From:	Matt Landos
To:	Committee, EC (SEN)
Cc:	Waters, Larissa (Senator); Cameron, Doug (Senator)
Subject:	Email 2- false baseline setting in Gladstone
Date:	Thursday, 30 May 2013 2:16:03 PM
Attachments:	02a-condock_dredge_mgt_plan--2010-12-3_part1.pdf NOTICE TO MARINERS 2009 .docx

Hi All,

Email 2 of submission to Senate Committee for GBR Bill.
I sent this email below to the Gladstone review. It demonstrates that the so called baseline testing was being done in the same area, at the same time, as where dredging and boat activity (documented in notice to Mariners) had already begun to stir up sediments and metals. This leads to the setting of an artificially high turbidity and metals baseline. Hence when the monitoring program was setup, even higher trigger values were set.
It is then no surprise that substantial harm to all in contact animals and seagrass occurred.
The level of turbidity and duration of exposure was unprecedented. Flood sediments clear quickly allowing seagrass recovery.

Best regards
Matt

Dr Matt Landos BVSc(HonsI)MACVS
Director, Future Fisheries Veterinary Service Pty Ltd
Honorary lecturer, associate researcher, University of Sydney

From: Matt Landos [mailto:matty.landos@gmail.com]
Sent: Thursday, 2 May 2013 10:52 AM
To: 'Powell, Celeste'; '

Subject: condock management plan

Hi Celeste,

Shows dredging in the area at the time when Vision were supposed to be collecting their baseline unimpacted water quality.
This clearly led to artificially high trigger value guidelines, and led to much higher impacts that are acceptable in a WHA.
Clear impacts to seagrass, biodiversity and survival of a vast array of species have been documented.

Please ensure documents are delivered to committee members in the inquiry.

This can be cross referenced to the notice to mariners documents which report dredge activity in relation to the works. See attached.

Regards
Matt

Dr Matt Landos BVSc(HonsI)MACVS
Director, Future Fisheries Veterinary Service Pty Ltd
Honorary lecturer, associate researcher, University of Sydney

NOTICE TO MARINERS

223 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: GLADSTONE HARBOUR

ACTIVITY: DREDGING OPERATIONS

Mariners are advised that the dredge Brisbane will commence dredging operations in Gladstone
Harbour commencing in the sea channels on Saturday 18 April 2009.
The dredge Brisbane will be operating for a period of approximately 16 days and will be monitoring VHF channels 13 and 16.
Mariners are requested to operate in a manner consistent with good seamanship while in the area
of operations.

Cancel this Notice: 10 May 2009

AUS Charts Affected: 244, 245, and 246

Maritime Safety Queensland Charts Affected: Gladstone (CC1)

Maritime Safety Queensland Beacon to Beacon Directory 8th Edition map 7, 8, 9, 10

NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).

For further information about this Notice, please contact:

The Gladstone Regional Harbour Master's office on 07 4973 1200

Authorised by: DIRECTOR (MARITIME SERVICES)

Issued: Brisbane 15 April 2009

QUEENSLAND

NOTICE TO MARINERS

228 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: GLADSTONE MARINA

ACTIVITY: DREDGING OPERATIONS

Mariners are advised that preparation work for dredging operations in the Gladstone Marina has
commenced. The dredge "Mabuiag" will commence dredging operations on 21 April 2009 and
will continue until the end of June 2009.
Dredging operations will be conducted on a 24 hour basis from 0600 hours Monday to 0600 hours Sunday. The dredge will monitor VHF channels 13 and 16, whilst channel 82 will be used
to contact marina personnel.
Lit red and green marker buoys will be deployed to mark the submerged pipeline and indicate the
location where vessels can safely cross.
Mariners are advised to proceed with caution and at slow speed when in vicinity of dredging operations.

AUS Charts Affected: 244, 245

Maritime Safety Queensland Charts Affected: Gladstone (CC1)

Maritime Safety Queensland Beacon to Beacon Directory 7th Edition map 7

NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).

For further information about this Notice, please contact:

The Gladstone Regional Harbour Master's office on 07 4973 1200

Authorised by: DIRECTOR (MARITIME SERVICES)

Issued: Brisbane 16 April 2009

QUEENSLAND
NOTICE TO MARINERS

262 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: FISHERMANS LANDING, GLADSTONE HARBOUR
ACTIVITY: DREDGING PREPARATIONS

Mariners are advised that the cutter dredge "Wombat" and associated support vessels will be anchored adjacent to southern end of Fishermans Landing No. 2 wharf in approximate position
latitude 23° 47.54' S, longitude 151° 10.97' E.
The dredge and associated support vessels will be preparing for dredging of the berthing pocket
at the new Fisherman's Landing No. 1 wharf. The preparation activities may pose several navigational hazards including floating pipe lines and persons working on vessels.
Mariners are requested to navigate with extreme caution and pass at a speed consistent with good
semanship.

AUS Charts Affected: 244, 245
Maritime Safety Queensland Charts Affected: Gladstone (CC1)
The Narrows (CC2)
Maritime Safety Queensland Beacon to Beacon Directory 7th Edition map 7
NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).
For further information about this Notice, please contact:
The Gladstone Regional Harbour Master’s office on 07 4973 1200
Authorised by: DIRECTOR (MARITIME SERVICES)
Issued: Brisbane 30 April 2009

QUEENSLAND
NOTICE TO MARINERS

267 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: UPPER HARBOUR

ACTIVITY: GEOTECHNICAL DRILLING OPERATIONS

Mariners are advised that geotechnical drilling operations on the northern side of the Targinnie
Channel and in the area off China Bay in the Upper Harbour will commence on Wednesday 6 May 2009 during daylight hours, approximately 0600 to 1800 hours. The drilling operations will
be carried out by the barge "Jembri-Dev" supported by "Reunion", and jack-up rig "Sideson II"
supported by "Wandana". See attachments for areas of operation.
All vessels will monitor VHF channel 13 and 16.
Mariners are advised to navigate with caution when in the area.

AUS Charts Affected: 245

Maritime Safety Queensland Charts Affected: None

Maritime Safety Queensland Beacon to Beacon Directory 8th Edition map 7

NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).

For further information about this Notice, please contact:

The Gladstone Regional Harbour Master’s office on 07 4973 1200

Authorised by: DIRECTOR (MARITIME SERVICES)

Issued: Brisbane 1 May 2009

QUEENSLAND
NOTICE TO MARINERS

268 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: FISHERMANS LANDING, GLADSTONE HARBOUR
ACTIVITY: DREDGING FISHERMANS LANDING NO. 1 (BERTH, APPROACHES AND SWING BASIN)
Refer to Notice: 262 (T) of 2009

Mariners are advised that the cutter dredge "Wombat" will be conducting dredging operations at
the new Fishermans Landing No. 1 berth, swing basin and approaches to the berth from Wednesday 6 May 2009 until approximately the 14 August 2009. The extent of the dredging activities is defined by the following points:

Position A: latitude 23° 47.795' S, longitude 151° 11.880' E to
Position B: latitude 23° 47.511' S, longitude 151° 11.440' E to
Position C: latitude 23° 47.505' S, longitude 151° 10.953' E to
Position D: latitude 23° 47.592' S, longitude 151° 11.068' E to
Position E: latitude 23° 47.600' S, longitude 151° 11.375' E, then back to Position A.

A floating pipe line will be in place between the "Wombat" and the booster in position latitude 23° 47.567' S, longitude 151° 10.933' E. The pipeline will be lit during hours of darkenss.

The "Wombat" and associated support vessels will be monitoring VHF channels 13 and 16. Mariners are requested to navigate with caution and pass at a distance and speed consistent with
safe navigation.

Cancel Notice: 262 (T) of 2009
AUS Charts Affected: 244, 245
Maritime Safety Queensland Charts Affected: Gladstone (CC1)
The Narrows (CC2)

NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).

For further information about this Notice, please contact:
The Gladstone Regional Harbour Master’s office on 07 4973 1200
Authorised by: DIRECTOR (MARITIME SERVICES)
Issued: Brisbane 1 May 2009

QUEENSLAND
NOTICE TO MARINERS

449 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: THE NARROWS

ACTIVITY: DRILLING AND CONE PENETRATION TESTING

Mariners are advised that drilling and cone penetration testing will be carried out within The Narrows area between Kangaroo Island and Curtis Island, Gladstone Harbour from 6 July 2009

until approximately 11 August 2009 in the following approximate positions:

latitude 23° 44.971' S, longitude 151° 10.044' E,
latitude 23° 44.968' S, longitude 151° 09.785' E,
latitude 23° 44.972' S, longitude 151° 10.080' E,
latitude 23° 44.973' S, longitude 151° 10.200' E,
latitude 23° 45.076' S, longitude 151° 09.760' E,
latitude 23° 45.080' S, longitude 151° 10.022' E,
latitude 23° 45.082' S, longitude 151° 10.243' E,
latitude 23° 45.084' S, longitude 151° 10.372' E.

The side jack up barge 'SIDESON 2' will be conducting the testing.

The works will be carried out during daylight hours only and 'SIDESON 2' will maintain a listening watch on Channels 13 and 16.

Mariners are requested to pass this operation at a slow speed and distance consistent with safe navigation.

AUS Charts Affected: 244, 245, 819

Maritime Safety Queensland Charts Affected: Gladstone (CC1), The Narrows (CC2)

Maritime Safety Queensland Beacon to Beacon Directory 7th Edition map 7 and 10

NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).

For further information about this Notice, please contact:

The Gladstone Regional Harbour Master’s office on 07 4973 1200

Authorised by: DIRECTOR (MARITIME SERVICES)

Issued: Brisbane 9 July 2009

NOTICE TO MARINERS

467 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: GLADSTONE HARBOUR

ACTIVITY: DREDGE ASSESSMENT

Refer to Notice: 309 (T) of 2009

Mariners are advised that 11 buoys will be deployed at various locations in Gladstone Harbour
for the purpose of dredge assessment. The buoys will be in place from the 15 July 2009 for a period of approximately eight weeks.

The buoys are yellow special markers with solar flashing lights.

The buoys will be located in the following positions:

BUOY NAME LATITUDE LONGITUDE

C1 23° 47.48’ S 151° 10.73’ E
C2 23° 47.26’ S 151° 12.00’ E
C3 23° 46.02’ S 151° 09.54’ E
C4-1 23° 48.46’ S 151° 10.25’ E
P14 23° 45.89’ S 151° 10.80’ E
P2 23° 48.51’ S 151° 12.95’ E
P7 23° 52.89’ S 151° 22.65’ E
P3 23° 28.63’ S 151° 15.42’ E
QE1 23° 46.64’ S 151° 09.30’ E
R5 24° 00.83’ S 151° 30.55’ E
OF 23° 47.47’ S 151° 10.76’ E

AUS Charts Affected 244 & 245

Maritime Safety Queensland Charts Affected: Gladstone (CC1)

NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).

For further information about this Notice, please contact:

The Gladstone Regional Harbour Master’s office on 07 4973 1200.

Authorised by: DIRECTOR (MARITIME SERVICES)

Issued: Brisbane 15 July 2009

QUEENSLAND
NOTICE TO MARINERS

507 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: GLADSTONE HARBOUR
ACTIVITY: DREDGE ASSESSMENT/WATER MONITORING BUOYS
Refer to Notice: 467 (T) of 2009

Mariners are advised that 11 buoys have been deployed at various locations in Gladstone Harbour for the purpose of dredge assessment. The buoys have been in place since the 15 July
2009 and will remain in place for approximately eight weeks.
The buoys are yellow special markers with solar flashing lights.
The buoys will be located in the following positions:

Buoy Name Latitude Longitude
C1 23° 47.48'S 151° 10.73'E
C2 23° 47.26'S 151° 12.00'E
C3 23° 46.02'S 151° 09.54'E
C4-1 23° 48.46'S 151° 10.25'E
P14 23° 45.89'S 151° 10.80'E
P2 23° 48.51'S 151° 12.95'E
P7 23° 52.89'S 151° 22.65'E
P3 23° 48.63'S 151° 15.42'E
QE1 23° 46.64'S 151° 09.30'E
R5 24° 00.83'S 151° 30.55'E
OF 23° 47.47'S 151° 10.76'E

Cancel Notice: 467(Temporary) of 2009
AUS Charts Affected 244, 245
Maritime Safety Queensland Charts Affected: Gladstone (CC1)
NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).
For further information about this Notice, please contact:
The Gladstone Regional Harbour Master's office on 07 4973 1200.
Authorised by: DIRECTOR (MARITIME SERVICES)
Issued: Brisbane 29 July 2009

QUEENSLAND
NOTICE TO MARINERS
535 (Temporary) of 2009
GLADSTONE PILOTAGE AREA
LOCALITY: UPPER HARBOUR
ACTIVITY: TURBIDITY MEASUREMENTS
Refer to Notice: None
Mariners are advised that turbidity measurements will take place south of Laird Point in the Upper Harbour for a period of approximately 4 weeks. The recording turbidity instrument will be
placed on a galvanised steel mooring in approximate position 23° 45.535' S, 151° 10.770' E and
will rise approximately 0.5m above the seabed when positioned on the seafloor. The instrument
mooring is not identified by any surface markers or floats.
Mariners should navigate with caution in the area.
Cancel Notice: None
AUS Charts Affected: 245
Maritime Safety Queensland Charts Affected: The Narrows (CC2)
NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).
For further information about this Notice, please contact:
The Gladstone Regional Harbour Master’s office on 07 4973 1200
Authorised by: DIRECTOR (MARITIME SERVICES)
Issued: Brisbane (Monday, 10 August 2009)

QUEENSLAND
NOTICE TO MARINERS

538 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: THE NARROWS
ACTIVITY: DRILLING AND CONE PENETRATION TESTING
Refer to Notice: 449/2009

Mariners are advised that drilling and cone penetration testing will be carried out within The Narrows area between Kangaroo Island and Curtis Island, Gladstone Harbour from 12th August
2009 until approximately 22nd August 2009 in the following approximate positions:
23° 47.475' S, 151° 12.708' E,
23° 47.625' S, 151° 12.814' E,
The side jack up barge 'SIDESON 2' will be conducting the testing.
The works will be carried out during daylight hours only and 'SIDESON 2' will maintain a listening watch on Channels 13 and 16.
Mariners are requested to pass this operation at a slow speed and distance consistent with safe navigation.

Cancel Notice: None
AUS Charts Affected: 245, 819
Maritime Safety Queensland Charts Affected: Gladstone (CC1), The Narrows (CC2)
NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).
For further information about this Notice, please contact:
The Gladstone Regional Harbour Master’s office on 07 4973 1200
Authorised by: DIRECTOR (MARITIME SERVICES)
Issued: Brisbane (Tuesday, 11 August 2009)

QUEENSLAND
NOTICE TO MARINERS

563 (Temporary) of 2009

GLADSTONE PILOTAGE AREA

LOCALITY: THE NARROWS

ACTIVITY: DRILLING AND CONE PENETRATION TESTING

Refer to Notice: 538 (T) of 2009

Mariners are advised that drilling and cone penetration testing will be carried out within The Narrows area between Kangaroo Island and Curtis Island, Gladstone Harbour, from 20 August
2009 until approximately 28 August 2009 in the following positions;
latitude 23° 47.475' S, longitude 151° 12.708' E
latitude 23° 47.625' S, longitude 151° 12.814' E
The side jack up barge 'SIDESON 2' will be conducting the testing. The works will be carried out during daylight hours only and 'SIDESON 2' will maintain a listening watch on VHF channels 13 and 16.
Mariners are requested to pass this operation at a slow speed and distance consistent with safe navigation.

Cancel Notice: 538 (T) of 2009

AUS Charts Affected: 245, 819

Maritime Safety Queensland Charts Affected: Gladstone (CC1)
The Narrows (CC2)

NOTE: Latitude and longitude positions on WGS84 horizontal datum (compatible with GDA94 datum).

For further information about this Notice, please contact:

The Gladstone Regional Harbour Master’s office on 07 4973 1200

Authorised by: DIRECTOR (MARITIME SERVICES)

Issued: Brisbane 20 August 2009

Dredge Management Plan – Construction Dock
Queensland Curtis LNG

Doc# 521532

Revision G

Table of Contents

1.0 INTRODUCTION

The purpose of this Dredge Management Plan (DMP) is to satisfy the requirements of:

- Part 5, Division 2 of the *Coastal Protection and Management Act 19*95 (Coastal Act) – the preparation of a voluntary DMP to replace the requirement to obtain allocation for the removal of quarry material. Once approved, it is intended that this DMP will remove the requirement for this dredging activity to obtain a Development Permit for Operational Works involving Tidal Works within the Coastal Management District;

- Schedule2, Part 4 of the Environmental Protection Regulation 2008, Environmentally Relevant Activity (ERA) 16 – Extractive and screening industries. Therefore this DMP is submitted as supporting documentation for the dredging activities specified in this DMP for a Material Change of Use involving ERA 16;

- Queensland Curtis Island Liquified Natural Gas (QCLNG) Controlled Action Approval made under the Environmental Protection and Biodiversity Act 1999 administered by the Department of Sustainability, Environment, Water, Population and Communities.

GPC (on behalf of QCLNG) also provide the DMP to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities for information purposes.

A Construction Environmental Control Plan (CECP) for Construction Activities associated with the Construction Dock on Curtis Island forms part of the DMP (Appendix 5).

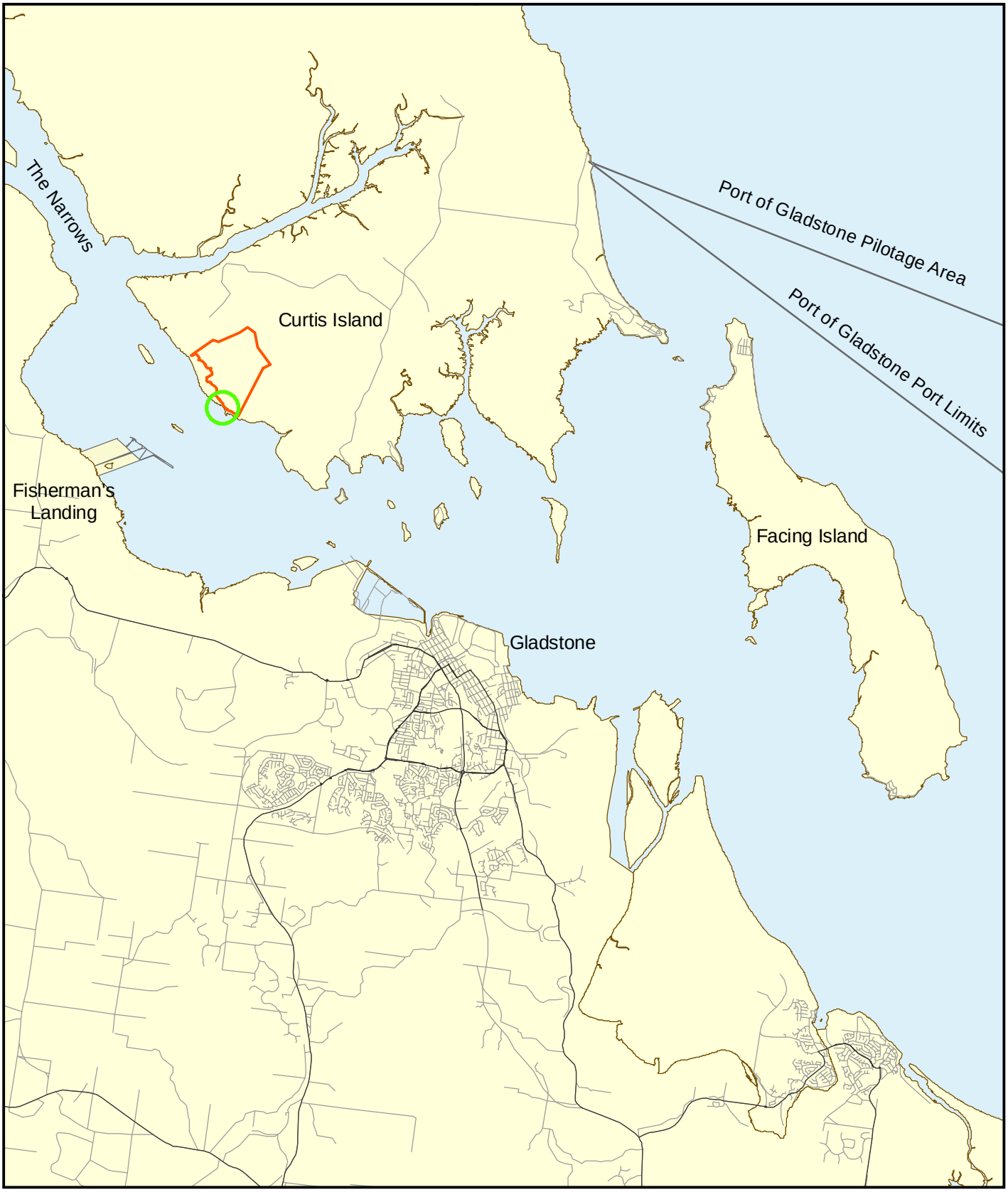
1.1 Objectives

An over-arching Draft DMP was prepared for the Supplementary Environmental Impact Statement (EIS) to manage all dredge operations associated with the Queensland Curtis Liquefied Natural Gas (QCLNG) Project. This DMP is site specific for capital dredging and material disposal activities associated with the QCLNG Project Construction Dock development. The estimated material to be dredged from the Construction Dock facility, including initial site access, is 355,000 m^3.

Spoil from the Construction Dock will be disposed of at the existing Fisherman's Landing reclamation area, which is managed by GPC under existing licence conditions, including criteria for tail-water discharge.

1.2 Project Area

The QCLNG Project Construction Dock is located on Curtis Island, within the Port of Gladstone, Queensland. The subject site has water frontage to the Gladstone Harbour opposite Passage Islands (South) and Fisherman's Landing, approximately 6km north-east of Gladstone City, and is formally described as within the tidal work area attached to land on Lot 2 on SP225924 (***Figure 1-1***).



Legend

- Proposed QCLNG Site Boundary
- Location of Proposed Project Site

Source: Cadastral Data - MapInfo StreetPro

Projection: UTM MGA Zone 56 Datum: GDA 94

0 1 2 4 km

N

QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title: Location of the Project Site within the Port of Gladstone
	Client	QGC - A BG Group business	
SINCLAIR KNIGHT MERZ SKM	Drawn KP	**Figure 1-1**	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. QGC does not warrant the accuracy of any such Maps and Figures.
	Approved PF	File No: 0008_CI_GIS060_R0	
	Date 23/03/10	Revision 0	

1.3 Proposed construction activities

The QCLNG Project Construction Dock will be constructed in phases; phase one Initial Site Access and a phase two Construction Dock Development.

The first phase of these works will be to gain access to the QCLNG Project site via a beach landing, using vessels with drop front ramps working on relatively limited movements and timing. This will facilitate the delivery of essential construction and infrastructure items for the commencement of site preparation and construction of the Construction Dock. These works will consist of three component parts:

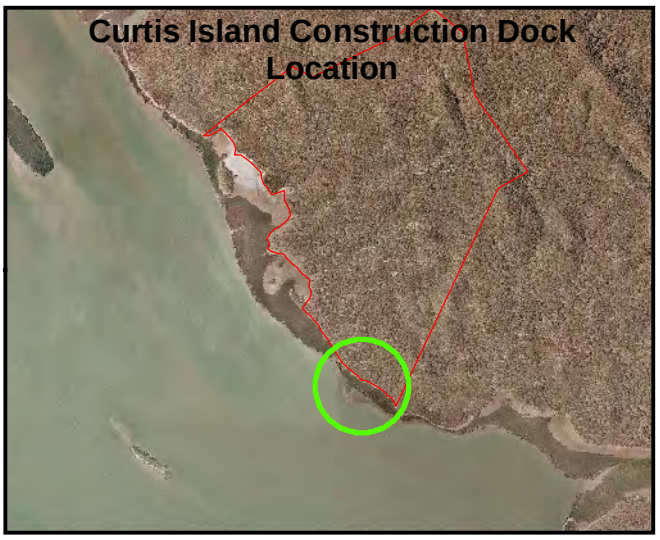
1. Dredging of the approach channel.

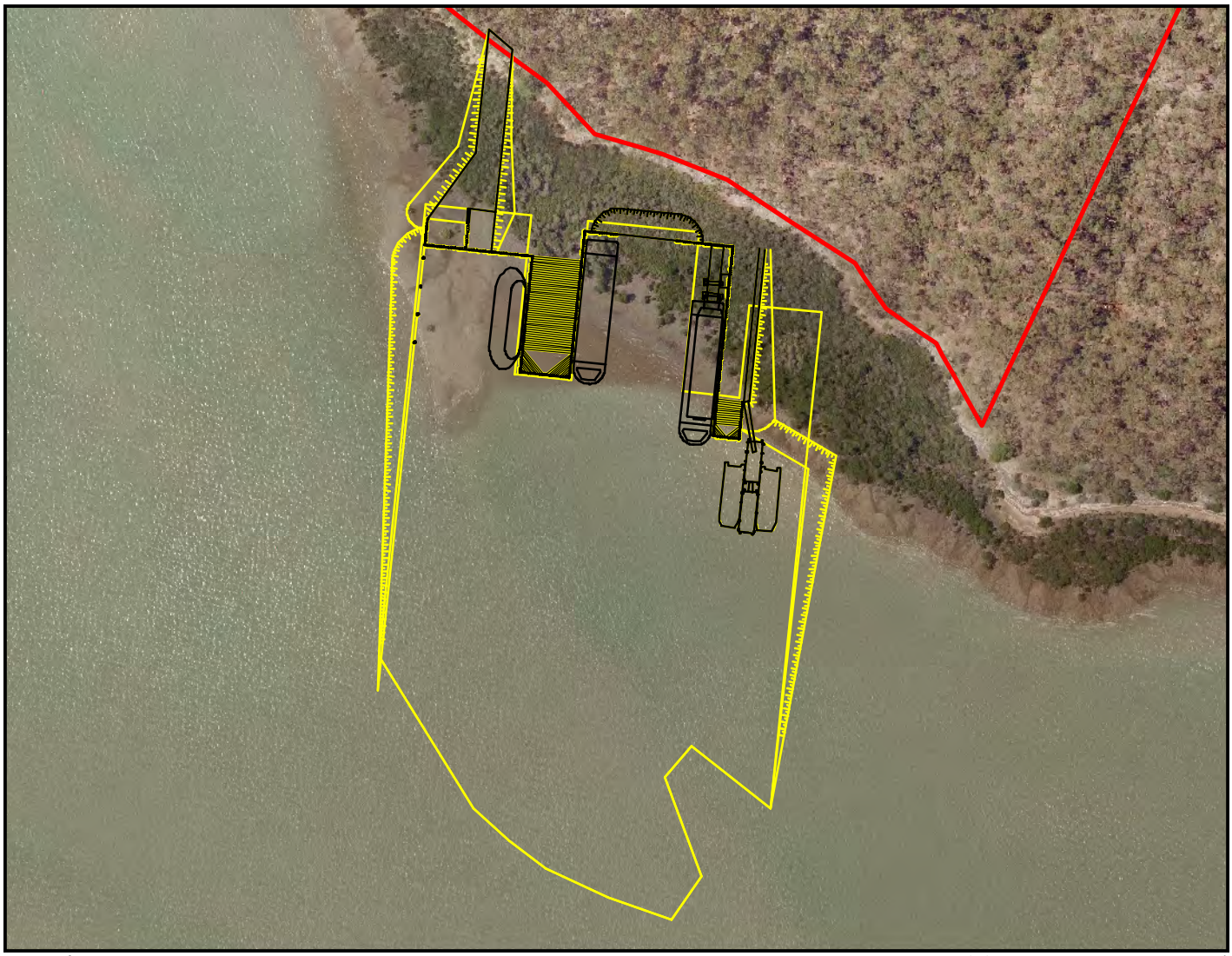
2. Construction of the bulkhead wall.

3. Construction of the earthworks causeway and road to the Site.

The proposed layout for the ISA is as shown in the drawings included in ***Figure 1-2***.

The purpose of the Construction Dock is to receive construction related equipment, infrastructure, materials, and personnel, for approximately the first eighteen (18) months of the site construction schedule for the QCLNG Project. After which time, the majority of such items, except aggregate, water, and fuel, will be loaded through the proposed Material Offloading Facility (MOF). A description of construction activities associated with the Construction Dock is detailed in Appendix 5 of this DMP.





Legend

- Proposed QCLNG Site Boundary
- Location of Proposed Project Site
- Proposed Layout

Source:
Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
Layout: Bechtel drawings SK-00-00001-00B, P1-00-00001_00B

Projection: UTM MGA Zone 56 Datum: GDA 94

0 25 50 100 m

N

QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title: Construction Dock Layout, Including Dredge Area
	Client	QGC - A BG Group business	
SINCLAIR KNIGHT MERZ SKM	Drawn KP	**Figure 1-2**	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. QGC does not warrant the accuracy of any such Maps and Figures.
	Approved PF	File No: 0008_CI_GIS061_R0	
	Date 23/03/10	Revision 0	

1.4 Dredging Works

To facilitate the construction activities described in ***Section 1.3***, GPC will dredge approximately 355,000 m^3 of material. The resulting dredged material will be disposed at the existing reclamation area at Fisherman's Landing. The site is bound by the Gladstone shipping channel to the north, Auckland Inlet to the east, Calliope River to the west, and the Gladstone mainland to the south. The disposal of the dredge spoil to the Fisherman's Landing reclamation area will be undertaken in accordance with GPC's existing reclamation approval, issued under Section 91 of the now repealed *Harbours Act 1955* through the *Transport Infrastructure Act 1994*, and as such does not form part of the Development Application for a Material Change of Use involving ERA 16.

GPC is seeking a currency period for the DMP of 2 years. Dredging and reclamation operations will be undertaken twenty four (24) hours per day, seven days a week and will commence in November 2010, with dredging to be completed by mid January 2010.

DERM and MSQ will be notified within seven days of commencement and on completion of the dredge operation.

2.0 LEGISLATIVE REQUIREMENTS

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

2.1 Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act 1999

An EPBC referral (Referral Number 2008/4401) was made on August 18 2009 for, amongst other things, the Construction Dock. The project was determined to be a controlled action on 15 September 2008. Following this, an EIS was prepared in 2009, which addressed both State and Commonwealth Legislation. The EIS examined the nature and extent of impacts associated with the proposed marine facilities, including the approach channel. This document details the requirements of a DMP with respect to addressing the relevant components of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) A Construction Environmental Control Plan (CECP) for Construction Activities associated with the Construction Dock on Curtis Island forms part of the DMP (Appendix 5).

Great Barrier Reef Marine Park Act 1975

The project is outside the Great Barrier Reef Marine Park.

2.2 State Legislation

Sustainable Planning Act 2009

The *Sustainable Planning Act 2009* (SPA) is Queensland's principal planning legislation. It establishes a framework for assessing new developments through a development approval system known as the Integrated Development Assessment System (IDAS). IDAS allows multiple assessments to be integrated into the one overall assessment. SPA repeals the *Integrated Planning Act 1997* (IPA) and seeks to deliver a more contemporary planning, development and building system to facilitate improved sustainable development outcomes.

The purpose of the SPA is to seek to achieve ecological sustainability by:

- Coordinating and integrating planning at the local, regional and State levels
- Managing the process by which development occurs, including ensuring the process is accountable, effective and efficient and delivers sustainable outcomes
- Managing the effects of development on the environment (including managing the use of premises)

Schedule 3, Part 1, Table 4, Item 5 of the *Sustainable Planning Regulation 2009* (SP Reg) specifies that Operational Work for Tidal Work or work within a Coastal Management District is assessable development under SPA. However, under the provisions of the *Coastal Protection and Management Act 1995* (Coastal Act), the requirement to obtain approval to undertake Tidal Works is fulfilled through an approved DMP. The Coastal Act section below contains further details on this issue.

Schedule 3, Part 1, Table 2, Item 1 specifies that a Material Change of Use (MCU) involving an Environmentally Relevant Activity (ERA) is assessable development under SPA. This DMP is submitted as supporting documentation for the Development Application for a MCU involving ERA 16 for the QCLNG Construction Dock dredging activities.

Environmental Protection Act 1994

The purpose of the *Environmental Protection Act 1994* (EP Act) is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains ecological processes on which life depends.

The protection of Queensland's environment is to be achieved by an integrated management program that is consistent with ecologically sustainable development. The proposed works will trigger an ERA 16 – Extractive Activity) therefore requiring licensing under the provision of the EP Act.

Notwithstanding this, GPC has a responsibility under the EP Act to ensure that no environmental harm occurs as a result of its activities.

Coastal Protection and Management Act 1995

The Coastal Protection and Management Act 1995 (Coastal Act) objectives are to:

- Provide for the protection, conservation, rehabilitation and management of the coast, including its resources and biological diversity
- Have regards to the goal, core objectives and guiding principles of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone
- Provide, in conjunction with other legislation, a coordinated and integrated management and administrative framework for the ecologically sustainable development of the coastal zone
- Encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.

The Coastal Act states that the removal of quarry material, which includes dredging activities, from State coastal land below the high water mark in a Coastal Management District is regulated by means of either a resource allocation or an approved DMP.

Under Part 5, Division 2 of the Coastal Act, a DMP voluntarily prepared by a government entity or other person, upon approval by DERM, replaces the requirement to obtain an allocation to remove quarry materials. Therefore, this DMP will act as the required approval document for the QCLNG

Construction Dock dredging activities under the provisions of the Coastal Act and is submitted to DERM for their approval.

In addition, a person who has an approved DMP is not required to have a Development Approval for Operational Work (Tidal Work) that would have been assessed by DERM against the Coastal Act, provided that any referral agencies' requirements have been incorporated into the plan or they have advised that they have no requirements for the works (refer to Section 100B of the Coastal Act). DERM assesses DMPs against the criteria set out in Section 93 of the Coastal Act. Included in these criteria is the requirement for a DMP to demonstrate consistency with the State Coastal Management Plan – Queensland's Coastal Policy (State Coastal Plan). An assessment of the consistency of the proposed Construction Dock dredging with the State Coastal Plan is contained in Section 4 of this DMP.

Fisheries Act 1994

The objectives of the *Fisheries Act 1994* include:

- Ensuring fisheries resources are used in an ecologically sensitive way
- Achieving the optimum community, economic and other benefits obtainable from fisheries resources
- Ensuring access to fisheries resources is fair.

The *Fisheries Act 1994* requires that a permit be obtained prior to causing a disturbance to, or removal of marine plants.

Based on information from seagrass mapping carried out in November 2009[1], no seagrass are known to be present within the dredge footprint. However, seagrass are known to have been present within the area of the dredge footprint and could reasonably be expected to grow there in future[2]. Mangroves are also known to be present within the proposed dredge area. Approximately 5.4 ha of mangroves are predicted to be directly impacted by the construction of the Construction Dock. A permit to remove marine plants protected under the *Fisheries Act 1994*, has been lodged by QGC, and at the time of preparation of this DMP is pending approval.

The proposed works are not within, or immediately adjacent to a Fish Habitat Area.

Nature Conservation Act 1992

The purpose of the *Nature Conservation Act 1992* is to provide legislative protection to Queensland threatened flora and fauna. The Act is administered by DERM. The dredge operation will comply with applicable requirements of the *Nature Conservation Act 1992* and associated operational policies and guidelines, although the Construction Dock facility dredge operation is not anticipated to significantly impact on species listed under the *Nature Conservation Act 1992*.

[1] Michael Rasheed, Pers. Comm.

[2] Rasheed MA, Thomas R, Roelofs AJ, Neil KM, Kerville SP (2003) Port Curtis and Rodds Bay seagrass and benthic macro-invertebrate community baseline survey, November/December 2002. Q103058, (DPI, Cairns).

Wild Rivers Act 2005

The purpose of the *Wild Rivers Act 2005* is to preserve the natural values of rivers that have not been significantly affected by development and thus have all, or almost all, of their natural values intact. The Act does this by regulating development within a declared wild river and its catchment area, and by regulating the taking of natural resources from the area. The Act establishes a framework that includes the declaration of wild river areas that may include:

- High preservation areas
- Preservation areas
- Floodplain management areas
- Sub artesian management areas.

The dredging works are outside Queensland's declared wild river areas.

Aboriginal Cultural Heritage Act 2003

The Act binds all persons, including the state, to provide effective recognition, protection and conservation of Aboriginal cultural heritage. The Act sets out the requirements for a Cultural Heritage Management Plan (CHMP) and a 'duty of care' guideline to assist in ensuring that Indigenous heritage is protected when works are undertaken.

Compliance with the guideline is not enforced, however the guideline affords strict compliance with the 'Duty of Care' of the Act. The marine area covered by the proposed dredging is unlikely to have any Indigenous cultural heritage values. However the 'duty of care' requirements set out under the Act will be implemented for this Project.

Queensland Heritage Act 1992

The Act requires any person who discovers an archaeological artefact that may be an important source of information about an aspect of Queensland's history reports the finding to the chief executive as per the requirements of s89 and s91 of the *Queensland Heritage Act 1992*.

The Construction Dock dredging has the potential to damage, destroy or disturb items or artefacts of cultural heritage (both Indigenous and European) significance within the dredge area.

There are no known shipwrecks or cultural heritage sites recorded within or adjacent to the proposed dredge area. Also, given the shipping and dredging history of the area it is likely that any potential remains would have previously been identified.

The objectives of the cultural heritage management in relation to dredging activities are to:

- Minimise adverse cultural heritage impacts resulting from dredging

- Ensure that all dredging contractors are aware of procedures to be followed in the event of items or artefacts of cultural heritage significance being identified.

Notification must also be given of discovery of an in-situ Historic Shipwreck or Relic under Section 17 of the Commonwealth *Historic Shipwrecks Act 1976* to the Queensland Museum, Museum of Tropical Queensland, 78-102 Flinders Street, Townsville Qld 4810.

2.3 Supplementary EIS (Dredging)

2.4 Reviewed Literature

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

- National Assessment Guidelines for Dredging 2009 (DEWHA, 2009)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000)
- Queensland Water Quality Guidelines (2009)
- Port Curtis Integrated Monitoring Program (2001)
- Australian Ballast Water Management Requirements 2008
- National Biofouling Management Guidelines for Commercial Vessels 2009
- National Biofouling Management Guidelines for Non-Trading Vessels 2009
- OSPAR Guidelines for the Management of Dredged Material (OSPAR 1998)
- Standard for Marine Construction Activities within Gladstone Harbour (June 2010)

3.0 METHODOLOGY

3.1 Dredge Operations

The dredging of the Construction Dock will be undertaken by a Cutter Suction Dredge (CSD). A CSD suction tube has a cutter head at the suction inlet, which loosens the dredge material and transports it to the suction mouth. The cutter can also be used for hard surface materials like gravel or rock. The dredged material is generally sucked up by a wear-resistant centrifugal pump and discharged through a pipeline.

Disposal / Reclamation Management

The relocation of dredged material is likely to be via a floating or submerged hydraulic pipeline supported by a number of booster pumps, dependent on the distance between the dredge head and the reclamation area. The dredged material will be transported as slurry via the pipeline to the reclamation area at Fisherman's Landing.

QGC will dispose of material resulting from dredging of the Construction Dock in GPC's existing Fisherman's Landing (FL) site (Drawing GPC 906-018). The existing Fisherman's Landing cells have the capacity to accommodate the estimated 355,000 m^3 of material from the dredging required for the Construction Dock.

3.2 Environmental Project Management

3.2.1 Dredge Working Group

A Dredge Working Group will be established prior to the commencement of dredging and spoil disposal, to oversee all aspects of the dredging operation; this includes environmental performance and regulatory compliance. The Dredge Working Group will be comprised of a senior representative from each of:

- Dredging Contractor
- Gladstone Ports Corporation (GPC)
- Queensland Gas Company (QGC)
- Maritime Safety Queensland (MSQ)

3.2.2 DWG Meetings

Kick-off Meeting

As soon as practicable after the Dredge Contract is awarded, a kick-off meeting will be convened whereby all members will be presented with the management plans associated with the dredging and material disposal activities.

Operational Meetings

During dredging operations the Dredge Working Group will meet on a weekly basis due to the short duration of the dredging activity associated with the Construction Dock. Environmental performance and regulatory compliance will be standing agenda items for all weekly meetings. This will include (but not be limited to) receiving advice on:

- Environmental monitoring
- Notification of incidents
- Recommendations for corrective actions and management measures.

Extraordinary Meetings

Extraordinary meeting will be convened as necessary in response to environmental or regulatory non-compliance alerts.

Final Review Meeting

Once the consolidated results of the monitoring and management program have been prepared, the Dredge Working Group will re-convene to review the findings. A report by will be prepared by the panel under direction of the Dredge Working Group and provided to QGC and the relevant regulatory authorities. This will include (but not be limited to):

- Collated results of environmental monitoring.
- List of any exceedances of environmental triggers and actions taken in response.
- List of any non-compliance their cause(s) and actions taken in response.

3.2.3 Community Consultation

The existing GPC Community Working Group will be used as a forum for community consultation for the Construction Dock dredging and material disposal. The GPC Community Working Group meets quarterly.

The Community Working Group will be provided with information on completed, current and future dredging and disposal operations, any monitoring exceedances, any management and mitigation measures that have been implemented, and any other aspects of dredging and disposal management and monitoring that may be relevant.

4.0 INFORMATION ADDRESSING KEY COASTAL PLANNING POLICIES

4.1 Commonwealth

The Port of Gladstone is located within the Great Barrier Reef World Heritage Area (GBRWHA), although all wharf areas, including the proposed development, are outside the State and Commonwealth Great Barrier Reef Marine Park boundary. All port facilities, including the proposed development, are located within Rodd's Bay Dugong Sanctuary B. Within the region, Balaclava Island and The Narrows, including the marine environment surrounding these, are designated as National Estates.

4.2 State

Areas of State Significance (Social and Economic) the proposed dredging will benefit the Port of Gladstone, which is of state economic significance due to its large export operations. The development of the site to operate as an aggregate loading facility will create an additional multipurpose facility for GPC.

The Construction Dock will be a temporary facility used to support the construction of a two-train LNG processing plant to the project site on Curtis Island.

4.2.1 Extractive Industry/ Dredging and Acid Sulfate Soils

GPC will comply with the latest edition of the Queensland Environmental Protection Agency's Instruction for the Treatment and Management of Acid Sulfate Soils, 2001, produced by DERM (formerly the Queensland Environmental Protection Agency in consultation with the Department of Natural Resources and Mines and the Department of Primary Industries).

The proposed management and mitigation measures for Acid Sulfate Soils are provided in ***Appendix 4***.

4.2.2 Future Needs for Access

The proposed dredging operation does not involve the construction of any physical barrier preventing existing access to the foreshores near the work.

The development of the Construction Dock facility will not unreasonably restrict usability of the harbour waters by either recreational or commercial vessels, apart from statutory security requirements.

4.2.3 Water Quality Management

GPC will provide a copy of the results of the Water Quality Monitoring Program to DERM within 28 days of dredge completion.

A specific water quality monitoring program has been developed to monitoring the predicted impacts of dredging and disposal activities for the Construction Dock. This monitoring program is provided in ***Section 8***.

4.2.4 Groundwater Quality

Groundwater in and adjacent to the site will not be impacted as a result of the Construction Dock dredging program.

4.3 Areas of State significance (Natural Resources) and Coastal Wetlands

Coastal wetlands of state significance are found within the Gladstone Harbour, fringing the mainland and harbour islands. Some mangroves and seagrass meadows exist in or near the Construction Dock dredging program.

4.3.1 Biodiversity

The Project is located within the Gladstone Port limits, with activities occurring on Curtis Island. The project site occurs within the GBRWHA, designated in 1982, but not within the GBRMP. RAMSAR wetlands or commonwealth marine parks are not located in the project area.

4.3.2 Seagrass

A description of seagrass habitats within the vicinity of the project area is provided in ***Section 5***. Predicted impacts to seagrass within the vicinity of the project area are provided in ***Section 6***. Proposed management, mitigation and monitoring of predicted impacts to seagrasses is detailed in ***Section 7***. Seagrass health in Port Curtis will be monitored annually through the Port Curtis Integrated Monitoring Program (PCIMP).

4.3.3 Mangroves

A description of mangrove habitats within the vicinity of the project area is provided in ***Section 5***. Predicted impacts to mangroves within the vicinity of the project area are provided in ***Section 6***. Proposed management and mitigation of predicted impacts to mangroves is detailed in ***Section 7***. A permit to remove marine plants protected under the *Fisheries Act 1994*, has been lodged by QGC, and at the time of preparation of this DMP is pending approval.

4.3.4 Corals

A description of coral habitats within the vicinity of the project area is provided in ***Section 5***. Predicted impacts to coral within the vicinity of the project area are provided in ***Section 6***. Proposed management, mitigation and monitoring of predicted impacts to corals is detailed in ***Section 7***.

4.3.5 Marine Fauna

A description of marine fauna potentially occurring within the vicinity of the project area is provided in ***Section 5***. Predicted impacts to marine fauna within the vicinity of the project area are provided in ***Section 6***. Proposed management and mitigation of predicted impacts to marine fauna is detailed in ***Section 7***.

4.3.6 Benthic

World heritage values that may require consideration with regard to the proposed action include benthic habitats and organisms. The Project is unlikely to have a significant impact on benthic habitats and organisms. A summary of predicted impacts to sensitive benthic habitats is provided in ***Section 6***. Proposed management, mitigation and monitoring (***Section 7***) is designed to reduce predicted impacts to benthic habitats.

4.3.7 Exemption of Royalty

GPC is exempt from payment of a royalty if the material is to be disposed of is not sold. This material will not be sold by GPC.

No royalty is to be paid for this project under Section 9 (3) of the Coastal Regulation. No royalty is payable by a port authority for quarry material removed, subject to the following:

(1) To maintain or improve navigational channels or navigation in its port if the material is disposed of:

  (a) in an area associated with port activities and approved by the Minister of the department through which the *Transport Infrastructure Act 1994* is administered; and

  (b) under relevant statutory environmental controls; or

(2) To reclaim land that is, or is proposed to be, strategic port land under the *Transport Infrastructure Act 1994*.

The Construction Dock dredging project area, including ISA, is in deep sub tidal water within the estuary of Port Curtis, immediately adjacent to the main shipping channel of the Port of Gladstone. The area in and adjacent to the site has not previously been dredged.

The area is adjacent to the central port area where significant urban and industrial development has occurred. Part of the land has already been dredged for navigational purposes.

4.3.8 Other Matters to Consider

Appendix 1 has acknowledgment notices from the Regional Harbour Master (Maritime Safety Queensland) and the Department of Employment, Economic Development and Innovation (DEEDI).

5.0 EXISTING ENVIRONMENT

5.1 Geotechnical and Geochemical

QGC geotechnical assessment of the Construction Dock facility (***Table 1***) has indicated the material to be dredged (-4.5 m) to consist of sandy clays, clayey silt to sandy gravelly silty clays (***Appendix 2*** and ***Appendix 3)***.

The borehole locations are shown in (***Appendix 2***).

Table 1: Physical characteristics of material present at the Construction Dock

		PSD				
Construction Dock Dredge Zone		**Cobbles (>6cm)**	**Gravel (>2mm)**	**Sand (0.06-2.00 mm)**	**Silt (2-60 µm)**	**Clay (<2 µm)**
		%	%	%	%	%
LOR		1	1	1	1	1
Core ID	**Sample Depth**					
EP04	0-0.5	<1	16	47	17	20
EP04	0.5-1.0	<1	7	16	57	20
EP06	0-0.2	<1	5	61	17	17
EP06	0.5-1.3	<1	2	21	29	48
EP14	0-0.5	<1	3	18	31	48
EP21	0-0.5	<1	5	14	47	34
EP24	0-0.5	<1	35	15	29	21
EP29	0-0.5	<1	15	49	15	21
EP29	1.0-1.5	<1	20	44	23	13
EP30	0-0.5	<1	20	35	33	12
EP30	1.5-2.4	<1	23	24	36	17
EP30	2.4-3.3	<1	<1	8	49	43
3848	0 - 0.5	<1	28	29	27	16
3848	3.5-3.9	<1	1	<1	8	91

The material to be dredged for the Construction Dock facility does not contain any introduced contaminants.

5.2 Biological Marine Environment

A detailed description of the existing marine environment is presented in the QCLNG Project EIS and Supplementary EIS, Chapter 5 Volume 8. A high level overview of the marine environment in and around the project area is presented in the following sections to provide context to the management measures presented in ***Section 7***.

5.2.1 Seagrass

Within the Port of Gladstone the following six species of seagrass have been identified:

1) *Halodule uninervis*
2) *Halophila ovalis*
3) *Halophila decipiens*
4) *Halophila minor*
5) *Halophila spinulosa*
6) *Zostera capricorni*

Regular seagrass monitoring within the Port of Gladstone, has been undertaken by the Marine Ecology Group of Fisheries Queensland[3]. This regular monitoring expands on baseline studies conducted in 2002, and in 2007 was included as an annual monitoring theme in the PCIMP. Mapping of seagrass habitats was again undertaken in 2009.

The 2002 baseline, and repeated 2009 seagrass survey identified coastal seagrass meadows in small patches along the south-western coastline of Curtis Island[4] (***Figure 5-1***). These beds were categorised as ephemeral, sparsely populated with low biomass. Mapping undertaken in November 2009 indicated that many of these meadows identified in baseline surveys had shrunk in size[5], such that no seagrass now occurs within the dredge footprint for the Construction Dock. However, seagrass is known to have occurred in this area and could reasonably be expected to grow in the absence of disturbance.

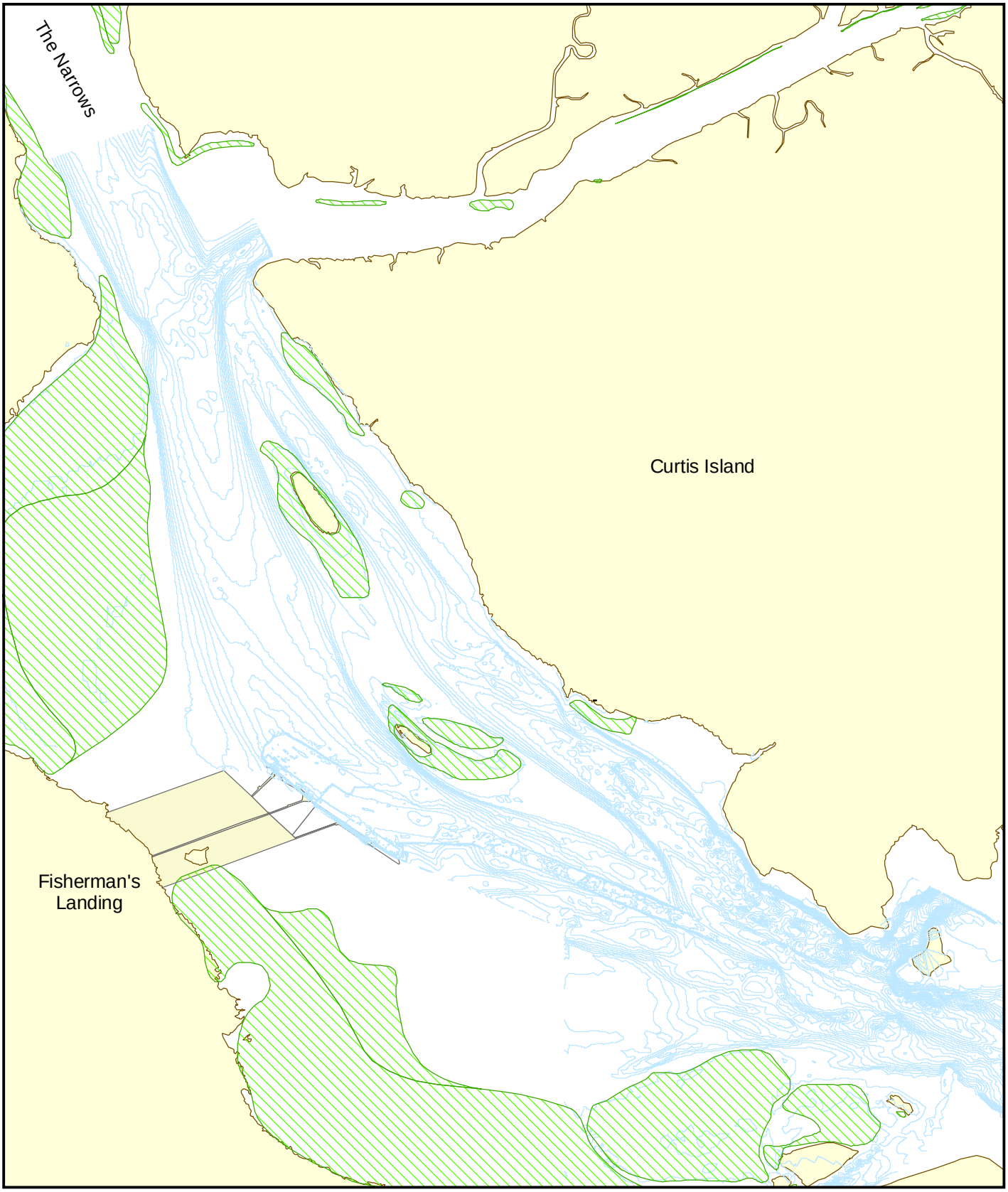
The more recent surveys have identified consistent changes between seagrass meadows within the Port of Gladstone and at reference sites in Rodds Bay. These changes have been linked to a combination of climate factors, tidal exposure, seagrass resilience and capacity for recovery. In addition, surveys of seagrasses throughout Queensland have demonstrated that fluctuating patterns of distribution and abundance are common[6].

3 Storey AW, Andersen LE, Lynas J, Melville F (2007) Port Curtis Ecosystem Health Report Card

4 Rasheed MA, Thomas R, Roelofs AJ, Neil KM, Kerville SP (2003) Port Curtis and Rodds Bay Seagrass and Benthic Macro-invertebrate Community Baseline

5 Pers. Comm. Michael Rasheed

6 Alquezar R, Small K, Hendry R (2007) Port Curtis Biomonitoring Programme: macroinvertebrate, mangrove and seagrass surveys November 2006. A report to Queensland Energy Resource Limited (QERL). Centre for Environmental Management, Central Queensland University, Gladstone, Queensland.



Legend

- Coastal Seagrass, 2002 baseline
- Bathymetric contours

Source:
Cadastral Data - MapInfo StreetPro
Seagrass distribution produced by Queensland Department of Primary Industries and Fisheries, 2002
Bathymetry Data: Gladstone Ports Corporation

Projection: UTM MGA Zone 56 Datum: GDA 94

0 250 500 1,000 1,500 m

N

QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title: Seagrass Distribution (based on 2002 mapping)
	Client	QGC - A BG Group business	
SINCLAIR KNIGHT MERZ SKM	Drawn KP	**Figure 5-1**	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. QGC does not warrant the accuracy of any such Maps and Figures.
	Approved PF	File No: 0008_CI_GIS059_R0	
	Date 23/03/10	Revision 0	

5.2.2 Reef Habitats

Locally, the benthic reef fauna and flora assemblages of Port Curtis exist within the constraints imposed by variable water (and air) temperature range, large tidal range, strong tidal currents and low light levels and associated high suspended solid concentrations. Most light-dependent reef-building corals, seagrass and seaweed (macroalgae) species therefore occur from the lower intertidal area to a depth not usually exceeding 2 m below low-water datum.

At the turbid fringing reef sites near Curtis Island, hard coral cover was found to be low (average of 4 per cent)[7]. In closer proximity to the QCLNG site, soft corals (zoanthids and gorgonians) have been recorded. Detailed information on the distribution and abundance of these soft corals is limited. However, a recent report suggests soft corals occur in sparse abundance between China Bay and Hamilton Point, with denser coverage on the rocky headland at Hamilton Point. The per cent coverage of these communities, which included sponges, ranged from 2 to 10 per cent[8].

5.2.3 Mangroves

Fourteen species of mangroves are reported from the Port of Gladstone region. The mangrove assemblage is dominated by *Rhizophora stylosa. Ceriops tagal* and *Avicennia marina* are also well represented, generally on the landward side of the assemblage. These mangrove assemblages are considered to be in a healthy state. The majority of mangroves identified in the project area dominate the mid-to-upper intertidal zones, fringing much of the mainland and Curtis Island between mean sea level and mean high water springs.

Extensive mangroves extend along the Curtis Island coastline from Graham Creek to Hamilton Point to the south beyond the project area. Intertidal mangrove habitat comprises 31.7%of all habitat types in the Port of Gladstone covering an area of 6,736 ha. Areas of mangrove, predominantly *Rhizophora* closed forest, are also found along the coastline of Curtis Island close to the proposed QCLNG marine facilities, and also adjacent to, to the south, north and inhabiting Passage Islands.

Impacts to mangroves from the development of the Construction Dock represents less than 0.0001% of the area of mangroves identified above.

5.2.4 Cetaceans

The results of GPC's aerial and boat-based surveys, which covered an area from north of Curtis Island to south of Rodds Bay, are consistent with current literature that acknowledges the importance of Rodds Bay as a key habitat area for significant marine megafauna species. The Indo-Pacific Humpback dolphin has been found by recent surveys[9] to be the most common coastal dolphin in the Port Curtis area with observed distribution from north of Curtis Island to south of Rodds Bay. The surveys identified a range of age classes using the region, suggesting that it is not only an important foraging area but an area important for calving of these marine mammals. No records were made of the Australian Snubfin dolphin.

7 BMT WBM 2009 Port Curtis Reef Assessment.

8 URS 2009 GLNG Marine Ecology Technical Report.

9 GPC Western Basin Dredging Project Draft EIS

5.2.5 Dugong

Dugongs are known to utilise seagrasses within Port Curtis. In particular, these seagrasses have been declared locally significant on the basis of dugong feeding behaviour.

A survey conducted in November 2005 estimated there were 183 (± 66) dugongs in the Port of Gladstone area[10]. Dugong feeding activity was observed on the majority of intertidal seagrass meadows surveyed during a study of benthic habitats in the port[11].

5.2.6 Turtles

The Green turtle (*Chelonia mydas*); Loggerhead turtle (*Caretta caretta*); and Flatback turtle (*Natator depressus*) are known to occur in Port Curtis, nesting on the eastern beaches on the seaward side of Curtis Island and Facing Island. However, there are no known turtle-nesting beaches within close proximity (within 5 km) to the proposed QCLNG Project and therefore there are no direct impacts predicted to nesting habitat.

Green turtles have been regularly observed within local seagrass meadows, particularly those on Pelican Banks (eastern side of Curtis Island).

Leatherback turtles (*Dermochelys coriacea*), Hawksbill turtles (*Eretmochelys imbricata*) and Olive Ridley turtles (*Lepidochelys olivacea*) are not known to nest in the Port Curtis area. Individuals may migrate through the area, but significant numbers of them are unlikely in the project area.

5.2.7 Water Mouse (Xeromys myoides)

The Water Mouse (X. myoides) is listed as vulnerable under the EPBC Act (1999). QCLNG has undertaken pre-clearance surveys of potential water mouse habitat near mangrove area associated with the Construction Dock site (October, 2010) and more broadly in the LNG facility site and the pipeline route. LNG site surveys did not identify the presence of the Water Mouse or Water Mouse nests. The methods employed in these surveys were in compliance with the EPBC Significant Impact Guidelines[12]. In view of the current results it was deemed that a specific Water Mouse management plan was not required for the Construction Dock dredging program.

10 Marsh H and Lawler I R (2006) Dugong distribution and abundance on the urban coast of Queensland: a basis for management. Marine and Tropical Science Research Facility Interim Projects 2005-06 FINAL Report Project 2.

11 Rasheed M A, McKenna S A, Taylor H A and Sankey T L (2008) Long term seagrass monitoring in Port Curtis and Rodds Bay, Gladstone – October 2007. DPI&F Publication PRO7-3271 (DPI&F, Cairns), 32 pp.

12 DEWHA (1999) Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999

6.0 PREDICTED ENVIRONMENTAL RISKS

The potential environmental impacts associated with the dredging and material disposal for the QCLNG Project have been assessed as part of the EIS process. The environmental risks associated with dredging of the Construction Dock are:

1) Deterioration of water and sediment quality leading to stress and/or loss to areas of seagrass and soft coral closest to the dredging activities.
2) Interactions between construction vessels and marine fauna, specifically turtles and marine mammals.
3) Accidental introduction of marine pest species from vessel hulls and ballast water.
4) Disturbance to acid sulfate soils.

6.1 Water Quality

Detailed 3D modelling has been carried out to predict the trajectory and fate of sediments released from the seabed during Construction Dock dredging operations. This modelling has been used to predict the distribution of total suspended solid concentrations and the rate of sedimentation. For modelled scenarios, the 95th percentile maps show isolated areas of increased turbidity (displayed as suspended sediment concentrations) above the 25 mg/L threshold. These areas are largely concentrated directly adjacent the dredging activities, with some isolated areas at Friend Point and the eastern side of The Narrows toward Targinie Creek.

For the modelled scenario, the most severe rates of sedimentation are localised in areas adjacent the dredging activities. The 95th percentile map shows localised areas of increased sedimentation rates resulting from the CSD operations, ranging between 5 and 5,000 g/m^2/day. Predicted areas characterised by rates above the threshold value of 200 g/m^2/day, occur directly adjacent the dredging activities, with isolated patches extending south toward China Bay and Hamilton Point, and north to the Narrows and the entrance to Targinie Creek.

6.2 Fauna Interaction

The likelihood of interactions between vessels used for dredging of the QCLNG Construction Dock and marine fauna is considered low. However, the protocols outlined in ***Section 7.4*** will be implemented to further reduce the potential for collisions with dolphins.

6.3 Introduced Marine Species

The risk of introducing non-native marine species during dredging for the QCLNG Construction Dock was not assessed in the EIS or Supplementary EIS. However, dredges and associated vessels are in the highest risk category as vectors for introduced marine pests[13]. As such, management strategies to minimise the potential for introduction of non-native species are included in this DMP (***Section 7.5***).

[13] Kinloch M, Summerson R, Curran D (2003) Domestic vessel movements and the spread of marine pests: Risks and Management Approaches. Bureau of Rural Sciences. Department of Agriculture, Fisheries and Forestry.

6.4 Acid Sulfate Soils

Where positive potential acid sulfate soils (PASS) deposits have been identified they are limited in volume, and well defined in the both the vertical and horizontal plane, providing a good foundation for sound management. In particular, the immediate near shore area bordering the present mangrove shore is the only area within the offshore Construction Dock area that will require close management. The great majority of the site has the inherent capability to balance any spot occurrences of latent acid potential with an overwhelming excess neutralising capacity.

Dredging for the Construction Dock will mix the material sufficiently to neutralise the thin acidic layer. The material will then be placed in the existing Fisherman's Landing reclamation area on land. An activity specific Acid Sulfate Soil (ASS) Management Plan has been developed (***Appendix 4***).

7.0 QCLNG CONSTRUCTION DOCK MANAGEMENT STRATEGIES

7.1 Overview

This DMP provides the basis for managing potential impacts relating to dredging and spoil disposal activities for the Construction Dock.

Five key management strategies have been developed to manage potential impacts of dredging for the Construction Dock. Each strategy includes a tiered approach to impact management. Management strategies are:

- Management Strategy 1 – Water Quality
- Management Strategy 2 – Marine Mammals Interaction
- Management Strategy 3 – Marine Turtles Interaction
- Management Strategy 4 – Introduced Marine Pests
- Management Strategy 5 – Acid Sulfate Soils

Potential risks to both the Water Mouse and migratory shorebirds were assessed according to the requirements for Matters of National Environmental Significance (i.e. protected by the EPBC Act) in either the QCLNG EIS or subsequent field surveys. There was no evidence of the presence of the Water Mouse (see Section 5.2.7) or significant feeding or roosting sites for migratory birds[14] in the vicinity of the Construction Dock site. Therefore, in view of the short duration of the dredging operations for this phase of the Project (approximately 5 weeks for the Early Works program) management strategies for these species were determined to be not required.

Other potential environmental impacts that fall outside the DMP implementation requirements shall be managed under the broader QCLNG Project Environmental Management Plan (EMP) that has been prepared for the Project. This includes the management of waste, hydrocarbons, chemicals, noise and lighting.

7.2 Management Strategy 1 – Water Quality

This DMP has adopted a best practice management approach to address the potential impacts of dredging program. This approach defines tiered impact zones, within which management and monitoring activities are pre-defined. Impact zones are defined in terms of direct and indirect effects, permanent and temporary effects, physical versus biological effects, and mortality versus sub-lethal effects[15,16]. The following zones have been specified for management of seagrass and corals during dredging for the QCLNG Construction Dock.

[14] Refer QCLNG EIS (2009)

15 Masini R, Sim C, McAlpine K (2008) Environmental Impact Assessment of Large-scale Dredging Projects.

16 SKM 2008 Pluto LNG Development: Dredging and Spoil Disposal Management Plan

Impact Zone

This zone represents the area within which mitigation and management strategies have been applied in the project design, planning and operational phases, to reduce the size and severity of impacts to the greatest extent reasonably practical. However, it is acknowledged (via the EIS and subsequent permitting processes) that – even after optimisation, mitigation and management – there will still be impacts to biota within this zone. This may include direct impacts, such as those within the dredging footprint, which are usually permanent. It is also likely to include indirect impacts (such as those caused by loss of light and by sedimentation), which may only be temporary. In the case of seagrasses and corals, regrowth is usually expected to occur within several years, assuming that the substrate is not damaged, and that water quality returns to normal after the impact period.

With project approvals premised on mortality within the impact zone, biota therein is not subject monitoring as part of this DMP. Any monitoring within this zone is only intended to confirm predicted impacts, to confirm any predicted recovery, and to assist in refining current and future models of impact predictions.

The QCLNG Project has defined an impact zone within which mortality is expected. Predictions made for this impact zone have used an expert working group approach (as documented in Volume 6, Section 2.4 of the QCLNG EIS). For dredging of the QCLNG Construction Dock, the outer boundary of the impact zone coincides with the modelled 50th percentile 25 mg/L SSC contour (***Figure 7-1***).

Sedimentation Impacts

To measure the effect on sediment deposition from the Construction Dock dredging program a sampling site BG10 ***(Figure 8-1)*** has been set up. This site has been chosen due to its relevance to the nearby soft coral populations and the potential impacts that increased sedimentation may have on these populations. The sedimentation sampling at BG10 and the reference site P5 have been provided as part of this DMP to support the ongoing development of a more comprehensive water quality monitoring program for the Western Basin Dredging. It has been recognised that an opportunity exists in this program to test some of these alternative water quality measurement techniques that are being used as research tools for the main works program. BG10 is provided in this program for information only.

The same quality parameters will be sampled at BG10 along with sediment deposition. A report on this site will be provided with the final report for the water monitoring program.

Management Area 1

This represents the zone where impacts to biota are expected, but where appropriate management during dredging operations is expected to limit these to sub-lethal impacts only, and where rapid recovery is expected following completion of dredging. For dredging of the QCLNG Construction Dock, this area is bounded by the 50th percentile 25 mg/L SSC contour and the 95th percentile 25mg/L SSC contour (***Figure 7-1***). It is within this area that most management and monitoring will be directed.

Management Area 2

Management Area 2 is the zone within which measurable physical effects (such as turbid plumes) may occur, but where no effects to biota were predicted. Monitoring sites will be established within Management Area 2, but these are intended to serve as comparator sites for detecting impacts within Management Area 1. For dredging of the QCLNG Construction Dock, this area exists outside the 95th percentile 25 mg/L SSC contour (***Figure 7-1***).

Unimpacted Area

Areas beyond Management Area 2 are those where no impacts are predicted for biota due to physical conditions such as turbidity and sedimentation. Monitoring sites within this area will serve as reference sites and will be placed sufficiently close to Management Area 2 such that there are no differences between naturally occurring changes inside and outside of these areas.

Predicted Impacts

Impacts to seagrass and corals due to the QCLNG Construction Dock dredging are predicted to be minor, but may occur due to altered water quality (including increased turbidity and sedimentation) (***Section 6***). A summary of potential predicted impacts to seagrasses and corals is provided below.

- No predicted direct impact to seagrass as a result of dredging for the QCLNG Construction Dock. This represents the area of seagrasses within the defined Impact zone, that will be exposed to depth averaged TSS concentrations greater than 25 mg/L (including forecast ambient TSS) for 50 percent of the time or more (i.e. 50th percentile).

- Approximately, 4.6 ha of seagrass may be temporarily impacted by the QCLNG Construction Dock dredging. This represents the area of seagrasses within the defined Management Area 1 which is the area where the greatest dredge management effort will be directed.

Management of Impacts to Water Quality	
Environmental Objective:	• To minimise adverse effects on water quality that may lead to losses of seagrasses and corals
Key Performance Indicators:	• Monitored water quality parameters • The number of exceedances of trigger levels at 'Management Area 1' monitoring sites
Management:	**General Management Strategies** • Accurate bathymetric survey will be carried out of the dredging areas • Differential GPS (DGPS) will be used on dredges to ensure direct impact is restricted to the approved dredging areas. **Preventative Measures** ***Reclamation Dewatering Discharge*** • The operation of the dewatering process within the existing reclamation area (e.g. internal bund walls) will be used as the main management measure to reduce TSS being discharged into the marine environment. • A suitable control (e.g. weir box) will be used at the discharge point to control the water level and the rate and timing of discharge.

Management of Impacts to Water Quality	

Pipeline

- Well maintained pipelines will be used to minimise leakage of turbid water during pumping of material to the reclamation area (***Figure 7-2***).
- Pipeline flow controls and inline monitoring will be utilised.
- Regular observation and inspection of pipelines will be undertaken.
- Any observed or detected leaks will be repaired as soon as practicable.
- Pumping will stop if a major rupture is identified (within the operational constraints of the equipment).

Responsive Measures

Reclamation Dewatering Discharge

Dredge dewatering from the existing Fisherman's Landing reclamation area will be monitored inside the discharge outlet, logged hourly for turbidity and pH. Total suspended solids will be monitored weekly. The table below outlines the parameters to be measured and their respective trigger values.

Monitoring Point	Parameter	Min	Max	Frequency
Discharge Point Weir box cell 2 FL	TSS	-	100 mg/L	Weekly
Discharge Point Weir box cell 2 FL	Turbidity	-	-	Hourly
Discharge Point FL	pH	6.5	9	Hourly
Discharge Point FL	Metals and Ammonia	As per approval conditions	As per approval conditions	Monthly or if pH is outside of trigger limits

Management responses for exceedances of discharge trigger values for the existing Fisherman's Landing reclamation area may include:

- Raising weir levels (final weir and others if required).
- Cease discharging from polishing pond until water clarity improves.
- Cease discharging from Cell 2 until water clarity improves.
- Reduce dredger delivery rate.

Management of Impacts to Water Quality

Water Quality Triggers and Management Responses

Five water quality sites will be established to monitoring predicted impacts to water quality resulting from dredging of the QCLNG Construction Dock. These will include three sensitive locations and two reference sites (***Section 8***).

Management Response Level	Trigger Value: Turbidity
No Exceedance	NTU < 30
Level 1	10 day rolling average of NTU > 30 and less than 50
Level 2	10 day rolling average of NTU > 50

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

Investigations of possible causes will examine:

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

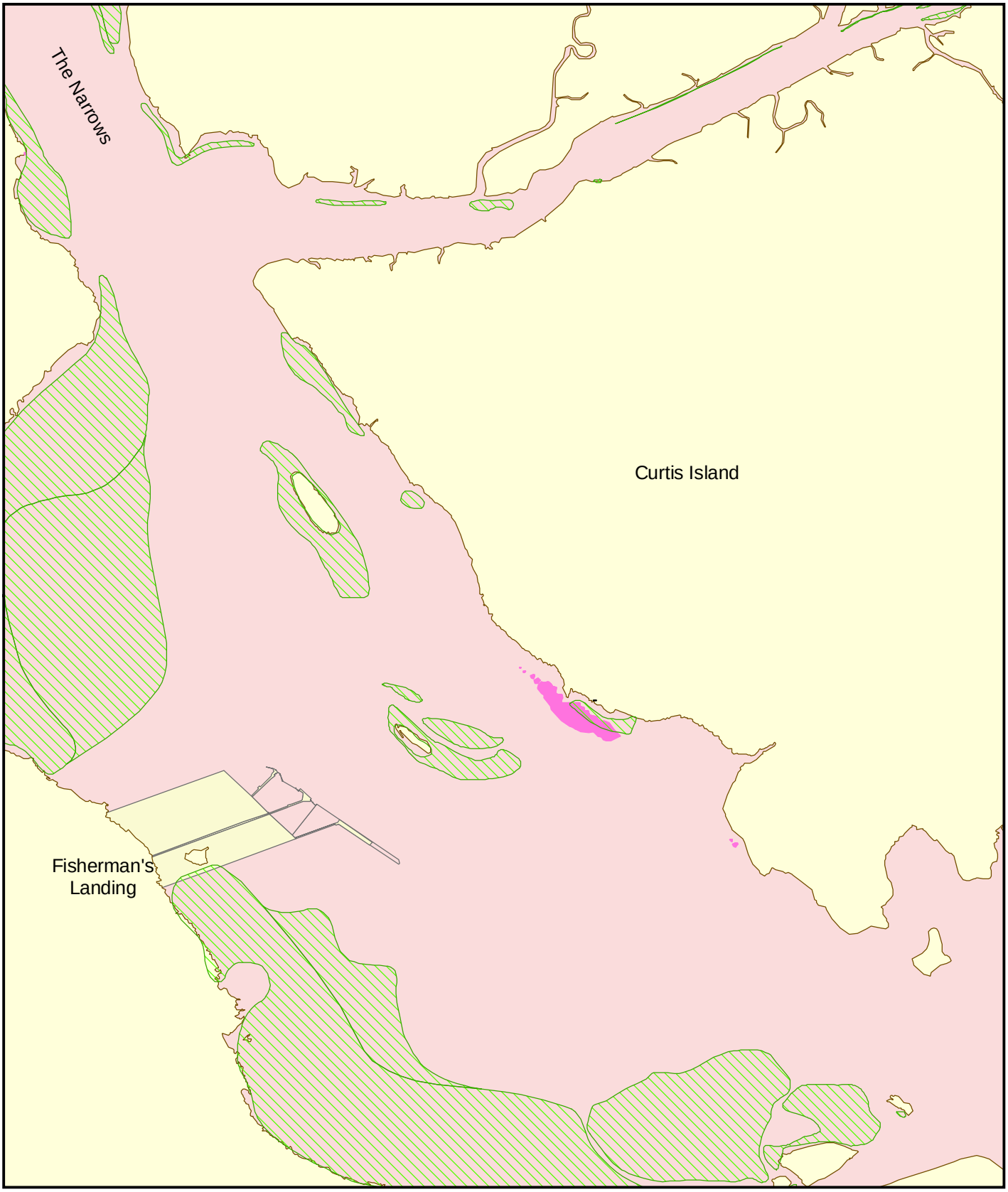
In the event that it is considered that dredging or spoil disposal has contributed to the exceedance, the following management and monitoring strategies will be implemented, related to each level of exceedance and response:

<u>Level 1 Management Response:</u>

- Report the exceedence and results of investigation to the weekly Dredging Working Group.
- Dredging Working Group to consider the report and outcomes of investigation and develop management strategies as necessary to manage the effects on water quality.
- Continue monitoring water quality.

Management of Impacts to Water Quality	
	Level 2 Management Response: • Immediately report exceedance and results of investigation to the Dredging Working Group. • Dredging Working Group to convene as soon as practicable to consider the report and implement appropriate management strategies for the protection of water quality. • A nominated Dredging Working Group representative to inform the DERM and Department of, Sustainability, Environment, Water, Population and Communities of the exceedance and proposed management response within 24 hours of detection. • Continue monitoring water quality. Management strategies may include: • Decreasing the average rate of dredging to reduce the amount of turbidity into the water column. • Assess the material being dredged and, where practicable, relocated the dredge head to dredge coarser material, which will allow finer sediments to settle out of the dredge plume. Finer material may only again be dredged when turbidity levels at sensitive locations have returned to below trigger values.
Monitoring:	• Bathymetric surveys will be carried out within the dredge area upon completion of dredging. • Water quality monitoring program (***Section 7***).
Reporting Requirements:	• Water quality reports (***Section 9***). • Regulatory reporting (***Section 9***).

Table 1 Management of Impacts to Water Quality



Legend

- Coastal Seagrass, 2002 baseline
- Impacts Zone (None This Figure)
- Management Area 1
- Management Area 2

Source:
Cadastral Data - mapInfo StreetPro
Seagrass distribution produced by Queensland Department of Primary Industries and Fisheries, 2002
Bathymetry Data: Gladstone Ports Corporation

Projection: UTM MGA Zone 56 Datum: GDA 94

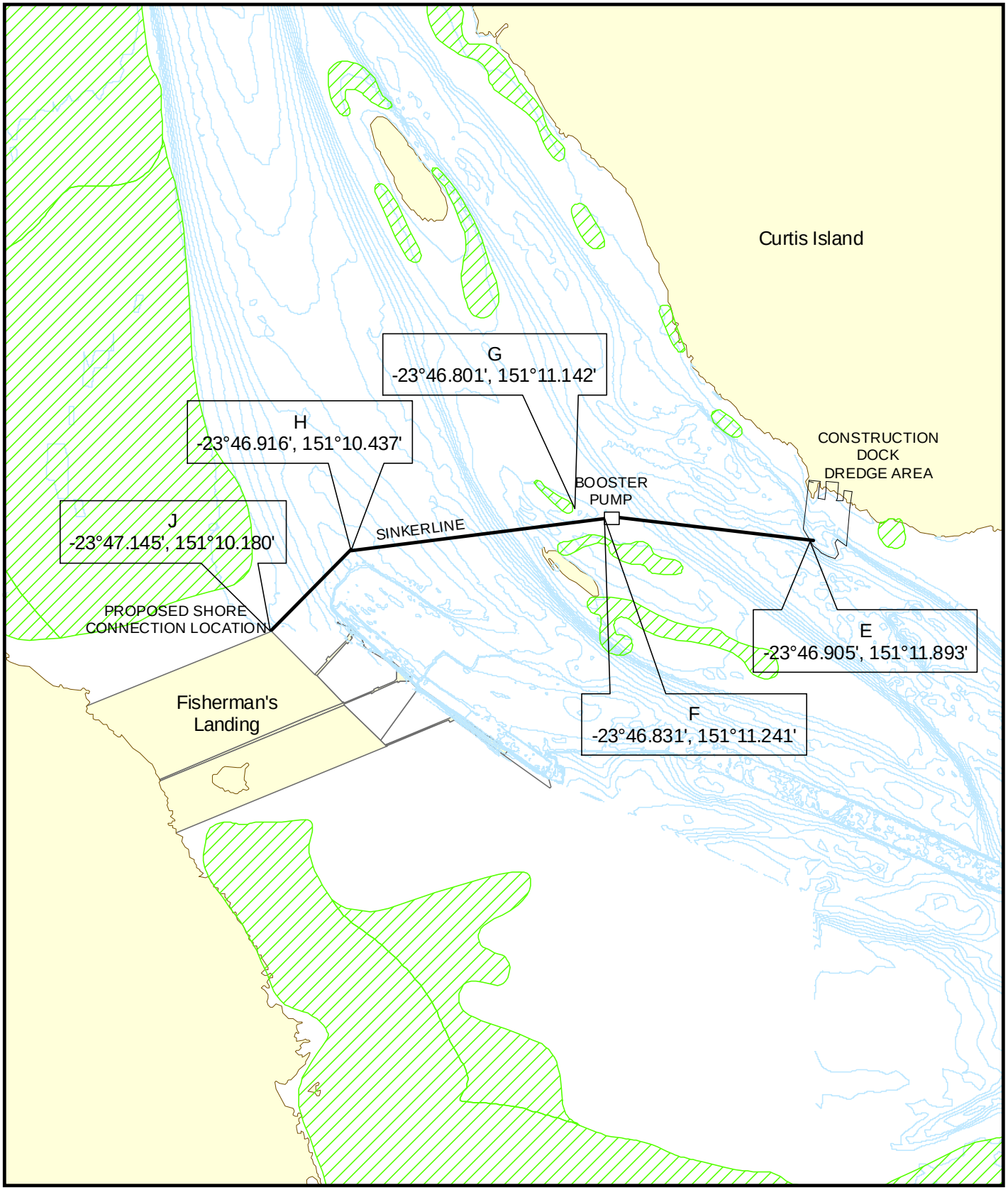
0 250 500 1,000 1,500 m

N

QUEENSLAND CURTIS LNG
A BG Group business

Project	Queensland Curtis LNG Project	Title	SSC Management Zones
Client	QGC - A BG Group business		
Drawn	KP	**Figure 7-1**	
Approved	PF	File No: 0008_CI_GIS063_R0	
Date	23/03/10	Revision 0	

SINCLAIR KNIGHT MERZ SKM



Legend

- Coastal Seagrass, 2010
- Bathymetric contours

Source:
Cadastral Data - mapInfo StreetPro
Seagrass Distribution produced by Queensland Department Employment, Economic Development and Innovation 2010
Bathymetry Data: Gladstone Ports Corporation

Projection: UTM MGA Zone 56 Datum: GDA94

0 200 400 800 m

N

QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title: Alignment of Discharge Line from CSD to Fisherman's Landing
	Client	QGC - A BG Group business	
ERM Environmental Resources Management Australia Pty Ltd	Drawn KP	Figure 1	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. QGC does not warrant the accuracy of any such Maps and Figures.
	Approved AT	File No: 0008_CI_GIS066_R2	
	Date 30/03/10	Revision 2	

7.3 Management Strategy 2 – Marine Mammals Interaction

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

Marine Mammal Management	
Environmental Objective:	To detect and avoid risks of injury/mortality to marine mammals as a result of the dredging and spoil management activities.
Key Performance Indicator:	Zero reported incidents of injury or mortality to marine mammals as a result of dredging and spoil management activities.
Management:	**Preventative Measures:** • The requirements for cetacean interactions specified under Part 8 of the EPBC Regulations 2000 (Cth.), the Australian National Guidelines for Whale and Dolphin Watching will be complied with. • Vessel speed limits will be applied to vessels operating within the construction area to reduce the risk of vessel strikes on marine mammals. • Adopt 'slow start' procedure for dredges to alert marine mammals and potentially deter them before the cutter head is started. • At times where the cutter head of the CSD is raised while the dredge pumps are still running (for example, during the pipeline flushing as part of normal operations), the cutter head will remain operational (that is, this continue to rotate) to act as a deterrent to any marine mammals in the vicinity of the dredge and reduce the risk of entrainment within the dredging equipment. **Responsive Measures:** • Weekly summary of marine mammal sightings will be presented to the Dredging Working Group. • Where marine mammals are identified within the vicinity of dredging works specified Safety Zone (within 150 m for species of conservation significance), operations will be temporarily moved or suspended to avoid contact. • The contractor will employ an appropriately trained spotter to ensure no marine species of conservation significance come within the relevant Safety Zones. • For dredge vessel activity undertaken outside of dredging operations, the vessel will comply with the following: o If a marine mammal approaches the vessel or comes within the 100 m avoidance area, the vessel will not change course or speed suddenly. o If a calf appears within 300 m of the vessel, the vessel will take the appropriate action to withdraw from this distance at a constant slow speed.

Marine Mammal Management	
	o These measures will be implemented where it is safe and practicable to do so, relative to vessel manoeuvrability, vessel draft considerations and other vessel activity within the port. • In the event that the dredging or spoil disposal activities result in injury or mortality to one or more marine mammals, a review of the current management measures will be undertaken in consultation with the regulatory authorities to identify potential additional management measures. • The Dredging Working Group will convene as soon as practicably to consider the outcomes of this investigation and implement appropriate management strategies for protection of marine mammals. **Note 1**: There is not considered to be a significant risk of impacts to marine mammals as a result of the deterioration in water quality (elevated turbidity). Potential impacts of increase turbidity on marine mammals will be managed via the water quality management measures presented in ***Section 7.2***. **Note 2**: In line with recent practice in the management of impacts to marine mammals on large scale dredging project in Australia, the above management measure will not apply to dolphin sightings. The speed and intelligence of dolphins means that there is a low risk of impacts to dolphins via vessel strike.
Monitoring:	Not applicable
Reporting:	• Immediately report any marine mammal injuries to DERM Hotline on 1300 130 372 and provide information on location, what the animal is, the animals state (alive of deceased). • All incidents resulting in marine mammal injury or mortality will be reported to DERM and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), within 1 business day . • All marine mammal sightings resulting in the application of management measures will be recorded.

Table 2 Marine Mammal Management

7.4 Management Strategy 3 – Marine Turtles Interaction

The interaction between marine turtle and the dredging equipment has the potential to cause injury or mortality to individual animals via direct striking or entrapment/entrainment. Refer to ***Section 5*** for details on the marine turtles present in the project area.

Marine Turtle Management	
Environmental Objective:	To detect and mitigate risks of injury/mortality to marine turtles as a result of the dredging and spoil management activities.
Key Performance Indicator:	Zero reported incidents of injury or mortality to marine turtles as a result of dredging and spoil management activities.
Management:	**Preventative Measures:** • Vessel speed limits will be applied to vessels operating within the construction area to reduce the risk of vessel strikes on marine mammals. • Adopt 'slow start' procedure for dredges to alert turtles and potentially deter them before the cutter head is started. • At times where the cutter head of the CSD is raised while the dredge pumps are still running (for example, during the pipeline flushing as part of normal operations), the cutter head will remain operational (that is, this continue to rotate) to act as a deterrent to any marine turtles in the vicinity of the dredge and reduce the risk of entrainment within the dredging equipment. • In the event that the dredging or spoil disposal activities result in injury or mortality to one or more marine turtles, a review of the current management measures will be undertaken in consultation with the regulatory authority. • Lighting onboard dredging and support vessels will be limited to a level required for safe and efficient operations. **Responsive Measures:** • Weekly summary of turtle sightings will be presented to the DWG • In the event that the dredging or spoil disposal activities result in injury or mortality to one or more turtles an investigation will be conducted to identify potential additional management measures and outcomes of this investigation will be presented to the DWG. The DWG will consider the report and implement appropriate management strategies for protection of turtles. **Note 1:** There is not considered to be a significant risk of impacts to marine turtles as a result of the deterioration in water quality (elevated turbidity). Potential impacts of increase turbidity on marine turtles will be managed via the water quality management measures presented in ***Section 7.2***.
Monitoring:	Not applicable

Marine Turtle Management	
Reporting:	• Immediately report any marine turtle injuries to DERM Hotline on 1300 130 372 and provide information on location, what the animal is, the animals state (alive of deceased). • All incidents resulting in marine turtle injury or mortality will be reported to DERM and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), within 1 business day. • All marine turtle sightings resulting in the application of management measures will be recorded.

Table 3 Marine Turtle Management

7.5 Management Strategy 4 – Introduced Marine Species

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

Table 4 Introduced Marine Species Management

7.6 Potential Acid Sulfate Soil Material

A site specific Acid Sulfate Soils Management Plan (ASSMP) for the construction of the Marine Facility, which includes the Construction Dock dredging is provided in ***Appendix 4***, pursuant the QCLNG Acid Sulfate Soil Strategic Management Framework attached to the QCLNG EIS.

The management framework has been developed to set the over-arching Strategic Management Framework with which all Contractors conducting any works which have the potential to disrupt Acid Sulfate Soils (ASS) are required to use as a basis for developing their own management plans. This document sets out the likely ASS locations in the project area and appropriate mitigation strategies and development of the site specific management plans. The framework is based on the Queensland State Planning Policy 2/02 Planning and Managing Development Involving Acid Sulfate Soils 2002 (SPP 2/02) and the other pertinent Queensland guidelines.

7.7 Environmental management Plan

The dredging Contractors will be required to prepare and implement an Environmental Management Plan for the Construction Dock facility.

8.0 MONITORING AND INSPECTION

8.1 Overview

Potential impacts of elevated turbidity and sedimentation from dredging for the QCLNG Construction Dock (***Section 6***) will be managed to remain within pre-determined "threshold levels". The threshold levels represent the levels above which there is considered to be a significant risk to sensitive biota.

The development of the management trigger values was based on the following:

- Analysis of baseline data on sensitive biota in the area (depth, distribution, percent cover, species, diversity, spatial extent)
- Analysis of baseline data on water quality parameters of relevance (turbidity, light climate, light attenuation, sedimentation, temperature)
- Analysis of relevant literature on relationships between the health of sensitive biota and water quality parameters
- Development of relationships between water quality parameters and sensitive biota in Port Curtis.

8.2 Monitoring Program

The objective of the monitoring program is to ensure that any potential impacts that may lead to adverse effects on sensitive biota are avoided or minimised.

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

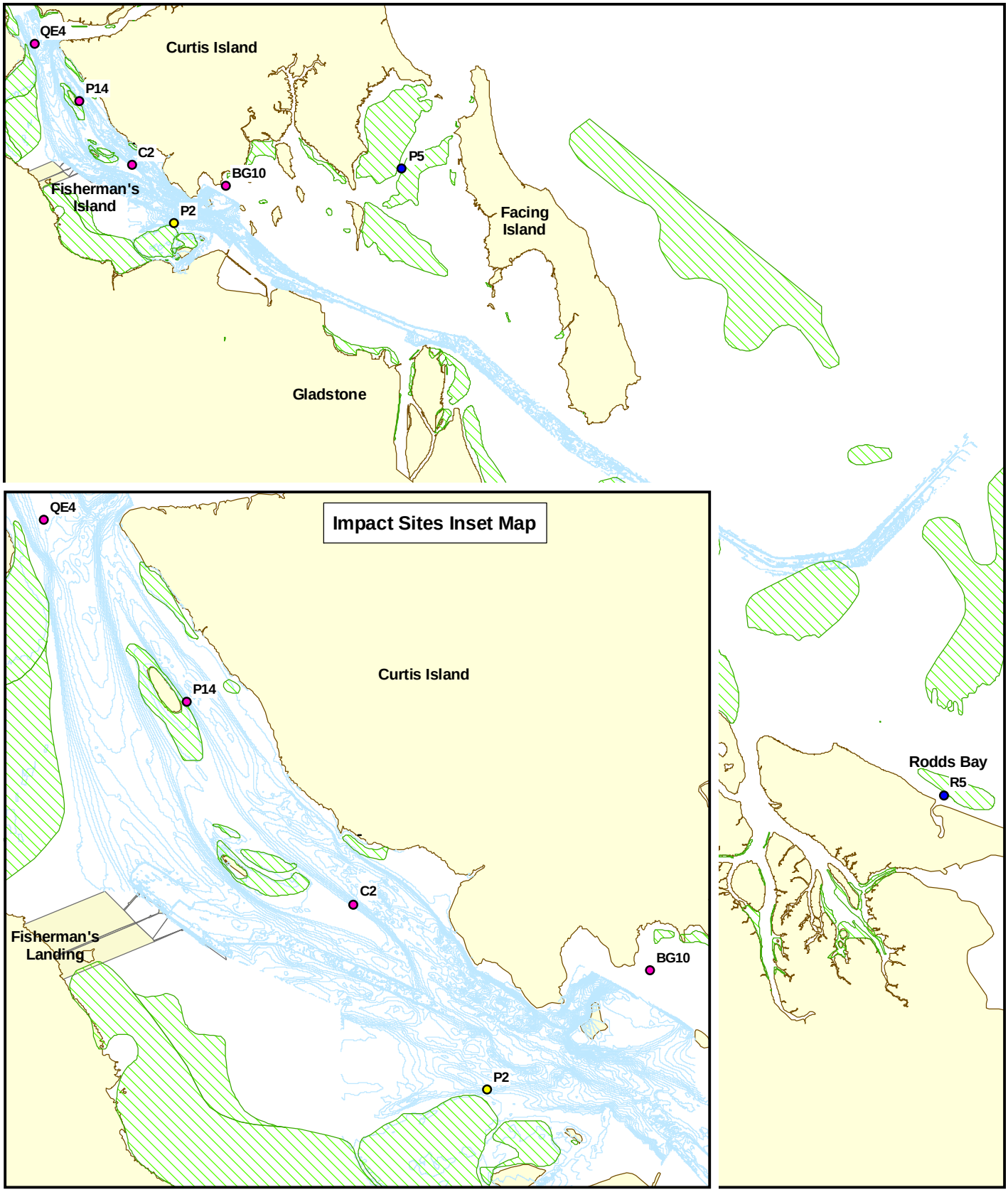
The monitoring and inspection programs that will be undertaken to support the management strategies are detailed in the following sections. The programs and surveys to be implemented include:

- Water quality monitoring
- Invasive marine pest surveys.

Water Quality Monitoring

The water quality monitoring program for the QCLNG Construction Dock will combine nephelometers, continually recording chemical parameters, weekly sampling for water chemistry, light, total suspended solids and depth profiled physical and chemical parameters.

Monitoring sites will be established at 5 locations; three defined as sensitive locations and two as reference sites. Existing PCIMP sites will be used as reference sites. Sensitive locations are located as close as possible (balanced against logistic constraints and leverage off the long-term PCIMP dataset) to existing seagrass meadows where modelling predicted that impacts may occur (***Figure 8-1***). Coordinates for monitoring locations are provided in ***Table 6***.



Legend

- Coastal Seagrass, 2002 baseline
- Bathymetric contours

Sampling Site

- Impact Site
- Intermediate Site
- Reference Site

Source:
Cadastral Data - MapInfo StreetPro
Seagrass distribution produced by Queensland Department of Primary Industries and Fisheries, 2002
Bathymetry Data: Gladstone Ports Corporation

Projection: UTM MGA Zone 56 Datum: GDA 94

0 1 2 4 6 km

N

QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title: QCLNG Construction Dock Water Quality Sampling Locations
	Client	QGC - A BG Group business	
SINCLAIR KNIGHT MERZ SKM	Drawn KP	**Figure 8-1**	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. QGC does not warrant the accuracy of any such Maps and Figures.
	Approved PF	File No: 0008_CI_GIS058_R0	
	Date 23/03/10	Revision 0	

Table 6: Coordinates of Water Quality Monitoring Sites

Site	Type	Coordinates (WGS84)
QE4	Impact	S23 44.661, E151 9.782
P14	Impact	S23 45.891, E151 10.803
BG10	Impact (sedimentation)	S23 47.729, E151 14.146
P2	Reference	S23 48.514, E151 12.950
P5	Reference	S23 47.403, E151 18.215

At each location a multiprobe Nephelometer will be deployed, mounted on a special marker (Harbour Master Approved), such that they are suspended in the water column at approximately 1.5 m from the surface. These units will continuously measure temperature, conductivity, dissolved oxygen, pH, and turbidity. All parameters will be recorded at 15 minute intervals and a telemetry unit will transmit data to a secure site every hour. Loggers will be calibrated during weekly monitoring.

Data will be statistically analysed to remove erroneous data points before being exported to a database to calculate a 10 day rolling median of turbidity (as NTU). Data recorded from Impact Sites will be adjusted to account for background recordings at the Reference Sites. These adjusted rolling NTU averages will be used to assess exceedances of trigger values (***Section 7.2***).

Following an exceedance which has invoked a management response, management strategies will not be lifted before a consistent downward trend in the 10 day rolling average has been observed.

Weekly monitoring will also be conducted at the same locations. Measurements for weekly monitoring will include:

1) Depth profiling of water chemistry parameters.

   Water chemistry will be recorded using a YSI6820 multi-parameter water meter. Parameters will be measured at all sites at 0.5 m intervals to the benthic surface.

2) Sedimentation.

   Sediment traps will be deployed at BG10 to measure gross sedimentation rates. The traps will be suspended approximately 3 m below the surface.

Table 7: Summary of baseline water quality monitoring program

Analysis	Parameters	Frequency
Physico-chemistry	Nephelometer (temperature, conductivity, dissolved oxygen, pH, turbidity, ORP)	Continual logging at 15 minute intervals; telemetered data transmitted at hourly intervals.
	Depth profiling (temperature, conductivity, dissolved oxygen, pH, turbidity, ORP)	Weekly
Water Analysis	Total Suspended Solids (TSS)	Weekly
	Gross sedimentation rates (**BG10 only**)	Weekly

Invasive Marine Pest Management and Monitoring

Vessel Inspections

An introduction of Introduced Marine Species (IMS) could, in the worst case, lead to irreversible impacts to the composition and function of the ecosystem through competition, predation, or habitat modification.

The key vectors for IMS on dredger vessels and associated immersible equipment requiring management attention include:

- Biofouling on vessel hulls and other external niches (such as propulsion units, steering gear and thruster tunnels)
- Biofouling of vessels' internal niches (such as sea chests, strainers, seawater pipe work, anchor cable lockers and bilge spaces)
- Biofouling on equipment that routinely becomes immersed in water (including but not limited to dredging equipment, cutters, ladders, and deck mounted tender vessels)
- Discharge of high risk ballast water.

A detailed risk assessment procedure has been developed to assess the likelihood of a particular contracted vessel and/or immersible equipment being infected by IMS prior to undertaking dredging and spoil disposal activities within the proposed project area.

The objective of the risk assessment is to identify the inherent level of IMS threat a contracted vessel or its immersible equipment poses. This will allow GPC to select the most appropriate vessels and immersible equipment and establish management measures to mitigate the identified threats to an acceptable low level.

The three risk categories are:

- LOW – low likelihood of IMS (no additional management measures required)
- UNCERTAIN – likelihood of IMS is not apparent (precautionary approach adopted, additional management measures required)
- HIGH – identified as a potential risk (additional management measures required).

The key risk assessment factors to be considered include:

- Vessel type
- Inspection history
- Internal treatment/inspection history
- Vessel desiccation period during mobilisation
- Presence and age of fouling control coating
- Presence or absence of internal treatment systems
- Internal treatment history
- Climatic region of operation
- Stationary or slow periods of operation and climatic region
- Type of vessel activity
- Adherence to AQIS ballast water requirements.

It should be noted that where there is no intention to operate the vessels and/or immersible equipment within the project area or the vessel and immersible equipment has been sourced locally then there is no requirement to proceed with this risk assessment procedure.

Where IMS inspection is established as the most appropriate course of action, a systematic out-of-water or in-water inspection of the vessel and/or immersible equipment should be undertaken, to specifically inspect for sediment or biofouling containing IMS of concern.

The inspection should be undertaken within seven days of the final vessel departure for the project area.

A suitably qualified marine scientist with experience in biofouling inspections will lead all IMS inspections. In-water inspections must be conducted in water with adequate visibility (as determined by Lead IMS Inspector). The method for in-water inspections is at the discretion of the Lead IMS Inspector and may include, but is not limited to:

- The Lead IMS Inspector undertaking physical inspection
- The Lead IMS Inspector remotely directing divers to undertake the inspection using live audio and visual communications.

Systematic inspections of the external and internal vessel areas will determine:

- Presence, extent and condition of the fouling control coating (FCC) (external areas)
- Presence and condition of internal fouling control systems
- Presence of sediment
- Extent of biofouling
- Presence of IMS of concern.

External hull inspections will include:

- Vessel hull
- All external niche areas (i.e. anodes, propellers, thrusters, sea chests).

Internal vessel inspections will include:

- Deck area and associated equipment (e.g. deck-borne tenders)
- Bilge spaces
- Anchor cable lockers
- Internal seawater cooling systems, to include strainers and strainer boxes.

Where possible, video and/or still images will be taken of all key areas (including external and internal niche areas) of the vessel.

At the completion of the vessel inspection, the Vessel and Immersible Equipment Checklist and Inspection Form must be completed, signed by the Lead IMS Inspector and faxed/emailed to the GPC Site Environmental Superintendent as soon as possible but within 24 hours of completing the inspection.

In-water inspections may need to be followed by an out-of-water inspection or other management measures, where the in-water inspection detects high levels of secondary or tertiary biofouling to the extent that detection/identification of IMS of concern cannot be achieved to a satisfactory level of confidence. This requirement will be determined by the Lead IMS Inspector.

The ballast water logs will also be inspected to confirm compliance with the AQIS Mandatory Ballast Water Requirements.

In the event that sediment or known or suspected IMS are identified, a photograph or video image showing the species will be taken and a sample will be taken and sent for expert taxonomic identification (if found on vessels within Australian waters). It should be noted, however, that the management strategy presented above will apply when suspected marine pest are identified and implementation of the strategy will not depend on the taxonomic identification due to the time required for such the taxonomic study.

At the conclusion of the vessel and immersible equipment risk assessment process, cleaning, treatment and re-inspection requirements, relevant documentation (copies of completed assessment sheets, inspection forms etc.) will be compiled and submitted to the DEEDI, AQIS and GBRMPA.

Documentation may include:

- Vessel history (including FCC certification and cleaning/maintenance history documentation)
- A copy of the completed Risk Assessment Scoring Sheet for each vessel and immersible equipment item
- A copy of the completed Vessel and Immersible Equipment Inspection Checklist and Inspection Form signed by the Lead IMS Inspector
- A copy of the final IMS inspection report (including photographs)

- Correspondence detailing actions undertaken following the initial risk assessment.

8.3 Dredge Spoil analysis

Dredge spoil deposited into the existing Fisherman's Landing reclamation area from the Construction Dock footprint will be sampled and analysed to determine the composition of the dredge spoil in accordance with the State approved QCLNG Acid Sulfate Soil Management Plan (Appendix 4).

The soil sampling program that will be conducted post dredging will be undertaken using an excavator with the samples being taken from the bucket. Eight locations will be sampled and analysed for the following;

- Chromium reducible sulfur
- Total actual acidity
- Metals consisting of – arsenic, cadmium, chromium, nickel, zinc, lead and copper

8.4 Monitoring Schedule

The monitoring activities will occur as follows:

1. Pre-dredging
   a. Water quality monitoring will commence at least 10 days prior to commencement of dredging operations
   b. Invasive Marine Species monitoring will occur prior to the commencement of dredging.
2. During Dredging
   a. Continual logging as well as weekly water quality monitoring at impact and reference sites
3. Post Dredging and Disposal
   a. In the event that results of monitoring activities indicate impacts are greater than were predicted, undertake further survey at relevant impact and reference sites within 12 months of completion. The need for further monitoring past this point will be determined in conjunction with the appropriate regulatory authorities.

8.5 Other Monitoring

The GPC is a member is a member of the Port Curtis Integrated Monitoring Program (PCIMP). PCIMP is conducting long-term 'whole of port' health indicator monitoring project for estuarine and marine environments and has published an ecosystem health report card for the Port of Gladstone and Port Curtis. The report card indicates the health of the waterways in the Port of Gladstone is very good. The report card and the full report document can be viewed at www.pcimp.com.au

GPC will continue to support the regional PCIMP as a monitoring initiative for dredging and sea disposal activities. Studies commenced to date include long term monitoring programs of mangroves and water quality within Gladstone Harbour, bio-monitoring, intertidal monitoring and climate change indicators.

9.0 REPORTING

9.1 General Reporting

Weekly reports to the DWG, including:

- Status of dredging operations
- Progress of water quality monitoring
- Any Level 1 exceedances incurred and actions implemented.

A monitoring report will be prepared and provided within 28 days from a request by the DERM to provide such report, this report shall include:

- Results of the monitoring
- An evaluation or explanation of the data from this monitoring program
- Details of any turtle or marine fauna sightings
- Details of any complaints received, including investigations undertaken, conclusions formed and action taken
- A summary of environmentally significant equipment failures or events
- An outline of corrective actions taken or proposed to reduce environmental harm.

9.2 Exceedance Reporting

If the water quality parameter for turbidity is observed to be above the Level 2 Management trigger then an incident report must be provided to DERM within the required timeframes. The report must contain:

- The date, time and location at which the monitoring was undertaken
- The suspected cause of the exceedance
- Actions taken to prevent further exceedances

To avoid doubt the Level 2 Management trigger value is:

Turbidity: 10 Day rolling average turbidity is greater than 50 NTU.

In the ev^{e}nt that the dredging or spoil disposal activities result in injury or mortality to one or more marine mammals or marine turtles advice of the incident will be provided to DERM immediately on 1300 130 372 and to DSEWPC within 1 business day of detection. As soon as practicable after the initial advice The DERM and DSEWPC will be provided with details of the incident including:

- The date, time and location at which the incident occurred
- Biological details of the fauna (such as species, size and estimated age)
- The suspected cause of the incidence

- Actions taken to prevent further exceedances

9.3 Final Reporting

A report from the bathymetric survey will be submitted to the DERM within three months of completion of works, certifying that the works (including any other associated works) have been constructed in accordance with the approved drawings and these conditions.

APPENDIX 1. – ACKNOWLEDGEMENT LETTER

Queensland Government

Maritime Safety
Queensland

Queensland **Transport**

16th March 2010

Attn. Andrew Tapsall
QGC – A BG Group Business
Level 26, 275 George Street
Brisbane Qld 4000

Dear Sir

Tidal Works Application – Dredge Management Plan for Construction Dock – Curtis Island

As a concurrence agency to the Coastal Protection and Management Act 1995, Maritime Safety Queensland has no objection to the proposal provided the following navigation and marine safety conditions are addressed.

1. The contractor must carry out the dredging works only in the areas according to GPC Drawing 906-007 and reclamation as depicted on GPC Drawing 096-018 included in the Dredge Management Plan received by email dated 23 February 2010.

2. The dredging authority must inform, in writing Maritime Safety Queensland, Regional Harbour Master, Gladstone at least 14 days prior to commencement of the works including the following:

a. The proposed date of commencement of the establishment of plant and commencement of the dredging program.
b. The proposed timetable associated with the works.
c. The name and address of the on-site contractor undertaking the works.
d. The name and telephone number (work and after hours) of a contact for the on-site contractor.

3. The dredging authority must issue any notices or advertisements as required by the Regional Harbour Master.

4. The applicant or his agent must ensure all works, including debris containment, removal and disposal, do not compromise or impede safe navigation.

Maritime Safety Queensland
Level 2, 136 Goondoon Street
PO Box 123
GLADSTONE Q 4680
ABN 13 200 330 520

Our ref E6299 & E6300
Your ref
Enquiries Viv King
Telephone +61 7 4973 1200
Facsimile +61 7 4972 5520
Website www.msq.qld.gov.au

5. Where possible all floating plant/pipelines and mooring for such plant/pipelines shall be kept clear of navigation channels when working or moored, and the moorings shall be marked and lit in accordance with the requirements of the Regional Harbour Master or his representative.

6. All subsea plant and pipelines must not interfere with navigational channels or swing basins, and where they cross such channels or basins must be laid to a depth of 3 metres under the sea bed.

7. The dredging authority must supply, install and maintain, at its own cost, any navigation lights, buoys, marks and any warning signs which the Regional Harbour Master, Gladstone considers necessary. All navigation aids must be constructed and operated in accordance with the requirements of Queensland Transport (Marine Operations).

8. If, for the dredging programme to proceed any navigational aids are required to be relocated, then these will be done on the Regional Harbour Master's requirements at the contractors cost.

9. All flood lighting or other lighting, except navigation lighting, installed on the dredging, plant or equipment must be shielded so as not to cause a navigation hazard to the satisfaction of the Regional Harbour Master, Gladstone.

10. All marine plant and equipment used by the dredging authority must:

    a. Carry the lights and shapes prescribed by The International Regulations for the Prevention of Collision at Sea 1972 and to the satisfaction of the Regional Harbour Master, Gladstone.
    b. Be in Queensland Registration as required by the *Transport Operations (Marine safety) Act 1994* and the *Transport Operations (Marine Safety) Regulations 2004.*
    c. Be fitted with effective silencing devices by the constructing authority to keep noise at a minimum.
    d. Be maintained by the dredging authority to minimise discharge of noxious fumes and pollutants.
    e. All operators of marine plant must hold the appropriate marine certificates of competency as prescribed by the above Act and Regulations.
    f. All dredging plant and equipment operating in the port of Gladstone must report their movements to Gladstone VTS on VHF Channel 13.
    g. All operators of dredging plant and equipment must adhere to their obligations under the *Transport Operations (Marine Pollution) Act 1995* and *Transport Operations (Marine Pollution) Regulations 2008.*

11. The dredging authority must inform the Regional Harbour Master of completion of the works within 14 days of practical completion.

12. The dredging authority must comply with all instructions issued by the Regional Harbour Master, Gladstone or his representatives and the works must be curtailed or cancelled if the Regional Harbour Master, Gladstone recommends such action.

13. The Regional Harbour Master or his representative will be a member for the Technical Advisory Group (TAG).

14. The dredging authority must complete the works within one year from the date of this letter. If construction is not completed, you will need additional or amended comments from the Regional Harbour Master.

Maritime Safety Queensland does not need to be further consulted if all of the above conditions are met.

Yours sincerely

Capt. Peter Marchbank
A/Regional Harbour Master (Gladstone)

Tapsall, Andrew

From: Mayer, Dan
Sent: Friday, 5 March 2010 2:37 PM
To: Tapsall, Andrew
Cc:

Subject: RE: Dredge Management Plan for Construction Dock - Curtis Island

Andrew

Fisheries Queensland has no objections to following a process that involves a dredge management plan. It is understood you are currently discussing this with DERM to deal with their statutory regulation of dredging issues. However we cannot yet comment on detailed matters that might be within the dredge management plan until the final outcome of the EIS process dealing with the development that will require the dredging is determined.

When the Coordinator General has issued a decision on the outcomes of the current significant development EIS process, we can then consider providing more detailed comments if required, although it is anticipated that where appropriate Fisheries Queensland's interests will be dealt with through our referral role/s associated with our state interests.

Our EIS comments are provided through the DEEDI Coordination Unit to deliver a whole of agency response. I understand from our meeting earlier today that you have now received those via the Coordination Unit.

Regards
Dan
Dan Mayer
Manager
Planning & Assessment
Fisheries Queensland
Department of Employment, Economic Development & Innovation

From: Tapsall, Andrew
Sent: Tuesday, 23 February 2010 2:12 PM
To: Mayer, Dan
Subject: Dredge Management Plan for Construction Dock - Curtis Island

Hello Dan

Gladstone Ports Corporation (GPC) is undertaking the dredging of the construction dock on Curtis Island, with QGC providing the technical support to lodge the Dredge Management Plan (DMP). As part of the Dredge Management Plan for ERA 16 (Extractive Activities), QGC requests DEEDI review our proposed Dredging Operation summary.

Please find attached information that addresses:

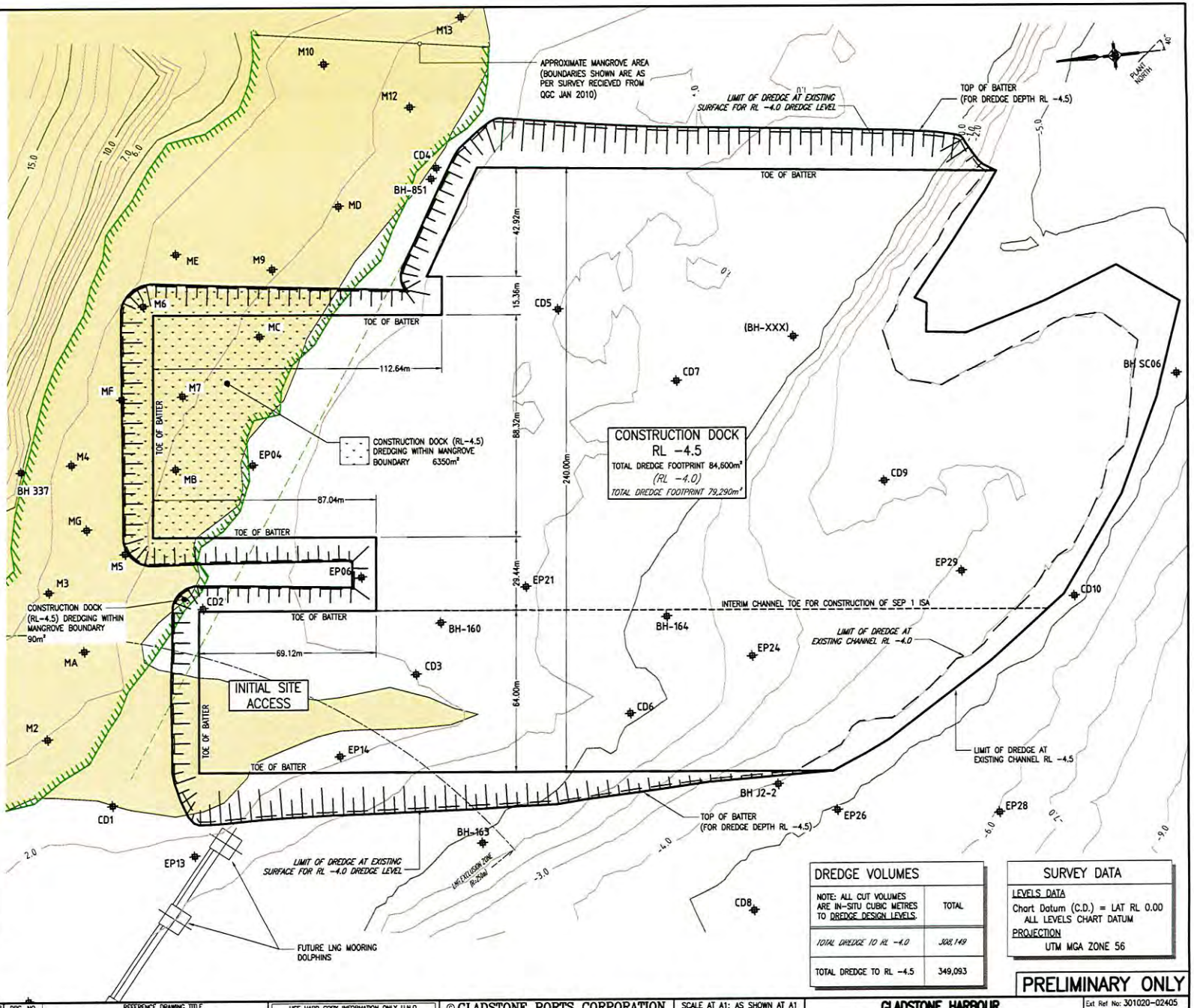
APPENDIX 2. – GEOCHEMICAL CORE LOCATIONS

GEOTECHNICAL BORE HOLE SETOUT DATA

EASTING	NORTHING	BH No	SOURCE
316500.0	7369657.0	BH-29	GOLDER ONSHORE (PHASE 1)
316491.0	7369744.0	BH-30	GOLDER ONSHORE (PHASE 1)
316366.0	7369670.0	BH-31	GOLDER ONSHORE (PHASE 1)
316300.0	7369852.0	BH-32	GOLDER ONSHORE (PHASE 1)
316112.0	7369721.0	BH-48	GOLDER ONSHORE (PHASE 1)
316254.0	7369556.0	BH-49	GOLDER ONSHORE (PHASE 1)
316392.0	7369393.0	BH-52	GOLDER ONSHORE (PHASE 1)
316282.0	7369255.0	BH-100	GOLDER MARINE STRUCTURES
316088.0	7369288.0	BH-101	GOLDER MARINE STRUCTURES
316189.0	7369261.0	BH-104	GOLDER MARINE STRUCTURES
316320.0	7369154.0	BH-105	GOLDER MARINE STRUCTURES
316139.5	7369061.7	BH J2-1	GHD JETTY 2
316374.6	7368854.3	BH J2-2	GHD JETTY 2
316121.8	7368582.9	BH J2-3	GHD JETTY 2
316369.6	7368603.4	BH SC01	GHD SPUR CHANNEL
316520.4	7368682.9	BH SC06	GHD SPUR CHANNEL
316592.0	7368289.1	BH SC07	GHD SPUR CHANNEL
316939.0	7368244.9	BH SC08	GHD SPUR CHANNEL
316849.6	7368557.2	BH SC11	GHD SPUR CHANNEL
316038.8	7368915.6	B15	GHD TURNING BASIN
316529.3	7369135.0	BH 337	GOLDER CURTIS ISLAND
316452.6	7369193.6	BH 336	GOLDER CURTIS ISLAND
316452.4	7368978.5	BH-160	GOLDER MARINE
316364.0	7368971.4	BH-163	GOLDER MARINE
316445.4	7368890.6	BH-164	GOLDER MARINE
316628.1	7368963.8	BH-851	GOLDER MARINE
316551.0	7368830.0	??	FUTURE BORE LOCATION TBA

GEOCHEMICAL BORE HOLE SETOUT DATA

BH No	EASTING	NORTHING	RL U/S M,GRV(LAT)	SOURCE
MA	316456.0	7369118.0	1.95	
MB	316524.0	7369075.0	2.35	
MC	316573.0	7369037.0	1.8	
MD	316621.0	7369001.0	2.4	
ME	316609.0	7369066.0	2.8	
MF	316554.0	7369093.0	2.4	
MG	316504.0	7369112.0	2.55	
M1	316444.5	7369163.9	3	
M2	316422.8	7369135.9	1.85	
M3	316480.6	7369129.3	2.4	
M4	316530.1	7369115.2	2.5	
M5	316492.9	7369098.1	2.35	
M6	316589.9	7369080.8	2.6	
M7	316552.7	7369069.3	1.7	
M8	316948.0	7369006.4	2.5	
M9	316599.1	7369029.3	2	
M10	316677.6	7369000.7	2.05	
M11	316712.0	7368966.1	2.2	
M12	316657.6	7368969.1	1.7	
M13	316690.2	7368945.5	1.5	
CD1	316394.2	7369113.4	2	
CD2	316467.8	7369070.1	2.1	
CD4	316632.2	7368961.4	2.1	
EP4	316051.1	7369373.1	−0.8	
CD3	316433.1	7368990.2		CONSTRUCTION DOCK
CD5	316571.6	7368920.0		CONSTRUCTION DOCK
CD6	316408.7	7368908.7		CONSTRUCTION DOCK
CD7	316538.2	7368877.1		CONSTRUCTION DOCK
CD8	316325.9	7368868.9		CONSTRUCTION DOCK
CD9	316489.9	7368800.8		CONSTRUCTION DOCK
CD10	316436.4	7368731.8		CONSTRUCTION DOCK
CD11	316444.2	7368650.7		CONSTRUCTION DOCK
EP04	316522.5	7369044.9	1.5	JETTY OPTIMISATION
EP06	316473.7	7369007.4		JETTY OPTIMISATION
EP13	316370.8	7369083.6		JETTY OPTIMISATION
EP14	316403.8	7369023.1		JETTY OPTIMISATION
EP21	316463.0	7368944.0		JETTY OPTIMISATION
EP24	316426.3	7368859.1		JETTY OPTIMISATION
EP26	316362.1	7368832.4		JETTY OPTIMISATION
EP28	316354.4	7368769.6		JETTY OPTIMISATION
EP29	316451.1	7368774.5		JETTY OPTIMISATION
EP32	316399.6	7368683.4		JETTY OPTIMISATION



DREDGE VOLUMES	
NOTE: ALL CUT VOLUMES ARE IN-SITU CUBIC METRES TO DREDGE DESIGN LEVELS.	TOTAL
TOTAL DREDGE TO RL −4.0	308,149
TOTAL DREDGE TO RL −4.5	349,093

SURVEY DATA

LEVELS DATA
Chart Datum (C.D.) = LAT RL 0.00
ALL LEVELS CHART DATUM

PROJECTION
UTM MGA ZONE 56

PRELIMINARY ONLY

15 0 15 30 45 60 75
SCALE OF METRES 1:750

NO.	DRN	DATE	REVISION DESCRIPTION	APPR	DRG. NO.	REFERENCE DRAWING TITLE
A	MLC	24.2.10	ISSUED FOR INFORMATION			REFER TO PLAN 906-008 FOR REFERENCE DRAWING TITLES
B	MLC	24.2.10	CONSTRUCTION DOCK AND MANGROVE AREAS ADDED TO PLAN			
C	MLC	25.2.10	REVISED CONSTRUCTION DOCK LAYOUT INCORPORATED, VOLUMES/AREAS REVISED			

AUTOCAD DATED

USE HARD COPY INFORMATION ONLY U.N.O.
ELECTRONIC CAD FILE ACCURACY IS NOT GUARANTEED.

3RD ANGLE PROJECTION U.N.O.
ALL DIMENSIONS IN MILLIMETRES U.N.O.
DO NOT SCALE

* SIGNATURES ON ORIGINAL DRG.

SCALE AT A1: AS SHOWN AT A1

DRAWN*	MLC	18.01.10
CHECK*	SL	
DESIGN*	SL	
APPROVE*		

GLADSTONE HARBOUR
PROPOSED EARLY WORKS DREDGING CONSTRUCTION DOCK
PROPOSED DREGDING, VOLUMES AND BORE HOLE PLAN

Ext Ref No: 301020-02405
GPC DRAWING No.
906-DEWHA1
A1 | Work Order No: CS090304 | REV. C

APPENDIX 3. – GEOCHEMICAL ANALYSIS

REPORT OF BOREHOLE: BH-100

SHEET: 1 OF 5

CLIENT:	Bechtel Australia	COORDS: 316280.6 m E 7369253 m N 56 MGA94	DRILL RIG: Rason 300 on Barge
PROJECT:	QCLNG	SURFACE RL: -0.85 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: SRT DATE: 28/2/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 33.53 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		0	-0.85	SPT 0.00-1.05m RW/1050mm			CH	CLAY High plasticity, grey to dark grey, some organics and shell fragments, wet, very soft	W	VS	NOTE: "ASS Sample" indicates disturbed sample collected for Acid Sulfate Soil testing. ASS Sample 0.00 - 0.25m ASS Sample 0.25 - 0.50m
			1		U50 1.50-1.90m							ASS Sample 1.50 - 1.60m
				1.80 -2.65				GC	Clayey GRAVEL Fine to coarse, subangular to angular, grey and brown, wet, very dense		VD	
			2		SPT 2.00-2.28m 11,30/125mm							
				2.80 -3.65				CH	Silty CLAY High plasticity, grey and brown, trace fine to medium gravel, moist, very stiff to hard			
			3		U50 3.00-3.30m PP = 500 kPa							
			4	4.10 -4.95	SPT 4.00-4.26m 22,30/105mm				. some zones tending to extremely low strength mudstone, pale grey and red brown, no gravel, relict rock structure	M	VSt-H	
			5		SPT 5.50-5.95m 5,7,11 N = 18							
			6									
			7	7.00 -7.85	SPT 7.00-7.45m 11,13,19 N = 32				. pale grey, red brown, and yellow brown			
			8		SPT 8.50-8.95m 17,20,27 N = 47							
			9									
			10	10.00								

REPORT OF BOREHOLE: BH-100

SHEET: 2 OF 5

CLIENT: Bechtel Australia
PROJECT: QCLNG
LOCATION: Curtis Island
JOB NO: 087632063

COORDS: 316280.6 m E 7369253 m N 56 MGA94
SURFACE RL: -0.85 m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 100/76 mm HOLE DEPTH: 33.53 m

DRILL RIG: Rason 300 on Barge
DRILLER: Shine Drilling
LOGGED: SRT DATE: 28/2/09
CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		10	-10.85	SPT 10.00-10.30m 16,30/150mm			CH	Silty CLAY (EW MUDSTONE) High plasticity, pale grey, red brown, and yellow brown, moist, very stiff to hard	M	VSt-H	
			11		SPT 11.50-11.95m 6,9,13 N = 22							
			12	12.00 -12.85					. relict rock structure and jointing			
			13		SPT 13.00-13.45m 6,13,18 N = 31							
			14		SPT 14.50-14.95m 6,12,22 N = 34							
			15									
			16		SPT 16.00-16.45m 10,15,28 N = 43							
				16.50 -17.35					. hard below approximately 16.5m		H	
			17									
			18		SPT 17.50-17.95m 7,13,22 N = 35							
			19		SPT 19.00-19.44m 9,18,30/140mm							
				19.30 -20.15					MUDSTONE Pale grey and yellow brown, extremely low strength			
			20									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-100

SHEET: 3 OF 5

CLIENT:	Bechtel Australia	COORDS: 316280.6 m E 7369253 m N 56 MGA94	DRILL RIG: Rason 300 on Barge
PROJECT:	QCLNG	SURFACE RL: -0.85 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: SRT DATE: 28/2/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 33.53 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		20						MUDSTONE Pale grey and yellow brown, extremely low strength			
					SPT 20.50-20.78m 18,30/125mm							
			21									
			22		SPT 22.00-22.28m 19,30/125mm							
			23									
					SPT 23.50-23.79m 19,30/140mm							
			24									
			25		SPT 25.00-25.25m 21,30/100mm							
			26	26.10 -26.95					, becoming very low strength below approximately 26.1m			
					SPT 26.50-26.72m 30/140mm,30/70mm							
			27									
			28		SPT 28.00-28.10m 30/100mm							
			29									
				29.59 -30.44	SPT 29.50-29.59m 30/90mm				For Continuation Refer to Sheet 4			
			30									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-100

SHEET: 4 OF 5

CLIENT:	Bechtel Australia	COORDS: 316280.6 m E 7369253 m N 56 MGA94	DRILL RIG: Rason 300 on Barge
PROJECT:	QCLNG	SURFACE RL: -0.85 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: SRT DATE: 28/2/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 33.53 m	CHECKED: DATE:

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR %	RQD %	DEPTH (meters)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	FRACTURE FREQUENCY (Defects per unit metre length) (5, 10, 15, 20, 25, 30)
				20							
				21							
				22							
				23							
				24							
				25							
				26							
				27							
				28							
				29							
					29.59		Continuation of Sheet 3				
NMLC				30	-30.44		MUDSTONE Fine grained, grey	EW			

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-100

SHEET: 5 OF 5

CLIENT:	Bechtel Australia	COORDS: 316280.6 m E 7369253 m N 56 MGA94	DRILL RIG: Rason 300 on Barge
PROJECT:	QCLNG	SURFACE RL: -0.85 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: SRT DATE: 28/2/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 33.53 m	CHECKED: DATE:

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR %	RQD %	DEPTH (meters)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$, MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	FRACTURE FREQUENCY (Defects per unit metre length) (5, 10, 15, 20, 25, 30)
NMLC		100	100	30			MUDSTONE Fine grained, grey	EW			
				31	31.40						
		27	0		-32.25		CORE LOSS				
				32	32.50						
NMLC		100	0		-33.43		MUDSTONE (Not Cored) SPT Sample MUDSTONE Fine grained, grey	EW		32.50-32.58m: SPT, 30/75mm	
				33	33.45		MUDSTONE (Not Cored) SPT Sample END OF BOREHOLE @ 33.53 m			33.45-33.53m: SPT, 30/80mm	
				34							
				35							
				36							
				37							
				38							
				39							
				40							

REPORT OF BOREHOLE: BH-104

SHEET: 1 OF 3

CLIENT:	Bechtel Australia	COORDS: 316191.2 m E 7369260 m N 56 MGA94	DRILL RIG: Rason 300 (Barge)
PROJECT:	QCLNG	SURFACE RL: -1.01 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: LCM DATE: 14/3/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 24.58 m	CHECKED: NAC DATE: 19/3/09

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L	Tidal above surface	0	-1.01	U75 0.00-0.50m PP = 50 kPa			CH	Silty CLAY High plasticity, grey, some shells, wet, very soft to soft	W	VS-S	
			1		FV 0.90m Sv = 13 kPa Sr = 4 kPa							
					U75 1.50-2.00m PP = 140 kPa							
				1.80 -2.81					. becoming moist, stiff below approximately 1.8m		St	
			2		SPT 2.00-2.45m 1,3,5 N = 8							
			3									
	M			3.30 -4.31					. becoming brown and grey, very stiff below approximately 3.3m			
					U50 3.50-3.95m PP = 210 kPa						VSt	
			4									
			5		SPT 5.00-5.45m 6,13,21 N = 34							
				5.20 -6.21				CI-CH	Silty CLAY (EW MUDSTONE) Medium to high plasticity, pale grey and orange brown, some fine to medium gravel, relict rock structure, moist, hard	M		
				6.00 -7.01					. grading to extremely low strength mudstone in places above approximately 9.0m		H	
	M-H		6		SPT 6.50-6.64m 30/140mm							
			7									
			8		SPT 8.00-8.25m 30,30/95mm							
			9									
					SPT 9.50-9.95m 11,20,30 N = 50							
			10									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-104

SHEET: 2 OF 3

CLIENT: Bechtel Australia
PROJECT: QCLNG
LOCATION: Curtis Island
JOB NO: 087632063

COORDS: 316191.2 m E 7369260 m N 56 MGA94
SURFACE RL: -1.01 m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 100/76 mm HOLE DEPTH: 24.58 m

DRILL RIG: Rason 300 (Barge)
DRILLER: Shine Drilling
LOGGED: LCM DATE: 14/3/09
CHECKED: NAC DATE: 19/3/09

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	M-H		10					CI-CH	Silty CLAY (EW MUDSTONE) Medium to high plasticity, pale grey and orange brown, some fine to medium gravel, relict rock structure, moist, hard			
			11	11.00 -12.01	SPT 11.00-11.45m 6,12,15 N = 27				, pale grey and brown below approximately 11.0m			
			12		SPT 12.50-12.95m 6,10,15 N = 25					M	H	
			13									
			14		SPT 14.00-14.45m 10,14,20 N = 34							
			15	15.50 -16.51	SPT 15.50-15.93m 12,19,30/125mm				MUDSTONE Pale grey and brown, extremely low strength			
			16									
			17		SPT 17.00-17.29m 21,30/140mm							
			18	18.50 -19.51	SPT 18.50-18.74m 24,30/90mm				, becoming extremely low to very low strength below approximately 18.5m			
			19									
			20	20.00								

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-104

SHEET: 3 OF 3

CLIENT: Bechtel Australia
PROJECT: QCLNG
LOCATION: Curtis Island
JOB NO: 087632063

COORDS: 316191.2 m E 7369260 m N 56 MGA94
SURFACE RL: -1.01 m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 100/76 mm HOLE DEPTH: 24.58 m

DRILL RIG: Rason 300 (Barge)
DRILLER: Shine Drilling
LOGGED: LCM DATE: 14/3/09
CHECKED: NAC DATE: 19/3/09

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	H		20	-21.01	SPT 20.00-20.45m 16,24,30/145mm				MUDSTONE Pale grey and brown, extremely low strength . becoming low strength below approximately 20.0m			
			21									
					SPT 21.50-21.56m 30/55mm							
			22									
			23		SPT 23.00-23.08m 30/75mm							
			24									
				24.58	SPT 24.50-24.58m 30/80mm				END OF BOREHOLE @ 24.58 m			
				-25.59								
			25									
			26									
			27									
			28									
			29									
			30									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-105

SHEET: 1 OF 3

CLIENT:	Bechtel Australia	COORDS: 316321.5 m E 7369152.2 m N 56 MGA94	DRILL RIG: Rason 300 on Barge
PROJECT:	QCLNG	SURFACE RL: -1.16 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: SRT/LCM DATE: 4/3/09
JOB NO:	087632063	HOLE DIA: 100 mm HOLE DEPTH: 25.42 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L	Tidal above bed level	0	-1.16	SPT 0.00-0.50m RW/500mm			CH	CLAY High plasticity, grey to dark grey, some organics and shell fragments, wet, very soft	W	VS	NOTE: "ASS Sample" indicates disturbed sample collected for Acid Sulfate Soil testing. ASS Sample 0.00 - 0.20m ASS Sample 0.40 - 0.50m
			1		U75 0.50-1.00m PP = 0-10 kPa							
				1.50								
				-2.66	FV 1.40m Sv = 15 kPa			GC	Clayey GRAVEL Fine to medium, subangular to angular, brown, high plasticity clay, moist to wet, medium dense	M-W	MD	
			2		U50 2.50-2.70m							
					SPT 2.70-3.15m 3,4,12 N = 16							ASS Sample 2.70 - 2.80m
			3	3.20								
				-4.36					. becoming gravelly clay			
				3.50								
				-4.66				CH	Silty CLAY High plasticity, pale grey and brown, trace fine to medium gravel, moist, very stiff to hard			
			4		U50 4.00-4.40m PP = >600 kPa							
	M		5									
					SPT 5.50-5.95m 11,15,19 N = 34							
			6									
				6.50								
				-7.66					. relict rock structure below approximately 6.5m	M	VSt-H	
			7		SPT 7.00-7.40m 18,28,30/100mm							
			8									
				8.50								
				-9.66	SPT 8.50-8.95m 8,8,10 N = 18				. pale grey and red brown			
			9									
			10	10.00								

REPORT OF BOREHOLE: BH-105

SHEET: 2 OF 3

CLIENT: Bechtel Australia
PROJECT: QCLNG
LOCATION: Curtis Island
JOB NO: 087632063

COORDS: 316321.5 m E 7369152.2 m N 56 MGA94
SURFACE RL: -1.16 m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 100 mm HOLE DEPTH: 25.42 m

DRILL RIG: Rason 300 on Barge
DRILLER: Shine Drilling
LOGGED: SRT/LCM DATE: 4/3/09
CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	M		10	-11.16	SPT 10.00-10.45m 4,6,8 N = 14			CH	Silty CLAY High plasticity, pale grey and red brown, trace fine to medium gravel, relict rock structure, moist, very stiff to hard	M	VSI-H	
			11		SPT 11.50-11.95m 5,8,12 N = 20							
			12		U50 12.00-12.40m PP = 280 kPa							
			13		SPT 13.00-13.45m 4,8,11 N = 19							
			14									
			15		SPT 14.50-14.95m 5,6,11 N = 17							
			16		U50 16.00-16.25m PP = 300 kPa							
				16.70 -17.86	SPT 16.50-16.95m 12,19,24 N = 43				MUDSTONE Pale grey and orange brown, extremely low strength			
			17		SPT 17.50-17.95m 9,17,30 N = 47							
			18									
			19		SPT 19.00-19.43m 11,22,30/125mm							
			20									

REPORT OF BOREHOLE: BH-105

SHEET: 3 OF 3

CLIENT: Bechtel Australia
PROJECT: QCLNG
LOCATION: Curtis Island
JOB NO: 087632063

COORDS: 316321.5 m E 7369152.2 m N 56 MGA94
SURFACE RL: -1.16 m DATUM: AHD
INCLINATION: -90°
HOLE DIA: 100 mm HOLE DEPTH: 25.42 m

DRILL RIG: Rason 300 on Barge
DRILLER: Shine Drilling
LOGGED: SRT/LCM DATE: 4/3/09
CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	M		20						MUDSTONE Pale grey and orange brown, extremely low strength			
					SPT 20.50-20.95m 9,16,30 N = 46							
			21									
			22		SPT 22.00-22.44m 12,26,30/135mm							
			23									
					SPT 23.50-23.78m 15,30/130mm							
			24									
			25		SPT 25.00-25.42m 12,23,30/120mm							
				25.42 -26.58					END OF BOREHOLE @ 25.42 m			
			26									
			27									
			28									
			29									
			30									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-336

SHEET: 1 OF 5

CLIENT:	Bechtel Australia	COORDS: 316452.6 m E 7369193.6 m N 56 MGA94	DRILL RIG: Hydrapower Scout
PROJECT:	QCLNG, Phase 2	SURFACE RL: 3.37 m DATUM: AHD	DRILLER: Drillsure
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: MP DATE: 13/7/09
JOB NO:	097632017	HOLE DIA: 100/76 mm HOLE DEPTH: 36.95 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L	Groundwater not encountered above 2.0m. Drilling water introduced at 2.0m.	0	3.37	DS 0.20-0.40m			ML	Clayey SILT Low liquid limit, brown, trace roots, dry	D	H/D	NOTE: "ASS Sample" indicates disturbed sample collected for Acid Sulfate Soil testing. ASS Sample 0.60 - 0.65m
				0.60 2.77	SPT 0.50-0.95m 12,17,22 N = 39			CL/GC	Gravelly CLAY/Clayey GRAVEL Low plasticity clay, fine to medium subangular gravel, mottled red brown, pale grey and orange brown, varying gravel content, dry, hard/dense			ASS Sample 0.90 - 0.95m
			1	1.00 2.37	SPT 1.00-1.25m 22,30/100mm				. very dense in some places below approximately 1.0m		H/D-VD	ASS Sample 1.00 - 1.05m ASS Sample 1.20 - 1.25m
				1.70 1.67	SPT 1.50-1.95m 16,22,7 N = 29			CI-CH/GC	. medium to high plasticity, moist, stiff to very stiff in some places below approximately 1.7m			ASS Sample 1.50 - 1.55m ASS Sample 1.80 - 1.85m
			2		U75 2.00-2.05m PP = 110 kPa SPT 2.05-2.50m 9,18,30/150mm					M	St-H/D-VD	ASS Sample 2.05 - 2.10m ASS Sample 2.45 - 2.50m
	L				SPT 2.70-2.84m 30/140mm							ASS Sample 2.70 - 2.75m ASS Sample 2.79 - 2.84m
			3	3.00 0.37	SPT 3.00-3.45m 16,15,10 N = 25				. coarse subangular gravel in some places below approximately 3.0m			ASS Sample 3.00 - 3.05m ASS Sample 3.20 - 3.26m
				3.50 -0.13	SPT 3.50-3.74m 24,30/90mm			CL	Silty CLAY (EW MUDSTONE) Low plasticity, pale grey and orange brown, some green grey, some sand, relict rock structure, grading to extremely weathered mudstone in some places, dry, hard			ASS Sample 3.50 - 3.55m ASS Sample 3.69 - 3.74m
RD			4		SPT 4.00-4.25m 29,30/100mm							ASS Sample 4.00 - 4.05m ASS Sample 4.20 - 4.25m
	L-M		5									
			6		SPT 5.50-5.93m 19,24,30/130mm					D	H	
			7		SPT 7.00-7.45m 9,14,19 N = 33							
			8									
			9		SPT 8.50-8.95m 12,22,27 N = 49							
			10									

REPORT OF BOREHOLE: BH-336

SHEET: 2 OF 5

CLIENT:	Bechtel Australia	COORDS: 316452.6 m E 7369193.6 m N 56 MGA94	DRILL RIG: Hydrapower Scout
PROJECT:	QCLNG, Phase 2	SURFACE RL: 3.37 m DATUM: AHD	DRILLER: Drillsure
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: MP DATE: 13/7/09
JOB NO:	097632017	HOLE DIA: 100/76 mm HOLE DEPTH: 36.95 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L-M		10		SPT 10.00-10.45m 11,18,21 N = 39			CL	Silty CLAY (EW MUDSTONE) Low plasticity, pale grey and orange brown, some green grey, some sand, relict rock structure, grading to extremely weathered mudstone in some places, dry, hard	D	H	
			11		SPT 11.50-11.95m 9,20,27 N = 47							
			12	12.50 -9.13					MUDSTONE Pale grey and orange brown, extremely low strength		EL	
			13		SPT 13.00-13.25m 20,30/95mm							
			14		SPT 14.50-14.64m 30/140mm							
	M		15									
			16	16.00 -12.63	SPT 16.00-16.07m 30/70mm				. very low to low strength below approximately 16.0m		VL-L	
			17		SPT 17.50-17.58m 30/80mm							
			18									
			19		SPT 19.00-19.15m 30/145mm							
			20	20.00								

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01a RL2

REPORT OF BOREHOLE: BH-336

SHEET: 3 OF 5

CLIENT:	Bechtel Australia	COORDS: 316452.6 m E 7369193.6 m N 56 MGA94	DRILL RIG: Hydrapower Scout
PROJECT:	QCLNG, Phase 2	SURFACE RL: 3.37 m DATUM: AHD	DRILLER: Drillsure
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: MP DATE: 13/7/09
JOB NO:	097632017	HOLE DIA: 100/76 mm HOLE DEPTH: 36.95 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	M		20	-16.63					MUDSTONE Pale grey and orange brown, very low to low strength		VL-L	
					SPT 20.50-20.91m 14,19,30/110mm							
			21									
					SPT 22.00-22.14m 30/140mm							
			22									
			23									
				23.53								
NMLC				-20.16	SPT 23.50-23.53m 30/30mm Core 23.53-24.50m TCR = 0% ROD = 0%				CORE LOSS			
			24	24.50								
RD	F			-21.13	SPT 24.50-24.60m 30/100mm				MUDSTONE Pale grey and orange brown, very low to low strength . medium strength in some places		VL-L	
			25									
			26									
					SPT 26.50-26.53m 30/30mm							
			27									
			28		SPT 28.00-28.08m 30/80mm							
			29									
					SPT 29.50-29.53m 30/30mm							
			30									

GAP gINT FN. F01a
RL2

REPORT OF BOREHOLE: BH-336

SHEET: 4 OF 5

CLIENT:	Bechtel Australia	COORDS: 316452.6 m E 7369193.6 m N 56 MGA94	DRILL RIG: Hydrapower Scout
PROJECT:	QCLNG, Phase 2	SURFACE RL: 3.37 m DATUM: AHD	DRILLER: Drillsure
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: MP DATE: 13/7/09
JOB NO:	097632017	HOLE DIA: 100/76 mm HOLE DEPTH: 36.95 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L		30						MUDSTONE Pale grey and orange brown, very low to low strength . medium strength in some places			
			31	31.00 -27.63	SPT 31.00-31.12m 30/120mm				. becoming dark grey below approximately 31.0m		VL-L	
	H		32	32.50 -29.13	SPT 32.50-32.50m 30/0mm				For Continuation Refer to Sheet 5			
			33									
			34									
			35									
			36									
			37									
			38									
			39									
			40									

REPORT OF BOREHOLE: BH-336

SHEET: 5 OF 5

CLIENT:	Bechtel Australia	COORDS: 316452.6 m E 7369193.6 m N 56 MGA94	DRILL RIG: Hydrapower Scout
PROJECT:	QCLNG, Phase 2	SURFACE RL: 3.37 m DATUM: AHD	DRILLER: Drillsure
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: MP DATE: 13/7/09
JOB NO:	097632017	HOLE DIA: 100/76 mm HOLE DEPTH: 36.95 m	CHECKED: DATE:

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR %	RQD %	DEPTH (meters)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	FRACTURE FREQUENCY (Defects per unit metre length) (5, 10, 15, 20, 25, 30)
				30							
				31							
				32							
					32.50		Continuation of Sheet 4				
NMLC					-29.13		CORE LOSS				
		42	0	33	33.02						
					-29.65		SANDSTONE/Silicified MUDSTONE	DW		33.02-35.50m: Core too fractured for detailed defect description, Sn, FeO	
					33.40		Fine to medium grained, orange brown, green grey and dark grey, highly fractured			33.16m: C, 70°, Pl, Ro, Sn, FeO	
					-30.03		CORE LOSS			33.31m: C, 55°, Ro, Sn, FeO	
		39	0	34	34.25						
					-30.88		SANDSTONE	DW			
							Medium grained, orange brown and green grey, highly fractured				
		100	0		35.00						
				35	35.10		CORE LOSS				
		80	0		-31.73		SANDSTONE	DW			
					35.50		Medium grained, orange brown and green grey, highly fractured				
		90	0		-32.18		CORE LOSS	DW		35.60m: J/V, 75°, Pl, Ro, quartz, Sn, FeO, 3mm thickness	
							SANDSTONE			35.60m: J, 0°, Un, Ro, Sn, FeO	
		100	0	36	36.20		Medium grained, orange brown and green grey, highly fractured			35.67-35.78m: Highly fractured zone consisting of joints dipping at 45° with clay or quartz infill	
					-32.83		CORE LOSS			35.85m: J, 60°, Pl, Ro, Sn, FeO	
					36.45					35.86m: J, 30°, Pl, Ro, Sn, FeO	
		67	13		-33.08		Silicified MUDSTONE	DW		35.87-36.53m: Core too fractured for detailed defect description, Sn, FeO	
							Fine grained, dark grey			36.53-36.62m: Irregular spaced weathered quartz intrusions, subvertical, Sn, FeO, 2-40mm thickness	
					36.95					36.62m: J, 60°, Pl, Sm, Sn, FeO	
				37			END OF BOREHOLE @ 36.95 m			36.65m: Mechanical break	
							Borehole grouted (cement/bentonite) to surface on completion.			36.67m: V, 35°, weathered quartz, Sn, FeO, 1mm thickness	
										36.68m: V, 35°, weathered quartz, 1mm thickness	
				38						36.75m: J, 15°, Un, Ro, Sn, FeO	
										36.83m: J, 55°, Pl, Sm, Sn, FeO	
				39						36.87-36.95m: Core too fractured for detailed defect description, Sn, FeO	
				40							

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

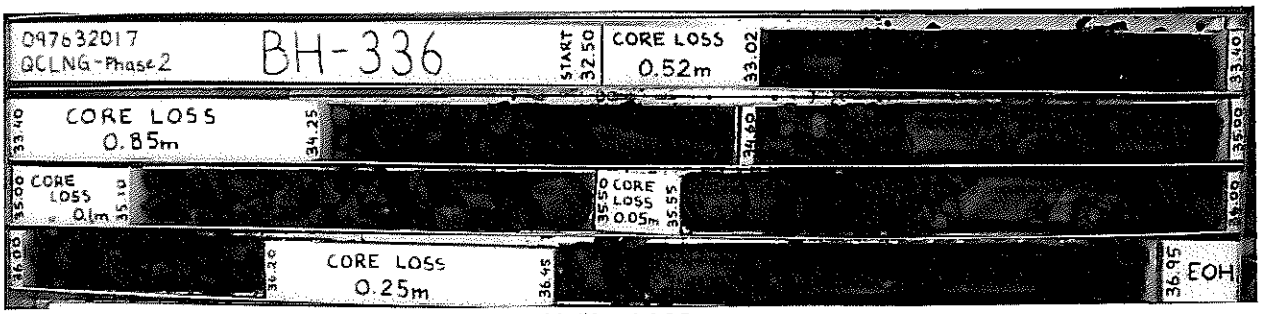
Golder Associates

PRELIMINARY REPORT OF PHOTOGRAPHS: BH-336

CLIENT: Bechtel Australia Pty Ltd
PROJECT: QCLNG, Phase 2
LOCATION: Curtis Island
JOB NO: 097632017

COORDS: 316452.6 mE 7369193.6 mN 56MGA94
SURFACE RL: 3.37 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 36.95 m

DEPTH RANGE: 32.50-36.95 m
DRILL RIG: Hydrapower Scout
DRILLER: Drillsure
LOGGED: MP DATE: 13/7/09
CHECKED: DATE



32.50 – 36.95 m

REPORT OF BOREHOLE: BH-337

SHEET: 1 OF 2

CLIENT:	Bechtel Australia	COORDS: 316529.3 m E 7369135.0 m N 56 MGA94	DRILL RIG: Hydrapower Scout
PROJECT:	QCLNG, Phase 2	SURFACE RL: 1.96 m DATUM: AHD	DRILLER: Drillsure
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: MP DATE: 15/7/09
JOB NO:	097632017	HOLE DIA: 100 mm HOLE DEPTH: 13.00 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L	Groundwater not encountered above 2.0m. Drilling water introduced at 2.0m.	0	1.96	DS 0.20-0.40m			CL	Sandy Silty CLAY Low plasticity, orange brown and yellow brown, dry to moist	D-M	VSI-H	NOTE: "ASS Sample" indicates disturbed sample collected for Acid Sulfate Soil testing. ASS Sample 0.50 - 0.55m
				0.50	SPT 0.50-0.95m 4,7,9 N = 16				. very stiff to hard below approximately 0.5m			
			1	1.46 1.00	SPT 1.00-1.45m 7,10,13 N = 23				. varying sand content, some pale grey, hard below approximately 1.0m			ASS Sample 0.90 - 0.95m ASS Sample 1.00 - 1.05m
				0.96 1.50	SPT 1.50-1.95m 12,16,23 N = 39				. relict rock structure below approximately 1.5m		H	ASS Sample 1.40 - 1.45m
			2	0.46 2.00	SPT 2.00-2.45m 13,26,30/145mm				MUDSTONE/SANDSTONE Yellow brown, orange brown and pale grey, extremely low strength			ASS Sample 2.00 - 2.05m
	L-M				SPT 2.50-2.95m 8,22,22 N = 44							ASS Sample 2.40 - 2.45m ASS Sample 2.50 - 2.55m
RD			3		SPT 3.00-3.45m 10,17,27 N = 44							ASS Sample 2.90 - 2.95m ASS Sample 3.00 - 3.05m
					SPT 3.50-3.95m 12,19,27 N = 46							ASS Sample 3.40 - 3.45m ASS Sample 3.50 - 3.55m
	L		4		SPT 4.00-4.45m 11,22,30/145mm							ASS Sample 3.90 - 3.95m ASS Sample 4.00 - 4.05m
					SPT 4.50-4.92m 13,27,30/120mm							ASS Sample 4.40 - 4.45m ASS Sample 4.50 - 4.55m
			5								EL	ASS Sample 4.87 - 4.92m
					SPT 5.50-5.94m 10,22,30/140mm							
			6									
			7		SPT 7.00-7.11m 30/110mm							
				7.50 -5.55					. very low strength below approximately 7.5m			
	L-M		8		SPT 8.50-8.65m 30/145mm						VL	
				9.00 -7.05					. low strength below approximately 9.0m			
	M		9								L	
			10	10.00								

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-337

SHEET: 2 OF 2

CLIENT:	Bechtel Australia	COORDS: 316529.3 m E 7369135.0 m N 56 MGA94	DRILL RIG: Hydrapower Scout
PROJECT:	QCLNG, Phase 2	SURFACE RL: 1.96 m DATUM: AHD	DRILLER: Drillsure
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: MP DATE: 15/7/09
JOB NO:	097632017	HOLE DIA: 100 mm HOLE DEPTH: 13.00 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	M		10	-8.05	SPT 10.00-10.07m 30/65mm				MUDSTONE/SANDSTONE Yellow brown, orange brown and pale grey, low strength			
			11									
					SPT 11.50-11.55m 30/50mm							
			12									
			13	13.00 -11.05					END OF BOREHOLE @ 13.00 m Borehole discontinued due to completion of field programme. Borehole grouted (cement/bentonite) to surface on completion.			
			14									
			15									
			16									
			17									
			18									
			19									
			20									

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-160

SHEET: 1 OF 3

CLIENT:	Bechtel Australia	COORDS: 316452.4 m E 7368978.5 m N 56 MGA94	DRILL RIG: Rason 300 (Barge)
PROJECT:	QCLNG	SURFACE RL: -0.79 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: CL DATE: 13/7/09
JOB NO:	087632063	HOLE DIA: 100 mm HOLE DEPTH: 26.20 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RT	M	Tidal above bed level	0	-0.79	U75 0.00-0.45m			CI	Silty CLAY	M-W	VS	NOTE: "ASS Sample" indicates disturbed samples collected for Acid Sulfate Soil testing.
				0.20	No recovery				Medium plasticity, dark grey to pale grey and brown orange, some shells, some fine gravel, moist to wet, very soft		St	ASS Sample 0.00 - 0.05m
				-0.99	SPT 0.00-0.45m							ASS Sample 0.30 - 0.35m
				0.50								ASS Sample 0.50 - 0.55m
				-1.29	SPT 0.50-0.95m			CI/ GC	. stiff below approximately 0.2m		St/L	
					3,3,6 N = 9				Gravelly CLAY / Clayey GRAVEL			
			1	1.00					Medium plasticity clay, fine to medium gravel, grey and brown orange, moist, stiff/loose			
				-1.79	U50 1.00-1.30m			CI				ASS Sample 1.00 - 1.05m
					PP = >600 kPa				Silty CLAY (EW MUDSTONE)		H	ASS Sample 1.25 - 1.30m
									Medium plasticity, pale grey and brown orange, moist, hard			
				1.80								
				-2.59	SPT 1.80-2.25m				. some brown, very stiff below approximately 1.8m			ASS Sample 1.80 - 1.85m
			2		9,11,17 N = 28							ASS Sample 2.10 - 2.15m
					SPT 2.80-3.25m					M		ASS Sample 2.80 - 2.85m
			3		9,12,16 N = 28							ASS Sample 3.20 - 3.25m
					SPT 3.80-4.25m						VSt	ASS Sample 3.80 - 3.85m
			4		11,16,25 N = 41							ASS Sample 4.15 - 4.20m
					SPT 4.80-5.25m							ASS Sample 4.80 - 4.85m
			5		13,15,23 N = 38							ASS Sample 4.95 - 5.00m
				6.00								
			6	-6.79					MUDSTONE			
					SPT 6.30-6.54m				Grey and brown orange, extremely low strength			
					22,30/85mm						EL	
			7									
				7.80								
				-8.59	SPT 7.80-7.93m				. very low strength below approximately 7.8m			
			8		30/130mm							
											VL	
			9									
					SPT 9.30-9.40m							
					30/100mm							
			10	10.00								

REPORT OF BOREHOLE: BH-160

SHEET: 2 OF 3

CLIENT:	Bechtel Australia	COORDS: 316452.4 m E 7368978.5 m N 56 MGA94	DRILL RIG: Rason 300 (Barge)
PROJECT:	OCLNG	SURFACE RL: -0.79 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: CL DATE: 13/7/09
JOB NO:	087632063	HOLE DIA: 100 mm HOLE DEPTH: 26.20 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RT	M		10	-10.79					MUDSTONE Grey and orange brown, very low strength		VL	
			11		SPT 10.80-10.95m 30/145mm							
			12		SPT 12.30-12.39m 30/90mm							
			13									
			14		SPT 13.80-13.92m 30/120mm							
			15		SPT 15.30-15.41m 30/110mm							
			16									
			17		SPT 16.80-16.90m 30/100mm							
			18	18.30								
				-19.09	SPT 18.30-18.57m 25,30/115mm				. pale grey and brown orange, extremely low strength below approximately 18.3m		EL	
			19	19.80								
			20	-20.59	SPT 19.80-19.90m				. dark grey and brown orange, very low strength below		VL	

REPORT OF BOREHOLE: BH-160

SHEET: 3 OF 3

CLIENT:	Bechtel Australia	COORDS: 316452.4 m E 7368978.5 m N 56 MGA94	DRILL RIG: Rason 300 (Barge)
PROJECT:	QCLNG	SURFACE RL: -0.79 m DATUM: AHD	DRILLER: Shine Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: CL DATE: 13/7/09
JOB NO:	087632063	HOLE DIA: 100 mm HOLE DEPTH: 26.20 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description			
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG / USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RT	M		20		30/100mm			approximately 19.8m MUDSTONE Grey and orange brown, very low strength		VL	
	H		21		SPT 21.30-21.36m 30/55mm						
			22								
			23		SPT 22.80-22.90m 30/100mm						
	M		24	24.30 -25.09	SPT 24.30-24.39m 30/85mm			. low strength below approximately 24.3m		L	
			25								
			26	25.80 -26.59 26.20	SPT 25.80-26.20m 18,22,30/100mm			. some quartz veins, extremely low strength below approximately 25.8m		EL	
				-26.99				END OF BOREHOLE @ 26.20 m Borehole discontinued due to completion of field programme.			
			27								
			28								
			29								
			30								

REPORT OF BOREHOLE: BH-163

SHEET: 1 OF 5

CLIENT:	Bechtel Australia	COORDS: 316364.0 m E 7368971.4 m N 56 MGA94	DRILL RIG: Fox B40 (Barge)
PROJECT:	QCLNG	SURFACE RL: -2.53 m DATUM: AHD	DRILLER: Schneider Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: BC DATE: 13/7/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 30.50 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	L	Tidal above bed level	0	-2.53	U75 0.00-0.30m			CH	Silty CLAY	W	VS	NOTE: "ASS Sample" indicates disturbed samples collected for Acid Sulfate Soil testing.
				0.20	PP = 150 kPa				High plasticity, dark grey, some fine to coarse sand, some shells, wet, very soft			ASS Sample 0.00 - 0.10m
	L-M			-2.73					. green grey, moist, stiff below approximately 0.2m		St	ASS Sample 0.25 - 0.30m
				0.70								
				-3.23				CH	Gravelly CLAY			
			1		SPT 1.00-1.45m				High plasticity, grey and pale brown, fine to coarse subangular silicified mudstone and some chert gravel,			ASS Sample 1.00 - 1.05m
					19,25,11 N = 36				varying gravel content, zones of silty clay, moist, very stiff			ASS Sample 1.40 - 1.45m
			2		SPT 2.00-2.42m							ASS Sample 2.00 - 2.10m
					9,25,30/120mm							ASS Sample 2.40 - 2.42m
	M-H		3		SPT 3.00-3.44m							ASS Sample 3.00 - 3.05m
					9,11,30/140mm							ASS Sample 3.35 - 3.44m
			4		SPT 4.00-4.15m							ASS Sample 4.00 - 4.05m
					30/150mm							
			5		SPT 5.00-5.09m					M		ASS Sample 5.00 - 5.05m
					30/90mm							
				5.40								
				-7.93				CH	Silty CLAY (EW MUDSTONE)		VSt	
			6						High plasticity, grey and pale brown, some fine to coarse subangular very high strength chert gravel, moist, very stiff			
									. grading to weathered mudstone, near vertical bedding in locations			
			7		SPT 6.50-6.74m							
					21,30/90mm							
	M		8		SPT 8.00-8.45m							
					10,14,20 N = 34							
			9									
					SPT 9.50-9.95m							
					14,25,29 N = 54							
			10	10.00								

This report of borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

REPORT OF BOREHOLE: BH-163

SHEET: 2 OF 5

CLIENT:	Bechtel Australia	COORDS: 316364.0 m E 7368971.4 m N 56 MGA94	DRILL RIG: Fox B40 (Barge)
PROJECT:	QCLNG	SURFACE RL: -2.53 m DATUM: AHD	DRILLER: Schneider Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: BC DATE: 13/7/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 30.50 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	M-H		10	-12.53					MUDSTONE Grey and pale brown, red brown staining on inferred joints, very low strength		VL	
				11.00								
			11	-13.53	SPT 11.00-11.04m 30/40mm				. grading to low strength below approximately 11.0m		L	
				11.60								
				-14.13					For Continuation Refer to Sheet 3			
			12									
			13									
			14									
			15									
			16									
			17									
			18									
			19									
			20									

REPORT OF BOREHOLE: BH-163

SHEET: 3 OF 5

CLIENT:	Bechtel Australia	COORDS: 316364.0 m E 7368971.4 m N 56 MGA94	DRILL RIG: Fox B40 (Barge)
PROJECT:	QCLNG	SURFACE RL: -2.53 m DATUM: AHD	DRILLER: Schneider Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: BC DATE: 13/7/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 30.50 m	CHECKED: DATE:

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR %	RQD %	DEPTH (meters)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	FRACTURE FREQUENCY (Defects per unit metre length) (5, 10, 15, 20, 25, 30)
				10							
				11							
					11.60		Continuation of Sheet 2				
NMLC		100	14	12	-14.13		MUDSTONE Fine grained, pale brown, some zones/veins of grey, very high strength silicified mudstone	DW		11.60-12.30m: Very high strength, fine to coarse subangular silicified mudstone gravel within extremely weathered mudstone/clay matrix 12.45m: J, 45°, Pl, Sm, Vr, silty clay 12.55-12.70m: J, 0-10°, Un, Sm, Cn, 30-80mm spacing 12.75-12.90m: Recovered as broken core 12.95m: J, 0°, Pl, Sm, Cn 13.00m: J, 0°, Pl, Sm, Cn 13.01-13.15m: Recovered as broken core 13.20-13.60m: Recovered as gravel with soft clay matrix 13.65m: J, 0°, Un, Sm, Cn 13.70-13.75m: Recovered as broken core 13.85m: J, 50°, Pl, Sm, Sn, FeO 13.94m: J, 0°, Un, Ro, Cn 14.00m: J, 30°, Pl, Sm, Cn 14.07m: J, 40°, Pl, Sm, Cn 14.08-14.14m: Fractured silicified mudstone seam 14.20-14.55m: Recovered as sandy gravel 14.60-16.00m: Highly fractured silicified mudstone zone 15.20-15.40m: J, 70°, Pl, Sm, Sn, FeO, closed 15.50-15.80m: Recovered as broken core 15.85-16.00m: numerous J, 30-60°, Pl, Sm, Sn, FeO, 40mm spacing 16.08m: J, 20°, Pl, Sm, Sn, FeO 16.12-16.25m: Recovered as broken core 16.29m: DS, silty clay with mudstone gravel, 20mm thickness 16.37m: DS, 30°, silty clay 16.47-16.57m: Recovered as broken core 16.63m: J, 20°, Pl, Sm, Cn 16.65-16.80m: Recovered as broken core 16.80-16.90m: Silicified mudstone gravel in weakly cemented matrix 16.94m: DS, 80°, silty clay 17.05-17.25m: numerous J, 70°, Pl, Sm, Sn, FeO, 50mm spacing 17.13m: J, 20°, Un, Sm, Cn 17.24-17.45m: Recovered as broken core with seams of very low strength mudstone 17.45-18.00m: Wash bored to install casing 18.00-18.40m: Core too fractured for detailed defect description 18.52m: DS, 10°, fine to medium subangular mudstone gravel, 10mm thickness 18.55-18.64m: J, 70°, Pl, Sm, Cn 18.61-18.67m: J, 60°, Pl, Sm, Cn 18.70-18.76m: J, 70°, Pl, Sm, Cn 18.84m: DS, 30°, silty clay, 15mm thickness 18.86-18.95m: J, 60°, Pl, Sm, Cn 19.00-19.25m: Core too fractured for detailed defect description 19.25-19.35m: numerous J, 0°, Un, Sm, Cn,	
		100	0								
		100	0	13							
		100	0								
		100	0	14							
		100	0		14.60		. silicified mudstone zone from 14.6m to 16.0m, grey, highly fractured, iron staining in closed defects				
		100	0		-17.13						
		100	0	15							
		100	0								
		100	0	16							
		100	33								
		100	0	17							
					17.45						
RT					-19.98		MUDSTONE (Not Cored)				
					18.00						
NMLC		100	0	18	-20.53		MUDSTONE Fine grained, pale brown, some zones/veins of grey, very high strength silicified mudstone				
		100	0								
				19							
		100	46		19.35						
					-21.88		Silicified MUDSTONE Fine grained, grey, red brown iron staining in closed/fused joints				
				20	20.00						

REPORT OF BOREHOLE: BH-163

SHEET: 4 OF 5

CLIENT:	Bechtel Australia	COORDS: 316364.0 m E 7368971.4 m N 56 MGA94	DRILL RIG: Fox B40 (Barge)
PROJECT:	QCLNG	SURFACE RL: -2.53 m DATUM: AHD	DRILLER: Schneider Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: BC DATE: 13/7/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 30.50 m	CHECKED: DATE:

Drilling						Field Material Description			Defect Information	
METHOD	WATER	TCR %	RQD %	DEPTH (meters)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	FRACTURE FREQUENCY (Defects per unit metre length) (5, 10, 15, 20, 25, 30)
NMLC		100	0	20	-22.53		Silicified MUDSTONE	DW		10-20mm spacing 19.35-20.30m: numerous J, 50-90°, fused/closed, Sn, FeO 19.53m: J, 20°, Pl, Sm, Sn, FeO 19.61m: J, 10°, Pl, Ro, Sn, FeO 19.75-20.30m: Core too fractured for detailed defect description 20.05-20.30m: numerous J, 60-70°, Pl, Sm, Sn, FeO, 40-80mm spacing 20.10-20.30m: numerous J, 0-10°, Pl, Sm, Sn, FeO, 30-90mm spacing	
					20.30						
		0	0	21	-22.83		CORE LOSS				
				22	22.20						
		100	0	23	-24.73		MUDSTONE Fine grained, pale grey and grey, some seams/veins of very high strength silicified mudstone	DW		22.20-23.00m: Seams of silicified mudstone, 20-80mm thickness, 40-150mm spacing 22.25-23.00m: Core too fractured for detailed defect description, some silicified mudstone gravel 22.41m: J, 60°, Pl, Sm, Cn 23.05m: DS, 40°, silty clay, 5mm thickness 23.15m: J, 30°, Un, Sm, Cn, possible drilling break 23.20-23.40m: Recovered as very high strength silicified mudstone gravel in mudstone matrix	
					23.40						
		20	0	24	-25.93		CORE LOSS				
					24.20						
		100	0		-26.73		Silicified MUDSTONE Fine grained, dark grey, red/brown iron staining in closed/fused joints	DW		24.20-24.57m: numerous J, 10-30°, Pl, Sm, Sn, FeO, 10-40mm spacing 24.25m: J, 40°, Pl, Sm, Sn, FeO 24.58-24.67m: J, 60°, Pl, Sm, Cn 24.61m: J, 30°, Pl, Sm, Cn 24.68m: J, 30°, Pl, Sm, Cn 24.71m: J, 30°, Pl, Sm, Sn, FeO 24.78m: J, 20°, Pl, Sm, Sn, FeO 24.81m: J, 50°, Pl, Sm, Sn, FeO, some fine gravel 25.02m: J, 10-30°, St, Sm, Sn, FeO, possible drilling break along closed/fused joint 25.82m: J, 0°, Un, Sm, Cn, possible drillling break 26.11-26.24m: DZ, very low strength mudstone with silty clay and high strength gravel, 130mm thickness	
		100	80	25							
		100	100	26							
		100	40	27						26.93-27.11m: numerous J, 30-40°, Pl, Sm, Cn, 50-90mm spacing 27.15-27.60m: numerous J, 20-60°, Un, Ro, Sn, FeO, 10-80mm spacing 27.30-27.60m: J, 80°, Un, Ro, Sn, FeO	
		100	62	28						27.93m: DS, silty clay with fine gravel, 20mm thickness 28.05-28.10m: Recovered as highly fractured/gravelly silicified mudstone 28.13m: J, 30°, Pl, Sm, Vr, silty clay 28.28m: J, 10°, Pl, Sm, Cn, some fine gravel 28.33m: J, 40°, Pl, Sm, Sn, FeO 28.50-28.65m: numerous J, 40-50°, Pl, Sm, Sn, FeO, 80mm spacing 28.70m: J, 10°, Un, Sm, Cn 28.79m: J, 10°, Un, Ro, Cn 28.79-28.85m: J, 70°, Pl, Sm, Cn 28.88m: DS, gravelly seam, 20mm thickness 29.01m: DS, silty gravelly seam, 15mm thickness 29.08m: DS, silty gravelly seam, 15mm thickness	
		100	71	29							
				30							

REPORT OF BOREHOLE: BH-163

SHEET: 5 OF 5

CLIENT:	Bechtel Australia	COORDS: 316364.0 m E 7368971.4 m N 56 MGA94	DRILL RIG: Fox B40 (Barge)
PROJECT:	QCLNG	SURFACE RL: -2.53 m DATUM: AHD	DRILLER: Schneider Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: BC DATE: 13/7/09
JOB NO:	087632063	HOLE DIA: 100/76 mm HOLE DEPTH: 30.50 m	CHECKED: DATE:

Drilling						Field Material Description				Defect Information	
METHOD	WATER	TCR %	RQD %	DEPTH (meters)	DEPTH RL	GRAPHIC LOG	ROCK / SOIL MATERIAL DESCRIPTION	WEATHERING	INFERRED STRENGTH $Is_{(50)}$ MPa (EL 0.03, VL 0.1, L 0.3, M 1, H 3, VH 10, EH)	DEFECT DESCRIPTION & Additional Observations	FRACTURE FREQUENCY (Defects per unit metre length) (5, 10, 15, 20, 25, 30)
NMLC				30			Silicified MUDSTONE Fine grained, dark grey, red brown iron staining in closed/fused joints	DW		29.10-29.13m: J, 60°, Pl, Sm, Cn 29.19-29.22m: J, 40°, Pl, Sm, Sn, FeO 29.30-29.35m: J, 70°, Pl, Sm, Sn, FeO 29.45m: J, 50°, Pl, Sm, Cn 29.55m: DS, gravelly seam, 4mm thickness 29.68m: DS, silty gravelly clay, 10mm thickness 29.75-30.10m: numerous J, 60-80°, Pl, Sm, Cn, 50-120mm spacing 29.93m: V, quartz 30.03-30.11m: J, 90°, Pl, Sm, Cn, discontinuous 30.35-30.45m: J, 70°, Pl, Sm, Cn 30.50m: J, 20°, Pl, Sm, Cn	
					30.50		END OF BOREHOLE @ 30.50 m				
				31							
				32							
				33							
				34							
				35							
				36							
				37							
				38							
				39							
				40							

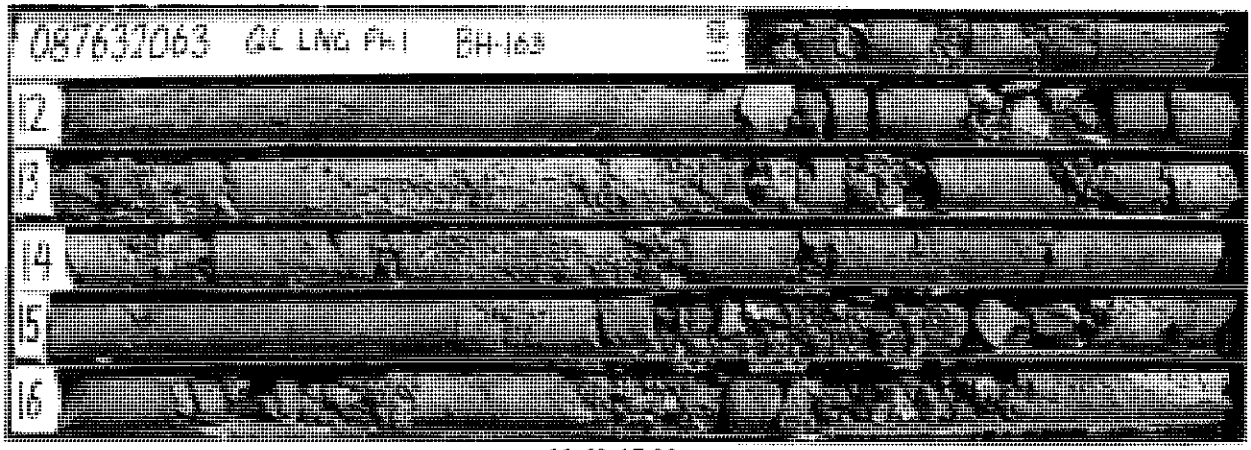
Golder Associates

PRELIMINARY REPORT OF PHOTOGRAPHS: BH-163

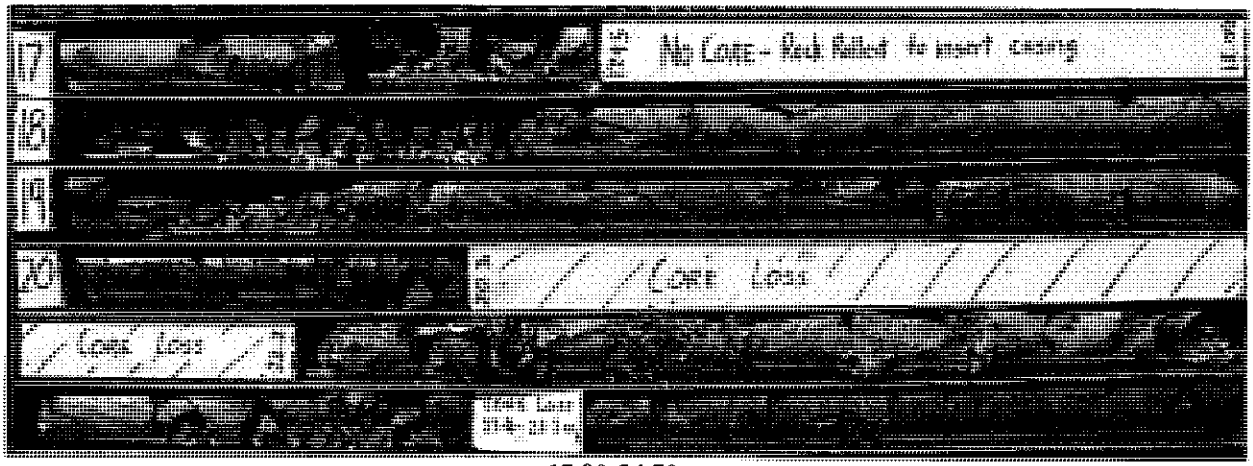
CLIENT: Bechtel Australia Pty Ltd
PROJECT: QCLNG
LOCATION: Curtis Island
JOB NO: 087632063

COORDS: 316364.0mE 7368971.4mN 56 MGA94
SURFACE RL: -2.53 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 30.50m

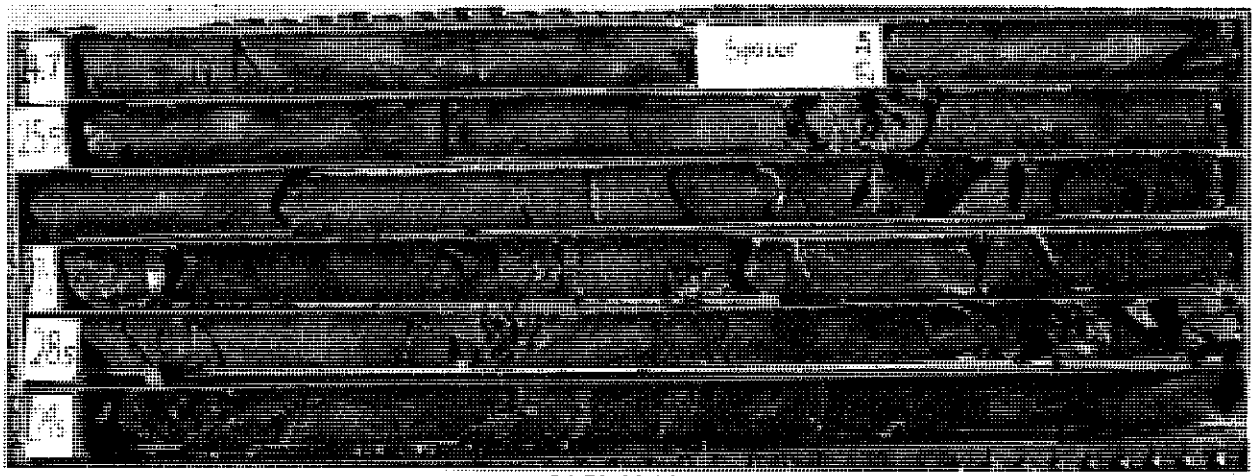
DEPTH RANGE: 11.60-30.50 m
DRILL RIG: Fox B40 (Barge)
DRILLER: Schneider Drilling
LOGGED: BC DATE: 13/7/09
CHECKED: DATE



11.60-17.00 m



17.00-24.70 m



24.70-30.50 m

REPORT OF BOREHOLE: BH-164

SHEET: 1 OF 1

CLIENT:	Bechtel Australia	COORDS: 316445.4 m E 7368890.6 m N 56 MGA94	DRILL RIG: Fox B40 (Barge)
PROJECT:	QCLNG	SURFACE RL: m DATUM: AHD	DRILLER: Schneider Drilling
LOCATION:	Curtis Island	INCLINATION: -90°	LOGGED: BC DATE: 16/7/09
JOB NO:	087632063	HOLE DIA: 100 mm HOLE DEPTH: 2.12 m	CHECKED: DATE:

Drilling					Sampling		Field Material Description				
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USC Symbol	SOIL / ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
RD	H	Tidal above bed level	0	0.15	U75 0.00-0.15m			GM	Silty GRAVEL	W	D	NOTE: Coordinates shown are approximate.
					SPT 0.15-0.41m 23,30/110mm			CI-CH	Fine to coarse, angular chert and silicified mudstone gravel, wet, dense			NOTE: "ASS Sample" indicates disturbed samples collected for Acid Sulfate Soil testing.
									Silty CLAY Medium to high plasticity, pale brown and grey, some fine to coarse subangular mudstone gravel, minor relict rock structure evident, moist, very stiff			ASS Sample 0.00 - 0.10m
			1						. grading to extremely weathered mudstone			ASS Sample 0.35 - 0.41m
RT	M				SPT 1.10-1.24m 30/140mm					M	VSt	ASS Sample 1.20 - 1.24m
			2	2.12	SPT 2.00-2.12m 30/120mm							ASS Sample 2.00 - 2.05m
									END OF BOREHOLE @ 2.12 m Borehole discontinued due to completion of field programme.			
			3									
			4									
			5									
			6									
			7									
			8									
			9									
			10									

APPENDIX 4. – ACID SULFATE SOILS MANAGEMENT PLAN

Acid Sulfate Soil Summary Document
Construction Dock, LNG Facility
QCLNG Project

QCLNG-AUS-PCT-ENV-RPT-0522 AUGUST 2010

☒	**Controlled**	☐	**Uncontrolled**
☒	**Restricted**	☐	**Confidential**

Uncontrolled when printed

DOCUMENT INFORMATION SHEET	
TITLE: Acid Sulfate Soil Summary Document – Construction Dock, LNG Facility	
PURPOSE AND SCOPE: This management procedure to be issued to Contractor(s) involved in the EPC for the Construction Dock at the LNG Facility to guide them in producing integrated ASS management plans for the construction works.	
DOCUMENT VERIFICATION	
Responsible:	
Signature:	**Position:** Construction General Manager
Name: Joe Dougherty	**Date:**
Accountable:	
Signature:	**Position:** Environment Manager - LNG
Name: James MacDermott	**Date:**
Consulted:	
Andrew Tapsall, Rob Bell, Adrian Vlok, Brett Kettle, Randall Byram, Richard Stump, Stephen Lawley, Trevor Graham (GeoCoastal), Paul Marsden (Bechtel), Mark Thorsteinsson (Bechtel), Mike Willoughby (GeoCoastal), Ron McMahon (Coffey)	
Informed:	
Andrew Tapsall, Brett Kettle, Randall Byram, Richard Stump, Stephen Lawley, Paul Marsden (Bechtel), Mark Thorsteinsson (Bechtel), Renee Goodwin.	
Endorsed:	
Signature:	**Position:** Manager Environment & Permitting - LNG
Name: Rob Bell	**Date:**

Revision Record

Issue	Date	Reason for Issue	Responsible	Accountable
1	28 Apr 10	Draft Internal Project Review	Andrew Tapsall	Ken Scheffler
2	30 Apr 10	Issued for Distribution	Joe Dougherty	James MacDermott
3	30 Aug 10	Draft Final Version after QASSIT comments	Richard Stump	

Table of Contents

1. Introduction

1.1 Purpose of this Document

Acid Sulfate Soils (ASS) exist across a large part of sub-tidal, intertidal and shoreline areas of the LNG Facility site on Curtis Island, Queensland. Appropriate management of ASS is required for engineering and environmental reasons.

This document is a Summary Document, developed to:

- provide a guideline to the EPC Contractor(s) undertaking works for the Construction Dock for the development by development of Acid Sulfate Soil (ASS) Management Plan(s);
- identify integration and interface requirements and issues for ASS management and ASS Management Plans (ASSMPs) for works for the Construction Dock;
- highlight any integration and interface issues with ASS management and ASSMPs prepared for other works within the LNG Facility; and
- identify how individual ASSMPs fit into the overall QCLNG Project Acid Sulfate Soil management framework.

1.2 Overall ASS management framework

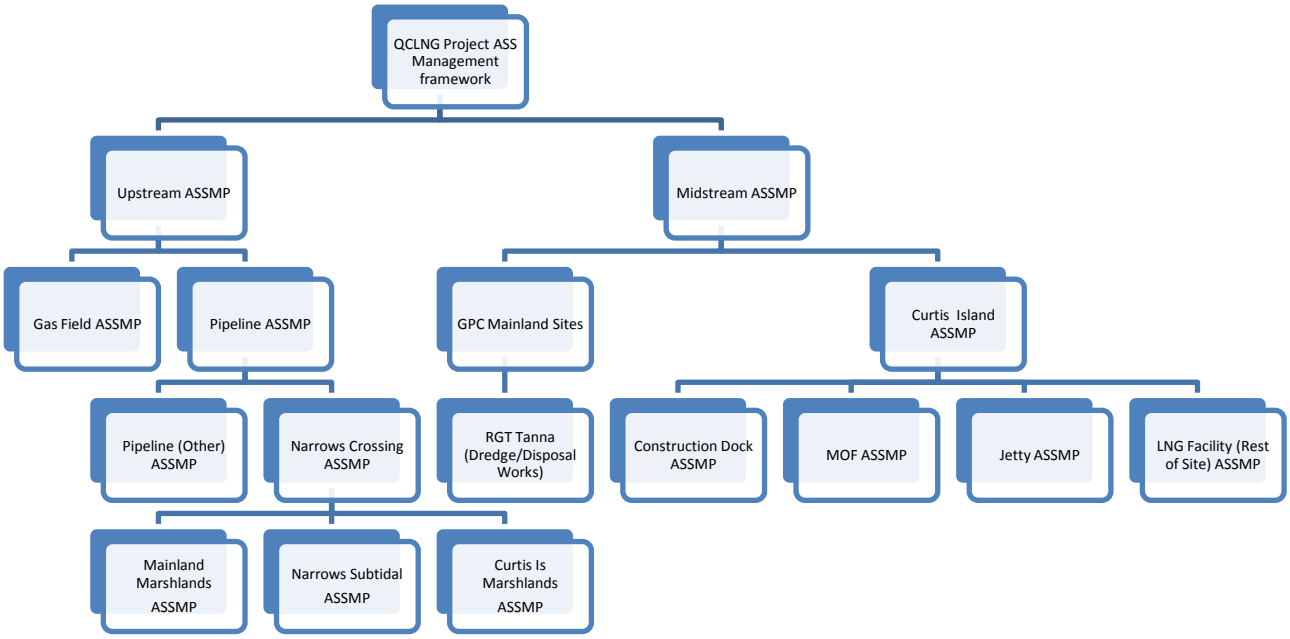
The Queensland Curtis Liquefied Natural Gas (QCLNG) Project is subject to joint environmental impact assessment processes under Queensland and Commonwealth legislation.

The draft Environmental Impact Statement (dEIS) identified ASS management as an important environmental issue for Project construction works in particular to coastal areas including Curtis Island. Chapter 4 of Volume 5 of the dEIS provides an outline of ASS conditions on Curtis Island and Appendix 5.2 provides the results of a detailed ASS Investigation for the LNG Facility site.[1]

A QCLNG Project ASS management framework (QCLNG Project ASSMF) was detailed in the supplementary EIS (sEIS).[2] This Management Procedure, its role and purpose, and relationship to other documentation is detailed in the QCLNG Project ASSMF and is described in *Figure 1* over page.

[1] See QCLNG Project, Draft Environmental Impact Statement at http://qclng.com.au/eis/draft-eis/
[2] See QCLNG Project, Supplementary Environmental Impact Statement, Appendix 2.2. Project ASS management framework at http://qclng.com.au/uploads/docs/sup-eis/app/Appendix-2.2-Project-Acid-Sulfate-Soils-Mng.pdf

Figure 1: QCLNG Project ASS MF



A detailed roadmap of relationship between this document and the associated documentation is illustrated in **Appendix 1.**

1.3 Regulatory Background

This overall ASSMF and associated ASS Management Plans have been prepared in accordance with the following policies:

- Queensland State Planning Policy 2/02 Planning and Managing Development involving ASS and the associated State Planning Policy 2/02 Guidelines
- Soil Management Guidelines chapter of the Queensland Acid Sulfate Soil Technical Manual, 2002
- Legislation and Policy Guide chapter of the Queensland Acid Sulfate Soil Technical Manual, 2004
- Laboratory Methods Guidelines - ASS chapter of the Queensland Acid Sulfate Soil Technical Manual, 2004
- Instructions for the Treatment and Management of ASS, 2001. Qld EPA in consultation with Dept. Natural Resources and Mines, July 2001, Version 1.0.

And with reference to:

- *Integrated Planning Act 1997*
- *Environmental Protection Act 1994*
- *Sustainable Planning Act 2009*
- *Fisheries Act 1994* and *Fisheries Regulation 1995*.

2. Construction Dock development

As a component of the marine infrastructure on Curtis Island, a temporary dock facility (Construction Dock) is required at the commencement of the overall LNG Facility construction to provide initial access to the site and to import preliminary construction materials such as aggregate and rock for roads, foundations and concrete production.

Construction of this facility will entail excavation of sediments both in the immediate offshore and within the intertidal zone to provide vessel access to the facility. The location of the Construction Dock in relation to the QCLNG Facility site is shown in **Figure 2**.

Figure 2 : Site Location

2.1 Site Location and Description

The Construction Dock is within the QCLNG Facility site, located in the Curtis Island Industry Precinct of the Gladstone State Development Area (GSDA). It is located approximately 6 km north-east of the city of Gladstone on the south-western side of Curtis Island immediately north of China Bay (**Figure 2***)*.

The area of the total Construction Dock footprint is approximately ten hectares, of which approximately 1.5 hectares occupies the intertidal zone.

The proposed dock development exploits a prominent shoal extending from the shore, which is shown, in both seismic profiling and from coring analyses, to be founded on a weathered residual extension of the island's geology.

2.2 Configuration & Design

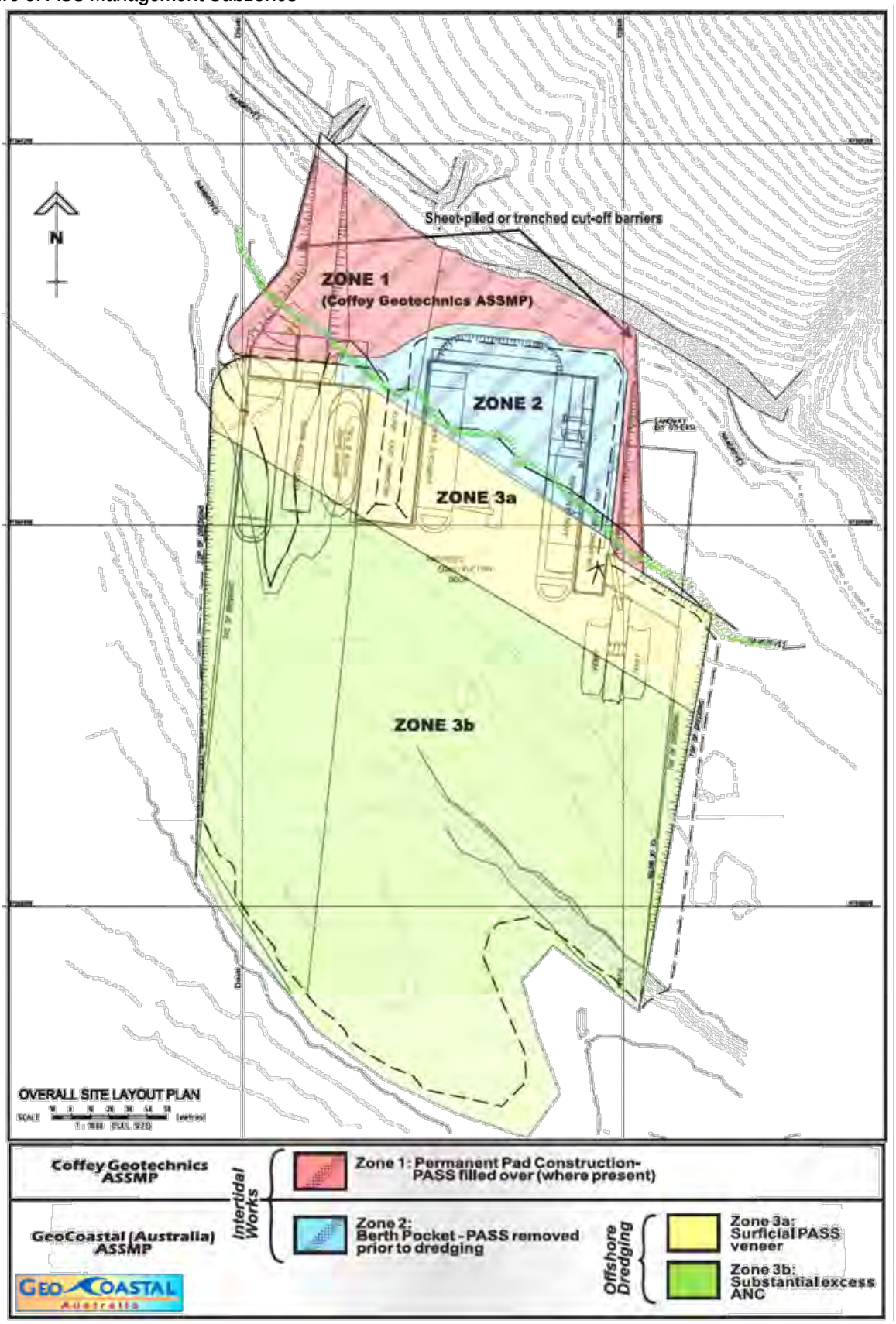
The Construction Dock configuration is a dredged embayment inlet protected by two breakwater/dock structures. The inlet terminates in a broad offloading ramp between the breakwater/dock structures. The breakwater/dock structures consist of a piled perimeter enclosing fill embankments. The design also involves floating docks and mooring piles on either side of the breakwater/dock structures. The dock is connected to the main RL 6.0 embankment by a short earth embankment and a heavy haul road located on residual soils. **Figure** *3* provides a schematic drawing of the proposed Construction Dock layout and configuration.

2.3 Contractors & Contractual Interfaces

QGC has appointed Bechtel Oil, Gas & Chemicals (Bechtel) as the prime contractor to construct the LNG Facility on Curtis Island. Bechtel will appoint a number of subcontractors to undertake a variety of civil and marine construction activities and works.

Dredging works required to provide an access channel to the Construction Dock have been contracted by QGC via Gladstone Ports Corporation (GPC) to the dredging contractor Dredging International (Dredeco). The practical division between Bechtel and Dredeco has been defined as the bulkhead wall of the Construction Dock. Acid sulfate soils exist in both areas of contractual responsibility and each party shall be responsible for managing ASS within their own construction areas and preparing individual ASSMP's. However, because of this contractual and physical interface an ASS Interface Plan will also be prepared to ensure the work is integrated, consistent and the interfaces are carefully managed.

Figure 3: ASS Management Subzones



3. Scope of ASS Responsibility

ASS management for the development of the Construction Dock can be separated into three distinct portions:

1. A sub-tidal dredged zone (to establish marine access).
2. An intertidal dredged zone extending landward to the outer extent of the mangrove fringe.
3. An intertidal/supratidal area which will be filled to create the dock landing and hardstand facilities.

Figure 3 provides a schematic drawing of the proposed Construction Dock layout and the three ASS management zones.

The separate ASS management zones and subzones and the areas of ASS management responsibility is summarised in the table below.

Table 1: Construction Dock ASS Management Responsibility

<table>
<tr><th colspan="5">Construction Dock Acid Sulfate Soils Management Responsibility</th></tr>
<tr><th>Zone</th><th>ASS Subzone</th><th>Client</th><th>ASSMP</th><th>ASSMP Execution</th></tr>
<tr><td>Offshore</td><td>• Zone 3a - Nearshore dredging PASS veneer
• Zone 3b - Offshore dredging : excess ANC*</td><td rowspan="2">QGC</td><td rowspan="2">GeoCoastal
(Appendix 2)</td><td>QGC Dredge Contractor</td></tr>
<tr><td>Intertidal</td><td rowspan="2">• Zone 2 - Berth Pocket: PASS removal
• Zone 1 - Permanent Pad: PASS filled over</td><td rowspan="2">Bechtel</td></tr>
<tr><td></td><td>Bechtel</td><td>Coffey Geotechnics
(Appendix 3)</td></tr>
</table>

*ANC: Acid Neutralising Capacity

Where:

Zone 1 is equivalent to the 3rd portion noted above that is subject to ASS management as described in the Coffey Geotechnics ASSMP (**Appendix 3**). The Coffey Geotechnics ASSMP deals **exclusively** with this intertidal area that will be filled-in, and refers to it as Zone 1.

Zones 2 and 3 are subject to ASS management as detailed in the GeoCoastal ASSMP (**Appendix 2**).

3.1 Zones 2, 3a and 3b

The dredging works footprint has a sub-tidal component and an intertidal-zone component. These two geographic components have also been separated according to the character of the sediments found there and method of sediment removal. Removal of sediment from all of Zone 3 will be via the dredging operations. Surface sediments containing ASS in Zone 2 will be removed via land-based techniques with the underlying non-ASS material subsequently dredged.

The main portion of the excavation footprint (approximately 85%) is sub-tidal with the remaining 15% being in the mangrove-dominated area (**Figure 3**). Acid sulfate analyses of the offshore (Zones 3a and 3b) sediments indicated they were predominantly alkaline (i.e., negative mean Net Acidity) with only low to moderate levels of PASS occurring in a thin surface layer extending approximately 60m immediately offshore from the mangrove boundary (Zone 3a). Investigation of the sedimentary sequence in the mangrove area (Zones 1 + 2) found it mainly comprised high level PASS-bearing, soft, silt/clay sediments (Holocene-aged) to an average depth of approximately 0.85m, overlying stiff, non-ASS substrate clays (pre-Holocene).

The management of ASS within Zones 2, 3a and 3b involving dredging is outlined in more detail in **Appendix *2***.

3.2 Zone 1

The remaining intertidal zone of the Construction Dock footprint is proposed to be filled-in. The berth pocket inlet terminates in a broad offloading ramp between the breakwater/dock structures. The design also involves floating docks and mooring piles on either side of the breakwater/dock structures. The dock is connected to the main RL 6.0 embankment by a short earth embankment and a heavy haul road located on residual soils.

The initial site access (ISA) stage of the Construction Dock will be constructed from both the land side and the water. Following the dredging of an access inlet, sheet/pipe piles will be driven across the top of the inlet where it meets the offloading ramp.

The mangroves and vegetation will be cleared to ground level by mechanical means from the shoreline outwards.

The ISA roadway and fill platforms will be constructed with a combination of rockspalls and geofabric and geogrid materials placed over the surface prior to fill placement to prevent shear failure under the fill. A guard layer of lime will be placed on the surface under the geofabric in areas of proposed fill. Imported gravel or cobble fill will then be placed over the ground reinforcement until a hard standing area above high water level is established.

Once an initial hard standing is established, the embankments will then be constructed by traditional earthworks methods. Fill soils will be placed in thin layers and compacted. Flat batters or the use of geofabrics or geogrid materials will be required in order that shear failure is avoided and there is not heaving at the toe of the fill. Earthworks elements are illustrated in ***Figure 4*** and ***Figure 5*** of this document.

Detailed management of ASS within Zone 1 is addressed in **Appendix 3**.

4. Acid Sulfate Soil Assessment

The occurrence and distribution of ASS within the offshore and intertidal areas of the Construction Dock footprint were investigated and stratigraphically mapped. The relevant information is contained within the following reports:

- *Proposed QCLNG Facility: Offshore Component of MOF, Jetty#1 and Pioneer Dock, Gladstone Queensland - Acid Sulfate Soil and Geomorphological Modelling Report.* September 2009. Prepared for Golder Associates.

- *QCLNG – Construction Dock Program, Gladstone Harbour, Queensland - Acid Sulfate Soil and Geomorphological Modelling Report.* November 2009. Prepared for QGC Ltd.

- *Construction Dock Program: Mangrove Zone Acid Sulfate Soil Investigation: QCLNG Dredging Project, Gladstone, Queensland.* February 2010. Prepared for QGC Ltd.

- *Addendum to the Acid Sulfate Soil Management Plan. QCLNG Construction Dock, Curtis Island, Queensland: Acid Sulfate Soil Assessment of the Treatment Pad Site Reference: 10/ASSMP305.1 Version 1.2 A, May 2010.*

- *Addendum to the Acid Sulfate Soil Management Plan. QCLNG Construction Dock, Curtis Island, Queensland: Re-Evaluation of Acid Neutralising Capacity in Dredge Zone 3a, Reference: 10/ASSMP305.1 Version 1.3 A, June 2010*

Within the mangrove dominated intertidal zone twenty sample locations across a 2.7 hectare area revealed that the sediments can be considered as PASS, and comprise Holocene, organic, soft silty, clay-mud, overlying residual firm to stiff clay (pre-Holocene). The thickness of Holocene PASS material ranged from 0.4m to 1.65m with an average depth of 0.87m across the site. Some inherent PASS was confirmed to occur in the upper pre-Holocene material (as found commonly throughout the QCLNG sediment investigation), accordingly, a depth of 0.25m was proposed for inclusion in the total ASS volume for Management purposes.

Net Acidities ranged from 0.25 to 6.77 %S with mean and median values of 2.19 and 1.87 %S respectively.

Results from sampling and analysis of offshore cores showed that the only sediments to exhibit an overall positive Net Acidity occur as a thin (average 0.5m thickness) surface layer extending approximately 50-60m seaward of the current mangrove line. This is due to the depositional architecture of the area, as derived from the stratigraphic modelling that revealed a prominent shoal of weathered residual material that extends from the shore has significantly impacted on Holocene-age deposition. This has occurred in two ways:

- it has limited the accommodation for the normally high acid sulfate soil-bearing, transgressive mangrove silt/clay sediments that commonly forms the basal unit of the Holocene sequence along this stretch of coast, and

- it has projected the foundation substrate available for receiving Holocene-age sediments into a moderate energy zone that has resulted in a ubiquitous sand and winnowed shell content.

Net Acidity levels recorded within the nearshore zone vary between negative values through low ranging to high categories with a mean value of -0.37 %S. Calculation of this value included samples where Acid Neutralising Capacity of the fine fraction **only**, was measured. The remaining Holocene aged sediments within the proposed excavation footprint exhibited a significant excess neutralizing capacity even when the safety margin, used in calculations, was doubled. This is consistent with sediment characteristics generally found in higher energy zones and in a marine progradational provenance.

A representative suite of pre-Holocene sediments (i.e. depositional and residual) were intersected at different levels on the slope, and only a small group of results, again underlying the characteristic modern nearshore depositional environment, revealed positive Net Acidity (NA). These potentially acidic sediments are dispersed among sediments with negative Net Acidity, and therefore, when recombined during dredging operations, would result in a modest overall net neutralising capacity in spoil from this nearshore zone (NA = -0.04 %S). The mean Net Acidity value for all pre-Holocene sediments tested was -0.31 %S.

In summary, the immediate nearshore area bordering the present mangrove shore is the only area within the offshore Construction Dock area that will require careful ASS management. The great majority of the offshore area has the inherent capability to balance any spot occurrences of latent acid potential with an overwhelming excess neutralising capacity.

5. ASS Risk Assessment

A number of aspects and risks have been considered in developing the detail of the two interfacing ASSMPs, these include:

5.1 Intertidal Civil Earthworks

1. Removal of mangroves, with the potential risks of exposure of the shallow PASS via ground disturbance and PASS adhering to root material.
2. Prevention of PASS oxidation in mangrove sediments entombed beneath the fill platform and adjacent to dredged areas
3. Prevention of PASS oxidation in sediments within mangrove area bordering the Construction Dock development
4. Use of fill soils and rock with low to moderate levels of non-sulfuric acidity.
5. Excavation and treatment of PASS
    - Potential acidity of excavated mangrove muds
    - Seawater quality around the intertidal excavation area
    - Stormwater containment at the treatment site
    - Stockpiling of neutralising agent(s) at the treatment site
6. Filling over PASS
    - Excavation of some PASS material when mucking out of hollow piles
    - Surface disturbances from persons and/or machinery
    - Heave or displacement of ASS under load during construction
    - Expulsion of acidic pore water during settlement

5.2 Dredging

The potential environmental risks associated with the offshore dredging include:

- Potential acidity of dredge spoil
- Quality of dredged sediment and decant water in dredge spoil receival ponds with respect to ASS

6. Management Approaches

6.1 Removal of Mangroves

Within the intertidal subzones mangroves will be removed by machines working from fill platforms built out from the shore.

Mangroves will be cut off above ground with no removal of in-ground roots. Disturbed surfaces are to be limed daily.

Where PASS is to be excavated and treated, ASS in muds attached to mangrove root material will be handled by:

- spreading, drying, and root separation by tyning on the treatment pad, and
- treatment of PASS and woodchip product from the roots with Aglime.

6.2 Use of Residual Soils for Fill

Fill materials excavated from above RL 6m will be lime treated during placement at a specified rate for the basal layer and every vertical metre of fill or part thereof.

6.3 Prevention of Oxidation of in-situ PASS

An low permeable compacted soil plug will be created during removal of PASS that will isolate entombed PASS left in situ from the effects of both dredging excavation and bulkhead construction works (**Figure 5**).

6.4 Treatment of Excavated PASS

PASS will be removed and treated under controlled site conditions, with a small volume from mucking out of piles. The following strategies will carried out:

- All removed PASS to be transferred to the treatment facility for neutralization and validation.
- Treatment facility to incorporate bunded containment of all PASS and leachate, retention pond for treatment of any runoff from PASS and controlled lime storage.

6.5 Expulsion of Pore Water

It has been estimated that the process of settlement of fill over the PASS will result in some 1,000 cubic metres of pore water being expelled through the soils over periods up to approximately 2 years. A lime rich sand will be used as a drainage filter around the downslope perimeter of all fill areas over ASS soils (i.e. in areas below RL 2m, (***Figure 4***). The sand drainage filter specifications are outlined in **Appendix 3** (8.3.2) including an estimated minimum pH of 5.5 as a performance indicator. Details of monitoring for pH levels in the extruded pore water are also outlined in **Table 3B** (downslope toe seepage measured at 2 locations, twice weekly). The proposed corrective actions include; cease construction and modify the design on site to maintain drainage zones, increasing lime applications in drainage zone if pH levels fall below 5.5, construct additional drainage zones, ASS engineer to issue non-conformance reports and then continue construction once the corrective actions are completed (***Table 3B*)**.

6.6 Prevention of Heave

There is potential for the natural soils at the toe of the fill embankments to heave under load (i.e. in areas below RL 2m). This heave can be prevented by appropriate design and construction methods including;

- the use of flat batters so that high loads are not present around the perimeter of the fill
- the use of commercial geofabric or geogrid materials to provide shear strength to the soil surface and prevent failure, and
- the use of sheet/pipe pile walls around the perimeter of the fill platforms (***Figure 3*****).**

6.7 Surface Disturbances

Disturbance and potential oxidation of PASS (where it is present at the surface) by persons and vehicles during earthworks and filling processes is to be limited by adopting measures such as:

- using vehicles with low ground bearing such as tracked machines or vehicles with wide wheels,
- using mats or other temporary access tools to reduce ground pressures, the daily placement of a basal lime layer over any disturbed areas, and
- restriction of construction traffic and people movements to within defined access ways as required by the work.

7. Construction Interface Management

The respective excavation and platform construction stages, and the transition between them are illustrated in ***Figure 4***, ***Figure 5*** and ***Figure* 6** and may be summarised as follows:

7.1 Earthworks Platform Construction

- Trim mangrove to ground level and remove by excavator-mounted attachments ~4m ahead of an advancing earthworks platform.
- Install (between tides) a membrane and gravel layer over the existing PASS surface.
- Advance fill and compact.
- Install fibreglass sheetpile cut-off barriers between the earthworks platform and adjacent mangrove forested areas.

7.2 Preparation of Dredge Pocket

- Trim mangrove to ground level and remove by excavator-mounted attachments ~4m ahead of an advancing earthworks platform.
- Excavate PASS and remove for treatment.
- Advance fill and compact sufficient to support equipment.
- After PASS removal win back excess platform fill to ~0m AHD for later use.

7.3 Cutter-suction dredging of Berth Pocket

- Dredge enters intertidal berth pocket area from which all PASS has been removed.
- After dredging a ~5m compacted earth plug seals the *in-situ* PASS face until installation of sheetpiled bulkheads and further filling.

Figure 4 Modes of Construction

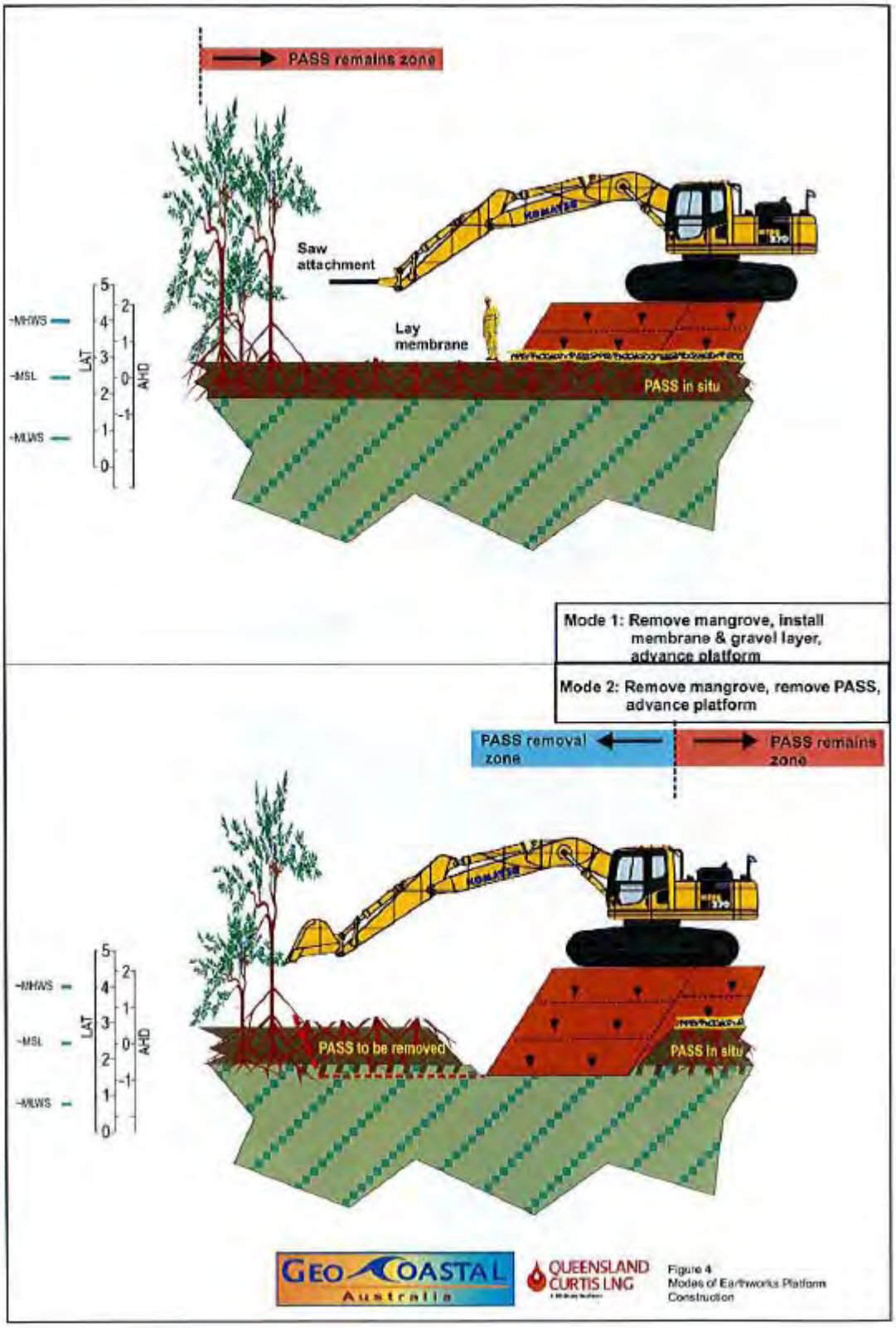


Figure 5 PASS removal, platform preparation and dredge removal

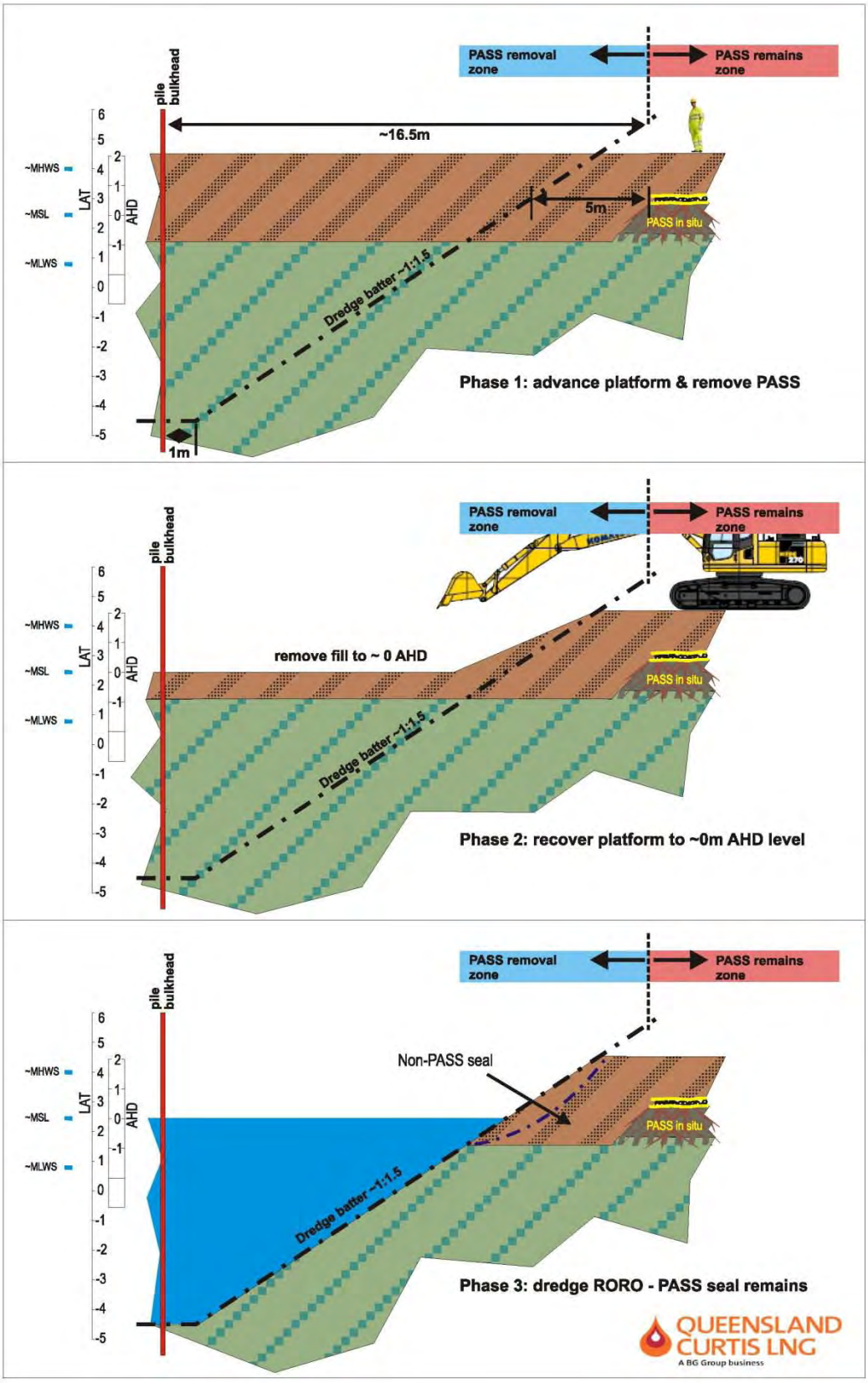
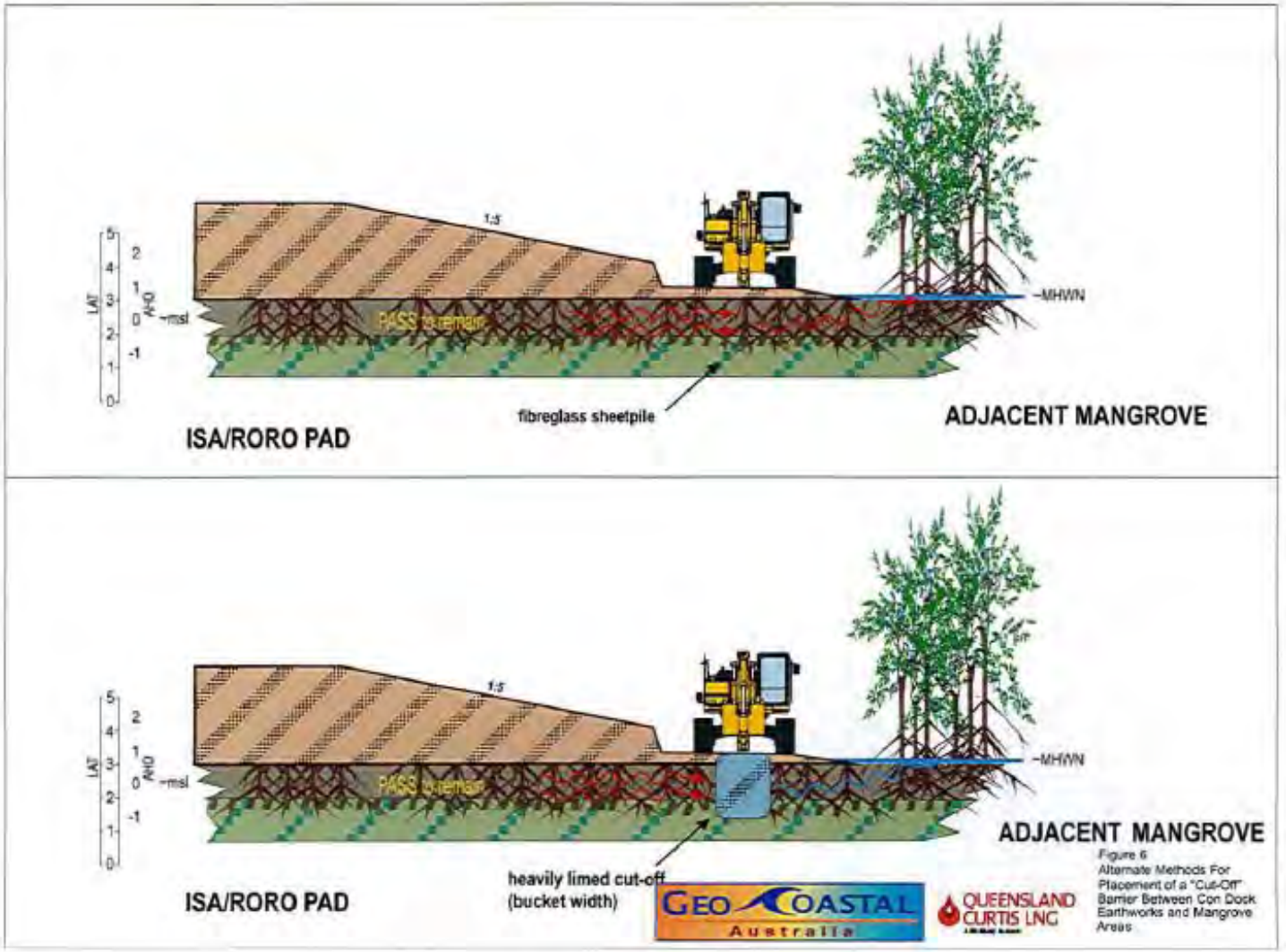


Figure 6 Alternative methods for placement of a cut-off barrier



8. Acid Sulfate Soil Management Plans

Construction of the various components of the QCLNG Project will be done by separate contractors.

For the intertidal earthworks and construction portions of the Construction Dock within the area designated for dredging and a 5m perimeter surrounding, the contractor (Bechtel) will undertake earthworks activities in accordance with ***Table 2A and 2B, Table 3A and 3B***, and with ***Appendix* 3**.

For the intertidal and offshore dredged portions of the Construction Dock, the dredging contractor (Dredeco) will undertake dredging activities in accordance with ***Appendix 2****,* and approved Construction Dock Dredge Management Plan.

Table 2A General ASS Management for Zone 2.		
REQUIREMENT	**ACTION**	**VERIFICATION**
ASS Specialist	An experienced ASS Consultant will be appointed during the operation of mangrove and PASS removal and treatment from the Construction Dock intertidal area (Zone 2) in which ASS may be disturbed. The ASS Consultant will: • Provide staff training and technical advice in managing ASS in accordance with this ASSMP. • Undertake validation testing and monitoring of surface water quality at the treatment site. • Report the implementation of the requirements of this ASSMP as per the verification means set out in the ASSMP. • Ensure that all site personnel comply with the elements of the treatment measures proposed. • Ensure any corrective action measures proposed by dredging personnel are approved before being implemented.	• The ASS Consultant shall prepare a weekly ASS compliance report. • The ASS Consultant shall record his/her presence on the site in the weekly report.
Training, Induction and Orientation	• Training, induction and orientation sessions will be conducted for all personnel employed for the purpose of excavating and treating ASS from the QGC portion of the Construction Dock facility. The training sessions will be designed by an experienced ASS Consultant and shall be conducted prior to the disturbance of any soils on the site. The sessions shall be designed to ensure staff are aware of the ASS issues on the site, can recognise the ASS on site and are aware of their responsibilities in managing the ASS. • An induction will be conducted prior to site works, relating to the following environmental management issues: o The individual's General Environmental Duty o Site specific conditions and implications for the management of ASS as described in this ASSMP o The elements of the treatment measures proposed o Issues with handling and treatment of ASS on site o Requirements of stockpiling soil o Awareness of validation testing and water monitoring o Familiarity with the requirements for record-keeping of results o Encouragement to suggest corrective action measures, and their implementation upon approval (note: any significant changes to the management plan will be subject to discussions with and the approval of the relevant regulatory authorities) • Toolbox meetings will be conducted on an as needed basis to address issues encountered during the operation and ensure personnel have a current understanding of environmental issues and controls. • Training shall be repeated for any new/replacement personnel and at six monthly (or other appropriate) intervals. • ***Table 2*** shall be provided for training of all staff involved in the excavation, transport or handling of soils on the site. A copy shall be displayed in the site office.	• A training register shall be maintained by the Contractor. The register shall list persons trained, training dates, the name of the trainer and shall be signed by all trainees. The register shall be examined on a weekly basis by the ASS Consultant and noted in his/her report • The presence of the copy of **Table 2 A & 2B, 3A & 3B, 4A & 4B** in the site office shall be noted by the ASS Consultant.
Complaints and Incidents	The Contractor shall maintain a register of complaints or environmental incidents. • The complaints register shall record the name of the complainant, the nature of the complaint, details of any investigations, the conclusions from investigations and details of any corrective actions or responses. • The incidents register shall record any ASS related environmental incidents. These may include fish kills or environmental harm or the presence of jarosite, iron staining or other indicators indicating the disturbance of ASS. • Incidents are to be reported to QGC and DERM as soon as possible in the event of an observed fish kill and/or substantial iron floc in surface waters.	• The ASS Consultant shall review the complaints register on a weekly basis and make comment in his/her weekly report. • The ASS Consultant shall review the incident register on a weekly basis and make comment in his/her weekly report.
Maintenance of Records	The Contractor shall maintain records of all activities relevant to ASS management. These shall be kept on the site and shall include but not be limited to: • Training Register	• The ASS Consultant shall examine the Contractor's records on a weekly basis and comment in his/her weekly report.

Table 2A General ASS Management for Zone 2.

REQUIREMENT	ACTION	VERIFICATION
	• Complaints Register • Incident Register • Non Conformance Report Register • Lime Register • Validation results for preparation of a Validation Report • Daily spatial tracking of volumes of ASS and Lime during excavation and treatment • High level traceability between volumes of sediment and corresponding validation sampling, testing, and treatment records • Monitoring results • ASS Consultant's weekly reports	
Auditing	The Contractor shall engage an independent and suitably experienced ASS consultant as an auditor to the project for ASS activities. The auditor shall conduct an audit of ASS activities on the excavation and ASS treatment sites during the operation and shall report to DERM. The timing of the audits shall be as follows: • Within 1 week of commencement of Construction Dock earthworks to ensure that all management systems are in place; • On a regular basis, eg. weekly during operations (ie. at least once) to review the site records and ensure that works are being conducted in accordance with the ASSMP; • On other occasions as deemed necessary by the auditor to review records and ensure that the works are being conducted in accordance with the requirements of the ASSMP.	• Copies of the auditor's reports.
Access	Visitors, including local, state and federal government officials visiting the site must attend the requisite site health, safety, security and environmental (HSSE) inductions as established by the contractor, HSSE policies, procedures and this ASSMP.	

Table 2B Specific ASS Management Strategies for Zone 2.

POTENTIAL RISK	MANAGEMENT ACTIONS	PERFORMANCE INDICATOR	VERIFICATION	CORRECTIVE ACTION
Potential acidity of excavated mangrove muds	• Preparation of compliantTreatment Pads o ASS treatment pads will have a guard layer of aglime applied at a minimal rate of 5kg/m^2 or 0.2 x the average of potential & existing acidity per metre depth of soil to be treated. o If ASS is to be treated in more than one layer, sufficient time must be allowed for validation testing and compliance of a layer before addition of more material. o The area is to be fully contained/constructed such that drainage/runoff water from the pad is directed to an appropriate receptacle for testing and treatment (if required). o Material free of ASS will be used to construct any bunds that may be required. • Treatment of excavated PASS with aglime o Excavated ASS material will be transferred to the treatment pad and placed on top of the guard layer. o ASS material is to be spread out in windrows of 300mm loose thickness for drying. o Spreading, drying, and separation of mangrove roots with PASS/mud attached will be done by tyning on the treatment pad, o Once dry, fine aglime will be applied evenly over the surface and thoroughly mixed into the soil via disc plough or rotary hoe in a minimal of three passes to provide a total of the designated liming rate. o Liming rate will be the calculated amount of 250.5 kg pure aglime/m^3 material. o The Acid Neutralising Value (ANV) of the aglime supplied may not be 100% (as assumed for pure lime) and will be identified from documentation provided by the lime supplier. If less than 100% a correction factor of 100/ANV will be applied to reach the weight equivalent of pure fine aglime o Treated ASS shall not be removed from the site until validation results show that performance criteria have been met. o PASS and woodchip product from the roots will also be treated with aglime. • Any spilled and/or sloughed ASS material is cleared from the site and delivered to the treatment pad on a daily	• Treatment Pad conforms to design specifications • No iron staining of soils or water • No sulfurous odour nor low pH in water bodies • Field testing and laboratory testing • Lime register • ASS Tracking Report • ASS Validation Report	• Treatment area inspected by ASS Consultant. Treatment of ASS will occur only on properly prepared and compacted areas or pads. • Inspection for spillages conducted by ASS Consultant • Validation testing of treated PASS material to be undertaken by ASS Consultant. o The limed material will be checked for successful neutralisation before being moved or covered using the sPOCAS or CRS suite of tests at a NATA accredited laboratory. o One validation test (comprising 6 composite samples) of the limed material will be conducted per 250m^3 of treated material o The validation test will be deemed to have passed if the NET ACIDITY result of the Acid-Base Accounting analysis is zero or negative and a minimum ANC of 1.5 times the existing plus potential acidity is present. o It is recommended to make a general photographic record of lime addition and mixing procedures and retain for reference • Contractors design review process	• Issue of non conformance report by ASS Consultant • Retesting of materials in vicinity of excavation using sPOCAS or CRS suite of tests. • Assessment of need for additional lime then application with thorough mixing and re-validation

Table 2B Specific ASS Management Strategies for Zone 2.

POTENTIAL RISK	MANAGEMENT ACTIONS	PERFORMANCE INDICATOR	VERIFICATION	CORRECTIVE ACTION
	basis			
Non-containment of lime and hydrated lime at treatment site	• Lime will be stored in a containment area (nominally 25 x 25 x 2m) adjoining the treatment pad (i.e. so that any discharge from the area is directed into the treatment pad drain, and ultimately the retention pond for water quality balancing before discharge to the external receiving environment). • Hydrated lime will be stored adjacent to the retention pond in a weatherproof structure (eg. shed or container) with appropriate signage and MSDS clearly displayed.	• Visual inspection that lime contained	• ASS Consultant's weekly report	• If inclement weather occurs the containment area will have the capability of being covered • If shed or container for hydrated lime is damaged it will be repaired and locked if necessary
Discharge water becomes acidified	• All stormwater or ASS leachate from stockpile or other exposed areas shall be diverted to the retention pond for monitoring and treatment (if required). • pH, water level, Electrical Conductivity, total Iron and total Aluminium concentrations to be monitored within the retention pond during current operation • Aluminium and iron concentrations will be compared with trigger threshold values. • Hydrated lime to be available for pH adjustment of water if required. • Monitoring of turbidity and dissolved oxygen will also be conducted prior to discharge and levels must comply with the Performance Criteria	• All <u>discharge</u> from the site shall comply with agreed monitoring indicators or current water quality guidelines [QWQG (2009) or ANZECC/ARMCANZ(2000)] including Dissolved Oxygen and Turbidity, and a **pH range of 6.5 – 9.0.** • Retained water to be <u>re-used in water trucks</u> for earthworks operations must be monitored prior to removal from the pond and be within the **pH range of 6.5 – 9.0.** • Discharge water trigger values for iron (Fe) and aluminium (Al) are: - **Total Fe = 387 ug/l** - **Total Al = 362 ug/l**	• Water quality to be monitored by ASS Consultant • pH, water level and Electrical Conductivity to be monitored within the retention pond in current operation. • The monitoring will be undertaken by a suitably trained and experienced Technician • The monitoring for DO, turbidity and pH will be undertaken daily and the metal concentrations will be tested weekly during the operation of the site. • Dissolved oxygen and turbidity to be measured prior to discharge • Al and Fe to be measured by an accredited laboratory.	• If retention pond quality falls outside the Performance Criteria, determine if it is linked to the construction operations and review and upgrade neutralisation treatment procedures. • If the quality of water to be discharged falls below this pH, it will be dosed with appropriate neutralising agents eg. hydrated lime to return it to acceptable levels. • Sufficient hydrated lime will be stored on site to allow pH adjustment of retained waters as noted above. • For sudden drops in water pH, it is important that quicklime or hydrated lime is available on-site, preferably in a ready mixed slurry form for adding to any low pH waters. • Hydrated lime will be stored in a weatherproof locked container and is to be handled only whilst wearing the appropriate personal protective equipment due to its corrosive nature. • pH must be monitored during and after the liming process to ensure an acceptable range is maintained. • If dissolved oxygen values are lower than specified it should be determined whether the discharge process will provide adequate aeration, otherwise additional aeration will be required. • If insufficient settlement of suspended solids results in levels of turbidity that exceed agreed values application of an ecologically sound flocculation agent will be undertaken. • If trigger values for iron and aluminium are exceeded on two consecutive occasions an investigation as per ANZECC/ARMCANZ (2000) Section 3.4.3.2 is to be undertaken. • Issue of non-conformance report by ASS consultant

Table 2B Specific ASS Management Strategies for Zone 2.

POTENTIAL RISK	MANAGEMENT ACTIONS	PERFORMANCE INDICATOR	VERIFICATION	CORRECTIVE ACTION
Unsuccessful treatment of ASS	Discuss and evaluate the performance of the ASSMP including: • the effectiveness of the operating strategies • any problems in implementing the ASSMP management strategies • any ASS incidents • requirements of runoff control and materials handling • effectiveness of any corrective action adopted.	• Further non conformance reports issued by ASS Consultant	• ASS Consultant's weekly reports	• The excavation and treatment operation will be reassessed and action taken to determine the problems causing the breach of standards; • If the problems are related to ineffective implementation of the ASS management plan, then the plan will be audited to ensure improved implementation. Monitoring and testing will be increased to ensure compliance with the established standards; • Any significant changes to the management plan will be subject to discussions with the EPC contractor, QGC and the relevant regulatory authorities.
Non Sulfuric Acidity	Lime treatment of fill materials. Lime treatment shall be a basal layer at the rate of 3 kilograms fine agricultural lime per square metre and lime at the rate of 3 kilograms per square metre for subsequent layers of 1 metre thickness or part thereof.	• Limed soils and rock	• Lime application observed by ASS Consultant • Lime application rates demonstrated by data from a lime register	• Cease work where lime not applied at specified rates • Issue of non conformance report by ASS specialist • Apply lime at appropriate rate • Commence work only when lime applied at specified rates
Sludge in retention pond/drains has high alkalinity/metals concentrations.	After completion of use of treatment pads, sludge will be tested for metals and alkalinity using the results from a NATA accredited laboratory, to assess disposal options.	• Compliance concentrations of metals and pH according to Queensland Guidelines (DERM).	• Results of testing made available to DERM.	• If material is found to comprise a Regulated Waste, it must be contained and handled according to the QLD Environmental Protection Regulation 2008.

Table 3A General ASS Management for Zone 1.		
REQUIREMENT	**ACTION**	**VERIFICATION**
ASS Specialist	• A full time ASS specialist shall be appointed to the site for the period during which any works which may disturb ASS are undertaken in areas below RL 5 metres AHD. The ASS specialist will provide staff training, provide technical advice in managing ASS in accordance with this ASSMP and shall monitor and report the implementation of the requirements of this ASSMP as per the verification means set out in the ASSMP.	• The ASS specialist shall prepare a weekly ASS compliance report. • The ASS specialist shall record his/her presence on the site in the weekly report.
Training and Orientation	• Training and orientation sessions will be conducted for all Contractor's and Subcontractor's staff involved in the excavation, transport or handling of soils on the site. The training sessions will be designed by an ASS specialist and shall be conducted prior to the disturbance of any soils on the site. The sessions shall be designed to ensure that staff are aware of the ASS issues on the site, can recognise the ASS on site and are aware of their responsibilities in managing the ASS. • **Table 3A and 3B** setting out the specific management strategies shall be provided to all staff involved in the excavation, transport or handling of soils on the site. A copy shall be displayed in the site office.	• A training register shall be maintained by the Contractor. The register shall list persons trained, training dates, the name of the trainer and shall be signed by all trainees. The register shall be examined on a weekly basis by the ASS specialist and noted in his report. • The presence of the copy of **Table 3A and 3B** in the site office shall be noted by the ASS specialist.
Complaints and Incidents	• The Contractor shall maintain a register of complaints or environmental incidents. • The complaints register shall record the name of the complainant, the nature of the complaint, details of any investigations, the conclusions from investigations and details of any corrective actions or responses. • The incidents register shall record any ASS related environmental incidents. These may include fish kills or environmental harm or the presence of jarosite, iron staining or other indicators indicating the disturbance of ASS.	• The ASS specialist shall review the complaints register on a weekly basis and make comment in his/her weekly report. • The ASS specialist shall review the incident register on a weekly basis and make comment in his/her weekly report.
Maintenance of Records	The Contractor shall maintain records of all activities relevant to ASS management. These shall be kept on the site and shall include but not be limited to: • Training Register • Complaints Register • Incident Register • Non Conformance Report Register • Lime Register showing dates, locations quantities and application rates for lime used • ASS specialist's weekly reports • Monitoring results	• The ASS specialist shall examine the Contractor's records on a weekly basis and comment in his/her weekly report.

Table 3A General ASS Management for Zone 1.		
REQUIREMENT	**ACTION**	**VERIFICATION**
Auditing	The Contractor shall engage an independent ASS consultant as an auditor to the project for ASS activities. The auditor shall conduct an audit of ASS activities on the site during the construction of the dock and shall report to DERM. The timing of the audits shall be as follows: • Within 1 week of commencement of work on the Construction Dock to ensure that all management systems are in place; • At least once during dredging operations to review the site records and ensure that works are being conducted in accordance with the ASSMP; • At least once during the mangrove cutting operations to review site records and ensure that works are being conducted in accordance with the ASSMP; • At least once during fill placement operations to review site records and ensure that works are being conducted in accordance with the ASSMP; • At least once during piling operations to review site records and ensure that the works are being conducted in accordance with the ASSMP; • On other occasions as deemed necessary by the auditor to review records and ensure that the works are being conducted in accordance with the requirements of the ASSMP.	• Copies of the auditor's reports.
Access	Visitors, including local, state and federal government officials visiting the site must attend the requisite site health, safety, security and environmental (HSSE) inductions as established by the contractor, HSSE policies, procedures and this ASSMP.	

Table 3B Specific ASS Management for Zone 1.				
POTENTIAL RISK	**MANAGEMENT ACTIONS**	**PERFORMANCE INDICATOR**	**VERIFICATION**	**CORRECTIVE ACTION**
Excavation of ASS below RL 5 metres	Design embankment to be all fill with no excavation below RL 5 metres No stripping topsoil below RL 5 metres Treatment of PASS from pile muck out	• No cut in design drawings • No cut during construction • No stripping allowed in specification • No stripping during construction • Presence of treatment area • Lime register • Field testing and laboratory testing	• Contractors design review process • Field observation by ASS specialist • Contractor's review process • Field observation by ASS specialist • Treatment area inspected by ASS specialist • Lime consumption at 400 kilograms per cubic metre • Test results show oxidised pH>6 and ANC >1.5 total acidity	• Cease work until corrective action in place • Issue of non conformance report by ASS specialist • Modification to design drawings and specification to comply if required • Continue construction with no excavation or stripping
Expulsion of Pore Water in fill areas below RL 2	Design embankment below RL 2 metres with lime rich sand drainage zone 1.0 metres wide and 0.3 metres deep in downslope toe. Mix 20 kg lime per cubic metre of sand mixed through sand drainage zone. Two bores established in downslope corners will be used to obtain initial baseline groundwater and weekly ongoing samples.	• Drainage zone shown in drawings • Drainage zone incorporated during embankment construction • Lime mixed into drainage zone • pH drop of 1 unit, Treatment pad leachate trigger values for iron (Fe) and aluminium (Al) are: - **Total Fe = 387 ug/l** - **Total Al = 362 ug/l**	• Contractors design review process • Drainage zone and lime application observed by ASS specialist • Lime used for this application shown in a lime register • Water level, pH, Electrical Conductivity, total Fe and total Al will be tested weekly for 6 months, but frequency can be reduced after 3 months as determined by ASS specialist	• Modify design if zone not shown • If no drainage zone, cease fill placement in embankment toe until drainage zone in place • Issue of non conformance report by ASS specialist. DERM to be advised of non-compliance and any remedial actions taken. • If groundwater pH is less than 5.5, increase lime application in drainage zone in new areas. Construct external drainage zone in completed zones. • Continue construction when corrective actions complete
Shear Failure and Heave in areas below RL 2 metres	Design embankment to prevent shear failure and heave. This may require flat fill batters, geofabric or geogrid earth reinforcement or use of sheet/pipe pile walls.	• Appropriate design for indicated ground conditions • No heave greater than 100 mm observed during construction	• Design check for shear failure in design review process • Works observed by ASS specialist during construction for indications of heave	• Redesign where factor of safety against heave is inadequate in design • Cease work if heave greater than 100 mm noted during construction • Issue of non conformance report by ASS specialist • Redesign platform to prevent failure based on failures noted • Continue construction with revised design and observe
Non Sulfuric Acidity	Lime treatment of fill materials excavated from above RL 6 metres. Lime treatment shall be a basal layer at the rate of 3 kilograms fine agricultural lime per square metre and lime at the rate of 3 kilograms per square metre for subsequent layers of 1 metre thickness or part thereof.	• Limed soils and rock	• Lime application observed by ASS specialist • Lime application rates demonstrated by data from a lime register	• Cease work where lime not applied at specified rates • Issue of non conformance report by ASS specialist • Apply lime at appropriate rate • Commence work only when lime applied at specified rates

Table 3B Specific ASS Management for Zone 1.				
POTENTIAL RISK	**MANAGEMENT ACTIONS**	**PERFORMANCE INDICATOR**	**VERIFICATION**	**CORRECTIVE ACTION**
Surface Disturbances in areas below RL 2 metres	Minimise disturbance by the use of defined access ways and low ground bearing pressure vehicles. Use mats or ground supports where more than 100 mm depth of where people are working over soft soils or disturbance. Mangroves to be cut by machine off fill working platforms built out from the shore. Some hand clearing may be necessary. Lime disturbed surfaces at the rate of 20 kilograms per square metre. In situ PASS left after dredging excavations to be isolated by fibreglass sheet pile and compacted earth cutoffs	• Depths of disturbance limited to 100 mm • All disturbed surfaces limed at specified rates • Lime register • Lime application • Appropriate ground support and working platforms • Treated surfaces • Use of cutoffs	• Depth of disturbance observed by ASS specialist • Use of defined access ways observed by ASS specialist • Lime application observed by ASS specialist • Lime application rates demonstrated by data from a lime register • Observation of ground support and working platform by ASS consultant • Clearing observed by ASS specialist • Lime application rates demonstrated by data from a lime register • Observation of cutoffs by ASS specialist	• Cease work until compliance has been achieved • Issue of non conformance report by ASS specialist • Determine modifications to reduce depth of disturbance • Apply lime to disturbed areas • Commence work when compliance achieved

Table 4A General ASS Management for Zone 3a and 3b.		
REQUIREMENT	**ACTION**	**VERIFICATION**
ASS Specialist	An experienced ASS Consultant will be appointed during the operation for the period of dredging during which any works which may disturb ASS are undertaken. The ASS Consultant will: • Provide staff training and technical advice in managing ASS in accordance with this ASSMP • Undertake validation testing and monitoring of surface water quality • Report the implementation of the requirements of this ASSMP as per the verification means set out in the ASSMP • Ensure that dredging personnel comply with the elements of the treatment measures proposed • Ensure any corrective action measures proposed by dredging personnel are approved before being implemented	• The ASS Consultant shall prepare a weekly ASS compliance report. • The ASS Consultant shall record his/her presence on the site in the weekly report.
Training, Induction and Orientation	Training, induction and orientation sessions will be conducted for all personnel involved in the dredging or handling of materials on the dredge spoil reclamation site. The training sessions will be designed by an experienced ASS Consultant and shall be conducted prior to the disturbance of any soils on the site. The sessions shall be designed to ensure that staff are aware of the ASS issues on the site, can recognise the ASS on site and are aware of their responsibilities in managing the ASS. An induction will be conducted prior to site works, relating to the following environmental management issues: • The individual's General Environmental Duty • Site specific conditions and implications for the management of ASS as described in this ASSMP • The elements of the treatment measures proposed • Avoidance of exposure of separated fines to oxidising conditions • Awareness of validation testing and water monitoring; • Familiarity with the requirements for record-keeping of results • Encouragement to suggest corrective action measures, and their implementation upon approval (note: any significant changes to the management plan will be subject to discussions with and the approval of the relevant regulatory authorities) Toolbox meetings will be conducted on an as needed basis to address issues encountered during the operation and ensure personnel have a current understanding of environmental issues and controls. Training shall be repeated for any new/replacement personnel and at six monthly (or other appropriate) intervals. This Table 3A and 3B shall be provided to all staff involved in the excavation, transport or handling of soils on the site. A copy shall be displayed in the site office.	• A training register shall be maintained by the Contractor. The register shall list persons trained, training dates, name of the trainer and shall be signed by all trainees. The register shall be examined on a weekly basis by the ASS Consultant and noted in his/her report • The presence of the copy of Table 4A and 4B in the site office shall be noted by the ASS Consultant.
Complaints and Incidents	The Contractor shall maintain a register of complaints or environmental incidents. • The complaints register shall record the name of the complainant, the nature of the complaint, details of any investigations, the conclusions from investigations and details of any corrective actions or responses. • The incidents register shall record any ASS related environmental incidents. These may include fish kills or environmental harm or the presence of jarosite, iron staining or other indicators indicating the disturbance of ASS. • Incidents are to be reported to QGC and DERM as soon as possible in the event of a fish kill and/or substantial iron floc in surface waters.	• The ASS Consultant shall review the complaints register on a weekly basis and make comment in his/her weekly report. • The ASS Consultant shall review the incident register on a weekly basis and make comment in his/her weekly report.

Table 4A General ASS Management for Zone 3a and 3b.		
REQUIREMENT	**ACTION**	**VERIFICATION**
Maintenance of Records	The Contractor shall maintain records of all activities relevant to ASS management. These shall be kept on the site and shall include but not be limited to: • Training Register • Complaints Register • Incident Register • Non Conformance Report Register • Validation results for preparation of a Validation Report • Daily spatial tracking of volumes of material during dredging • High level traceability between volumes of sediment and corresponding validation sampling, testing, and mitigation records • Monitoring results • ASS Consultant's weekly reports	• The ASS Consultant shall examine the Contractor's records on a weekly basis and comment in his/her weekly report.
Auditing	The Contractor shall engage an independent and suitably experienced ASS consultant as an auditor to the project for ASS activities. The auditor shall conduct an audit of ASS activities on the dredge spoil reclamation site during the dredging operation and shall report to DERM. The timing of the audits shall be as follows: • Within 1 week of commencement of Construction Dock dredging to ensure that all management systems are in place; • On a regular basis, eg. weekly during dredging operations (ie. at least once) to review the site records and ensure that works are being conducted in accordance with the ASSMP; • On other occasions as deemed necessary by the auditor to review records and ensure that the works are being conducted in accordance with the requirements of the ASSMP.	• Copies of the auditor's reports.
Access	Visitors, including local, state and federal government officials visiting the site must attend the requisite site health, safety, security and environmental (HSSE) inductions as established by the contractor, HSSE policies, procedures and this ASSMP.	

Table 4B Specific Management for Zone 3a and 3b.

POTENTIAL RISK	MANAGEMENT ACTIONS	PERFORMANCE INDICATOR	VERIFICATION	CORRECTIVE ACTION

ASS Oxidation from Dredge Spoil	• The placement of discharged high-ANC sediment in the early phase of dredging will strategically target placement of a buffering layer around the perimeter of the receival facility as a precautionary tool against possible low-level positive Net Acidity in later discharge.
	• Attention will be focused at the discharge point to the differentiation of sediment fractions via sluicing and settling resulting in concentrated areas of fines. Validation testing should target these fines to confirm their neutrality and, should positive Net Acidity be detected, strategies devised both at the dredging front and discharge pipe to effectively encompass them with excess neutralising sediment
		• No iron staining of soils or water
		• No sulfurous odour nor low pH in water bodies
		• Hydrated lime register
		• Field testing and laboratory testing
		• Dredge Management Plan
			Validation testing will be undertaken of reclaimed dredge spoil -
			• The validation test will be conducted by an experienced and suitably qualified professional.
			  ◦ The target for dredge discharge is an NA ≤ 0.03%S
			  ◦ No sample shall exceed (0.04%S)
			  ◦ One precautionary validation test (comprising 6 composite samples) of dredged material from Zone 3a will be conducted per 1000m^3
			  ◦ One precautionary validation test (comprising 6 composite samples) of dredged material from Zone 3b will be conducted per 5000m^3
			• One validation test (comprising 6 composite samples) of the dredged material will be conducted; for Zone 3a- 1 per 1000m^3 and for Zone 3b – 1 per 5,000m^3 of dredge discharge (nearshore and intertidal zones). See Table 6.2; Appendix 3 (GeoCoastal Report).
			Contractors design review process
				• Issue of non conformance report by ASS Consultant
				• Retesting of materials in vicinity of excavation using sPOCAS or CRS suite of tests.
				• Implementation of a strategy to provide in situ interment with high Acid Neutralising Capacity dredge sediments or other mitigation measures e.g. strategies devised both at the dredging front and discharge pipe to effectively encompass them with excess neutralising sediment.

Tailwater discharging from Reclamation Area becomes acidified	• Tailwater pH, water level, Electrical Conductivity and total iron and aluminium concentrations to be monitored weekly within the retention pond in current operation.
	• Hydrated lime to be available for pH adjustment of water if required.
	• Hydrated lime will be stored in a weatherproof structure (eg. shed or container) with appropriate signage and MSDS clearly displayed.
		• All tailwater discharge from the site shall comply with agreed Dredge Management Plan monitoring indicators or current water quality guidelines [QWQG (2009) or ANZECC/ARMCANZ (2000)]
		• pH of dredge retention waters to remain within the range **6.5 - 9.0 pH units**.
		• Total iron and aluminium concentrations to be compared to trigger values, as estimated from ETVs:
		  ◦ **Fe – 580 ug/L**
		  ◦ **Al – 543 ug/L**
			• Water quality monitoring by appointed Consultant
			• Tailwater pH, water level and Electrical Conductivity to be monitored within the retention pond in current operation.
			• Monitoring to be undertaken by suitably trained and experienced Technician
			• Monitoring to be undertaken daily during the operation of the site
			• Sampling and laboratory measurement of total iron and aluminium concentrations to be undertaken weekly during the operation of the site.
				• If tailwater quality falls outside the Performance Criteria, determine if it is linked to the construction operations and review and upgrade neutralisation treatment procedures, eg. of spilled dredge spoil etc.
				• If appropriate, re-direct dredging to area where sediments mapped with Acid Neutralising Capacity.
				• If the quality of tailwater to be discharged falls below this pH, it will be dosed with appropriate neutralising agents eg. hydrated lime to return it to acceptable levels.
				• Sufficient hydrated lime will be stored on site to allow pH adjustment of retained waters as noted above.
				• For sudden drops in water pH, it is important that quicklime or hydrated lime is available on-site, preferably in a ready mixed slurry form for adding to any low pH waters.
				• Hydrated lime will be stored in a weatherproof locked container and is to be handled only whilst wearing the appropriate personal protective equipment due to its corrosive nature.

Table 4B Specific Management for Zone 3a and 3b.				
POTENTIAL RISK	**MANAGEMENT ACTIONS**	**PERFORMANCE INDICATOR**	**VERIFICATION**	**CORRECTIVE ACTION**
				• pH must be monitored during and after the liming process to ensure an acceptable range is maintained. • If trigger values for iron and aluminium are exceeded on two consecutive occasions an investigation as per ANZECC/ARMCANZ (2000) Section 3.4.3.2 is to be undertaken. • Issue of non conformance report by ASS consultant.
Unsuccessful treatment of ASS	• Discuss and evaluate the performance of the ASSMP including: o the effectiveness of the operating strategies; o any problems in implementing the ASSMP management strategies; o any ASS incidents o effectiveness of any corrective action adopted.	• Further non conformance reports issued by ASS Consultant	• ASS Consultant's weekly reports	• The dredging operation will be reassessed and action taken to determine the problems causing the breach of standards; • If the problems are related to ineffective implementation of the ASS management plan, then the plan will be audited to ensure improved implementation. Monitoring and testing will be increased to ensure compliance with the established standards; • any significant changes to the management plan will be subject to discussions with the EPC contractor, QGC and the relevant regulatory authorities.

9. References

Ahern CR, McElnea AE, Sullivan LA. (2004). Acid Sulfate Soils Laboratory Methods Guidelines. In: *Queensland Acid Sulfate Soil Technical Manual*. Dept. Natural Resources, Mines and Energy, Indooroopilly, QLD.

ANZECC/ARMCANZ (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality. National Water Quality Management Strategy; No. 4.* Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand. ISBN 09578245 05. Environment Australia.

Dear S.E, Moore N.G, Dobos S.K, Watling K.M and Ahern C.R. (2002). Soil Management Guidelines. In*: Queensland Acid Sulfate Soil Technical Manual.* Dept. Natural Resources & Mines, Indooroopilly, QLD.

Dear SE, Moore NG, Watling KM, Fahl D and Dobos SK (Eds) (2004). Legislation and Policy Guide. In *Queensland Acid Sulfate Soil Technical Manual*. Department of Natural Resources and Mines, Indooroopilly, Queensland, Australia. Version 2.2.

Department of Environment & Resource Management (Queensland) (2009). *Queensland Water Quality Guidelines.* Version 3.

GeoCoastal (Australia) (2009). *Acid Sulfate Soil and Geomorphological Modelling Report: Proposed QCLNG Facility: Offshore Component of MOF, Jetty and Pioneer Rock Dock Gladstone, Queensland.* September 2009, commissioned Golder Associates/Bechtel Australia.

GeoCoastal (Australia) (2009a). *Acid Sulfate Soil and Geomorphological Modelling Report QCLNG – Construction Dock Program, Gladstone Harbour, Queensland.* November 2009, commissioned QGC Ltd.

GeoCoastal (Australia) (2010). *Construction Dock Program: Mangrove Zone Acid Sulfate Soil Investigation: QCLNG Dredging Project, Gladstone, Queensland.* February 2010, commissioned QGC Ltd.

Qld EPA (2001). *Instructions for the Treatment and Management of Acid Sulfate Soils.* Qld EPA in consultation with Dept. Natural Resources and Mines, July 2001, Version 1.0.

SKM (2010). *Dredge Management Plan – Construction Dock Queensland Curtis LNG*, for QGC Ltd.

State Planning Policy 2/02: *Planning and Managing Development Involving Acid Sulfate Soils*. Made under Schedule 4 of the *Integrated Planning Act 1997.* Queensland Government.

SPP2/02 Guideline, Acid Sulfate Soils Version 2. Dept. Local Government and Planning, and Dept. Natural Resources and Mines.

10. Appendices

APPENDIX 1 RELATIONSHIP BETWEEN PROJECT ACID SULFATE MANAGEMENT DOCUMENTS

APPENDIX 2 ASSMP, CONSTRUCTION DOCK, GEOCOASTAL (AUSTRALIA) PTY LTD.

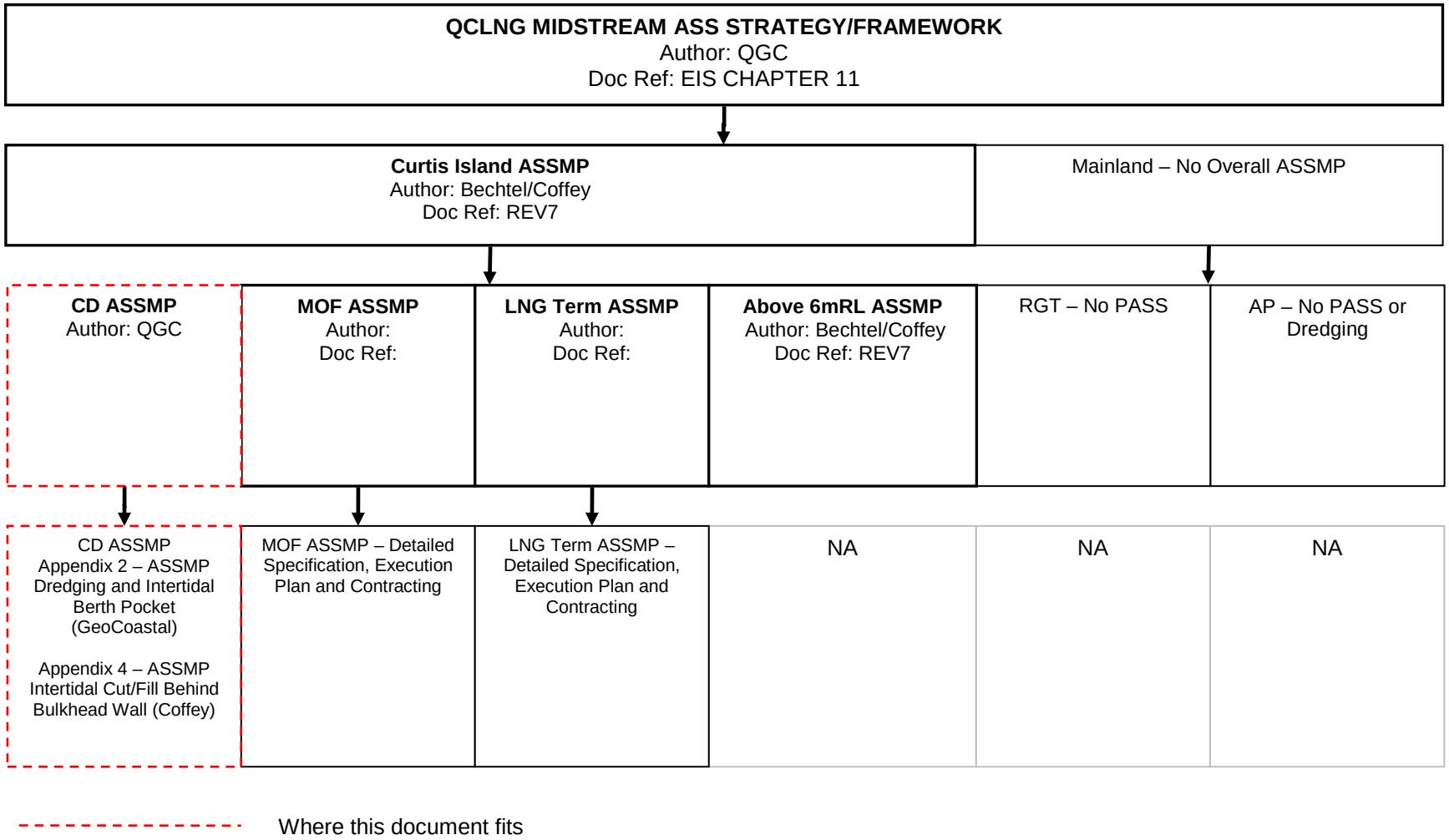
Reference: 10/ASSMP305.1
Version 1.4.1
July 2010

APPENDIX 3 ASSMP, CONSTRUCTION DOCK, COFFEY GEOTECHNICS PTY LTD

GEOTKPAR01648AA/B (Revision 4)
2nd September 2010

APPENDIX 4 ACID SULFATE SOIL DEFINITIONS

APPENDIX 1 RELATIONSHIP BETWEEN PROJECT ACID SULFATE MANAGEMENT DOCUMENTS



ACID SULFATE SOIL MANAGEMENT PLAN

QCLNG CONSTRUCTION DOCK:

OFFSHORE DREDGE ZONE & QGC INTERTIDAL/MANGROVE ZONE

CURTIS ISLAND, QUEENSLAND.

Prepared for

QGC Pty Ltd

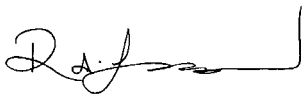
Reference: 10/ASSMP305.1
Version 1.4.1
July 2010

DOCUMENT CONTROL

Title: Acid Sulfate Soil Management Plan, QCLNG Construction Dock: Offshore Dredge Zone & QGC Intertidal/Mangrove Zone, Curtis Island, Queensland.

Reference: 10/ASSMP305.1 Version 1.4.1

Reviewed:

Position	Principal Scientist	Name	Rundi Larsen
Date	31 July 2010	Signature	

Approved for Release:

Position	Project Manager	Name	Trevor Graham
Date	31 July 2010	Signature	

GeoCoastal (Australia) Pty Ltd
ABN 75 083 753 735
111 Stanbrough Road
PO Box 4051 Gumdale
Queensland 4154 Australia
Phone: +61 7 3890 7392
Fax: +61 7 3890 7599
info@geocoastal.com.au
www.geocoastal.com.au

CONTENTS

ANNEX 1

FIGURES

TABLES

Acid Sulfate Soil Management Plan, QCLNG Construction Dock: Offshore Dredge Zone & QGC Intertidal/Mangrove Zone, Curtis Island, Queensland.

1 INTRODUCTION

1.1 BACKGROUND AND PROJECT DESCRIPTION

Prior to commencement of construction of the Queensland Curtis LNG Facility on Curtis Island, a dock is required to provide early site access and facilities for off-loading materials (i.e. the QCLNG Construction Dock). Construction of this dock will entail excavation of sediments both in the immediate offshore and within the intertidal zone to provide vessel access to the facility. The location of the Construction Dock within the QCLNG Project area is shown in Figure 1-1.

Within the intertidal (mangrove) zone of the Construction Dock footprint there will be an area or pocket where dredging is required whilst the remainder will require filling to create hardstand for loading/offloading facilities (refer Figure 1-2). Contractual arrangements have resulted in different work methodologies being developed for management and handling of acid sulfate soils during construction of these areas. ASS management within the offshore and intertidal areas influenced by dredging will be explained in Sections 3 and 4 of this ASSMP whilst ASS management of intertidal areas designated for fill and construction activities is the subject of an ASSMP prepared by Coffey Geotechnic for Bechtel Australia.

1.1.1 Areas subject to dredging

GeoCoastal (Australia) Pty Ltd was commissioned by QGC Ltd to prepare an Acid Sulfate Soil Management Plan (ASSMP) for proposed activities that trigger the *State Planning Policy 2/02: Planning and Managing Development Involving Acid Sulfate Soils* within the areas to be dredged, that is the offshore footprint and the intertidal zone dredge pocket. These zones are separable by both geographic character and method of sediment removal as noted below and further described in following sections.

Deepening of the seafloor to allow building of the Construction Dock is proposed to be achieved predominantly by dredging, as the main portion of the footprint (~85%) lies offshore with around 15% across the mangrove zone (approx. 1.5 hectares). Within the mangrove zone, approximately 0.9 hectares is subject to surface PASS removal followed by dredging of underlying material. Acid sulfate soil investigations of offshore sediments found them to be alkaline overall (negative mean Net Acidity) with only low to moderate levels of PASS occurring in a thin surface veneer extending to ~60m immediately offshore from the mangrove boundary. Investigation of the sedimentary sequence within the mangrove zone found it to be comprised of high level PASS-bearing, soft, Holocene-aged silt/clay sediments to an average depth of ~0.85m, overlying stiff, pre-Holocene, non-ASS substrate clays. Removal of the upper intertidal Holocene sediments by dredge has been deemed to be problematic and unfeasible, in part due to the network of mangrove roots which are inextricably bound within the PASS layer. Therefore, it is proposed that site works in the dredge pocket will excise the intertidal mangrove and PASS by landward excavation and neutralisation prior to the subsequent arrival of the dredge to remove the remaining non-ASS substrate.

1.1.2 Areas subject to filling

As noted above, the remaining intertidal zone is proposed to be filled, and ASS management strategies for this area have been developed by Coffey Geosciences, commissioned by Bechtel Australia. The Coffey Geosciences methodology documentation is provided in a separate ASSMP.

Discussions between all parties regarding the interface between the different methods have taken place to address any identified ASS management-related issues and are included within the relevant sections.

This ASSMP therefore covers management of PASS in these phases:

1. Removal of mangroves and intertidal PASS material and treatment of the latter, from within the defined section of approximately 0.9 hectares.
2. Emplacement of an impervious seal that isolates the effects of both dredging excavation and bulkhead construction works. Logically this seal needs to be emplaced beyond the maximum extent of the dredge collapse batter to achieve this result.
3. Removal of offshore sediment and non-PASS intertidal substrate by dredge.

On-site works required to be undertaken will involve the following elements:

- creation of a temporary compacted earthworks platform using locally sourced fill,
- use of the platform for controlled removal of mangrove and excavation of PASS,
- the platform will also provide an impervious seal to surrounding PASS which is planned to be entombed *in situ,*
- inclusion of low level (3 kg/m^2) lime applications during placement and compaction of fill which has been found to have low to moderate amounts of non-sulfuric acidity,
- construction of a fully contained treatment facility,
- transfer of PASS to treatment pad for neutralisation and verification testing,
- monitoring of retained water.

This Acid Sulfate Soil Management Plan has been prepared using results of acid sulfate and geomorphological investigations undertaken within the subject site as reported in the following documents:

GeoCoastal (Australia) (2009). *Acid Sulfate Soil and Geomorphological Modelling Report: Proposed QCLNG Facility: Offshore Component of MOF, Jetty and Pioneer Rock Dock Gladstone, Queensland.* September 2009, commissioned Golder Associates for Bechtel Australia.

GeoCoastal (Australia) (2009a). *Acid Sulfate Soil and Geomorphological Modelling Report QCLNG – Construction Dock Program, Gladstone Harbour, Queensland.* November 2009, commissioned QGC Ltd.

GeoCoastal (Australia) (2010). *Construction Dock Program: Mangrove Zone Acid Sulfate Soil Investigation: QCLNG Dredging Project, Gladstone, Queensland.* February 2010, commissioned QGC Ltd.

Addendum to the ASSMP QCLNG Construction Dock, Curtis Island, Queensland: *Acid Sulfate Soil Assessment of the Treatment Pad Site.* Ref: 10/ASSMP305.1 Version 1.2 A, May 2010.

Addendum to the ASSMP QCLNG Construction Dock, Curtis Island, Queensland: *Re-Evaluation of Acid Neutralising Capacity in Dredge Zone 3a.* Ref: 10/ASSMP305.1 Version 1.3 A, June 2010.

Figure 1-1 Location of the Construction Dock site at the QCLNG facility, Curtis Island, Queensland

.

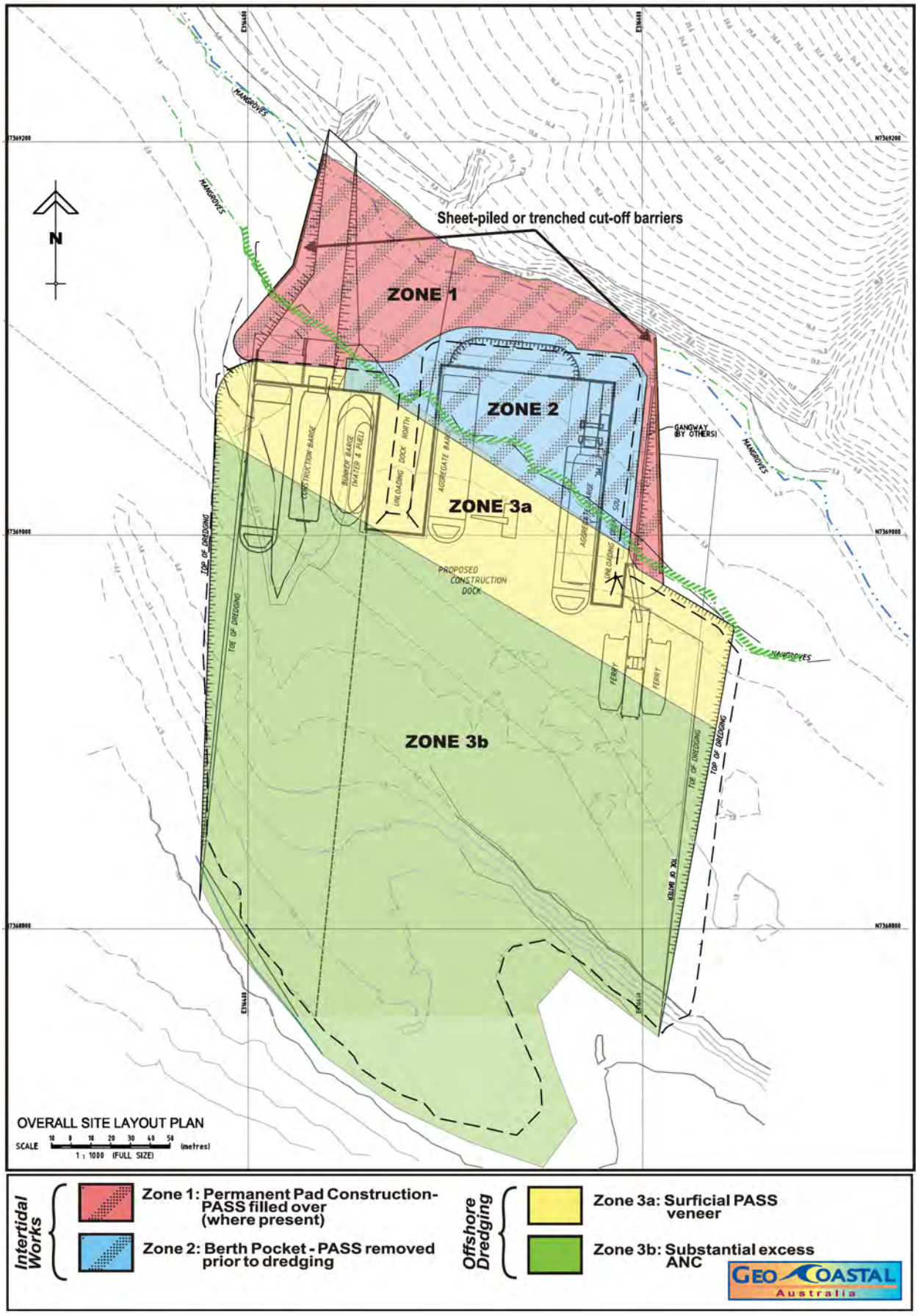


Figure 1-2 ASS Management Subzones in the QCLNG Construction Dock.

1.1.3 Structure of ASSMP

This Acid Sulfate Soil Management Plan (ASSMP) is presented in four Sections:

Section 1: Introduction - provides background information to the proposed works and occurrence of Acid Sulfate Soils (ASS) as identified in the above reports.

Section 2: Characterises and describes the ASS present at the site which is subject to disturbance. Water issues and features of environmental significance are also addressed in this Section.

Sections 3 and 4: Works methodologies and management strategies for the intertidal and offshore zones respectively.

Sections 5 & 6: contains Management Directives regarding disturbance and treatment of ASS within ASS Management Action Tables, derived from the information provided in Sections 3 and 4. Management issues addressed in this section include treatment, monitoring, validation of treatment, performance indicators, responsibilities, contingencies, reporting and administration of the Plan.

Approved amendments or addenda to any section of the Plan will be prepared in consultation between the EPC Contractor for intertidal works or EPC Contractor for dredging, QGC, and the regulatory authority (currently the Queensland Department of Environment and Resource Management [DERM]) and labelled with an updated Version number as appropriate.

1.2 SITE DESCRIPTION

1.2.1 Construction Dock location

The location of the proposed Construction Dock is within QGC's LNG site that falls within the Curtis Island Industry Precinct of the Gladstone State Development Area (GSDA). It lies approximately 6 km north-east of the city of Gladstone on the south-western side of Curtis Island immediately north of China Bay (Figure 1-1).

1.2.2 Cadastral information

The Construction Dock will be attached to Lot 2 on SP 225924.

1.2.3 Sediments to be disturbed by dredging

Approximately 350,000m^3 of sediments including those offshore from the mangrove line and those from the intertidal area to create the RORO berth (shown in Figure 1-2) are to be dredged and disposed of at the existing Fishermans Landing reclamation area (Figure 1-1).

1.2.4 Stratigraphy

1.2.4.1 Offshore

The proposed Construction Dock exploits a prominent shoal extending from the shore, which is shown in both seismic profiling and from coring to form a weathered residual extension of the island proper. This has significantly impacted on Holocene-age deposition in two ways:

i. it has limited the accommodation for the normally high acid sulfate soil-bearing, transgressive mangrove silt/clay sediments which commonly forms the basal unit of the Holocene sequence along this stretch of coast, and

ii. it has projected the foundation substrate available for receiving Holocene-age sediments into a moderate energy zone which has resulted in a ubiquitous sand and winnowed shell content.

The majority of boreholes terminated in either mature clay or clayey gravel consistent with a residual soil developed from the Wandilla Formation parent rock that southern Curtis Island is composed of. These clays were characteristically light greyish green to olive, stiff, highly plastic silt/clays and gravelly silt/clays. Not surprisingly, the more nearshore boreholes, commonly became [℘]kaolinitic at shallow depth. Further down the slope this clay substrate is overlain by complex pre-Holocene clayey gravel and sand deposits in places. These clayey sand deposits become progressively thicker and more common toward the base of the slope and beneath the modern channel to the west of the Construction Dock footprint. Gravel throughout tends to be chert/quartz dominated, subangular to angular and variable in size but ranging to 4-60mm.

1.2.4.2 Intertidal

The mangrove forest within the construction footprint has developed on a low angle terrace extending from the nearshore to a distinct break of slope to the island hills. The presence of mangroves within this intertidal zone has facilitated the accretion of a highly organic, silt/clay deposit of ~ 1.1m average thickness during the Holocene.

1.3 OBJECTIVES OF ASSMP

This Plan has been prepared by GeoCoastal (Australia) Pty Ltd on behalf of QGC, and should be read in conjunction with the ASS Investigation reports listed above. It will form part of QCLNG's Environmental Management Plan and supplement the Dredge Management Plan for the proposed activities.

The major objective of the ASSMP is

- To provide a framework to manage impacts of disturbance of acid sulfate soils, and prevent environmental harm both on- and off-site. By identifying, managing, treating, monitoring and reporting ASS, the site manager's (in this case the Engineer, Procure, Construct (EPC) contractor's) obligations under the Environmental Protection Act 1994 will be met.

Specific aims for the Construction Dock site are:

- To prevent and control generation of acid and other ASS leachate products from both extracted or excavated sediments, and *in situ* sediments abutting the excavated area;
- To manage discharge of retained and/or surface waters that may be affected by ASS leachate products.

Other prime aims are to provide:

- A structure for regulatory authorities and the EPC contractor to confirm compliance with legislative policies and the conditions contained in the Plan;
- Evidence of the above via accurate record-keeping and other documentation;
- Evidence to the community that the operation is being managed according to environmentally responsible and sound principles.

[℘] kaolin – A soft, fine, earthy, non-plastic, usually white or nearly white clay (rock) composed essentially of clay minerals of the kaolin group, principally kaolinite, derived from *in situ* decomposition (extreme weathering or pneumatolysis) of aluminous minerals (such as feldspars in a granitic rock), containing a variable proportion of other constituents (quartz, mica flakes) derived from the parent rock,…. (Bates and Jackson, 1987).

1.4 POTENTIAL ENVIRONMENTAL RISKS

The following issues are addressed in regard to management of ASS:

- Prevention of PASS oxidation in mangrove sediments entombed adjacent to the dredged area
- Potential acidity of excavated mangrove muds
- Seawater quality around the intertidal excavation area
- Use of fill soils and rock with low to moderate levels of non-sulfuric acidity.
- Stormwater containment (excavation site and treatment site)
- Stockpiling of neutralising agent(s)
- Potential acidity of dredge spoil
- Quality of dredged sediment and decant water in dredge spoil receival ponds with respect to ASS

1.5 LEGISLATIVE GUIDANCE FOR ASSMP

This Plan has been prepared in accordance with the following documents:

- Qld *State Planning Policy 2/02 Planning and Managing Development involving Acid Sulfate Soils* and the associated *State Planning Policy 2/02 Guidelines*
- *Soil Management Guidelines* chapter of the Queensland Acid Sulfate Soil Technical Manual, 2002
- *Legislation and Policy Guide* chapter of the Queensland Acid Sulfate Soil Technical Manual, 2004
- *Laboratory Methods Guidelines - Acid Sulfate Soils* chapter of the Queensland Acid Sulfate Soil Technical Manual, 2004
- *Instructions for the Treatment and Management of Acid Sulfate Soils, 2001.* Qld EPA in consultation with Dept. Natural Resources and Mines, July 2001, Version 1.0.

And with reference to the:

- *Integrated Planning Act 1997*
- Queensland *Environmental Protection Act 1994.*

Integrated Planning Act 1997

The *Integrated Planning Act 1997* (IPA) includes SPP 2/02.

Queensland Environmental Protection Act 1994

The *Environmental Protection Act 1994* (Act) compels all persons, including the State of Queensland to prevent environmental harm. All individuals involved in management of an activity have a General Environmental Duty (GED) established under Section 319 of the Act, to ensure no environmental harm (serious or material) occurs as a result of undertaking the activities.

GPC therefore has a responsibility under the EP Act to ensure the GED is observed and all activities are planned and carried out with due diligence. This entails that the environmental risks associated with disturbance of ASS have been assessed and minimised where possible, as described in this Plan.

Also under the Act water quality must be monitored and managed as defined under the Environmental Protection (Water) Policy 1997 (EPP Water) and water discharged to the environment must meet criteria in the ANZECC/ARMCANZ Water Quality Guidelines (2000) or Queensland Water Quality Guidelines (DERM; 2009) and/or locally established water quality guidelines prior to being discharged.

1.6 ROLES AND RESPONSIBILITIES

Construction of the various components of the QCLNG Project will be done by separate Engineer, Procure, Construct (EPC) Contractors.

1. For the earthworks and construction portions of the Construction Dock within the area designated for dredging and a 5m perimeter surrounding, the EPC Contractor will undertake earthworks activities in accordance with this ASSMP and will engage suitably qualified personnel to conduct on-site ASS sampling, monitoring and reporting to QGC in a format approved in consultation with both a suitably qualified auditor and DERM.
2. For the intertidal and offshore dredged portions of the Construction Dock, the EPC Contractor will undertake dredging activities in accordance with this ASSMP and will engage suitably qualified personnel to conduct on-site ASS sampling, monitoring and reporting to QGC in a format approved in consultation with both a suitably qualified auditor and DERM.

It is the responsibilty of the EPC Contractors' ASS Consultants and the auditor to ensure:

- The EPC Contractor is aware of site specific conditions and implications for the management of acid producing soils within the site
- Site personnel undertake an induction and training relevant to the Ass Management Zone (ie. intertidal/mangrove zone and/or the offshore dredge zone
- The EPC Contractor complies with the elements of the ASSMP
- Approval of any corrective action proposed by the EPC Contractor.
- Conduct monitoring and sample collection;
- Maintain records (including but not limited to volumes and location of ASS excavated and treated during the period and post neutralisation verification test results) for incorporation into ASS Tracking and ASS Validation reports;
- Prepare a weekly report for QGC on the following:
    - Any problems in implementing ASSMP management strategies
    - Compliance with ASS testing requirements, run-off control and materials handling;
    - Effectiveness of any corrective action adopted;
    - Overall compliance with the ASSMP

The EPC Contractor has the following responsibilities:

- Be aware of site conditions and requirements of implementation of the ASSMP;
- Discussion and modification of site operations to comply with the ASSMP;
- Propose any non-conformances and corrective actions to the Consultant;
- Implement approved corrective actions.

1.7 DEFINITIONS

Explanations of acid sulfate terms as described in the *SPP 2/02 Guidelines* include:

Actual acid sulfate soils (AASS): Soil or sediment containing highly acidic soil horizons or layers affected by the oxidation of soil materials that are rich in iron sulfides, primarily pyrite. This oxidation produces hydrogen ions in excess of the sediment's capacity to neutralize the acidity, resulting in soils of less than pH 4. These soils can often be identified by the presence of jarosite (a yellow coloured mineral).

Potential acid sulfate soils (PASS): Soils or sediments containing iron sulfides or sulfidic material that have not been exposed to air and oxidized. The field pH of these soils in their undisturbed state is pH 4 or more, and may be neutral or slightly alkaline.

The term **acid sulfate soil** generally includes both actual and potential ASS. Actual and potential ASS are often found in the same soil profile, with actual ASS generally overlying potential acid sulfate soil horizons.

Aerobic – said of conditions that can exist only in the presence of free oxygen. Cf. Anaerobic

Agricultural lime: A neutralizing agent commonly used to treat acidic soils; by composition, it is commonly 95-98% pure calcium carbonate ($CaCO_3$). It is insoluble in pure water, with a pH of ~8.3; application rates will depend on the purity and fineness of the product.

AHD (Australian Height Datum): the datum used for the determination of elevations in Australia. The determination used a national network of bench marks and tide gauges. Mean sea level ≈ zero elevation AHD.

Anaerobic conditions: conditions whereby air (oxygen) is excluded, usually by waterlogging.

Aquifer: rock or sediment in a formation, group of formations or part of a formation that is capable of storing and transmitting water (or another fluid) in significant quantities to bores, wells or springs.

ASSMP: the approved Acid Sulfate Soil Management Plan, including any amendments or addendums that may be approved from time to time.

DERM: the Queensland Department of Environment and Resource Management

Drain water: water contained in a drain, which flows into a drain, or flows immediately from a drain.

Environmental Harm: any adverse effect or potential adverse effect (whether temporary or permanent and of whatever magnitude, frequency or duration) on an environmental value, and includes environmental nuisance.

Extracting groundwater: this includes drainage, pumping or otherwise removing groundwater.

Flocculation: the process whereby small particles clump together into particles of greater mass; commonly seen as iron flocs in streams.

Framboidal (pyrite): microscopic pyrite crystals aggregated in clusters resembling the shape of a raspberry. Common in ASS.

Groundwater: subsurface water in the zone of saturation, including water below the watertable and water occupying cavities, pores and openings in underlying soil and rock.

Holocene: a period of time from about 10 000 years ago to the present, an epoch of the Quaternary period.

Integrated Development Assessment System (IDAS): IDAS is a framework that establishes a common statutory system for making, assessing and deciding development applications.

IPA planning scheme: an IPA planning scheme is a scheme prepared under the *Integrated Planning Act 1997*.

Jarosite: an acidic pale yellow iron sulfate mineral: $KFe_3(SO4)_2(OH)_6$. Jarosite is a by-product of the acid sulfate soil oxidation process, formed at pH less than 3.7; commonly found precipitated along root channels and other soil surfaces exposed to air.