and emergencies:

- In the first instance, reporting of all incidents and non-conformances should be to the Site Supervisor who would generally direct the Dredging Contractor to initiate corrective action for environmental incidents.
- In the case of an environmental emergency, after first notifying the Principal's Representative the Site Supervisor will help co-ordinate and manage a response.
- Depending on the nature and magnitude of the incident, the Principal's Representative may be required to notify MSQ, NQBP, DoE and/or DEHP as appropriate. It is the Principal's Representative responsibility to ensure that the MSQ, NQBP, DoE and DEHP contact numbers and relevant officers' names are at hand prior to the commencement of the project.
- Significant environmental incidents should be logged in writing, with all relevant details recorded, after corrective action has been completed. The log book must be made available for inspection by the Site Supervisor and Principal's Representative, or regulating agencies, at all times.

The Principal's Representative will report the following information to DEHP and DoE, if at any time during the course of, dredging or placement activities any unanticipated environmental risk is identified:

- Nature of incident and type of risk associated with the incident, including (where possible) volume, nature and chemical composition of substances released
- Measures taken to mitigate the risk
- The success of the measures undertaken
- Proposed future monitoring.

This information will be developed with the assistance of the Site Supervisor and Dredging Contractor.

10.4 Compliance monitoring, auditing, documentation and reporting

A program of compliance monitoring, auditing and reporting will be implemented to ensure that the requirements of the DMP are being met. This will involve:

- Inspections of works and reporting to the Site Supervisor
- Auditing against required control measures and approval conditions
- Reporting to the Principal's Representative any areas of non-compliance with this DMP, licences, permits and approvals.

In conjunction with the Dredging Contractor and Site Supervisor, the Principal's Representative (on behalf of the Approval Holder) will maintain accurate records substantiating all activities with or relevant to the conditions of approval, including measures taken to implement the plans and make them available to the requesting regulatory agency upon request.

11 Review

If the Dredging Contractor wishes to carry out any activity otherwise than in accordance with the DMP, the Dredging Contractor must provide to the Principal's Representative a variation proposal which will be reviewed by the Principal's Representative. If supported by the Principal's Representative, the Dredging Contractor will be responsible for developing a revised version of the relevant plan. The activity will not commence until the Principal's Representative has approved the varied plans in writing. If approval conditions require approval by the Minister or administering authority prior to implementation, the activity will not commence until this approval has been received in writing.

Where improvement to the DMP is recommended, a revised plan will be provided to the Principal's Representative for approval in writing prior to implementation.

12 Marine Water Quality and Seagrass Monitoring Plan Outline

This section describes the proposed marine water quality and seagrass monitoring plan to be implemented during the project dredging activities. This section describes:

- The existing seagrass communities and the relative ecological importance of offshore seagrass compared to nearshore seagrasses communities
- Nearshore seagrass community light requirements and potential turbidity criteria
- The locations of sites and the monitoring parameters for return water discharge monitoring (before and post discharge) and the seagrass monitoring plan.
- Proposed indicative adaptive management process.

12.1 Existing seagrass communities

The seagrass community at Abbot Point is demonstrated to be highly dynamic, changing as a function of season and heavily influenced by extreme weather events (Unsworth *et al.,* 2010).

The deeper offshore seagrass community is dominated by *Halophila* species. *Halophila* species are generally small bodied opportunistic seagrasses that exhibit fast growth habits, are considered well adapted for recovery after disturbance events and are able to exploit resources under high light conditions, but are quick to disappear when light levels deteriorate (Longstaff *et al.,* 1999; McMillan, 1991; Hammerstrom *et al*., 2006; Ralph *et al*., 2007).

The seagrass community in the shallower nearshore areas is dominated by *Halodule uninervis*. This species is more sensitive to disturbances and experiments have shown that this species has a higher reliance on asexual reproduction with limited reliance on seed banks for recovery (Rasheed *et al*., 2014).

Based on the marine ecology habitat impact assessment undertaken as part of the Abbot Point Growth Gateway Project (WorleyParsons, 2014), the nearshore seagrass communities at Abbot Point may be potentially impacted primarily by the discharge waters from the return water outlet and the offshore seagrasses may be potentially impacted by the dredging plume associated with dredging of T0.

The offshore seagrass community will not be the focus of the adaptive management program because:

- The offshore seagrasses are highly dynamic and well adapted to recovery after disturbance events
- Delineating between dredging related impacts to offshore seagrass and natural impact variation in this community is very difficult due to its ephemeral nature
- The marine ecology impact assessment found the impacts to the light climate due to dredging is confined to an area that is approaching the apparent tolerance limit of offshore seagrass survival
- The intra-annual (within a year) variation of seagrass growth as measured in April and September 2013 indicates the outer boundary of the offshore seagrass community changes significantly at this outer boundary (Figure 12-1)

- The intra-annual variation of seagrass growth as measured by the long-term monitoring program at offshore seagrass monitoring blocks indicates the seagrass is present or absent in these blocks depending upon the seasonal survey timing (Figure 12-2)
- It is unlikely that marine fauna such as turtles and dugong would rely heavily on such a sparse and ephemeral offshore seagrass habitat which occurs along the outer edge of the light requirement boundary.

The focus of the adaptive management strategy will be on the more sensitive nearshore seagrass community where seagrasses have been identified as being more susceptible to impact and appear to take longer to recover from disturbance.

595000 600000 605000 610000 615000 620000 625000

7810000 7805000 7800000 7795000

April 2013

CAMP ISLAND
ABBOT BAY
CURLEWIS BAY
MOUNT LUCE
ABBOT POINT

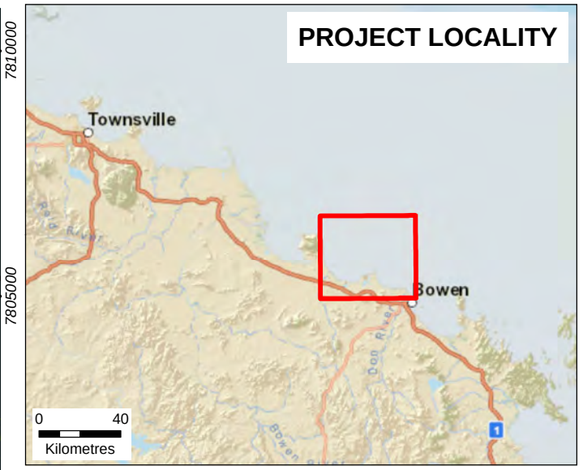
595000 600000 605000 610000 615000 620000 625000

September 2013

CAMP ISLAND
ABBOT BAY
CURLEWIS BAY
MOUNT LUCE
ABBOT POINT

0 1 2 3
Kilometres
SCALE: 1 : 125,000 (at A3)
GDA 1994 MGA Zone 55
N W E S

PROJECT LOCALITY



Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

LEGEND

- Dredged material pipeline (indicative)
- Return water pipeline (indicative)
- Dredging footprint
- Dredging study area
- Dredged material containment pond
- Dredged material containment pond study area
- Port limit
- Australian Maritime Boundaries - Coastal (State) waters
- Abbot Point Strategic Port Land
- Deposition zone of moderate impact - dry season
- TSS zone of moderate impact - dry season
- Light climate - Zone of moderate impact
- Baseline seagrass meadows - April 2013
- Baseline seagrass meadows - Sept 2013

Source information:
Dredging study area
Setout points derived from coordinates on NQBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NQBP
Dredged material and return water pipelines
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Department of State Development, Infrastructure and Planning, (DSDIP)
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={4091CAF1-50E6-4BC3-B3D4-229AA318231A}
Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited -Port of Abbot Point Land Use Plan - October 2010
Seagrass monitoring and survey data
TropWATER (Centre for Tropical Water & Aquatic Ecosystem Research) - James Cook University

REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
0	14/07/2015	Issued for information	MH	KM	SN		

Queensland Government

QUEENSLAND GOVERNMENT

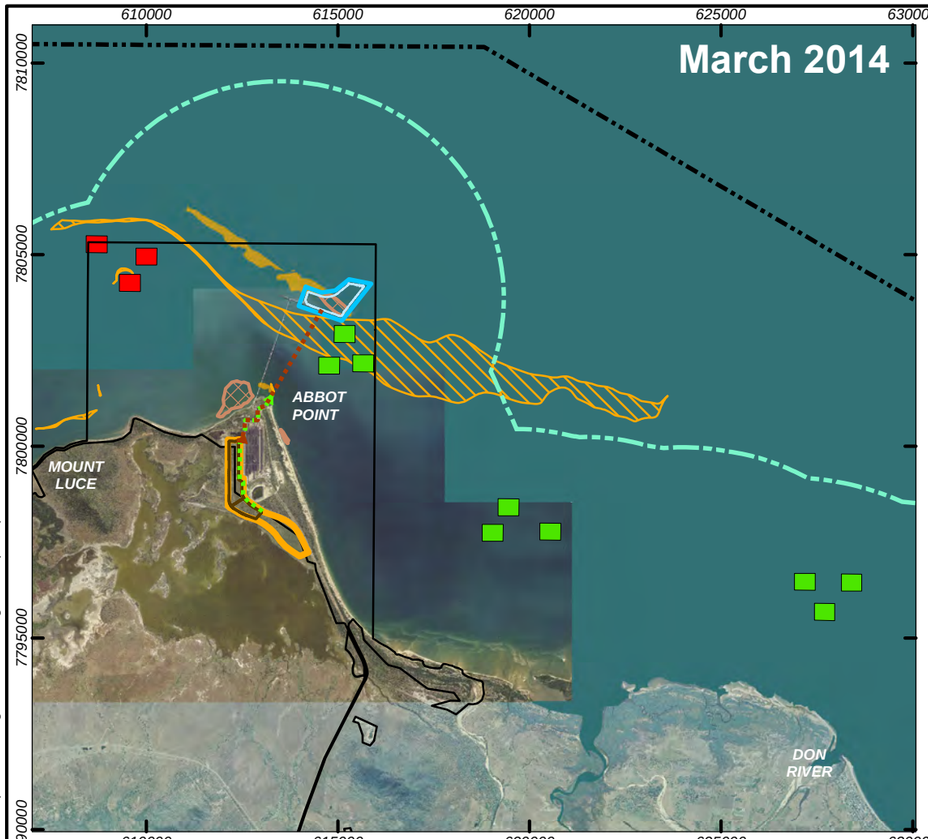
ABBOT POINT GROWTH GATEWAY PROJECT

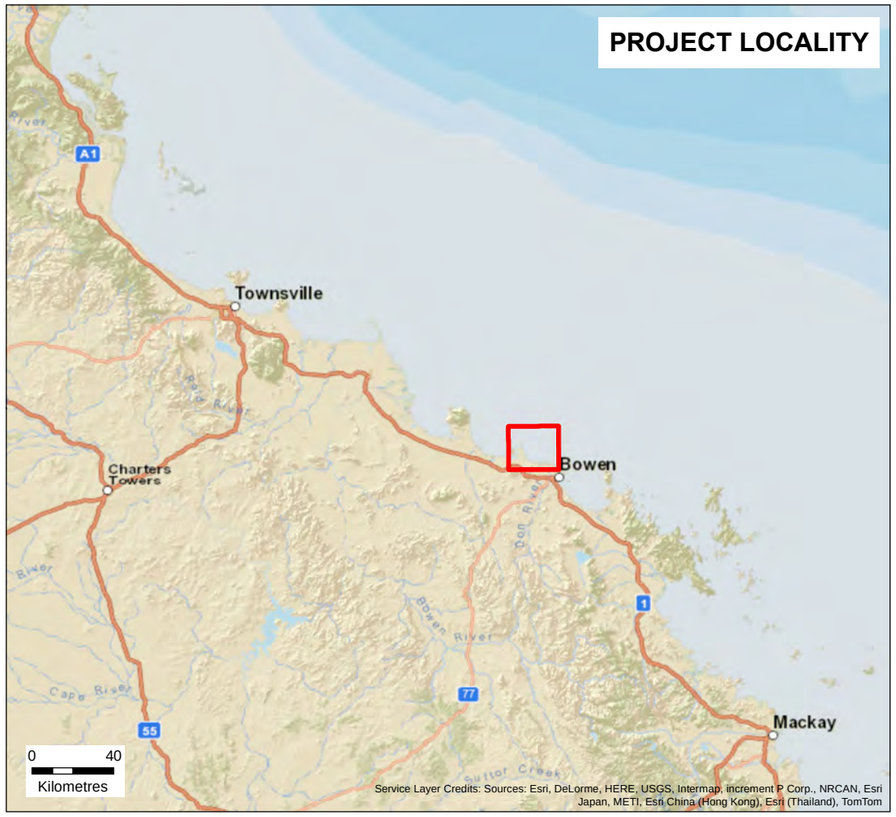
Figure 12-1
Offsite impact areas and seagrass growth variability in 2013

Figure: 301001-01956-00-GM-SKT-0082 | Rev: 0

G:\301001\01956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0082-0 (Marine seagrass inter-annual variability).mxd

Compiled by BRISBANE GEOMATICS



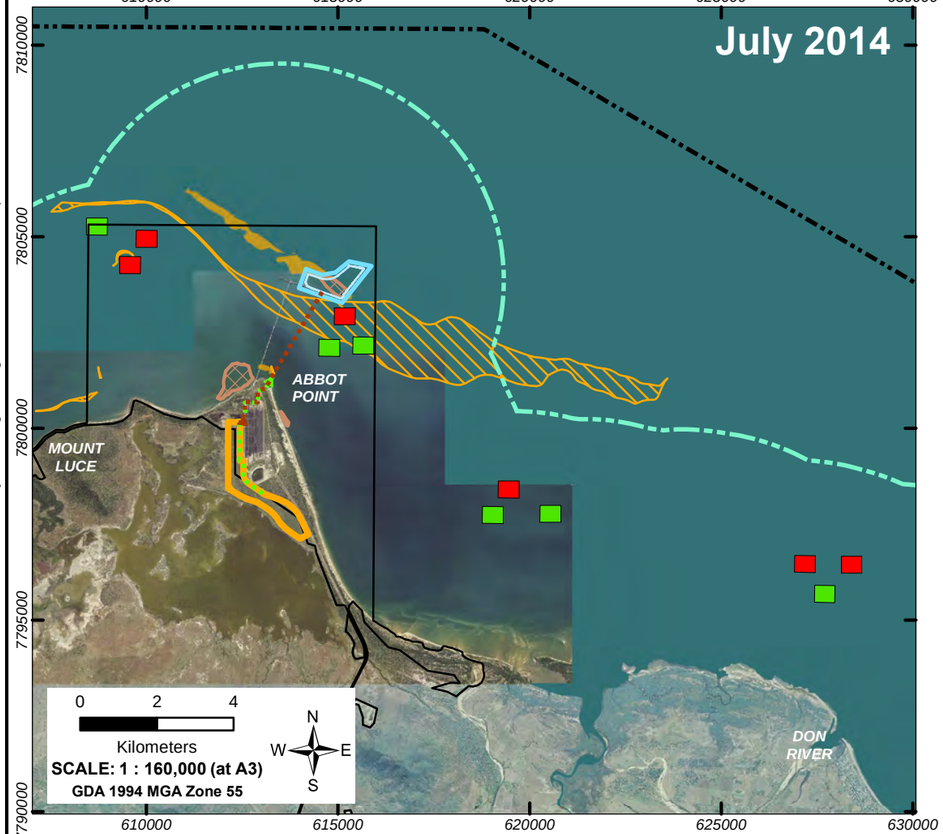


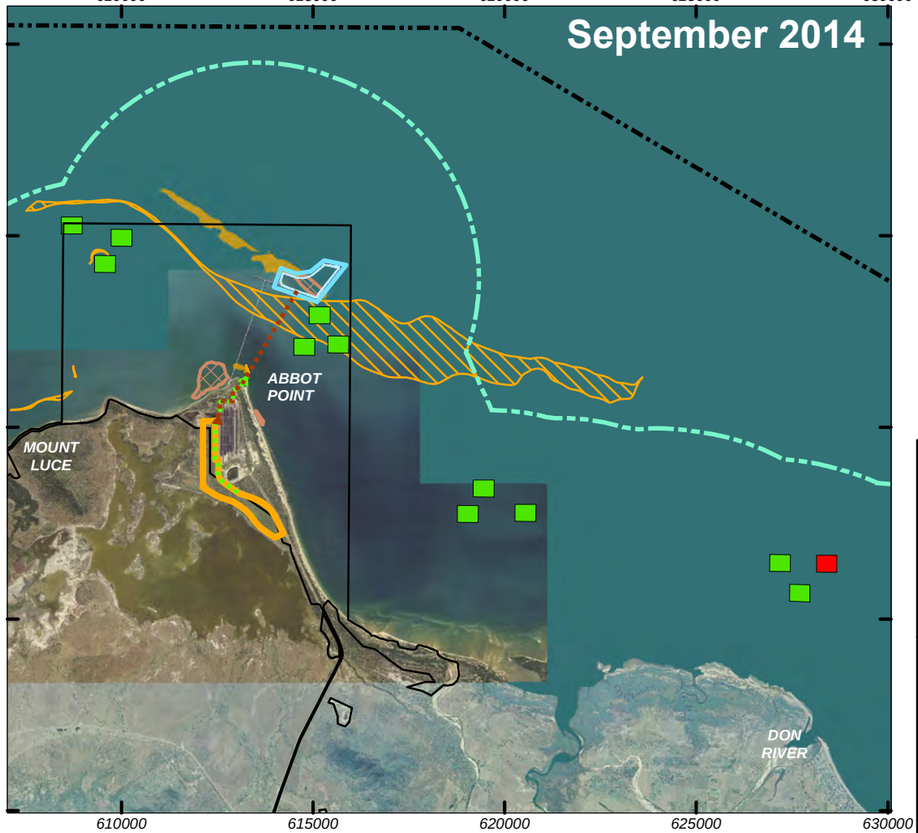
LEGEND

- Dredged material pipeline (indicative)
- Return water pipeline (indicative)
- Dredged material containment pond
- Dredged material containment pond study area
- Dredging footprint
- Dredging study area
- Port limit
- Australian Maritime Boundaries - Coastal (State) waters
- Abbot Point Strategic Port Land
- Deposition zone of moderate impact - dry season
- Light climate - Zone of moderate impact
- TSS zone of moderate impact - dry season

Seagrass monitoring locations 2014

- Seagrass absent
- Seagrass present





Source information:
Dredging study area
Setout points derived from coordinates on NQBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NQBP
Dredged material and return water pipelines
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Department of State Development, Infrastructure and Planning, (DSDIP)
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={4091CAF1-50E6-4BC3-B3D4-229AA318231A}
Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited -Port of Abbot Point Land Use Plan - October 2010
Seagrass monitoring and survey data
TropWATER (Centre for Tropical Water & Aquatic Ecosystem Research) - James Cook University

REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
0	14/07/2015	Issued for information	MH	KM	SN		

Queensland Government

QUEENSLAND GOVERNMENT

ABBOT POINT GROWTH GATEWAY PROJECT

Figure 12-2
Offsite Impacts and seagrass monitoring blocks in 2014

Figure: 301001-01956-00-GM-SKT-0086 | Rev: 0

G:\301001\01956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0086-0 (Marine seagrass monitoring and impacts).mxd

Compiled by BRISBANE GEOMATICS

12.1.1 Nearshore Seagrass light requirements

Monitoring of the light available to seagrasses on the seafloor has been undertaken at three nearshore sites since October 2011. This data in combination with nearshore seagrass biomass and distribution data collected over the same period are key to the development of light based management values.

Based on these assessments TropWATER recommend the daily light based requirements for the nearshore seagrasses are 5mol/m^2/day over a rolling 7 day average (McKenna *et al*., 2015).

12.1.2 Turbidity triggers

Turbidity data has been collected at a range of sites offshore from Abbot Point since November 2011 (Figure 12-3). The sites which most represent the water quality environment at the discharge location are Coastal Middle, Coastal West and WQ5.

The combined turbidity data from these sites for each seagrass season (growing and senescence) were interrogated and the descriptive statistics for this data are summarised in Table 12-1**.**

Table 12-1 Summary statistics for turbidity (NTU) for each seagrass growing season and at the nearshore coastal shelf positions

Seagrass season	Mean	Median	80th Percentile	95th Percentile	Min	Max
Growing (July to December)	6	3	9	25	0	68
Senescence (January to June)	9	3	12	36	0	209

The 80th percentile value of 9NTU (shaded) for the growing season will define the turbidity adaptive management criteria. This is consistent with the Queensland Water Quality Guidelines which state for slightly to moderately disturbed environments this metric is the most appropriate.

595000 600000 605000 610000 615000 620000

7815000 7810000 7805000 7800000 7795000 7790000

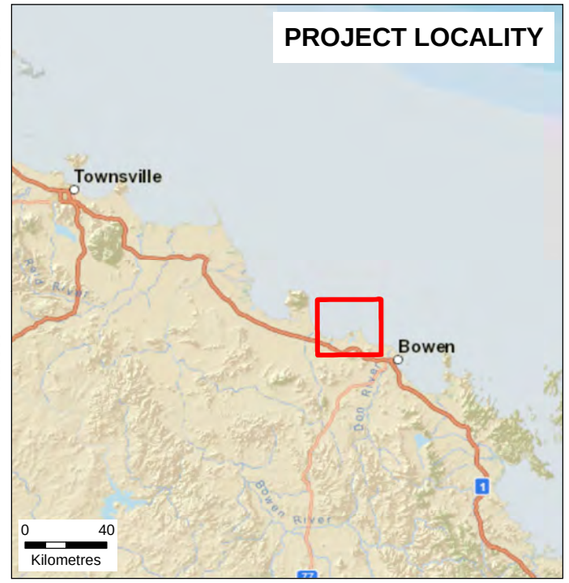
LEGEND

- Dredged material pipeline (indicative)
- Return water pipeline (indicative)
- Dredged material containment pond
- Dredged material containment pond study area
- Dredging footprint
- Dredging study area
- Port limit
- Australian Maritime Boundaries - Coastal (State) waters
- Abbot Point Strategic Port Land
- Logger, surface samples and depth profiling 2011-2012
- Logger, surface samples and depth profiling 2013-2014
- Seagrass meadows - 1987 to July 2014 (composite)

WQ6
WQ4
DEEPWATER WEST
INSHORE MIDDLE
WQ1
CAMP ISLAND
ABBOT BAY
WQ2
WQ3
COASTAL MIDDLE
ABBOT POINT
INSHORE WEST
WQ5
COASTAL WEST
MOUNT LUCE
CURLEWIS BAY
WQ7
COASTAL EAST

0 1 2 3
Kilometres
SCALE: 1 : 100,000 (at A3)
GDA 1994 MGA Zone 55
N W E S

PROJECT LOCALITY



Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

Source information:
Dredging study area
Setout points derived from coordinates on NQBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NQBP
Dredged material and return water pipelines
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Department of State Development, Infrastructure and Planning, (DSDIP)
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 - http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={4091CAF1-50E6-4BC3-B3D4-229AA318231A}
Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited -Port of Abbot Point Land Use Plan - October 2010

REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
0	14/07/2015	Issued for information	MH	KM	SN		

Queensland Government

QUEENSLAND GOVERNMENT

ABBOT POINT GROWTH GATEWAY PROJECT

Figure 2-1
Marine Water Quality Monitoring Sites
2010 - 2014

Figure: 301001-01956-00-GM-SKT-0050 | Rev: 0

G:\301001\01956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0050-0 (Marine Water Quality Monitoring 2010-2014).mxd

Compiled by BRISBANE GEOMATICS

12.2 Indicative monitoring plan outline

The monitoring program will have the following components:

- Validating the hydrodynamic modelling predictions
- Nearshore seagrass impact monitoring at fixed locations
- Water quality monitoring of the plume from the return water discharge
- Monitoring the dredging and return water plumes in the event of a notification trigger
- Sedimentation monitoring from the plume from the return water discharge
- Monitoring of discharge waters within the DMCP, prior to return
- Ongoing broad scale monitoring of seagrass presence/absence, health and biomass.

12.2.1 Validating the hydrodynamic modelling predictions

Monitoring of the plumes is designed to demonstrate the reliability of plume modelling and the validity of the impact predictions and will involve:

- Boat-based plume mapping activities using a boat mounted water quality logger to have a quantitative measure of turbidity
- Depth profiling with the water quality logger to measure the variability in the plume through the water column at a number of locations close to and away from the dredger
- Water sampling to give NTU to TSS conversion allowing direct comparison of turbidity measurements.

12.2.2 Seagrass impact monitoring at fixed locations

All proposed monitoring sites are part of the ongoing TropWATER seagrass monitoring program (Figure 12-4). The proposed monitoring program for the Project will utilise these sites with some upgrades to the current program as follows:

- Continued quarterly light (PAR) and temperature assessments at all existing monitoring locations with the addition of a turbidity sensor and sedimentation measuring capability
- The upgrade of existing loggers at nearshore Site 9 and Site 7 to telemetry loggers (to inform the adaptive management program) with the addition of a turbidity sensor and sedimentation capability.

It is proposed that the monitoring programs are tailored to the time during the year within which the dredging is undertaken. For example during the senescence season the monitoring would be scaled back.

LEGEND

- Dredged material pipeline (indicative)
- Return water pipeline (indicative)
- Dredged material containment pond
- Dredged material containment pond study area
- Dredging footprint
- Dredging study area
- Port limit
- Australian Maritime Boundaries - Coastal (State) waters
- Abbot Point Strategic Port Land
- Existing TropWATER monitoring site
- Proposed return water monitoring site (also existing TropWATER monitoring site)
- Seagrass monitoring locations
- Deposition zone of moderate impact - dry season
- TSS zone of moderate impact - dry season
- TSS zone of influence - dry season
- TSS 95th percentile 2007 dry season - 1.5mg/L
- Light climate - Zone of moderate impact
- Seagrass meadows - 1987 to July 2014 (composite)

590000 595000 600000 605000 610000 615000 620000 625000

7825000 7820000 7815000 7810000 7805000 7800000 7795000

INSET

Offshore Site 1
Offshore Site 2
Nearshore Site 9
Nearshore Site 7
0 1 Kilometers

PROJECT LOCALITY

Townsville
Bowen
Don River
Bowen River
0 40 Kilometres

Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

CAMP ISLAND
ABBOT BAY
Refer to inset
Offshore Site 1
Offshore Site 2
Nearshore Site 9
ABBOT POINT
MOUNT LUCE
Nearshore Site 7
Offshore Site 3
CURLEWIS BAY
Nearshore Site 3

0 1 2 3
Kilometres
SCALE: 1 : 125,000 (at A3)
GDA 1994 MGA Zone 55
N W E S

G:\301001\01956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0049.mxd

Source information:
Dredging study area
Setout points derived from coordinates on NQBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NQBP
Dredged material and return water pipelines
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Department of State Development, Infrastructure and Planning, (DSDIP)
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={4091CAF1-50E6-4BC3-B3D4-229AA318231A}
Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited -Port of Abbot Point Land Use Plan - October 2010

REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
0	17/07/2015	Issued for information	MH	KM	SN		

Queensland Government

QUEENSLAND GOVERNMENT

ABBOT POINT GROWTH GATEWAY PROJECT

Figure 12-4
Dredging Management Plan Monitoring Sites and Areas of Temporary Impact

Figure: 301001-01956-00-GM-SKT-0049 | Rev: 0

Compiled by BRISBANE GEOMATICS

12.2.3 Receiving environment monitoring - return water discharge

Real time logging

It is proposed that the monitoring of the discharge waters will be undertaken by *in situ* telemetered loggers located at nearshore Site 9 (potential impact) and Site 7 (reference) for the following parameters:

- pH
- Dissolved oxygen
- Turbidity
- Temperature
- Salinity
- Sediment deposition.

Boat based monitoring

The discharge monitoring will involve a periodic boat based monitoring program**.** Assuming a 12 week dredging program, for example, monitoring may be undertaken during the first week, week 6 and week 12. The monitoring will measure various parameters using a hand held probe at three depth profiles (surface/mid/seafloor) various distances from the near return water discharge monitoring sites and reference sites (4 near discharge sites 100m, 200m, 500m, 1km and 4 reference sites >2 km from the discharge in an area unaffected by the discharge waters), for the following parameters:

- pH
- Dissolved oxygen
- Turbidity
- Temperature
- Salinity.

12.2.4 Receiving environment - Sedimentation

Elevated sedimentation rates predicted by the hydrodynamic modelling are very minor and limited to areas in very close proximity to the dredging operations and in the vicinity of the discharge point. Sedimentation will be monitored:

- Quantitatively at Site 9 and Site 7 as described above.
- Visually at the discharge point and at all fixed seagrass monitoring sites using underwater drop video, pre, mid and post dredging

12.2.5 Monitoring of return waters within the DMCP

Monitoring at the weir box within the DCMP will consist of:

- 7 day rolling-average TSS (while discharging) for comparison against a 100 mg/L average criterion and/or a comparable criterion for turbidity
- Daily pH monitoring (while discharging) – to confirm in range of 6 to 9, and to inform any liming requirement of supernatant water prior to discharge
- Daily dissolved oxygen and salinity (coincident with pH monitoring).

12.2.6 Monitoring in the event of a notification trigger

This component of the monitoring program is designed inform and assist the adaptive management program in the event a notification trigger is reached and potentially will include:

- Boat based depth profiling with a hand held water quality logger to measure the variability in the plume through the water column at a number of locations close to and away from the dredger
- Use of a drone to map the extent of the surface plumes from the dredging and discharge location, which will also be used to inform the location of boat based sampling.

12.2.7 Broad scale seagrass monitoring

The existing NQBP TropWATER monitoring program is considered adequate to address any long-term questions relating to impacts and recovery of seagrass and water quality at the Port. This program involves:

- Quarterly assessments of established monitoring sites
- Wet and dry season updated baseline mapping of seagrass within the broader port limits
- Light (PAR) (with the addition of turbidity) and temperature assessments at the seabed.

12.3 Proposed approach to adaptive management

The proposed approach, outlined below, is a two-tiered adaptive strategy of an initial alert and response period, and if criteria continue to be exceeded then a notification to regulators requirement is triggered.

Adaptive management

Monitoring location: nearshore monitoring Site 9

Criteria to be applied:

1. Ten day rolling average of daily median turbidity is greater than 9 NTU
2. Seven day rolling average (nearshore seagrass) daily light requirement is less than 5mol/m^2/day.

Alert trigger

If criteria 1 or 2 are met for more than 48 hours, then:

- Initiate a data review to ensure that the investigation trigger does not reflect data anomalies or errors in data entry and analysis
- Check the recent history of discharge and dredging operation
- Review the extent of visible plumes and results of vessel-based monitoring
- Review the tide, weather, and current conditions
- Compare against turbidity and light environment at nearshore reference Site 7
- Consider the use of drone photography or MODIS satellite imagery to better establish if wider natural factors are causing the exceedance
- If exceedance is thought to be resulting from the return water and/or dredging, then adapt operational activities (i.e. release rates of return water and/or dredging rate) to reduce turbidity in the marine environment.

Notification trigger

If criteria 1 and 2 are both met for more than 7 days then:

- Continue with actions above
- Notify DoE and relevant Queensland regulators
- Hold meeting with DoE/regulators to agree actions to be taken.

13 References

Australasian Groundwater and Environmental Consultants Pty Ltd (AGE), 2015. *The Port of Abbot Point Growth Gateway Project Groundwater Studies*. Prepared for Advisian on behalf of DSD

BMT WBM (2012). *Kaili (Caley) Valley Wetlands Baseline Report*. Prepared for the Office of the Coordinator-General, Department of State Development, Infrastructure and Planning

BMT WBM (2015). *Technical Report for Wetland Hydrology, Water Quality and Aquatic Ecology Components.* Prepared for Advisian on behalf of DSD

Department of State Development (DSD) (2015). *Abbot Point Growth Gateway Project*. Webpage: http://www.statedevelopment.qld.gov.au/major-projects/abbot-point-growth-gateway-project.htmlAccessed 25/06/15.

Eco Logical Australia (ELA) and Open Lines (2013). *Abbot Point Cumulative Impact Assessment*. Prepared for the Abbot Point Working Group

GHD (2012). *Terminals 0, 2 and 3, Abbot Point, Queensland, Capital Dredging Sediment Sampling and Analysis Plan Implementation Report*. Prepared for North Queensland Bulk Ports Corporation Limited

Golder (2015a). *Preliminary Acid Sulfate Soil Investigation - Report for the Containment Pond Area - Abbot Point Growth Gateway, Dredge Material Containment Ponds*. Prepared by Golder and Associates for DSD, 14 July 2015

Golder (2015b). *Preliminary Acid Sulfate Soil Management Plan - Abbot Point Growth Gateway, Dredge Material Containment Ponds*. Prepared by Golder and Associates for DSD, 22 July 2015

Hammerstrom, K.K., Kenworthy, W.J., Fonseca, M.S. & Whitfield, P.E. (2006). *Seed bank, biomass and productivity of Halophila decipiens a deep water seagrass on the west Florida continental shelf.* Aquatic Botany, volume 84, pp. 110-120

Katestone (2015). *Air Quality Assessment of the Abbot Point Growth Gateway Project*. Report prepared for Advisian on behalf of SDS

Longstaff, B.J. & Dennison, W.C. (1999). *Seagrass survival during pulsed turbidity events: the effects of light deprivation on the seagrasses Halodule pinifolia and Halophila ovalis.* Aquatic Botany volume 65, pp. 105-121

McMillan, C. (1991). *The longevity of seagrass seeds*. Aquatic Botany volume 40, pp. 195-198

North Queensland Bulk Ports Corporation Limited (NQBP) (2010). *Port of Abbot Point Land Use Plan*.

Ralph, P.J., Durako, M.J., Enriquez, S., Collier, C.J. & Doblin, M.A. (2007). *Impact of light limitation on seagrasses*. Journal of Experimental Marine Biology Ecology volume 350, pp. 176-193.

SLR (2015a) *Abbot Point Growth Gateway Project, Terrestrial Noise Impact Assessment.* Report prepared for Advisian on behalf of DSD.

SLR (2015b) *Abbot Point Growth Gateway Project, Underwater Noise Impact Assessment.* Report prepared for Advisian on behalf of DSD.

Unsworth, R.K.F., McKenna, S.A. and Rasheed, M.A. (2010). *Seasonal dynamics, productivity and resilience of seagrass at the Port of Abbot Point: 2008-2010.* DEEDI Publication, Fisheries Queensland, Cairns, pp. 68

WorleyParsons (2015). *Abbot Point Growth Gateway Project: Marine Ecology Technical Report*. Prepared for DSD