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Abbot Point Growth Gateway Project

Environmental Impact Statement

Volume 2 - Environmental Impact Statement

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Table 8-9 Social impact management actions

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Acronyms and Abbreviations

Abbreviation/Acronym	Description
µg	Micrograms
AASS	Actual Acid Sulfate Soils
Abbot Point	Refers to the existing Abbot Point port area and adjacent industrial land (includes the onshore parts of the project area)
Abbot Point area	Incorporates Abbot Point (as defined above), as well as the Caley Valley Wetlands (including the western estuary) and beaches and approximately a five nautical mile radius around the existing offshore port area
ABS	Australian Bureau of Statistics
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AHD	Australian Height Datum
AIMS	Australian Institute of Marine Science
ALARP	As Low As Reasonably Practicable
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
APSDA	Abbot Point State Development Area
ARI	Average Recurrence Interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS	Australian Standard
ASS	Acid Sulfate Soils
ASSMP	Acid Sulfate Soils Management Plan
AU\$	Australian Dollars
BAAM	Biodiversity Assessment and Management Pty Ltd



Abbreviation/Acronym	Description
BOM	Bureau of Meteorology
BTEX	Benzene, toluene, ethylbenzene, and xylenes
CEMP	Construction Environmental Management Plan
CIA	Cumulative Impact Assessment
cm	Centimetre
CO ₂ -e	Carbon Dioxide Equivalent
CSD	Cutter Suction Dredge
dBA	A-weighted Decibels
DEHP	Queensland Department of Environment and Heritage Protection
DERM	Department of Environment and Resource Management (now DEHP)
DEWHA	Australian Department of Environment, Water, Heritage and the Arts (now DoE)
DMCP	Dredged Material Containment Pond
DMP	Dredging Management Plan
DO	Dissolved Oxygen
DoE	Australian Department of the Environment
DPA	Dugong Protection Area
Queensland DSD	Queensland Department of State Development
EAA	East Asian-Australasian
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EMP	Environmental Management Plan



Abbreviation/Acronym	Description
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FTE	Full Time Equivalent
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area
GHG	Greenhouse Gas
ha	Hectare
HFB	Horizontal Flow Barrier
IMS	Introduced Marine Species
ISO	International Organisation for Standardisation
km	Kilometre
km/h	Kilometres per hour
LAeq	A-weighted, Equivalent Sound Level
LAmx	A-weighted, Maximum Sound Level
LAT	Lowest Astronomical Tide
LGA	Local Government Area
m	Metres
mg	Milligrams
mg/cm ²	Milligrams per square centimeter
mg/L	Milligrams per litre
MIW	Mackay, Isaac and Whitsunday



Abbreviation/Acronym	Description
ML	Megalitres
mm	Millimetres
Mm ³	Million cubic meters
MNES	Matters of National Environmental Significance
MOF	Material Offloading Facility
MOL	Maximum Operating Level
MSQ	Maritime Safety Queensland
Mt	Million tonnes
Mtpa	Million tonnes per annum
NAGD	National Assessment Guidelines for Dredging
NESMP	North-East Shipping Management Plan
NGBR	North Galilee Basin Rail
NQBP	North Queensland Bulk Ports Corporation Ltd
NTU	Nephelometric Turbidity Units
OEMP	Operation Environmental Management Plan
PAR	Photosynthetic Active Radiation
PASS	Potential Acid Sulfate Soils
PER	Public Environment Report
PM10	Particulate matter 10 micrometres or less in diameter
PM2.5	Particulate matter 2.5 micrometres or less in diameter
ppt	Parts per thousand
PQL	Practical Quantification Limit



Abbreviation/Acronym	Description
Primary DMCP	Primary Dredged Material Containment Pond (the northernmost DMCP)
Project area	The project area refers to all areas to be disturbed by project activities. It encompasses the DMCP study area, the dredging study area, the footprint of the temporary pipeline alignments (onshore and offshore) and the areas required for ancillary activities such as laydown area, long-term stockpiles and site office.
PTS	Permanent Threshold Shift
QGSO	Queensland Government's Statistician Office
RE	Regional Ecosystem
REEFVTS	Great Barrier Reef and Torres Strait Vessel Traffic Service
RL	Reduced Levels
RMS	Root Mean Square
SA2	Bowen Statistical Area 2
SARA	Queensland State Assessment and Referral Agency
SDA	State Development Area
Secondary DMCP	Secondary Dredged Material Containment Pond (the southernmost DMCP)
SEVT	Semi-Evergreen Vine Thicket
SIA	Social Impact Assessment
SIMP	Social Impact Management Plan
SLA	Statistical Local Area
SSC	State Suburb (Code)
T0	Terminal 0 - coal terminal to be developed by Adani at Abbot Point
T1	Terminal 1 - coal terminal at Abbot Point operated by Adani



Abbreviation/Acronym	Description
T2	Terminal 2 - land set aside for coal terminal to be developed at Abbot Point
T3	Terminal 3 - coal terminal to be developed by Hancock Coal at Abbot Point
TEC	Threatened Ecological Community
TPH	Total Petroleum Hydrocarbons
TropWATER	The Centre for Tropical Water and Aquatic Ecosystem Research
TSHD	Trailing Suction Hopper Dredge
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
TSSC	Threatened Species Scientific Committee
TTS	Temporary Threshold Shift
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change



1 Introduction

1.1 Project overview

The Abbot Point Growth Gateway Project (the Project) will develop infrastructure to support development to expand the export capacity of the Port of Abbot Point.

Abbot Point is located approximately 25km north of Bowen on the North Queensland coast. The port comprises an existing coal export facility that has been in operation since 1984. In 2008, the surrounding area was declared a State Development Area (SDA) by the Coordinator-General to provide land and plan for the establishment of industrial and port-related development of regional, State or national significance, light industry requiring co-location with that industrial and port related development and associated facilities and local utilities. In November 2014, the SDA was amended to incorporate the project area and the remaining area of Abbot Point. The regional locality of the Project is shown in Figure 1-1.

North Queensland Bulk Ports Corporation Ltd (NQBPC) is the relevant port authority.

The Project relates to activities to support development of planned Terminal 0 (T0; approved under the *Environment Protection and Biodiversity Conservation Act 1999* - EPBC Act - 10 December 2013). Dredging of berth pockets and arrival/departure apron is required to provide safe shipping access to the T0 offshore facility. The scope of the approved T0 project does not directly include dredging of the required berth pockets or apron areas.

The Project involves:

- Construction of onshore dredged material containment ponds (DMCPs) within the area previously allocated for the development of Terminal 2 (T2) and adjoining industrial land
- Capital dredging of approximately 1.1 million m³ (Mm³) *in situ* volume of previously undisturbed seabed for new berth pockets and ship apron areas required to support the development of T0
- Relocation of the dredged material to the DMCP and offshore discharge of return water via temporary pipelines
- Ongoing management of the dredged material including its removal, treatment, and beneficial reuse within the port area and the SDA, where appropriate.

Figure 1-2 illustrates the key project components. The project area is defined as encompassing the:

- DMCP study area
- Dredging study area
- Footprint of the temporary pipeline alignments (onshore and offshore)
- Areas required for ancillary activities such as laydown area, long-term stockpiles and site office.

Throughout this document, 'Abbot Point' refers to the existing Abbot Point port area and adjacent industrial land (includes the onshore parts of the project area). Where the 'Abbot Point area' is referenced, this incorporates Abbot Point (as defined above), as well as the Caley Valley Wetlands (including the western estuary) and beaches and approximately a five nautical mile radius around the existing offshore port area.



On 17 April 2015, the Queensland Department of State Development (DSD) lodged an application with the Commonwealth Department of the Environment (DoE). The Commonwealth Government determined that the Project is a controlled action under the EPBC Act and that an Environmental Impact Statement (EIS) is required. State approvals are also required for the Project and are outlined in Section 1.5.12.2.

1.2 Proponent

The Proponent of the Project, with ongoing management responsibilities, is the Queensland DSD.

The Queensland DSD's representative is:

Michael Schaumburg, Director-General, Department of State Development

T: +61 7 3452 6921

F: +61 7 3220 6465

P: PO Box 15009, City East QLD 4002

E: abbotpoint@dsd.qld.gov.au

The Queensland DSD (the Proponent) was established as an administrative unit of the State of Queensland on 16 February 2015. The Queensland DSD represents the State of Queensland in relation to the proposed action.

The Proponent has a sound record of responsible environmental management and there are no proceedings against the State of Queensland, represented by the Queensland DSD, relating to the protection of the environment or the conservation and sustainable use of natural resources under a Commonwealth, State or Territory law.

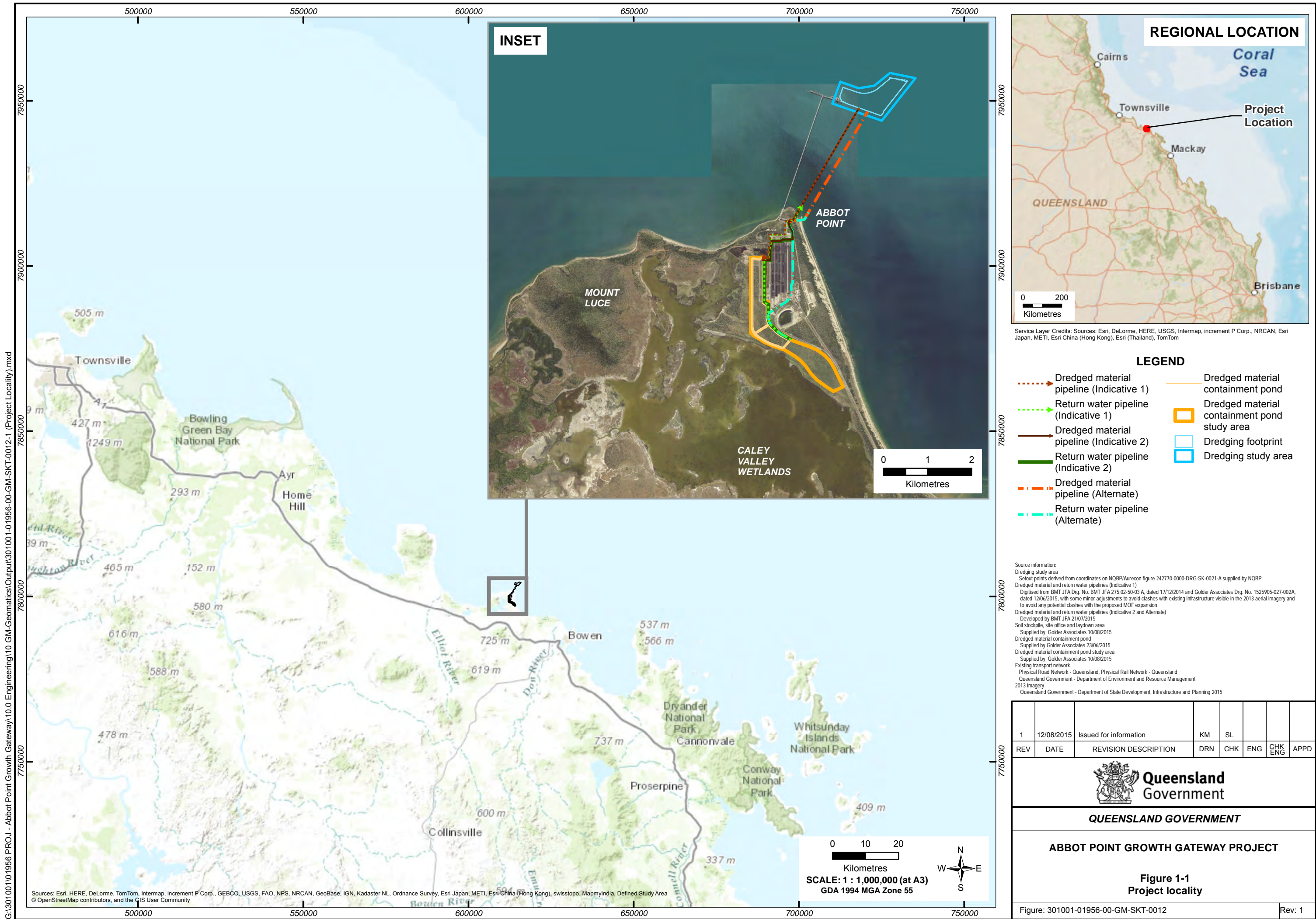
The Proponent operates within and in accordance with a planning and environmental framework, which promotes environmental responsibility, protects environmental values from harm and ensures development is ecologically sustainable. This planning and environmental framework includes a range of legislation, policies and instruments that provide for the protection of Queensland's environment, management of the State's natural resources and regulation of land uses.

It is proposed that responsibility for delivery of the Project would be transferred to NQBP prior to the commencement of construction. NQBP has a sound record of environmental management, with no proceedings against it in relation to any non-compliance with any Commonwealth, State or Territory approvals or permits.

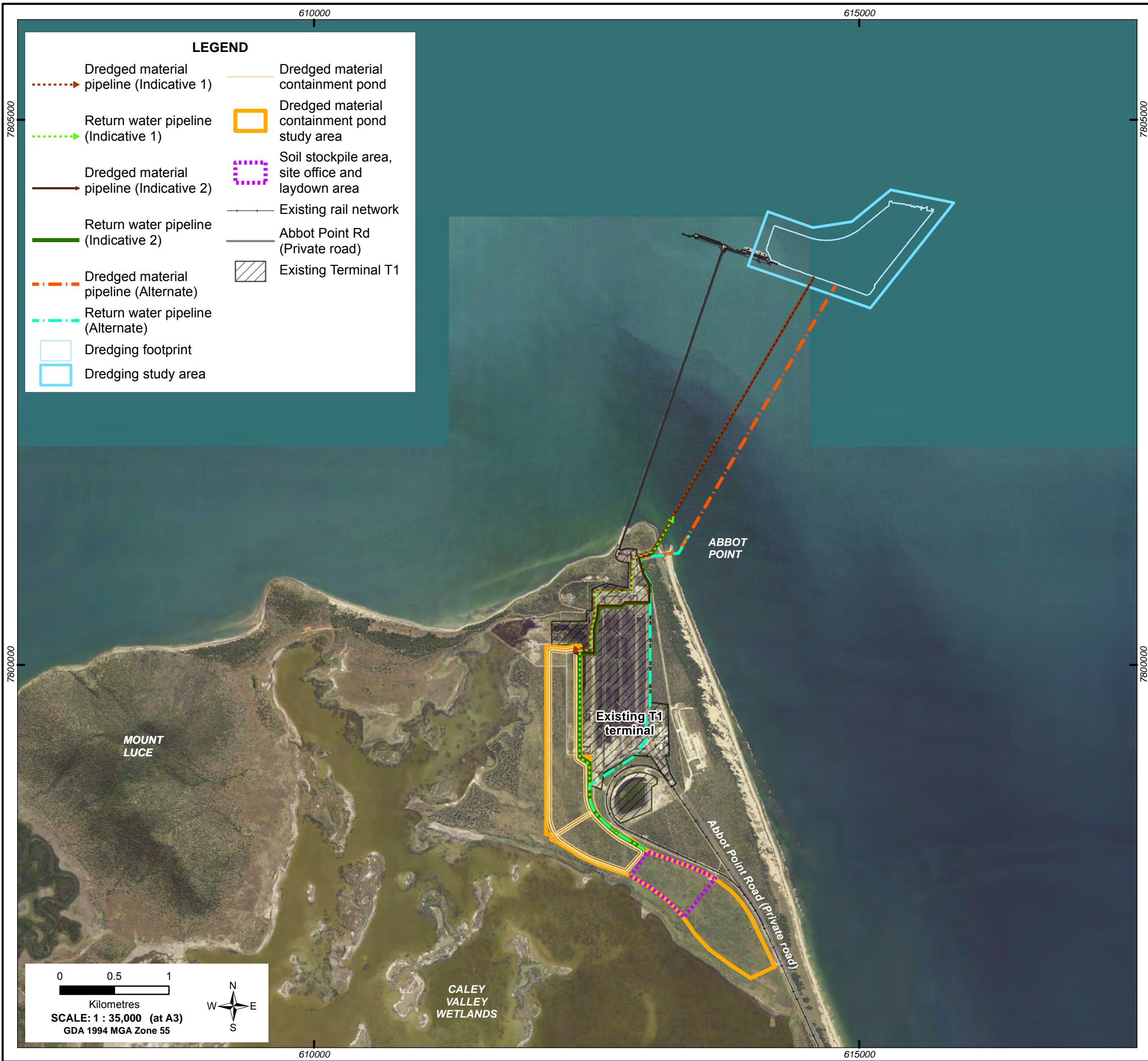
NQBP has a satisfactory record of environmental management, having undertaken many capital and maintenance dredging activities over in excess of 30 years. NQBP maintains an Environmental Management System that is externally certified compliant to the International Standard Australian Standard/New Zealand Standard (AS/NZS) International Organisation for Standardisation (ISO) 14001: 2004. The company has also developed:

- An Environment Policy
- The Port of Abbot Point Land Use Plan
- The Port of Abbot Point Environmental Management Plan (EMP).

G:\30100101956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0012-1 (Project Locality).mxd




G:\301001\101956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0013-1 (Project components).mxd



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

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digilised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Existing Terminal T1
Digilised from 2013 imagery and cadastral boundaries

1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 1-2 Project components							
Figure: 301001-01956-00-GM-SKT-0013							Rev: 1



1.3 Project background

1.3.1 General

The ongoing global growth and demand for coal coupled with the development of coal mines in the Bowen and Galilee Basins has necessitated planning for additional coal export infrastructure from Abbot Point to accommodate production and supply rates.

The Queensland and Australian Governments have signalled a preference for the expansion of existing ports, rather than the creation of new port locations on the Queensland coast. This position responds to the United Nations Educational, Scientific and Cultural Organisation (UNESCO) Mission Report (Reactive Monitoring Mission to Great Barrier Reef) which recommended that the Australian Government *“Not permit any new port development or associated infrastructure outside of the existing and long-established major port areas within and adjoining the property [the Great Barrier Reef World Heritage Area]”* (UNESCO, 2012).

Abbot Point is strategically located to provide the required support for Queensland’s coal sector, with established rail infrastructure, an existing port with potential for onshore growth on Strategic Port Land and a declared SDA designated for heavy industry and port development. The port provides existing export capacity for coal mines in the northern Bowen Basin, with coal supplied to Abbot Point by existing rail infrastructure.

There are two approved port expansion proposals at Abbot Point, namely Terminal 0 (T0; Adani Abbot Point Terminal) and Terminal 3 (T3; GVK Hancock). Construction of these projects will provide the critical export capacity required to facilitate export of coal to be mined from the Galilee Basin. Abbot Point is also a considerable distance from residential areas and is one of the few natural deep-water harbour locations along the eastern seaboard which, unlike most other Australian Ports, does not require regular maintenance dredging (NQBP, 2010).

The Project is required to facilitate the development of the new T0 by authorising the dredging of the required two berths and apron area.

In December 2011, NQBP first proposed dredging of 3Mm³ to facilitate the development of the three new proposed terminals T0, T2 and T3 and the relocation of the dredged material to an offshore relocation area (Figure 2-12) in the GBRMP. This action was approved under the EPBC Act (EPBC 2011/6213) by the Federal Environment Minister in December 2013.

The former Queensland Government Department of State Development Infrastructure and Planning then developed the Abbot Point Port and Wetlands Strategy which sought to avoid the placement of dredged material at sea, proposing onshore placement and beneficial reuse of dredged material in future port development. The Strategy consisted of two separate referrals under the EPBC Act:

1. One referral [EPBC 2014/7355] involved the construction of embankments to create primary and secondary dredged material management areas within a beneficial reuse area covering part of the Caley Valley Wetlands. This project included the construction of three sections of a rail embankment that would support the future expansion of the North Galilee Basin Rail (NGBR) project.



2. The other referral [EPBC 2014/7356] consisted of dredging approximately 1.7Mm³ of seabed for the purpose of ship berth pockets and aprons to support the development of T0 and T3.

However, these referrals were withdrawn in March 2015. The current Queensland Government has proposed an alternative onshore placement location at the proposed Terminal 2 site.

The proposed Abbot Point Growth Gateway Project is a relatively small scale and short duration dredging project, outside of the GBRMP and Caley Valley Wetlands. The Queensland DSD has referred the Project for assessment and approval under the EPBC Act, and this EIS is a requirement under this process.

1.3.2 Environmental

The Project is located within the Abbot Point State Development Area (APSDA) and the port limits of Abbot Point.

Additionally, as illustrated in Figure 1-2 the offshore components of the Project are located within the Great Barrier Reef World Heritage Area (GBRWHA) and adjacent to the GBRMP which covers part of the GBRWHA. The onshore pipelines and placement of dredged material will be undertaken adjacent to the GBRWHA and the Caley Valley Wetlands. The GBRWHA and Caley Valley Wetlands provide habitat for EPBC Act listed threatened species and communities and listed migratory species.

1.3.3 Socio-economic

Townships local to the Project include Bowen, Bowen township fringe settlements and a number of agricultural settlements between Bowen and Abbot Point. The local study area is considered to be the Bowen State Suburb (Bowen SSC) as defined by the Australian Bureau of Statistics (ABS).

The Project will likely be serviced by the broader Whitsunday Regional Council local government area (LGA) from the view of supply of workforce, goods and services.

1.3.4 Native Title, Aboriginal and European cultural heritage

The Project is situated within the boundaries of registered native title determination QUD554/2010. The native title determination found the Juru People hold non-exclusive native title rights and interests in land and waters within Abbot Point and the APSDA.

Kyburra Munda Yalga Aboriginal Corporation (Kyburra) holds the native title rights and interests on trust for the Juru People and is the prescribed body corporate for the native title holders under the *Native Title Act 1993*.

The Native Title determination is subject to a suite of tenures and Indigenous Land Use Agreements (ILUAs) that deal with development at Abbot Point and in the APSDA. This includes the Port of Abbot Point and APSDA ILUA (QI2011/063). The parties to this ILUA are the Juru People, the State of Queensland, NQBP, the Coordinator-General and Juru Enterprises Limited. It also includes the Juru People and Adani Abbot Point Terminal ILUA (QI2013/036).



There are a number of registered Aboriginal cultural heritage sites and areas within Abbot Point and the APSDA. These cultural heritage sites and areas are listed on the Aboriginal Cultural Heritage Database and Register and include shell middens and scatters at Dingo Beach, fish traps at Dingo Beach and at Shark Bay, shell middens and hearths at Dingo Beach and a camp on the western edge of the Caley Valley Wetlands basin. The registered Aboriginal cultural heritage sites and areas do not fall within the proposed action referral area.

The Catalina plane wreck is located 24km to the east of the dredging area. The Catalina is an example of the iconic Catalina or 'Black Cats' which were active in the western Pacific during World War II for long range bombing, reconnaissance and rescuing allied personnel.

1.4 Related Adani actions

The following Adani projects are approved under the EPBC Act and are associated with the Project:

- T0 being developed by Adani Abbot Point Terminal Pty Ltd (EPBC Act 2011/6194; CDM Smith, 2013a). Status of the action is 'approved'.
- The NGBR project being developed by Adani (EPBC 2013/6885; GHD, 2013b). Status of the action is 'approved'.
- Carmichael Coal Mine and Rail being developed by Adani (EPBC 2010/5736; GHD, 2013a). Status of the action is 'approved'.

However, it is recognised that the T0 development will ultimately provide export services for a range of sources including those outside of Adani's projects.

1.5 Legislative and policy framework

A number of regulatory approvals are required under both Commonwealth and Queensland legislation. This section provides an overview of key relevant legislation and policies as well as a summary of the approvals that are likely to be required for construction and operation of the Project.

1.5.1 Australian Government Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legal framework to protect and manage nationally and internationally important aspects of the Australian environment including its biodiversity and heritage places.

The stated objectives of the Act are to:

- Provide for the protection of the environment, especially Matters of National Environmental Significance (MNES)
- Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources
- Promote the conservation of biodiversity
- Provide for the protection and conservation of heritage
- Promote a cooperative approach to the protection and management of the environment involving governments, the community, landholders and Indigenous peoples



- Assist in the cooperative implementation of Australia's international environmental responsibilities
- Recognise the role of Indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity
- To promote the use of Indigenous peoples' knowledge of biodiversity with the involvement of, and in cooperation with, the owners of the knowledge.

1.5.2 Australian World Heritage Management Areas

The Australian World Heritage management principles are set out in Schedule 5 of the *Environment Protection and Biodiversity Conservation Regulations 2000*. The primary purpose of management of a declared World Heritage Property (such as the GBRWHA) must be, in accordance with Australia's obligations under the World Heritage Convention, to “*identify, protect, conserve, transmit to future generations and, if appropriate, rehabilitate the World Heritage values of the property*”. Obligations include management planning (e.g. *Great Barrier Reef 2050 Long-Term Sustainability Plan*), and the application of an environmental impact assessment and approval process that takes into account any impacts of an action on World Heritage values of the property and provides adequate opportunity for public consultation.

1.5.3 National Heritage management principles

The EPBC Act establishes the National Heritage List, which includes natural, Indigenous and historic places that are of outstanding heritage value to the Australian nation. The list includes the GBR. The National Heritage management principles are:

1. The objective in managing National Heritage places is to identify, protect, conserve, present and transmit, to all generations, their National Heritage values
2. The management of National Heritage places should use the best available knowledge, skills and standards for those places, and include ongoing technical and community input to decisions and actions that may have a significant impact on their National Heritage values
3. The management of National Heritage places should respect all heritage values and seek to integrate, where appropriate, any Commonwealth, State, Territory and local government responsibilities for those places
4. The management of National Heritage places should ensure that their use and presentation is consistent with the conservation of their National Heritage values
5. The management of National Heritage places should make timely and appropriate provision for community involvement, especially by people who: (a) have a particular interest in, or associations with, the place, and (b) may be affected by the management of the place
6. Indigenous people are the primary source of information on the value of their heritage and the active participation of Indigenous people in identification, assessment and management is integral to the effective protection of Indigenous heritage values
7. The management of National Heritage places should provide for regular monitoring, review and reporting on the conservation of National Heritage values.



1.5.4 Ecologically sustainable development

The principles of ecologically sustainable development are enunciated in section 3A of the EPBC Act. These principles have been considered and, where possible, incorporated in the Project as follows:

- a) **Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations (the ‘integration principle’)**

The Project responds to the economic and social needs of the central Queensland region. It will facilitate the development of future port terminals providing employment, income and security for the region.

The Project is appropriate in scale, meeting the needs of current projects and establishing low impact infrastructure for the future.

The Project eliminates the need to dispose of dredged material in the marine environment and Caley Valley Wetlands, thus avoiding impacts on other users and valued environmental assets.

- b) **If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (the ‘precautionary principle’)**

Throughout the project design and assessment, a precautionary approach has been adopted. The methodology employed in the assessment has identified information gaps and uncertainty. Specific studies have been commissioned to address these where possible. The Project has been designed from conception to minimise environmental impacts, both onshore and offshore. When compared with abandoned project alternatives, the Project significantly avoids and minimises impacts.

Project redesign and modification has occurred where avoidable impacts were identified, for example the alteration of the Project to avoid the Caley Valley Wetlands.

Where any level of uncertainty has remained, a risk-based and precautionary approach has been adopted. In the absence of information, a worst-case scenario favouring environmental outcomes has been applied.

- c) **The principle of inter-generational equity - that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations (the ‘intergenerational principle’)**

The Project is being undertaken within an existing port area identified as one of five priority port development areas by the Queensland Government (*Queensland Ports Strategy 2014*). The concentration of development within a select number of ports will avoid impacts in other areas and reduce the pressure on high value conservation areas along the coast.

The Project will deliver improved infrastructure and management measures to protect the values of the Caley Valley Wetlands, including opportunities to enhance and rehabilitate degraded areas.



d) The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making (the 'biodiversity principle')

The Project has eliminated the need to dispose of dredged material offshore in the GBRMP and GBRWHA. This has been done taking into account the guiding principles contained in the World Heritage Convention, the Convention on Migratory Species and the Protocol to the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972*.

For example, in the establishment of the Project it was determined essential that a cutter suction dredge (CSD) be used as this would significantly improve sediment suspension and plume impacts on water quality, in comparison to other dredging techniques.

Impacts associated with the Project are anticipated to be contained in the immediate vicinity of the Project. The ecological and World Heritage Area values within the project area will be maintained through the application of appropriate management, mitigation and offsetting measures. The objective of maintaining or enhancing the existing ecological processes of areas within, and adjacent to, the Project has been a key consideration.

e) Improved valuation, pricing and incentive mechanisms should be promoted (the 'valuation principle')

Overall drivers for the Project have included:

- Maximising use of existing disturbed onshore areas which have previously been assessed and approved for infrastructure development
- Creating opportunities to beneficially reuse dredged material through the application of best practice placement and material management techniques to achieve recovery of construction grade sands in the future
- Dredged material volumes should be reduced to focus on immediate project needs to avoid environmental impacts, unnecessary costs and the risk of creating stranded assets.

1.5.5 Great Barrier Reef strategic assessment

The Australian Government and the Queensland Government completed a comprehensive strategic assessment of the GBRWHA and adjacent coastal zone in accordance with section 146 of the EPBC Act. The strategic assessment:

- Investigated the adequacy of the existing management arrangements for the GBRWHA
- Assessed current and future development policies and planning in the GBRWHA and the adjacent coastal zone, and analysed likely direct, indirect and cumulative impacts.

The comprehensive strategic assessment has two key components; a marine component and a coastal component. The Great Barrier Reef Marine Park Authority (GBRMPA) led the marine component while the Queensland Government led the coastal component.

The assessment examined whether the appropriate planning processes and management arrangements are in place to ensure development occurs sustainably and does not impact unacceptably on MNES, including the Outstanding Universal Value of the GBRWHA.

1.5.5.1 Marine component

The *Great Barrier Reef Region Strategic Assessment - Strategic Assessment Report* recommended a number of improvements with respect to local, State and national



Section 1

Introduction

government programs. Relevant to port activities, the assessment described the need to adopt a strategic approach to port development including through, amongst other things (GBRMPA, 2014b):

- *“Improving certainty regarding the location of ports, and reducing further fragmentation of coastal ecosystems through a Queensland ports strategy that concentrates port development to around long-established major ports in Queensland*
- *Improving understanding and management of environmental impacts from dredging and dredged material disposal in the GBRWHA, recognising the current uncertainty around the duration, intensity and extent of predicted dredging material plumes, and their impacts on the region’s values. In particular by:*
 - *Exploring with proponents and government agencies all alternatives which may avoid and reduce the need for dredging and dredged material disposal, and provide better environmental outcomes*
 - *Ensuring dredging and dredged material disposal decisions take account of the Great Barrier Reef hydrodynamic and water quality guidelines, and do not exceed ecosystem thresholds”.*

The *Great Barrier Reef Region - Strategic Assessment Program Report* outlines the GBRMPA’s 25-year management program to protect and manage the GBR, including relevant MNES. The Program Report indicated the GBRMPA will support the development of a Queensland Ports Strategy concentrating port development around long-established major ports in Queensland and encourage port master planning (GBRMPA, 2014b).

1.5.5.2 Coastal component

The *Great Barrier Reef Coastal Zone Strategic Assessment Strategic Assessment Report* provides a recommendation that the Queensland Government “*Implement arrangements to concentrate port development around long-established major ports in Queensland, and encourage port master planning which includes community engagement*” (Queensland Government Department of State Development Infrastructure and Planning, 2013).

The Coastal Zone Strategic Assessment Report (amongst other things) outlines the commitments and undertakings of the Queensland Government to ensure adequate protection of protected matters of the EPBC Act.

1.5.5.3 Relevance of strategic assessments to the Project

The marine component and the coastal component conclude that the GBRMPA and the Queensland Government will support and ensure (respectively) more efficient and concentrated use of major long-established major ports, such as Abbot Point (within which the Project is proposed).

The Project is consistent with the recommendations of the GBRMPA (2014a) strategic assessment regarding the exploration of alternatives for dredging and dredged material disposal as the Project has sought to facilitate beneficial reuse of dredged material. Furthermore, the assessment of the Project (described in this report) takes account of the GBR hydrodynamic and water quality guidelines and applies appropriate impact assessment thresholds.



1.5.6 Great Barrier Reef Outlook Report 2014

In terms of the current environmental health of the GBRMP, the *Great Barrier Reef Outlook Report 2014* (GBRMPA, 2014a) assesses the current condition of the all ecosystems within the region (including mangroves, seagrass, coral reefs and open ocean), all aspects of the region's heritage values (including World Heritage, outstanding universal and cultural values and historic places) and their links with other environmental, social and economic values. The Outlook Report 2014 also examined pressures facing the GBR, current responses to these pressures and the likely future outlook for the region's values.

Assessments of ecosystem health and biodiversity in the Outlook Report 2014 indicate that the GBR as a whole retains the values and qualities contributing to its Outstanding Universal Value as recognised in its listing as a World Heritage property. The northern third of the GBR region has good water quality and its ecosystems are believed to be in good condition. However, key habitats, species and ecosystem processes in the central and southern inshore area of the GBR continue to deteriorate, particularly inshore seagrass meadows and coral reefs. The greatest risks to the GBR have not changed since the Outlook Report 2009. Climate change, poor water quality from land-based runoff, coastal development and some impacts related to fishing were identified as the major threats to the future vitality and resilience of the GBR in the Outlook Report 2014.

The Outlook Report 2014 summarises that the impacts of port operations to the marine environment include: clearing and modifying coastal habitats; disturbance, displacement, dredging, disposal and re-suspension of dredged material; injury and death of wildlife; chemical and oil spills; some contribution to marine debris; altered light regimes; diminished aesthetic values; and air and noise pollution.

The Report also highlights that the specific impacts of dredging and port infrastructure construction are well documented and most severe at the dredging site, but that some impacts (such as turbidity, sedimentation, noise and disruption of fish habitats) may occur at a distance from dredging and disposal. However, localised impacts of dredging, such as seabed disturbance, transport or re-suspension of contaminants, alteration of sediment movement and changes in coastal processes can be severe. Burial or smothering of plants and animals on the seafloor, degradation of water quality and loss and modification of habitats are highlighted as the major direct impacts of dredging and disposal of dredged material.

These specific impacts of dredging highlighted in The Outlook Report are considered in Section 6.

1.5.7 North-East Shipping Management Plan

The *North-East Shipping Management Plan* (NESMP; October 2014) has been developed by the North-East Shipping Management Group, comprised of Queensland and Australian Government agencies in conjunction with industry and key interest groups to review shipping trends and develop and oversee implementation of an integrated approach to shipping management in the GBR, Torres Strait and the Coral Sea. The plan focuses on improving safety and environmental outcomes for Safety of Life at Sea class commercial trading ship activity in Australia's north-east region.

The plan, which includes a work program, has two main aims:



- To describe measures currently in place to manage the safety of shipping in the sensitive marine environments of Australia's north-east region and propose additional protective measures to further minimise the environmental impacts of these activities in the short, medium and long-term
- To inform the *Great Barrier Reef Region Strategic Assessment* and the *Reef 2050 Great Barrier Reef Long-Term Sustainability Plan* (Reef 2050 Plan) of the current and proposed measures in place to mitigate known and potential impacts of shipping affecting the Outstanding Universal Value and integrity of the GBRWHA and other MNES.

1.5.8 Synthesis of current knowledge of the biophysical impacts of dredging and disposal on the Great Barrier Reef

In response to increasing interest from government, industry and the wider community in port development, and specifically dredging within and adjacent to the GBR region, an independent panel of experts have authored the *Synthesis of current knowledge of the biophysical impacts of dredging and disposal on the Great Barrier Reef (2015)*. This review was commissioned by the Australian Institute of Marine Science (AIMS) and the GBRMPA to assess the available information relating to the effects of dredging activities in the GBR region. As such, this report provides an independent synthesis of the current knowledge of the effects of dredging and sediment disposal on the physicochemical environment and the biological values of GBRWHA, as assessed by a panel of experts.

The Report was largely completed in late 2014. However, changes to the Report were made to take into account changes in the publicly available forecasts of dredged volumes and disposal locations given Federal and Queensland Government commitments to ban the sea disposal of capital dredged in the GBR region. In November 2014, the Federal Minister for the Environment committed to a ban on the disposal of capital dredged material in the GBRMP (which forms 99% of the GBRWHA). In February 2015, the new Queensland Government committed to legislate to restrict capital dredging to existing port facilities (within the regulated port limits of Gladstone, Hay Point/Mackay, Abbot Point and Townsville), and to prohibit the sea-based disposal of capital dredged material. The revised 2015 synthesis report accounts for this new government policy.

The expert panel summarises the potential impacts of dredging as:

- Seabed removal by excavation during dredging: dredging is generally carried out in soft-sediment habitats, sometimes supporting seagrass, and does not involve the excavation of coral reefs. The area directly affected is generally only a small proportion of the relevant habitat, though the effect is severe within the footprint and could be significant regionally. However, overall the ecological significance of direct removal to the GBR is considered small.
- Changes to bathymetry and hydrodynamics: changes are localised and sufficiently predictable via modelling.
- Increased artificial lighting and underwater noise: it may have significant impacts on marine species, though it is difficult to distinguish to what extent, if any, effects are due to dredging.
- Release of fine sediments: dredging plumes can be significant, increasing turbidity, sedimentation and reducing light availability to marine organisms. Extent and duration of plumes may have been underestimated in previous assessments.



- Potential contributions to chronic suspended sediment: sediments dispersed from dredging plumes may be re-suspended and transported to contribute to a long-term chronic increase in fine suspended sediment concentrations in the inshore GBR. The extent to which this occurs compared to background levels and impacts on marine life was not agreed on by the expert panel. Dredging may provide a significant contribution to inshore fine sediments compared to river inputs, though this is reduced by onshore placement of dredged material.

1.5.9 Reef 2050 Long-Term Sustainability Plan

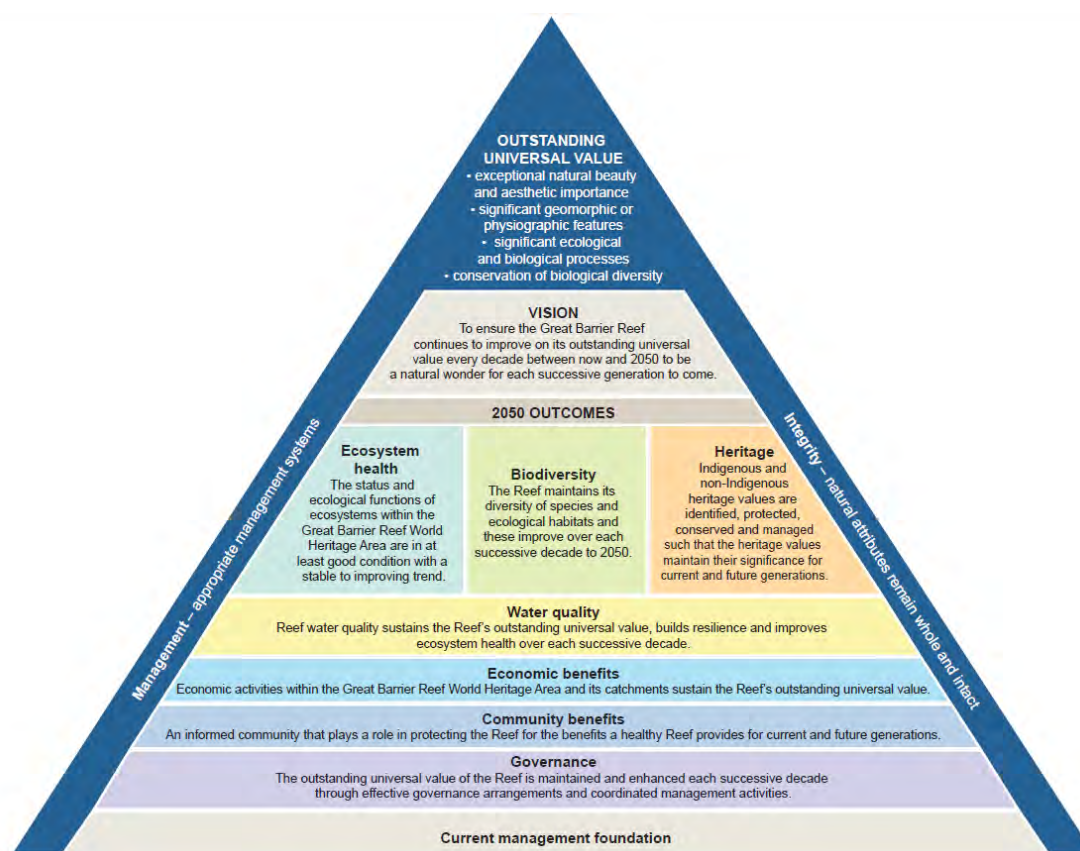
The *Reef 2050 Long-Term Sustainability Plan* (Reef 2050 Plan) responds to the World Heritage Committee's recommendation that Australia develop a long-term plan for sustainable development to protect the Outstanding Universal Value of the Reef. In spite of the recently released *Great Barrier Reef Outlook Report 2014* confirming that the Reef system as a whole retains its Outstanding Universal Value, it is still an asset which requires ongoing protection and management. In particular, the Report identified ongoing risks to the health of the Reef associated with climate change and the immediate threats of poor water quality from land-based runoff, coastal land use change, and some remaining impacts of fishing including illegal fishing.

The vision for the GBRWHA is:

"To ensure the Great Barrier Reef continues to improve on its Outstanding Universal Value every decade between now and 2050 to be a natural wonder for each successive generation to come"

A key objective of the Reef 2050 Plan is developing Reef resilience in the face of a variable and changing climate. It proposes that by improving water quality, maintaining biodiversity and ensuring port development and shipping have minimal impact on the Reef, the government can target the activities over which it has most control.

The Plan has seven overarching themes reflecting the priorities for action, namely: ecosystem health, biodiversity, heritage, water quality, community benefits, economic benefits and governance Figure 1-3.



Source: Commonwealth of Australia, 2015

Figure 1-3 Reef 2050 overarching themes

Relevant to the Abbot Point Growth Gateway Project development, the Reef 2050 Plan includes measures by the Queensland Government to ensure that development in the GBR coastal zone occurs in an ecologically sustainable manner and that negative impacts on Outstanding Universal Value are avoided. In particular, the Australian and Queensland Governments are taking action to limit the impact of ports and port development on the GBR.

In this regard, developers of port-related projects are required to:

- Meet the standards required by the EPBC Act for protection of MNES
- Develop a Direct Benefit Environmental Offsets Management Plan to maximise the Reef's health and resilience
- Restrict capital dredging to within the regulated port limits of Gladstone, Hay Point/Mackay, Abbot Point and Townsville
- Prohibit the sea-based disposal of material into the GBRWHA generated by port-related capital dredging
- Consider the beneficial reuse of port-related capital dredged material, such as for land reclamation in port development areas, or disposal on land where it is environmentally safe to do so
- Demonstrate the project is commercially viable.



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Establish a maintenance dredging framework which identifies future dredging requirements, ascertains appropriate environmental windows to avoid coral spawning and protect seagrass, and examines opportunities for beneficial reuse of dredged material or on-land disposal where it is environmentally safe to do so.

As such, the Reef 2050 Plan ensures that port development (and associated dredging activities) in the World Heritage Area and the adjacent coastal zone are strictly controlled. The Plan also demonstrates the government's support for on-land disposal or land reclamation for capital dredged material at Abbot Point.

1.5.10 Great Barrier Reef Marine Park Regulations 1983

The *Great Barrier Reef Marine Park Regulations 1983* have recently been amended by the *Great Barrier Reef Marine Park Amendment (Capital Dredge Spoil Dumping) Regulation 2015*, to prevent the GBRMPA from granting approvals for the dumping of more than 15,000m³ of capital dredged material in the GBRMP.

The amendment also revoked the approval granted by GBRMPA to NQBP for the disposal of 3Mm³ of capital dredged material in the GBRMP, associated with the Abbot Point T0, T2, and T3 Capital Dredging Project.

1.5.11 Sustainable Ports Bill 2015

The *Sustainable Ports Development Bill 2015* provides for the protection of the GBRWHA through managing port-related development in and adjacent to the area. This will be achieved through:

- Prohibiting particular future development in the GBRWHA
- Providing for the development of master plans that establish a long-term vision for the future development of priority ports consistent with the principles of ecologically sustainable development
- Implementing master plans through port overlays that regulate development in and surrounding priority ports.

It implements the key port-related actions of the Reef 2050 Plan to:

- Restrict new port development in and adjoining the GBRWHA to within current port limits and outside a State Marine Park
- Prohibit capital dredging for the development of new or expansion of existing port facilities in the GBRWHA outside the priority ports
- Prohibit the sea-based disposal of port-related capital dredging spoil material within the GBRWHA
- Mandate that capital dredged material generated at the priority ports be beneficially reused or disposed of on land where it is environmentally safe to do so.

The Bill requires a long-term approach to planning at priority ports to ensure coordination and consistency of planning and development. Accordingly, the Bill mandates port master planning for priority ports: ports of Gladstone, Abbot Point, Hay Point/Mackay and Townsville.

The proposed legislation aims to balance the development of the State's major ports with the protection of the GBR, providing better economic and environmental outcomes for Queensland.



The Sustainable Ports Bill supersedes the previous government's *Queensland Port Strategy 2014*.

1.5.12 Regulatory approvals

1.5.12.1 Australian Government

The Project was referred under the EPBC Act to DoE on 17 April 2015. In accordance with sections 75 and 87 of the EPBC Act, via correspondence dated 14 May 2015, the Australian Government Minister for the Environment (the Minister) deemed the Project a controlled action assessable under the EPBC's EIS process.

The Project's controlling provisions are:

- World Heritage properties
- National Heritage places
- Listed threatened species and communities
- Listed migratory species
- Commonwealth marine areas
- Great Barrier Reef Marine Park.
- The Commonwealth Government determined that an EIS is required for the Project

1.5.12.2 Queensland Government

The Project triggers a number of Queensland State approvals and permits. Offshore and onshore works will be subject to two distinct approval processes, as follows:

- Offshore works will be carried out within Strategic Port Land and will therefore be subject to the approval process under the *Sustainable Planning Act 2009* and associated Integrated Development Assessment System process.
- Onshore works will be wholly located within the APSDA and will therefore be subject to the approval process under the APSDA Development Scheme (November 2014) for which the Coordinator-General will be the Assessment Manager, with relevant referral entities for technical advice.

The following key approvals are triggered by the Project:

- Offshore works:
 - Operational work that is tidal works: the proposed dredging and land placement activities are considered tidal works under the *Sustainable Planning Act 2009* because they occur in tidal waters.
 - Operational work that is the removal, damage or destruction of marine plants: the proposed dredging will cause removal of, and disturbance to seagrass, which is classed as marine plants under the *Queensland Fisheries Act 1994*.
 - Approval from Maritime Safety Queensland (MSQ), ensuring the proposed works are carried out safely, without undue restrictions on maritime traffic, professional and recreational fishing activities.
 - Environmental Authority to carry out an Environmentally Relevant Activity (ERA) 16(1)(b), being dredging more than 1,000,000t in a year, and associated Material Change of Use for an ERA.



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- Onshore works:
 - Material Change of Use and operational work under the APSDA Development Scheme, which will include the following:
 - Assessment against the APSDA Development Scheme assessment criteria
 - Assessment of proposed remnant vegetation clearing
 - Assessment of the Project's traffic impacts on the Bruce Highway and its intersection with Abbot Point Road
 - Assessment of the Project's traffic impacts on existing railway crossings and traffic on Abbot Point Road
 - Assessment of the Project's proposed development on land owned by NQBP
 - Assessment of DMCP construction earthworks encroaching over a small portion of the Caley Valley Wetlands mapped Wetland Protection Area (although not encroaching on the wetland itself).

The assessment process applicable to the offshore works under the *Sustainable Planning Act 2009* includes a thorough assessment of the potential environmental impacts of each activity involved, with a particular focus on Matters of State Environmental Significance.

The assessment carried out by the Department of Environment and Heritage Protection (DEHP) of the application of an Environmental Authority for ERA16(1)(b) focuses on the potential environmental impacts of the dredging operations to water, air, land and also considers impact of waste production. DEHP's assessment of the application for tidal works considers impacts of the installation and operation of marine pipelines to the marine environment as well as those of the return water discharge. Potential impacts to seagrass are assessed in detail by the Commonwealth Department of Agriculture when considering the approval application for removal, damage or destruction of marine plants.

As part of their assessments, the above government departments will consider the impact prevention, minimisation and management measures proposed by the project proponent. Further, they can require additional measures to be implemented to ensure sound environmental outcomes. In addition, compliance with approval conditions can be verified by the departments to ensure the required prevention, minimisation and management measures are implemented by the Proponent.

The assessment of the Material Change of Use application for the onshore works carried out by government departments under the APSDA Development Scheme encompasses various environmental matters including contaminated land, Acid Sulfate Soils (ASS), water quality and wetland integrity. These assessments are generally undertaken by DEHP as technical advice agency to the Coordinator-General. Similar to the *Sustainable Planning Act 2009* assessment process, prevention, minimisation and management measures proposed by the Proponent are evaluated and additional measures can be imposed prior to approval being granted or as approval conditions. Verification of compliance with approval conditions also applies.

1.5.13 International agreements

Australia is a signatory to a range of international conventions and agreements that obligate the Australian Government to prevent pollution and protect specified habitat, flora and fauna. The conventions relevant to the Project are listed in Table 1-1. Also listed are the obligations



and their relevance to the Project; and the sections of the EIS where these obligations are addressed where relevant.

Table 1-1 International conventions, Australia's obligations and Project relevance

Convention or Agreement	Overview	Obligations and Relevance	How Addressed in EIS
Migratory bird agreements between Australia and the north Asian countries of Japan (Japan-Australia Migratory Bird Agreement), China (China-Australia Migratory Bird Agreement) and the Republic of Korea (Republic of Korea-Australia Migratory Bird Agreement)	<ul style="list-style-type: none"> Protects migratory bird habitats Limiting circumstances where migratory birds may be taken or harmed. 	<p>Obligation is to introduce protective measures for the preservation of species or sub-species of migratory birds which are listed in the agreements.</p> <p>Relevant to direct or indirect impacts on relevant species that may be impacted as a result of the Project.</p>	All migratory bird species listed in the annexes of the bilateral agreements are protected in Australia as matters of National Environmental Significance under the EPBC Act. Potential project-related impacts to migratory birds are assessed in Section 4.4.7.
Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 2003	<ul style="list-style-type: none"> Improves the status of threatened migratory species through national action and international agreements. 	<p>Obligation is to introduce protective measures for the preservation of all terrestrial, marine and avian migratory species listed in appendices 1 and 2 of the convention.</p> <p>Relevant to direct or indirect impacts on relevant species that may be impacted as a result of the Project.</p>	All terrestrial, marine and avian migratory species are protected in Australia as matters of National Environmental Significance under the EPBC Act. Potential project-related impacts to these species are discussed in Section 4.
Convention concerning the protection of the World Cultural and Natural Heritage 1972	<ul style="list-style-type: none"> Identifies, protects and conserves cultural and natural heritage sites. 	<p>Obligation is to ensure those places listed as either World or National Heritage are protected from adverse impacts.</p> <p>Relevant to the marine components of the Project that are within</p>	The GBRWHA is the only listed World or Natural Heritage place relevant to the Project. Potential project-related impacts to this area are discussed in Section 4.6.



Convention or Agreement	Overview	Obligations and Relevance	How Addressed in EIS
		the GBRWHA.	
United Nation Convention on Biological Diversity 1992	<ul style="list-style-type: none"> Ensures conservation of biological diversity and sustainable use of its components Promotes fair and equitable sharing of the benefits drawn from genetic resources. 	<p>Obligation is to identify and monitor components of biological diversity and threats to these components and adopt necessary conservation measures.</p> <p>Relevant to construction and operation of the Project where biological impacts may result.</p>	<p>Under the convention, Australia is required to create a system of protected areas to conserve ecological important ecosystems and biodiversity.</p> <p>The GBRMP and the Caley Valley Wetlands are the closest protected areas to the Project; the potential impacts to these protected areas are discussed in Section 4.44.4 and 4.7 respectively.</p> <p>Appropriate mitigation and management measures which address any potential impacts are included in these sections.</p>

1.6 Stakeholder engagement

1.6.1 Stakeholder consultation process

The Abbot Point Growth Gateway Project represents an environmentally and fiscally responsible approach to expanding the Port of Abbot Point. In accordance with the Queensland Government's commitment to protect the Reef:

- No dredging will occur in the GBRMP
- No dredged material will be placed in the GBRMP or GBRWHA
- Dredged material will not be relocated to the Caley Valley Wetlands.

It is also consistent with Australian and Queensland Government commitments for managing and protecting the GBRWHA, including those actions detailed in the Reef 2050 Plan.

Pending approval, construction of the port expansion will directly provide employment and economic development opportunities in the communities of Bowen, Mackay and Townsville. Once the expanded port is operational, it will pave the way for significant employment opportunities across Queensland and provide a boost to the State's economy.

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The development of the Port Master Plan and future development of Abbot Point will draw on the Abbot Point Growth Gateway Project investigations.

Key stakeholder groups for the Project include:

- The Bowen community
- Government agencies, including the Whitsunday Regional Council
- Port and industry groups
- Central Queensland business and commerce groups
- Environmental organisations
- Academics in fields relating to coral, seagrass, water quality, etc.
- The tourism industry peak body
- Organisations currently involved with Abbot Point
- Traditional Owners

Consultation with advisory agencies, members of the public and other stakeholders has formed an integral part of the EIS process and will continue to be a fundamental element of the Project's development. The stakeholder consultation process aims to ensure clear, transparent, multi-lateral communication regarding the Project and particularly encourages interested stakeholders to engage with the project development process. The process provides an opportunity for the Proponent to inform stakeholders about the Project, to obtain information from stakeholder groups and to respond to concerns through appropriate actions.

Two rounds of customer research have informed the development of the Communication and Engagement Strategy. These findings have been used to develop an evidence-based approach to communications. Market research identified the need for a multi-layered approach to communications that takes into account levels of awareness and understanding of the Project and associated issues and government policies.

1.6.2 Communications and Engagement Strategy

A Communications and Engagement Strategy for the approvals stage of the Abbot Point Growth Gateway Project has been developed and is currently being implemented. This strategy builds on the network of stakeholders identified for the previous projects.

It focuses on providing project updates and information on relevant government initiatives to key stakeholders, including the Bowen community. Given the feedback and interest shown on the previous project, making this information easily accessible to members of the public, not just in Queensland but across Australia, was a priority.

The Communications and Engagement Strategy includes:

- Communication objectives
- Situational analysis
- Market research findings
- Review of previous communications
- Strategic approach
- Communication protocols
- Evaluation methods
- Action plan
- Stakeholder contact database.



1.6.2.1 Engagement objectives

The main objective of the Engagement and Communications Strategy is to provide information to government departments, approval agencies, industry, local communities and businesses, and the general public including State-wide, national and international audiences.

Stakeholder engagement and communication activities for the Project have included:

- Identification of new stakeholders
- Reconnecting with and building stakeholder networks from those of previous projects
- Direct communication with key stakeholder groups to provide an understanding of the Project, the approval processes and avenues to provide feedback
- Engaging with members of the Bowen, Mackay and Townsville communities to identify concerns, issues and interests
- Raising awareness of the Project's scope and key differences from that of previous project proposals for the Port of Abbot Point
- Fostering regular and ongoing communication with stakeholders, including the Bowen community, to ensure issues are captured and project information and progress updates are easily accessible.

These communication objectives are also supported by the following communication goal of the Queensland DSD to *"build and maintain confidence in government's capacity to lead and deliver on State development opportunities for Queensland's future"*.

Communications also highlight how the Project adheres to the Queensland Government's policies and community expectations of the Project.

1.6.2.2 Market research

Market research was commissioned in October 2014 to assess awareness and attitudes associated with Abbot Point, and to better understand the information needs of the community. A total of 971 interviews and online surveys were conducted.

A second round of market research was conducted in June 2015 to again assess awareness and to gain a more thorough understanding of information needs. A total of 1,011 interviews and online surveys were conducted.

Both rounds of research included online surveys focused on Queensland residents aged 18 years and over living in:

- Brisbane
- Gold Coast
- Sunshine Coast
- Other South-east Queensland
- Gympie/Maryborough
- Bundaberg
- Rockhampton/Gladstone
- Bowen/Whitsunday
- Mackay
- Townsville
- Cairns/Innisfail



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- Far North Queensland.

Smaller market research samples were also undertaken in Sydney and Melbourne, given that the department has received correspondence from interested persons in these locations.

Key findings from the research included:

- Most respondents could see the benefits of infrastructure development, with almost 80% of Queenslanders believing that it is critical to growth in Regional Queensland
- Key concerns included:
 - Minimising the risk of shipping accidents, oil spills, etc.
 - Minimising the impact of dredging on coral reefs, sea grass and marine life
 - Limiting damage to the Reef
 - The Project must follow strict environmental conditions.

Findings from market research have been used to inform information requirements as well as communication tools and engagement schedules currently being implemented.

Communication materials focus on providing an overview of the Project and addressing these concerns.

1.6.2.3 Approach to communications and engagement

Based on market research findings and an analysis of communications for previous Abbot Point expansion projects, the Communications and Engagement Strategy aims to support a range of project messages and increase the opportunity to connect and communicate with stakeholders.

This strategy identifies activities currently being implemented to address the following:

- Information needs of the public. These activities focus on developing a widespread understanding of the Project as a viable solution for port expansion that would deliver both environmental protection and economic development goals.
- Information needs of the local community and businesses. These activities aim to provide information on the indicative construction timetable, the tangible benefits to regional communities and opportunities for local businesses and workforces.
- Information needs for key stakeholders. These activities aim to engage with stakeholders from industry, peak bodies, economic development groups, academic and environmental sectors to develop a comprehensive understanding of the Project and of the need for the port's expansion.
- Public consultation requirements under statutory approval processes, in accordance with Commonwealth DoE guidelines. These activities support the transparent implementation of public consultation and ensure the opportunity to 'have your say' is broadly communicated.

This approach, which aims to provide detailed and balanced information, is supported by market research findings.



1.6.3 Engagement methods

The following communication and engagement tools and activities have been or are currently being implemented:

- Direct stakeholder engagement
- Community feedback opportunities through the dedicated email address and community hotline
- Website information hub
- An online community of industry, community members and interested parties
- Direct engagement (meetings, letters, emails)
- Suite of information materials.

1.6.3.1 Direct stakeholder engagement

The project team's contact details have been made available, with one-on-one engagement occurring regularly, especially with community members.

Many phone calls were received from members of the public and key stakeholders following the announcement of the Abbot Point Growth Gateway Project, while many proactive phone calls have been made by the project team to establish new contacts to grow the existing stakeholder network and to communicate project information.

1.6.3.2 Community feedback opportunities

Media statements: Five media releases for the Abbot Point expansion project have been sent to all media outlets across the State and continue to be available to the public from the Queensland Government's statement page:

- <http://statements.qld.gov.au/Statement/2015/3/11/palaszczuk-govt-charts-new-course-for-abbot-point>
- <http://statements.qld.gov.au/Statement/2015/4/18/galilee-basin-coal-jobs-come-one-step-closer>
- <http://statements.qld.gov.au/Statement/2015/5/19/next-stage-begins-for-abbot-point-expansion>
- <http://statements.qld.gov.au/Statement/2015/7/1/statement-from-treasurer-curtis-pitt>
- <http://statements.qld.gov.au/Statement/2015/6/24/tender-process-starts-for-port-of-abbot-point-expansion>

Email: a dedicated email address was established in March 2015 and has been promoted consistently as the Project progresses.

Community hotline: A community hotline phone number was established for the previous project on 3 October 2014. This dedicated hotline remains in use and is frequently utilised by members of the Bowen and surrounding communities to gain information on the Project's progress. The project team has responded to approximately 150 hotline phone calls.

Mail: From the announcement of the project in March to 30 June 2015, 34 letters and emails have been received by the Department and the offices of the Premier, Deputy Premier and Minister for State Development in relation to the port's expansion.

Website: The Project has had a high profile presence on the Queensland DSD's website since March 2015. This included a large banner on the homepage, which received 48,815



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visits between 11 March and 3 July 2015. The Project also has a dedicated sub-section on the website which attracted a total of 5,784 hits over the same period.

Departmental events: The Project had a large presence at the Department's premier event, the Regional Queensland Showcase. This event was held in Brisbane to promote Queensland's regional communities and was attended by over 2,500 people. The Project was promoted on the Department's stand through audio visual displays and handouts, as well as on NQBP's display stand.

Social media: based on market research and the findings of the previous project, a dedicated twitter account was established. @abbotpoint sends out tweets each weekday. These tweets provide information regarding the Project's progress, the necessity of Queensland's ports, environmental information and related project information. The account was established on 15 May 2015 and as at 15 July 2015 had 156 followers. The online community continues to grow rapidly, as most tweets are re-tweeted numerous times. This has proved an essential tool in providing regular information to the community and key industry stakeholders.

National advertising: Public notices were published in *The Australian*, the *Mackay Daily Mercury* and *The Bowen Independent* newspapers to launch the public consultation period.

Project referral: The project referral has been available to the public on the Commonwealth DoE website since 17 April 2015. During the public consultation period for the project referral, approximately 39,700 responses were received by the Commonwealth Government.

1.6.4 Key stakeholder engagement activities

Significant engagement activities were undertaken for the previous project with environmental, industry, fishing and business and community groups. Engagement activities will continue to focus on these groups.

The following activities are integral to the Project's engagement schedule and are currently being implemented:

- Community information session
- Mackay and Bowen business forum
- Stakeholder information sessions with:
 - Conservation and wetland groups
 - Industry groups
 - Fishing industry
 - Organisations directly involved with the Port of Abbot Point and associated infrastructure
 - Academic groups
 - Indigenous groups (see also Section 8.1)
 - Local government
 - Harbour Master.



1.6.4.1 Intra-government engagement

For the duration of the Project, the team has been engaging with relevant Queensland Government and Commonwealth Government agencies. These include:

- Department of Environment and Heritage Protection and the Office of the GBR
- Department of the Premier and Cabinet: consultation and collaboration with the Reef Plan Secretariat, including regular briefings for the State and Commonwealth Government's Ministerial Forum
- The Queensland DSD, including ongoing consultation with:
 - Queensland Ports Strategy team
 - Great Barrier Reef team
 - Ports Master Planning team
 - Economic Research and Analysis
 - Office of the Coordinator-General
- Ongoing consultation with the Federal DoE, including:
 - GBRMPA
 - Wildlife, Heritage and Marine Division
 - Office of the Assistant Secretary, Queensland Branch.

1.6.5 Issues identified through consultation

Engagement to date has identified a number of potential project issues, which have been considered in the development of the EIS. These issues have been summarised in Table 1-2.



Table 1-2 Stakeholder issues and concerns identified to date

Issue	Description
Shipping operations	<ul style="list-style-type: none"> ▪ Increase in volume of ships along the Queensland coastline
Port operations	<ul style="list-style-type: none"> ▪ Coal dust
Port land and adjacent wetland	<ul style="list-style-type: none"> ▪ Impacts on flora and fauna
Assessment	<ul style="list-style-type: none"> ▪ Environmental assessment process (Commonwealth)
Dredging	<ul style="list-style-type: none"> ▪ Turbidity ▪ Seagrass ▪ Coral ▪ Marine wildlife, including dolphins and turtles
Sedimentation ponds	<ul style="list-style-type: none"> ▪ Design ▪ Return water releases ▪ Management of spoil ▪ Issues relating to learnings from the Port of Gladstone
Reef	<ul style="list-style-type: none"> ▪ Health of the GBR ▪ Water quality ▪ The UNESCO World Heritage Committee's decision not to list the Reef as 'in danger'
Fishing	<ul style="list-style-type: none"> ▪ Access to commercial fishing areas ▪ Impacts on commercial fishing grounds ▪ Compensation ▪ Increase in volume of ships and anchorages
Economic	<ul style="list-style-type: none"> ▪ Importance of regional development (particularly to Bowen community) ▪ Employment and training opportunities ▪ Use of local suppliers ▪ Lengthy process of approvals



1.6.6 Ongoing engagement and communication

The project team will deliver ongoing stakeholder engagement and communication activities throughout the life of the Project to ensure stakeholders have access to information and the opportunity to provide feedback.

This feedback will be addressed and incorporated into communication planning to ensure that the Project is meeting its commitments and is continuously improving engagement efforts.

Overview of proposed engagement activities

- National advertising and commencement of public consultation on draft EIS
- Twenty business days public consultation on EIS
- Community information session in Bowen
- Mackay and Bowen business forum
- Industry group briefings in Brisbane
- Academics briefing in Townsville
- Meeting with fishing groups in Bowen
- Conservation group and wetland briefing in Brisbane
- Ongoing briefings with local, State and Federal Government stakeholders

1.7 Environmental Impact Statement approach

The approach to environmental assessment is tailored to address the EIS Guideline provided by DoE (**Appendix A**), and in doing so assess the environmental impacts of the Project and particularly the potential for the Project to impact on the MNES controlling provisions.

The assessment undertaken to inform this report has followed a systematic, repeatable and risk-based methodology. The key steps in the method are:

1. Define the project description, including spatial scale, infrastructure elements, construction activities, operational requirements, and potential related activities.
2. Using existing information to determine:
 - a) The environmental features that may potentially be impacted, including the scale at which impacts may occur
 - b) The potential impacts from each of the project activities and the environmental features that may be affected
3. Using the above information and the existing information scope, commission project-specific studies to further inform the assessment. These studies were particularly focused on critical baseline information on matters such as water quality and hydrology, plume modelling, groundwater, ecology (terrestrial and marine).

A number of the specialist investigations are by nature inter-related, for example the groundwater and air quality assessments informed the hydrology, aquatic ecology and water quality investigations. These in turn informed the terrestrial ecology assessment and the overall impact assessment of MNES.



4. Using a risk-based approach and informed by the information obtained in the previous three steps, relevant experts considered and evaluated the likelihood and level of impact on surrounding environmental values.

This step included a consideration of appropriate mitigation and avoidance measures which fed back to produce a mitigated impact assessment.

5. Project impacts were specifically assessed in relation to relevant MNES (per the EPBC Act controlling provisions)
6. In accordance with the EPBC Act Offset Policy, offset strategies were then identified based on the residual significant impacts of the Project.

Topic experts have prepared all of the supporting studies.

1.7.1 Environmental Impact Statement document structure

In scoping and undertaking the EIS, particular reference has been made to addressing the EIS Guidelines for the Project (DoE, 2015) as included in **Appendix A. Appendix B** provides cross-references to the relevant EIS sections for each of the specific (Section 3) requirements of EIS Guideline.

The EIS is presented in three distinct volumes, namely:

- Volume 1 - executive summary
- Volume 2 - main report
- Volume 3 - appendices, including supporting technical studies.

Volume 2 (this document) structures the presentation of the EIS elements as summarised in in Table 1-3.



Table 1-3 Environmental Impact Statement - Volume 2 structure

Section	Description
Section 1	Introduces the Project and provides general contextual information including legislative framework, stakeholder engagement and the EIS approach.
Section 2	Provides a detailed project description and assessment of alternatives to the Project.
Section 3	Defines the environmental values relevant to the assessment and describes the current baseline condition of: <ul style="list-style-type: none"> ▪ The project area ▪ Surrounding 'general' environmental values ▪ Relevant MNES (controlling provisions).
Section 4	Presents the results of the assessment of the Project's impacts on : <ul style="list-style-type: none"> ▪ The immediate project area ▪ Surrounding 'general' environmental values ▪ Relevant MNES (controlling provisions).
Section 5	Describes the Project's approach to environmental management and the proposed approach to offsetting the Project's significant residual impacts as required by the EPBC Act Offset Policy.
Section 6	Considers impacts of activities external to the Project. Specifically: <ul style="list-style-type: none"> ▪ Describes and presents the 'consequential' environmental impacts of related projects ▪ Considers which other activities have potential to impact additively cumulatively with the Project and evaluates the risk of the cumulative impacts.
Section 7	Presents the direct and indirect greenhouse gas (GHG) emissions of the Project and compares these to global GHG emissions.
Section 8	Provides information on the broad social and economic impacts of the Project.
Section 9	Summarises the key EIS conclusions.
Section 10	Provides a list of references used during preparation of the EIS.



1.7.2 Studies informing the Environmental Impact Statement

1.7.2.1 Previous studies

Abbot Point and the adjacent APSDA have been the subject of extensive environmental studies completed as part of the Abbot Point Cumulative Impact Assessment (CIA) and other projects that have sought approval under the EPBC Act and Queensland legislation (Eco Logical Australia (ELA) and Open Lines, 2013).

Numerous Environmental Impact Assessment (EIA) investigations have been undertaken and previously used by the Commonwealth Government in the assessment and approval process. These studies have been made publicly available and subject to community consultation processes. Further, these studies were completed in the support of Commonwealth and Queensland State regulators, demonstrating a high level of endorsement.

There have been a number of recent EIA investigations undertaken at Abbot Point for a variety of projects. These impact assessments have been used as base information for this EIS and the subsequent targeted studies undertaken. The most recent and significant of which include those identified in Table 1-4.



Table 1-4 Abbot Point recent environmental impact assessment

EIA Date	EIA Title	Project Description	Project Status
2006	Abbot Point Coal Terminal Stage 3 Expansion EIS and supplement to the EIS	T1 expansion for Ports Corporation Queensland	Approved and Completed
2009	Abbot Point Coal Terminal X110 Expansion EIS	T3 development initially proposed by NQBP, later by GVK Hancock	Approved
2010	Proposed Abbot Point Multi Cargo Facility EIS	Offshore reclamation project for NQBP	Discontinued
2013	Abbot Point, T0, T2 and T3 Capital Dredging Public Environment Report (PER)	Dredging for T0, T2 and T3 proposed by NQBP	Approved
2013	Abbot Point CIA	Cumulative assessment of impacts associated with proposed development of T0, T2 and T3 (including dredging)	Completed
2013	Abbot Point Coal T0 EIS	T0 development proposed by Adani	Approved
2014	Abbot Point Wetland Strategy - Abbot Point Port and Wetland Project	Construction of dredged material management areas to receive dredged material	Discontinued
	Abbot Point Wetland Strategy - Abbot Point Dredging and Onshore Placement of Dredged Material Project	Dredging and onshore placement of material in dredged material management areas	Discontinued

Each of these assessments relied upon numerous specialist investigations to undertake their respective assessments.

1.7.2.2 Additional specialist investigations

A number of specialist investigations specific to the Project have been undertaken to support the EIS. The scope of each was determined following the review of existing information (particularly that described above). These specialist investigations (as listed in Table 1-5) are provided in **Volume 3 - Appendices**.



Table 1-5 Environmental Impact Statement - specialist investigations

Volume 3	
Appendix Number	Specialist investigation undertaken
Appendix E	Soil assessment
Appendix F	Acid Sulfate Soils investigations
Appendix G	Contaminated land assessment
Appendix H	Air quality assessment
Appendix I	Greenhouse gas assessment
Appendix J	Noise impact assessment (terrestrial)
Appendix K	Noise impact assessment (underwater)
Appendix L	Groundwater assessment
Appendix M	Marine seagrass light requirements assessment
Appendix N	Hydrodynamic modelling
Appendix O	Hydrology, water quality and aquatic ecology assessment
Appendix P1	Terrestrial ecology assessment
Appendix P2	Terrestrial ecology - assessment of alternative pipeline alignment s and soil stockpile / pipeline laydown area
Appendix P3	Terrestrial ecology - assessment of alternative pipeline alignment
Appendix P4	Assessment of implications of revised dust modelling results on terrestrial ecology
Appendix Q1	Marine ecology assessment
Appendix Q2	Marine ecology - alternate shoreline pipeline corridor impact assessment
Appendix R	Social impact assessment
Appendix S	Economic impact study
Appendix T	Fisheries impact assessment



2 Project Description

2.1 Location

Abbot Point is located approximately 25km north of Bowen on the North Queensland coast. The port comprises an existing coal export facility that has been in operation since 1984.

In 2008, the surrounding area was declared an SDA (the Abbot Point SDA, or APSDA) under the *State Development Public Works Organisation Act 1971* to facilitate the establishment of large-scale industries. In November 2014, the APSDA was amended to incorporate the Port of Abbot Point (including the project area). NQBP is the relevant port authority.

The existing Abbot Point Coal Terminal (T1) is under long-term lease (99 years) to Mundra Port Holdings P/L and currently operated by a third party operator under contract.

In 2011, T1 was expanded to increase export capacity to 50Mtpa. The T1 onshore infrastructure consists of access roads, rail loops and rail unloading facilities, coal handling, stockpiling areas, workshop, sewerage treatment plant, car park, workshop, amenities block and administration facilities. T1 offshore infrastructure consists of a trestle jetty spanning 2.75km into the Port of Abbot Point, loading conveyors, two shipping berths with mooring dolphins and associated shiploaders. A Material Offloading Facility (MOF) is also located to the south-east of the T1 jetty at Abbot Point.

Abbot Point is strategically located to provide the required support for Queensland's coal sector, with established rail infrastructure, an existing port with potential for onshore growth on Strategic Port Land and APSDA designated for this purpose. The Port provides existing export capacity for coal mines in the northern Bowen Basin, with coal supplied to Abbot Point by rail.

There are two approved port expansion proposals at Abbot Point - T0 (Adani Abbot Point Terminal) and T3 (GVK Hancock). When constructed, these projects will provide the critical export capacity required to facilitate export of coal to be mined from the Galilee Basin.

Abbot Point is also a considerable distance from residential areas. It is also one of the few natural deep-water harbour locations along the eastern seaboard of Queensland.

The onshore component of the Project, including the DMCP and onshore pipeline portions, is located within the APSDA and entirely on Strategic Port Land, on a parcel of land previously identified for the development of T2. It is bordered to the south and west by the Caley Valley Wetlands, to the north by Dingo Beach, and to the east by T1.

The offshore component, including the dredging area and offshore pipeline portions, is fully located within port limits at Abbot Point, which are bounded to the east, west and north by the GBRMP. The offshore project footprint is located within the GBRWHA. No project works are proposed within the Marine Park.

The Project's regional locality is shown in Figure 1-1.



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2.1.1 Project lots

The entirety of the Project will be undertaken in State waters, land contained within the APSDA and on Strategic Port Land.

Lots proposed to be used for the construction and operations of the Project are listed in Table 2-1 and shown on Figure 2-1 and Figure 2-2.

Table 2-1 Project lots

Lot Number	Project Component	Tenure
Offshore		
Lot 101 SP 256311	Dredging footprint	Lands Lease (State)
Lot 51 SP 243721	Dredged material delivery pipeline	Lands Lease (State)
Lot 49 SP 185904	Dredging footprint Dredged material delivery pipeline	Lands Lease (State)
Lot 50 SP 243721	Dredging footprint	Lands Lease (State)
Lot 103 SP2 71829	Dredged material delivery pipeline Return water pipelines	Lands Lease (State)
Onshore		
Lot 52 HR 1732	Dredged material delivery pipeline Return water pipelines	Lands Lease (State)
Lot 21 SP 271830	Dredged material delivery pipeline Return water pipelines	Freehold
Lot 22 SP271830	Dredged material delivery pipeline Return water pipelines	Lands Lease (State)
Lot 54 SP 243724	Dredged material delivery pipeline Return water pipelines	Freehold
D SP 243724	Dredged material delivery pipeline Return water pipelines	Easement
Lot 33 SP 124849	DMCP	Freehold
Lot 48 SP 243724	Dredged material delivery pipeline	Freehold



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Lot Number	Project Component	Tenure
	Return water pipelines	
Lot 52 SP 243724	DMCP	Freehold
	Dredged material delivery pipeline	
	Return water pipelines	
Lot 58 SP 240224	DMCP	Freehold
	Return water pipelines	
Lot 57 SP 240224	DMCP	Freehold
	Return water pipelines	
Lot 33 SP 253263	DMCP	Freehold
	Return water pipelines	
Lot 53 SP 243724	DMCP	Freehold
	Return water pipelines	


It should be noted the final pipeline routes (Section 2.2.3.1) and associated Lot descriptions for temporary dredged material and return water transfer may be subject to change.

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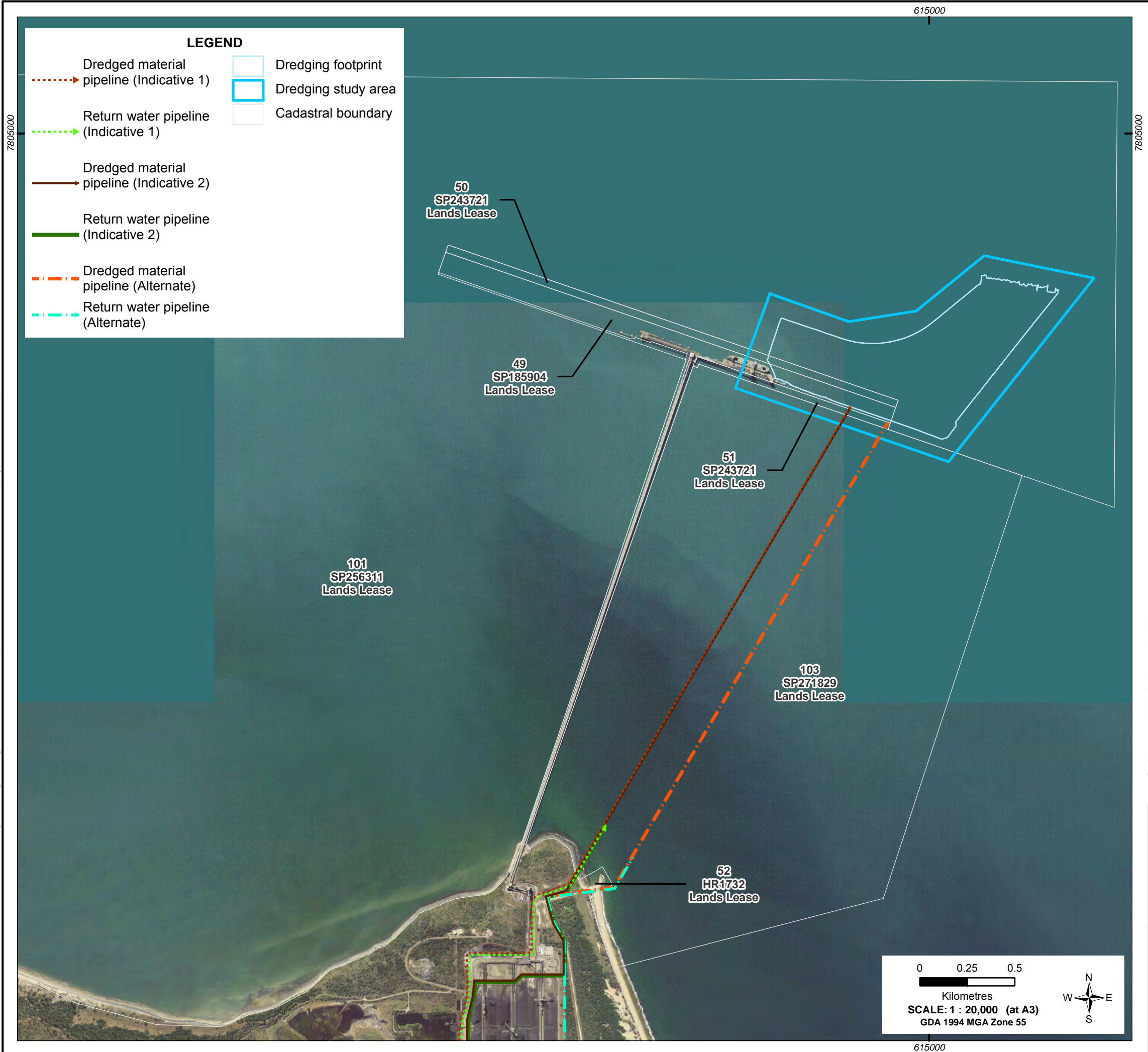


Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275 02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
<http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?lid=4091CAF1-50E6-4BC3-B3D4-229AA318231A>
Queensland Government - Department of Natural Resources and Mines


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ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 2-1 Project lots - onshore							
Figure: 301001-01956-00-GM-SKT-0014							Rev: 1

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Source information:
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[http://qldspatialinformation.qld.gov.au/catalogue/custom/detail.page?fid=\(4091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatialinformation.qld.gov.au/catalogue/custom/detail.page?fid=(4091CAF1-50E6-4BC3-B3D4-229AA318231A))
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ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 2-2 Project lots - offshore							
Figure: 301001-01956-00-GM-SKT-0015							Rev: 1



2.2 Project components

2.2.1 General

The Project will facilitate the development of T0. Dredging of berth pockets and arrival/departure apron is required to provide safe shipping access to the T0 offshore facility. The scope of the approved T0 project did not include dredging of the required berth pockets or apron areas.

The Project involves:

- Construction of the DMCP within the area previously allocated for the development of T2 and adjoining industrial land
- Capital dredging of approximately 1.1Mm³ *in situ* volume of seabed for new berth pockets and ship apron areas required to support the development of T0
- Relocation of the dredged material to the DMCP and the offshore discharge of return water via temporary pipeline infrastructure
- Ongoing management of the dredged material including its removal, treatment, and beneficial reuse within the port area and the APSDA where appropriate (subject to any relevant approvals being obtained for that use)
- Decommissioning of the DMCP, which will be planned for in a decommissioning plan to be approved prior to the end of the DMCP design life.

Figure 1-2 illustrates the key project components.

2.2.2 Dredging

2.2.2.1 Capital dredging

The capital dredging footprint is approximately 61ha, of which 10.5ha is for the berth pockets and 50.5ha is for the apron area. The extent of dredging required for the T0 project includes the development of berth pocket and apron to design depths of -21.0m Lowest Astronomical Tide (LAT) and -18.5m LAT, respectively. The area to be dredged covers the same area that was proposed to be dredged for T0 purposes as part of both the previous Abbot Point Dredging and Onshore Placement of Dredged Material project (DoE, 2014a) proposed by the Department of State Development, Infrastructure and Planning (EPBC 2014/7356) and the prior Abbot Point Terminals 0, 2 and 3 Capital Dredging project (which was proposed by NQBP and approved by DoE as described in Section 1.4 (EPBC 2011/6213).

It is estimated that approximately 1.1Mm³ *in situ* volume of dredged material will be dredged during the program.

This volume has been calculated based on:

- The proposed T0 dredging extents.
- Abbot Point hydrographic survey carried out by Queensland Government Hydrographic Services on 27 October 2014
- Dredged batter slopes of 1V:5H
- An over-dredging allowance of 0.5m
- Allowance of an extra 50,000m³ siltation from the date of the most recent survey and the commencement of dredging



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A breakdown of the volume of material to be dredged for the berths and apron of T0 is provided in Table 2-2.

Table 2-2 Estimated volumes to be dredged for T0

Design Dredge Levels		Plan Area to be Dredged (to top of batter) (m ²)			In Situ Volume to be Dredged (including 0.5m over-dredge) (m ³)		
Berth	Apron	Berths	Apron	Total	Berths	Apron	Total
-21	-18.5	105,535	501,127	606,662	376,832	674,986	1,051,818

The actual volume removed during the dredging program will be monitored by progress surveys, and confirmed at the completion of dredging by a post dredging survey.

During the dredging process, the consolidated materials are loosened from the seabed by the dredging and mixed with water to form a slurry that is pumped to the DMCP. Air and water become entrained within the soil particles during this process, and the combined volume of water, air and dredged materials received in the DMCP, or the bulked dredging volume, can be much greater than the *in situ* volume, depending on material type.

The minimum design volume to be stored, based on an estimated bulking factor of 2.15 and the bulked material settling to an average Reduced Level (RL) of RL 7.0m, is 2,370,000m³.

Dredging and deposition of the dredged material into the DMCP will be completed in a single campaign over approximately 5 to 13 weeks, after which dewatering and consolidation will occur over time. The dredging operation will operate on a 24 hours per day, 7 days per week cycle to limit the length of the campaign.

2.2.2.2 Maintenance dredging

Abbot Point is a naturally deep water port which, unlike most other Australian Ports, does not require regular maintenance dredging (NQBP, 2010). The existing berth pockets at T1 have only required two minor campaigns of maintenance dredging (in 1986 and 2008) since the port commenced operations in 1984, despite the area having been subject to a number of extreme cyclonic events during that time.

Examination of records for the berth originally dredged at the port (a second berth was developed as part of the X50 expansion of T1; 2008 to 2010) indicated that less than 20,000m³ of maintenance dredging has been required since it was commissioned in 1984 (CDM Smith, 2013b).

This demonstrates that little transport and deposition of fine grained material into dredged areas at the port has occurred since initial port construction and supports the inference by CDM Smith (2013b) that maintenance dredging is not likely to be required (for the areas to be dredged as part of the Project) for up to 20 years. Should the requirement for maintenance dredging arise, the relevant approvals would be sought as necessary.

**Section 2****Project Description****2.2.2.3 Material to be dredged**

A number of geotechnical assessments of the material to be dredged have been undertaken including the following:

- Aurecon Hatch report: Abbot Point Offshore Geotechnical investigation Report, Volume 1 and 2 dated 15 July 2009 and reference number H6000-30-001 (T0)
- Golder Associates report: Abbot Point Offshore Geotechnical Investigation, dated November 2012, Fieldwork report with reference number 127681206-009-R-Rev0 and Laboratory Testing report with reference number 127681206-010-R-Rev0 (T0)
- GHD report: Hancock Coal Offshore Geotechnical Investigation, Factual Report, dated May 2012, and reference number 41-23408-C-RP-004 Rev 0 (T3)
- GHD report: Abbot Point, Terminals 0, 2 and 3, Capital Dredging Draft Environmental Report, (EPBC 2011/6213/GBRMPA G34897.1), Appendix G: Sediment Sampling and Analyses Plan Implementation Report, dated July 2012
- Various earlier investigations have been executed since 1977 for Abbot Point which have been referred to in the Golder Associates report.

Marine sediment studies at Abbot Point have essentially identified four material types, based on material composition, as follows:

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

The four material types identified each exist as a soil matrix of sand, silt, clay and some gravel.

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

Particle size distribution assumptions have also been derived using this existing information for use in the assessment of the Project as follows (% by mass):

- 60% coarse (sand and gravel)
- 40% fines (silts and clays).

Of the fines, 20% are assumed to silts and 20% clay.

All sediments have been screened and tested in accordance with the *National Assessment Guidelines for Dredging (NAGD, 2009)* and found not to contain contaminant substances at levels of environmental concern.

Tests of marine sediments within the dredging area indicate that whilst sediments are Potential Acid Sulfate Soils (PASS), they have a neutralising capacity greater than the acid generating capacity. This suggests that sediments are 'self-neutralising'. However, given the acid generating potential and the volume of material to be dredged and placed on land, a Preliminary Acid Sulfate Soils Management Plan (ASSMP) has been developed for the

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Project, and is attached in **Appendix X**. The Preliminary ASSMP outlines management measures including additional sampling and analysis during the placement of dredged material and contingency measures for neutralisation treatment.

2.2.2.4 Dredge plant

Prior to the commencement of dredging, the dredging contractor will establish temporary onshore facilities including site offices and laydown areas in a suitable location within the existing disturbed component of the project area.

For the purposes of the assessment it has been assumed that a medium to large CSD will be used to dredge all materials. A CSD is the most suited to the relocation of dredged materials onshore and will create considerably less turbidity at the dredging site than alternate dredging methods.

A CSD is a stationary or self-propelled vessel that uses a rotating cutter head to loosen the seabed material. A suction inlet located beneath the cutter head is connected by a suction tube directly to one or more centrifugal pumps. The vacuum force at the suction inlet sucks up the loosened material. This material mixes with water and is then pumped onshore, as slurry, by a part-floating and part-submerged pipeline. A booster pump may be required given the considerable pumping distance to the DMCP.

During significant storm events, whilst the dredge is equipped with its own storm anchor, it will likely demobilise from the dredging location and moor at a safe location out of the storm range, such as at Bowen or Townsville.

2.2.2.5 Ancillary dredge activities

The dredging contractor may also elect to mobilise a bed levelling plant to site to assist with the final clean-up of high spots at the completion of dredging. Bed levelling includes a tug or workboat towing a heavy horizontal bar across the bottom of the seafloor to knock seafloor 'spots' that are above the desired depth into adjacent deeper areas.

A range of additional vessels will be required to support the dredging activities, such as a multi-cat workboat, a tug, survey launch, crew boat and other support vessels. When not in use, these vessels will typically raft up to the dredge. Crew for these vessels will either deploy from the existing MOF, or from the nearby ports such as Bowen.

Bunkering (including activities such as refuelling and transfer of waste and sewage) is permitted on port waters, and is to be undertaken in accordance with *MSQ Guide for the Prevention of Ship-Sourced Pollution and for the Safe Transfer of Bunkers in Queensland Waters*.

Temporary anchorages for work vessels and dredge plant support vessels, including refuelling vessels, are likely to be required. Cyclone moorings will also be required if these vessels are unable to utilise existing cyclone moorings at nearby Port Denison (Bowen).



2.2.3 Pipelines

Pipelines to be installed as part of the Project include:

- Temporary dredged material delivery pipelines from the dredging area to the DMCP (to be removed on completion of dredging)
- Temporary return water pipelines (up to two) from the DMCP to a subtidal discharge location (to be removed on completion of dredging).

Dredged material (including seawater) will be pumped ashore via the dredged material delivery pipeline connecting the CSD to the DMCP. The dredged material delivery pipeline includes: floating, riser, submerged and onshore components.

The floating line is connected to the CSD and is a flexible, floating pipeline that allows the CSD to traverse the dredging area without the need to manually relocate pipeline. Up to three anchors may be used to assist the floating line to maintain its position during dredging. These are ship anchors that are expected to cause only temporary impacts and no additional disturbance outside of the dredging footprint.

The submerged line is a section of pipeline that sits on the seafloor and is connected to the floating line by a small riser line. The riser is held in position by a small floating pontoon anchored to the seafloor, and is typically located at the edge of the dredging area. The submerged line is filled with seawater and/or dredged material and the steel pipeline has sufficient self-weight to hold it stationary on the seafloor. It will also be anchored in certain locations to minimise movement.

The submerged line is joined to the onshore line which delivers the dredged material into the DMCP.

Due to the long pumping distances, a booster pumping station may be required to augment the pumping capacity of the CSD selected by the dredging contractor. The booster pumping station is typically located offshore on a large anchored barge and risers are used to connect the booster to the submerged line. Some contractors may also consider using a shore based booster station which would be located close to where the sinker line joins the onshore pipeline.

The length of pipeline required to deliver dredged material from the dredging areas to the primary DMCP will include approximately 1km of floating pipe, 3km of sinker/rising pipe and approximately 1.5km of onshore pipe. The dredged material delivery pipeline is expected to be up to 1.2m in diameter.

The return water pipeline will run from the DMCP discharge point to a shallow subtidal area near the Abbot Point headland (adjacent the existing port MOF), where return water will be discharged subject to meeting licensed discharge criteria. The length of return water pipeline will include approximately 300m of offshore pipeline, and approximately 4.0km of onshore pipeline. The discharge depth is expected to be approximately -4m LAT.

The CSD will typically only be dredging and pumping material into the DMCP for approximately 55 to 65% of the time, as a CSD's normal operation requires significant periods of 'downtime', e.g. to move locations, for maintenance or refuelling. However, the return water pumping system is expected to operate close to 100% of the time to maintain water levels within the ponds and to ensure return water quality meets the approval conditions for discharge limits.

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The return water system will consist of either one or two return water pipelines to suit the dredging contractor's operation.

2.2.3.1 Pipeline alignments

Three pipeline alignment options are being considered: Indicative 1, Indicative 2 and Alternate (refer Figure 2-3). These options are being discussed with relevant stakeholders and have sought to maximise the use of existing disturbed areas. The preferred alignment will be selected in consideration of the needs of existing port users and construction limitations. As design evolves, further information will be provided to DoE and included in the final EIS.

Where appropriate and on land, the dredged material and return water pipelines will be co-located to minimise disturbance. The pipeline corridor width for the onshore section is expected to be up to 12m wide when the dredged material delivery and return water pipelines are run concurrently and where appropriate land is available.

Indicative 1 dredged material delivery pipeline and return water pipeline follow the northern most alignments. Offshore, Indicative 1 dredged material delivery pipeline extends to the dredging area while Indicative 1 return water pipeline extends to the designated subtidal return water discharge location. Both pipelines cross the shoreline to the north of the MOF. From the shoreline, the Indicative 1 alignments traverse a portion of disturbed vegetation and then run adjacent to the existing T1 conveyors in a north-south direction. At the northern boundary of the T1 coal stockpile area, the alignments run east-west across an area previously used as a quarry for extraction of construction materials. The alignments then run in a north-south direction along the western boundary of T1, with the dredged material delivery pipeline terminating in the north-east corner of the DMCP and the return water pipeline continuing adjacent to the eastern DMCP embankment to the south-east corner of the DMCP.

Indicative 2 dredged material delivery pipeline and return water pipeline share the same offshore alignment as Indicative 1 alignments and cross the shoreline at the same location, north of the MOF. From the shoreline, the Indicative 2 alignments traverse a portion of disturbed vegetation and then continue along the road running east-west between the T1 conveyors and the MOF. The Indicative 2 alignments then follow the north-south road located east of T1, before joining with and following an internal east-west road through T1. Along this road, pipeline infrastructure will run beneath stacker-reclaimer infrastructure and will be located such that it causes minimal disturbance to existing operations. The Indicative 2 alignments then follow an internal north-south road along the western boundary of T1 before turning east and reaching the north-east corner of the DMCP. The dredged material delivery pipeline terminates at this location, while the return water pipeline continues along the same alignment as the Indicative 1 return water pipeline, adjacent to the eastern DMCP embankment, terminating at the south-east corner of the DMCP.

The Alternate dredged material delivery pipeline and return water pipeline follow an independent offshore alignment to the Indicative 1 and Indicative 2 alignments, being located approximately 200m further to the south-east and crossing the shoreline south of the MOF. The Alternate dredged material delivery pipeline provides an alternative alignment to its Indicative 2 equivalent, starting west from the intersection between the road running east-west from the MOF and the north-south road located east of T1. Similarly to the Alternate



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dredged material delivery pipeline, the Alternate return water pipeline follows the road leading to the MOF until the aforementioned intersection. At this intersection, it turns south along the road to the east of T1 as per the Indicative 2 alignments. Where the Alternate return water pipeline meets the internal east-west T1 road, it continues south along the eastern boundary of T1 until the southern end of the coal stockpiles, where it proceeds in a south-westerly direction along the existing rail loop. It then reaches the eastern DMCP embankment and turns towards the south-eastern corner of the DMCP, along the same alignment as the Indicative 1 and Indicative 2 return water pipelines.

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Source information:
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Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Existing Terminal T1
Digitised from 2013 imagery and cadastral boundaries

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Figure 2-3 Alternative pipeline alignments							
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2.2.3.2 Pipe procurement and installation

Pipeline segments may be delivered to Abbot Point either by road or sea. Pipelines transported by road will be delivered to an onsite laydown area. Laydown areas for pipe stacking and storage are anticipated to include the existing laydown yard/works area at the T0 site, or alternatively an area south-east of the DMCP, as an extension to the site office and laydown area.

The submerged pipeline will be fabricated by welding individual pipe lengths into a series of long 'strings' between 500m to 1,000m long. Should the submerged pipe be delivered to Abbot Point by road, the strings will be fabricated at a convenient laydown area onsite (likely near the existing port MOF). The strings will be capped with 'blank flanges' at either end allowing them to remain buoyant in water. Marine support vessels (tug, or multi-cat workboat) will be used to pull strings offshore as they are fabricated until the desired submerged pipe length is achieved. Depending on available area at the existing MOF and other port user requirements, a corridor to the south of the MOF may be required to tow the string lengths offshore. The approximately 12m wide corridor will be subject to disturbance due to pipe movement. Until required, pipe strings will temporarily be stored offshore in a suitable location (e.g. adjacent the MOF) either: as a submerged pipe string on the seafloor (appropriately secured and in a location considerate of benthic conditions and sensitive receptors), or as a pipe floating string at a temporary anchorage.

Alternatively, should the submerged pipe be delivered to Abbot Point by sea, the pipes may be welded into strings at another location off-site (e.g. Townsville), ends capped and towed to the port by tugs over sea.

Once all the necessary pipe strings are fabricated, the first string will be towed into the final submerged pipeline position by tug and workboat. The first string will be towed to the landward end so the connection to the onshore pipeline can be completed. The pipeline is then partially submerged, with the seaward end raised to the surface by workboats until the next pipe string is brought into position. The first and second pipe strings are connected together by a bolted flange connection or ball joints, and the second pipeline is then partially submerged as the line is extended out to sea. The process is repeated until the desired sinker line length is achieved, with the end of the submerged line connected to the riser for later connection to the CSD or booster pumping station as required.

The floating pipeline will be connected onshore by a series of flexible joints which allow the pipe to move so that it can follow the dredge as it traverses the dredging area. The floating line is towed into position and connected to the riser and to the CSD. The position of the floating line during dredging is controlled by tethering it to support vessels or to temporary anchors.

The onshore pipes will be constructed by moving individual pipe lengths into position on the respective pipeline alignments by truck and crane, whereupon they are connected together and to the sinker line or to the DMCP return water pumps as required through flanged (bolted) connections.

To demobilise the sinker pipe, the floating line is disconnected and compressed air is pushed through the pipe from the seaward end expelling water at the shoreward end until the entire

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sinker line is afloat. Each bolted flange connection/ball joint are then disconnected, allowing strings to be removed and brought to shore one at a time starting at the seaward end.

2.2.3.3 Lighting requirements

Indicative lighting requirements during and following pipe installation include:

- Pipe stacking yard - between four and six towers
- Pipe welding station for the sinker pipe (near the existing MOF) - between four and six towers
- Onshore dredged material and return water pipes - three towers at two separate roving onshore locations where pipes are being connected
- Dredged material discharge point - between four and six units, initially situated at the northern end of the DMCP, slowly moved south as the dredged material fills the DMCP
- Return water pump out station - between four and six units at the pump out station at the southern end of the DMCPs.

2.2.4 Dredged material containment ponds

Dredged material will be pumped via temporary pipelines to the DMCP. There will be no dredged material placement in the GBRMP, the GBRWHA or the Caley Valley Wetlands. Details of the DMCP are shown in Figure 2-4.

The onshore area has been made available by NQBP for the development of DMCP infrastructure. The nominated area is located on the T2 site plus adjoining industrial land between the existing rail loop and the Caley Valley Wetlands to the south. The area is between the operating coal export terminal T1 and GVK Hancock's approved terminal site T3. Prior to T1 development in 1984, the site was cleared and used as agricultural land.

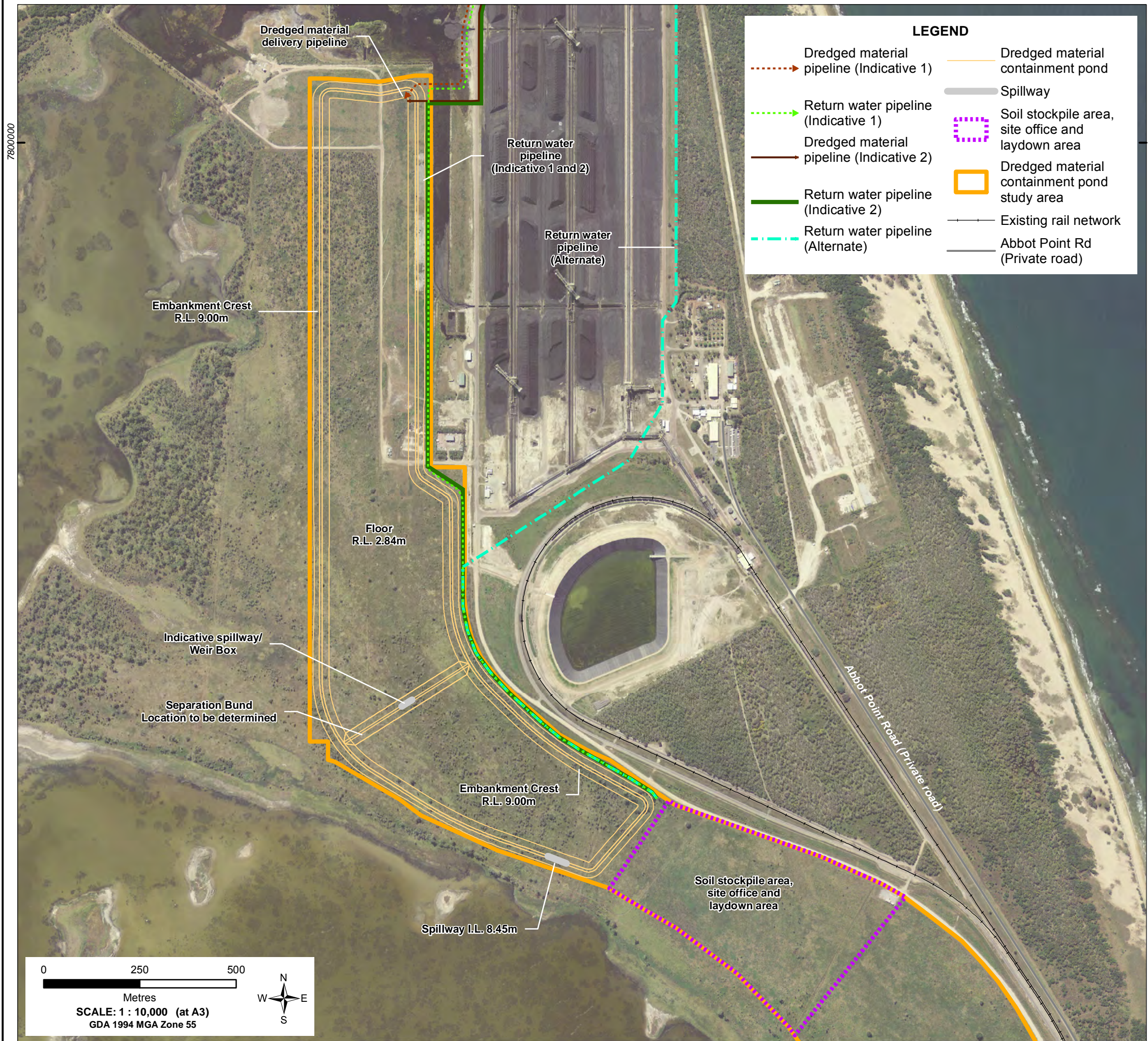
The DMCP area has been sited:

- Largely on industrial land previously identified for T2
- In proximity of the existing port, noting its ultimate use will be to provide suitable land and fill for port expansion once the dredged material has dried and settled
- In proximity of proposed dredging activities
- Outside of the Caley Valley Wetlands (a minimum 50m buffer is proposed from the edge of the mapped wetland regional ecosystems (vegetation management regional ecosystems and remnant map - version 8.0 coastal) and the Project's footprint)
- To meet requirements for T0 dredging only.

It is noted that the DMCP area partly overlaps with the approved GVK Hancock T3 Terminal infrastructure and is adjacent to the following (Figure 2-5):


- Approved Adani T0 Terminal Infrastructure
- Existing T1 Terminal Infrastructure
- Existing Aurizon Rail Loop.

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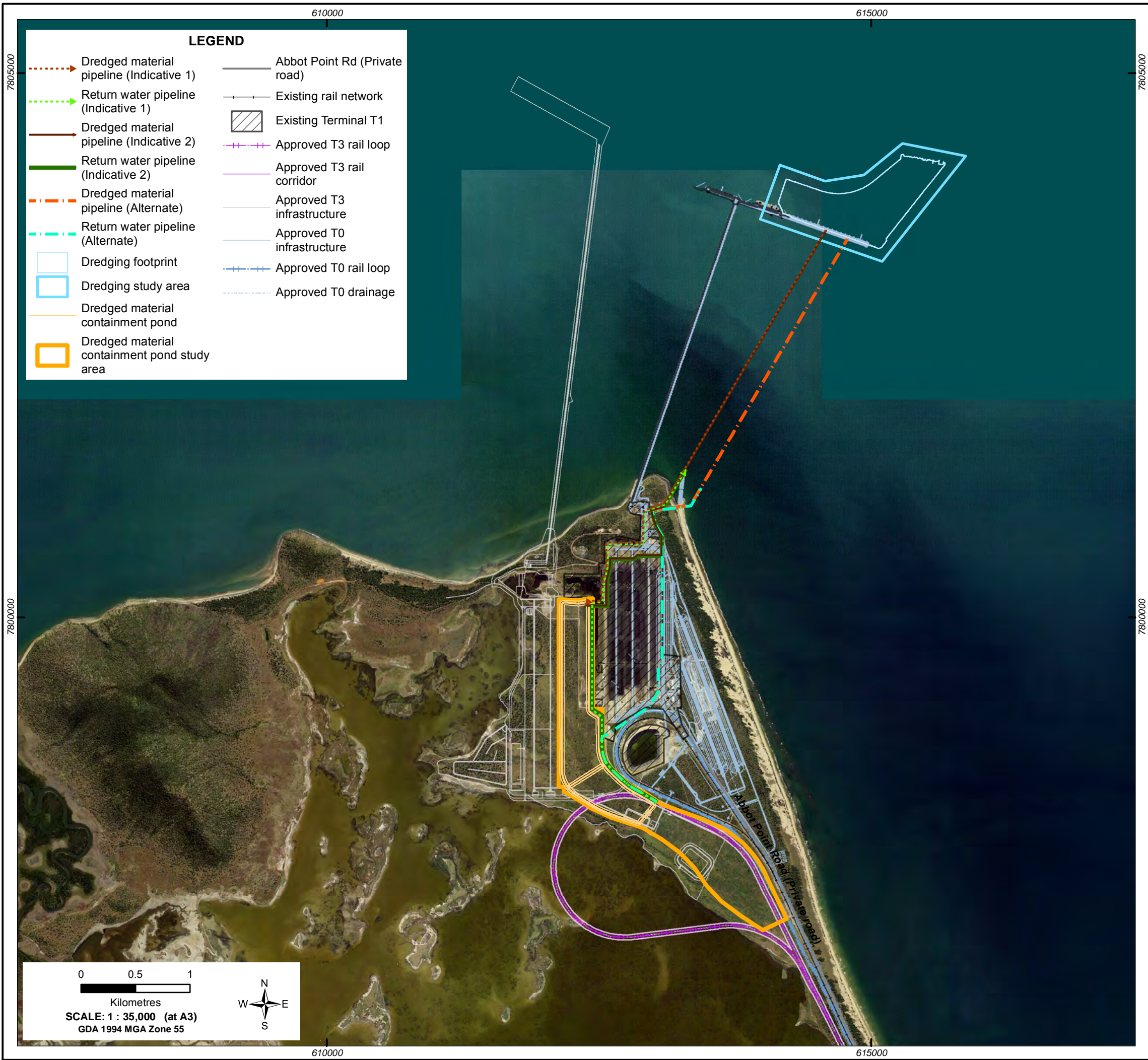


Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digilised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Existing Terminal T1
Digilised from 2013 imagery and cadastral boundaries


1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 2-4 Dredged material containment pond arrangement							
Figure: 301001-01956-00-GM-SKT-0117							Rev: 1

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

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
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Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Cadastre
Queensland Government - Department of Natural Resources and Mines
Downloaded on 23/03/2015 <http://qldspatial.information.qld.gov.au/catalogue/>
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Department of State Development, Infrastructure and Planning, (DSDIP)
Existing Terminal T1
Digitised from 2013 imagery and cadastral boundaries
Approved Onshore Infrastructure/T3 approved infrastructure
Extracted from SK060_bound_mga55_MDS.dwg supplied by Queensland Government - Department of State Development, Infrastructure and Planning 2015
T0 approved infrastructure
Supplied by Adani Mining Pty Ltd | Adani Abbot Point Terminal Pty Ltd 14/04/2015

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REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 2-5 Existing and approved infrastructure							
Figure: 301001-01956-00-GM-SKT-0003							Rev: 1



Existing and future approved infrastructure has been taken into account during the impact assessment process and will be considered in the detailed design. The intention is that existing infrastructure will be avoided.

In the circumstance that the proposed siting of the DMCP overlaps with existing and/or approved infrastructure, final siting will be subject to consultation with the relevant stakeholders.

2.2.4.1 DMCP design

The DMCP design has been guided by application of a Consequence Category Assessment as outlined in the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures*. Details are provided in **Appendix D**.

The overall DMCP area will be separated into a primary DMCP and a secondary DMCP via an internal bund. Details of the DMCP are shown on Figure 2-4 and **Appendix D**.

Embankments

It is proposed that earth embankments will be used to form the DMCP. These will be constructed for the outer perimeter of the primary and secondary DMCP, as well as the internal bund separating these DMCPs. The embankment height, crest and batters will be optimised through detailed design to minimise earthworks volumes, maximise storage capacity, minimise leakage through embankment walls, prevent failure and allow required access for construction, operations and maintenance.

A schematic of a typical embankment cross-section is provided in **Appendix C**. The earth embankments are mainly constructed on top of the existing ground profile, with proposed final embankment crests up to approximately RL 9.0m. The height from natural ground will be between 4m and 7m. The embankment crest width will be up to 7m, and slopes will be 3H:1V. The embankment crest will be capped with a gravel layer, and external batters will be vegetated using topsoil won during construction to provide erosion protection.

The current preliminary design has been developed considering internal borrow as source for embankment material construction. The design targets a final finished DMCP floor level of approximately RL 2.84m. As such, there will be areas where the final DMCP finish level is practically at existing ground level, and areas where over 2m of excavation is required to reach the final DMCP finish level.

Results of an ASS investigation undertaken for the Project indicate the absence of Actual Acid Sulfate Soils (AASS) and PASS within the upper 5m of soil across the proposed DMCP site (refer to **Appendix D**). Excavation below this depth is not proposed.

The separation of the DMCP into primary and secondary sections will facilitate accelerated management of material in the secondary DMCP post dredging should the need arise. This will enable the secondary DMCP to be more rapidly returned to a landform suitable for the development of currently approved T3 infrastructure.

All embankments will include an access road to allow access to any part of the DMCP. A permanent security fence, approximately 2.1m high will be installed around the perimeter of the DMCP.



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Liner design

A liner (e.g. Low Density Polyethylene liner - or similar) will be installed on the inside face of the DMCP embankments to assist in maintaining integrity of the embankment (by managing internal erosion caused by seepage), to provide erosion control of embankments during dredging, and to minimise potential lateral seepage from the DMCP. The floors of the DMCP are to be unlined.

Stormwater management

A stormwater management system has been designed for the Project and is described in the Preliminary Stormwater Management Plan attached in **Appendix Y**. Key details are summarised below.

Stormwater design criteria

The design seeks to manage rainfall received (and supernatant fluid) within the DMCP's footprint, by providing sufficient freeboard to contain and manage design wind and storm events, during and post dredging. This will also assist in providing means to reduce the permanent pool of water to facilitate drying and conditioning of dredged material for beneficial reuse.

In determining design levels of the DMCP, for example the final embankment crest height and spillway invert, a range of short duration (6 to 72 hours) and long duration (1 to 3 months) design storm events were considered for the 2, 5, 10, 20, 50 and 100 year Average Recurrence Interval (ARI).

The criteria (derived from the *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures*) for the short duration and long duration storm storage allowance was adopted as the minimum of the 72 hour 20 year ARI storm event and the 3 month duration 20 year ARI wet season respectively.

It is considered that a short duration event can occur at any time. As such the DMCPs are designed to accept the full storm volume/depth and allow for the potential that the facility could be operating at the Maximum Operating Level (MOL) of RL 8.0m at the start of the event. The adopted spillway invert or Full Supply Level is RL 8.45m or 0.45m above the MOL. A fuse plug level is proposed at RL 8.65m, final embankment crest at RL 9.0m and temporary wave bund crest at RL 9.4m. The total storage allowance above the spillway is therefore 0.95m providing a total storage depth of 1.4m above the MOL.

External stormwater management strategy

The external stormwater management strategy addresses rainfall and associated stormwater runoff from the outer DMCP embankment. The external stormwater management strategy:

- Maintains, as much as possible, the existing hydrology associated with pre-development catchments
- Limits impacts to the DMCP embankment from erosive flow velocities associated with intercepting and diverting local drainage catchments around the DMCP embankment
- Limits the erosion impact of ponding of water against the DMCP embankment from local catchment drainage, regional flood levels, storm surge, and mean sea level rise
- Returns (at completion of dredging) the DMCP area to a landform which mimics pre-development catchment areas.

**Section 2****Project Description****2.2.4.2 DMCP construction**

The key construction activities are outlined below.

Pre-construction works

Ahead of commencement of construction, the following activities are expected to be undertaken:

- Ordering project equipment and materials
- Removal or relocation of existing infrastructure facilities, including:
 - Relocation of existing fence
 - Relocation of stockpiled material on the north-eastern portion of the site to suitable location as directed by NQBP
 - Decommissioning, demolition and removal of disused waste water treatment plant
- Undertaking pre-clearance surveys
- Establishing and commencing monitoring programs
- Undertaking site surveying
- Supplying and installing perimeter fence
- Supplying and installing project signage
- Installing site amenities and laydown area establishment - a suitable previously cleared area will be identified for site amenities set-up including site offices, crib rooms, toilet block, laboratory and workshop, as well as a laydown area for delivery of imported goods such as liner material and small stockpiles of materials.

Site preparation

Initially, the footprint and working areas will be demarcated and the outer boundary erosion and sediment control measures installed.

At least 2 turkey nest ponds (up to 5ML capacity) will be constructed for construction water storage and implementation of stormwater management plans. It is expected that turkey nests would be constructed within the embankment footprint using borrow pits.

The entire DMCP footprint, embankment footprint and the stormwater diversion drain footprint area will be cleared and grubbed of any vegetation. Grubbed vegetation is proposed to be mulched and stockpiled to be reused during construction for stormwater mitigation measures, side-slope erosion protection and possibly final site rehabilitation.

The DMCP footprint, embankment footprint and the stormwater diversion drain footprint areas will be stripped of topsoil to a minimum depth of 100mm. Topsoil will be stockpiled and potentially reused for side-slope erosion protection. It is proposed to use scrapers to undertake this task in conjunction with dozers and excavators for stockpile management and water carts for dust suppression.

The stormwater diversion drain will be cut to design lines and levels using graders and excavators. The diversion drain will be over-excavated to allow for backfill with minimum 100mm of ameliorated top soil. Topsoil will be placed using a tractor and spreader.



Internal and external embankment construction

Embankment subgrade will be scarified and prepared for embankment construction. Material will be stockpiled onsite within the DMCP footprint as required. It is proposed to use scrapers to undertake the bulk earthworks in conjunction with dozers and graders for ripping as required and general surface trimming.

Materials from the internal borrow will be utilised for bulk earthworks for external and internal embankments. Material will be conditioned to required specifications using dozers, water carts and tractor ploughs. External and internal embankment construction will be undertaken using scrapers that will source conditioned material from the borrow area to place directly on the embankments.

Some material may be encountered during subgrade preparation that will require confirmation of its suitability for use in embankment construction. This material will initially be cut and stockpiled within the DMCP footprint using scrapers. It may then be cut from stockpiles and placed over used borrow areas either to allow access to additional suitable material, or to form a suitable DMCP floor with limited steps and low areas.

Alternatively, this material could be relocated from the DMCP footprint to a stockpile located on adjacent industrial land, south-east of the DMCP (refer Figure 2-4). This material would provide the port with a source of general fill that could be used for future port projects. This stockpile may require up to approximately 18.6ha of land. **Appendix P2** assesses the potential siting of the stockpile in relation to potential terrestrial ecology impacts.

Containment liner installation

As part of DMCP footprint subgrade preparation, internal embankment walls will be prepared to receive the containment liner. Detail trimming will be completed using graders, after which final trimming will be undertaken with posi-tracks with grazer bar and finished with smooth drum rollers. In lots, and just prior to liner installation, the embankment subgrade will be wet down with water carts and prepared with smooth drum roller to receive the liner.

Liner panels will be placed with a tele-handler from crest to toe. Welding between panels will be undertaken using wedge welding machines and defect, tears, T-Seams and similar will be repaired using extrusion welding equipment.

A crest anchor trench will be excavated, preferably with a trenching machine, to ensure adequate alignment and minimum disturbance to crest edge. The crest anchor trench will be backfilled with compacted cement stabilised soil.

The toe anchor trench will be excavated using a mid-size excavator and backfilled with compacted cement stabilised soil.

Access roads, spillway, stormwater diversion drains and fence installation

Access roads will be constructed on the crest of embankment and on the eastern perimeter of the DMCPs. Suitable material for formation of a trafficable capping layer will need to be imported. It will be placed with scrapers, and either compacted or rolled. Once the crest capping is complete, the wave, safety and liner protection bund will be placed and shaped.



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Internal and external spillways will be excavated through the embankments once all other embankment earthworks and lining activities have been completed and any necessary lining, armouring and fuseplug layerworks installed.

Construction water

It is expected that between approximately 60ML and 100ML of water will be required for the purpose of DMCP construction. Construction water sources are yet to be determined but are likely to be multiple and off-site. The Deco/Fynbat Quarry along Abbot Point Road operated by Hillery Quarries (approximately 10km from the project area) is considered a major source of construction water. The use of groundwater from existing bore fields or new bores is considered unlikely.

Construction equipment

Construction equipment anticipated to be used for construction is as follows:

- General:
 - 10 x light vehicles.
- Stockpile management and material conditioning - two stockpiles in the project area:
 - 2 x Dozers D9 or equivalent
 - 4 x 40kL water trucks or equivalent in volume
 - 4 x tractor ploughs for soil mixing.
- DMCP embankment construction:
 - 15 x Cat 637 scrapers or equivalent
 - 8 x 40kL water trucks or equivalent in volume
 - 4 x Cat 825 compactors or equivalent
 - 2 x 18 tonne pad foot drum rollers
 - 2 x Cat 14H graders or equivalent
 - 1 x Cat 16 grader or equivalent
 - 1 x tractor with laser bucket
 - 2 x 45t dump trucks
 - 1 x Cat 965 front end loader or equivalent
 - 2 x 32t excavators
 - 1 x 45t excavator
 - 4 x D9 dozer or equivalent (a D10 or bigger dozer might be required in case hard clay requires ripping)
 - 2 x 12t smooth drum rollers.
- Liner installation on internal DMCP batters:
 - Specialised liner equipment such as wedge welding machine (up to eight), extrusion welding guns (up to six), leister guns, wheel mounted generators, etc.
 - 2 x 4t tele-handlers.

Lighting requirements

To facilitate safe working conditions, night lighting will be required. Directional lighting will be utilised to minimise environmental impacts. Indicative lighting requirements include:

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- Embankment construction - A minimum of four to six illumination towers per working area considering that there will be the potential of two borrow areas running concurrently.
- Liner installation - A minimum of four to six illumination towers per working area considering that there will be the potential of two liner installation front areas running concurrently.
- Haul Roads - A minimum of six to eight illumination towers will be required to illuminate the haul road or the scraper circuit depending on the number of critical points such as corners, sharp bends, access and ramps.
- Contractor's works areas - Some additional lighting will be required at the contractor's site office / works yard for both DMCP construction and during dredging operations, and the temporary stockpile area if required.

Lighting requirements will be dependent on the type and extent of works that would occur at night time (if required), and will be confirmed by the construction contractor.

2.2.5 Dredged material management

2.2.5.1 During the dredging campaign

The dredged material delivery pipeline will deliver the dredged material slurry into the DMCP. The dredged material discharge location will be located initially in the northern most portion, and the DMCP will be progressively filled in a southerly direction during the dredging campaign. The discharge location will be progressively repositioned, via addition of flexible and rigid pipeline sections, as the coarse material 'beach' forms. Dredged material at the entry point to the DMCP is typically controlled using conventional earthmoving equipment (i.e. dozers and excavators).

The coarse material (i.e. sand and gravel), together with non-friable clay 'balls', is estimated to represent between 65 and 75% of the total dredged material. This material will settle relatively rapidly near the discharge location, gradually forming a mound or 'beach' above the ponded water level.

The fines material (i.e. silt and clay) will progressively settle out of suspension away from the discharge location, and it is estimated that all coarse material (i.e. 65% to 75% of all dredged material), together with approximately two-thirds of the fines material, will be retained in the northern part of the DMCP (i.e. the primary DMCP).

An adjustable height weir (e.g. drop-board weir box) will be located within the internal embankment separating the primary and secondary DMCP, to enable controlled flow of dredged materials between these two DMCPs. A weir box will also be used to pass water into a final 'pumping DMCP' at the end of the secondary DMCP, prior to its release from the DMCP.

The weir boxes are typically prefabricated steel boxes with timber drop-board across the inlet and short lengths of large diameter pipe at the outlet. The drop-boards can be inserted or removed as necessary to control the height of the upstream water level, and this operation is carried out manually and safely from the embankment crest. By maintaining the water level in the DMCPs as high as possible, the residence time of suspended sediments within the DMCP is increased and maximises removal of sediments from suspension. The water then flows into the internal cell of the weir box where the flow energy is dissipated before exiting through the downstream outlet comprised of multiple large diameter pipes connected to the

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base. The adjustable height of the weir box provides an important function, enabling control of water levels within the DMCP to ensure return water quality discharge criteria are met.

Pumps will be installed to return water from the south-east (tail end) of the secondary DMCP back to the ocean. The pump for the return water pipeline will operate continuously, subject to the return water quality meeting discharge approval limits.

The DMCP has been designed to achieve return water quality of average total suspended solids (TSS) concentration of 100mg/L.

2.2.5.2 Post dredging

The vast majority of return water will be pumped out of the DMCPs and transported to the ocean through the return water pipeline prior to dredging contractor demobilisation. This final return water pump-out process will be carried out when dredging activities are complete and the internal weirs have had all drop-boards removed. At dredging contractor demobilisation, the return water pumps and pipeline will be removed.

Post dredging, sea water remaining within the dredged material, along with any rainfall that falls within the DMCP, will progressively seep vertically through the unlined floor as the material consolidates. Initially the water retained within the DMCP will be a mix of fresh rain water and saline sea water. However, the quantity of saline water in the system is finite and as such the salinity of the mixed fresh/saline seepage post dredging will decrease with time.

Lateral seepage that may exit the downstream side of the embankments is not expected to be significant due to the lining of the internal embankments. Seepage that may occur will be captured by the stormwater drainage system. Groundwater modelling undertaken for the Project (refer **Appendix L**) indicates that while vertical seepage from the DMCP results in groundwater mounding, this remains below ground level with no surface expression predicted.

Monitoring for potential acid generation associated with the dredged material will be undertaken in accordance with the Preliminary ASSMP (refer **Appendix X**).

Once water quality within the DMCP is suitable for release to the receiving surface water environment, outlets in the embankments will be constructed in strategic locations. Any surface runoff generated from the surface of the DMCP will be directed to the natural or existing (T1) drainage network as overland flow towards the T3 site, to largely reinstate pre-existing surface water regimes. All runoff generated during this phase will be managed in accordance with the Preliminary Stormwater Management Plan (**Appendix Y**).

2.2.5.3 Long-term management

Immediately after completion of dredging, the dredged material will be in its most saturated and unconsolidated state. The strength and degree of consolidation of this material will increase with time under self-weight consolidation. Fine materials (particularly in the secondary DMCP) within the dredged material (clays and silts), will take longer to consolidate. Separation of the coarser fractions (sands and gravels) from the finer materials (clays and silts) during the onshore placement process will provide a range of materials that can be used for purposes including competent construction fill or ground improvement activities of adjacent port sites, or within the APSDA.

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The dredged material may potentially be beneficially reused as general fill in the construction of future port developments (e.g. T0 or T3) or remain on T2 and adjoining industrial land. Alternatively, the dredged material may be moved elsewhere including within the SDA to facilitate the development of the T2 site and adjacent industrial land, subject to appropriate approvals being in place.

Subject to appropriate regulatory approvals being in place, the dredged material may be mixed or improved within the DMCP prior to removal for beneficial reuse. In targeted areas, such as those areas associated with approved but not yet constructed infrastructure, this may be undertaken immediately post dredging.

There is potential that the DMCP could be made available for future dredging campaigns, e.g. T3 and maintenance dredging, if this is able to be accommodated within the operational life of the DMCP. However, this is not considered as part of the current Project.

The DMCPs have a design life of 10 years, which will be further defined during the design phase. The DMCPs may be decommissioned at or prior to the end of the design life. No specific post-decommissioning end use for the DMCP site has been determined, due to the timelines involved. Decommissioning timing and future uses of the DMCP site will be defined by market conditions and demand for industrial development sites at Abbot Point. As such, it is not appropriate at this point in time to specify timeframes for the decommissioning of the DMCP. However, the end use of the DMCP site will need to be consistent with the area planning scheme in effect at that point in time. The Proponent commits to meeting with regulatory agencies no later than two years prior to the end of the design life of the DMCPs to discuss draft concept plans for decommissioning and possible end use of the site, and the concept plan's consistency with the planning intent for the locality. Outcomes will be documented in a decommissioning plan to be approved prior to the end of the DMCP design life.

2.3 Project schedule and timeframes

Project stages include:

- Pre-construction activities
- DMCP construction, including construction contractor mobilisation and demobilisation
- Dredging operations, including pipeline installation and dredging contractor mobilisation and demobilisation
- Decommissioning of the DMCP.

Table 2-3 summarises the major activities for the DMCP's construction and dredging operations stages. Timing of the decommissioning of the DMCP is not shown as it is dependent on potential beneficial reuse requirements and future port needs, and is subject to discussion with other port users.

DMCP construction is expected to occur over a three to six month timeframe and is dependent on all relevant approvals being received. It is expected that working hours will generally be between 6am and 6pm, seven days per week. However it is noted that DMCP construction activities may need to be carried out on a 24 hours per day, 7 days per week cycle to meet schedule requirements.



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Mobilisation of the dredge and supply and installation of dredging pipelines will occur over a four to five month timeframe and may occur concurrently with (and independently of) DMCP construction.

Capital dredging cannot commence before the DMCP is fully construction. It will commence as soon as practical thereafter and once all the relevant approvals are in place. Dredging and placement of the dredged material into the DMCP will be completed in a single campaign over approximately 5 to 13 weeks, after which dewatering and consolidation will occur over time.

The dredging operation will operate on a 24 hours per day, 7 days per week cycle to limit the length of the campaign.

Demobilisation of the dredging contractor can only occur at full completion of dewatering activities.

Table 2-3 Indicative project schedule

Activity	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Mobilisation of DMCP construction contractor												
Construction of DMCP												
Dredging contractor mobilisation (including pipeline installation)												
T0 dredging												
Demobilisation (including pipe removal)												

2.4 Project alternatives

As described in the referral for the Project under the EPBC Act, the proposed action includes capital dredging of approximately 1.1Mm³ *in situ* volume of seabed for new berth pockets and ship apron areas required to support the development of T0 planned at Abbot Point by Galilee Basin project developer Adani. The action also includes relocation of the dredged material to the DMCPs and associated discharge of return water offshore.

The Abbot Point Growth Gateway Project aligns with the objectives of the proposed *Sustainable Ports Development Bill 2015* and the Reef 2050 Plan, and as outlined below, will have the least impact on MNES when compared with alternatives considered to date.

In developing the current Project, the feasibility of a number of alternatives, including former development proposals, was assessed. These included:

- Taking 'no action'
- T0 alternatives

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- Alternatives to avoid or reduce dredging.

The results of these feasibility assessments are provided in Section 2.4.1 to Section 2.4.3 for background purposes.

The outcomes of these assessments led to the development of the current onshore placement options. Current project alternatives, i.e. those which relate to the onshore placement of dredged material, are comparatively assessed (including in relationship to MNES impacts) in Section 2.4.4.

The Abbot Point Growth Gateway Project aligns with the objectives of the proposed *Sustainable Ports Development Bill 2015* and the Reef 2050 Plan, and as outlined below, will have the least impact on MNES compared with alternatives considered to date.

2.4.1 Do nothing alternative

At a number of Queensland ports, including Abbot Point, there is current latent or unused port capacity against the total name plate capacity. However, for Abbot Point this nameplate capacity (of 50Mtpa) is fully contracted. Adani's Carmichael Coal Mine at full capacity will produce up to 60Mtpa of product coal. The Project has a long-term and sustained ramp up that requires certainty that port capacity is available at critical times. As a result of Abbot Point's fully contracted capacity, capacity cannot be guaranteed without developing T0 infrastructure which will provide up to 70Mtpa of export capacity for Adani's Carmichael Coal Mine (and potentially additional export capacity for other Galilee Basin or Bowen Basin mine proponents).

Latent capacity at various ports across Queensland does not provide a viable export scenario for export requirements of this magnitude.

The alternative of taking no action has consequences associated directly with the Project, along with consequences associated with the action which the Project facilitates, i.e. construction and operation of T0 by Adani as well as for other indirectly related projects, including the Carmichael Coal Mine and other Galilee Basin coal mines proposed for development which may become potential users of T0.

The global demand for coal coupled with the development of coal mines in the Bowen and Galilee Basins has necessitated planning for additional coal export infrastructure from Abbot Point to accommodate production and supply rates. The development of T0 will allow for additional throughput of 70Mtpa. The port is of strategic importance to both the Commonwealth and the State of Queensland, presenting a critical link between new projects in the Bowen and Galilee Basins and the ability to efficiently export materials to overseas customers.

Up to five major thermal coal developments are proposed for the regions south-west and north-west of Alpha in the Galilee Basin, including Adani's Carmichael Coal Mine and Rail project (EPBC 2010/5736). These coal mining developments are at various stages of the assessment and approvals process.

To 'do nothing' as an alternative to the taking of the proposed action would have a significant impact on the development of at least the NGBR project, the Carmichael Coal Mine and a portion of the Carmichael Rail project, each critical to the economy of Queensland and



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Australia and the associated social and employment benefits. Certainty as to the development of the Abbot Point T0 Project is required in order for these projects to proceed.

The direct consequences of taking no action are effectively the non-realisation of socio-economic benefits associated with the Project. These are described in detail in Section 8.2, and include:

- Creation of up to 164 FTE job opportunities during peak construction
- Creation of opportunities for businesses to supply goods and services to the Project
- Increased economic certainty and reduced anxiety for local communities.

The EIS developed for the Adani Abbot Point T0 project by CDM Smith (2013) described the consequences of not proceeding with the T0 project in terms of trade, social and economic benefits and infrastructure.

Specifically, the EIS describes the T0 project's need for material and services during construction and operation, and identifies local communities as playing a key role in supply of materials and provision of services. The EIS describes the increase in employment levels due to the project, with associated benefit to local businesses and to local and Queensland economies. The economic impact assessment identified an estimated workforce requirement of 500 workers during construction and a peak operational workforce in the order of 200 to 250 full time and contract FTE positions.

The economic impact assessment anticipates that total output (or consumption) effects will peak during construction at AU\$197.0 million per annum in the Mackay, Isaac and Whitsunday (MIW) region, AU\$134.9 million per annum in the rest of Queensland and AU\$34.0 million per annum in the rest of Australia.

During operations, the anticipated total output (or consumption) effects for the project is between AU\$52.4 million and AU\$111.1 million per annum within the MIW region and between AU\$19.4 million and AU\$47.5 million per annum in the rest of Queensland. The EIS summarises the consequences of not proceeding with the project as resulting in *"the loss of significant numbers of future potential jobs and considerable revenue to both the local and State economies"*, and further identifies that *"there would be significant negative consequences for the development of coal developments in the Galilee Basin"*.

2.4.2 Terminal 0 development alternatives

The Adani Abbot Point T0 project was approved under the EPBC Act by the Minister in December 2013 (EPBC 2011/6194). Adani considered alternative locations for port development along the Queensland coast:

- Terminal sites within Abbot Point
- Designs for the project in its proposed location.

The EIS for the Adani Abbot Point T0 project identified no suitable alternative locations for establishment of the terminal, either elsewhere along the Queensland coast or within Abbot Point, noting that alternative siting within the port would require extension into the Caley Valley Wetlands.

In the assessment of alternative design options, consideration was given by Adani (CDM Smith, 2013a) to:

- Maximising terminal storage capacity



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- Relative cost of development
- Minimising the land area required
- Avoiding direct impacts on terrestrial MNES and the Caley Valley Wetlands
- Minimising direct impacts to marine MNES and the marine environment
- Interfacing with existing port facilities (T1) and minimising impacts to those facilities.

The EIS for the Adani Abbot Point T0 project concluded that the proposed T0 design represents the optimal solution and that any alternative design would increase the spatial footprint and construction requirements resulting in an inferior outcome (CDM Smith, 2013a).

The *Sustainable Ports Development Bill 2015* establishes priority ports in Queensland, Abbot Point being one, to concentrate port development and infrastructure development, provide economic and land use certainty, and avoid new or greenfield port developments in other areas of the Queensland coast.

Abbot Point is best placed of the priority ports to provide the required support for Queensland's coal growth sector, with established rail infrastructure, an existing port with potential for onshore growth on Strategic Port Land and adjacent APSDA. The Port is also a considerable distance from residential areas and is one of the few natural deep-water harbor locations along the eastern seaboard.

There are no feasible alternative locations where development could be undertaken without encroaching on the GBRMP and GBRWHA. The Queensland and Australian Governments have signalled their preference for the expansion of existing ports, rather than the creation of new port locations on the Queensland coast. This position responds to the United Nations Educational, Scientific and Cultural Organisation (UNESCO) The Mission Report (*Reactive Monitoring Mission to Great Barrier Reef*) which recommended that the Australian Government "Not permit any new port development or associated infrastructure outside of the existing and long-established major port areas within and adjoining the property [the Great Barrier Reef World Heritage Area]" (UNESCO, 2012).

Potential issues relating to the creation of a new port in a new location would include:

- Increased environmental impacts on Marine Park and World Heritage Area
- Environmental and social impacts of developing a new significant deep-water harbour and associated extensive dredging program
- Developing associated infrastructure requirements including rail, roads, associated services and community support facilities
- Additional expenditures associated with building a new port.

Abbot Point was identified for the development of T0 because:

- It is strategically and geographically well positioned to support coal trade from the Galilee Basin
- It is removed from residential development areas that are incompatible with coal export facilities
- It can support multiple berths and shipping depths to handle bulk cargo vessels up to cape size, with minimal capital and maintenance dredging.

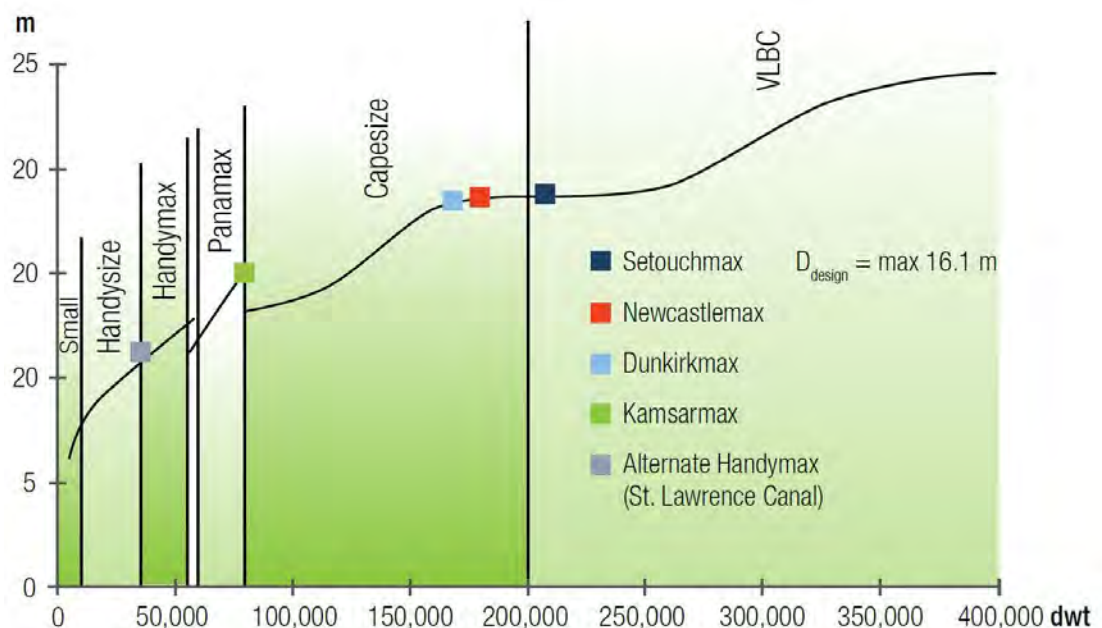
It is considered, therefore, that the best environmental, social and economic outcome involves the further development of the existing and long established Port of Abbot Point.



2.4.3 Alternatives to avoid or reduce dredging

In order to ensure that the approved T0 coal terminal can operate effectively and safely, sufficient depth of water at the berth pocket and apron locations is required to allow ships to arrive, berth, load and depart the port without significant constraint. Efficient port operations aim to minimise short-loading of ships (i.e. not filling vessels to capacity in order to maintain under keel clearance) and minimise tidal delays (i.e. having to wait for the tide to rise to a particular level to allow ships to arrive, be loaded, and/or depart).

In order to deal with increasing trading volumes, the size of vessels used to transport bulk material has increased over time. Figure 2-6 illustrates the increasing size of bulk carriers which will normally be stated as the maximum possible dead-weight tonnage (dwt) which corresponds to the fully loaded deadweight. The figure also indicates the increasing draft requirements of larger vessels. Australia's international competitiveness, particularly in the commodity markets against countries such as Brazil, South Africa and Indonesia, depends on keeping pace with these trends (Ports Australia, 2014).



Source: MAN, 2010

Figure 2-6 Increasing size of bulk carriers and draft requirements

The increase in the size of vessels over time means that ports have to provide deeper access channels allowing greater economic efficiencies whilst also ensuring vessel, infrastructure and environmental protection. The use of smaller vessels would result in increased shipping traffic, increased economic risk and substantially impact on the economy and efficiency of ports to the detriment of Australia's international competitiveness. As such, dredging is an essential part of port operations in Australia and globally to facilitate safe and efficient waterside access.

Preliminary design for the T0 development has identified an appropriate berth pocket level as -21.0m LAT and an appropriate apron level of -18.5m LAT. To completely remove the need for the Project, without significant impact on port operational requirements, the



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proposed berths would need to be located where the existing seabed is at -21.0m LAT. This point is approximately 2.3km further out to sea than the existing T1 berths and the currently proposed T0 berth location and would be located within the GBRMP.

As part of the dredging project previously proposed by NQBP (EPBC 2011/6213), a detailed examination of alternative trestle and berth designs (for T0 and T3) terminal developments was undertaken to determine if a safe, viable and environmentally sound option exists to avoid dredging or reduce the volume of material required to be dredged.

Options to avoid or reduce dredging volumes are primarily limited to the construction of longer trestles, which would place the wharf and berth areas in deeper water further from shore and partially within the GBRMP. The previous examination of options involved an evaluation of five designs:

- **Option 1** - wharf alignment adjacent to T1 berths as per T0 and T3 approved terminal developments (base case)
- **Option 2** - extending the trestles several kilometres using base case formation to the -21m LAT contour
- **Option 3** - extending the T3 and T2 trestles in a more westerly direction to provide more navigational room to the -21m LAT contour
- **Option 4** - extending the trestles 2km to 3km using their current formation to the -18.5m LAT contour to avoid dredging of approaches, but not berth pockets
- **Option 5** - moving the T0 trestle to the west of the exiting T1 terminal and extending the trestles 2km to 3km to the -18.5m LAT contour to avoid dredging of approaches but not berth pockets.

Development of berthing facilities as described at Section 2.4.2 (Option 1) is considered the only feasible option to facilitate the development of T0 and T3. As such, dredging is necessary to enable access for ships to the loading facilities. The amount of dredging required has been optimised to enable efficient and safe access to the loading facilities of the proposed T0 and T3 terminals.

The five options were developed for assessment and comparison. These are depicted in the following sketches and key considerations for each option are further described.



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Source: GHD (2012)

Figure 2-7 Option 1

Key considerations relevant to Option 1 (Figure 2-7) were:

- Minimises navigational obstruction to T1 berths, and of new berths to each other
- Infrastructure is contained to a relatively small area
- Avoids significant dredging into Clark Shoal, while keeping infrastructure outside of the GBRMP
- Possible future planned port development is not obstructed.

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Source: GHD (2012)

Figure 2-8 Option 2

Key considerations relevant to Option 2 (Figure 2-8) were:

- Location of berths at -21.0m contour to result in no dredging for departure apron or berth pockets
- Siting of eastern jetty (T0) outside of the line of the existing T1 leads, in an effort to facilitate T1 arrivals and departures from/to the east
- Infrastructure situated within GBRMP, additional approval and tenure allocations will be necessary.



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Source: GHD (2012)

Figure 2-9 Option 3

Key considerations relevant to Option 3 (Figure 2-9) were:

- Location of berths at -21.0m contour to result in no dredging for departure apron or berth pockets
- Siting of eastern jetty (T0) outside of the line of the existing T1 leads, in an effort to facilitate T1 arrivals and departures from/to the east
- Siting of western jetties (T2 and T3) outside of the line of the existing T1 leads, in an effort to facilitate T1 arrivals and departures from/to the west
- Infrastructure situated within GBRMP, additional approval and tenure allocations will be necessary.



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Source: GHD (2012)

Figure 2-10 Option 4

Key considerations relevant to Option 4 (Figure 2-10) were:

- Location of berths at -18.5m contour to result in dredging only being required for berth pockets (to -21.0m)
- Siting of eastern jetty (T0) outside of the line of the existing T1 leads, in an effort to facilitate T1 arrivals and departures from / to the east. Siting of western jetties (T2 and T3) outside of the line of the existing T1 leads, in an effort to facilitate T1 arrivals and departures from / to the west
- Infrastructure situated within GBRMP, additional approval and tenure allocations will be necessary.

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Source: GHD (2012)

Figure 2-11 Option 5

Key considerations relevant to Option 5 (Figure 2-11) are:

- Location of berths at -18.5m contour to result in dredging only being required for berth pockets (to -21.0m)
- Siting of T0 jetty to the west of T1, to remove potential navigational obstruction to east of existing T1, requiring onshore cross-over of terminals T1 and T0
- Compromise between jetty lengths and slight obstruction within the line of the existing T1 western leads
- Infrastructure situated within GBRMP, additional approval and tenure allocations will be necessary.

The five options were compared with respect to navigational safety, dredging volume, estimated capital cost difference, implications on port planning, implementation programme and any other issues that may be particular to certain options.

The comparative analysis included input from MSQ, Commonwealth DoE and the GBRMPA with the outcomes summarised as:

- Option 1 is the preferred option due to the low safety risk, minimal impacts of dredging (particularly with the proposed onshore placement) and minimal impact to timing of projects
- Options 2 and 3 were not considered feasible due to concerns with navigational safety

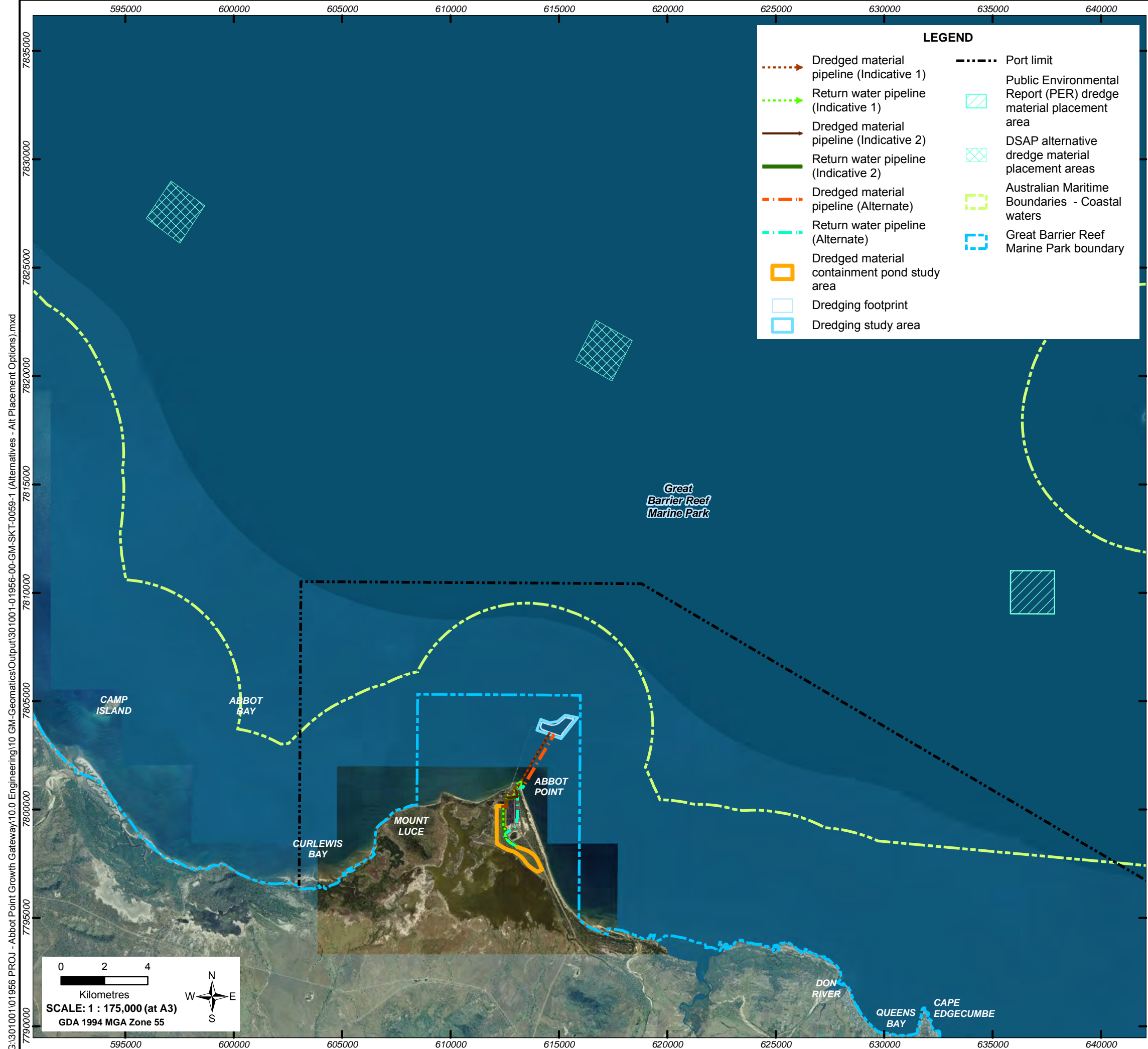


- Option 4 was not feasible due to uncertainty in approval requirements and timeframes, difficulties in operating a port within a Marine Park and significant additional costs associated with extension of the jetties by 2km to 3km
- Option 5 is unfeasible due to uncertainty in approval requirements and timeframes, difficulties in operating a port within a Marine Park and significant additional costs associated with extension of the jetties by 2km to 3km.
- Options 4 and 5 would also still require dredging
- Relevant to options 2 to 5, there has been considerable opposition and concern about industrial activity within the GBRMP
- Options 2 to 5 would also require amendment or reassessment of existing approved projects.

All of the trestle extension options are an order of magnitude more expensive. Potentially these costs are prohibitive, or may be disproportionate, considering the level of environmental impact of the base case with onshore placement of material.

2.4.4 Alternatives to placement of dredged material

This section discusses and provides a comparison of the alternative placement options for the dredged material, which have been considered. These options are shown in Figure 2-12.



PROJECT LOCALITY

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

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 - [http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=\(4091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=(4091CAF1-50E6-4BC3-B3D4-229AA318231A))
Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited -Port of Abbot Point Land Use Plan - October 2010

1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD

QUEENSLAND GOVERNMENT

ABBOT POINT GROWTH GATEWAY PROJECT

Figure 2-12
Alternative dredged material placement locations

Figure: 301001-01956-00-GM-SKT-0059Rev: 1



2.4.4.1 Offshore placement option

In December 2011, NQBP proposed dredging of 3Mm³ to facilitate the development of the three new proposed terminals (at that time) T0, T2 and T3 and the relocation of the dredged material to a new, deep water offshore relocation area in the GBRMP (Figure 2-12).

Dredging was proposed to be undertaken using a Trailer Suction Hopper Dredge (TSHD).

This action was approved under the EPBC Act (EPBC 2011/6213) by the Minister in December 2013. However, it is considered that the Project carries a reduced environmental footprint.

Relevant potential environmental impacts identified in the Public Environment Report (PER) for the project (GHD, 2012c) are summarised as follows:

- Physical environment
 - Water quality impacts associated with turbid plumes from dredging and material relocation with water subject to low suspended sediment loading (predicted 5mg/L to 10mg/L).
 - Low potential for impacts due to release of sediment contaminants and nutrients to the water column, given that sediment analysis indicates that contaminant and nutrients concentrations are less than *NAGD 2009* screening levels.
 - Alteration of the surface sediment structure in the dredging area by increasing the silt and clay content.
 - Alteration of sediment composition of the relocation area due to deposition of predominately coarser sediments, being fine sands, on top of currently predominately finer sediments, being silt and clay.
- Biological environment
 - Direct removal of benthic assemblages due to dredging activity (assemblages removed in the dredging area and buried in the dredged material relocation area). Impacts to benthic communities would be temporary as recolonisation by similar communities of the disturbed areas was predicted to occur after a brief period of settling.
 - Mobilisation of sediment due to dredging and placement activities resulting in turbidity plumes potentially indirectly affecting light-dependent species, filter feeders and having potential flow-on effects to higher trophic groups. TSS values near dredging operations were predicted to exceed dry season conditions but be comparable to those experienced during wet season conditions. Sediment deposition was predicted to occur across open seabed and the margins of potential seagrass habitat.
 - Plume sediments have potential to indirectly impact benthic communities by blocking light availability. Up to approximately 2,000ha of potential seagrass habitat (deepwater) were predicted to be affected by plumes such that light availability will decrease to less than 1% surface irradiance during the dredging campaign. No coastal seagrass meadows, or potential seagrass meadow habitat, were predicted to be affected by light losses. The assessment noted that the area affected by dredging-related light loss and the duration of the impact is likely to be less than that affected by wet season conditions and as such, impacts relating to reduced light availability, were

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considered comparable to the observed variability experienced at Abbot Point. No significant impacts to potential or actual seagrass habitat were predicted to be likely as a result of light depletion.

- Direct smothering of benthic ecology in areas adjacent to dredging due to sediments settling out of plumes. Increased sedimentation was predicted to occur as a result of dredging activities. The majority of deposition across areas affected by plumes was considered comparable to observed variability at Abbot Point and as such, the sparsely distributed benthic communities were expected to be resilient to this effect, with the exception of the assemblages within the immediate vicinity of the dredging activity. Approximately 1 ha of potential benthic fauna habitat was expected to experience sedimentation greater than the depth at which they may successfully migrate.
- Risk of direct injury/mortality of fauna due to vessel strike during dredging and dredged material relocation was considered to be low at Abbot Point given the slow speed of the dredge and the deep offshore environment in which the dredge would operate. The risk of turtle mortality from dredging activities was considered low with the application of turtle exclusion devices and restriction of dredging windows
- Introduction of marine pests and diseases through discharge of species carried in ballast water or sediments or from biofouling of vessel hull surfaces. Given that vessels currently adhere to legislative requirements and that no pest species have been introduced to date under these control measures, the risk of introduction was considered to be low.

The assessment concluded that with the implementation of management measures, including a dredging EMP, the project would not have a significant impact on any of the controlled matters for the action; the GBRWHA, the GBR National Heritage Place, listed threatened species, listed migratory species, Commonwealth marine areas or the GBRMP.

The approval of the action (EPBC 2011/6213) included conditions regarding the potential for the Minister to approve an alternative dredged material placement site, given that peer reviewed scientific evidence from the implementation of a Disposal Site Analysis Plan demonstrated that use of the alternative site would result in equivalent or lesser environmental impacts for MNES. Conditions required that the Disposal Site Analysis Plan to be developed must include comparative assessment of alternative dredged material placement locations. NQBP commenced development of the DSAP including consideration of alternative offshore placement locations (as shown on Figure 2-12) but is now committed to the onshore disposal alternative which forms part of the Project.

2.4.4.2 Alternative onshore placement options

The former Queensland Government Department of State Development Infrastructure and Planning developed the Abbot Point Port and Wetlands Strategy (Figure 2-12) which sought to avoid the placement of dredged material at sea and beneficially reuse it in future port development, as well as enhance the Caley Valley Wetlands through rehabilitation, management and protection programs.

The Abbot Point Port and Wetlands Strategy included two projects. The first project (the Abbot Point and Wetland Project) involved the construction of embankments to create

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primary and secondary dredged material management areas within a beneficial reuse area covering part of the Caley Valley Wetlands. This project included the construction of three sections of a rail embankment that would support the future expansion of the NGBR project.

The second of the projects (the Abbot Point Dredging and Onshore Placement of Dredged Material project) consisted of dredging approximately 1.7Mm³ of seabed for the purpose of ship berth pockets and aprons to support the development of terminals T0 and T3. Dredging was proposed to be undertaken using a CSD with the dredged material to be pumped via pipeline to the onshore dredged material management areas and excess water returned from the dredged material management areas to a subtidal location near the Abbot Point headland.

The Abbot Point Port and Wetland Strategy projects were referred to the Minister under the EPBC Act in October 2014 and Preliminary Documentation (WorleyParsons, 2014) was prepared and submitted by the Queensland Department of State Development, Infrastructure and Planning (DSDIP) to the Minister in December 2014. The proposed projects were withdrawn from the EPBC Act assessment process in March 2015. The Queensland Government has now proposed an alternative onshore placement location for use.

Relevant potential impacts identified in the Preliminary Documentation (WorleyParsons, 2014b) for the projects are summarised below.

Abbot Point and Wetland Project

Site survey results indicated that the Caley Valley Wetlands is an important habitat for listed birds due to overall species diversity, as well as six specific species, namely the migratory Red-necked Stint, Sharp-tailed Sandpiper, Latham's Snipe, Great Egret, Caspian Tern and the endangered Australian Painted Snipe, due to their individual population numbers.

The Preliminary Documentation indicated that the Abbot Point and Wetland Project was expected to result in significant residual impact, both direct and indirect, to migratory birds and the Australian Painted Snipe due to the direct loss of approximately 114.3 ha of foraging habitat and the indirect loss or degradation of an estimated 16.4 ha due to increased activity and noise. Offsets to compensate for these impacts were proposed for the Abbot Point and Wetland Project.

WorleyParsons (2014b) reflected the analysis identified in the Abbot Point CIA (ELA and Open Lines, 2013) with respect to heritage attributes of the GBRWHA. This analysis drew from Lucas *et al.* (1997), which provided clarification of the basis on which the GBR was listed as a World Heritage Property (i.e. its heritage attributes). Lucas *et al.* examined 29 natural heritage attributes that contribute to the Outstanding Universal Value of the GBRWHA. The cumulative impact assessment analysis identified three of the 29 natural heritage attributes as being relevant to Abbot Point, namely aesthetics, birds and marine mammals.

The Preliminary Documentation identified that the Abbot Point and Wetland Project will neither have significant impact on the visual amenity of the Abbot Point area¹, nor on marine

¹ The Abbot Point area incorporates Abbot Point as well as the Caley Valley Wetlands (including the western estuary) and beaches and approximately a five nautical mile radius around the existing offshore port area



mammals. However, as described above, the Abbot Point and Wetland Project was expected to result in significant residual impacts to migratory birds stemming from the direct and indirect loss of foraging habitat. Offsets to compensate for these impacts were proposed for the Abbot Point and Wetland Project.

The assessment found that the Project would not have significant impacts on the GBRMP.

Abbot Point dredging and onshore placement of dredged material project

The Preliminary Documentation (WorleyParsons, 2014b) found that the Abbot Point Dredging and Onshore Placement of Dredged Material project would not have significant impacts on World Heritage Properties, National Heritage Places, listed threatened species and communities, listed migratory species or the GBRMP. The absence of residual impact was largely due to the onshore placement of dredged material and the dredging methodology, which avoided placement of dredged material in the marine environment and significantly reduced the material spillage during the dredging operations owing to the use of a CSD. The assessment considered that the extremely limited dredging plume generated by this type of dredge, and placement of dredged material onshore, eliminated the risk of impact on the coral reefs of the Great Barrier Reef (GBR).

2.4.4.3 Summary comparative description

A comparative description of the potential impacts on relevant MNES during normal construction and operation of each of the dredged material placement alternatives that have been considered is provided in Table 2-4. The comparison assumes that the proposed Abbot Point Growth Gateway Project is the baseline level of assessment. Qualitative descriptors are provided regarding whether the alternative option is considered to have greater, lesser or equivalent levels of potential adverse impact on the relevant MNES, regardless of whether the impact is considered to be significant. Further descriptive text is provided where relevant regarding the rationale for the rating.

The assessment is necessarily qualitative in nature, given that the impacts on MNES are not directly comparable, and the assessment undertaken for the alternatives were each based on a different quantity of dredging. Nonetheless the assessment is considered sufficient to differentiate between the potential adverse impacts of each of the alternative options on MNES.



Table 2-4 Comparative assessment of potential impacts to MNES of previously considered alternatives with Abbot Point Growth Gateway Project

Relevant MNES♦	Onshore Placement - Port and Wetland Strategy Projects	Offshore Placement - Approved NQBP Capital Dredging Project
	<i>Potential level of adverse impact relative to the Abbot Point Growth Gateway Project*</i>	
Listed threatened and migratory marine species	Equivalent Equivalent dredge and dredging method proposed (for T0 component), with equivalent impacts to marine habitat expected	Greater Alternate dredge and dredging method, with predicted greater impacts to marine habitat (through sedimentation, water quality and light level impacts) and likely greater potential for marine fauna interactions due to vessel strike (i.e. a TSHD is significantly faster moving than a CSD) and entrapment in dredge (e.g. turtles may be trapped in a TSHD)
Listed threatened and migratory avian species	Greater This project would likely cause direct loss of approximately 114.3 ha of foraging habitat and the indirect loss or degradation of an estimated 16.4 ha	Equivalent No anticipated impacts to Caley Valley Wetlands and associated habitat for avian species and low potential for indirect impacts
GBRWHA and National Heritage place	Greater Equivalent with respect potential impact to key attributes of aesthetics and marine mammals, whilst greater with respect potential impact to birds (as described above)	Greater Lesser with respect potential impact to birds (as described above); however, this is counteracted by substantially greater direct impacts in the World Heritage Area due to dredged material placement in the World Heritage Area, greater predicted impacts to marine habitat (through sedimentation, water quality and light level impacts) and likely greater potential for marine fauna interactions (as described above)
GBRMP	Equivalent Equivalent dredge and dredging	Greater Greater direct impacts in the GBRMP



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Relevant MNES♦	Onshore Placement - Port and Wetland Strategy Projects	Offshore Placement - Approved NQBP Capital Dredging Project
	method proposed (for T0 component), with equivalent impacts to the GBRMP expected	due to dredged material placement in the GBRMP and greater predicted impacts to marine habitat (through sedimentation, water quality and light level impacts) of the GBRMP and likely greater potential for marine fauna interactions (as described above) in the GBRMP
Commonwealth marine areas	Equivalent Equivalent dredge and dredging method proposed, with equivalent impacts to Commonwealth marine areas expected	Greater Greater predicted impacts to marine habitat (through sedimentation, water quality and light level impacts) of the Commonwealth marine area and likely greater potential for marine fauna interactions (as described above) in the Commonwealth marine area

* MNES are aggregated where appropriate

* Greater, lesser or equivalent potential for adverse impact when compared with the Abbot Point Growth Gateway Project

The alternative of offshore placement is an operationally simpler approach to dredging in that it does not require onshore infrastructure, only a dredge (a TSHD) and support vessels to be mobilised to site and commence working. The onshore placement alternatives require development of the DMCP, mobilisation of the dredge (a CSD) and pipework connecting the dredging area to the DMCP, management of the material in the DMCP (including return water) and ongoing management of the DMCP, including material contained within those. The CSD (as a low mobility vessel) required for onshore placement requires effort to locate and relocate in each of the areas to be dredged and therefore has some potential to impact navigation associated with the existing port activities, whereas a TSHD that would be used for offshore placement has high mobility and therefore minimal potential to impact navigation at the port.

Consequently the onshore placement options require a greater length of time to execute dredging and incur a substantially greater cost than the offshore placement option. Onshore placement options are technically more complex and coupled with the greater timeframe and cost associated entail greater technical and commercial risk than offshore placement, including greater potential risk of delay or associated impacts due to unplanned events, such as extreme weather. Technical risk associated with the Project is dealt with in detail in Section 4.2 and **Appendix U**. Given effective management of this risk, it is considered unlikely that abnormal events will translate to greater impacts on MNES for onshore placement relative to offshore placement.



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The alternative onshore placement option is considered likely to have equivalent or greater adverse impacts on each of the MNES relevant to the action when compared to the proposed Project. The alternative offshore placement option is considered likely to have greater adverse impacts on each of the MNES relevant to the action, with the exception of listed threatened and migratory avian species, for which the offshore placement option is likely to have lesser impacts than onshore placement due to greater separation of offshore placement activity from habitat for avian species.

In summary the proposed Project is considered to have lesser adverse impacts on MNES overall than either of the alternative offshore and onshore placement options considered.



3 Existing Environment

3.1 General

This section of the EIS collates information relevant to the Project and surrounding areas to describe baseline conditions and trends of the environment. Data has been gathered from a number of sources, including both desktop and field investigations, including those reports that have been completed as part of the Project.

While this section notes the relevance of individual aspects of the existing environment to MNES, comprehensive consideration of the expression of MNES in the project area is discussed in Section 3.2. Socio-economic and cultural baseline conditions are discussed in Section 8.

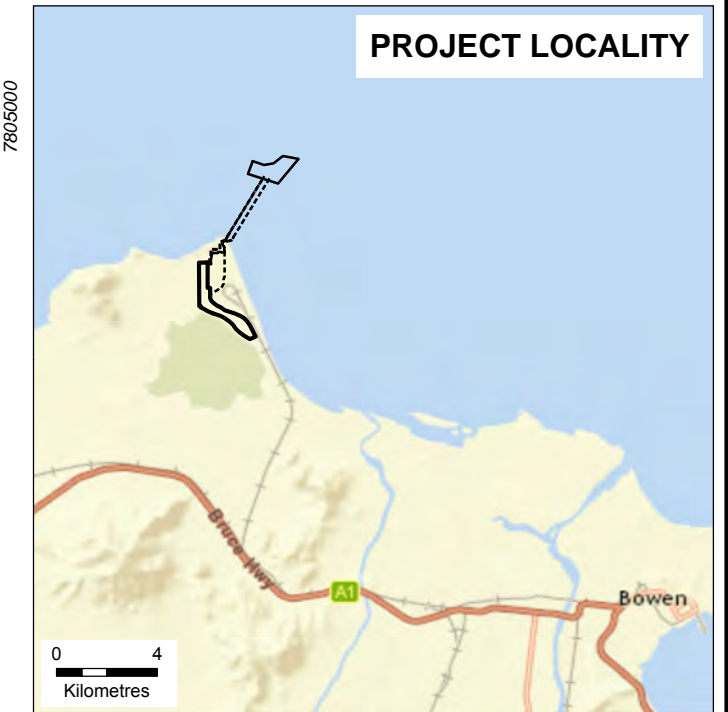
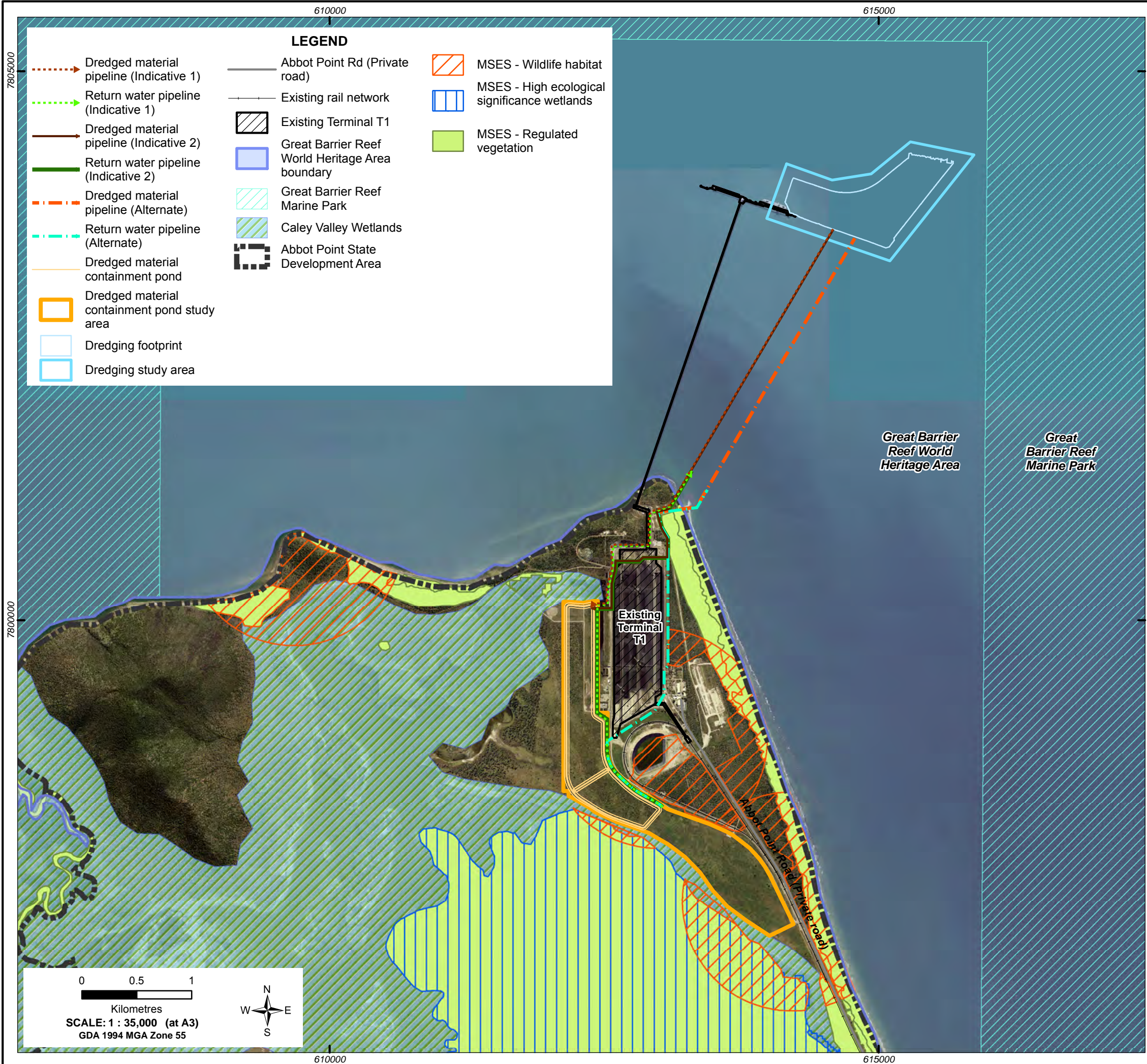
The environmental values of the project area reflect both its proximity to adjacent land uses including the existing T1 and ecologically important areas as shown in Figure 3-1.

Prior to the development of T1 in the 1980s, the terrestrial area of Abbot Point was used for agriculture. Consequently, vegetation across much of the land at Abbot Point is regrowth vegetation.

The marine environment at Abbot Point is typical of the nearshore coastal environment of the central GBR region. Marine waters surrounding the waters at Abbot Point support a number of marine ecosystems and communities, including seagrass, mangrove and intertidal soft sediment and rocky habitats, rocky reefs and algal communities.


The DMCPs are located on previously impacted Strategic Port Land that is adjacent to the Caley Valley Wetlands, which is listed on the *Directory of Nationally Important Wetlands*. This is a largely ephemeral wetland and is important habitat for a number of bird species (including listed threatened and migratory species). The wetland covers 5,154ha and is one of the largest intact wetland systems between Townsville and Bowen (BMT WBM, 2012).

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Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
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Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Cadastral
Queensland Government - Department of Natural Resources and Mines
Downloaded on 23/03/2015 <http://qldspatialinformation.qld.gov.au/catalogue/>
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
World Heritage Areas
Australian Government - Department of Sustainability, Environment, Water, Population and Communities
Downloaded on 20/05/2013 from: http://www.environment.gov.au/metadataexplorer/tull_metadata.jsp?docId=%7B6C54FE6C-2773-47C6-8CBC-4722F29081EF%7D&loggedIn=false
Great Barrier Reef Marine Park Boundary
Australian Government - Great Barrier Reef Marine Park Authority (GBRMPA) 2012
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited - Port of Abbot Point Land Use Plan - October 2010
Abbot Point State Development Area - Nov 2014, 2013 Imagery,
Department of State Development, Infrastructure and Planning, (DSDIP)
Existing Terminal T1
Digitised from 2013 imagery and cadastral boundaries
Matters of State environmental significance - v4.1 - Queensland
Queensland Government - Department of Environment and Heritage Protection

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 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-1 Project environmental context							
Figure: 301001-01956-00-GM-SKT-0114							Rev: 1



3.1.1 Climatic and hydrodynamic conditions

Climatic and hydrodynamic conditions of Abbot Point are relevant to the Project as they provide information required for the assessment of potential impacts related to dredging plumes and re-suspension of material following dredged material relocation. Relevant meteorological data has been sourced from the Bureau of Meteorology (BOM) weather monitoring station located at Bowen Airport (Station ID# 033257). The BOM station (latitude: 20.02°S, longitude: 148.22°E) is located less than 2km to the west of the town of Bowen and approximately 20km south-east of Abbot Point and provides representative meteorological data for the project area.

3.1.1.1 Wind

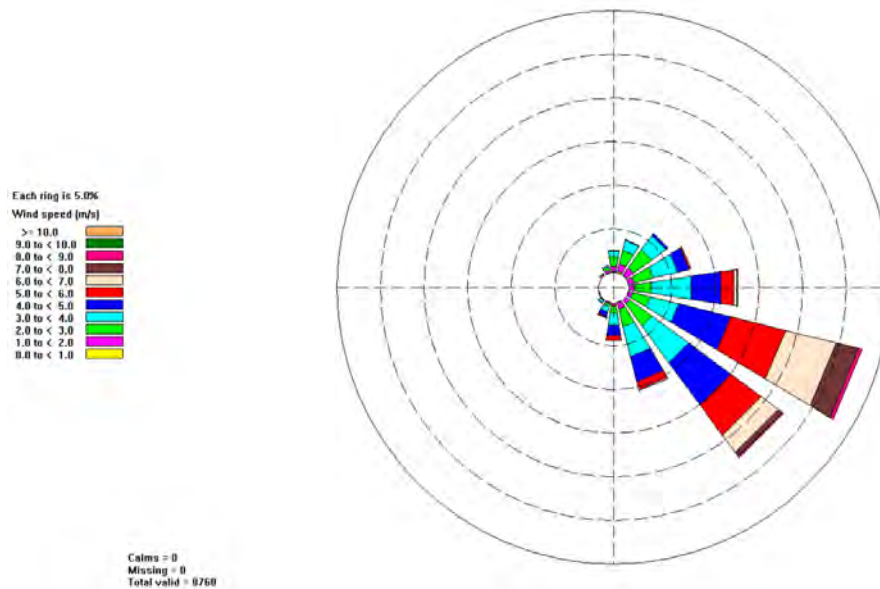
Winds around Abbot Point tend to be strong throughout much of the year due to the exposed nature of the area. The annual distribution of wind speed and wind direction indicates that Abbot Point is dominated by strong winds from the east to south-south-east, with a reduced frequency of moderate winds from the south to south-south-west and north to east-north-east directions and very few winds from the south-west to north-north-west direction. Seasonal analysis indicates that winds from the east-south-east to south dominate during autumn and winter, while winds from the north to south-east dominate during spring and summer. The diurnal wind rose shows the strong east-south-east sea breeze developing during the day and dominating in the afternoon (12pm to 6pm). The east/south-east prevailing winds travel across existing active onshore areas of the port before they reach the DMCP study area.

There were four historical events recorded during the study period between February 2013 and May 2014 where wind speeds exceeded 50km/h. These occurred between 10 and 11 April 2014, between 27 and 30 January 2014, between 8 and 9 March 2014, and on 13 April 2014. The events in January 2014 and April 2014 are linked to the occurrence of Tropical Cyclone Ita and Tropical Cyclone Dylan respectively (Section 3.1.1.4). All other events may be linked with other storm systems. No cyclones have occurred in the Bowen region since Tropical Cyclone Dylan.



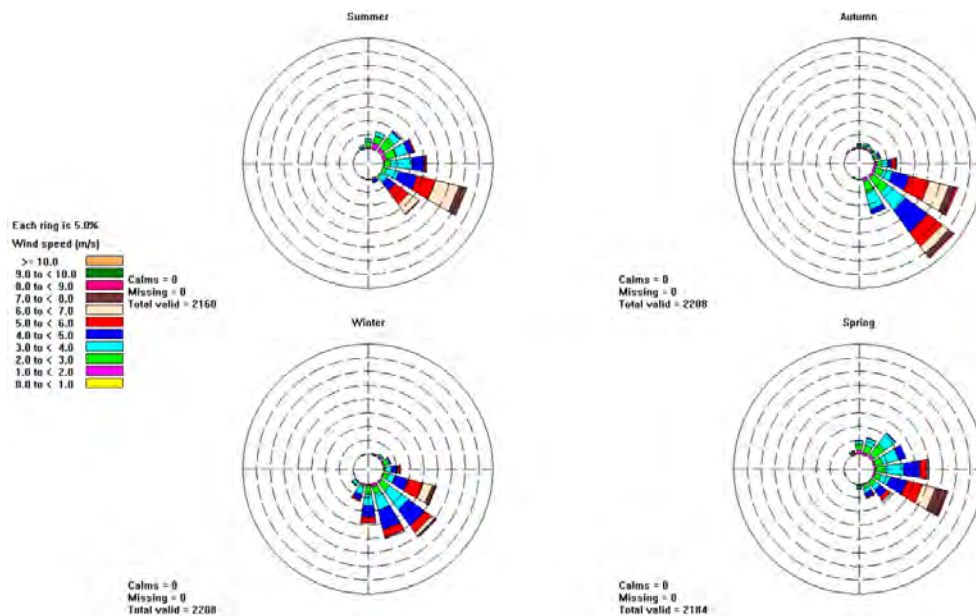
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Source: Reproduced from Katestone (2015; **Appendix H**)

Figure 3-2 Annual wind speed (m/s) and wind direction (°) at Abbot Point



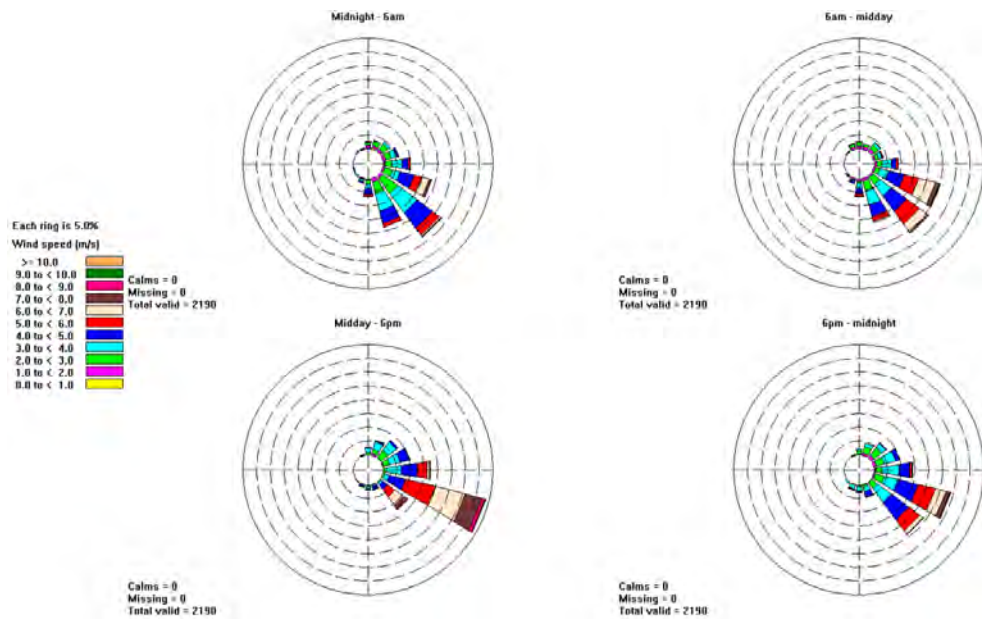
Source: Reproduced from Katestone (2015; **Appendix H**)

Figure 3-3 Seasonal distribution of wind speed (m/s) and wind direction (°) at Abbot Point



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Source: Reproduced from Katestone (2015; **Appendix H**)

Figure 3-4 Diurnal distribution of wind speed wind speed (m/s) and wind direction (°) at Abbot Point

3.1.1.2 Rainfall

The Abbot Point area experiences climatic conditions typical of monsoon areas, in which heavy rainfall occurs during the summer months alongside dry, mild winters. There are four weather stations monitored by BOM surrounding Abbot Point, with 3 having data records longer than 20 years. These three sites include Bowen Airport (station ID 033257, 1987 to 2014), Gumlu Days Road (station ID 033030, 1913 to 2014) and Wattlevale Station (station ID 033150, 1971 to 2014). Mean annual rainfall across the sites is approximately 876.4mm/year, with approximately 85.7% of rainfall occurring during the wet season months (November to April; BOM, 2014; Figure 3-5).

Two elevated rainfall events occurred during the February 2013 to May 2014 monitoring period. These occurred on 23 November 2013 and 14 April 2013, with daily median rainfall of 133.7mm/day and 127.8mm/day respectively (Table 3-1). The rainfall event on 14 April 2013 is associated with the passing of Tropical Cyclone Ita over Bowen (Section 3.1.1.4), with the rainfall event on 23 November 2013 being associated with a storm system. All other rainfall events are associated with storm systems with the exception of the event on 31 January 2013, which was associated with the passing of Tropical Cyclone Dylan over Bowen (Section 3.1.1.4).



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Table 3-1 Summary statistics for each parameter at three season profiles (combined data from all monitoring sites)

Parameter	Season	Count	Mean	Median	Min	Max	20th Percentile	80th Percentile	Standard Deviation	Standard Error
Wind Speed (off shore; km/h)	All	11545	24.38	24.26	0.27	73.54	15.50	33.04	9.82	0.09
	Wet	6481	25.06	25.29	0.27	73.54	16.03	33.23	10.02	0.12
	Dry	5064	23.51	22.74	0.33	47.72	14.81	32.70	9.50	0.13
Tide Elevation (LAT; m)	All	68927	1.83	1.80	-0.03	4.15	1.19	2.47	0.69	0.00
	Wet	38544	1.86	1.84	-0.02	4.14	1.22	2.51	0.69	0.00
	Dry	30383	1.79	1.76	-0.03	3.64	1.16	2.42	0.68	0.00
Significant Wave Height (m)	All	22160	0.56	0.53	0.06	3.81	0.29	0.80	0.28	0.00
	Wet	12038	0.59	0.58	0.06	3.81	0.32	0.82	0.29	0.00
	Dry	12038	0.59	0.58	0.06	3.84	0.26	0.77	0.29	0.00
Daily Rainfall (mm/day)	All	1187	2.13	0.00	0.00	267.40	0.00	0.00	10.58	0.31
	Wet	658	3.48	0.00	0.00	267.40	0.00	1.20	13.90	0.54
	Dry	529	0.45	0.00	0.00	26.40	0.00	0.00	2.38	0.10



Section 3

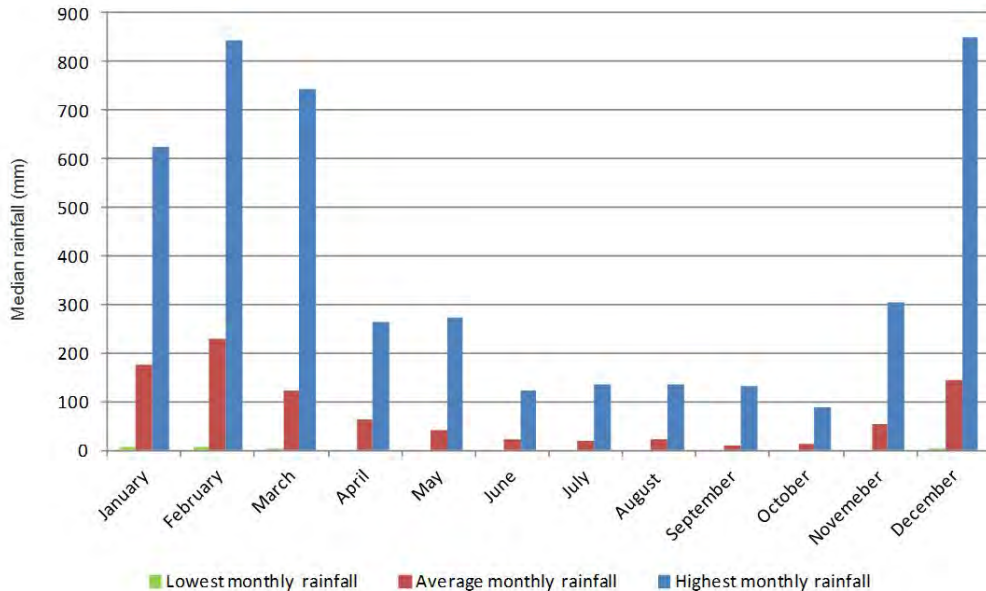
Existing Environment

Parameter	Season	Count	Mean	Median	Min	Max	20th Percentile	80th Percentile	Standard Deviation	Standard Error
Daily River Discharge (ML/day)	All	33052	735.80	6.79	0.00	208184.74	0.00	124.01	6482.72	35.66
	Wet	19568	1217.42	9.28	0.00	208184.74	0.00	197.21	8391.26	59.99
	Dry	13484	36.86	3.80	0	304.23	0.00	57.91	66.27	0.57



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Source: Reproduced from Katestone (2015; **Appendix H**)

Figure 3-5 Range of lowest, average and highest monthly rainfall at Bowen Airport Automatic Weather Station (1987 to 2014)

3.1.1.3 Waves and tides

The GBR acts as a natural barrier for the majority of long period swell wave events. Occasionally, large wave events generated inshore of the Reef occur due to tropical cyclones or severe tropical storms.

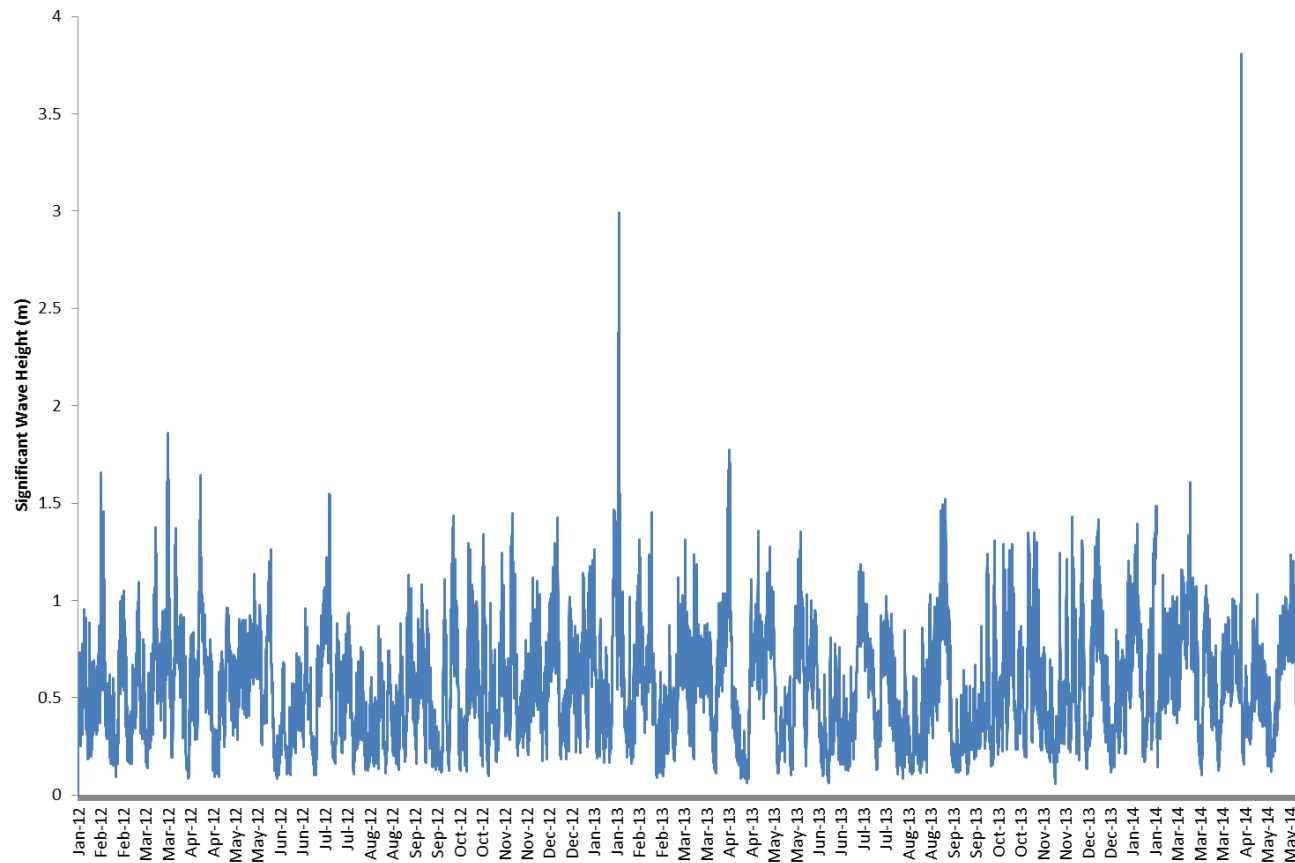
Wave data for Abbot Point is available from the Queensland Government which operates a wave rider buoy 2km from the Abbot Point Coal Terminal, in 14m of water (Department of Science, Information Technology and Innovation, 2014). The instrument continuously measures wave height (significant wave height, maximum wave height), wave energy (peak zero crossing period and zero crossing period), wave direction (peak wave direction) and sea surface temperatures. An example of the significant wave heights from the Abbot Point wave rider buoy from 1 February 2013 to 1 June 2014 is displayed in Figure 3-6.

Tidal information for Bowen recorded every 10 minutes (Station number 061007A) was provided by the Tidal Unit at MSQ. The tides at Abbot Point are generally classified as mixed, mainly semidiurnal, with a maximum tidal range of 2.4m. The tide elevation records for the entire monitoring period are provided in Figure 3-7.



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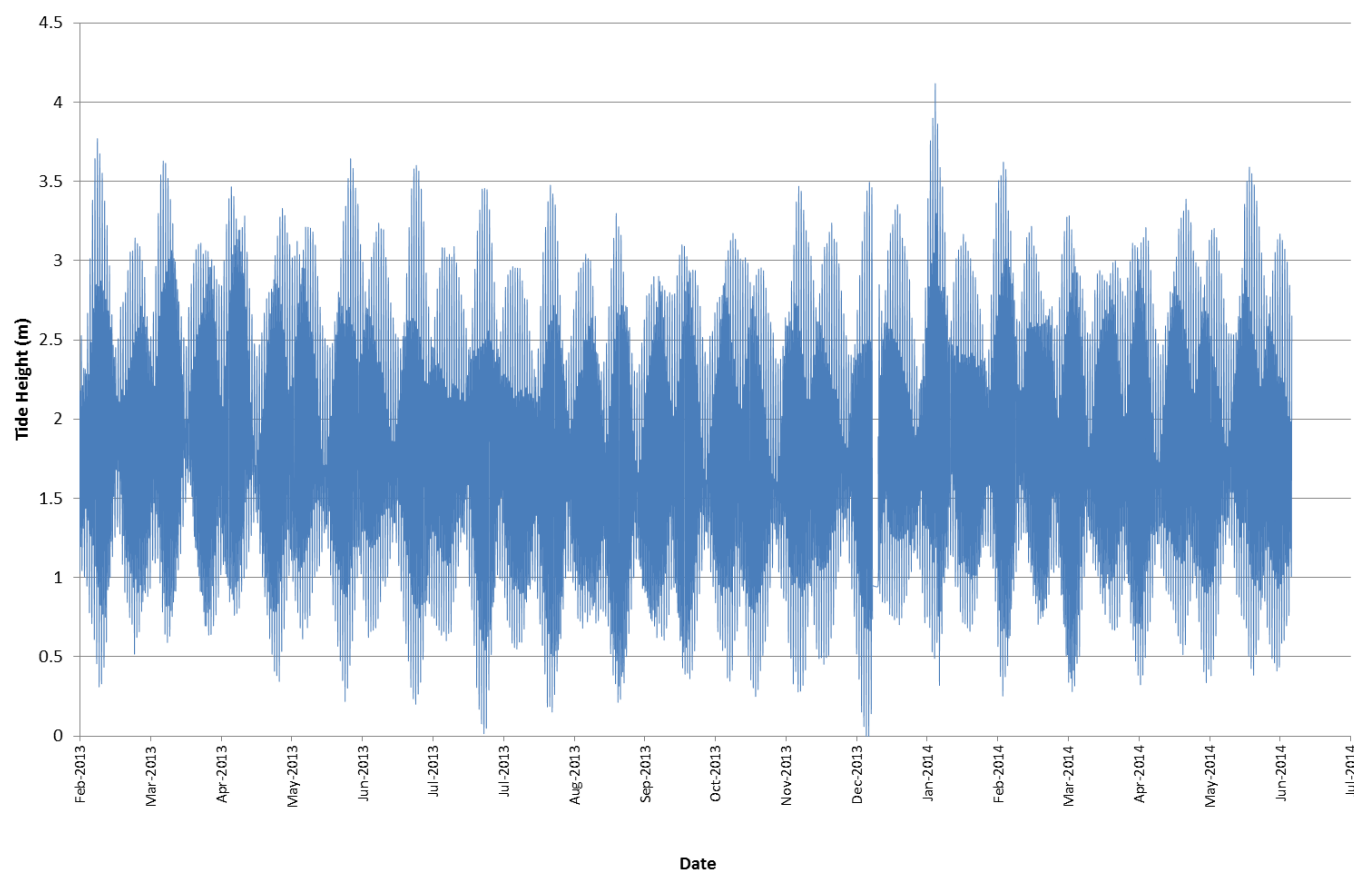
Source: Department of Science, Information Technology and Innovation, 2014

Figure 3-6 Significant wave height recorded at Abbot Point



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Source: MSQ, 2014

Figure 3-7 Tide elevation recorded at Bowen



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3.1.1.4 Currents

Peak current speeds of approximately 0.3 m/s occur during spring tides, with higher speeds occurring to the east of the existing wharf. During neap tides the peak current speeds are again higher to the east of the existing wharf, with peak speeds of between 0.1m/s to 0.2 m/s, while to the west of the existing wharf the peak speeds are consistently less than 0.1 m/s. The peak flood currents occur just before high water and flow to the east-south-east and peak ebb currents occur just before low water and flow to the west-north-west.

3.1.1.5 Extreme events

Significant weather events, such as tropical cyclones and flooding have had a prominent effect on Abbot Point and the surrounding area in recent years. From an ecological perspective these events are particularly relevant to water quality and benthic habitats. Extreme weather events that have taken place since March 2009 are listed in Table 3-2.

Table 3-2 Extreme weather events at Abbot Point and Bowen - March 2009 to October 2014

Date	Event	Location
March 2009	Tropical Cyclone Hamish (category 5)	125km off the coast at Bowen
February 2010	Flooding	Don River, approximately 7km south of Abbot Point
March 2010	Tropical Cyclone Ului (category 3)	Airlie Beach, south of Bowen
December 2010	Wettest December on record for Queensland.	Widespread and significant flooding
January 2011	Tropical Cyclone Anthony (category 2)	Crossed the coast at Bowen
January/ February 2011	Severe Tropical Cyclone Yasi (category 5)	Mission Beach, north of Bowen
March 2011	Highest rainfall on record at Bowen with extensive and prolonged flooding of Don River	Bowen and Don River
January 2013	Tropical Cyclone Oswald (category 1)	Large parts of the Queensland coast
January 2014	Tropical Cyclone Dylan (category 2)	Crossed the coast 35km east of Bowen (BOM, 2014)

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Date	Event	Location
April 2014	Tropical Cyclone Ita (category 1)	Crossed near Bowen (110mm of rain recorded in Bowen in one hour; BOM, 2014)

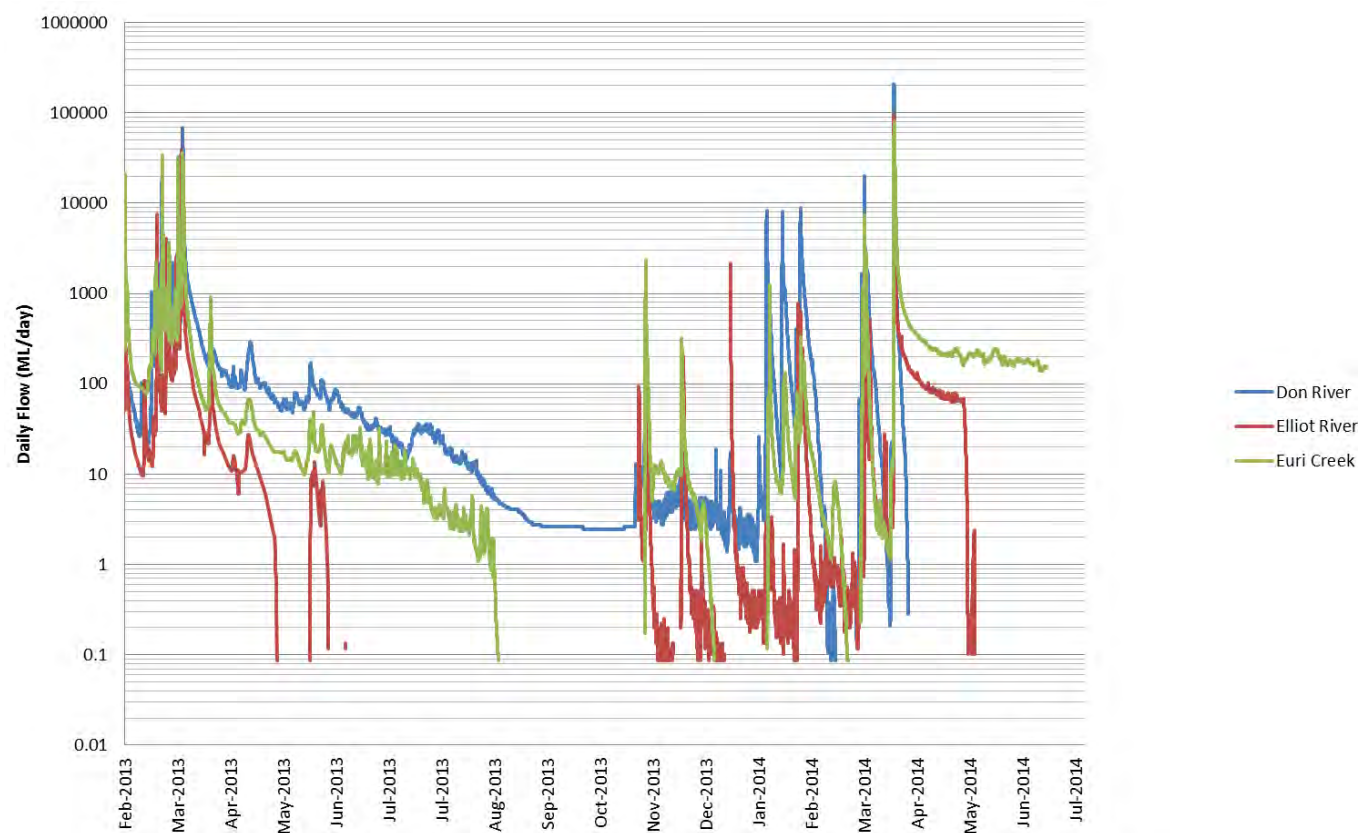
3.1.1.6 River discharge

Data for river discharges is provided by the Department of Natural Resources and Mines. Three waterways discharge surface water into marine water surrounding Abbot Point. These waterways are the Don River, Euri Creek, and Elliot River. Flow rates greater than 100ML/day tend to occur from November to April, with increased river discharge closely linked with rainfall events (Figure 3-8 and Figure 3-9). Discharge events where average river discharge across all sites was over 5,000ML/day occurred on 22 February 2013 (approximately 7,990ML/day), 5 March 2013 (approximately 18,215ML/day), and 13 April 2014 (approximately 22,070ML/day; Figure 3-9). The discharge event on 13 April 2014 could be linked to the occurrence of Severe Tropical Cyclone Ita (Section 3.1.1.4), whilst the other discharge events may be linked to other storm events.



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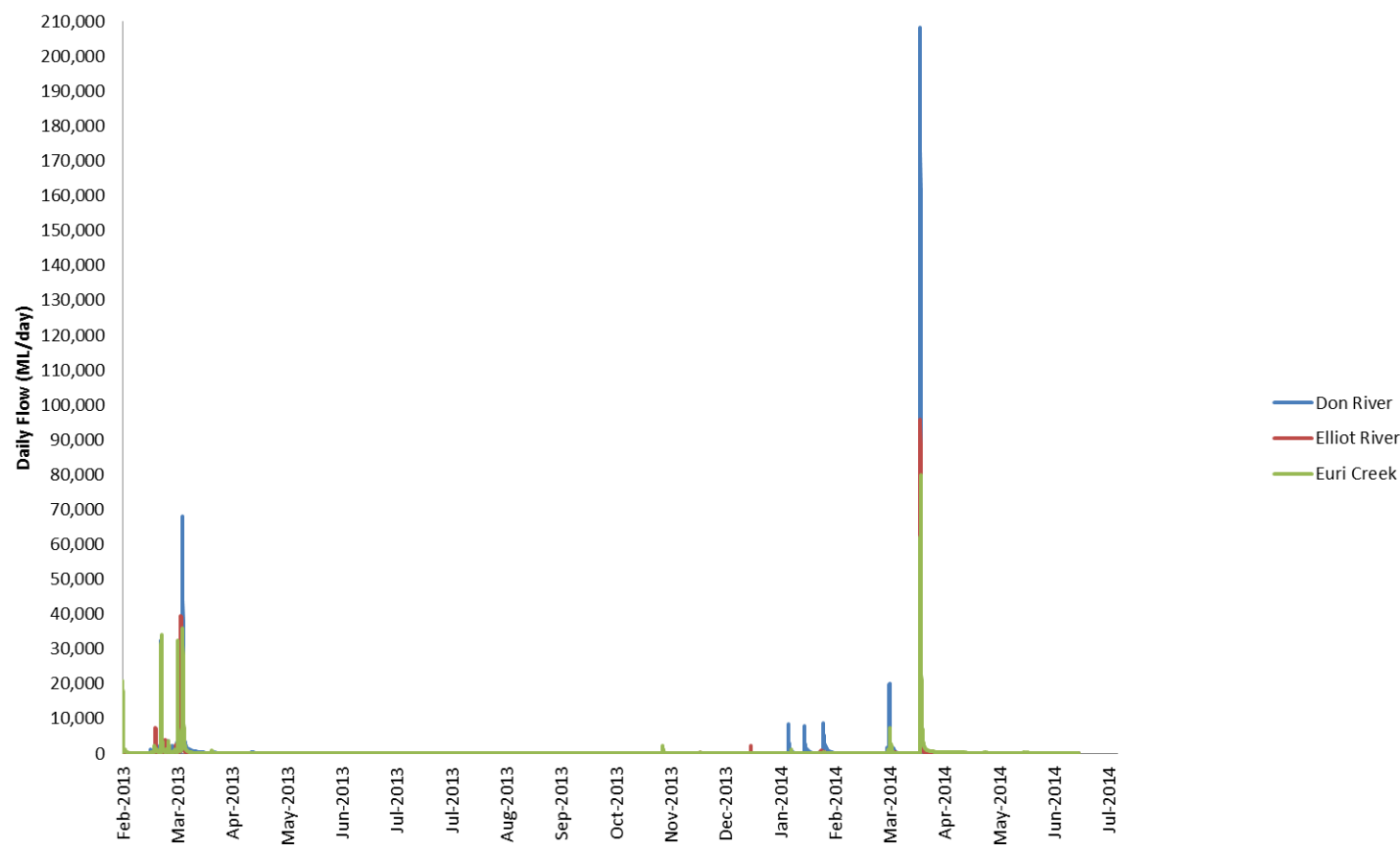
Source: Department of Natural Resources and Mines, 2014

Figure 3-8 River discharge across all stream gauge sites around Abbot Point



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Source: Department of Natural Resources and Mines, 2014

Figure 3-9 Average river discharge across all stream gauge sites around Abbot Point



3.1.2 Land

Description of existing land conditions has been divided into topography, soils, geology, ASS and contaminated land. These are discussed separately in the sections which follow.

3.1.2.1 Topography

A study of topographical information undertaken for the Project (**Appendix E** and **Appendix G**) outlines the relevant aspects of the existing environment.

The study area is gently undulating with a slight overall gradient from the higher elevation land in the south and south-west (approximately 4m Australian Height Datum (AHD) to 5mAHD) to the lowest portion in the north-east corner (approximately 2.8mAHD). The DMCP is located on coastal sands that form a sand plain at approximately 3mAHD to 5mAHD. Topography within the existing coal facility has been changed through filling activities during construction.

The regional topography comprises undulating hills, tidal flats and flood plains.

3.1.2.2 Geology

The following geological information has been summarised from information provided in the Soil Assessment and Management Plan (**Appendix E**).

The Ayr 1:250,000 geological mapping indicates that the DMCP occur in only one mapping unit, Qr, shown in Figure 3-10. These Quaternary sediments are comprised of low linear dunes composed predominantly of sand with some interbedded silt.

The majority of the area mapped as Qr is a sand plain that is 3m to 4m above the Caley Valley Wetlands to the south. The sand plain has poorly sorted sands (likely formed as a series of beach ridges) and finer and better-sorted sands that have likely been reworked by aeolian activity. This means that the sandy clay in the subsoils found on the sand plain was likely formed by pedogenesis rather than deposited as a sedimentary feature.



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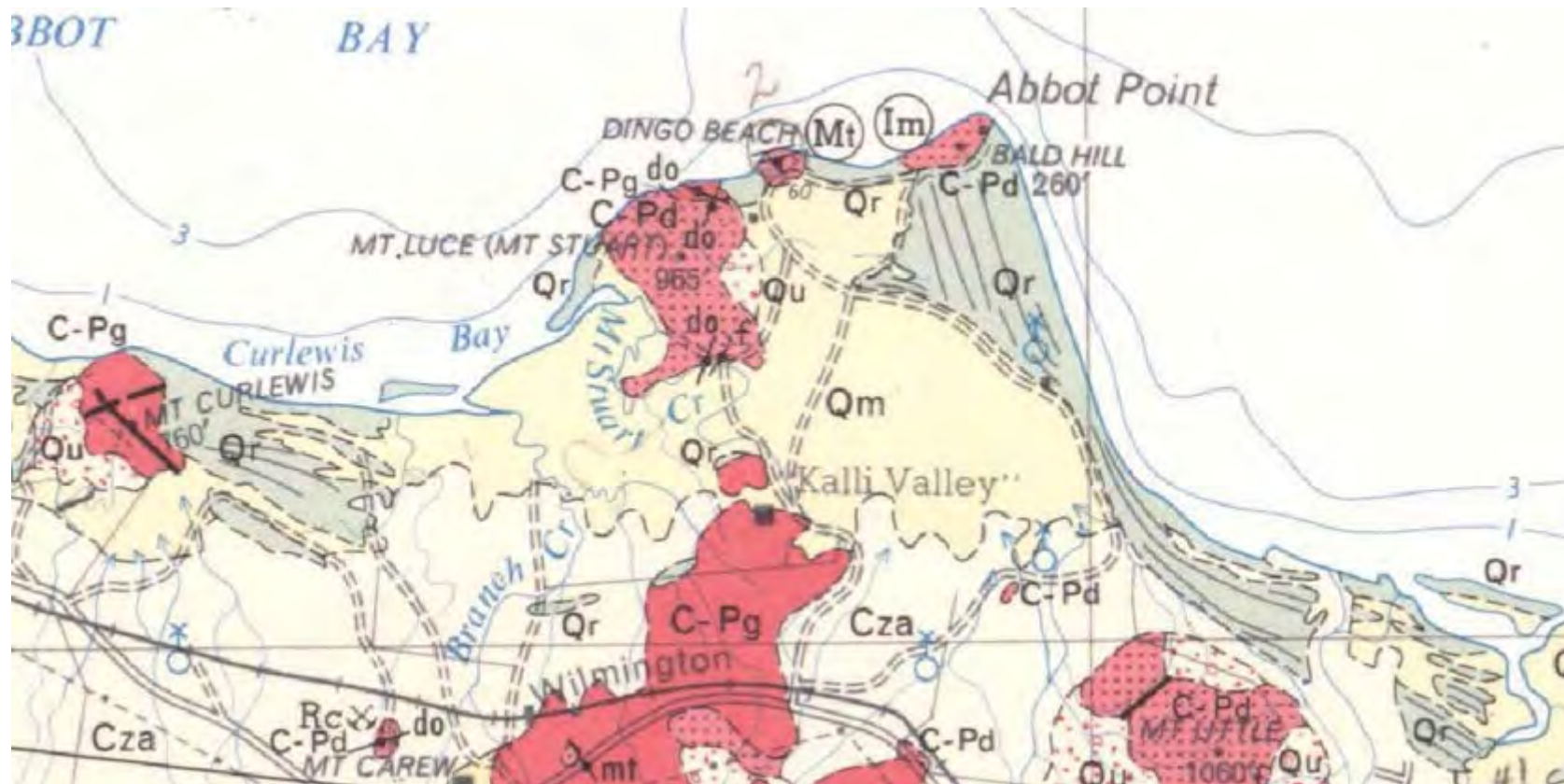


Figure 3-10 Regional geology from Ayr (1:250,000 geological series sheet SE 55-15)



3.1.2.3 Soils

The soil assessment undertaken for the Project (**Appendix E**) identifies the soils occurring within the onshore portion of the project area.

Two soils have been identified within and adjacent to the DMCPs. The Qr1 soil, which predominates across the proposed DMCPs' footprint is a Chromosol with a 10cm sand to coarse loamy sand A1 horizon overlying a conspicuously bleached sand to coarse sand A2 horizon to around 90cm. Ferromanganiferous nodules up to 5cm may occur in the lower A2 horizon that overlies a yellow and grey mottled coarse sandy clay B horizon around 1m to 2m thick, overlying sands. These soils support mainly *Melaleuca viridifolia* and are seasonally waterlogged (during summer months) then drought affected during late winter/spring. These soils have very low fertility. Exchangeable cations and Emerson ratings suggest the clay subsoils are not dispersive, despite some exchangeable sodium percentages (ESPs) that are above 6%.

The Qr2 soils (Chromosols) occur on the edges of the sand plain above the wetland and occur to the south-west of the proposed DMCP. These soils have developed on similar sandy materials as the Qr1 but are better-drained. Reddish brown sandy clay B horizons occur from 90cm and the overlying A horizons are brown and not bleached. There will be many intergrades between the Qr1 and Qr2 soils depending on the drainage conditions. The Qr2 soils support *Corymbia tessellaris* with a shrub understory and provide a more conducive edaphic environment for plant growth than the Qr1 soils. They have very low fertility.

3.1.2.4 Contaminated land

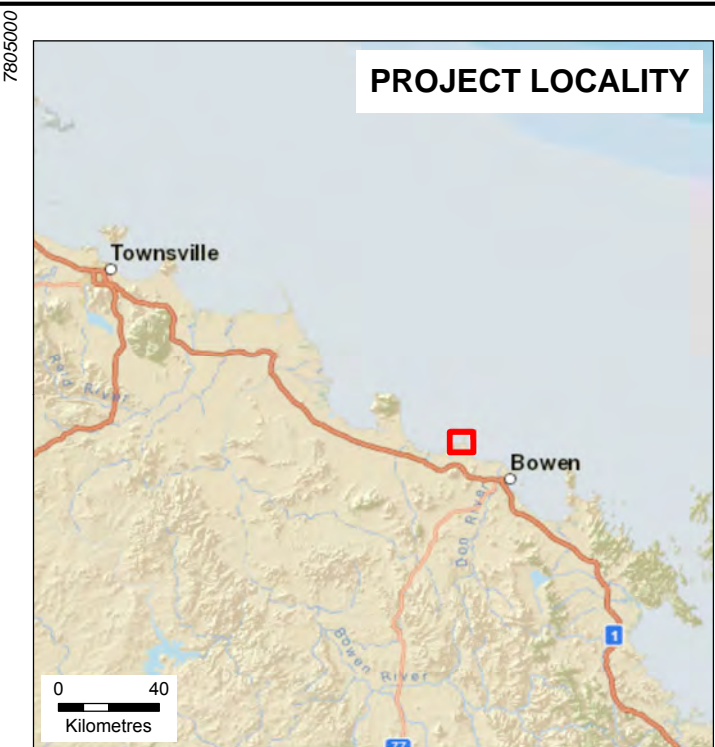
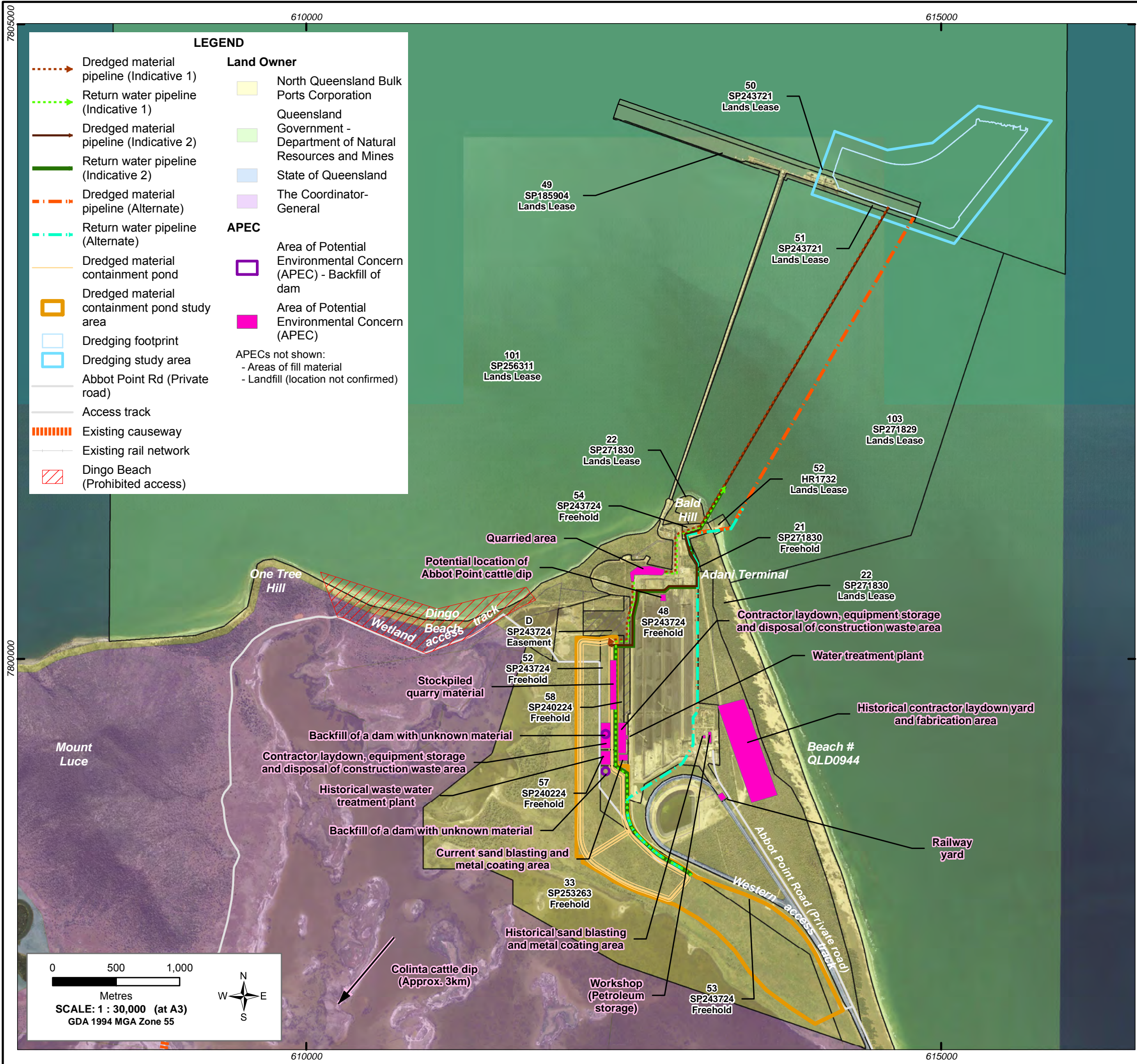
A Preliminary Site Investigation undertaken for the Project (**Appendix G**) outlines the relevant aspects of the existing environment as described below.

Areas of existing potential contaminated land were identified through a desktop site history review, which included a review of previous environmental investigations, relevant Queensland Government Department and Whitsunday Regional Council records, Environmental Management Register and Contaminated Land Register search results, anecdotal information provided by previous landowners, and historical aerial photographs. The following areas were identified as having the potential to contain contaminated land and are shown on Figure 3-11:

- Waste water treatment plant
- Laydown, equipment storage and disposal of construction waste area
- Stockpile of quarry material
- Backfilling of two dams with an unknown material.


The contamination status within the areas listed above is currently unknown.

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Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
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Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
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2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
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[http://qldspatialinformation.qld.gov.au/catalogue/custom/detail.page?fid=\(4091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatialinformation.qld.gov.au/catalogue/custom/detail.page?fid=(4091CAF1-50E6-4BC3-B3D4-229AA318231A))
Queensland Government - Department of Natural Resources and Mines
Land Ownership
Digitised from NOBP map "Port of Abbot Point with Land Owners", dated 17/12/2013. Map No. NOBP2013-033d.
Updated with information supplied by client.
Contaminated Land Sampling Locations
Site survey undertaken by WorleyParsons Nov 2014

1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-11 Areas of potential environmental concern with reference to contaminated land							
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3.1.2.5 Acid Sulfate Soils

The Acid Sulfate Soils (ASS) assessment undertaken for the Project (**Appendix F**) considered the relevant aspects of the existing environment as described below.

The investigation included a desktop assessment and a sampling program which comprised 25 boreholes to depths of up to 5m across the footprint of the pond area including a series of locations spaced at about 100m intervals along the south-western footprint boundary (i.e. closest to the Caley Valley Wetlands) where the highest risk of encountering ASS was expected.

Net acidity for all soil samples were below the adopted assessment criterion (outlined in **Appendix L**) and therefore did not indicate the presence of AASS or PASS to the depth of assessment (5m below the ground surface).

Groundwater sampling generally indicated a relatively stable and neutral pH with a high capacity to buffer any acidity generated. Test results do not indicate that groundwater has been affected by historical oxidation of sulfides, although relatively high levels of aluminium and iron have been detected in some groundwater samples.

3.1.3 Groundwater

The groundwater assessment undertaken for the Project (**Appendix L**) includes discussion of existing groundwater conditions and associated hydrogeology.

Groundwater field studies include two recent campaigns which have been used to establish an understanding of existing groundwater conditions. The first undertaken in November 2014 focussed on the wetland area west of the proposed T3 area, while the second undertaken in March 2015 investigated the T2 area (i.e. the project site for the DMCPs). The investigations indicate that:

- The pH of groundwater is slightly acidic to slightly alkaline and varies from 6.4 to 8.1
- Sodium and chloride are the dominant salts
- Salinity (as total dissolved solids) varies from 800mg/L to 105,000mg/L, which is described as varying from brackish to a hypersaline brine
- All geological sequences located within the Port area are potentially water-bearing and constitute an aquifer where saturated.

Geological units can be characterised into four aquifer groups:

- Bedrock aquifer
- Alluvial sediments
- Coastal dune system
- Coastal mudflats.

The bedrock aquifer comprises mafic igneous geology and forms a fractured rock aquifer with groundwater flow within fractures, joints, and other discontinuities within the rock mass. Connell Hatch (2009) indicated a decomposed, weathered upper profile occurs within the foothills of Bald Hill and Mount Luce which is overlain in places with 3m to 12m of colluvium. The extent of groundwater associated with these sediments is not defined. Where groundwater does occur, it is likely to be laterally restricted.

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The groundwater field studies intersected alluvial sediments over the majority of the T2 and T3 areas. Drilling results indicate the occurrence of terrace sediments in the T2 and T3 areas to at least 20m thick, with the upper 10m comprising variable mixtures of sands, silts, clays, and a basal sand sequence. Hollingsworth and Associates (1979) indicate the presence of 'shoe string' sand aquifers, i.e. narrow, sinuous sands and gravels, south of the wetland.

Connell Hatch (2009) describe the coastal dune system as comprising coarse grained permeable beach sands that are laterally restricted to the eastern parts of the Port area. The sands are described as being up to 4m thick, and occur on top of 3m to 6m of residual soils (clayey and sandy silts) overlying decomposed rock.

The coastal mudflats extend west and south of the T1, T2, and T3 areas and comprise interbedded sequences of unconsolidated clay, silt, and sand sediments of variable permeability. Recent drilling results confirm that the mudflats west of the T3 area generally comprise 2m of clayey/silty sand overlying a similar thickness of lower permeability clay. These upper sediments overly interbedded sequences of sandy and clayey sediment that host hypersaline groundwater.

GHD (2012d) describes that recharge rainfall occurs in the higher terrain and recharges the bedrock and alluvial terrace deposits. Groundwater movement is principally under gravity towards the coast with discharge generally into the Coral Sea.

Groundwater levels fluctuate in response to the summer dominated rainfall. During the dry season, when recharge to groundwater systems reduces and evaporation and evapotranspiration effects are high, groundwater levels slowly fall. Conversely, in the wet season, when there is a greater supply of fresh rainfall recharge to the groundwater system, groundwater levels rise.

During the wet season, there is expected to be a zone beneath the wetland mudflat where fresher wetland water overlies and mixes with underlying saline to hypersaline water. This zone will only be present if there is a transmissive hydraulic connection between the wetland and the underlying groundwater system whereby flooding of the wetland influences the underlying groundwater quality in the wet season.

Regionally, groundwater discharge occurs towards the Caley Valley Wetlands, with localised discharge towards the ocean along the coastal fringes. The hypersaline groundwater, intersected within the wetland and at depth below the elevated terraces in the T1, T2 and T3 areas, suggests limited flow of groundwater occurs in this hypersaline zone. It appears that this hypersaline groundwater is effectively trapped as stagnant groundwater that has probably formed from evapo-concentration processes due to combination of seawater ingress during extreme high tides and brackish groundwater seepage into the wetland.

The direction of groundwater flow in the proposed DMCP area appears to be a subtle reflection of the surface terrain with flows in a southerly and westerly direction towards the main bodies of water making up the Caley Valley Wetlands.

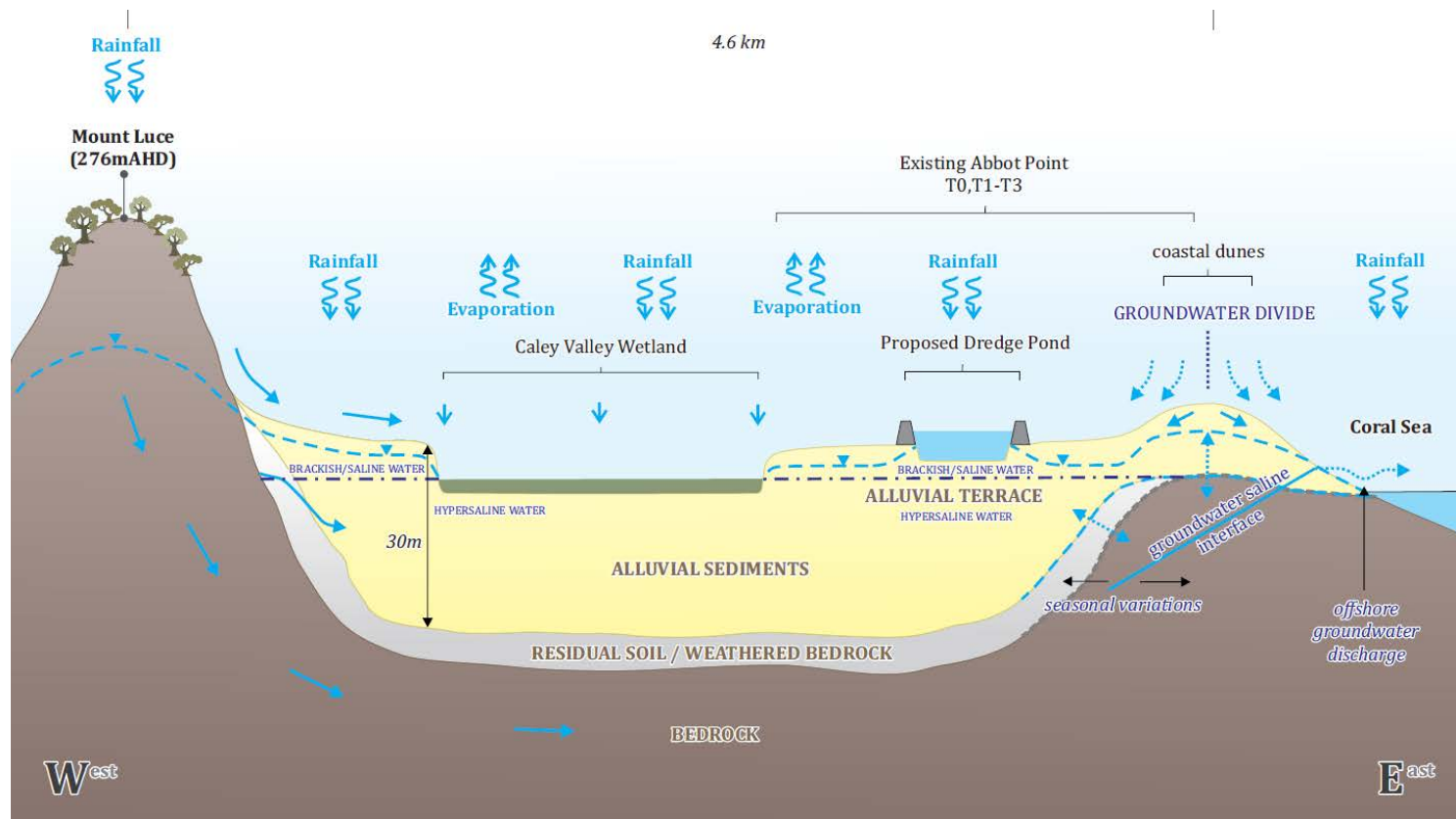
GHD (2012d) provides a hydrogeological conceptualisation of the groundwater study. This indicates that recharge rainfall occurs in the higher terrain and recharges the bedrock and alluvial terrace deposits. Groundwater movement is principally under gravity towards the coast with discharge generally into the Coral Sea.

Figure 3-12 shows the conceptual understanding of the behaviour of the groundwater system.



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Source: Reproduced from AGE (2015; **Appendix L**)

Figure 3-12 Conceptual hydrogeological model



3.1.4 Hydrology

The hydrological assessment undertaken for the Project (**Appendix O**) considers the relevant aspects of the existing environment.

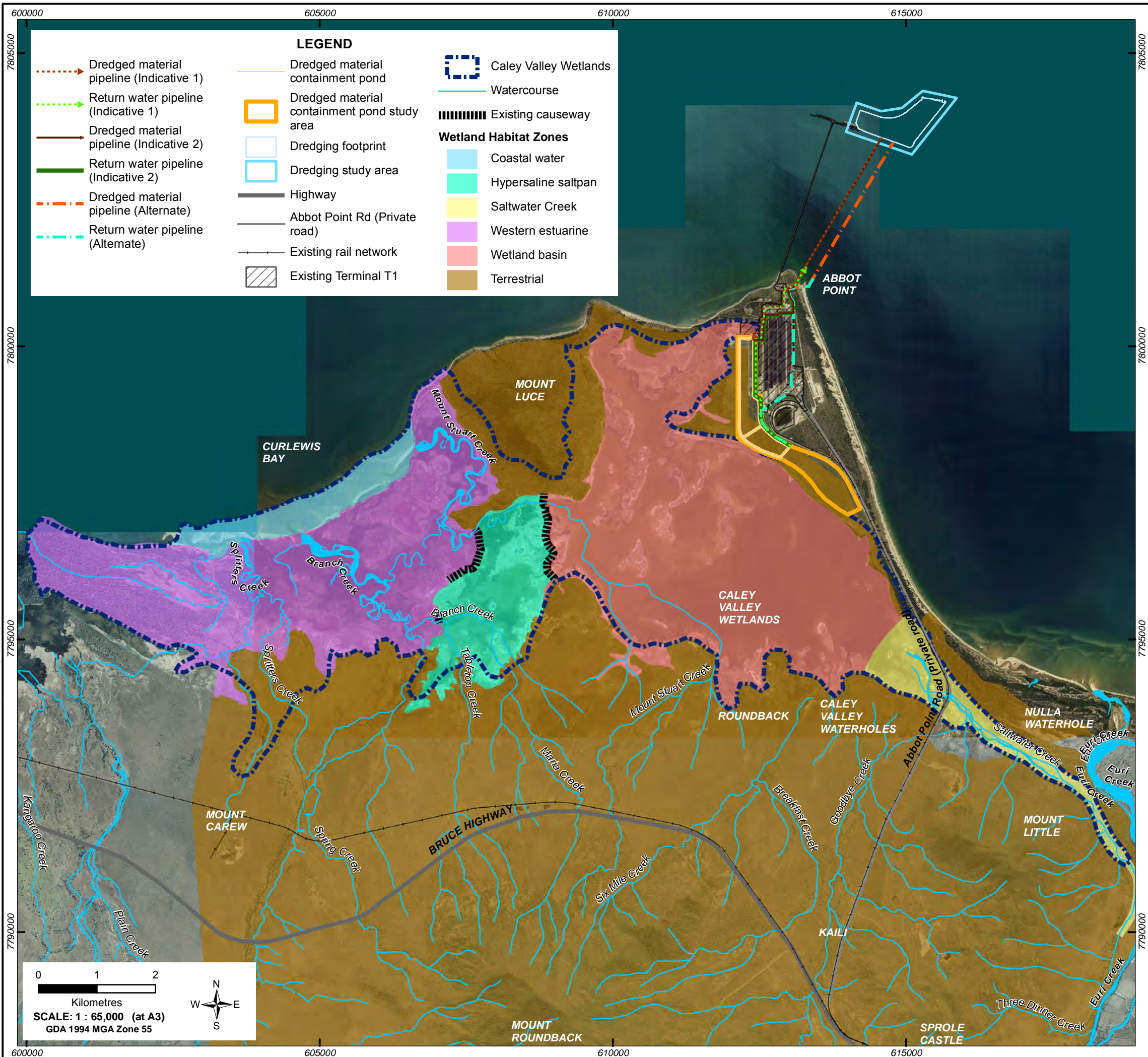
The Caley Valley Wetlands adjacent to the project area can be divided into three distinct hydrological areas, including the:

- Tidally-dominated western wetland areas (including the coastal water zone, western estuarine zone, and the hypersaline zone)
- Wetland basin zone (a distinct hydrological zone)
- Saltwater Creek and non-tidal drainages (including the Saltwater Creek zone and the terrestrial zone).

Figure 3-13 shows the location of the different wetland zones. The Project does not involve construction of infrastructure within the wetland area.


The dominant hydrological processes operating in these three distinct areas of the wetland are summarised in the following sections. Additional information pertaining to the hydrological setting and surface water quality is also provided.

\\aubr\pdfs\02\brisbane\Projects\301001\01956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0109-1 (WBM CVW Habitat Zones).mxd



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

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
[http://qldspatialinformation.qld.gov.au/catalogue/custom/detail.page?fid=\(4091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatialinformation.qld.gov.au/catalogue/custom/detail.page?fid=(4091CAF1-50E6-4BC3-B3D4-229AA318231A))
Queensland Government - Department of Natural Resources and Mines
Existing Terminal T1
Digitised from 2013 imagery and cadastral boundaries
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Broad Habitat Types
Interpreted by BAAM (2015) from Vegetation management regional ecosystem and remnant map - v8.0 coastal
Queensland Government - Department of Natural Resources and Mines
Abbot Point - Caley Valley Wetlands
Directory of important wetlands - Queensland Queensland Government - Department of Environment and Heritage Protection
Wetland habitat zones
BMT WBM - Abbot Point Gateway Project - Technical Report for Wetland Hydrology, Water Quality and Aquatic Ecology Components, July 2015

1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-13 Caley Valley Wetlands - Wetland Habitat Zones							
Figure: 301001-01956-00-GM-SKT-0109							Rev: 1



3.1.4.1 Hydrological setting

The Caley Valley Wetlands is located in the Don River Basin, which extends from Bowen in the south to near the mouth of the Burdekin River within the North Queensland Dry Tropics climate zone. This zone experiences major seasonal variation in freshwater inputs from local runoff and rainfall.

The catchment of the wetland is shown in Figure 3-14. The fluvial hydrology of the wetland is dominated by local runoff from the Salisbury Plain, and the slopes of Mount Roundback and Mount Little located to the south and south-east of the wetland respectively. The wetland is fed by numerous creek systems, which include (from west to east): Plain, Splitters, Spring, Branch, Tabletop, Maria, Mount Stuart, Six Mile, Goodbye, and Saltwater Creeks. Saltwater Creek also conveys breakout flow from the larger Don River catchment via the connecting Euri Creek.

The catchment of the wetland is approximately 83,000ha. Saltwater Creek is the largest stream which flows into the wetland, and typically holds water throughout the year. Despite its name, Saltwater Creek is a freshwater system. All of the other streams that drain into the wetland are ephemeral with some such as Splitters, Branch, and Mount Stuart Creeks can contain semi-permanent pools during the dry season. The lower reaches of these creeks are tidal, with mangroves fringing channels and inter-tidal overbank areas.

The hydrology of the wetland is controlled by three interactive processes as described below.

Tidal processes

Tidal processes are a major control on water levels in the western sections of the wetland. The maximum tidal range for Abbot Point is 2.4m; however, storm surges resulting from low atmospheric pressure and onshore winds can raise maximum tidal heights. Tidal regimes in the GBR lagoon and lower reaches of the wetland are semidiurnal.

Catchment inflows

Freshwater runoff from the local catchment generally occurs in a seasonal pattern with significant rainfall and catchment runoff during the summer months (December to March), and relatively little rainfall and runoff during the winter months (April to November). During the dry season, tidal water movement dominates the western section of the wetland with saline waters entering from Curlew Bay. During the wet season, catchment runoff originates from the Salisbury Plain and the slopes of Mount Roundback and Mount Little. Spring, Table Top, Main, and Mount Stuart Creeks drain into the western wetland at Curlew Bay while Six Mile, Goodbye, and Saltwater Creeks drain into the eastern wetland. During the wet season, the wetland can fill with freshwater. The natural and artificial topography of the wetland means that some of this water will remain ponded in basins, which then evaporates during subsequent non-rain periods. A portion of the ponded water will also be transferred into groundwater reserves.

Groundwater processes

Groundwater levels below the wetland are expected to be shallow and generally within 5m or less of the ground surface. Based on groundwater studies undertaken in 2014, it is believed that groundwater flowing northward from the higher topographies to the east and west



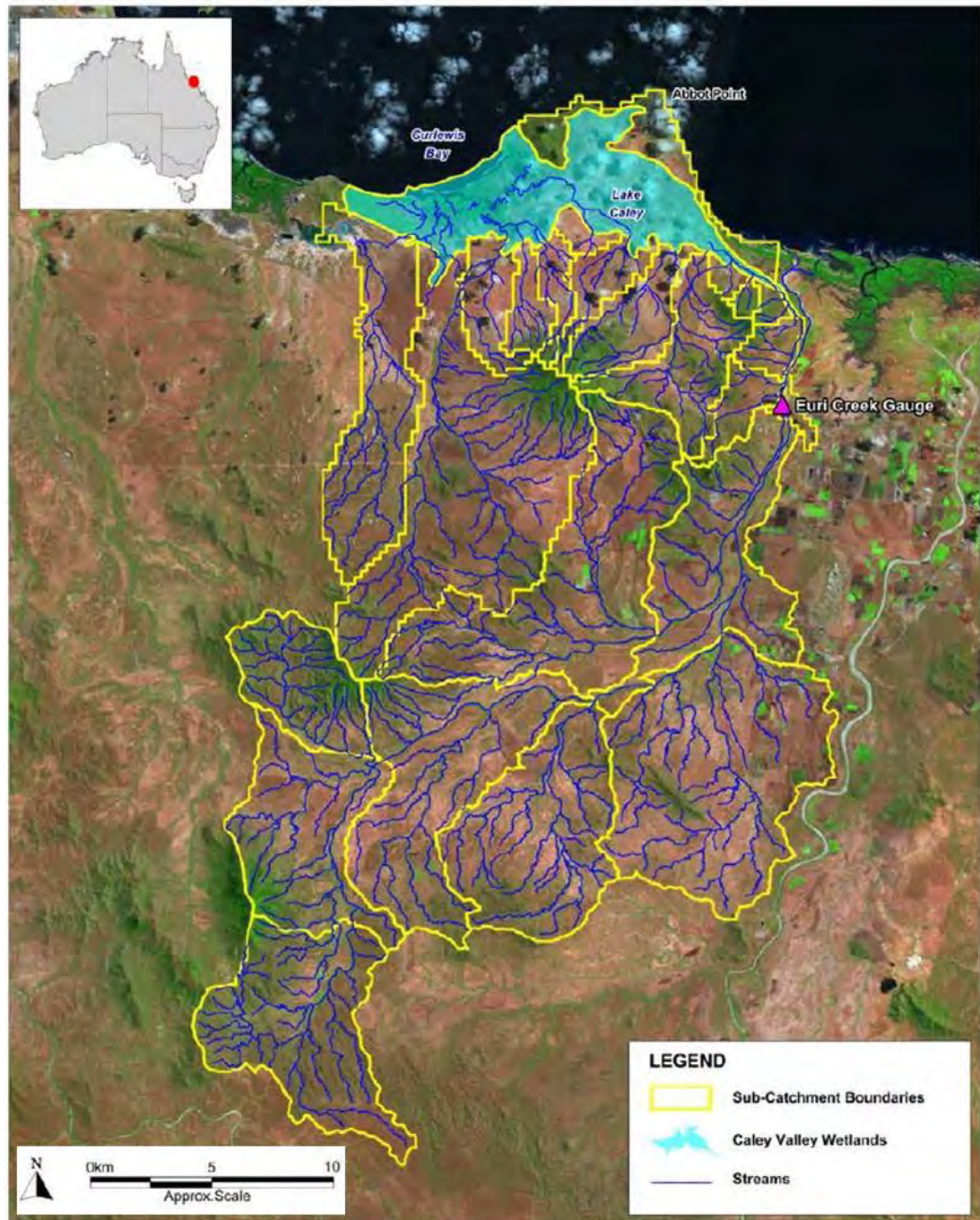
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discharge into the wetland. Groundwater forms an important source to the wetland during the dry season when freshwater inputs are minimal. This is inferred due to the deep pools of water maintained in some areas during the dry season. For example, a central pool in the wetland basin zone experiences semi-permanent inundation and is referred to as Lake Caley. Groundwater may also interact with wetland surface water within the hyporheic zone beneath ephemeral waterways. This is indicated by the shallow depth to groundwater suggested below many of the creeks including Branch, Goodbye, Maria, Kangaroo, Saltwater, Plain, Split, Splitters, Tabletop, and Mount Stuart Creeks.

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Source: Reproduced from BMT WBM (2015; **Appendix O**)

Figure 3-14 Sub-catchments and stream network map



3.1.4.2 Tidally dominated western wetland areas

The hydrology of the coastal water zone, the western estuarine zone and hypersaline zone is regulated by tidal processes. Flooding can lead to a temporary increase in water levels in these areas. The area is comprised of three functional habitat zones namely: open coast (beaches), mangrove/saltmarshes, and saltpan (high value) and impounded hypersaline waters (degraded). The presence/absence and health of these ecosystems are highly dependent on wetland hydrology and flushing.

The DMCP and associated infrastructure are not located within the wetland; however, there are two bunds located adjacent to the western sections of the wetland which influence tidal hydraulics and therefore ecosystem functioning in wetland areas to the east of the bunds (refer to Figure 3-14 for bund locations).

The Western Bund, located on Mount Stewart Creek, was constructed in the early 1980s. This bund restricts tidal movements into the wetland, particularly within the northern section of the wetland between the Western Bund and the Causeway (the area which represents the hypersaline zone). Approximately 46ha of mangroves (GHD, 2010) have been replaced by saltpan and ponded hypersaline waters upslope of the Western Bund as a result of inadequate flushing. Furthermore, by limiting tidal exchange, the Western Bund represents an aquatic fauna movement barrier, reducing fish habitat values of the wetland.

Results from hydrodynamic modelling suggest that during large spring tides the Western Bund can be overtopped, with marine waters becoming impounded upslope of the bund despite the apparent 'leaky' nature of this structure, and salinity increases as water evaporates. During spring tides, tidal waters also propagate along Branch Creek around the southern side of the Western Bund and onto the saltpan of the hypersaline zone. The Causeway creates a further barrier to tidal interaction with the wetland basin zone and, although this bund can also be overtopped, this only occurs during very large spring tides. During sustained rainfall periods, freshwater may flush the area upstream of the Western Bund; however, the bund remains a flow obstruction until upstream water levels are sufficiently high to overtop the crest of the bund.

Such overtopping is likely to occur only once or twice in a wet year depending on antecedent conditions and as such the area remains highly saline. During dry periods, marine waters become impounded upslope of the western estuarine zone outer bund despite the apparent 'leaky' nature of this structure, and salinity increases as water levels decline in response to evaporation.

3.1.4.3 Wetland basin

Water levels and depths within the wetland basin zone undergo dramatic seasonal and inter-annual variability. In the wet season, the wetland can be 18km long and 6km wide, and cover an area of 5,154ha. Under high flow conditions, water flows through the wetland basin zone in a predominantly east to west direction. During prolonged dry conditions, waters within the wetland basin contract into the area known as Lake Caley; a shallow (<0.2m deep in November 2014) depression located in the centre of the basin. The wetland can at times be completely dried out.

The Causeway presents a major barrier to the hydrological interactions between the tidally dominated western wetland areas and the basin. The bund was originally constructed in the

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1950s and refurbished in the early 1980s to provide access for construction equipment to the Abbot Point Coal Terminal. Tidal water movements cross under this structure via a small culvert (300mm diameter pipe which is generally silted) located on the southern end of the Causeway during infrequent, high spring tides. It is also possible that tidal waters may occasionally overtop the Causeway via a low-lying depression located on the northern end of the bund. The Causeway would be overtopped during high flood events combined with strong northerly winds.

While the wetland basin zone is partially tidal, its hydrology is mostly regulated by runoff with likely, although unquantified, groundwater interactions. The groundwater interactions are considered likely given the reasons outlined in Section 3.1.4.1.

Dominated by ephemeral brackish marsh and samphire ecosystems, the wetland basin zone requires cyclic wetting and drying to maintain the dominant ecosystems and dependent species. As with the Western Bund, by limiting flows the Causeway represents an aquatic fauna movement barrier, reducing the fish habitat value of the wetland.

3.1.4.4 Saltwater creek and non-tidal drainage

Saltwater Creek, located in the south-eastern corner of the wetland, is the largest creek system draining into the wetland. During flow events, Saltwater Creek connects to the Euri Creek and Don River to the east, and the wetland basin zone in the west. During non-flow periods, Saltwater Creek forms a long continuous pool that is disconnected from the wetland and Euri Creek/Don River system. A small (<0.2m high) bund is located across the creek at its confluence with the wetland basin zone which is likely to limit saltwater intrusion from wetland basin during non-flood periods; however, there are no measurements or data to determine the role of this bund in regulating the hydrology of the wetland or creek.

There are no reports of Saltwater Creek completely drying; however, field surveys in November 2014 (drought conditions) found that water depths across the creek were <1m, and typically <0.5m. No studies have examined the role of groundwater in recharging Saltwater Creek. A small channel connects Saltwater Creek to mangrove forests in the Euri Creek system. Marine waters could potentially intrude into Saltwater Creek from the east during large spring tide events or during storm surges. Notwithstanding this potential interaction, tidal processes do not appear to be a key control on the hydrology or water quality of Saltwater Creek, based on the following:

- Field measurements of water levels and electrical conductivity undertaken at two sites in Saltwater Creek during a spring tide cycle (October to November 2010) did not identify a strong tidal signal
- The freshwater to slightly brackish water character Saltwater Creek do not suggest that tidal processes have a pronounced effect on water quality under typical conditions
- A fluvial delta and small bund occurs at the mouth of Saltwater Creek, and appears to limit any tidal water movement into Saltwater Creek from the wetland basin zone.

The remaining creeks that flow into the wetland are ephemeral drainages, most of which dry or contain small pools during dry periods. Site inspections undertaken in November 2014 identified standing water in the lower reaches of one creek (Branch Creek), whereas all other streams were dry.



3.1.4.5 Local hydrological conditions

There are several local drainage catchments that overlap the DMCP footprint. These catchments areas are shown in Figure 3-15.

The drainage catchments were delineated using GIS topographical interpretation and visual assessment.



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Source: Reproduced from Golder Associates (2015; **Appendix Y**)

Figure 3-15 Local drainage catchments



3.1.5 Surface water quality conditions

The surface water quality assessment undertaken for the Project (**Appendix O**) summarises and considers the baseline condition of the Abbot Point area.

3.1.5.1 Salinity

Salinity data, together with patterns in vegetation community structure, reveal that a salinity gradient exists within the wetland, resulting in the creation of marine, hypersaline, brackish, and freshwater waterbodies along this gradient. Monitoring indicates that the salinity of the wetland varies from freshwater to hypersaline conditions.

Freshwater inputs from Saltwater Creek and other runoff during the wetter months dilute saline influences from tidal intrusion downstream. During drier months when rainfall is reduced, the tidal inflow and greater effects of evaporation contributes to greater salinity, particularly where the bunds limit tidal and freshwater flushing. Groundwater is also likely to be an important source of salt in the wetland, particularly during the dry season.

A water quality monitoring program completed in 2010 captured six months of physicochemical *in-situ* and laboratory analyte parameters on a monthly basis (i.e. 6 events) at 14 sites across the wetland. Patterns in salinity within each functional zone are discussed further in the sections which follow.

Coastal water zone

The coastal water zone is dominated by marine waters, except during major floods, which are expected to result in short-term reductions in salinity. There are no salinity data currently available for the coastal water zone within the wetland, although some data are available for adjacent port waters (WBM, 2006).

Western estuarine zone

Monthly monitoring data within this zone indicates salinity was typically within the range of marine conditions (GHD, 2010). Measurements taken in October to November 2010 (BMT WBM) also showed that the estuarine channels in the western sections of the wetland (the lower reaches of Branch Creek and Mount Stewart Creek) are typically marine to slightly hypersaline in character during dry periods (approximately 35g/L to 45g/L). The slightly hypersaline conditions have also been recorded in the upper reaches of Mount Stewart Creek immediately downslope of the Western Bund (WBM, 2006; BMT WBM, 2010). Salinity measurements undertaken by BMT WBM indicate that the highest salinities occur during low tides, suggesting some leakage of ponded hypersaline waters through the Western Bund wall.

Salinity can show marked declines following rain events. For example, a 100mm rainfall event on 18 November 2010 resulted in salinities declining to 24,000 μ S/cm (approximately 15g/L, or one third seawater) in the upper reaches of the Mount Stewart Creek, and 353 μ S/cm (freshwater) in the upper estuary of Branch Creek.

**Section 3****Existing Environment****Hypersaline zone**

The hypersaline zone broadly occurs between the Causeway and Western Bunds (refer to Figure 3-14). Salinity regimes in this zone vary over time in response to catchment rainfall patterns, varying from freshwater conditions during floods, to hypersaline during dry periods.

During spring tides, tidal waters propagate along Branch Creek and onto the saltpan. It is also likely that tidal waters would intrude into this zone through the Western Bund. During dry periods, marine waters become impounded upslope of the Western Bund despite the apparent 'leaky' nature of this structure, and salinity increases as water levels decline in response to evaporation. Waters within this zone can have very high salinities (>100g/L; WBM, 2006), and a thick crust of salt and algae can form during dry conditions.

As water depth increases in response to catchment runoff, salt concentrations are reduced through dilution, and can approach brackish water conditions. The October/November 2010 monitoring results indicate that salinity was generally >60g/L (hypersaline), but reduced to 21.6g/L (approximately 60% seawater) following catchment rainfall in mid to late November. This can result in major shifts in vegetation community structure, with a range of brackish water macrophytes establishing in this zone during prolonged wet periods.

Wetland basin zone

The wetland basin zone occurs in wetland areas upslope of the Causeway and downslope of Saltwater Creek. A weak east to west salinity gradient exists within this zone during non-flood periods, varying in response to rainfall conditions. During non-flow periods, large areas of the wetland basin zone experience salinities approaching marine conditions. This is reflected in the largely estuarine character of vegetation in this zone.

While estuarine conditions persist following rainfall events, salinity can show rapid and marked declines following catchment rainfall. Logger measurements indicated that during non-rainfall periods (27 October 2010 to 1 November 2010), salinity ranged:

- From 27,979 μ S/cm (approximately 16g/L salinity, or 46% seawater) in the eastern part of the wetland basin zone (site 3)
- To 48,804 μ S/cm (approximately 29g/L, or 82% seawater) in the western part of the wetland basin zone and 70,153 μ S/cm (42g/L, hypersaline) immediately upslope of the Causeway.

Salinity showed little variation over time for most of the subsequent measurement period at site 3 (eastern part of the wetland basin zone), but did decline to approximately 10,000 μ S/cm (6g/L, or 17% seawater) following >150mm of rainfall between 18 and 23 November 2010. At the two sites located in the western sections of the wetland basin zone, salinity showed marked declines in response to rainfall events, most notably between 18 and 23 November 2010 when salinities declined to approximately 10,000 to 13,000 μ S/cm (6g/L to 8g/L, or 17% to 22% seawater).

However, monitoring in February 2010 to March 2010, February 2011, and May 2011 to June 2011 showed that the wetland basin zone tended towards freshwater conditions (recorded values all less than approximately 2,500 μ S/cm) particularly with freshwater inputs from Saltwater Creek and other runoff during these periods diluting saline influences.

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The variable salinity is a distinct feature of the wetland basin zone. For example, Abbot Point Coal Terminal monitoring data for a site located in the north of the zone immediately downstream of the Abbot Point Coal Terminal settlements ponds shows that equivalent salinity ranged from approximately 1g/L (freshwater) to 10g/L (approximately 28% seawater). Salinity regimes here are driven by rainfall, with cumulative three-month rainfall explaining approximately 80% of the variation in EC. Similar fluctuations in salinity were observed by GHD (2010) at sampling sites throughout the wetland basin zone.

Saltwater Creek zone

Saltwater Creek has a freshwater to slightly brackish character. Monthly monitoring undertaken by GHD (2010) at two sites in Saltwater Creek revealed a slight increase in salinity over time, approaching 2,000 μ S/cm during dry periods. Similarly, measurements undertaken by BMT WBM during a dry period in October 2010 indicate that the downstream sections of the creek typically had salinities <1,600 μ S/cm (freshwater), whereas further upstream, slightly brackish conditions were recorded (3,800 μ S/cm, 2.2g/L or 6% of seawater).

Salinity can show marked short-term variability in response to rainfall in the catchment as shown by continuous measurements of electrical conductivity taken on 30 October 2014 and 3 November 2014 and associated *in situ* measurements, which were around 3,000 μ S/cm (BMT WBM, 2014). Similarly, logger data (BMT WBM, 2012) shows that a rainfall event in late November 2010 resulted in an increase in salinity in the downstream sections of the creek (3,343 μ S/cm), suggesting that the slightly brackish waters upstream were being pushed downstream by the stream flow. However, in upstream areas, there was little change in measured salinity during this rainfall event.

These complex salinity patterns appear to be partly a function of seawater intrusion into the creek from the east. A small channel that connects Saltwater Creek to the sea remained dry throughout the measurement period, suggesting that any connection that occurs is intermittent. No correlation between water levels at either sites in Saltwater Creek and tidal height were observed during the measurement period, again suggesting that any intrusion of seawater via tidal processes, if present, would only occur intermittently. It is notable that riparian vegetation along Saltwater Creek does include mangroves, suggesting that the creek maintains some connectivity to the sea.

3.1.5.2 Nutrients, dissolved oxygen and algae productivity

Benthic metabolism is an important indicator of the health of the wetland as it refers to the rates of gross primary production and community respiration as they respond to environmental variables including light, temperature regimes, nutrient loads, and rates of production. Production and biomass are often found to be positively correlated. Nutrients and dissolved oxygen (DO) therefore provide important indicators of productivity and its implications on ecosystem health.

Nutrient data is available from snapshot surveys undertaken by BMT WBM (2010), GHD (2011) and WBM (2006) at a site sampled within the hypersaline zone (site C) and two sites within the wetland basin zone (Figure 3-13). At the time of the survey, site C (hypersaline zone) had lower nitrogen but higher phosphorus concentrations than the two sites located in the wetland basin zone (sites 5 and E). Organic nitrogen was the dominant nitrogen species

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at all sites, and site C also had higher concentrations of nitrogen oxides and ammonia than the other sites.

The BMT WBM October to November 2010 study assessed nutrient concentrations at nine sites throughout the wetland. Total nitrogen ranged from 0.9mg/L (site 9, wetland basin zone) to 1.9mg/L (site 2, Saltwater Creek zone), with exceedances of default regional guideline values outlined by the Department of Environment and Resource Management (DERM, 2009) at most sites. The concentration of total nitrogen at sites in the hypersaline zone tended to increase from March to May 2010. There was also an increase observed between February and May 2011; however, this was not as significant as was observed in 2010. The total nitrogen concentration in the central wetland (WQ10) and eastern wetland (WQ13 and WQ14) also increased from April to July 2010; however, the same trend was not observed in 2011. Organic nitrogen dominated, although concentrations of ammonia exceeded guideline values at most sites.

Total phosphorus concentrations also exceeded the regional guideline value at all sites in 2010; however, filterable reactive phosphorus, which is bio-available and therefore able to exert a major influence on algae growth, was recorded in low concentrations. No other spatial or temporal patterns were identified for total phosphorus.

DO concentrations can show great spatial variability throughout the wetland. For example, continuous measurements of DO (BMT WBM, 2014) indicate variations of between:

- Approximately 50% and 450% at site 1A, east of the western (outer bund) within the hypersaline zone
- Approximately 5% and 20% at site 3A, downstream of the Causeway within the hypersaline zone
- Approximately 10% and 160% at site 4, within Saltwater Creek downstream of the rail bridge
- Approximately 25% and 325% at site 6 (Lake Caley).

Higher DO values recorded are correlated with daylight hours (and higher temperatures) and vice versa.

Similarly, sampling by the Department of Environment, Water, Heritage and the Arts (DEWHA, 2010) in 1999 recorded DO concentrations ranging from 50%sat (4.5mg/L) in the northern section of the wetland basin zone (taken at 9:30am) to 267%sat (20.4mg/L) south of Lake Caley (time of sampling not documented).

Sampling in 2005 (WBM, 2006) suggested that most sites were well oxygenated, with slightly depressed concentrations recorded in the western estuarine zone immediately downstream of the Western Bund.

DO concentrations tend to vary greatly over time in response to changes in algae and microbial production (which varies seasonally and, in the case of algae, between day and night) and wetland hydrology. DEWHA (2010) suggests that the nutrient enriched sediments in these areas represent an important source of nutrients for the wetland ecosystem.

The high nutrient concentrations, coupled with shallow water (which allows light penetration to the base of the wetland) are driving primary productivity in the wetland. Large mats of benthic algae are common in the shallow waters of the hypersaline zone and wetland basin zone. During daylight hours when photosynthesis occurs, the algae and benthic microbes in

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these zones rapidly metabolise the readily available nutrients releasing supersaturated levels of oxygen into the water column. However, increased algal biomass drives increased plant respiration, drawing on DO and when the algae die, bacterial decomposition spikes, using up most or all of the DO available. This creates an anoxic, or oxygen-depleted, environment where fish and other organisms cannot survive. DO results presented in BMT WBM (2014) demonstrate how photosynthesis shuts down at night resulting in rapid and significant declines in DO levels.

3.1.5.3 Trace metals

WBM (2006) found that concentrations of most trace metals were higher at the site in the hypersaline zone (site C) than the two sites in the wetland basin zone (Figure 3-13). By contrast, the BMT WBM October to November 2010 study found that sites in the hypersaline zone had lower trace metal concentrations than other parts of the wetland. In this study, the Saltwater Creek zone and the western estuarine zone had the highest concentrations of most trace metals.

Trace metal concentrations were compared with *Australian and New Zealand Environment and Conservation Council (ANZECC)/Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ; 2000)* toxicant trigger values (95% species protection level). In summary, WBM (2006) found that:

- Trace metal concentrations were below marine trigger values at all sites (which are applicable given the saline nature of waters at the time of sampling)
- In the October to November 2010 study, the Saltwater Creek zone had concentrations of aluminium, chromium, copper, and zinc which exceeded respective freshwater trigger levels (which are applicable given the conditions at the time of sampling)
- The same study also found that the following trace metals had concentrations above *ANZECC/ARMCANZ (2000)* trigger values for marine waters: copper (all sites except the hypersaline zone), chromium (western estuarine zone), and zinc (western estuarine zone, and one site in the wetland basin zone).

More recently, surface water quality monitoring results indicate that the concentration of total metals in the wetland during February, March, July, and June of 2010 (GHD, 2010; GHD, 2011) exceeded the ANZECC guideline for aluminium, boron, chromium, cobalt, copper, iron, lead, nickel, vanadium, and zinc at a number of sites. Concentrations of metals were generally highest in February 2010, during the wet season.

There are many factors that influence spatial and temporal patterns in concentrations of trace metals and other pollutants. In particular, rainfall can exert a major influence on trace metal concentrations. It is noted that the November 2010 sampling was undertaken immediately following a rainfall event at the end of the dry season (GHD, 2011). Such 'first flush' events can flush large quantities of soil and other pollutants from the surrounding catchment into receiving waters, resulting in a temporary spike in pollutant concentrations. The WBM (2006) study may be more representative of background conditions.

Sampling across a range of sites and across a range of time periods is required to adequately characterise background water quality conditions (DERM, 2010) and the drivers leading to changes in water quality conditions. This is critical to establishing local water quality objectives for the wetland prior to industry and infrastructure development occurring in the APSDA.



3.1.5.4 pH

Sampling carried out as part of a study by Peter Hollingsworth and Associates (1981) indicated that the two sites immediately upslope of the Causeway within the hypersaline zone were alkaline, with pH ranging from 8.5 to 9.8. The north-east corner of the wetland basin zone (immediately downstream of the Abbot Point Coal Terminal) has a variable pH, with either mildly acidic or mildly alkaline conditions occurring (Figure 3-13). These variations would be associated with upstream inputs of low pH waters from Abbot Point Coal Terminal. Measurements of pH in 1999 (DEWHA, 2010) ranged from 7.8 on the flat south-east of Mount Luce to 8.9 on the eastern side of the northern end of the Causeway.

Sampling from 2005 (WBM, 2006) indicated that pH throughout other parts of the wetland basin zone ranged between 8.65 and 9.24. During the period 2005 to 2008, the pH in Lake Caley proper was highly variable, ranging from approximately 6 to 9.5 (GHD, 2009a).

3.1.6 Marine water quality

A number of previous assessments of marine water quality at Abbot Point have been undertaken. These are outlined in WorleyParsons (2014a). Aspects relevant to the current Project are outlined below.

Figure 3-16 shows the locations of all monitoring sites since 2009.

3.1.6.1 Water quality monitoring programs 2009 to 2012

As outlined in the Abbot Point PER (GHD, 2012c), the marine water quality at Abbot Point is influenced by coastal (currents and waves) and fluvial processes (discharges from coastal rivers and creeks), as well as weather conditions. These processes contribute to significant temporal, and in particular seasonal, variations in water quality. A high degree of seasonality in rainfall at the Abbot Point region influences fluctuations in turbidity, TSS and salinity, whereby increased runoff and freshwater inputs result in increased suspended solids in the water column and reduced salinity. Observed peaks in turbidity tended to coincide with months when heavy rainfall was recorded, although occasionally peaks in turbidity coincided with high wind speeds and the localised re-suspension of sediments.

Nutrient parameters also showed seasonal variability as a result of seasonal variation in fluvial inputs. Higher values of total nitrogen and phosphorus were reported during the dry season, which, similar to turbidity, are often linked to periods of strong winds and localised re-suspension of nutrients. The degree of spatial variation in water quality conditions at Abbot Point was considerably less than the temporal variation. This suggests that the coastal waters of Abbot Point are well mixed under non-flood conditions, which is consistent with other coastal waters of the GBR.

A number of parameters were outside relevant water quality guidelines, which consistently included TSS, nutrients and DO and, at a lesser frequency, chlorophyll-a and pH during the wet season. These results indicate that the waters of Abbot Point exhibit elevated levels of these parameters, particularly during the wet season when high rainfall and runoff increase inputs of nutrients and terrigenous sediment, with implications for biological processes. This indicates that site-specific guidelines would be more applicable for the Abbot Point area in order to incorporate seasonality, coastal processes and fluvial influences specific to the area.



3.1.6.2 Water quality monitoring program February 2013 to June 2014

The results of the most recent baseline water quality monitoring program are comprehensively presented in the *Abbot Point Baseline Water Quality Monitoring Report* (WorleyParsons, 2014a). Methodologies and graphical representation of results are provided in this report. A summary of the results are presented in the following sections.

Sea temperatures

The overall median sea temperature was 26.3°C, ranging from a median of 27.4°C in the wet season to 22.7°C in the dry season. The median sea temperature varied considerably with depth and ranged between 27.1°C and 25.5°C. There was considerable temperature variation between seasons; the wet season was characterised by median temperatures between 27°C and 28°C at all sites compared to the dry season where temperatures ranged between 22°C and 23°C. The maximum temperature of 30°C was recorded during the wet season at the shallowest site while the lowest temperature of 20.41°C was recorded at the second shallowest site during the dry season.

Electrical conductivity (mS/cm)

Median electrical conductivity across all sites was 52.68mS/cm and varied within a small range between 52.29mS/cm and 53.28mS/cm. The electrical conductivity is generally highest in the wet season.

Salinity (ppt)

Median salinity across all sites was 34.75 parts per thousand (ppt), ranging from 34.72ppt in the dry season to 34.96ppt in the wet season. Salinity was highly variable in the wet season months; there was no consistent pattern in the intensity of salinity between seasons.

Dissolved oxygen (%sat)

Median DO (%sat) across all sites was 91.73%, ranging from 88.82% in the wet season to 96.51% in the dry season. The lowest DO (%sat) was 75.00% recorded at a number of sites during both seasons, and the highest of 119.40% was recorded during the dry season. The DO (%sat) was generally lower in the wet season compared to the dry season. The median DO (%sat) was outside the lower and upper guideline limits for open coastal environments at most sites.

Dissolved oxygen (mg/L)

The values of DO (mg/L) are very closely related to the DO (%sat) measurements and follow the same patterns. Median DO (mg/L) across all sites was 6.15mg/L ranging from 5.69mg/L in the wet season to 6.63mg/L in the dry season. The lowest DO (mg/L) was 4.66mg/L recorded during the wet season and the highest was 8.53mg/L recorded during the dry season. The DO (mg/L) was generally lower in the wet season compared to the dry season.

pH

Median pH across all sites was 8.20, ranging from 8.15 in the wet season to 8.23 in the dry season. The lowest pH of 7.03 was recorded during the dry season and the highest pH of 8.94 was also recorded during the dry season. The pH was generally lower in the wet

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season compared to the dry season at most monitoring locations. The overall median pH at each site independent of season was within the lower and upper guideline limits for open coastal environments at all but one site. Variations in pH between the dry and wet seasons meant the median pH values at some sites were outside the upper or lower guideline boundaries.

Turbidity

Median turbidity (Nephelometric Turbidity Units; NTU) across all sites was 2.27NTU, ranging from 2.07NTU in the dry season to 2.47NTU in the wet season. The TSS equivalent, based on the 1.45 factor derived from preliminary testing (see Marine Ecology Technical Report - **Appendix Q1**, Section 2.3.3.11) are median across all sites of 3.3mg/L and a range of 3mg/L in the dry season and 3.6mg/L in the wet season. Turbidity below detectable limits was recorded at all sites during both seasons; while the highest turbidity of 654NTU (948mg/L) was recorded during the wet season. The turbidity was generally higher in the wet season compared to the dry season at all but one site. The overall median turbidity was above the *Queensland Water Quality Guidelines*' (DEHP, 2009) open coastal guideline value of 1NTU (1.45mg/L) at all sites during all seasons.

Daily photosynthetically active radiation (mol/m²/day)

Median daily photosynthetically active radiation (PAR) across all sites was 0.39mol/m²/day, ranging from 0.38mol/m²/day in the dry season to 0.40mol/m²/day in the wet season. The lowest daily PAR of 0.00mol/m²/day was recorded at all sites during both seasons; the highest daily PAR of 9.67mol/m²/day was recorded during the wet season. The daily PAR was generally higher in the wet season compared to the dry season at most sites. Daily PAR was generally higher in the shallow waters compared to the deeper waters, the exception being the shallowest site which generally has low light all year around.

3.1.6.3 Summary of physicochemical parameters

The main driver of water quality in marine waters surrounding Abbot Point during the 16 months of sampling (February 2013 to June 2014) was the passage of two cyclones; Tropical Cyclone Dylan on 31 January 2014 and Tropical Cyclone Ita on 13 April 2014. The elevated wave height and winds and the associated flooding rains that each cyclone caused brought about the largest changes in all measured parameters during periods either side of the events. During Tropical Cyclone Dylan, the impacts on turbidity and daily benthic light availability (measured as PAR) were the most profound. The intensity of the impacts was generally related to depth, with shallower sites having the largest overall changes in temperature, salinity, pH, turbidity and benthic light compared to the deeper sites. The total loss of benthic light due to elevated suspended solids in the water column from cyclonic influences often extended for over 10 days.

The downward changes in sea temperatures, salinity and pH which were triggered by the cyclones persisted for several weeks before returning to pre-cyclone values.

Periodic increases in wind and waves due to the passage of storms also influenced all measured parameters. The shallower sites were again highly influenced by these events with increased suspended sediment in the water column.

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Wet seasons compared to dry seasons were characterised by higher sea temperatures, lower pH and DO and higher suspended solid concentrations (measured as turbidity). Sites located closest to freshwater inputs from local creeks and rivers exhibited the largest changes in salinities in the wet season. These sites also experienced the lowest pH values and largest ranges of DO concentrations.

Daily benthic light availability (measured as PAR) was highest in the wet season compared to the dry season. The increases in turbidity during the wet season that work to reduce PAR on the seabed are offset by the longer days and more intense sunlight available to benthic organisms in this season. Daily PAR was generally higher in the shallow waters compared to the deeper waters; the exception being the shallowest site (WQ5) which generally has low light all year around. This could be related to the elevated turbidity this site experiences throughout the entire year which serves to lower the benthic light regime, perhaps on a daily tidal cycle. In addition, the gross sedimentation measured using sediment traps was the highest at this site. Similar relationships between sedimentation rates, elevated turbidity, and low light environments are evident at WQ1 and WQ4.

Total ammonia, nitrogen, phosphorous

Total ammonia was generally higher and more variable during the wet season compared to the dry season. Combined data for both seasons were on or slightly below the guideline values (*Water Quality Guidelines for the GBRMP*). Total nitrogen was generally higher during the wet season compared to the dry season, and was most variable during the dry season and below the guideline values. Total phosphorus was generally higher and more variable in the dry season compared to the wet season, and was generally well below the guideline values.

Dissolved and total potassium, sulfur and chlorophyll-a

Dissolved and total potassium concentrations were higher in the wet season compared to the dry season. Sulfur concentrations were higher in the wet season compared to the dry season. Sulfur concentrations were similar across sites and followed a similar temporal trend. Chlorophyll-a concentrations were higher and more variable in the wet season compared to the dry season; median concentrations during both seasons were above the *Water Quality Guidelines for the GBRMPA*. Chlorophyll-a concentrations were similar across all sites.

Dissolved and total metals

Most dissolved concentrations of metals were similar between the dry and wet seasons with the exception of aluminium which had much higher (two to four times) concentrations in the dry season compared to the wet season.

For all samples, the concentrations of dissolved cadmium, chromium, lead, mercury, nickel, cobalt and zinc were below the laboratory's limit of reporting or below the applicable guidelines (*Water Quality Guidelines for the GBRMP*) where such values were available. Concentrations of dissolved copper were above guidelines on occasion at specific sites.

Dissolved copper and dissolved zinc were detected at low concentrations during previous water quality monitoring in the Caley Valley Wetlands (GHD, 2011). The existing port operations were highlighted as a potential source of elevated dissolved copper and zinc concentrations. The elevations of dissolved copper measured offshore during the baseline

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program were not limited to areas adjacent to the wetland or port facilities (e.g. WQ5); they are spread throughout the region including at offshore sites situated >25km from the wetland outlet and >15km from the port. The ANZECC 95% species protection guideline value for dissolved zinc was not exceeded during the baseline surveys.

For all surface water samples, the concentrations of total cadmium, lead, mercury, nickel, cobalt and zinc were all below the limit of reporting or below the applicable guidelines where such values were available. The concentrations of two metals, chromium and copper were above guidelines on occasion at specific sites. Mean total chromium concentrations were above the ANZECC 95% species protection value at WQ5 on one occasion. As with the dissolved copper concentrations, mean total copper concentrations were above the ANZECC 95% species protection values at a number of sites (WQ1, WQ2, WQ3, WQ4 and WQ5 - refer to Figure 3-16) primarily during one field trip in January 2014

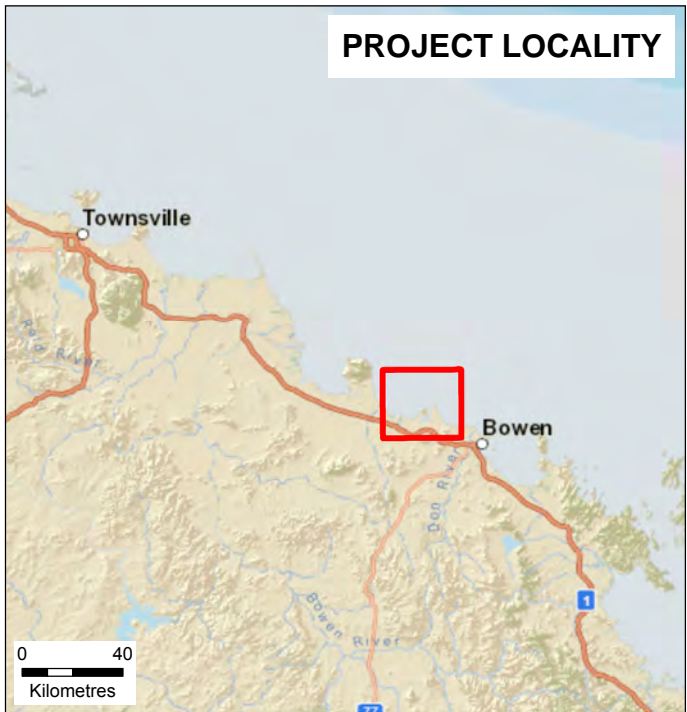
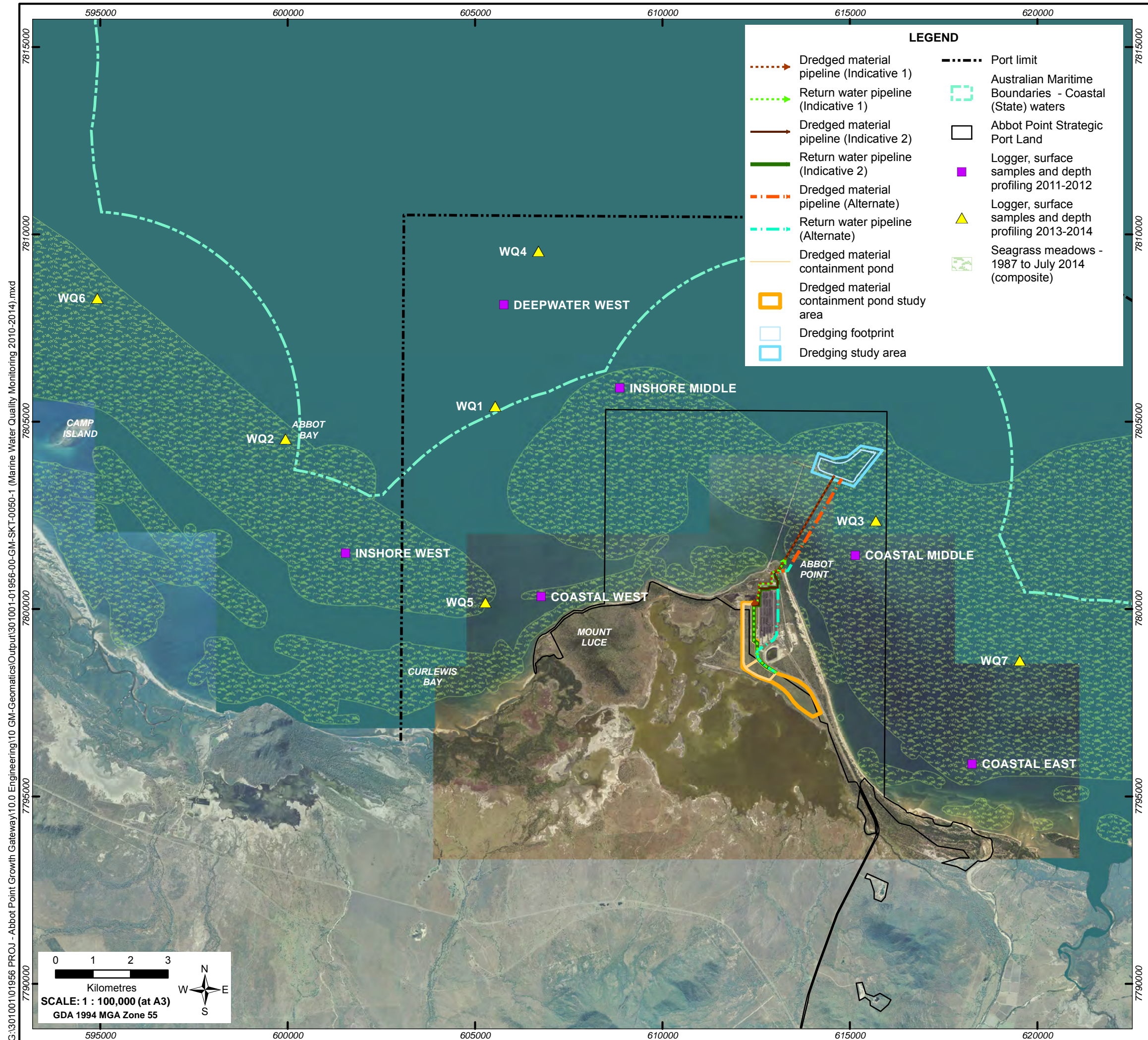
Hydrocarbons, pesticides and herbicides

Polycyclic aromatic hydrocarbons, total petroleum hydrocarbons (TPH), and benzene, toluene, ethylbenzene, and xylenes (BTEX) were not present in concentrations higher than the limit of reporting for all samples. In addition, no samples had hydrocarbon concentrations that exceeded applicable water quality guidelines.

Organochlorine pesticides, organophosphate pesticides), and multiresidual pesticides were not present in concentrations higher than the limit of reporting for the majority of samples. No samples had pesticide or herbicide concentrations that exceeded applicable water quality guidelines.


Pathogens

There were no seasonal variations in the concentrations of *E. coli* or faecal coliforms. The highest concentration of faecal coliforms was measured at the site closest to the mouth of Euri Creek/Don River during April 2014. Concentrations of Enterococci were elevated at a number of sites on occasion. The site closest to the Don River/Euri Creek recorded the highest concentrations in February 2014. There was very little variation in Enterococci between seasons.



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

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
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Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
[http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=\(4091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=(4091CAF1-50E6-4BC3-B3D4-229AA318231A))
Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited -Port of Abbot Point Land Use Plan - October 2010

1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-16							
Marine water quality monitoring sites 2010 - 2014							
Figure: 301001-01956-00-GM-SKT-0050							Rev: 1



3.1.7 Air quality

The air quality assessment undertaken for the Project (**Appendix H**) considers and summarises existing ambient air quality.

With the exception of the existing T1 coal terminals emissions (primarily coal dust), dust sources at Abbot Point are likely to be natural features of the environment, such as salt spray, pollens, grass seeds and wind erosion of bare ground. The closest existing industrial activity to the site is at Bowen. Limited dust deposition monitoring information is available. Previous studies conducted in Australia have estimated a background dust deposition level of between 20mg/m²/day and 40mg/m²/day for rural areas in the absence of anthropogenic activities. A dust deposition rate of 40mg/m²/day is considered consistent with the available data from monitoring conducted at Abbot Point in 1999 and 2003.

Table 3-3 summarises predicted ground level concentrations of dust levels due to T1 and natural background sources at the following receptor zones:

- Caley Valley Wetlands freshwater zone (actually brackish) - located south and south-west of the project area
- Caley Valley Wetlands estuarine zone - located west and south- west of the project area
- The GBRMP
- The GBRWHA.

These sensitive receptors and their proximity to the project area are shown in Figure 3-17.

Dust deposition rates and trace element levels due to the operation of T1 were predicted to comply with the vegetation criteria and other reference criteria established for the Caley Valley Wetlands and marine environments (refer to **Appendix H**).



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Table 3-3 Range of ground level dust concentrations and deposition rates at the receptor zones due to T1 and background levels of dust

Pollutant	Averaging Period	Units	Caley Valley Wetlands (Estuarine)			Caley Valley Wetlands (Freshwater)			GBRMP			GBRWHA			Reference Criteria
			L	M	H	L	M	H	L	M	H	L	M	H	
Total Suspended Particulate (TSP)	Annual	µg/m³	56	57	70	56	57	58	56	56	59	56	56	113	90 ^a
PM ₁₀ (6 th highest)	24-hour	µg/m³	31	33	60	29	34	47	28	29	39	28	30	123	50 ^a
PM _{2.5}	Annual	µg/m³	<1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	4	8 ^a
	24-hour		1	1	8	1	2	4	<1	1	3	<1	1	23	25 ^a
Dust deposition	120 days	mg/m²/month	40	45	142	40	41	46	40	41	47	40	41	218	200 ^b
	Monthly		41	47	216	40	42	50	40	41	51	40	41	354	120 ^c



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Note:

L = lowest; M = median; H = highest

^a *Environmental Protection (Air) Policy 2008* for health and wellbeing

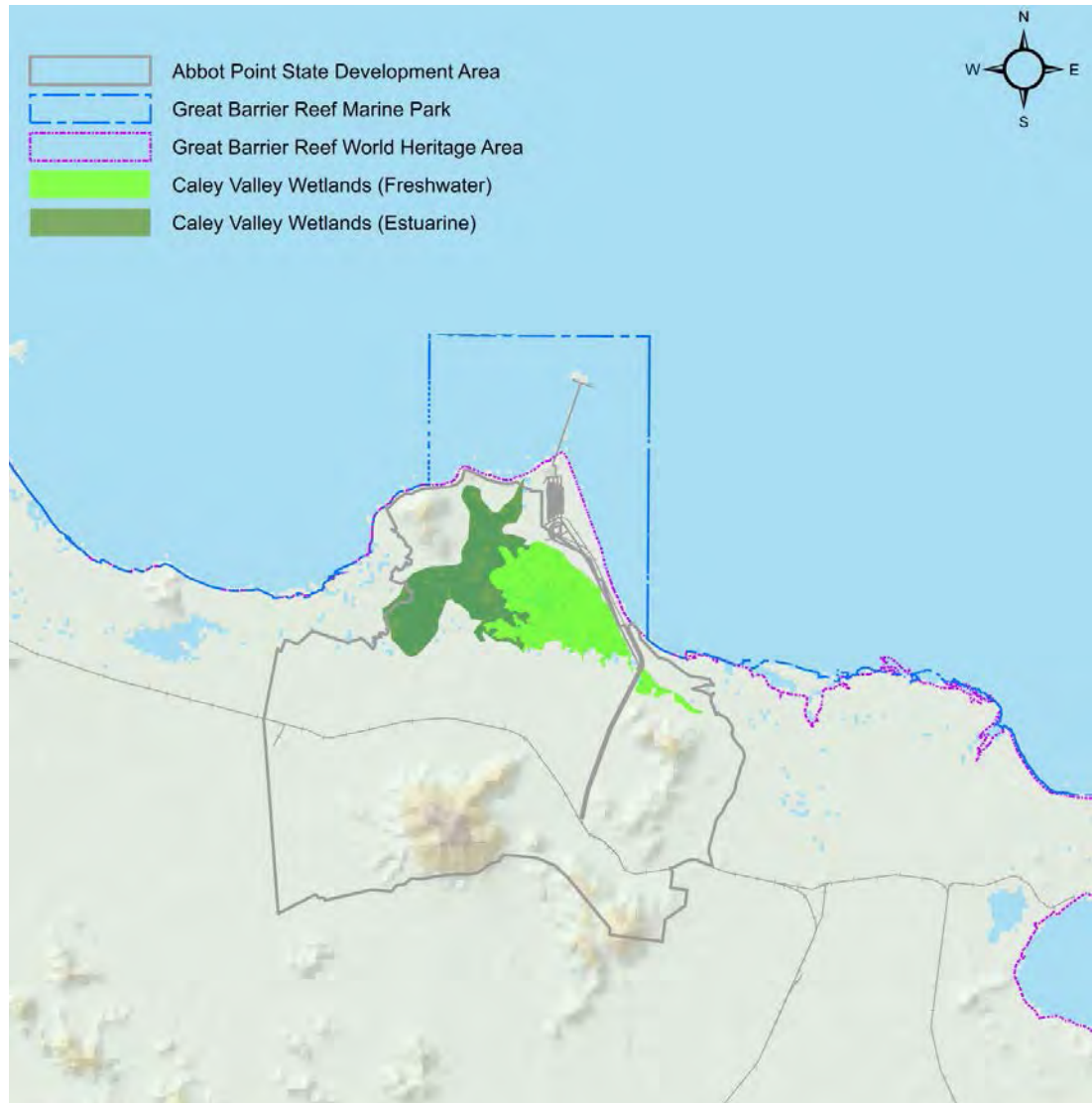
^b Dust deposition threshold for vegetation protection

^c DEHP guideline for dust nuisance



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Source: Reproduced from Katestone (2015; **Appendix H**)

Figure 3-17 Air quality sensitive receptor zones

**Section 3****Existing Environment****3.1.8 Acoustic environment**

It is relevant for the Project to consider both marine and terrestrial acoustic environments.

3.1.8.1 Terrestrial noise

The terrestrial noise assessment undertaken for the project (**Appendix J**) considers the existing noise amenity of the Abbot Point area.

The acoustic environment in the project vicinity is dominated by:

- Existing port facilities
- Rail noise
- Natural noise including wind, birds, and insects.

Noise monitoring (GHD, 2009a) has previously been carried out in the Abbot Point area, specifically associated with the proposed T1 and T2 developments. The noise monitoring locations considered to be relevant are summarised in Table 3-4.

Table 3-4 Noise monitoring locations

Site	Location	Detail
Location 03	Abbot Point Road	Residential dwelling located off Abbot Point Road. Monitoring undertaken across road and not at dwelling (note dwelling no longer exists).
Location 04	Wetland site	Access track adjacent to wetland to the west of the existing port facility.
Location 05	Concrete slab (near hill)	Concrete slab to the north-west of the site.

Monitoring results are summarised in Table 3-5 and it is considered that, of the three monitoring locations relevant to the study, Location 4 was most impacted by noise emissions from T1. Location 5 had the lowest background and ambient noise levels due to remoteness from the terminal and transport corridors.

To provide a more comprehensive understanding of the existing noise environment, and to allow a baseline comparison, the Project's terrestrial noise assessment has modelled existing noise levels in the Abbot Point area, including the Caley Valley Wetlands.

Figure 3-18 shows the predicted 45 and 60 dB(A) contours (as relevant to fauna alarm and flight response) for the existing scenario (T1 and rail noise).



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Table 3-5 Terrestrial noise monitoring results

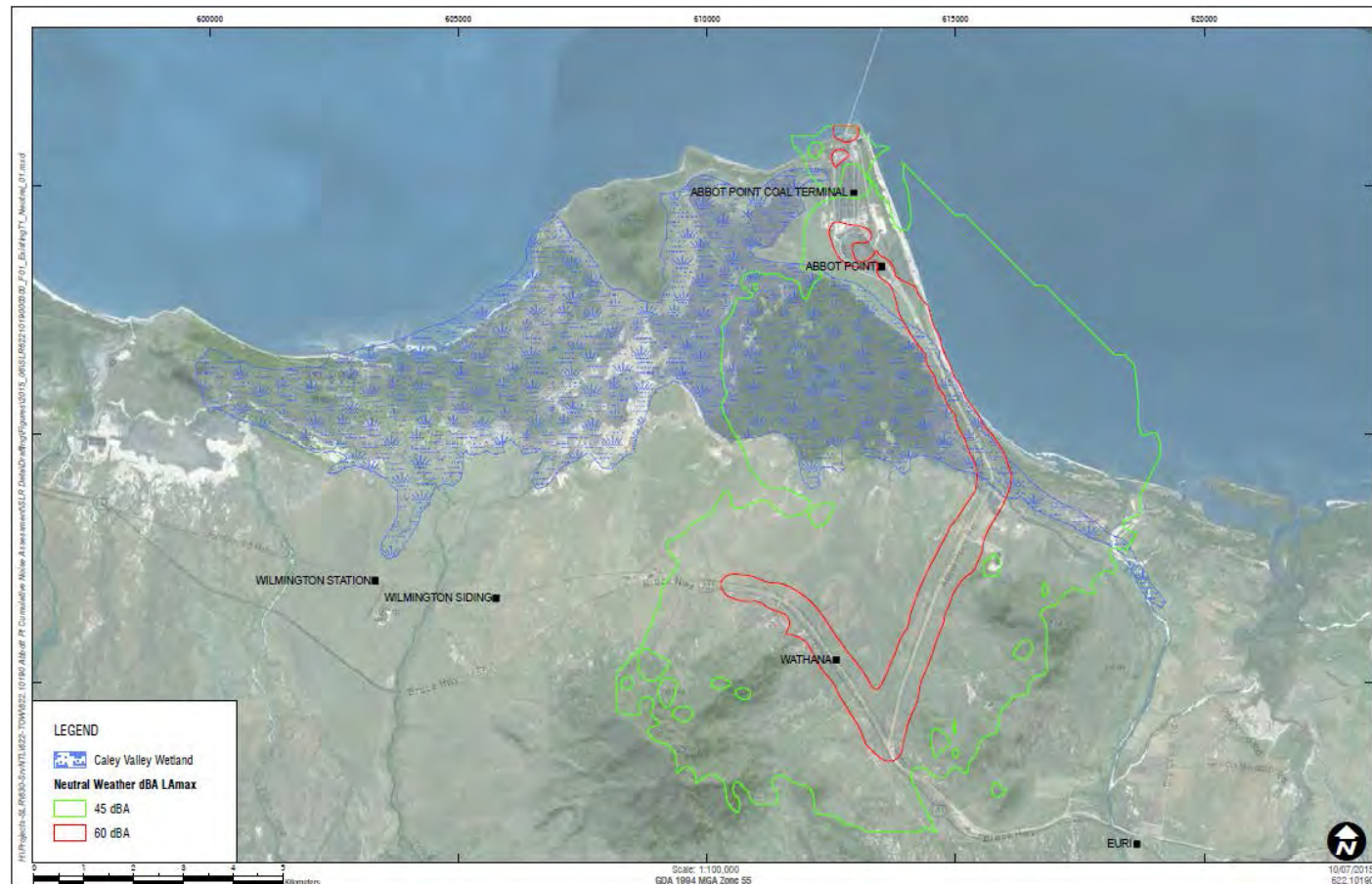
Site	Ambient Noise Level LAeq (dBA)		
	Day	Evening	Night
Location 03 (Abbot Point Road)	58	54	50
Location 04	54	53	51
Location 05	41	46	46

Note: Background noise levels (LA90) are the measured noise levels exceeded for 90% of the time. **Appendix J**, Figure 3 shows monitoring locations.



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Source: Reproduced from SLR (2015; Appendix J)

Figure 3-18 Existing T1 and rail noise L_{Amax} during neutral weather conditions



3.1.8.2 Underwater noise

The underwater noise assessment undertaken for the Project (**Appendix K**) gives consideration to the major sources of ambient noise in the shallow waters around Abbot Point as likely to include shipping noise from port shipping channel, wind-generated noise, fish chorus and snapping shrimp noise, precipitation noise from rain and hail, and thermal noise.

Commercial vessels and bulk carriers are expected to dominate the shipping contribution to the ambient noise environment around Abbot Point. Shipping noise generally has dominant energy below 1kHz and is typically generated by propellers and thrusters. The received shipping noise levels are dependent on the distance to the shipping channel. The dredging areas for T0 is adjacent to the existing T1 and close to the existing shipping channel. Considering the typical bulk carriers with source levels normally above 180dB re 1μPa at 1m (Alexander *et al.*, 2014), the noise levels from the shipping activities around the proposed dredging areas are expected to be as high as 120dB re 1μPa.

Fish chorus and snapping shrimps are likely to be an important contributor to the ambient noise environment in the waters around Abbot Point, covering frequency range from below 100Hz to as high as above 100kHz, and resulting overall noise levels can be well above 100dB re 1μPa during the active chorus period.

3.1.9 Ecology

Abbot Point and its environs support a complex of marine, estuarine, fresh water and terrestrial ecosystems. It is surrounded to the east, north and west by the Coral Sea within the GBRWHA, and dominated by the wooded habitats of Mount Luce and the extensive Caley Valley Wetlands.

This section describes the general ecological values of the project area through data collated by specialist technical assessments undertaken for the Project for marine, aquatic and terrestrial ecology respectively (**Appendix Q1**, **Appendix O** and **Appendix P1**), and which themselves consider previous studies at Abbot Point, including for other projects. Each of these investigations has been undertaken in a defined study area within the broader project area, each of which is articulated in the relevant section.

Section 3.2 describes environmental aspects relevant to the MNES which have been determined as controlling provisions for the EPBC Act assessment of the Project.

3.1.9.1 Marine ecology

Abbot Point lies within the GBRWHA and is adjacent to the GBRMP, and is managed by the GBRMPA. The marine environment within the project area is characterised by a predominantly heterogeneous habitat of soft-sediment, seagrass and algae, with highly variable water depths partitioned by shoals and channels. The marine environment to the south-east and north-west of Abbot Point is shallow and contains creek mouths, beaches, mud flats and mangrove habitats. Terrigenous (terrestrially derived) inputs into the marine environment surrounding Abbot Point originate from several main sources including the Don River, Elliot River, and Euri Creek.

The key environmental values of the marine environment of the project area include:



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- Diversity of inshore marine habitats including seagrass, soft bottom habitats, beaches, and estuarine areas
- Presence of marine species, some of which are threatened and/or migratory
- Presence of higher order predators (e.g. dolphins) indicating functioning food webs.

Seagrass

Seagrass mapping has been undertaken at Abbot Point since 1987 (Rasheed *et al.*, 2005; Unsworth *et al.*, 2010; McKenna and Rasheed, 2011; McKenna and Rasheed, 2014). A composite map of seagrass distribution between 1987 and 2013 has been produced to ascertain where seagrass is present or has been present historically and as such is considered potential seagrass habitat (Figure 3-19). In 2008, a detailed study was undertaken to map more than 20,000ha of deepwater and coastal seagrass communities within Abbot Point during the wet season and the dry season. These baseline studies were used to establish long-term monitoring sites and inform future development options that would have minimal impact on seagrass communities (McKenna and Rasheed, 2011). Following severe weather events in 2010 to 2013 (Section 3.1.1.4) seagrasses within the broader port limits were remapped (McKenna and Rasheed, 2014).

Long-term monitoring sites have been monitored quarterly between 2008 and 2014, providing important site-specific temporal and spatial information relating to seagrasses at Abbot Point. These monitoring locations are presented in Figure 3-19. Additional mapping of seagrass communities within the proposed dredging footprint and immediate surrounds were undertaken on 11 December 2014. The results of these surveys are incorporated into the same figure and discussed in the following section. The results of all surveys specific to the T0 dredging footprint are incorporated into Figure 3-20.

Images of the typical seagrass communities within the dredging footprint and seagrass communities in nearshore areas observed during the September 2014 surveys are displayed as insets in Figure 3-19. Within the dredging footprint (top three panels of the figure) the images represent the dominant open substrate, sparse seagrass meadow (1% cover), and light seagrass meadow (1% to 5%). The more prolific nearshore shallow water seagrass meadow is represented by the image at the bottom of the figure.

Of the 14 species of seagrass found in Queensland, seven species have been consistently identified within the port limits during surveys, being:

- *Cymodocea serrulata*
- *Cymodocea rotundata*
- *Halodule uninervis*
- *Zostera capricorni*
- *Halophila decipiens*
- *Halophila ovalis*
- *Halophila spinulosa*.

These occur as meadows containing mixed species which are transient and patchy in distribution. *H. spinulosa* dominates deepwater areas and *H. uninervis* dominates inshore areas. These species are colonising species and are typically well represented outside the port limits. The seagrasses at Abbot Point are considered to be highly dynamic, based on long-term monitoring, and influenced by extreme weather events and seasons (McKenna



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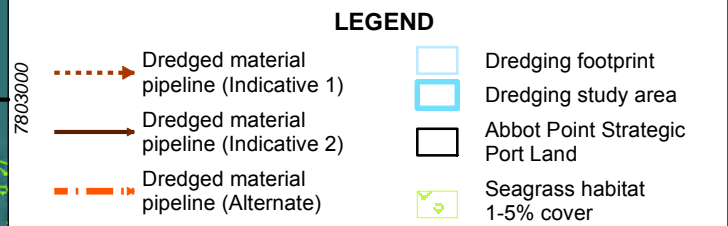
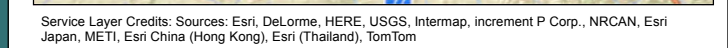
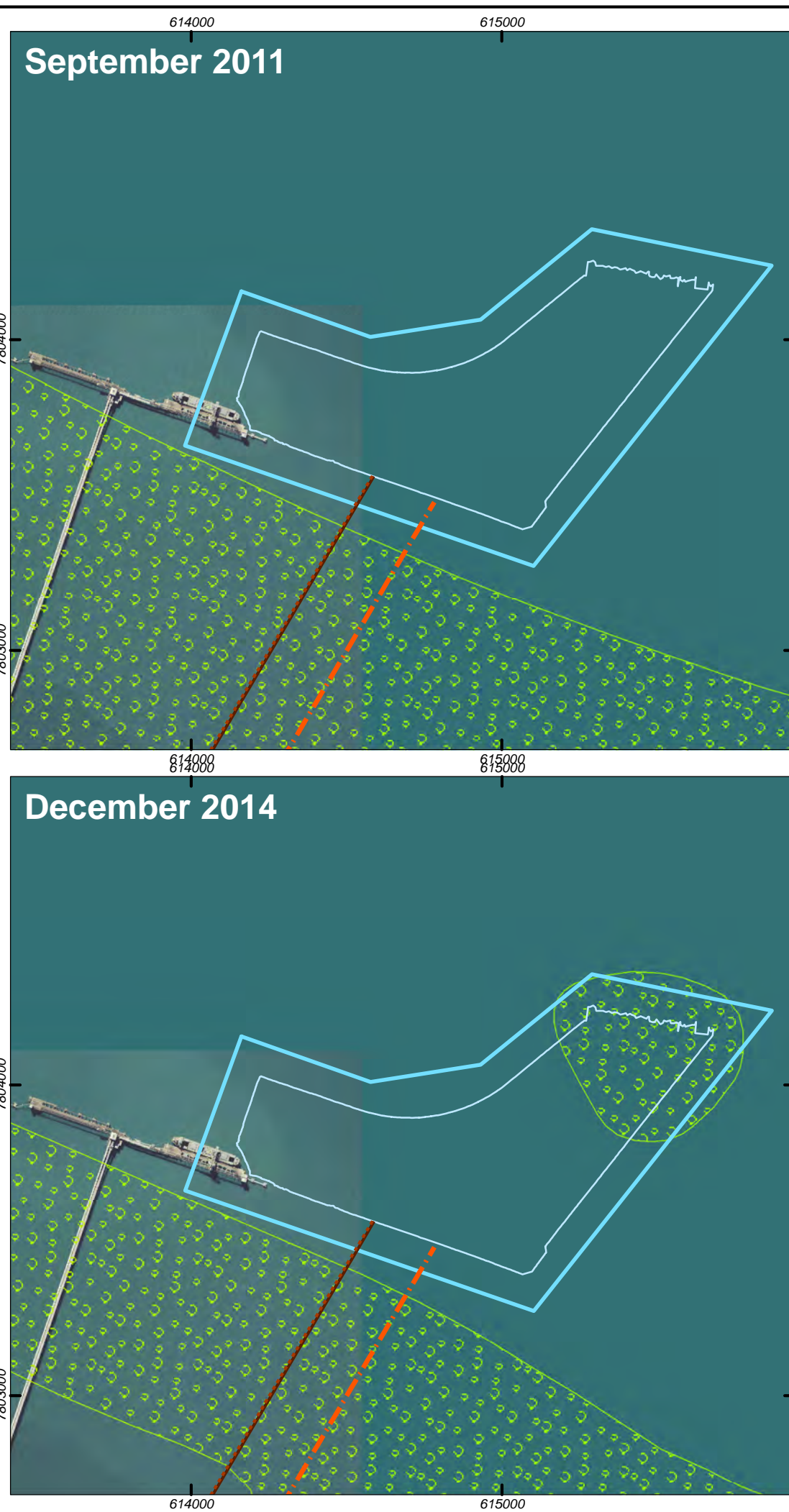
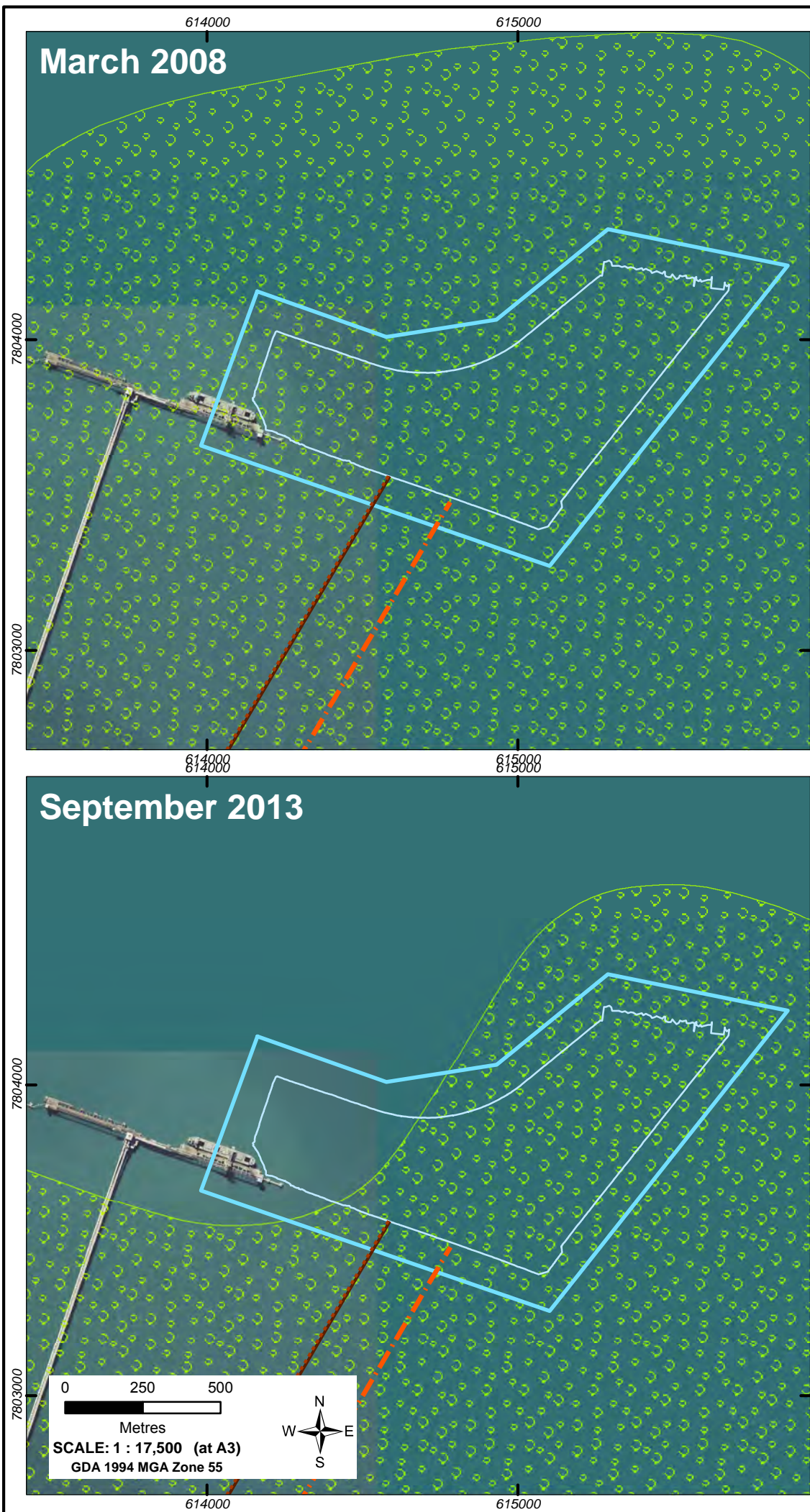
and Rasheed, 2011). During their 2008 to 2011 monitoring, McKenna and Rasheed (2011) reported that seagrass is minimal at the end of the wet season and at its highest density and distribution at the end of spring or beginning of summer.

Major declines in seagrass density and biomass at Abbot Point and other long-term monitoring locations in Queensland have occurred since November 2010, and are attributed to extreme weather events. The total extent of all seagrass meadows in the broader Abbot Point area declined by 60% between the 2008 and 2013 wet season surveys. However, by the 2013 dry season survey, the total meadow area had increased again to be similar to the 2008 dry season (McKenna and Rasheed, 2014).


The broader scale baseline surveys in 2013 have found meadows of the key inshore species *H. uninervis* and *Zostera muelleri* near to Abbot Point that could provide a means of recovery for Abbot Point meadows through dispersal of seeds and other propagules.

Coastal meadows have demonstrated strong differences between meadow types and species in their capacity to recover following disturbance events. Long-term monitoring indicated coastal areas dominated by *H. uninervis*, which uses asexual reproduction, has high light requirements and are more susceptible to long-term impacts than deepwater meadows which tend to be dominated by *H. spinulosa*, which uses a combination of asexual and sexual reproduction (McKenna and Rasheed, 2011). Remapping of the broader area in 2013 found meadows of *H. uninervis* and *Z. muelleri* near to Abbot Point that could provide a means of post-disturbance recovery for Abbot Point meadows through dispersal of seeds and other propagules. Deepwater seagrass meadows showed some recovery following the extreme weather events in 2011, but then declined following Tropical Cyclone Oswald in 2013 (McKenna and Rasheed, 2014).

The most recent surveys of the dredging footprint were undertaken in December 2014 and found seagrass in the north-eastern section of the dredging footprint area, and in a larger area on the inside of the current wharves encompassing offshore monitoring site 2 (Figure 3-19). Seagrass in the dredging footprint consisted of a light cover of *H. decipiens*, while seagrass in the surrounding areas consisted of a light cover of *H. decipiens*, *H. ovalis* and *H. spinulosa*. The deepwater seagrass showed physical signs of senescing (deterioration with age) which can be typical for this time of year. Conducting the survey late in the year may have missed the seasonal peak in seagrass abundance and distribution at Abbot Point which occurs between September and late November/early December. Coastal seagrass around Abbot Point continued its 2014 trend of recovery.



Source information:
Dredging study area
Setout points derived from coordinates on NOBPI/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275 02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
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Abbot Point Strategic Port Land
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Seagrass monitoring and survey data
TropWATER (Centre for Tropical Water & Aquatic Ecosystem Research) - James Cook University

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<p align="center">Figure 3-20 Historical seagrass habitat in the proposed T0 dredging footprint and surrounds</p>							
Figure: 301001-01956-00-GM-SKT-0075						Rev: 1	



Macroalgal communities

Macroalgal communities at Abbot Point have been identified as widespread but patchy in distribution and typically with low percentage cover. A survey in 2005 observed algae communities as covering approximately half of the area surveyed, but with most having less than 5% cover.

During surveys within the port limits, GHD (2009a) detected algae in association with small patches of hard substrate, which were scattered across the area. Macroalgae recorded included:

- Nine green algae (phylum Chlorophyta)
- Four brown algae (phylum Phaeophyta)
- Seven red algae (phylum Rhodophyta).

The most commonly occurring algae were *Chondria spp.*, *Peyssonnelia spp.*, *Chaetomorpha spp.*, *Acetabularia spp.*, *Laurencia spp.*, and a red filamentous alga. The distribution of macroalgal taxa was generally consistent between sites surveyed. The macroalgae observed were usually associated with small patches of hard substrates such as shell grit.

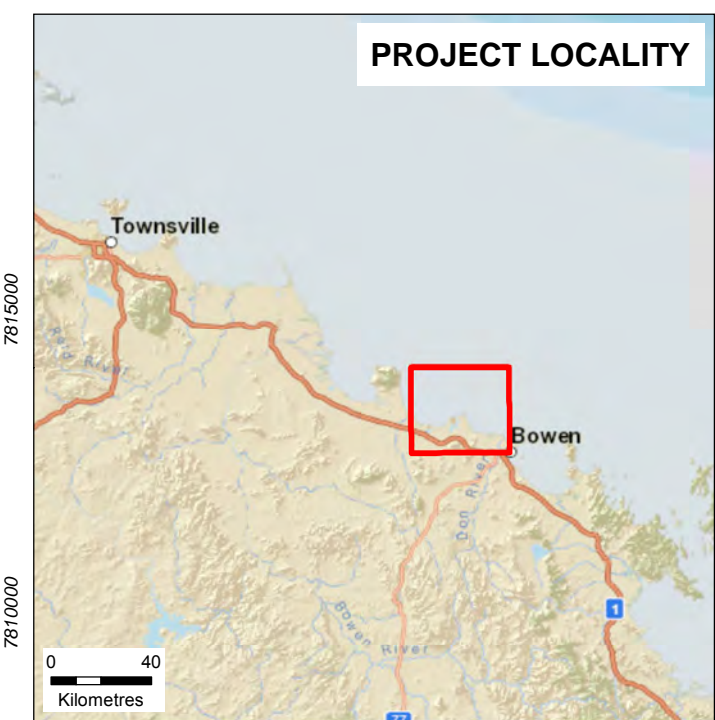
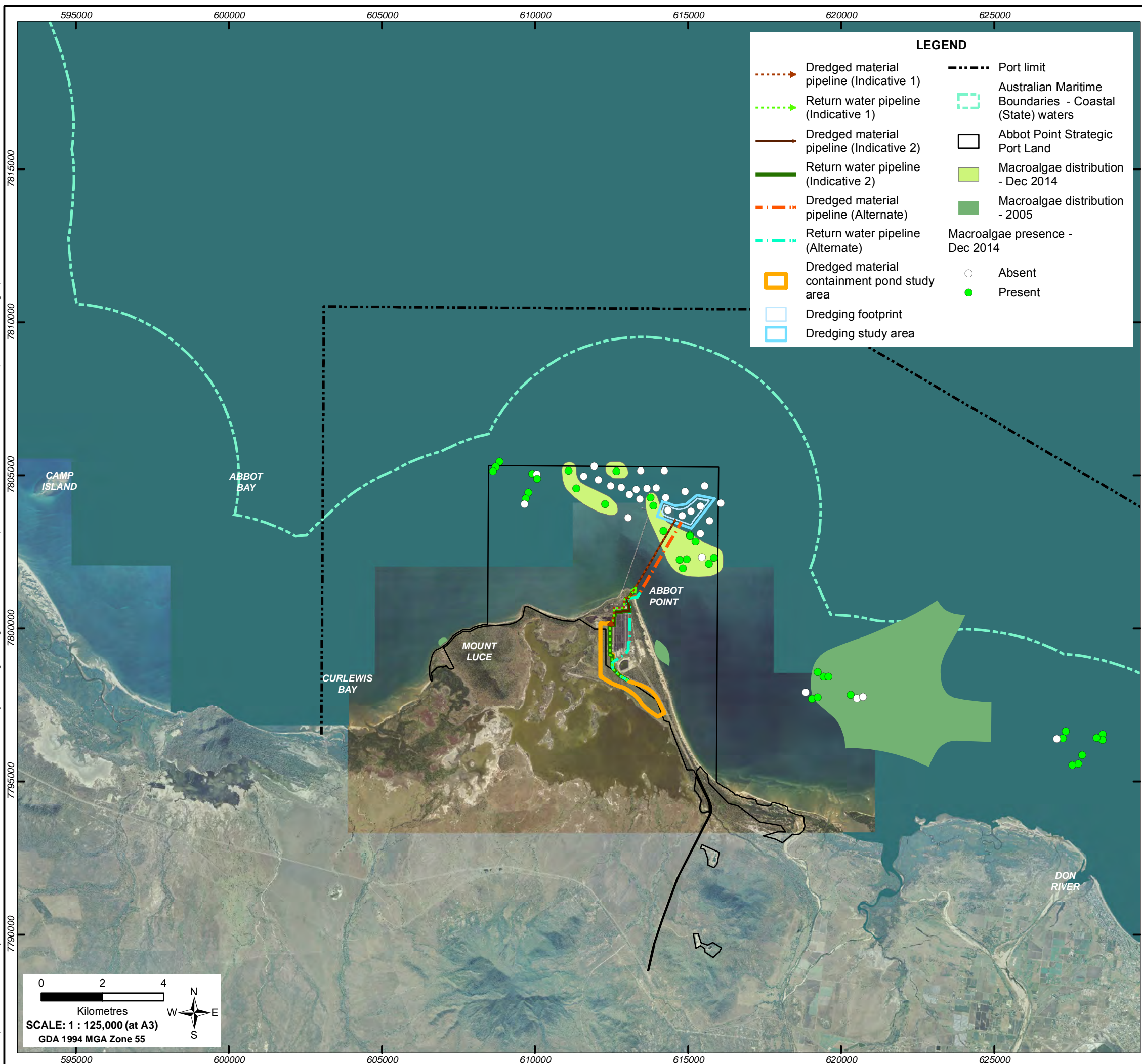
Findings also indicate temporal variability in the presence of species, with a shift in species composition observed between the 2005 and 2009 surveys. The long-term algal communities are not assessed as part of the long-term seagrass monitoring at Abbot Point.

A high abundance of red and green algae has been previously recorded on the rocky reef habitat located adjacent to the Abbot Point beach (Rasheed *et al.*, 2005).

Twelve macroalgal taxa were observed within the Abbot Point area beyond the port limits during surveys carried out for the Abbot Point PER using video transect surveys (BMT WBM, 2012). Three species of *Halimeda* were recorded, with species distribution corresponding to the distribution of low mud content substrates. Other unidentified green, red and brown algae were present in association with the *Halimeda spp.*, in particular crustose coralline algae, which became more abundant with proximity to reef (BMT WBM, 2012). The algae community distribution from habitat surveys in the Abbot Point area is represented in Figure 3-21.


The most recent surveys of macroalgae in the proposed dredging footprint and immediate surrounds were undertaken by TropWATER in December 2014. The preliminary results are presented in Figure 3-21 and indicate that no macro algae was present within the dredging footprint area, macroalgae was found in areas surrounding the footprint and in offshore monitoring sites 1 and 2 (shown on Figure 3-21). Macroalgae near the dredging footprint occurred as light sparse patches, while in the surrounding areas, algae cover tended to be higher in abundance and distribution. The dominant macroalgae were species of *Caulerpa* and *Halimeda*. Red macroalgae were also found in some samples.

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Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
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Macroalgae survey - December 2014
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TropWATER (Centre for Tropical Water & Aquatic Ecosystem Research) - James Cook University
Macroalgae survey - 2005
North Queensland Bulk Ports

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Figure 3-21 Algae community distribution at Abbot Point							
Figure: 301001-01956-00-GM-SKT-0046							Rev: 1



Benthic macroinvertebrates including coral communities

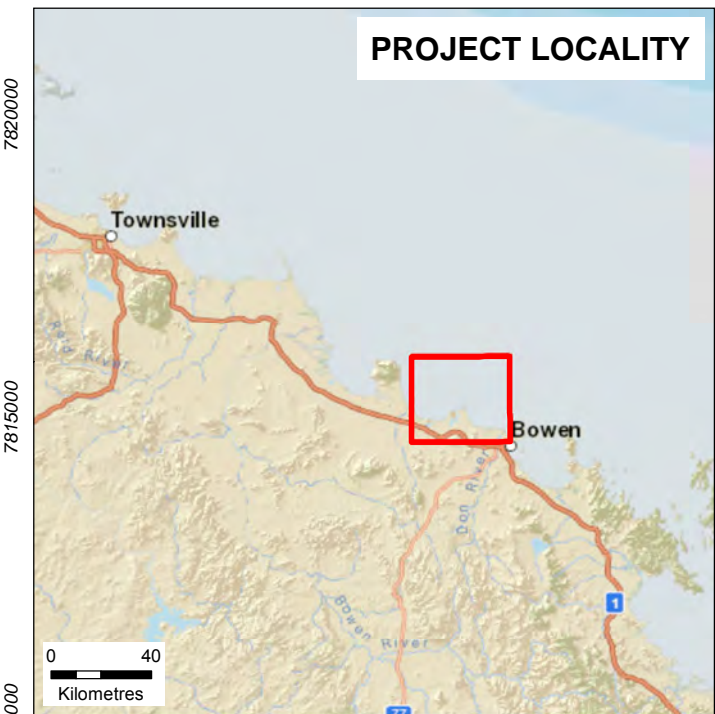
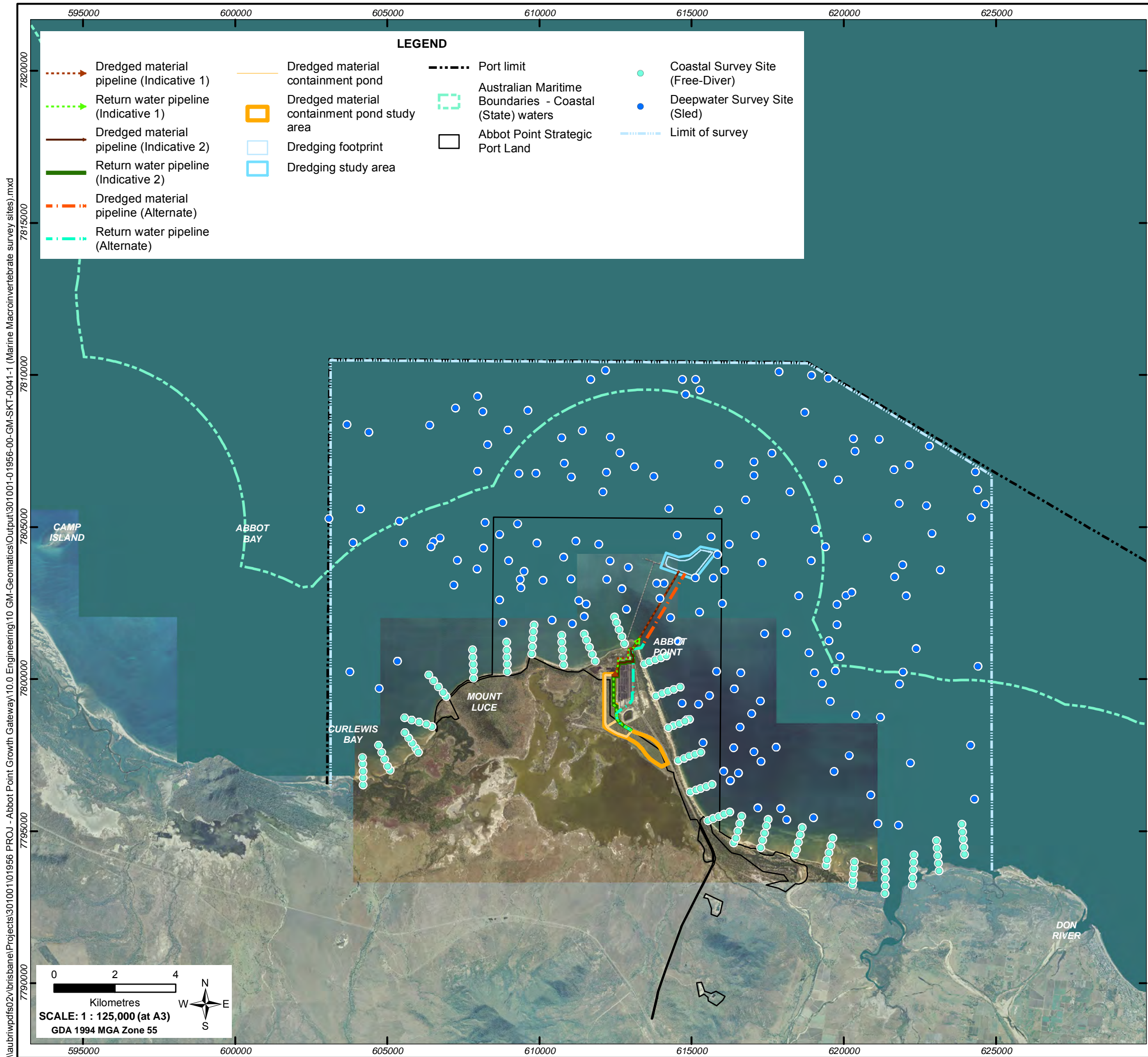
Benthic macroinvertebrate assemblages in Abbot Point are low in both diversity and abundance (GHD, 2012a). Spatial and temporal heterogeneity is typical of these macroinvertebrate communities. The seafloor is open and provides little habitat structure for benthic macroinvertebrates resulting in patchy distributions (GHD, 2012a). Cnidarians (soft and hard corals, jelly fish, anemones, and hydrozoans) have been recorded throughout the Abbot Point area in very low densities (<10% coverage when recorded; GHD, 2009c).

Further afield, more extensive hard and soft coral communities can be found growing on rocky outcrops surrounding Nares Rock and Camp Island. The most extensive coral communities are located offshore at Holbourne Island (for more detail and specific locations see Section 3.1.10 and Figure 3-27).

Ecological surveys carried out in 2012 identified soft corals, hydroids, hard corals, anemones, and one sea pen. Hard corals recorded within the T0, T2 and T3 Capital Dredging project area consisted of individual fungid corals (BMT WBM, 2012). A similar species composition was recorded at sandy inshore locations that are consistent with the T0, T2 and T3 Capital Dredging project area habitat (GHD, 2008; GHD, 2009c). These areas supported soft corals, sea pens, sub-massive corals, massive corals, and mushroom corals. All corals observed were very small in size (<1cm to 30cm), often occurred as single coral, and were very sparsely distributed across the T0, T2 and T3 Capital Dredging project area (less than one coral per ha). Sea pens were the most frequently occurring taxa, and are considered common within soft-sediment tropical benthic systems. Mushroom corals were the second most common coral taxa and are also commonly found along the inshore coastal systems of Queensland (GHD, 2008; GHD, 2009c).


The majority of the Abbot Point area can be classified as open substrate with a low density (1% to 10%) cover of benthic macroinvertebrates. No areas of high density and very few areas of medium density coverage were found occurring in Abbot Point. The distribution of benthic macroinvertebrates across the T0, T2 and T3 Capital Dredging project area was patchy and varied both spatially and temporally (GHD, 2008; GHD, 2009c).

GHD (2009c) previously observed sedentary benthic macroinvertebrates during surveys of the port limits. Ascidians were the most abundant, followed by echinoderms, molluscs, polychaetes, and small crustaceans. These were concentrated around isolated patches of rubble and rock where other organisms grow. Benthic survey sites are presented in Figure 3-22. Benthic macroinvertebrate densities in the Abbot Point area from the 2009 surveys are presented in Figure 3-23.

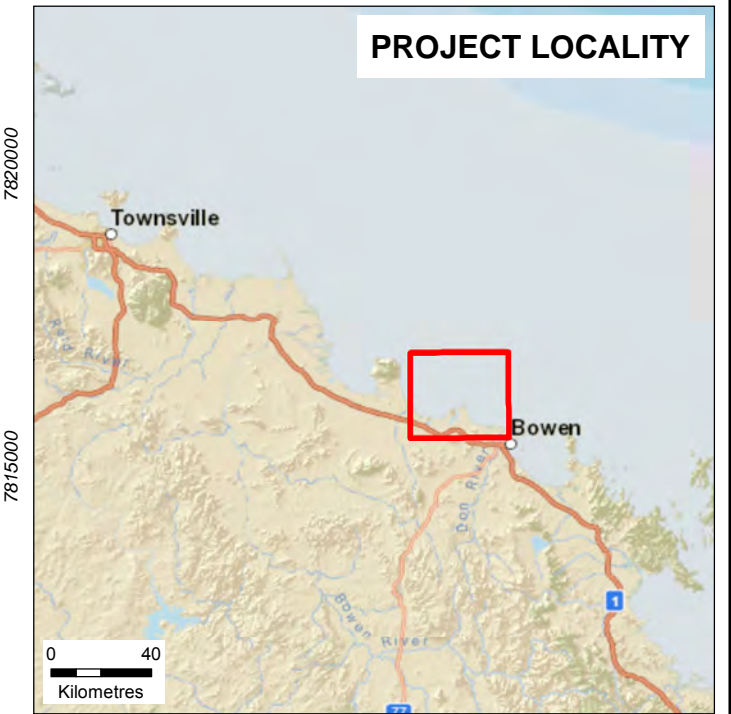
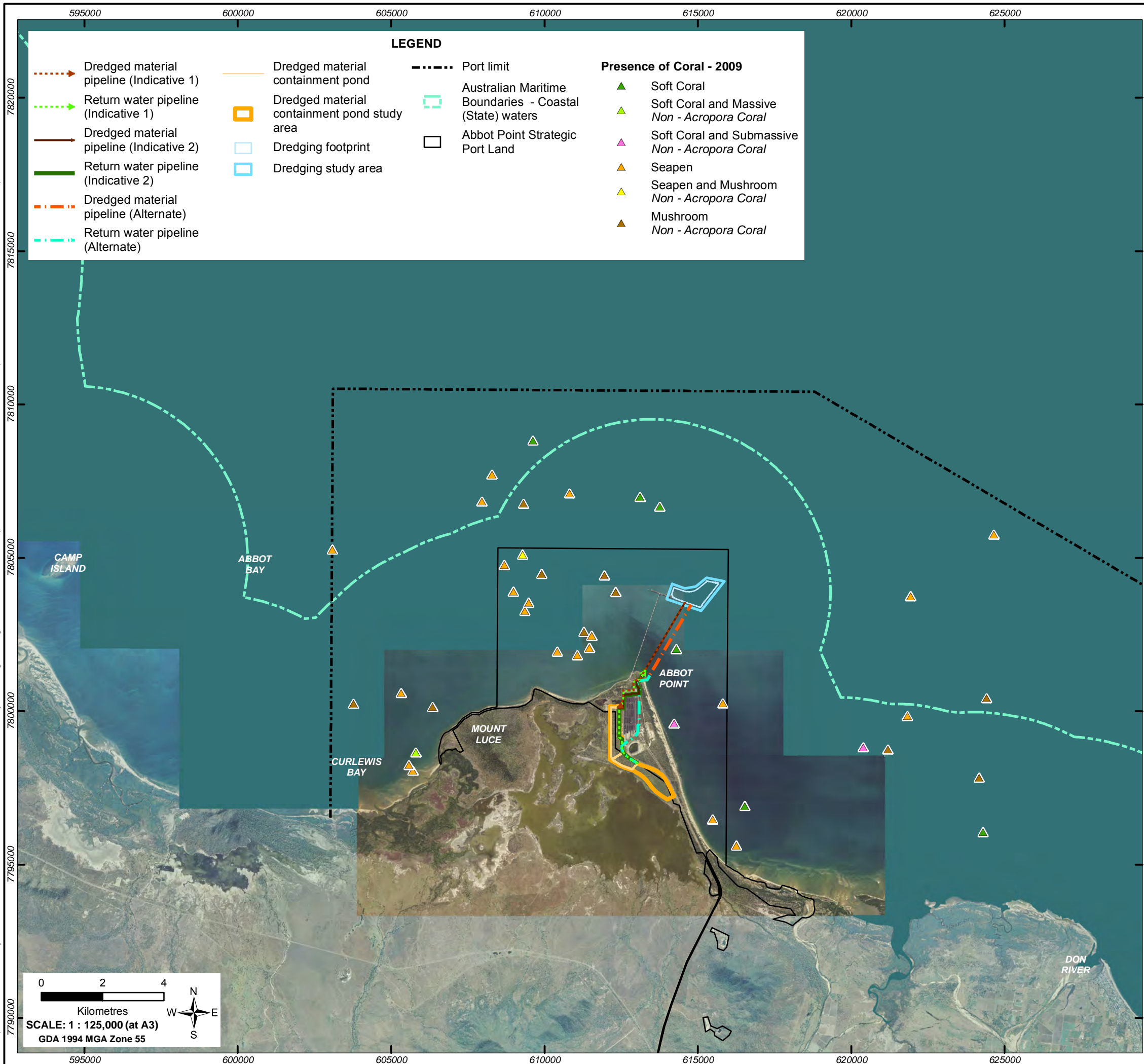


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Figure 3-22 Marine macroinvertebrate survey sites							
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Figure 3-23 Macroinvertebrate distributions at Abbot Point							
Figure: 301001-01956-00-GM-SKT-0044							Rev: 1



Relevance to MNES

The marine environment at Abbot Point provides habitat for a range of threatened and/or migratory marine fauna. These include Humpback Whales, marine turtles, Dugong, and inshore dolphins.

The use of the Abbot Point area varies between species. In east coast wide assessments, the Abbot Point area has not been identified as an area of high conservation value for Humpback Whales or Dugongs. However, the area does maintain some local values for Dugongs and marine turtles which forage in local seagrass and algal communities. There is limited information on the importance of the area for inshore dolphin species and it is possible the Abbot Point area has local importance in this regard.

3.1.9.2 Terrestrial ecology

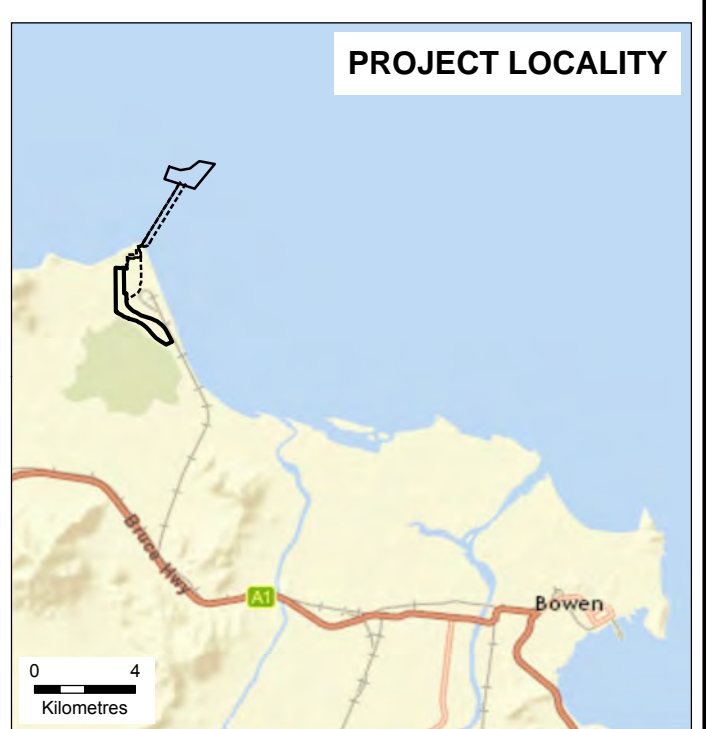
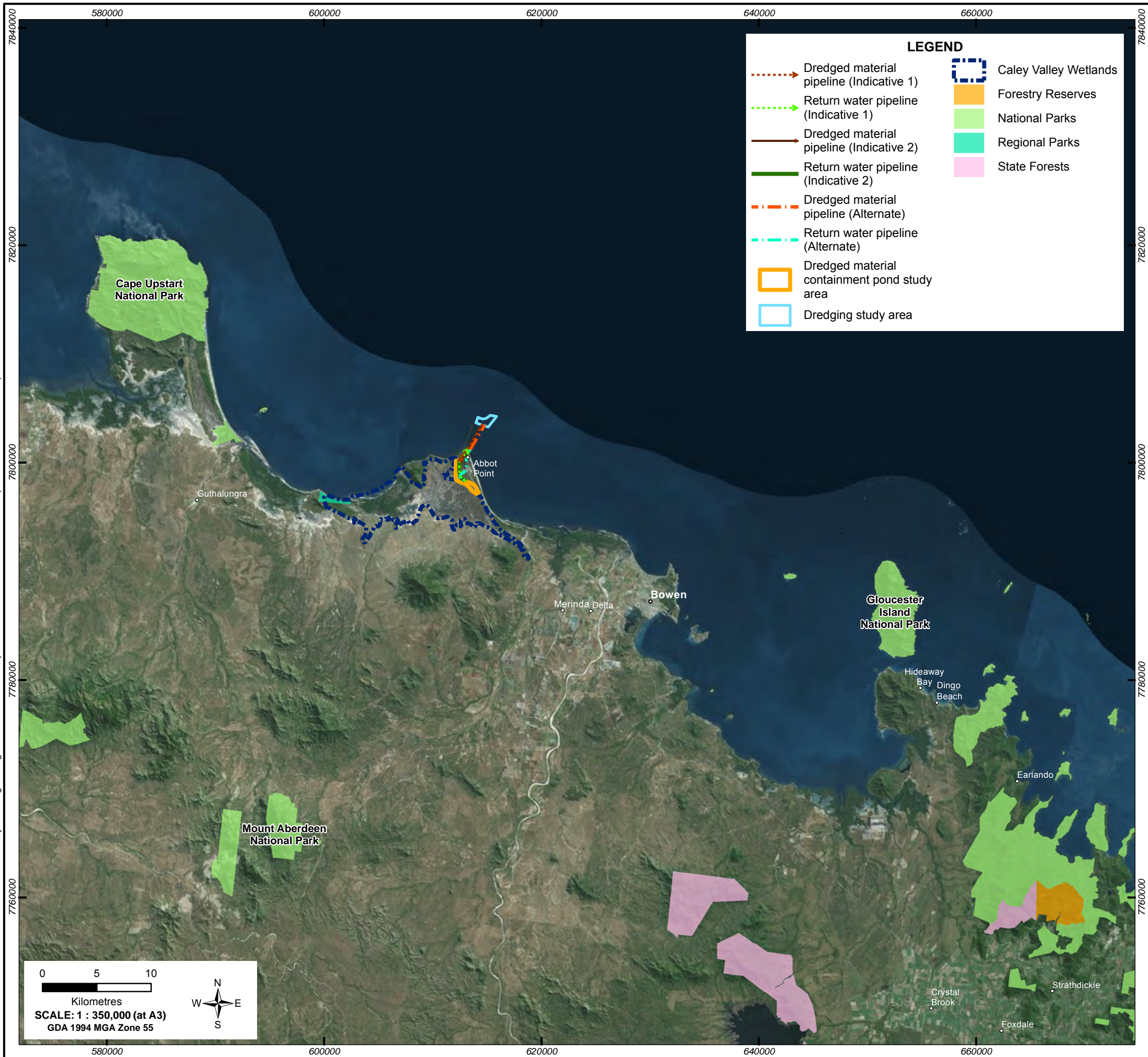
Abbot Point is located within the Bogie River Hills Interim Biogeographic Regionalisation for Australia Bioregion, a subregion of the Brigalow Belt North Bioregion. The subregion has been subject to broad-scale clearing primarily for agricultural activities. Despite considerable modifications to the landscape, natural habitats do persist and include areas of fragmented and connected remnant vegetation, watercourses, and wetland.

The onshore project area is located adjacent and within an existing industrialised section of the Port of Abbot Point. The non-industrialised portion of the onshore project area is highly disturbed and consists primarily of non-remnant vegetation, with some patches of regrowth and very small patches of remnant *Corymbia-Melaleuca* woodland.

The nearest protected areas to Abbot Point are shown on Figure 3-24. Mount Aberdeen National Park (located 40km to the south-west), Cape Upstart National Park (located 30km to the north-west), and Gloucester Island National Park (located 40km to the south-east). Immediately to the west of the project area, a wildlife corridor extends across the Caley Valley Wetlands. This corridor forms part of a larger wildlife movement corridor, connecting the wetland to Mount Aberdeen National Park, 40km south-west of Bowen (BMT WBM, 2012).


Remnant vegetation to the west and south of the Abbot Point Coal Terminal also forms part of a wildlife corridor, and the largely intact coastal vegetation provides relatively good habitat connectivity between the wetland and Cape Upstart National Park to the north-west (BMT WBM, 2012). However, there is poor connectivity in a direct line (north to south) between the wetland and the ranges due to extensive clearing for cattle grazing (BMT WBM, 2012).

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Figure 3-24 Protected areas							
Figure: 301001-01956-00-GM-SKT-0108							Rev: 1



Section 3

Existing Environment

Terrestrial habitats

For the purposes of the terrestrial ecology assessment, the study area incorporates the DMCP study area, pipeline alignments and laydown/stockpile areas.

The terrestrial habitats present at Abbot Point, grouped into broad habitat types from Regional Ecosystem (RE) mapping (Version 9, DEHP, 2015) are shown on Figure 3-25. The condition of these habitats varies substantially according to historical land management practices (e.g. grazing) and the abundance of weed species (GHD, 2009a).

Strips of microphyll vine forest and Semi-Evergreen Vine Thicket (SEVT) habitat are located leeward of the frontal dunes on the northern and eastern beaches of Abbot Point, 300m and 150m from the project area respectively (Figure 3-25). These communities are structurally complex, providing suitable habitat for a range of mammals and birds. Plant species associated with these habitats also provide a large supply of food for native fauna, especially birds. The dense understorey of vine thicket communities also provides excellent foraging and nesting habitat.

Woodland habitat occurs in both remnant and regrowth forms at Abbot Point. Remnant woodland areas are moderately structurally complex, containing mature trees and a moderately dense understorey. These remnant areas also tend to have a higher native grass cover and abundance of woody debris relative to regrowth, providing habitat for reptile and mammal species.

Regrowth woodland habitat tends to be less structurally complex, predominantly containing a single low tree layer and a ground layer dominated by exotic pasture grassland. These areas contain habitat primarily suitable for common woodland species, but also include potential habitat for the vulnerable Squatter Pigeon *Geophaps scripta scripta*.

Raptors, including the White-bellied Sea-Eagle *Haliaeetus leucogaster* and Eastern Osprey *Pandion haliaetus*, may utilise remnant woodland for nesting and wetland areas for foraging. Cattle Egret may also utilise areas of non-remnant grasslands for foraging.

Non-remnant pasture grassland habitats occur in several large areas on Abbot Point and along the southern boundary of the Caley Valley Wetlands (Figure 3-25). These areas generally have low habitat value, containing limited vegetation and structural diversity. They are also dominated by exotic pasture species. Exotic grasslands may provide habitat for the Squatter Pigeon. The DMCP footprint area and the stockpile/site office area to the south-west of the DMCP are dominated by this type of habitat, where patches of regrowth vegetation can also be found.

Foreshore habitats consist of sandy beaches and rocky headlands. These habitats generally provide foraging habitat for shorebirds and waterbirds, such as terns, gulls, egrets, and storks. The beaches also provide breeding habitat for marine turtles (described in Section 3.2.2.4).

No EPBC Act listed threatened flora have been identified during present or past field assessment in the Abbot Point area.

Remnant vegetation and wetland occur adjacent to and within 500m of the project area, in all directions. These areas are described in detail in the Terrestrial Ecology Technical Report in **Appendix P1** and include:



Section 3

Existing Environment

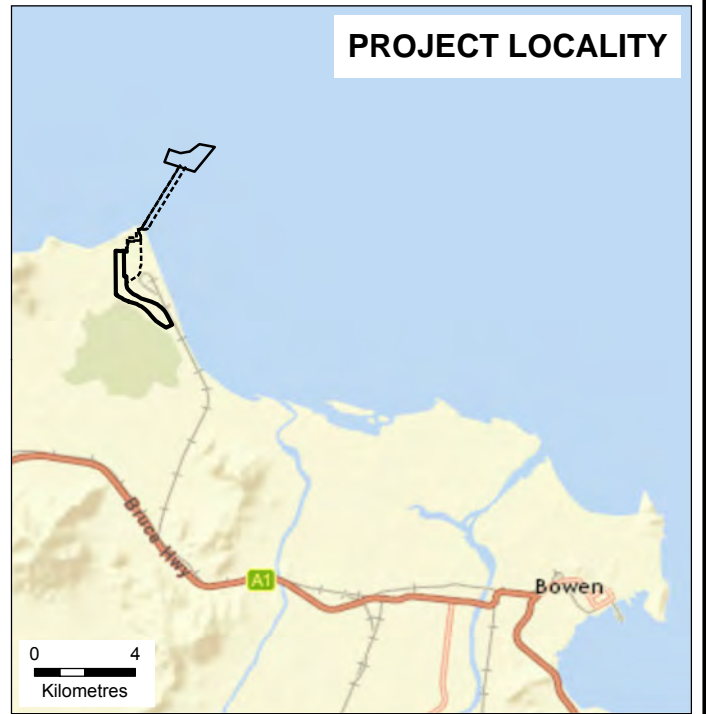
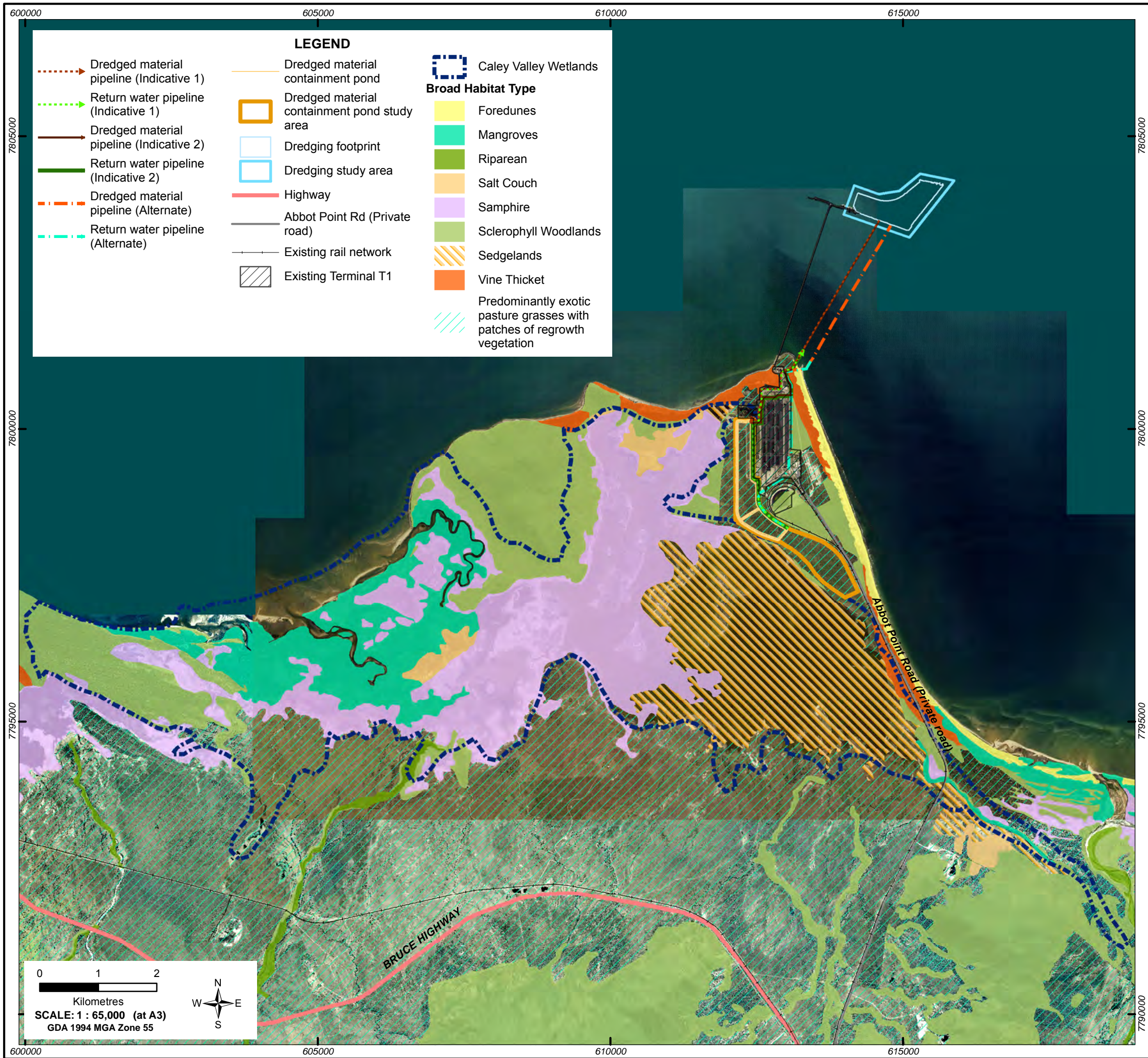
- Remnant SEVT on coastal dune (RE11.2.3) and igneous rock (11.12.4a) within 300m to the north and north-west, within 150m to the south-east, and adjacent to the dredging pipeline corridor
- Remnant grassland and herbland on fore dunes (RE11.2.2) within 300m to the north-west, and within 150m to the south-east
- Remnant *Corymbia tessellaris* woodlands (RE11.2.5) within 250m to the west
- Remnant *Corymbia tessellaris* and *Melaleuca dealbata* woodlands (RE11.2.5) within 50m to the east, south-east, and south-west
- Remnant samphire within 300m to the west
- Remnant Marine Couch *Sporobolus virginicus* (RE11.1.1) grasslands within 50m of the south-western edge, and within 300m to the west
- Palustrine wetland (RE11.3.27x1c) within 50m of the south-western edge, within 300m to the west, and within 250m to the south.

The DMCP study area has been heavily disturbed in the past for cattle grazing. Prior to disturbance, the DMCP study area formerly supported a *Corymbia-Melaleuca* woodland complex of beach ridges and swales; however, historical grazing has created induced grasslands with regrowth patches of various sizes and heights. The northern section of the DMCP study area contains a large patch of moderately dense regrowth woodland that is 5m to 6m tall (Figure 3-26). This patch is dominated by Swamp Teatree *Melaleuca dealbata*. A second, sparser patch of regrowth woodlands occurs in the central section of the project area, and is dominated by both *Melaleuca dealbata* and Carbeen *Corymbia tessellaris*. A small patch of approximately 10 mature *Corymbia tessellaris* trees occurs adjacent to the central patch of woodland regrowth, near the eastern boundary of the DMCP study area.

A high cover of perennial weeds occurs across the grassy sections of the project area, particularly Buffel Grass *Cenchrus ciliaris*, Passion Flower *Passiflora foetida*, and Flannel Weed *Sida cordifolia*. Other weeds of note include Snakeweed *Stachytarpheta jamaicensis* and Mimosa Bush *Vachellia farnesiana*. Rubber Vine *Cryptostegia grandiflora* and Lantana *Lantana camara* are also likely to be present in this area. Prickly Acacia *Acacia nilotica* and Chinese Apple *Ziziphus mauritiana* are also known to occur in the broader Abbot Point area (Unidel, 2011).


There are no records of pests within the project area. However, several exotic fauna species are known to occur in the adjacent Caley Valley Wetlands, including the Cane Toad *Rhinella marina*, Pig *Sus scrofa*, Rabbit *Oryctolagus cuniculus*, Black Rat *Rattus rattus*, House Mouse *Mus musculus*, Fox *Vulpes vulpes*, Asian House Gecko *Hemidactylus frenatus*, and Northern Mallard *Anas platyrhynchos* (ELA, 2014; Wildlife Online; Unidel, 2011).

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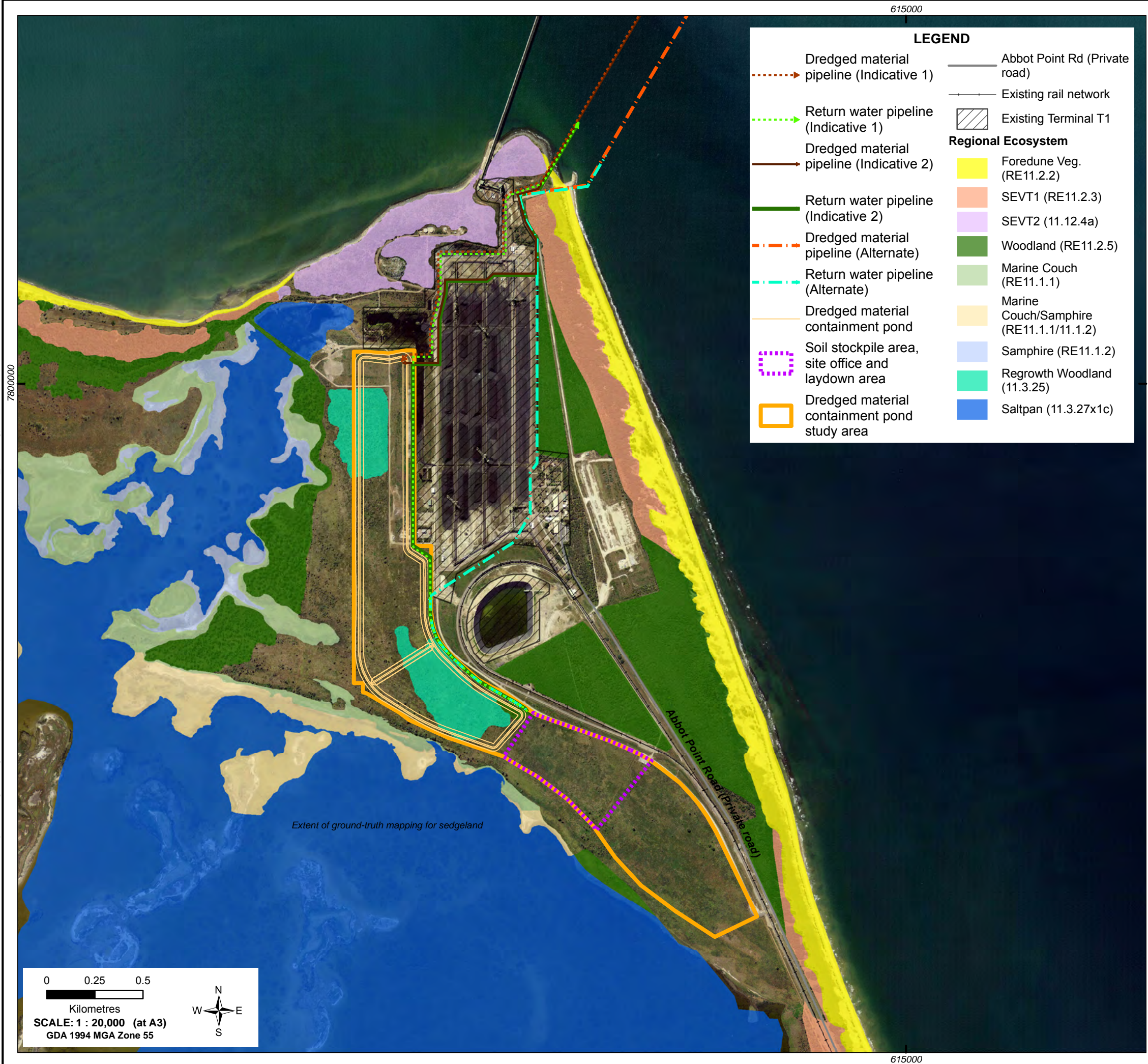


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ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-25 Abbot Point broad habitat types							
Figure: 301001-01956-00-GM-SKT-0107							Rev: 1

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LEGEND

Dredged material pipeline (Indicative 1)

Return water pipeline (Indicative 1)

Dredged material pipeline (Indicative 2)

Return water pipeline (Indicative 2)

Dredged material pipeline (Alternate)

Return water pipeline (Alternate)

Dredged material containment pond

Soil stockpile area, site office and laydown area

Dredged material containment pond study area

Abbot Point Rd (Private road)

Existing rail network

Existing Terminal T1

Regional Ecosystem

Foredune Veg. (RE11.2.2)

SEVT1 (RE11.2.3)

SEVT2 (11.12.4a)

Woodland (RE11.2.5)

Marine Couch (RE11.1.1)

Marine Couch/Samphire (RE11.1.1/11.1.2)

Samphire (RE11.1.2)

Regrowth Woodland (11.3.25)

Saltpan (11.3.27x1c)

PROJECT LOCALITY

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

Source information:

Dredging study area

Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP

Dredged material and return water pipelines (Indicative 1)

Digilised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion

Dredged material and return water pipelines (Indicative 2 and Alternate)

Developed by BMT JFA 21/07/2015

Soil stockpile, site office and laydown area

Supplied by Golder Associates 10/08/2015

Dredged material containment pond

Supplied by Golder Associates 23/06/2015

Dredged material containment pond study area

Supplied by Golder Associates 10/08/2015

Existing transport network

Physical Road Network - Queensland, Physical Rail Network - Queensland

Queensland Government - Department of Environment and Resource Management

2013 Imagery

Queensland Government - Department of State Development, Infrastructure and Planning 2015

Cadastral Boundaries

Downloaded 08/06/2015 -

[http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=\(4091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=(4091CAF1-50E6-4BC3-B3D4-229AA318231A))

Queensland Government - Department of Natural Resources and Mines

Existing Terminal T1

Digilised from 2013 imagery and cadastral boundaries

2013 Imagery

Queensland Government - Department of State Development, Infrastructure and Planning 2015

Regional ecosystems

Eco Logical Australia - 2015

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Queensland Government

QUEENSLAND GOVERNMENT

ABBOT POINT GROWTH GATEWAY PROJECT

Figure 3-26

Remnant vegetation in the vicinity of the project area

Figure: 301001-01956-00-GM-SKT-0088

Rev: 1

Compiled by BRISBANE GEOMATICS



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Wetland habitats for terrestrial species

The 5,154ha Caley Valley Wetlands (described in detail in Section 3.1.9.3) consists of both subtidal and intertidal marine and estuarine wetland, including one large fresh and brackish water wetland contained within a partially artificial impoundment (shown as 'sedgelands' on Figure 3-25).

The wetland is an important habitat for many local terrestrial fauna species, providing a relatively intact environment in an otherwise disturbed landscape (BMT WBM, 2012). The wetland has high ecological value for waterbirds, and is considered a significant aggregation site for migratory shorebirds and other waterbirds (State of Queensland, 2015). The wetland's adjacency to the ocean allows connectivity between the wetland and coastal environments of the GBRWHA, with many of the bird species inhabiting the wetland also using the beaches and intertidal areas for foraging (State of Queensland, 2015). The Caley Valley Wetlands is considered to contain important and significant natural habitats for *in situ* conservation of bird diversity.

The wetland provides habitat for an abundance of waterbirds, estimated to be over 24,000 individuals in February and March 2012 and approximately 48,000 individuals in June 2012 (Biodiversity Assessment and Management Pty Ltd; BAAM, 2012). Habitat availability is seasonal, with the number and variety of birds present dependent on rainfall in the catchment, subsequent water levels in the wetland, and the breeding, foraging and roosting habitats that become available as the wetland dries. This cyclic wetting and drying is typical of wetlands in the dry tropics and is important to maintain dominant ecosystems and dependent species.

There are times when the wetland basin does not fill if wet season rainfall in the catchment is insufficient (e.g. under drought conditions). At these times the numbers of waterbirds and shorebirds present within the wetland habitats is significantly reduced, and for some species suitable foraging and breeding opportunities would be absent.

Various field surveys have identified a total of 15 migratory shorebird species as well as resident shorebird species at Abbot Point as follows:

- Black-tailed Godwit
- Common Greenshank
- Common Sandpiper
- Curlew Sandpiper
- Eastern Curlew
- Greater Sand Plover
- Latham's Snipe
- Little Curlew
- Marsh Sandpiper
- Oriental Plover
- Pacific Golden Plover
- Red-necked Stint
- Sharp-tailed Sandpiper
- Wandering Tattler
- Whimbrel.



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The BAAM (2012) surveys detected the endangered Australian Painted Snipe *Rostratula australis* in the wetland during both wet and dry seasons following significant rainfall in the catchment. Individuals were recorded utilising shallow water and fringing mudflat habitats.

Shallow water wetland areas and fringing mudflat habitats border all open water habitats in the wetland. They consist of well-vegetated areas of sedges and rushes around the outside of the open water habitat, as well as the mudflats bordering the wetland itself. The well-vegetated areas tend to be utilised by cryptic bird species such as rails and snipes.

Less vegetated shallow water areas tend to be utilised by wader species, while mudflat areas provide further suitable foraging for wader species as well as resting habitat for shorebird species such as terns.

Open water wetland habitat consisting of deeper water devoid of vegetation such as sedges and rushes provide suitable habitat primarily for bird species from the *Anatidae* (ducks, geese and swans) family.

As a large, regional water source the wetland also provides habitat for a range of other terrestrial vertebrate species. Up to 50 species of mammal and reptile (including introduced species) have been found in and adjacent to the wetland, including two species of freshwater turtle. Eleven native frog species have been recorded in the wetland and surrounding vegetation (BMT WBM, 2010).

The majority of the wetland habitat is in good condition, with the exception of a hypersaline zone of approximately 46ha created by an artificial bund in the central-western portion of the wetland, grazing impacts along the extensive southern boundary of the wetland, and localised impacts of feral pig activity and weed intrusion on the edges of freshwater habitats.

Relevance to MNES

The project area is highly disturbed and consists primarily of non-remnant vegetation, with some patches of regrowth and very small patches of remnant *Corymbia-Melaleuca* woodland. There is no clearing of threatened flora or Threatened Ecological Communities (TECs) proposed as part of the Project.

The Squatter Pigeon is the only threatened species likely to utilise habitats within the DMCP study area. A number of threatened and migratory species are known to occur adjacent to the DMCP study area and are relevant MNES for the assessment of indirect impacts of the Project. These values are mostly associated with the Caley Valley Wetlands and adjacent coastal foreshores, which provide important feeding and roosting habitat for migratory birds. The endangered Eastern Australian Painted Snipe also utilises these habitats.

Those terrestrial species and habitats that are MNES at Abbot Point are described in detail in Section 3.2.1. These matters are:

- EPBC Act listed migratory shorebirds
- EPBC Act listed migratory birds
- EPBC Act listed threatened species (Australian Painted Snipe and Squatter Pigeon)
- Waterbirds contributing to the Outstanding Universal Value of the GBRWHA
- EPBC Act TEC - SEVT of the Brigalow Belt (north and south) and Nandewar Bioregions.



3.1.9.3 Aquatic ecology

Although the Project is being undertaken outside the boundaries of the Caley Valley Wetlands, the wetland remains an important feature of the landscape adjacent to the project area and is significant in terms of the habitat and ecosystem services it provides. As such, the ecology of the wetland has been described in this section of the report.

The Caley Valley Wetlands is a continuous wetland aggregation, spatially defined by the Directory of Important Wetlands Australia (DEWHA, 2010) as *Abbot Point - Caley Valley Wetland QLD 001*. The wetland covers an area of 5,154ha and extends approximately 18km from Mount Curlewis in the west to Euri Creek in the east.

The wetland has complex geology and soil conditions with features of an alluvial plain, lacustrine plain and estuarine plain. Landform elements in the wetland include the lowest lying basin or lake, ephemeral drainage channels, tidal channels, alluvial plains, intertidal and supratidal flats, hills in the north and to the south, and beach and dunes on the coast.

Nutrient-rich sediments represent an important source of nutrients for the wetland ecosystem. The high nutrient concentrations, coupled with shallow water (which allows light penetration to the base of the wetland) drive primary productivity within the wetland.

Habitat types

The wetland supports vegetation composed of a mosaic of mangroves, samphire, sedgelands, and Salt couch (Figure 3-13). Mangroves are most well-developed within tidal estuarine plains within the western estuarine zone and along Saltwater Creek. Saltmarsh wetland dominates the western estuary occurring on the low gradient estuarine plains and in the wetland basin, which is subject to seasonal ponding.

Figure 3-13 also shows the location of two historical bunds which influence tidal hydraulics and therefore ecosystem functioning in wetland areas to the east of the bunds.

During prolonged dry conditions, waters within the wetland basin contract into the area known as Lake Caley, a shallow depression located in the centre of the basin, which can at times completely dry out. Dominated by ephemeral brackish marsh and samphire ecosystems, the wetland basin zone requires cyclic wetting and drying to maintain dominant ecosystems and dependent species. Sedgelands are located on the fringes of the basin and on raised sediment beds within the basin. The sedgelands are periodically inundated with fresh water during the wet season (which become brackish to saline) but the raised sediment beds, comprised of catchment derived sediments, dry out faster than the surrounding lake pools. The sedgelands are tolerant of periodic freshwater and brackish inundation and dry out completely each year.

The landward limit of saltmarsh throughout the wetland is fairly well defined indicating a strong salinity gradient between the wetland and the surrounding dune plains which have been partially cleared for grazing. The variable soil conditions, topography, groundwater, and inundation levels promote high variability in saltmarsh composition and structure over very small distances, with saltmarsh wetland supporting both bare and vegetated habitats.

The most extensive samphire habitats of the wetland occur above the zone of seasonal pooling on estuarine flats with deep saline clay soils formed from estuarine sediments.



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Salt couch grassland is the most landward saltmarsh type of the wetland, occurring on estuarine sediments with saline cracking clays well above the zone of seasonal inundation and outside hypersaline areas.

The main freshwater/brackish stream in the wetland is Saltwater Creek. This creek forms a permanent aquatic refuge and has high habitat values for waterbirds and fish. The riparian fringe of Saltwater Creek is dominated by a mix of paperbarks on the higher banks with mangroves dominating the lower banks.

The upper banks and alluvial plains have been predominantly cleared but support low lying patches of Salt couch grassland and samphire.

Whilst the species composition of vegetation within Saltwater Creek is indicative of a freshwater to brackish system, the mangroves (dominated by more freshwater tolerant species) indicate some saline influence. In addition, the dominant aquatic macrophytes, though most widespread in freshwater systems, are tolerant of slightly brackish water conditions.

Numerous small freshwater streams drain into the wetland (e.g. Mount Stewart, Six Mile and Goodbye Creeks) with Maria, Tabletop, Branch, and Splitters Creeks discharging into the hypersaline zone. These creeks are of an ephemeral nature and traverse a highly cleared landscape. As a result, they support narrow and disjointed riparian fringe vegetation.

No threatened flora species listed under the EPBC Act were recorded in the wetland during a survey in October 2014 (BMT WBM, 2014) or in previous surveys. Based on the data review and searches of the current Wildnet and EPBC Protected Matters Search Tool, no threatened wetland-dependent flora species were identified as likely to occur in the Abbot Point area, including the project area.

Aquatic fauna

Saltwater Crocodile *Crocodylus porosus* could feed in the western estuary. Saltwater Crocodiles are known to occur in the region, although there are few confirmed records for the Abbot Point area. Nesting and breeding sites and preferred feeding habitats are typically mangrove-lined creeks.

The Green Turtle *Chelonia mydas*, and possibly nearshore dolphin species, could enter the lower sections of the western estuary to feed. The middle and upper reaches of the creeks within the western estuary are narrow and shallow, and do not support suitable habitat for these species (Section 3.2.2).

Extensive areas of high quality fish habitat occur in the western estuary and coastal water zones. This includes well-flushed mangroves, tidal channels with undercut banks, and intertidal flats in the lower estuary and coastal water zone. The intertidal environments provide shelter and/or foraging areas for fish and shellfish during high tide. Subtidal habitats, which provide refugia during low tide, occur throughout this area. The habitats found here also represent potential breeding habitat for a range of fish species, as well as nursery habitat for numerous estuarine fish, marine fish, and shellfish.

Habitats in these sections of the wetland are in a largely undisturbed condition, and have a high degree of connectivity to wetland and coastal areas outside the wetland. However, the



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Western Bund and Causeways would limit connectivity to the wetland, which would have an impact on fish habitat values.

The hypersaline zone contains undisturbed saltpan habitat and impounded hypersaline waters within an area that once supported mangrove forest. Saltpan habitats are occasionally inundated during large spring tides and by floodwaters. Case studies elsewhere demonstrate that saltpan and saltmarsh habitats provide important functional values from a fisheries perspective, particularly as habitat for crustaceans, which form the diet of economically significant species.

The impoundment behind the Western Bund is typically hypersaline, with salinity well beyond the tolerance limits of most fish species. The impoundment connects to the western wetland during large spring tides and floods, but is isolated from other areas for much of the year (due to the effects of the Western Bund and Causeway). This area is considered to have low fish habitat values in its current state.

The wetland basin zone can provide habitat for small-bodied fish during dry periods when water levels are shallow, with a greater number of species present during floods due to higher water levels, larger waterbody size, and enhanced connectivity with other wetland areas. Wetland habitats north of the wetland basin zone support fish habitat values that are representative of those in the wider wetland basin. The sedges, saltmarsh, and areas of open water would provide habitat for fish during wet conditions.

Saltwater Creek provides high quality fish habitat. It represents a semi-permanent/permanent aquatic fauna refugia, forms part of a fish movement corridor, and contains a wide range of structurally complex micro-habitats that are in good condition. There are few current pressures on this creek, although it is possible that at very low water levels during hot periods DO concentrations could represent a stress to fish.

No fish or aquatic macroinvertebrate species recorded within the wetland or the wider Don River basin are listed as threatened under Commonwealth (EPBC Act) legislation. None of the fish species known to be present are considered to be threatened or near threatened at an international level, as defined under International Union for Conservation of Nature Red List.

The aquatic fauna value of the wetland is supported by the following critical processes:

- Tidal flushing and inundation in the western estuary and coastal water zones - which maintain estuarine vegetation communities, water quality, and connectivity.
- Cyclic wetting and drying in the wetland basin - which controls salinity, maintains vegetation communities used by fish communities, and controls aquatic plant and animal populations. While wet periods provide favourable conditions for fish and aquatic macroinvertebrate communities, dry periods within the wetland basin result in:
 - A loss of fish and aquatic macroinvertebrate biomass
 - A reduction in area of available spawning and feeding habitat for native fish, introduced fish, and many aquatic invertebrates
 - The control of populations of weeds and pest fish
 - The absence of connectivity between the wetland basin and other sections of the wetland.



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- Semi-permanent freshwaters in the Saltwater Creek zone - which supports aquatic vegetation and fauna refugia values.

Ecosystem services

As discussed previously, although the Project is being undertaken outside the wetland area, the Caley Valley Wetlands provides a range of ecosystem services at a local (wetland-specific) scale; some of which are relevant to supporting the Outstanding Universal Value of the GBRWHA. These values are discussed more fully in **Appendix O** (Hydrologic, Water Quality and Aquatic Ecology) and are summarised below in the context of the following types of ecosystem services (Millennium Ecosystem Assessment, 2005) that are relevant to aquatic ecology, namely:

- Provisioning services - products obtained from ecosystems
- Regulating services - benefits obtained from regulation of ecosystem services
- Supporting services - services necessary for the production of all other ecosystem services.

Provisioning services

Provisioning services are direct products provided by the ecosystem, such as fisheries resources. While the Caley Valley Wetlands is not an important area for fishing, it provides a range of fisheries habitat values. In particular, the western section of the wetland provides good quality habitat for mud crabs, barramundi and a range of other fish species, while Saltwater Creek provides habitat for barramundi. While the wetland basin does not support high quality fish habitat, this zone would provide linkages between Saltwater Creek and the GBRWHA during floods.

Regulating services

Wetlands can provide a range of regulating services including climate regulation, hydrological regimes, pollutant control, erosion control and protection against natural hazards.

Coastal wetlands such as the Caley Valley Wetlands play an important role in the context of trapping and processing of catchment pollutants, particularly sediments and nutrients, as well as floodwaters. The catchments draining into the wetland primarily consist of grazing lands, and therefore potentially represent a locally significant source of pollutants to the GBRWHA. Shallow sections of the wetland basin also contain extensive areas of microalgae mats, which would trap and process nutrients. These processes are especially important given the significant water quality stress on coastal ecosystems in the GBRWHA due to catchment derived inputs of pollutants.

Supporting services

Supporting services are those that underpin the other ecosystem services. The supporting services provided by the Caley Valley Wetlands that are considered particularly important in the context of linkages with the GBRWHA are:

- Detention of catchment flows prior to discharge into the GBRWHA
- Nutrient cycling and ecosystem productivity
- Habitat provisioning
- Connection of ecosystems and pathway for fish migration



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- Ecosystem health and resilience.

Relevance to MNES

While the Caley Valley Wetlands is a wetland of national importance as listed in the Directory of Important Wetlands in Australia; under the EPBC Act the entire wetland would be considered an MNES only if it were listed under the *Ramsar Convention (the Convention on Wetlands of International Importance)*. The wetland has not been nominated for Ramsar listing, although DoE (DEWHA, 2010) states that: *“the site provides an outstanding example of wetlands on a tropical prograding coast. Permanent water, a wide range of wetland habitats, very rich food resources and sheltered roosting and breeding sites cause the site to be exceptionally important for waterbirds. The importance of the site is such that it meets criteria for identifying wetlands of international importance adopted by the Ramsar Convention (e.g. 1a, 1c, 2a, 2c).”*

Components of the wetland support MNES, specifically:

- The wetland habitats that support EPBC listed threatened bird species (addressed in Section 3.2.1.3)
- The wetland habitats that support EPBC listed migratory bird species (addressed in Sections 3.2.1.1 and 3.2.1.2)
- The estuarine reaches of in the western portion of the wetland that are included in the GBRWHA and the GBR National Heritage Place (discussed in Section 3.1.4.2)
- The contribution to GBRWHA Outstanding Universal Values related to waterbird habitat (addressed in Section 3.2.1.4) and broader Outstanding Universal Values via ecosystem services.

3.1.10 Protected areas

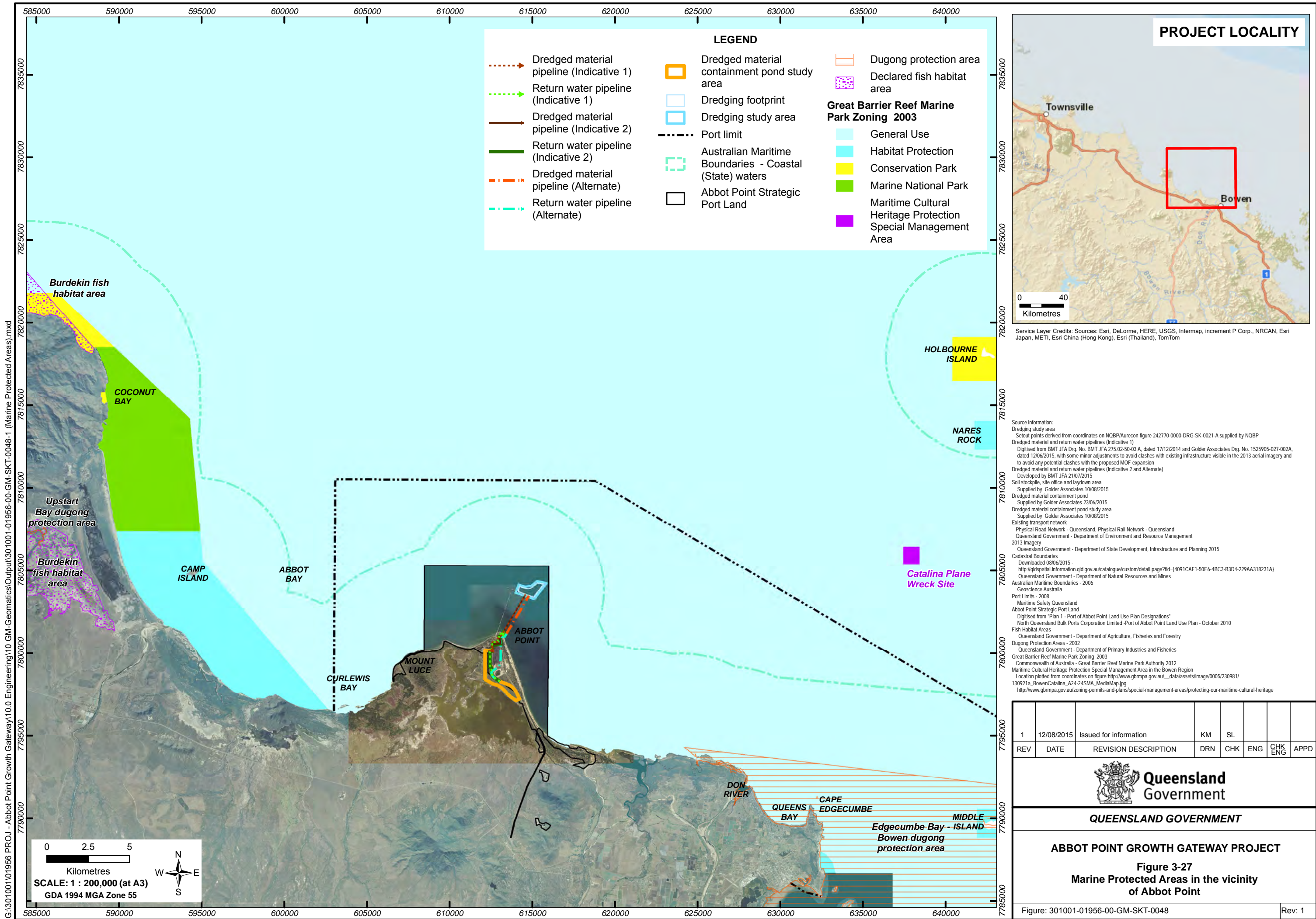
The offshore project activities are proposed to be undertaken within the GBRWHA but outside the GBRMP and Commonwealth marine areas. The majority of the marine environment at Abbot Point is characterised by open seabed habitat with highly variable water depths including shoals and channels. This habitat supports small patches of benthic macroinvertebrate communities and low diversity seagrass beds and rocky reefs (see Section 3.1.1).


The proposed works will only take place within port limits. No reef complexes of high biodiversity have been identified within the port limits. To the east and west of the port limits, habitats of conservation and biodiversity significance are recognised. Sections 3.2.3, 3.2.6 and 3.2.7 of this report discuss the following MNES protected matters:

- The GBRWHA
- The GBRMP
- Commonwealth marine areas protected under the EPBC Act.

Other protected areas discussed in the following sections and shown in Figure 3-27 are:

- Dugong Protection Areas (DPAs)
- Fish Habitat Areas
- Cape Upstart Marine National Park Zone
- Holbourne Island Conservation Park Zone
- Nares Rock and Camp Island Habitat Protection Zones.



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QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-27 Marine Protected Areas in the vicinity of Abbot Point							
Figure: 301001-01956-00-GM-SKT-0048							Rev: 1



3.1.10.1 Dugong and fish protection areas

Abbot Point is located between two DPAs, namely 'Dugong Sanctuary A' at Upstart Bay (44km north-west of Abbot Point) and 'Dugong Sanctuary B' at Edgumbe Bay (35km south-east of Abbot Point). The embayments in Upstart Bay and in Edgumbe Bay adjacent to the DPAs are designated as Fish Habitat Areas (Figure 3-27).

3.1.10.2 Conservation and habitat protection zones

Holbourne Island is the most northerly National Park island in the Whitsundays and is located 31km from the dredging area (Figure 3-27). The park's diverse vegetation ranges from grassland and stunted shrubs on the hillsides to vine thickets on the foreshores. A small forest of *Pisonia* trees occurs near the shore, which is unusual because this forest type usually occurs on coral cays, not continental islands. Holbourne Island National Park is a major nesting site for Green and Flatback Turtles and is an important breeding habitat for several bird species. The Holbourne Conservation Park (Yellow) Zone that surrounds the Island allows for increased protection and conservation of areas of the Marine Park, while providing opportunities for reasonable use and enjoyment including limited extractive use. Most extractive activities are allowed in a Conservation Park (Yellow) Zone with additional restrictions for most fishing activities.

The marine waters surrounding Nares Rock and Camp Island are classified as Habitat Protection Zones (Figure 3-27). The Habitat Protection (Dark Blue) Zone provides for the conservation of areas of the GBRMP by protecting and managing sensitive habitats and ensuring they are generally free from potentially damaging activities. Trawling is not permitted in the Habitat Protection (Dark Blue) Zone. Nares Rock is located 30km east of the T0 dredging area. Camp Island is located 20km to the west of the T0 dredging area. The Habitat Protection (Dark Blue) Zone continues to provide for reasonable use of areas and makes up about 28% of the GBRMP.

A Marine National Park Zone is located on the eastern side of Cape Upstart 27km from the T0 dredging area (Figure 3-27). The Marine National Park (Green) Zone is a 'no-take' area and extractive activities like fishing or collecting are not allowed without a permit. Anyone can enter a Marine National Park (Green) Zone and participate in activities such as boating, swimming, snorkelling and sailing. Travelling through a Marine National Park (Green) Zone with fish on board is also allowed (it is only an offence to fish in a Marine National Park - Green - Zone). The Marine National Park (Green) Zone makes up about 33% of the GBRMP.

3.2 Matters of National Environmental Significance

Studies have demonstrated that the waters in the vicinity of Abbot Point provide transient habitat for a range of threatened and migratory species including the Dugong, Humpback Whale, the Australian Snubfin Dolphin, Indo-Pacific Humpback Dolphin, Loggerhead Turtle, Green Turtle, and Flatback Turtle. The dredging area and temporary offshore pipeline infrastructure will occur within the GBRWHA and will be located adjacent to but not within the GBRMP.

The Outlook Report 2014 indicates that the GBR as a whole retains the values and qualities contributing to its Outstanding Universal Value as recognised in its listing as a World



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Heritage property. The northern third of the GBR region has good water quality and its ecosystems are believed to be in good condition. However, key habitats, species and ecosystem processes in the central and southern inshore area of the GBR continue to deteriorate, particularly inshore seagrass meadows and coral reefs. The greatest risks to the GBR have not changed since the Outlook Report 2009. Climate change, poor water quality from land-based runoff, coastal development and some impacts related to fishing were identified as the major threats to the future vitality and resilience of the GBR in the Outlook Report 2014.

The Report summarises that the impacts of port operations to the marine environment include: clearing and modifying coastal habitats; disturbance, displacement, dredging, disposal and re-suspension of dredged material; injury and death of wildlife; chemical and oil spills; some contribution to marine debris; altered light regimes; diminished aesthetic values; and air and noise pollution.

The Report also highlights that the specific impacts of dredging and port infrastructure construction are well documented and most severe at the dredging site, but that some impacts (such as turbidity, sedimentation, noise and disruption of fish habitats) may occur at a distance from dredging and disposal. However, localised impacts of dredging, such as seabed disturbance, transport or re-suspension of contaminants, alteration of sediment movement and changes in coastal processes can be severe. Burial or smothering of plants and animals on the seafloor, degradation of water quality and loss and modification of habitats are highlighted as the major direct impacts of dredging and disposal of dredged material.

The DMCP where deposition of materials will occur is located on land that is adjacent to the Caley Valley Wetlands, which is listed on the Directory of Nationally Important Wetlands. This wetland is a largely ephemeral wetland that is important for a number of bird species (including listed threatened and migratory species). The wetland covers 5,154ha and is one of the largest intact wetland systems between Townsville and Bowen and is considered to be in a largely undisturbed condition (BMT WBM, 2012).

**Section 3****Existing Environment****3.2.1 Terrestrial Matters of National Environmental Significance****3.2.1.1 Environment Protection and Biodiversity Conservation Act listed migratory shorebirds****East Australian-Australasian Flyway**

The East Asian-Australasian (EAA) flyway extends from Siberia and Alaska through east and south-east Asia (most predominately China and Korea) to Australia and New Zealand. The EAA flyway is utilised by at least five million migratory shorebirds (Gosbell and Clemens, 2006).

Migratory species using the EAA flyway undertake annual migrations of thousands of kilometres between their southern feeding areas and breeding areas in the northern hemisphere. Species have been recorded travelling over 10,000km non-stop, with total return distances from northern breeding grounds to southern feeding areas exceeding 29,000km.

Northward migration to the breeding grounds typically takes place from March to early June. The birds arrive for the Arctic breeding season and must breed and fledge offspring within a six to seven week window of favourable summer climatic conditions. The return migration to non-breeding or feeding areas occurs from July to October. Most migratory shorebird species have delayed maturity, and will skip their first northerly migration by staying in Australia. The young of some species will not return to breed until they are two or more years old. These immature birds may undertake partial migration from southern to northern areas of Australia.

During migration, birds move through staging areas. Staging habitat is defined as areas that meet shorebird feeding and roosting requirements during migration. Shorebirds exhibit strong site fidelity to preferred feeding and roosting areas and do not readily use alternative areas (Tudor, 2002).

Habitat in Australia

Australia provides important feeding habitat for migratory shorebirds of the EAA flyway. The migratory shorebirds that regularly visit Australia have a wide variety of habitat requirements, spatial distributions and patterns of habitat use (Marchant and Higgins, 1993). Migratory shorebirds start arriving in northern Australia in August, and then disperse throughout the country. Migratory shorebird habitat in Australia provides:

- Feeding areas with abundant food resources. Physical characteristics of feeding areas primarily consist of intertidal mudflats, sandy beaches, salt pans and rocky intertidal areas. The characteristics of high value feeding areas include large populations of invertebrates, low disturbance and un-degraded soils. Several species also readily feed in wet or moist substrates on coastal or inland freshwater wetlands.
- Roosting areas where migratory shorebirds can sleep and preen during non-feeding times. Roosting areas in proximity to feeding areas reduce energetic costs and maintain positive energy flow. Physical characteristics of roosting areas include little or no vegetation on open ground that remains above water during high tides (Tudor, 2002).

Habitat on the north-east Queensland coast



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Over the southern summer, Queensland supports the second highest population of migratory shorebirds in Australia and a greater number of species than any other State or Territory (Gosbell and Clemens, 2006).

The north-east Queensland coast provides significant habitat for migratory shorebirds (Driscoll, 1993). The wetlands of north-east Queensland provide a diverse range of habitat values even in instances where the abundance of shorebirds recorded in them is low (Clemens *et al.*, 2008).

The diversity of Queensland habitat used by migratory shorebirds includes:

- Coastal habitats - coastal wetlands, estuaries, mudflats, rocky inlets, reefs, sandy beaches, and mangroves
- Inland habitats - inland wetlands, floodplains, and grassland area.

Queensland has significant ephemeral wetland areas both on and near the coast as well as inland. Ephemeral wetland environments are characterised by short, infrequent, and unpredictable water availability, which determines if and when birds are present.

The importance of ephemeral wetlands as shorebird habitat is due largely to the fact that species that utilise ephemeral wetlands have adapted to annual variation in water conditions, and are known for their flexible annual distribution patterns. These species exploit a large network of wetlands that extend over hundreds of kilometres. Each year they select from among the subset of sites that are sufficiently wet (Robinson and Oring, 1996). Therefore, while one particular ephemeral wetland may not be critical as habitat to any one species, a regional wetland network is critical.

Migratory shorebirds at Abbot Point

The Caley Valley Wetlands, located adjacent to the DMCP study area, provides habitat for migratory shorebirds listed under the EPBC Act. The location of these habitats is shown on Figure 3-13. The likelihood assessment undertaken for the Project (**Appendix P1**) indicates that 19 migratory bird species are known, likely or have potential to occur at Abbot Point, including those that are also threatened species.

Table 3-6 lists those migratory bird species that are not also threatened species. Threatened species are addressed in Section 3.2.1.3.

Surveys of migratory shorebirds and other wetland/waterbird species were most recently completed by BAAM in 2012 as part of the Abbot Point CIA (BAAM, 2012). These surveys provide detailed information on the abundance of various species within the Caley Valley Wetlands. They were focussed on migratory shorebirds and any listed threatened wetland bird species (in particular the Australian Painted Snipe).

The BAAM (2012) survey approach was tailored to consider the guidelines in EPBC Act policy statement 3.21 (DEWHA, 2009a) for assessing population and habitat importance for migratory shorebirds. The baseline survey objective was to obtain an estimate, based on count data and extrapolation to any unsurveyed areas, of the total abundance of each species of migratory shorebird within the Caley Valley Wetlands system. Survey effort concentrated on the central part of the wetland, referred to as the Closed Marsh and Open Marsh zones shown on Figure 3-13, and adjacent coastal areas. The surveys comprised five



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field visits in February/ March (during the wet season), in June (during the dry season), and November/December (before the onset of seasonal rains).

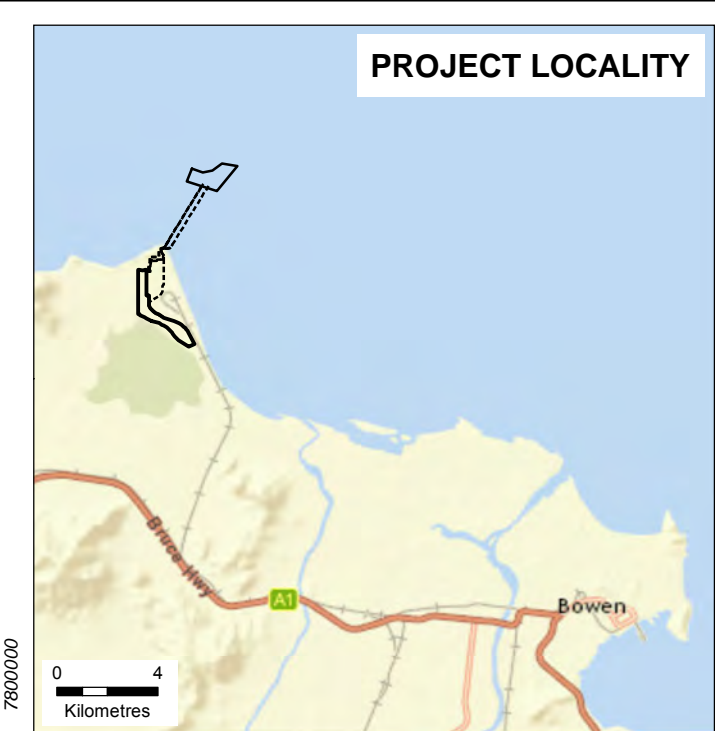
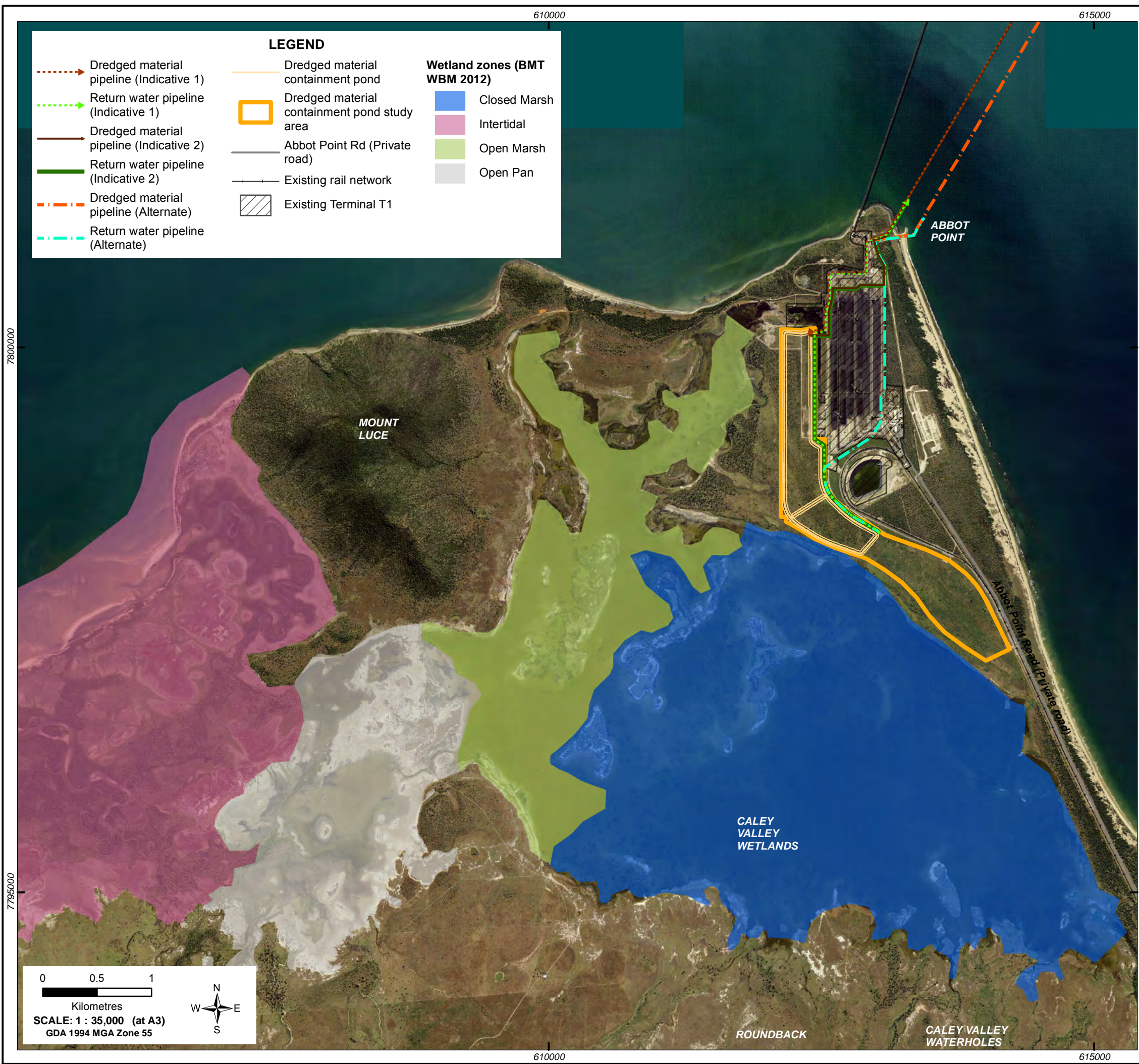
Rainfall conditions in the 12 month period preceding the BAAM (2012) survey were likely to have resulted in the wetland experiencing water level conditions that were optimal for migratory shorebirds and the Australian Painted Snipe. This was reflected in the high numbers of birds recorded in the BAAM (2012) surveys when compared with those of previous surveys.

BMT WBM (2012) also conducted shorebird and waterbird surveys during October and November 2010, with the objective of describing patterns in habitat use. These surveys informed a broad baseline environmental study of the Caley Valley Wetlands.

The results of the collective surveys and database records indicate the high diversity of migratory shorebird species using the Caley Valley Wetlands. The number of species found at the wetland represents almost half the total number of migratory shorebirds listed under the EPBC Act.


It is significant that over half the species found at Abbot Point were recorded on multiple occasions in areas including Closed Marsh, Open Marsh and salt pan components of the wetland and coastal foreshore habitats (Figure 3-28). This is perhaps partly because migratory shorebirds exhibit strong site fidelity and will return to the same site year after year (Clemens *et al.*, 2008), but may also be indicative of the quality and diversity of local habitat.

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

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
[http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=\(4091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=(4091CAF1-50E6-4BC3-B3D4-229AA318231A))
Queensland Government - Department of Natural Resources and Mines
Existing Terminal T1
Digitised from 2013 imagery and cadastral boundaries
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Caley Valley Wetland wetland zones
BMT WBM 2012

1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-28 Map showing functional zones within the Caley Valley Wetlands							
Figure: 301001-01956-00-GM-SKT-0089							Rev: 1



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Table 3-6 Migratory shorebird species that are known, likely or have potential to occur in the Abbot Point area, DMCP and, pipeline alignments (excluding those species that are also threatened species)

Scientific Name	Common Name	EPBC Act Status	Likelihood ²			Justification
			DMCP	Pipeline	Study area	
<i>Actitis hypoleucos</i>	Common Sandpiper	Migratory	No	Unlikely	Likely	Previously recorded in the western sections of the Caley Valley Wetlands (GHD, 2010). Suitable foraging habitat comprises shallow water on bare soft mud at the edges of wetlands, which occur approximately 50m from the DMCP.
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Migratory	No	No	Known	Occurs across the Caley Valley Wetlands in moderate to high densities, including adjacent to the DMCP. Suitable habitat comprises muddy edges of wetlands with emergent vegetation, which occur approximately 50m from the DMCP.

² **Known:** The species was detected during field assessment, or is known from past surveys in the study area and is not now considered locally extinct; **Likely:** A medium to high probability that the species occurs in the study area or regularly visits the study area because suitable habitat occurs, the study area is within the known distribution of the species, there are records of the species in the vicinity of the study area, and the species is not now considered locally extinct; **Potential:** either - (a) there are no past records of the species in the vicinity of the study area but suitable habitat occurs and there is insufficient information on the distribution of the species (e.g. it is naturally rare and difficult to detect, or there has been insufficient survey effort) to categorise the species as likely or unlikely to occur, or (b) there are past records of the species in the vicinity of the study area but habitat in the study area is marginal or spatially limited meaning that the species' presence on the study area would be transitory at best; **Unlikely:** A very low probability that the species occurs in the study area because suitable habitat does not occur, the study area is outside the known distribution of the species, there are no records of the species in the local region despite adequate survey effort, the species is considered locally extinct, or the species has not been observed despite sufficient spatial and temporal survey effort for detecting the species



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Scientific Name	Common Name	EPBC Act Status	Likelihood ²			Justification
			DMCP	Pipeline	Study area	
<i>Calidris ruficollis</i>	Red-necked Stint	Migratory	No	Known	Known	Recorded mostly in the Open Pan section of the wetland, with a single record approximately 50m from the DMCP. Also observed on the Eastern Beach in relatively low numbers. Suitable habitat comprises coastal wetlands and ocean beaches, which occurs adjacent to the DMCP, on Dingo Beach, and in the pipeline foreshore area.
<i>Charadrius leschenaultii</i>	Greater Sandplover	Migratory	No	No	Likely	Recorded from the south-west of the Caley Valley Wetlands. Suitable habitat comprising sheltered beaches with large intertidal mudflats or sandbanks occurs within 500m of the DMCP, at Dingo Beach.
<i>Charadrius veredus</i>	Oriental Plover	Migratory	Potential	Potential	Potential	Recorded in the western sections of the Caley Valley Wetlands (GHD, 2010). Suitable habitat comprising near-coastal grasslands, sandy beaches and wetlands occurs in and adjacent to the DMCP, and at the Pipeline foreshore area (ELA, 2014). Not recorded within 2km of the project area despite multiple shorebird surveys.



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Scientific Name	Common Name	EPBC Act Status	Likelihood ²			Justification
			DMCP	Pipeline	Study area	
<i>Gallinago hardwickii</i>	Latham's Snipe	Migratory	No	No	Known	Occurs across the marsh sections of the eastern Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprising ephemeral freshwater and brackish wetlands with vegetation occurs adjacent to the DMCP.
<i>Limosa lapponica</i>	Bar-tailed Godwit	Migratory	Unlikely	Potential	Potential	Previously recorded from the south-west of the Caley Valley Wetlands. Primary habitat comprises tidal flats and saltmarshes, located within 2km of the project area. Suboptimal habitat includes sandy beaches and areas of short grass, which occurs in and within 500m of the DMCP and in the pipeline foreshore area (ELA, 2014). Not recorded within 2km of the project area despite multiple shorebird surveys.
<i>Limosa limosa</i>	Black-tailed Godwit	Migratory	No	No	Known	Occurs in the southern and eastern Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprises shallow, sparsely vegetated, near-coastal wetlands, which occurs adjacent to the DMCP.



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Scientific Name	Common Name	EPBC Act Status	Likelihood ²			Justification
			DMCP	Pipeline	Study area	
<i>Numenius minutus</i>	Little Curlew	Migratory	Likely	No	Known	Recorded in the central Caley Valley Wetlands, within 500m of the DMCP. Suitable habitat comprises short dry grassland, open woodlands with grassy understorey, and seasonally inundated floodplains, which occurs in and adjacent to the DMCP.
<i>Numenius phaeopus</i>	Whimbrel	Migratory	No	Known	Known	Occurs predominately in the central and western sections of the Caley Valley Wetlands (estuarine environments). Also occurs in coastal areas of Abbot Point, including within 500m of the DMCP (Dingo Beach), and on Eastern Beach, where the pipeline is located. Suitable habitat comprises open un-vegetated mudflats, sandy beaches, and saline grasslands which occurs in the pipeline foreshore area (ELA, 2014), at Dingo Beach, and adjacent to the DMCP.



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Scientific Name	Common Name	EPBC Act Status	Likelihood ²			Justification
			DMCP	Pipeline	Study area	
<i>Pluvialis fulva</i>	Pacific Golden Plover	Migratory	No	Known	Known	Recorded in high densities on Abbot Point Eastern Beach, where the pipeline is located. Predominately coastal, but also recorded in the far south-east section of the Caley Valley Wetlands. Suitable habitat comprises beaches, mudflats, and fresh and brackish wetlands with muddy margins which occurs in the pipeline foreshore area (ELA, 2014), at Dingo Beach, and adjacent to the DMCP.
<i>Tringa brevipes</i>	Grey-tailed Tattler	Migratory	No	No	Potential	Previously recorded from the south-west of the Caley Valley Wetlands. No primary habitat of tidal mudflats within 2km of the project area. Suboptimal habitat of coastal wetlands occur within 500m of the DMCP. Not recorded within 2km of the project area despite multiple shorebird surveys.
<i>Tringa glareola</i>	Wood Sandpiper	Migratory	No	No	Potential	Recorded within 5km of project area (Wildlife Online Search), but not recorded during multiple bird surveys over multiple seasons. Suitable habitat comprises well-vegetated shallow freshwater wetlands and inundated grasslands which occur adjacent to the DMCP.



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Scientific Name	Common Name	EPBC Act Status	Likelihood ²			Justification
			DMCP	Pipeline	Study area	
<i>Tringa incana</i>	Wandering Tattler	Migratory	No	Known	Known	Restricted to the coastal habitats. Known from Abbot Point Eastern Beach and the far western coast of the Caley Valley Wetlands area. Suitable habitat comprises beaches, mudflats, and fresh and brackish wetlands with muddy margins which occur in the Pipeline foreshore area (ELA, 2014) and within 500m of the DMCP (at Dingo Beach).
<i>Tringa nebularia</i>	Common Greenshank	Migratory	No	No	Known	Occurs across the Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprising wetlands occurs adjacent to the DMCP.
<i>Tringa stagnatilis</i>	Marsh Sandpiper	Migratory	No	Unlikely	Known	Occurs across the Caley Valley Wetlands, including adjacent to the DMCP. Primary habitat of wetlands occurs adjacent to the DMCP. Suboptimal habitat comprising beaches occurs in the Pipeline foreshore area (ELA, 2014) and at Dingo Beach within 500m of the DMCP. Not recorded using beach areas at Abbot Point despite multiple shorebird surveys.



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The Australian Government has issued a set of specific guidelines (DEWHA, 2009a; Commonwealth of Australia, 2014) for assessing the importance of habitat for migratory shorebird species in Australia. These guidelines (referred to as EPBC Act policy statement 3.21) outline a set of criteria for identifying 'important habitat'. The associated background paper (DEWHA, 2009b) that accompanies the policy statement provides detailed recommendations about survey requirements for migratory shorebirds.

Under the guidelines (DEWHA, 2009a), important habitat for migratory shorebirds (excluding Latham's Snipe) includes sites that support:

- At least 0.1% of the flyway population of a single species
- At least 2,000 migratory shorebirds
- At least 15 migratory shorebird species.

Important habitat for Latham's Snipe (DEWHA, 2009a) includes sites that:

- Support at least 18 individuals of the species
- Are naturally occurring open freshwater wetlands with vegetation cover nearby (for example, tussock grasslands, sedges, lignum, or reeds within 100m of the wetland).

The guidelines also provide a definition of 'a site' as:

"The entire (discrete) area of contiguous habitat used by the same group of migratory shorebirds, which may include multiple roosts and feeding areas."

It is therefore relevant to undertake an assessment of whether Abbot Point provides important habitat for migratory shorebirds as a key first step in the impact assessment. For the purposes of this report, 'the site' is defined as the Caley Valley Wetlands (as per the Directory of Important Wetlands Australia mapping), which is a discrete area of continuous habitat used by the same group of birds at Abbot Point.

Table 3-7 provides details of the total counts, population estimates and percentage of the flyway population of migratory shorebirds for the main wetland.

The Caley Valley Wetlands is habitat for ecologically significant proportions of the populations of three of these migratory species: Latham's Snipe *Gallinago hardwickii*, Sharp-tailed Sandpiper *Calidris acuminata*, and Red-necked Stint *Calidris ruficollis*. Curlew Sandpiper and Eastern Curlew were recently listed as critically endangered, and while the referral decision for the Project preceded the listing, the migratory population of these species at Abbot Point should also be considered important. The wetland is also habitat for an ecologically significant proportion of the Australian Painted Snipe (a shorebird that is listed as migratory, but is not included in the EPBC Act Draft Guidelines. Curlew Sandpiper, Eastern Curlew and Australian Painted Snipe are discussed as threatened species in Section 3.2.1.3.



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Table 3-7 Total counts, population estimates and % flyway population for main wetland

Scientific Name	Common Name	Feb Count	Feb Est.	Mar Count	Mar Est.	Jun Count	Jun Est.	Nov Count	Dec Count	0.1% Level	% Pop
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	781	1,199	351	377	1	2	556	129	160	0.75
<i>Calidris ruficollis</i>	Red-necked Stint	389	389	1,224	1,224	47	47	343	117	325	0.38
<i>Charadrius leschenaultii</i>	Greater Sand Plover	0	0	1	1					110	<0.01
<i>Gallinago hardwickii</i>	Latham's Snipe	29	54	7	9			2	2	100	0.05
<i>Limosa limosa</i>	Black-tailed Godwit	1	1			1	1	2		160	<0.01
<i>Numenius madagascariensis</i>	Eastern Curlew	1	1	1	1			1	34	38	<0.01
<i>Numenius minutus</i>	Little Curlew	0	0	1	1					180	<0.01
<i>Numenius phaeopus</i>	Whimbrel	3	3	2	2			2	22	100	<0.01
<i>Pluvialis fulva</i>	Pacific Golden Plover	1	1					2		100	<0.01
<i>Tringa nebularia</i>	Common Greenshank	37	42	35	35			14	3	60	0.07
<i>Tringa stagnatilis</i>	Marsh Sandpiper	11	19	10	10			26	3	100- 1000	<0.01



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Scientific Name	Common Name	Feb Count	Feb Est.	Mar Count	Mar Est.	Jun Count	Jun Est.	Nov Count	Dec Count	0.1% Level	% Pop
Australian Painted Snipe <i>Rostratula australis</i> is a shorebird that is still listed as migratory, but is not included in the EPBC Act Draft Guidelines											
<i>Rostratula australis</i>	Australian Painted Snipe	3	8			24	35			1.88	1.87

Source: BAAM (2012)

**Section 3****Existing Environment****Eastern Curlew**

The Eastern Curlew was listed as critically endangered under the EPBC Act in 2015. In Australia, habitat includes intertidal mud and sand flats for feeding, and sand bars and spits for roosting at high tide. In Australia, threats to the species include human disturbance, habitat degradation, hydrological changes and invasive plants (Threatened Species Scientific Committee; TSSC, 2015a). Disturbance to pre-migratory Eastern Curlews can affect their ability to migrate to the northern hemisphere to breed during the Australian winter.

There is no habitat for Eastern Curlew within the project area. Surveys undertaken during 2012 recorded low numbers, except during December 2012 when 34 individuals were counted at high tide within the Open Pan Zone of the wetland, 4km west of the project area. The species prefers estuarine environments within the wetland and has not been observed in the area of the wetland immediately adjacent to the project area. BMT WBM (2012) noted individuals from a 2006 survey roosting on Dingo Beach 500m from the project area.

Curlew Sandpiper

The Curlew Sandpiper was listed as critically endangered under the EPBC Act in 2015. In Australia, foraging habitat includes intertidal mudflats and non-tidal wetlands. Roosting occurs on sand spits, wetlands, lagoons and sometimes on mangroves (TSSC, 2015b). In Australia, threats to the species include human disturbance, habitat degradation, hydrological changes and invasive plants (TSSC, 2015b). The species is also threatened by wetland degradation in East Asia along its migratory route.

There is no habitat for the Curlew Sandpiper within the study area. There are two Wildlife Online records of the Curlew Sandpiper from the Caley Valley Wetlands. Between 8 and 10 individuals were also observed by BMT WBM (2012) in the Closed Marsh of the wetland, approximately 2.5km south-west of the project area. There were no sightings of the species during the BAAM (2012) surveys. The species appears to be an infrequent visitor to the Caley Valley Wetlands, and there is no evidence to suggest that areas of the wetland that are adjacent to the project area are preferred habitat.

Red-necked Stint

The Red-necked Stint is the smallest shorebird in Australia and is listed as migratory under the EPBC Act. The species was found in significant numbers at Abbot Point during 2012. The BAAM (2012) wet season survey found the species restricted to the Open Pan Zone and western edge of the freshwater areas. This survey found a total of 134 birds on the western edge of the palustrine area in the north-western section of the Closed Marsh and 1,088 individuals foraging in the Open Pan Zone. During this survey period, Red-necked Stints were observed to be foraging in large flocks with other shorebird species, mainly sandpipers. The diversity of habitats at the wetland allows the Red-necked Stint to use the muddy shallows of the Open Pan Zone as well as the edges of the main wetland basin.

There is no habitat for Red-necked Stint within the study area. The BAAM (2012) dry season survey found 47 Red-necked Stints on the south-western edge of the Open Marsh Zone. This finding potentially adds to the relevance of Caley Valley Wetlands as an important habitat for migratory shorebirds. Red-necked Stints arrive in Australia from August (possibly July) with most from early September. Almost all have arrived in Australia by November.

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They begin the return to breeding grounds from late February through to April although a few remain until May (DoE, 2015a). The 47 Red-necked Stints counted on the site in late June 2012 were most likely young birds, which had not migrated to breed and were spending the northern hemisphere summer in Australia.

While most Red-necked Stints observed at the Caley Valley Wetlands have been located more than 500m from the project area, the species is likely to occasionally utilise habitats in closer proximity to the project area.

Latham's Snipe

There is no habitat for Latham's Snipe located within the study area, although the species has been sighted throughout eastern sections of the Caley Valley Wetlands, utilising a range of habitats within the Open and Closed Marsh zones.

Unlike the other key shorebird species considered in this assessment, the preferred habitat of the Latham's Snipe includes grasslands (marine couch) on the edges of inundated areas. Such habitats occur closest to the project area, and would be suitable at times when the wetland is full of water. The species has been demonstrated to utilise a variety of habitats throughout the eastern Caley Valley Wetlands, most likely in response to the location of suitable habitat during various stages of the wetland's wetting and drying cycle.

The sighting records and habitat use for the Latham's Snipe indicate that the species utilise wetland habitats adjacent to the project area.

3.2.1.2 Environment Protection and Biodiversity Conservation Act listed migratory birds

Likelihood assessment undertaken for the Project (**Appendix P1**) indicates that 16 migratory (non-shorebird) bird species are known, likely or have potential to occur at Abbot Point (Table 3-8). An ecologically significant proportion of the Eastern Great Egret *Ardea modesta* population (>1%) occurs in the Caley Valley Wetlands (CDM Smith, 2013a). Survey results of BAAM (2012) also indicate that the wetland provides important habitat for an ecologically significant proportion of the species, and that sections of the wetland adjacent to the DMCP study area are utilised by the species.

Survey results also indicate that the Caley Valley Wetlands supports ecologically significant populations of the Caspian Tern *Hydroprogne caspia*, although use of the wetland adjacent to the DMCP study area appears to be limited (BAAM, 2012). BMT WBM (2012) also reported more than 300 Little Terns *Sternula albifrons* feeding adjacent to the Open Pan Zone of the wetland (6km west of the project area), and 50 Little Terns including nests on a sand spit in the wetland's Intertidal Zone. The wetland therefore has potential to support an ecologically significant proportion of the Little Tern population.



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Table 3-8 Significance of habitat for other migratory species that are known, likely or have potential to occur in the Abbot Point area, DMCP and pipeline alignments

Scientific Name Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
<i>Apus pacificus</i> Fork-tailed Swift	Likely	No	Likely	<p>Recorded within 5km of the project area (Wildlife Online Search). Predominately aerial. Suitable habitat comprises coastal areas with dry and open habitat, including foothills which occur in and adjacent to the DMCP.</p> <p>Potential to occur as an occasional visitor.</p> <p>Presence of important habitat or an ecologically significant proportion of the species considered highly unlikely as the area does not support:</p> <ul style="list-style-type: none"> ▪ Breeding habitat ▪ Important feeding or roosting areas.
<i>Ardea ibis</i>	Likely	No	Known	<p>Recorded in the north and the south of the Caley Valley Wetlands, including adjacent to the DMCP, and in grasslands adjacent to the south of the wetland (GHD, 2010). Suitable habitat comprises</p>

³ Known: The species was detected during field assessment, or is known from past surveys in the study area and is not now considered locally extinct; Likely: A medium to high probability that the species occurs in the study area or regularly visits the study area because suitable habitat occurs, the study area is within the known distribution of the species, there are records of the species in the vicinity of the study area, and the species is not now considered locally extinct; Potential: either - (a) there are no past records of the species in the vicinity of the study area but suitable habitat occurs and there is insufficient information on the distribution of the species (e.g. it is naturally rare and difficult to detect, or there has been insufficient survey effort) to categorise the species as likely or unlikely to occur, or (b) there are past records of the species in the vicinity of the study area but habitat in the study area is marginal or spatially limited meaning that the species' presence on the study area would be transitory at best; Unlikely: A very low probability that the species occurs in the study area because suitable habitat does not occur, the study area is outside the known distribution of the species, there are no records of the species in the local region despite adequate survey effort, the species is considered locally extinct, or the species has not been observed despite sufficient spatial and temporal survey effort for detecting the species



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Scientific Name Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
Cattle Egret				<p>wooded areas, terrestrial wetlands, low-lying grasslands which occur in and adjacent to the project area.</p> <p>Presence of important habitat or an ecologically significant proportion of the species considered unlikely as:</p> <ul style="list-style-type: none"> ▪ Caley Valley Wetlands does not represent preferred breeding or foraging habitat for this species ▪ Less than 0.1% of the population is present at Abbot Point.
<i>Ardea modesta</i> Eastern Great Egret	No	No	Known	<p>Abundant across the Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprises wetlands which occur adjacent to the DMCP.</p> <p>Recorded within the Caley Valley Wetlands by BAAM (2012). Surveys recorded 232 and 289 individuals respectively in the February and March wet season surveys. A total of 386 individuals were recorded during the dry season survey, although it is estimated that the actual number present at this time was 583.</p> <p>Likely that presence within the wetland varies as water levels changes over time.</p> <p>Presence of important habitat or an ecologically significant proportion of the species considered likely as greater than 0.1% of the population is present at Abbot Point.</p>
<i>Chlidonias leucopterus</i> White-winged Tern	Potential	No	Potential	<p>Occurs in the central southern Caley Valley Wetlands, within 2km of the DMCP. Suitable habitat comprises grasslands, wooded lands, wetlands which occur in and adjacent to the DMCP.</p> <p>Not recorded in or adjacent to the project area, despite shorebird and other fauna surveys over multiple years and seasons.</p>



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Scientific Name Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
				A total of 19 individuals recorded in the Closed Marsh Zone (BAAM, March 2012). This is less than 0.1% of the total estimated population, therefore presence of important habitat or an ecologically significant proportion of the species is considered unlikely.
<i>Egretta sacra</i> Eastern Reef Egret	No	Likely	Known	<p>Recorded in the northern coastal areas of the Caley Valley Wetlands, including within 500m of the DMCP. Suitable habitat comprises beaches which occur in the pipeline foreshore area (ELA, 2014) and at Dingo Beach within 500m of the DMCP.</p> <p>Recorded within the Caley Valley Wetlands by BAAM (2012). Surveys recorded no individuals in February and one individual in March.</p> <p>Presence of important habitat or an ecologically significant proportion of the species is considered unlikely as:</p> <ul style="list-style-type: none"> ▪ Caley Valley Wetlands does not represent preferred breeding or foraging habitat for this species ▪ The area does not support a sufficient population of the species to be considered an ecologically significant proportion.
<i>Haliaeetus leucogaster</i> White-bellied Sea Eagle	Known	Likely	Known	<p>Recorded across the Caley Valley Wetlands and coastal areas of Abbot Point. Suitable habitat comprises large areas of open water in coastal habitats and wetlands, coastal dunes which occur adjacent to the DMCP and in the Pipeline foreshore area (ELA, 2014). Suitable nesting habitat comprises tall open forest or woodlands close to water which occur within 200m of the DMCP.</p> <p>Six to eight individuals recorded foraging across the Caley Valley Wetlands and perching near Abbot Point Road during the BAAM wet season survey (BAAM, 2012).</p> <p>Survey recorded two nests/roosts in eucalypts on the fringe of the wetland near to the proposed T2</p>



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Scientific Name Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
				<p>and T3. BAAM also identified potential nest sites on the opposite side of the wetland near the causeway (BAAM, 2012).</p> <p>Likely that the Caley Valley Wetlands provides a locally important foraging resource for the White-Bellied Sea Eagle when conditions are favourable but not important habitat.</p> <p>Presence of important habitat or an ecologically significant proportion of the species considered unlikely as:</p> <ul style="list-style-type: none"> While the area is locally important to the individuals that occur there, the area does not support a sufficient population of the species to be considered an ecologically significant proportion Other suitable habitat is likely to occur within the region Large areas of potential foraging habitat will remain undisturbed Potential nesting/roosting trees are not considered to be a limiting feature in the landscape.
<i>Hydroprogne caspia</i> Caspian Tern	No	Known	Known	<p>Occurs across the Caley Valley Wetlands and coastal areas, including adjacent to the DMCP and Eastern Beach, where the pipeline is located. Suitable habitat comprises near-coastal wetlands and shores which occur adjacent to the DMCP and in the pipeline foreshore area (ELA, 2014).</p> <p>BAAM (2012) recorded:</p> <ul style="list-style-type: none"> A total of 14 individuals in January A total of 81 individuals in February A total of 204 individuals in June - this represents approximately 0.2% of the total population of this species. <p>The Abbot Point area may also provide breeding habitat as the species nests on beaches.</p>



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Scientific Name Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
				Presence of important habitat or an ecologically significant proportion of the species is considered likely as greater than 0.1% of the population was found to be present at Abbot Point.
<i>Merops ornatus</i> Rainbow bee-Eater	Known	Known	Known	<p>Observed across the Abbot Point area, including in and adjacent to the DMCP and the temporary pipeline area. Suitable habitat comprises open forests and woodlands, and cleared or semi-cleared habitats which occur in and adjacent to the DMCP, and adjacent to the pipeline foreshore area.</p> <p>Surveys from 1999 to 2008 consistently record the species at Abbot Point.</p> <p>Presence of important habitat or an ecologically significant proportion of the species is considered unlikely as:</p> <ul style="list-style-type: none"> ▪ Broad distribution across Australia ▪ Reasonably large Australian population ▪ General habitat use and therefore habitat availability within the region.
<i>Monarcha melanopsis</i> Black-faced Monarch	No	No	Likely	<p>Recorded in the Abbot Point area by Ecoserve (2007). Suitable habitat comprises SEVT and coastal foothills which occur within 500m of DMCP, and adjacent to the pipeline foreshore area.</p> <p>Previous surveys have recorded the Black-faced Monarch at the proposed action site.</p> <p>Presence of important habitat or an ecologically significant proportion of the species considered unlikely as:</p> <ul style="list-style-type: none"> ▪ Broad distribution across Australia ▪ General habitat use and therefore habitat availability within the region.



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Scientific Name Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
<i>Myiagra cyanoleuca</i> Satin Flycatcher	No	No	Likely	<p>Recorded in the Abbot Point area by Ecoserve (2007). Suitable habitat - eucalypt forests near wetlands - occurs within 200m of the DMCP.</p> <p>Previously been recorded in the Abbot Point area by Ecoserve (2007; no count info).</p> <p>Presence of important habitat or an ecologically significant proportion of the species considered unlikely as:</p> <ul style="list-style-type: none"> ▪ Broad distribution across Australia ▪ Limited records at Abbot Point.
<i>Pandion cristatus</i> Eastern Osprey	Likely	Known	Known	<p>Regularly recorded in the north of Abbot Point, including the Caley Valley Wetlands, and coastal areas, including the pipeline foreshore area. Suitable habitat comprising large areas of open water in coastal habitats and wetlands, beaches occurs adjacent to the DMCP and in the pipeline foreshore area (ELA, 2014). Suitable nesting habitat comprises dead or partly dead trees and artificial structures which occur within 200m of the DMCP.</p> <p>Surveys from 1999 to 2007 consistently record the species at Abbot Point.</p> <p>A single Eastern Osprey was recorded on two separate occasions during the BAAM wet season survey. The individual was observed foraging along the coast near the proposed action site.</p> <p>BAAM note that the individual was not foraging over the wetland and that there are no Eastern Osprey nests in the area of the proposed action.</p> <p>Presence of important habitat or an ecologically significant proportion of the species considered unlikely as:</p>



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Scientific Name Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
				<ul style="list-style-type: none"> While the area is locally important to the individuals that occur there, the area does not support a sufficient population of the species to be considered an ecologically significant proportion Other suitable habitat is likely to occur within the region Large areas of potential foraging habitat will remain undisturbed Potential nesting/roosting trees are not considered to be a limiting feature in the landscape.
<i>Plegadis falcinellus</i> Glossy Ibis	No	No	Known	<p>Occurs across the Caley Valley Wetlands, including adjacent to the DMCP. Suitable habitat comprising wetlands and coastal areas occurs adjacent to the DMCP.</p> <p>Recorded within the Caley Valley Wetlands by BAAM (2012). Surveys recorded no individuals in February and 41 individuals in March.</p> <p>Presence of important habitat or an ecologically significant proportion of the species is considered unlikely as less than 0.1% of the population was found to be present at Abbot Point.</p>
<i>Rhipidura rufifrons</i> Rufous Fantail	Likely	No	Likely	<p>Recorded in remnant woodlands west of Dingo Beach. Suitable habitat of SEVT, <i>Melaleuca</i> thickets, regrowth forests occurs in and adjacent to the DMCP.</p> <p>BAAM dry season survey found Rufous Fantail in the forest and forest-thicket to the south of the wetland.</p> <p>Presence of important habitat or an ecologically significant proportion of the species is considered unlikely as common and widely distributed across Australia.</p>
<i>Sterna hirundo</i>	No	Unlikely	Known	<p>Observed feeding on inshore waters around Abbot Point (WBM, 2006). Not recorded again despite multiple shorebird surveys. Suitable habitat comprising ocean beaches and near-coastal wetlands</p>



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Scientific Name Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
Common Tern				<p>occurs adjacent to the DMCP and in the pipeline foreshore area (ELA, 2014).</p> <p>Presence of important habitat or an ecologically significant proportion of the species considered unlikely as the species only has a moderate potential to occur at Abbot Point</p>
<i>Sternula albifrons</i> Little Tern	Potential	Likely	Known	<p>Occurs across the Caley Valley Wetlands and Abbot Point coastal areas, including adjacent to the DMCP and Eastern Beach where the pipeline is located. Congregates in large numbers in the far west, south-west, and south of the wetland. Nests on the coastal area in the far west of the wetland. Suitable habitat comprises beaches and spits on lakes which occur in the pipeline foreshore area (ELA, 2014), and adjacent to the DMCP.</p> <p>BAAM (2012) recorded 48 individuals across the Closed Marsh Zone. Feeding activity by more than 300 Little Terns was recorded by BMT WBM (2012) on beaches adjacent to the Open Pan, approximately 6km west of the project area.</p> <p>Nesting activity and 50 individuals also recorded on a sand spit in the wetland's Intertidal Zone.</p> <p>Considered likely that the species uses the wetland in moderate numbers on an irregular basis.</p> <p>Presence of important habitat or an ecologically significant proportion of the species is deemed possible based on the numbers observed feeding and nesting by BMT WBM (2012).</p>
<i>Thalasseus bengalensis</i> Lesser Crested Tern	No	Potential	Potential	<p>Recorded in the coastal area in the far west of the Caley Valley Wetlands. Suitable habitat comprising sandy coasts occurs within 500m of the DMCP at Dingo Beach, and in the pipeline foreshore area (ELA, 2014).</p> <p>A total of 6 individuals were recorded in the February BAAM (2012) survey.</p>



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<i>Scientific Name</i> Common Name	Likelihood ³			Potential Presence of Important Habitat or an Ecologically Significant Proportion of the Species
	DMCP	Pipeline	Study area	
				Presence of important habitat or an ecologically significant proportion of the species is considered unlikely as less than 0.1% of the population were found to be present at Abbot Point.



3.2.1.3 Environment Protection and Biodiversity Conservation Act listed threatened species

The Project's ecological assessments (**Appendix P1**, **Appendix P2**, and **Appendix P3**) included a likelihood assessment which indicated that four threatened bird species are known, likely or have potential to occur at Abbot Point. These are the Curlew Sandpiper, Squatter Pigeon, Eastern Curlew and Australian Painted Snipe (Table 3-9). No threatened flora, mammals or reptiles are known to occur, likely to occur or potentially occurring in the terrestrial environments of Abbot Point. Marine turtles that utilise sandy beaches for nesting are addressed in Section 3.2.2.4.



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Table 3-9 EPBC Act threatened species that are known, likely or have potential to occur at Abbot Point, the DMCP and pipeline alignments

Scientific Name	Common Name	EPBC Act Status	Likelihood			Justification
			DMCP	Pipeline	Study area	
<i>Calidris ferruginea</i>	Curlew Sandpiper	Critically endangered, migratory	No	Unlikely	Likely	Observed in the central southern area of the Caley Valley Wetlands. Suitable habitat is intertidal mudflats and non-tidal wetlands near the coast. Occurs adjacent to the DMCP.
<i>Geophaps scripta scripta</i>	Squatter Pigeon	Vulnerable	Likely	No	Likely	Observed around the Caley Valley Wetlands, including within 200m of the project area. Suitable habitat comprises grasslands with bare patches, which occur across the project area.
<i>Numenius madagascariensis</i>	Eastern Curlew	Critically endangered, migratory	No	Likely	Known	Occurs in the central and western sections of the Caley Valley Wetlands, including (estuarine environments) 3km to 4km from the project area. Roosts in the intertidal areas of Dingo Beach (WBM, 2006), which is within 500m of the project area. Suitable habitat comprises mudflats and ocean beaches, which occur in western and central sections of the wetland, at Dingo Beach, and in the pipeline foreshore area (ELA, 2014).
<i>Rostratula australis</i>	Australian Painted	Endangered,	No	No	Known	Known from the marsh areas of the eastern Caley Valley Wetlands (BAAM, 2012). This includes the



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Scientific Name	Common Name	EPBC Act Status	Likelihood			Justification
			DMCP	Pipeline	Study area	
	Snipe	migratory				area immediately adjacent to the south-west edge of the project area. Suitable habitat comprises wetland fringes with emergent vegetation, which occurs adjacent to the DMCP.



Curlew Sandpiper

The Curlew Sandpiper was listed as critically endangered under the EPBC Act in 2015. In Australia, foraging habitat includes intertidal mudflats and non-tidal wetlands. Roosting occurs on sand spits, wetlands, lagoons and sometimes on mangroves (TSSC, 2015b). In Australia, threats to the species include human disturbance, habitat degradation, hydrological changes and invasive plants (TSSC, 2015b). The species is also threatened by wetland degradation in East Asia along its migratory route. No recovery plan for this species is currently available.

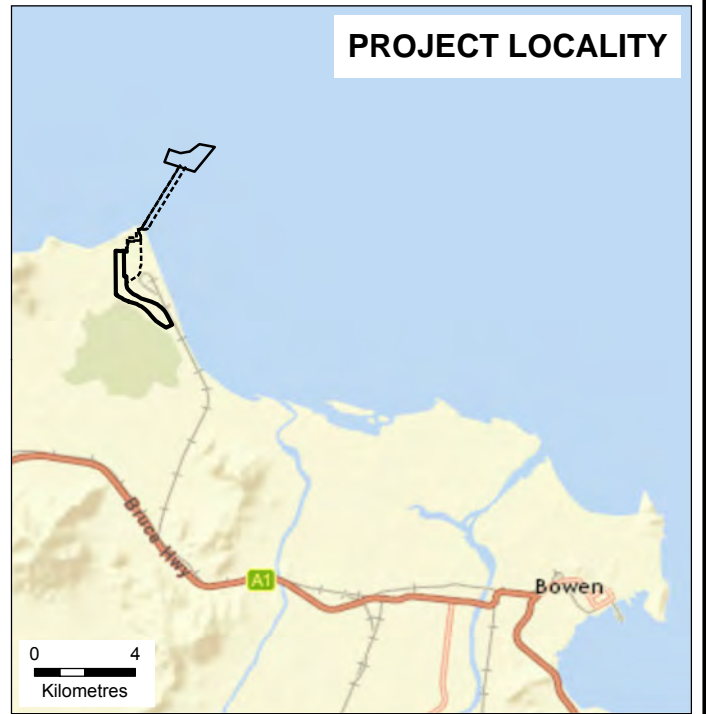
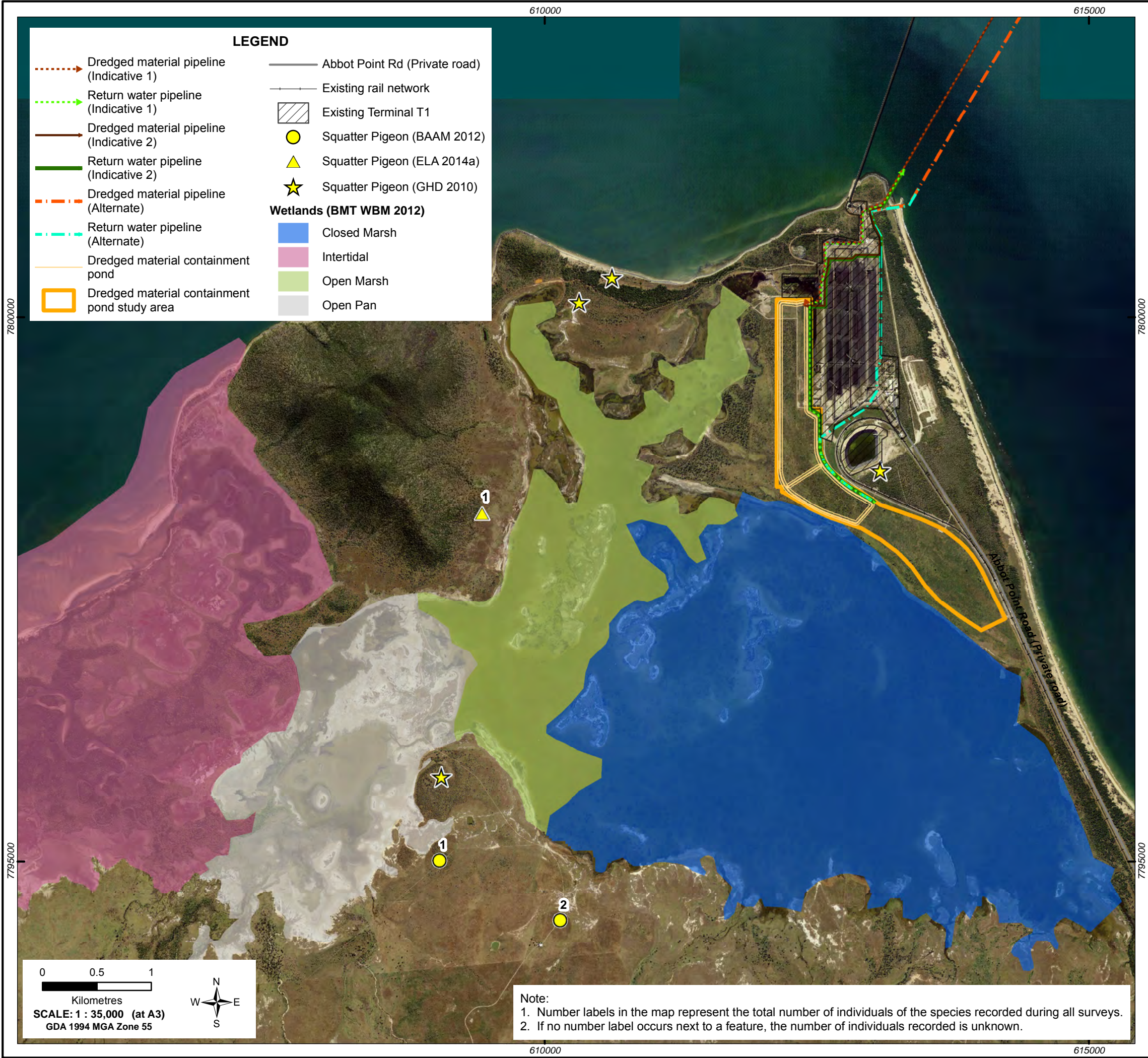
There are two Wildlife Online records of the Curlew Sandpiper from the Caley Valley Wetlands. Between 8 and 10 individuals were also observed by BMT WBM (2012) in the Closed Marsh of the wetland, approximately 2.5km south-west of the project area. There were no sightings of the species during the BAAM (2012) surveys. The species appears to be an infrequent visitor to the Caley Valley Wetlands, and there is no evidence to suggest that areas adjacent to the project area are preferred habitat.

Squatter Pigeon

The Squatter Pigeon is a medium-sized ground-dwelling pigeon listed as vulnerable under the EPBC Act. The *2010 Action Plan for Australian Birds* (Garnett *et al.*, 2011) downgraded the species from near threatened (per the 2000 action plan; Garnett and Crowley, 2000) as there have been no recent declines and the species persists at numerous sites across a broad distribution. The *International Union for Conservation of Nature Red List Guidelines* (BirdLife International, 2012) categorise the Squatter Pigeon as 'of least concern' and state that the species has a very large range and does not approach the thresholds for listing as vulnerable for range or population size criteria. No recovery plan for this species is currently available.

The Squatter Pigeon has been observed regularly in small numbers at Abbot Point (Ecoserve, 2007; GHD, 2009a; BAAM, 2012). Sightings have occurred in several habitat types, including adjacent to the existing terminal, in coastal areas near Dingo Beach, and in woodlands in the south-west of Abbot Point. There are no recorded sightings within the project area (Figure 3-29).

G:\301001\01956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0090-1 (ELA_Squatter Pigeon).mxd



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

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digilised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
[http://gldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=\(A091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://gldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=(A091CAF1-50E6-4BC3-B3D4-229AA318231A))
Queensland Government - Department of Natural Resources and Mines
Existing Terminal T1
Digilised from 2013 imagery and cadastral boundaries
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Caley Valley Wetland wetland zones
BMT WBM 2012
Squatter Pigeon Sightings
BAAM 2012, ELA 2014, GHD 2010

1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-29 Map showing the location of Squatter Pigeon sightings across the study area							
Figure: 301001-01956-00-GM-SKT-0090							Rev: 1

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Given the Squatter Pigeon is listed as vulnerable under the EPBC Act, it is relevant to understand whether the Abbot Point area supports an 'important population' of the species in undertaking this impact assessment. No populations have been identified as being important to the long-term survival of the Squatter Pigeon, nor have areas of critical habitat been determined (DoE, 2015a). The species is thought to interbreed across its entire geographic range, and it is a habitat generalist that uses both remnant and disturbed areas.

Within the Abbot Point region, the Squatter Pigeon has been observed in five of eight fauna surveys between 2007 and 2014. These records have been distributed across Abbot Point in a variety of habitats. Overall, it is considered that the Squatter Pigeon population at Abbot Point is small and does not meet the criteria for an important population or habitat critical to the survival of the species (as defined in the *Significant Impact Guidelines 1.1*) for the following reasons:

- The species is ubiquitous in this part of its geographic range
- The species is not restricted by habitat availability at Abbot Point or within the region (this is particularly the case because the species is a habitat generalist)
- The numbers recorded at Abbot Point are small and the species is neither rare nor disjunct from the broader population (which occurs across a large range)
- It is not at the edge of the range of the species and is therefore not important in terms of range expansion and recovery.

Given the above, there is no evidence to suggest the individuals found at Abbot Point are important in terms of maintaining genetic diversity.

Eastern Curlew

The presence and habitat of the Eastern Curlew is discussed in Section 3.2.1.1. No recovery plan for this species is currently available; however, the *Draft Wildlife Conservation Plan for Migratory Shorebirds* (Commonwealth of Australia, 2014) indicates that an Eastern Curlew taskforce is to be formed and a single species action plan developed by 2017.

Australian Painted Snipe

The Australian Painted Snipe is listed as endangered under the EPBC Act. The species occurs in shallow freshwater and brackish wetlands, and is most common in eastern Australia. The species has undergone a severe decline since the 1950s and in particular during the past 26 years, due to loss and degradation of wetland habitats. Specific threats to habitats include changes to hydrology affecting water depth and agricultural modifications associated with cattle trampling, nutrient enrichment and increased cropping (TSSC, 2013). No recovery plan for this species is currently available.

Closed and Open Marsh habitats of the Caley Valley Wetlands are considered important habitat for the Australian Painted Snipe. The species has been found in unusually high numbers in 2012, representing 1.8% of the total population of the species. The three Australian Painted Snipe recorded in the BAAM (2012) wet season survey were flushed in short and relatively sparsely vegetated edge habitat flooded with shallow fresh water on the southern fringe of the Closed Marsh Zone. In the BAAM (2012) dry season surveys, 24 individuals were observed equally in the Open and Closed Marsh zones of the wetland. It is notable that within the Open and Closed Marsh zones the Australian Painted Snipe was

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located very broadly across all areas, from the northern most section of the Open Marsh to the very southern edge of the Closed Marsh.

BAAM (2012) recorded that the species was present in family groups during the June survey. The only group observed well prior to flushing included two juvenile birds that were noticeably smaller than the attendant adult, suggesting recent breeding activity, most likely on the wetland itself (although breeding elsewhere and subsequent movement to the wetland cannot be discounted). Australian Painted Snipe are known to breed in the Caley Valley Wetlands; a clutch of eggs collected on 9 April 1978 in the Caley Valley Wetlands is catalogued in the Australian National Wildlife Collection (Atlas of Living Australia, 2012). The breeding season at Abbot Point is likely to extend from February to September, with nesting most likely over the period from March to May.

3.2.1.4 Waterbirds contributing to the Outstanding Universal Value of the Great Barrier Reef World Heritage Area

The GBRWHA has a great variety of natural heritage attributes that contribute to its Outstanding Universal Value, with 29 attributes identified by Lucas *et al.* (1997) in a comprehensive review. Of those attributes, three were identified by ELA and Open Lines (2012) as being relevant to Abbot Point (aesthetics, birds, and marine mammals). While several other natural heritage attributes are present within the Abbot Point region, they were assessed not to be present at a scale or value that was relevant to the GBRWHA as a whole. Thus, for the assessment of project impacts on World Heritage values, a focus on aesthetics, birds and marine mammals is warranted.

Lucas *et al.* (1997) noted that areas of international importance for migratory shorebirds located both adjacent to and within the World Heritage Area are important natural heritage attributes of the GBRWHA. Whilst the Caley Valley Wetlands is not located within the World Heritage Area, it is a significant aggregation site for migratory shorebirds and other waterbirds.

Although the Project is being undertaken outside the bounds of the Caley Valley Wetlands, there are some aspects of the wetland that are relevant in the context of assessing potential impacts on World Heritage values associated with birds. These include (ELA and Open Lines, 2012):

- Location of the wetland adjacent to the World Heritage Area, allowing connectivity between the two, which is an important ecological process (Criterion 9 of UNESCO 2013)
- The presence of threatened species such as the Eastern Curlew, Curlew Sandpiper and Australian Painted Snipe, which contribute to the *in situ* conservation of diversity (Criterion 10 of UNESCO 2013)
- Aggregations of large numbers of birds over the wet season and summer months can be considered a superlative natural phenomenon (Criterion 7 of UNESCO 2013).

3.2.1.5 Environment Protection and Biodiversity Conservation Act listed threatened ecological community

There is no SEVT within the footprint of the DMCP or the pipeline alignments. A strip of vegetation mapped as a SEVT (RE 11.2.3) occurs along the eastern beach dune system and is located approximately 50m from the proposed pipeline alignments (Figure 3-26).



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One TEC occurs at Abbot Point: SEVT of the Brigalow Belt (north and south) and Nandewar Bioregions. At this location the SEVT TEC is represented by RE11.2.3 - Microphyll vine forest '*beach scrub*' on sandy beach ridges and dune swales (ELA, 2014). One patch of SEVT TEC (RE11.2.3) occurs within 300m of the project area (to the north-west), and another patch occurs within 150m of the south-eastern section (Figure 3-26). A third patch of SEVT TEC occurs approximately 750m east of, and runs parallel with, the northern section of the project area. The northern border of this SEVT TEC patch lies adjacent to (and approximately 5m (Indicative 2 or Alternate alignment) to 50m (Indicative 1 alignment) from the proposed temporary pipeline alignment.

Three flora field assessments conducted at Abbot Point provide information relevant to SEVT:

- Terrestrial fauna and flora surveys were undertaken by GHD during the dry season in 2008 and wet season in 2009. The survey during dry conditions was conducted over a 13 day period in October/November 2008. The wet season survey was conducted over a 14 day period in March/April 2009. Sampling during both the wet and dry seasons consisted of one 30m x 30m quadrant within SEVT known to occur in the northern extent of the Abbot Point area (GHD, 2009b). This area was confirmed to support the EPBC Act listed community.
- Flora surveys were undertaken by Unidel in October 2009. This survey was conducted over two days in October 2009 and examined the presence and absence of threatened flora species and communities with one site located within the northern extent of the known area of SEVT (Unidel, 2011). This area was confirmed to support the EPBC Act listed community.
- ELA (2014b) conducted surveys of SEVT areas adjacent to Dingo Beach in December 2014 to assist with the assessment of another project within the Port of Abbot Point. The survey identified SEVT meeting the description of RE 11.2.3 being a low microphyll rainforest occurring on quaternary coastal dunes and beaches. This area was confirmed to support the EPBC Act-listed community.

Within the Abbot Point area, SEVT was generally assessed to be in good condition. However, some areas had been heavily invaded by Rubber Vine (*Cryptostegia grandiflora*) and were in poor condition (GHD, 2009b). Characteristics of the ecological community from GHD (2009b) are described as:

- Sandy substrate
- Sparse canopy vegetation
- Dense woody shrub layer
- Abundance of vines
- Little understorey vegetation
- Abundant leaf litter and woody debris.

There is no SEVT within the footprint of the DMCP or the pipeline alignments. A strip of vegetation mapped as a SEVT (RE 11.2.3) occurs along the eastern beach dune system and is located 5m (Indicative 2 or Alternate alignment) to 50m (Indicative 1) from project infrastructure, depending on the proposed pipeline alignment (Figure 3-26).



3.2.2 Marine Matters of National Environmental Significance

The Protected Matters Search Tool identified 19 EPBC Act listed migratory or threatened marine fauna species that may occur in the project area and areas that may be impacted by the Project. These species have been categorised by likelihood of occurrence in the study area and areas that may be impacted by the Project.

In line with the Significant Impact guidelines 1.1 (DoE 2013a), if a species is 'known (to occur)', 'likely (to occur)', or 'potentially occurring', the level of species-specific information (where available) has been increased to provide sufficient background information to properly assess the species against the relevant significant impact criteria.

An assessment of the likelihood of occurrence of each of these species is summarised in Table 3-10. Only fauna listed as threatened or migratory under the EPBC Act have been assessed for potential impacts.



Table 3-10 Likelihood of occurrence of EPBC Act listed threatened or migratory marine species

Common name Scientific name	EPBC Act Status	Habitat Suitability and Distribution	Likelihood of Occurrence
Mammals			
Humpback Whale <i>Megaptera novaeangliae</i>	V, M	Humpback Whale adults and calves have been recorded within the vicinity of the project area (GHD, 2010), potentially using the area for resting on their southern migration from calving grounds. Presence in the area is seasonally high from August to October. The wider area is recognised as a biologically important area for breeding and calving (DoE, 2014b).	Known
Killer Whale <i>Orcinus orca</i>	M	There have been no recorded sightings of Killer Whales within the project area during studies related to the Project or previous projects. Concentrations are reported in cooler waters in Tasmania, South Australia and Victoria (DoE, 2014c)	Unlikely
Blue Whale <i>Balaenoptera musculus</i>	E, M	No previous records in the region. Blue Whales are generally oceanic and migratory through Australian waters. There are several recognised feeding areas off the southern coasts of Victoria, South Australia and Western Australia (DoE, 2014d).	Unlikely
Bryde's Whale <i>Balaenoptera edeni</i>	M	Species data deficient on habitat suitability and distribution. There are no specific feeding or breeding grounds recorded in Australian coastal waters (DoE, 2014e).	Unlikely
Indo-Pacific Humpback Dolphin <i>Sousa chinensis</i>	M	A total of 112 Indo-Pacific Humpback Dolphin sightings were recorded during surveys at Abbot Point. It is not known whether the project area supports breeding individuals as no calves or breeding behaviour has been observed within the area, and it is not known if	Known



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Common name Scientific name	EPBC Act Status	Habitat Suitability and Distribution	Likelihood of Occurrence
		the dolphins observed are residents or transients that occasionally use the area (DoE, 2014f).	
Australian Snubfin Dolphin <i>Orcaella heinsohni</i>	M	A total of 20 Snubfin Dolphin sightings were recorded during surveys at Abbot Point. It is not known whether the project area supports breeding individuals as no calves or breeding behaviour has been observed within the area, and it is not known if the dolphins observed are residents or transients that occasionally use the area (DoE, 2014g).	Known
Dugong <i>Dugong dugon</i>	M	Dugong adults, a juvenile and calves were observed in the project area during surveys at Abbot Point. The project area is a potential foraging area. Abbot Point was identified as an area of low conservation importance for Dugongs in the Southern GBR (Grech and Marsh, 2007).	Known
Reptiles			
Green Turtle <i>Chelonia mydas</i>	V	The most frequently recorded marine turtle species in the port limits and surrounding waters surveyed at Abbot Point (GHD, 2010). They have been found to have a high association with inshore rocky reefs that run parallel to Abbot Beach (Bell 2003; CDM Smith 2013). Beaches within the port area have been identified as supporting low density nesting habitat (Bell 2003, GHD, 2010; CDM Smith 2013; DoE, 2014h). Recent aerial surveys (Hof and Bell, 2014) indicate that the distribution of Green Turtle nesting stretches along the majority of the Whitsunday-Burdekin-Townsville coastline with higher density nesting occurring on mainland coastal	Known



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Common name Scientific name	EPBC Act Status	Habitat Suitability and Distribution	Likelihood of Occurrence
		beaches at Rita Island, Paradise Bay and Abbot Point.	
Flatback Turtle <i>Natator depressus</i>	V	<p>Flatback Turtles typically utilise coastal tropical waters and soft bottom habitat (DoE, 2014i). Flatback Turtles have been recorded within port limits in the vicinity of the project area and there is evidence of low density nesting habitat in the area (Bell 2003; GHD, 2010; CDM Smith 2013).</p> <p>Flatback Turtles are known to be associated with the rocky reef area that extends approximately 2.5km south of the existing MOF, just south of the existing wharf (CDM Smith 2013). Recent aerial surveys (Hof and Bell, 2014) indicate that the distribution of Green Turtle nesting stretches along the majority of the Whitsunday-Burdekin-Townsville coastline with higher density nesting occurring on mainland coastal beaches at Rita Island, Paradise Bay and Abbot Point.</p>	Known
Hawksbill Turtle <i>Eretmochelys imbricate</i>	V	<p>Hawksbill Turtles have been recorded along the inshore rocky reefs that run parallel to Abbot Beach, as per Green Turtles (GHD, 2010).</p> <p>Typically utilise coastal tropical and subtropical species, foraging in tidal and subtidal coral and rocky reefs. Nesting is not known to occur in the area (DoE, 2014j).</p>	Known
Loggerhead Turtle <i>Caretta caretta</i>	E	<p>Has been recorded within the port limits in the vicinity of the project area (GHD, 2010). Are known to be associated with the rocky reef area that extends approximately 2.5km south of the MOF (CDM Smith 2013).</p> <p>Typically inhabits open waters with either soft or hard substrates, including</p>	Known



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Common name Scientific name	EPBC Act Status	Habitat Suitability and Distribution	Likelihood of Occurrence
		rocky and coral reefs, muddy bays, sandflats, estuaries and seagrass meadows. There are no nesting beaches within the project area and no habitat critical to the species survival (DoE, 2014k).	
Olive Ridley Turtle <i>Lepidochelys olivacea</i>	E	Coastal tropical waters, soft bottomed habitats feeding predominantly on gastropods and bivalves. They have been recorded in the area; however, sightings are rare (Bell 2003). Nesting is not known to occur in the area (DoE, 2014l).	Known
Leatherback Turtle <i>Dermochelys coriacea</i>	E	There are no known records of Leatherback Turtles occurring in the area. Suitable foraging habitat is present in the waters offshore of Abbot Point; however, Leatherback Turtles are rarely found in Queensland and have not been recorded to have nested in eastern Australia since 1996. Leatherbacks are a largely pelagic species. Nesting is not known to occur in the area (GHD, 2010; DoE, 2014m).	Unlikely
Saltwater Crocodile <i>Crocodylus porosus</i>	M	One individual was recorded by within the Abbot Point area but the species has not been historically recorded in the area (GHD, 2011). Evidence of a Saltwater Crocodile was found on the downstream section of Goodbye Creek on the eastern side of the Caley Valley Wetlands (BMT WBM, 2012). The limited habitat within the project area is not considered important habitat for this species.	Known
Sharks and rays			
Great White Shark <i>Carcharodon carcharias</i>	V	Suitable habitat may be present within the project area; however, the closest identified aggregation area, considered	Unlikely



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Common name Scientific name	EPBC Act Status	Habitat Suitability and Distribution	Likelihood of Occurrence
		the most northernmost for the species is offshore from Rockhampton, approximately 550km south of the project area (DoE, 2014n).	
Mackerel Shark <i>Lamna nasus</i>	M	The Mackerel Shark has not been previously recorded during surveys of Abbot Point. There is little information available on the distribution of the species in Queensland. Foraging habitat is predominately in pelagic environments (DoE, 2014o).	Unlikely
Whale Shark <i>Rhincodon typus</i>	V	The Whale Shark has not previously been recorded within the waters of Abbot Point. The species is known from Queensland waters (DoE, 2014p); however, there are no aggregation areas near the project area.	Unlikely
Green Sawfish <i>Pristis zijsron</i>	V	Not recorded in the project area. Historically, the habitat utilised by <i>Pristis zijsron</i> includes predominantly large tropical river systems, as the species has only been captured in muddy tidal rivers and estuaries (DoE, 2014q). Most recent capture is from the Mackay region (approximately 200km to the south of Abbot Point), approximately two years ago.	Unlikely
Giant Manta Ray <i>Manta birostris</i>	M	Two Giant Manta Rays were opportunistically recorded during the marine megafauna surveys that occurred from 2008 to 2009. However, the project area is not considered an aggregation site or an area that contains breeding or important feeding areas for the manta ray (GHD, 2009e). Giant Manta Rays are generally associated with offshore reefs and islands (DoE, 2014r).	Known

The survey sites for marine megafauna are presented in Figure 3-30. The results of the megafauna surveys as identified in the Abbot Point PER are presented in Figure 3-31.



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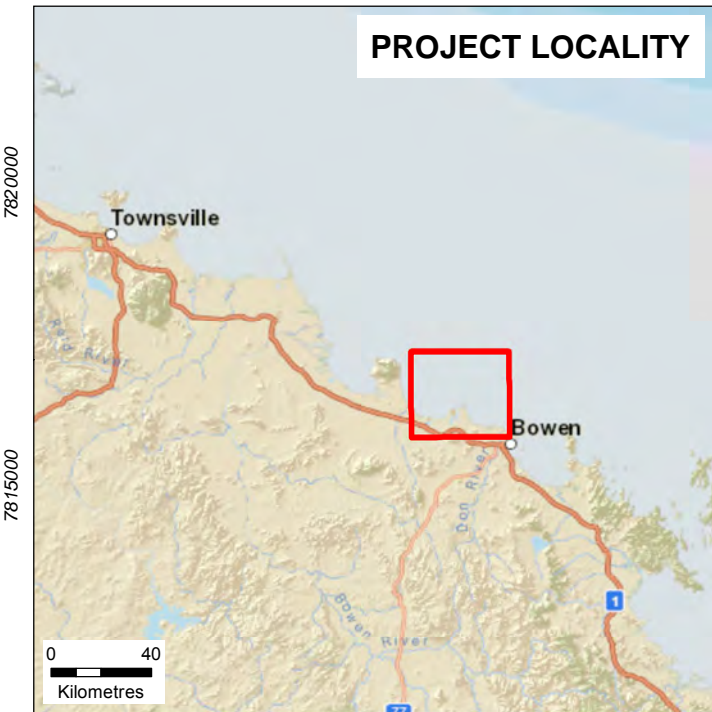
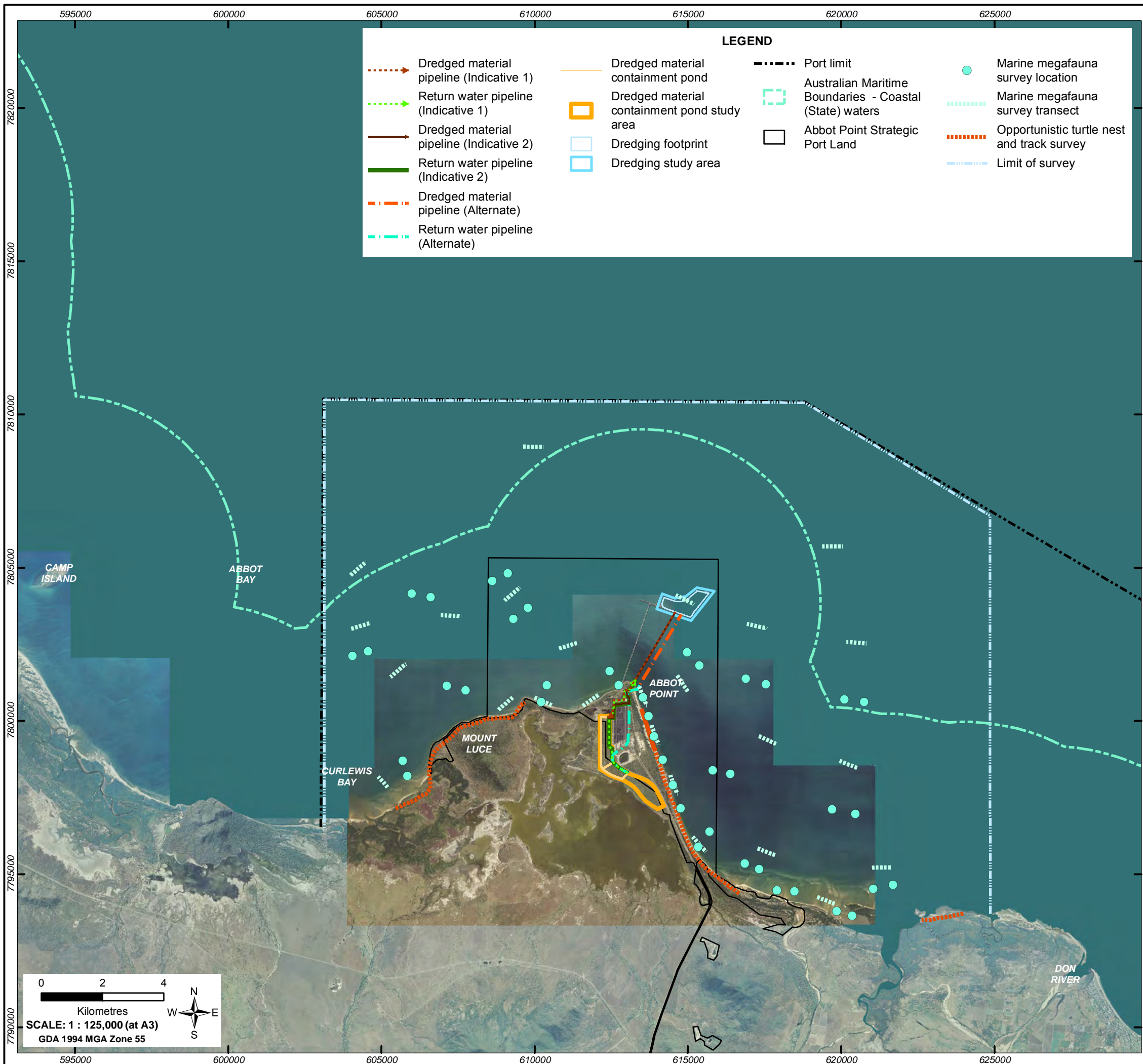
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The methods used to survey these communities and the results are detailed in Section 3.2 of the *Abbot Point, T0, T2, and T3 Capital Dredging Project* (GHD, 2012c) and in the GHD (2009e) *Megafauna Assessment Report: Proposed Abbot Point Multi Cargo Facility EIS*. These surveys are considered relevant to the Project as both of the projects they were carried out for included development over the offshore project area.

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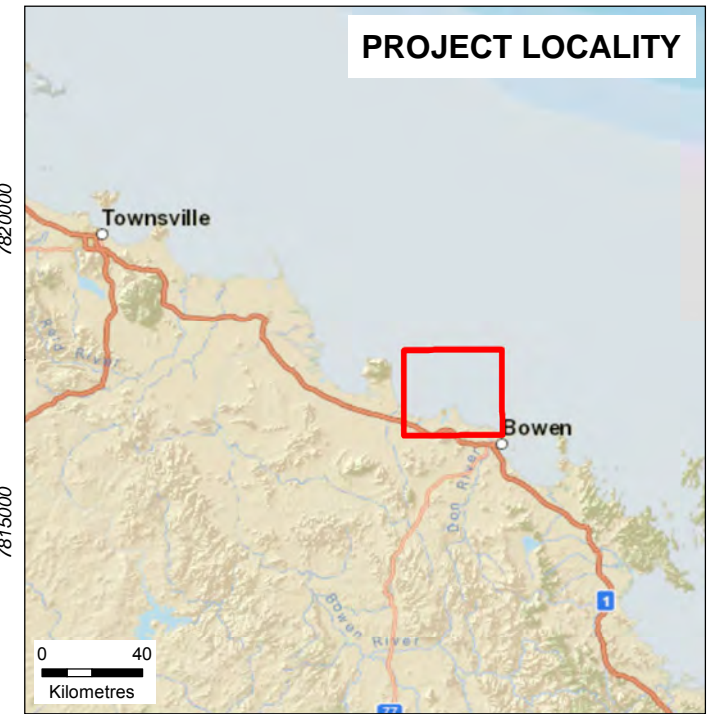
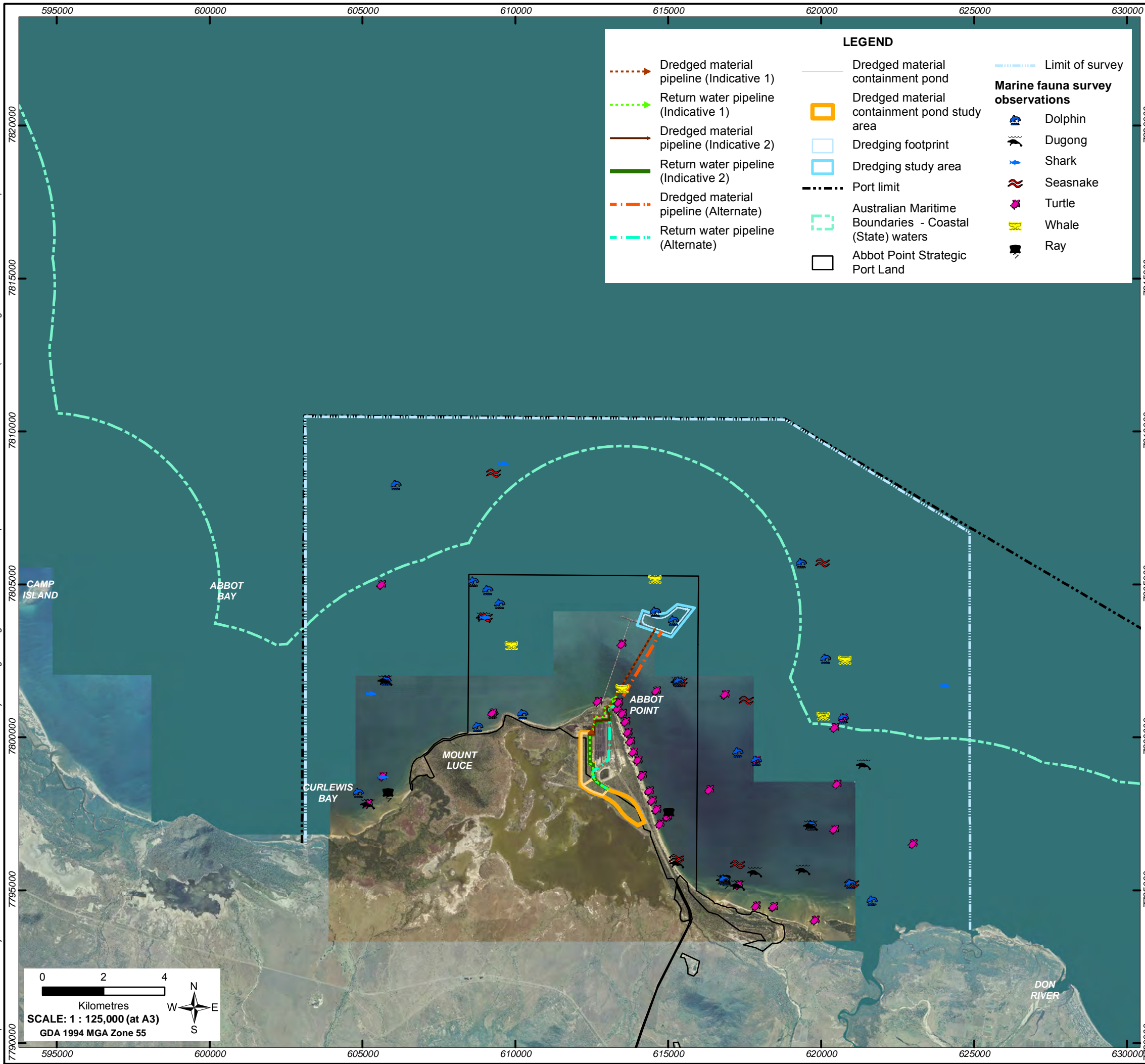


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Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
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Dredged material and return water pipelines (Indicative 2 and Alternate)
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Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
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<http://qldspatialinformation.qld.gov.au/catalogue/custom/detail.page?fid={4091CAF1-50E6-4BC3-B3D4-229AA318231A}>
Queensland Government - Department of Natural Resources and Mines
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QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-30 Marine megafauna survey sites							
Figure: 301001-01956-00-GM-SKT-0055							Rev: 1

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Figure 3-31 Marine megafauna recorded at Abbot Point							
Figure: 301001-01956-00-GM-SKT-0054							Rev: 1



3.2.2.1 Whales - Humpback Whales

The observations of Humpback Whales at Abbot Point during the month of September suggest transitory, opportunistic use of this area as a resting habitat as the whales migrate south to their feeding grounds in the Antarctic. The protected coastline and variable water depths at Abbot Point may provide a refuge environment for some whales, although others were observed to swim past the area (GHD, 2009e). Known core aggregation areas for Humpback Whales closest to Abbot Point occur further south, off the Mackay coast in the Whitsunday region and in Hervey Bay.

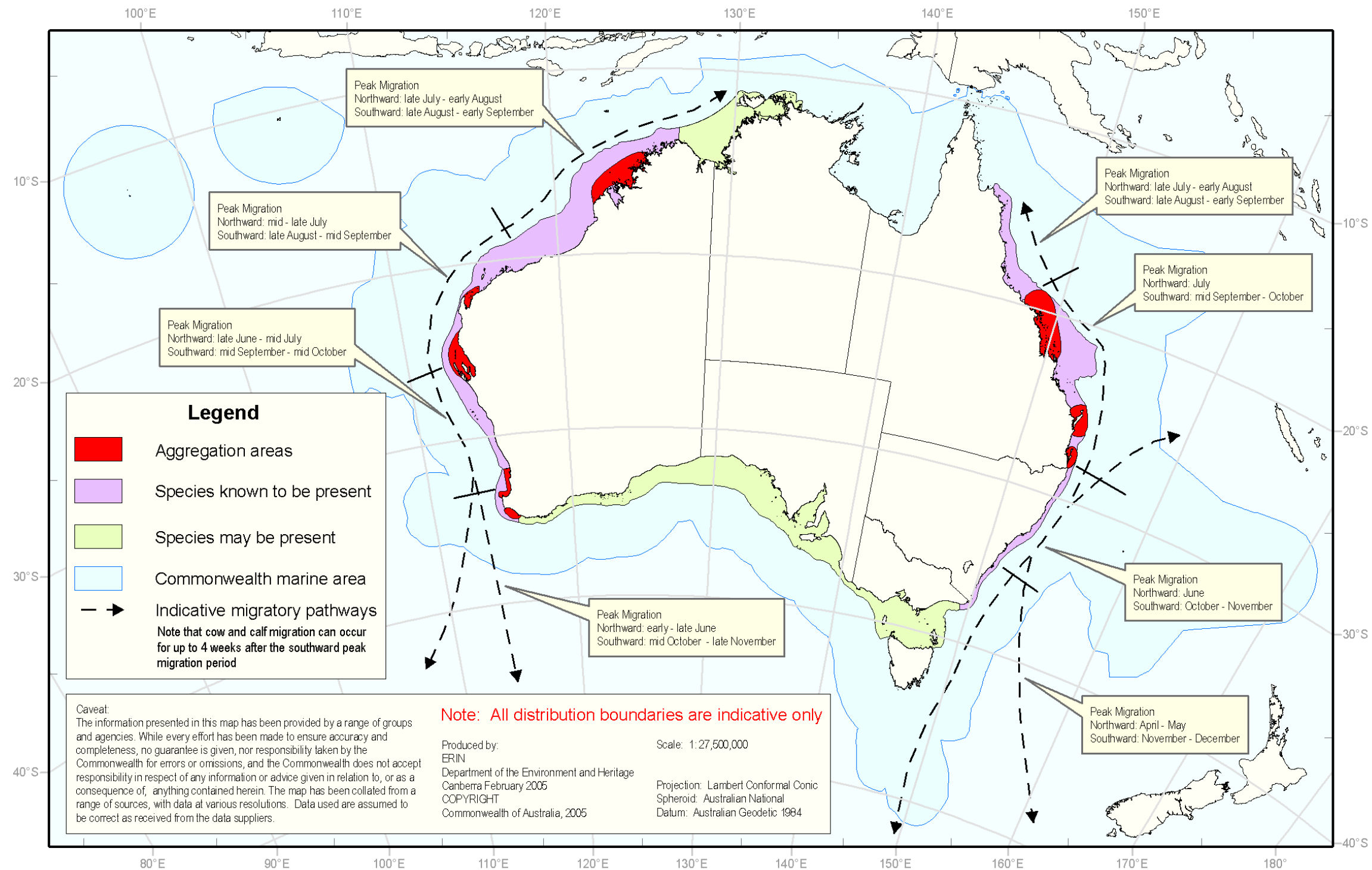
The *Humpback Whale Recovery Plan 2005 - 2010* provides an indicative map of aggregation areas for the species in Australia (Figure 3-32). Abbot Point is located towards the northern extent of an aggregation area which has been mapped for the Whitsunday region. However, the Recovery Plan notes that these boundaries are indicative only and there is inherent variability in the movement of the species. This, combined with the environmental suitability modelling, suggests that Abbot Point is not an important aggregation area and is not identified as such in the Humpback Whale Recovery Plan (Commonwealth of Australia, 2005) or the Smith *et al.* (2012) study.

The number of individuals observed within the project area (14) is very low considering the estimate for the east coast population in 2010 was approximately 15,000 (Noad *et al.*, 2011). Of the 14 individuals observed, only 4 (2 adults and 2 calves) were sighted within the shallow coastal waters of Clark Shoal. The relevance of Abbot Point to the Humpback Whale is likely to be that of a migratory path north and south which supports opportunistic resting or feeding within the relative protection of its shallow coastal waters during the southern migration.



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Source: DEHP (2005)

Figure 3-32 Distribution, migration and recognised aggregation areas of the Humpback Whale



3.2.2.2 Inshore dolphins

Surveys for marine megafauna within the marine ecology study area were undertaken between 2008 and 2009 (GHD, 2009e). A total of 50 transects and 42 spot sites were surveyed over 9 months between June/July 2008 to June 2009. Surveys were not completed during January to March due to unsafe weather conditions.

Indo-Pacific Humpback and Snubfin Dolphins were observed in the waters offshore of Abbot Point during the survey. Key results from the survey included:

- One hundred and twelve Indo-Pacific Humpback Dolphin sightings were recorded during survey months except for April and October. The highest frequency of observations occurred in May and September in water depths of between 4.5m and 19.5m.
- Twenty Snubfin Dolphin sightings were recorded in June/July, September, and October, in water depths between 9m and 13m.
- A mixed pod of Snubfin and Indo-Pacific Humpback Dolphin were recorded on one occasion.

It is not known whether the study area supports breeding individuals as no calves or breeding behaviour has been observed in the area, and it is not known if the dolphins observed are residents, or only transients that occasionally use the area.

There are no population estimates for either the Australian Snubfin or Indo-Pacific Humpback Dolphin in the study area, nor are there any confirmed national estimates for the two species. Studies of Queensland coastal locations including Townsville, Gladstone/Port Alma, and the Great Sandy Strait have indicated that:

- Populations of these species are generally small, usually with less than 100 individuals in any one location
- Recent studies indicate that these small populations can be relatively disconnected due to geographic isolation and genetic separation
- Studies indicate that both species show a level of site fidelity, with evidence of female philopatry in Indo-Pacific Humpback Dolphins
- There is currently very little published information on the scale of movement between habitats and between regions along the coast.

Detailed studies have not been undertaken in the study area to determine whether these population characteristics are also true for the Australian Snubfin and Indo-Pacific Humpback Dolphins observed at Abbot Point. In the absence of such information, a precautionary approach needs to be applied and populations of both dolphin species need to be considered as potentially disconnected, small (<100), and potentially genetically distinct. The conservation importance of Australian Snubfin and Indo-Pacific Humpback Dolphins in a local context should therefore be considered as high.

The lack of regional and national population data for both species makes it difficult to understand the importance of the population of Australian Snubfin and Indo-Pacific Dolphins in a broader context. Therefore, further detailed studies are required in order to understand whether Abbot Point provides important habitat or supports an ecologically significant proportion of the populations of these species.

**Section 3****Existing Environment****3.2.2.3 Dugong**

Abbot Point is located between two DPAs, namely 'Dugong Sanctuary A' at Upstart Bay (44km north-west of the T0 dredging footprint) and 'Dugong Sanctuary B' at Edgumbe Bay (35km south-east of the T0 dredging footprint; Figure 3-33).

Aerial surveys for Dugong were completed between 1987 and 1999 along the Queensland coast from Cape Upstart south to Edgumbe Bay, inclusive of the Abbot Point area as part of broader systematic surveys of the GBRWHA (Marsh and Lawler, 2001). These surveys recorded estimates of 312 (1987), 0 (1992) and 203 (1999) Dugongs in the area surrounding Abbot Point (GHD, 2009e). A Dugong population model was developed using the distribution and abundance data from the surveys to identify areas of high to low conservation value (Grech and Marsh, 2007). Abbot Point was identified as an area of low conservation value.

Other areas in the southern GBR are known to support more significant populations of Dugongs than Abbot Point, including Upstart Bay and Edgumbe Bay to the north-west and south-east of Abbot Point, Cleveland Bay and Hervey Bay.

The presence of Dugongs at Abbot Point is likely to be strongly influenced by the abundance and health of seagrass meadows. Seagrass within the study area is naturally variable as a result of seasonal and inter-annual changes in environmental factors (i.e. rainfall, cyclonic events, and flooding). A detailed description of the distribution and abundance of seagrass at Abbot Point is provided in Section 3.1.9.1.

Surveys for marine megafauna in the Abbot Point area were undertaken between 2008 and 2009 (Figure 3-31; GHD, 2009d). Results from the surveys included:

- Observations of 24 Dugongs including 16 adults, 1 juvenile and 3 calves
- Individuals were largely associated with seagrass meadows containing *H. uninervis* and *H. spinulosa*
- Individuals were observed in water depths between 2.5m and 14m throughout the waters of the existing port facilities
- Individuals were found to be present throughout most of the year (observed in June/July, August, September, October, December, and April).

Dugongs are known to travel short and long distances between food sources. The distance between the DPAs of Upstart Bay and Edgumbe Bay is approximately 80km. There is potential for individuals to move between these areas in search of foraging habitat. It is likely that these individuals would use the seagrass habitat within the study area and immediate surrounds for foraging. Abbot Point may therefore provide an opportunistic feeding area for Dugongs as they travel between the two DPAs. Figure 3-33 illustrates the relationship between Dugong habitat values (seagrass beds), DPAs and between Upstart Bay and Edgumbe Bay.

Given the available information, it is considered unlikely that the study area supports locally important Dugong habitat or an ecologically significant proportion of the Dugong population in Australia. This conclusion is supported by the following factors:

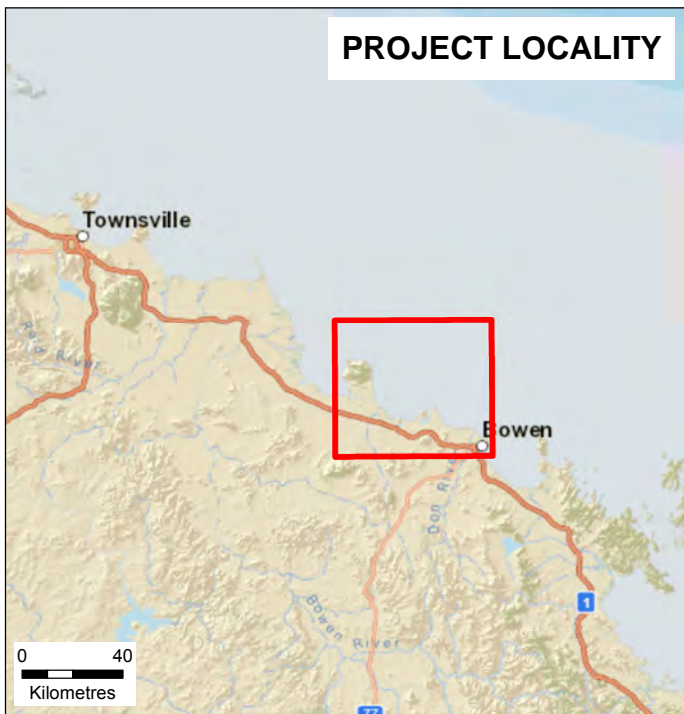
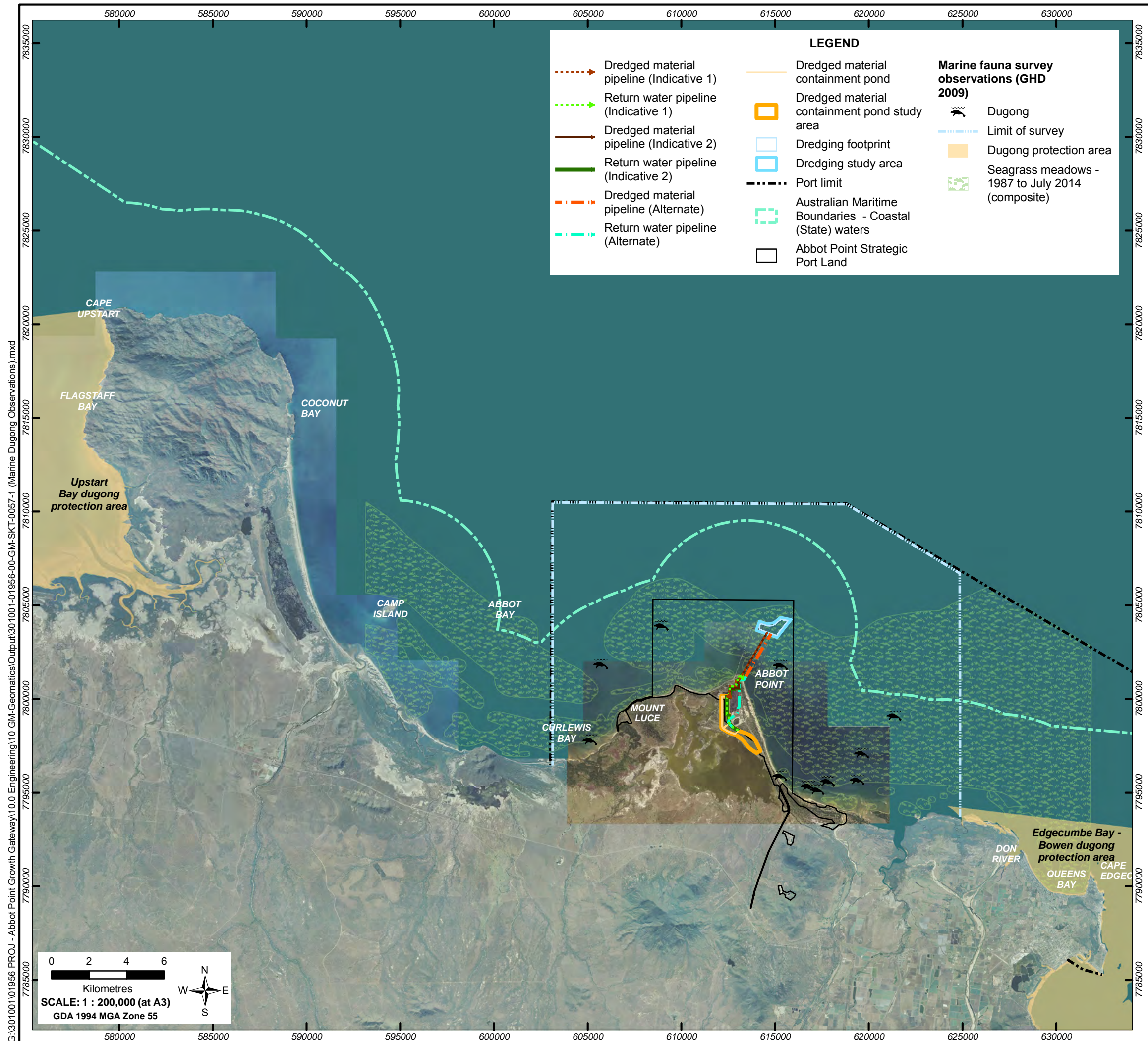
- Abbot Point has been previously identified as an area of low conservation importance for Dugongs in the southern GBR, based on Reef-wide, long-term data (Grech and Marsh, 2007)



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- Seagrass distribution and abundance is naturally highly variable in the study area, with the most recent surveys recording reduced areas (when compared to 2008) of low density, patchy areas of seagrass (McKenna and Rasheed, 2014), indicating seagrass abundance is not stable or currently present in high abundance
- Dugongs recorded in the study area are likely to be transient individuals, moving between the more important areas of Cape Upstart to the north and Edgecumbe Bay to the south and have, to date, not been recorded in significant abundances at Abbot Point
- Abbot Point is not at the limit of the distribution range of Dugongs along the east coast of Australia
- Abbot Point is not known to provide any critical breeding, feeding, or resting habitat for Dugongs in the local or regional area.



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Dugong Protection Areas - 2002
Queensland Government - Department of Primary Industries and Fisheries

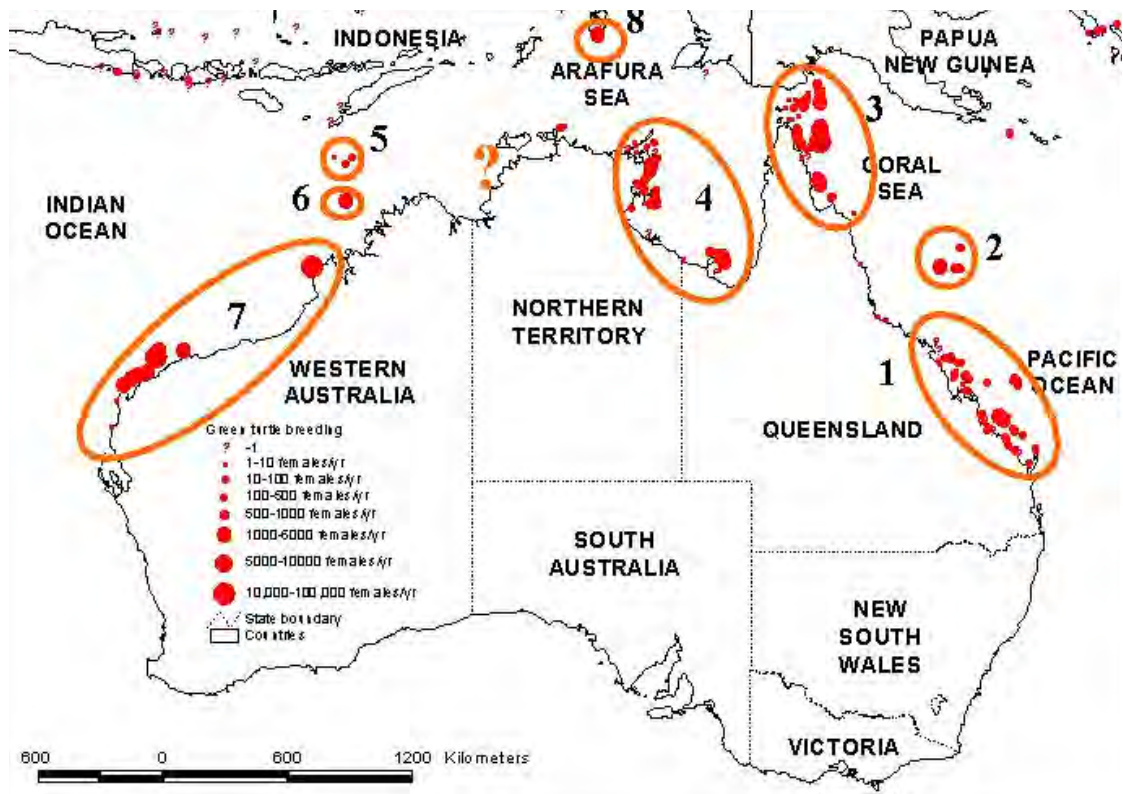
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Figure 3-33 Dugongs observed at Abbot Point and Dugong Protection Areas							
Figure: 301001-01956-00-GM-SKT-0057							Rev: 1

3.2.2.4 Marine turtles

Green Turtle

Green Turtles nest, forage and migrate across tropical northern Australia and are found in tropical and subtropical waters throughout the world. They forage in shallow coastal areas, in particular on seagrass beds and are, as such, likely to forage in the study area. They feed principally on seagrass and seaweeds, although juveniles are also carnivorous.

The DoE (2014h) identifies that the total Australian population of Green Turtles is estimated to be more than 70,000 individuals. It has been identified that within Australia there are seven separate breeding aggregations of Green Turtles (Bowen *et al.*, 1992; Moritz *et al.*, 2002; Dutton *et al.*, 2002) as shown in Figure 3-34.



Source: Limpus (2008a)

Figure 3-34 Genetically identifiable Australian breeding stocks of Green Turtles



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Within the identified study area, there is no known critical or important habitat for Green Turtles, as defined in the Recovery Plan (Environment Australia, 2003).

The identified habitat critical for the survival of Green Turtles nearest to the project area is the Capricorn-Bunker Group islands, which are approximately 520km south of the existing Port of Abbot Point. This habitat is not listed on the *EPBC Act Register of Critical Habitat*, but rather is identified in the *Recovery Plan for Marine Turtles in Australia* (Environment Australia, 2003). The Capricorn-Bunker Group is known to support natal and inter-nesting habitat. The description of this habitat includes all land above sea level in the Capricorn-Bunker Group, including all waters within a 20km radius of that land (Environment Australia, 2003).

Raine Island, which lies over 900km to the north of Abbot Point, supports the largest known marine turtle rookery in the world. Green Turtles nest on the island, and are part of the northern GBR genetic stock. The total number of turtles is variable between years, and can be as many as 131,000 (Limpus, 2008).

In a study for the Abbot Point PER, the area between Bowen and Gloucester Island (approximately 25km to the south-east of Abbot Point) was noted as having a high abundance of marine turtles, with Green Turtles observed to be abundant along the length of seagrass flats on the south-west side of Edgumbe Bay.

A baseline turtle population dynamics study was undertaken in 2003 to identify areas of turtle nesting and foraging within Hay Point, Abbot Point, and Lucinda Port areas (Bell, 2003). The 12 month study, including 336 search hours and 1 night of nesting turtle survey (for Abbot Point to Gloucester Island), identified the following results of relevance to the Abbot Point area:

- Three potential Green Turtle nesting tracks were recorded along the beach between Euri Creek and the existing coal loading facility at Abbot Point
- Four Green Turtles (three juveniles and one adult) were caught and released in the creek systems and associated protected coastal flats from Euri Creek to the mouth of the Don River
- Captured and released Green Turtles were in areas where low-density seagrass beds existed
- A single adult Green Turtle was recorded approximately 150m offshore and adjacent to the Abbot Point coal loading facility
- The Green Turtles identified in the study area are thought to be associated with the southern GBR genetic stock
- More recent marine fauna surveys (GHD, 2009d) observed turtles within the coastal waters of Abbot Point, including 76 observations of Green Turtles within water depths of between 1.1m and 14.9m (Figure 3-31); although no turtles were observed within the dredging footprint
- Turtle nesting was also recorded in the area with a total of four tracks recorded in November and seven in December 2008; the tracks were not distinguishable between Flatback and Green Turtles.

CDM Smith (2013b) undertook surveys of turtle nesting sites over a walking transect extending for 6km south from the existing MOF located south of Abbot Point. The beach and adjacent foredunes were examined for nesting turtle tracks on 19 and 20 December 2012



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and 29 January 2013. The suitability of beach habitat for turtle nesting was also determined. A summary of results is provided below:

- Evidence of limited marine turtle nesting was recorded in December 2012, with 11 sets of tracks recorded over the transect length
- Tracks were found at the southernmost extent of transect, indicating that nesting may occur further south of the survey area
- Three sets of tracks appeared to result in a successful nesting attempt
- Six tracks could be attributed to a specific species: five being Flatback Turtles and one being a Green Turtle
- Two examples of hatchling emergence were recorded but could not be attributed to a specific species
- The first tracks were located 2.2km south of the MOF and others within the stretch of beach 1.4km south of this
- No evidence of nesting or hatching emergence was recorded in January 2013; however, ex-Tropical Cyclone Oswald occurred a week prior to the survey and may have impacted hatchling emergence through high inundation levels
- Both the December and January surveys indicated a concentration of marine turtles (including Green Turtles, Loggerhead Turtles, and Flatback Turtles) associated with the rocky reef that extends approximately 2.5km south of the MOF; an indicative estimate of 16 to 25 turtles using this area was made.

Most recently, in December 2014, an aerial survey (using a Robinson 44 rotating wing helicopter) of turtle nesting track data and predator activity was undertaken over the Whitsunday-Burdekin-Townsville region (between Euri Creek and Magnetic Island; Hof and Bell, 2014). Data were supported by ground-truthed nesting data collected by community groups. Key findings of the survey included:

- Flatback and Green Turtle nesting occurs along the majority of the Whitsunday-Burdekin-Townsville coastline
- Higher density nesting occurs on mainland coastal beaches including Rita Island (51 tracks), Paradise Bay (22 tracks), and Abbot Point (21 tracks) respectively
- Wunjunga Beach was found to support regionally high density nesting of Flatback Turtles
- A regional density of 185 Flatback and Green Turtle nesting attempt tracks were recorded, with the majority identified as Flatback Turtles
- Predator tracks (primarily pig) were identified on mainland coastal beaches at Abbot Bay, Abbot Point, eastern Cape Upstart, Rita Island, Bowling Green Bay/eastern coast of Cape Cleveland, AIMS beach, and Paradise Bay
- Overlapping turtle nesting and predator activity indicative of 'hot spots' for further investigation included Rita Island, the eastern beaches of Cape Cleveland particularly Paradise Bay, and Abbot Bay including Abbot Point.

Abbot Point is not critical to the survival of Green Turtle populations given that it has not been identified as a key nesting or inter-nesting area for Green Turtles and is not considered a major nesting rookery. However, Abbot Point is within the region considered by GBRMPA as a high priority foraging area (Upstart Bay to Midge Point; Dobbs *et al.*, 2007). Specifically, CDM Smith (2013b) identified the Abbot Point area as having *"nesting habitat suitable with appropriate beach access and access to the supra-littoral zone for marine turtles"*.

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The level of nesting observed at Abbot Point for Green Turtles is considered to be 'low-density' when compared with other known turtle rookeries in Queensland. However, Bell (2003) states that the Abbot Point area provides an important mainland nesting habitat in North Queensland and is likely to be ecologically important to individual turtles that return to this nesting beach in future, as marine turtles show fidelity to their natal nesting beaches. In addition, these low density nesting areas may make important reproductive contributions, particularly if they produce a disproportionate number of female hatchlings compared to island beaches with higher nesting densities (CDM Smith, 2013a). As such, the site should be considered as locally important.

Flatback Turtle

Flatback Turtle nesting locations occur from the Bundaberg region, north to northern Western Australia (Figure 3-35). The most significant breeding site is Crab Island in the western Torres Strait.

There are no identified critical habitat areas for Flatback Turtles in Queensland (Environment Australia, 2003) and Abbot Point has not been identified as a key nesting or inter-nesting area for Flatback Turtles. However, Flatback Turtles are known to nest in the Abbot Point area and are also likely to forage in the study area.

In particular, the Mackay and District Turtle Watch Association (2012) identified that approximately 30 to 100 Flatback Turtles nest annually across approximately 30 beaches in the Mackay region, each female laying eggs approximately 3 times in a season.

Another marine fauna survey (GHD, 2009d) observed turtles within the coastal waters of Abbot Point, including 10 observations of Flatback Turtles in a depth range of between 1.2m and 12m; although no turtles were observed within the dredging footprint (Figure 3-31). Turtle nesting was also recorded in the area with a total of four tracks recorded in November and seven in December 2008. The tracks were not distinguishable between Flatback and Green Turtles.

CDM Smith (2013b) also found evidence of limited marine turtle nesting in December 2012, with 11 sets of tracks recorded over the transect length. Six tracks could be attributed to a specific species, with five of these being Flatback Turtles.

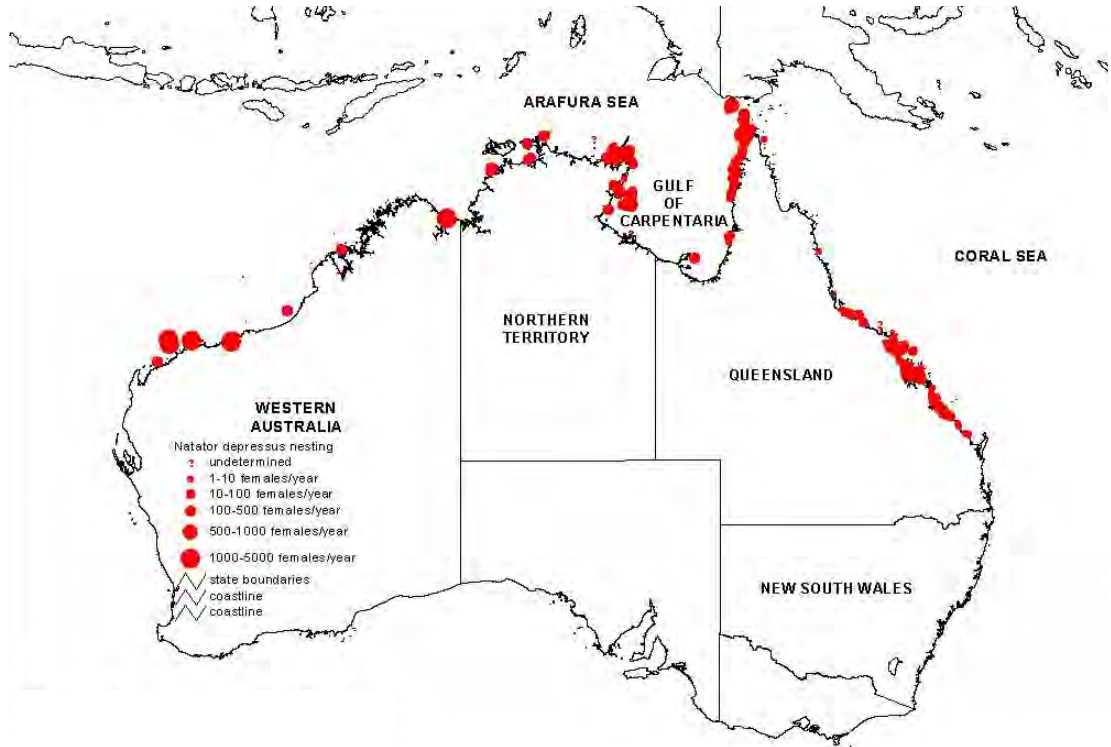
Hof and Bell (2014) undertook aerial surveys in December 2014 and reported that Flatback Turtle nesting occurs along the majority of the Whitsunday-Burdekin-Townsville coastline with higher density nesting on mainland coastal beaches including Rita Island (51 tracks), Paradise Bay (22 tracks) and Abbot Point (21 tracks) respectively. Wunjunga Beach was also found to support regionally high density nesting of Flatback Turtles. A regional density of 185 Flatback and Green Turtle nesting attempt tracks were recorded in this survey, with the majority identified as Flatback Turtles (Hof and Bell, 2014).

The level of nesting observed at Abbot Point for Flatback Turtles is considered to be 'low-density' when compared with other known turtle rookeries in Queensland, such as Wild Duck Island, known to support 20 nesting Flatback Turtles per night (during an average year). As the nesting beach adjacent to Abbot Point is considered to be 'low density', it is not likely to be important or critical to the survival of Flatback Turtles populations in Queensland, but is likely to be ecologically important to individual turtles that return to this nesting beach in

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future. At a regional scale, the Abbot Beach has been identified as having medium significance for Flatback Turtle nesting (Hardy and Stoinescu, 2012).



Source: Limpus (2007)

Figure 3-35 Distribution of Flatback Turtle nesting beaches

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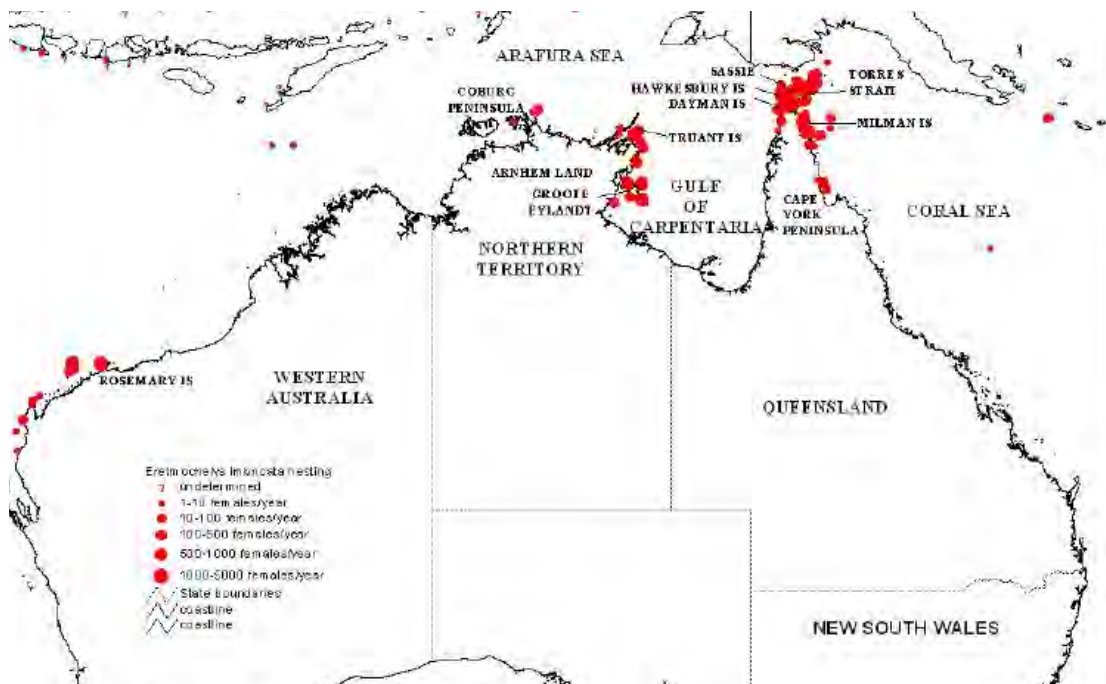
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Hawksbill Turtle

Hawksbill Turtles nesting locations are mainly confined to tropical beaches in Australia (Figure 3-36). Previous marine fauna surveys undertaken at Abbot Point (GHD, 2009d) observed turtles within the coastal waters of Abbot Point (Figure 3-31) including three observations of Hawksbill Turtles within water depths of 3m. No turtles were observed in the Project's dredging footprint.

There is no known critical or important habitat or known nesting (as defined in the *Recovery Plan for Marine Turtles in Australia*; Environment Australia, 2003) for Hawksbill Turtles within the study area or the broader region. No nesting activity has been recorded in the Abbot Point region and only one Hawksbill Turtle nesting event has been recorded in the last 70 years in the GBR south of Princess Charlotte Bay (Limpus, 2009).

The Hawksbill turtle may potentially use the study area for foraging. Areas of seagrass and algal communities that occur within the inshore and offshore areas of Abbot Point provide foraging habitat for Hawksbill Turtles.



Source: Limpus (2009)

Figure 3-36 Distribution of Hawksbill Turtle nesting beaches in Australia



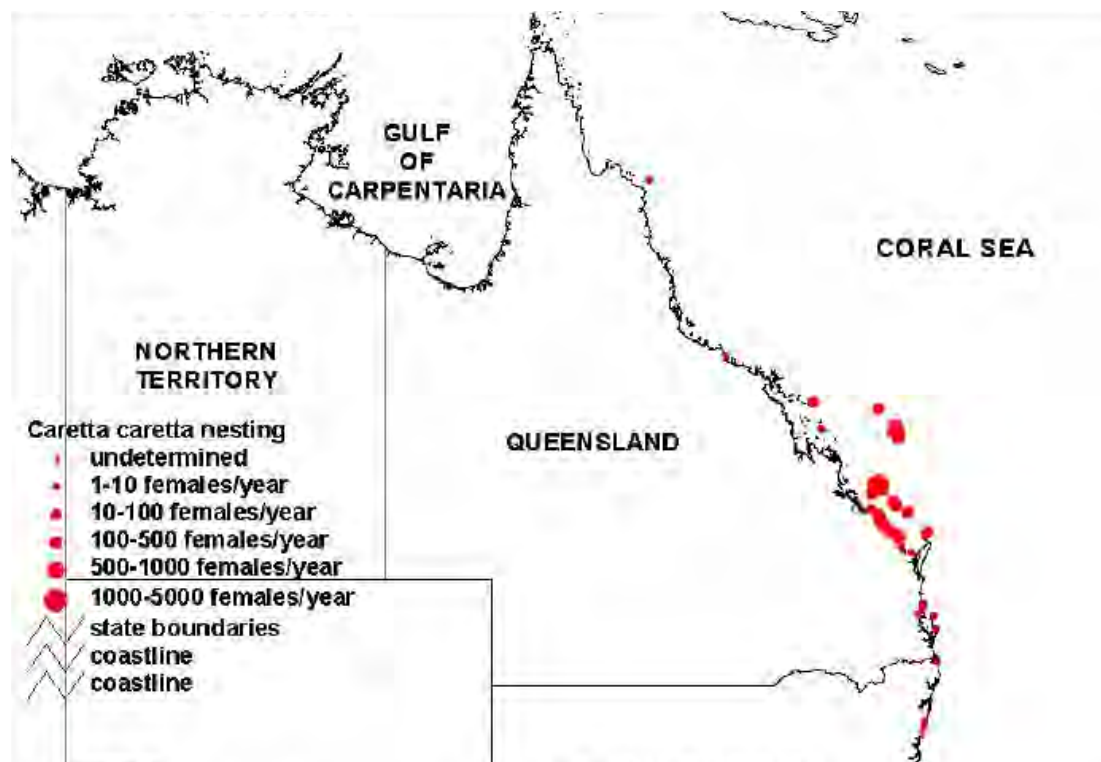
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Loggerhead Turtle

The nearest high density Loggerhead Turtle nesting areas to Abbot Point is the Capricorn-Bunker Group islands, which are approximately 520km to the south of the existing Port of Abbot Point (Limpus, 2008b; Figure 3-37). There is suitable foraging habitat for Loggerhead Turtles in the waters offshore of Abbot Point, and two Loggerhead Turtle adults were observed in waters surrounding the port during December 2008, between 3m and 10m depth (Figure 3-31; GHD, 2009d).

CDM Smith (2013b) has also reported Loggerhead Turtles to be associated with the rocky reef that extends approximately 2.5km south of the MOF.



Source: Limpus (2008b)

Figure 3-37 Distribution of Loggerhead Turtle nesting sites in eastern Australia

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Olive Ridley Turtle

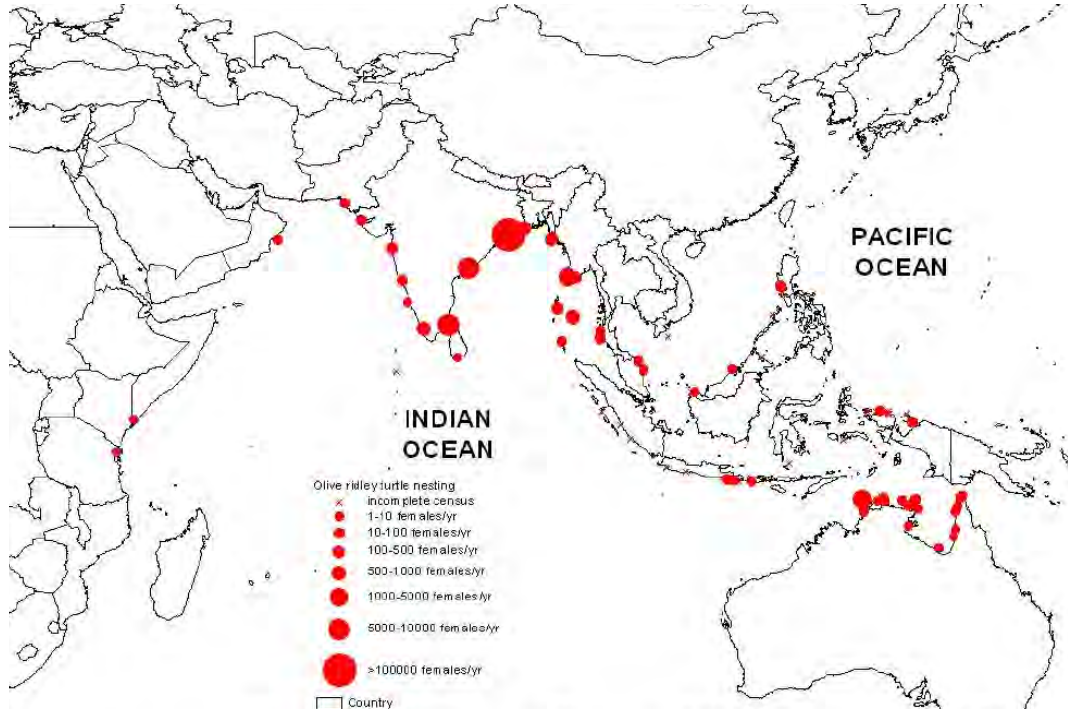
Although there are major nesting aggregations in other parts of the world, there are no dense nesting aggregations of Olive Ridley Turtles in Australia (Figure 3-38). Olive Ridley Turtles have previously been confirmed to be present at Abbot Point, although sightings of this species in the GBRMP are rare (GHD, 2009e; GBRMPA, 2014a).

Abbot Point has not been identified as an area of high conservation importance for the Loggerhead or Olive Ridley Turtles in the GBR, and the area is not considered to represent habitat critical to the survival of any of these species. This is due to:

- The very low number of Loggerhead and Olive Ridley Turtles sighted in the area
- Absence of any nesting activity for these species in the area.

There are no known nesting records for either of these turtle species in the Abbot Point area. Existing records for these endangered turtle species indicate that the coastal and offshore waters near Abbot Point support only small numbers of foraging individuals of Loggerhead and Olive Ridley Turtles. Further, the study area is not listed under the breeding areas considered critical for any of these species under the *Recovery Plan for Marine Turtles in Australia* (Environment Australia, 2003).

Marine turtles are a group of species within the GBR that were identified as 'at-risk' and a vulnerability assessment for marine turtles has been developed. This assessment detailed concerns for marine turtles within the GBR and recommended management measures.



Source: Limpus (2008c)

Figure 3-38 Distribution of Olive Ridley Turtle breeding sites in the Indian Ocean - Western Pacific



Giant Manta Ray

Two Giant Manta Rays were opportunistically recorded during the marine megafauna surveys that occurred at Abbot Point from 2008 to 2009 (Figure 3-31). These were observed to be feeding over relatively shallow habitats of 2.6m to 7m depth. However, the study area is not considered an aggregation site or an area that contains breeding or important feeding areas for the Manta Ray.

3.2.3 Great Barrier Reef World and National Heritage Area

As a World Heritage Area, the GBRWHA is recognised under the World Heritage Convention as having Outstanding Universal Value. The concept of Outstanding Universal Value is defined in the *Operational Guidelines for the Implementation of the World Heritage Convention* (UNESCO 2013) as “cultural and/or natural significance, which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity”.

The boundaries and heritage attributes of the GBRWHA are the same as those for the National Heritage Place, and as such it is appropriate to discuss these together.

The GBRWHA is the world's third largest World Heritage property and was inscribed on the World Heritage List in 1981. It covers an area of approximately 348,000km² and extends (Figure 3-39):

- Along the coast of Queensland for 2,000km from the top of Cape York to just north of Fraser Island
- From the low water mark on the Queensland coast seaward to the outer boundary of the Marine Park, beyond the edge of the continental shelf.

The GBRWHA includes the GBRMP (managed by the GBRMPA), as well as many islands, cays and intertidal areas protected by Queensland Government legislation.

The GBR is protected under the EPBC Act as a:

- World Heritage Area
- National Heritage Place
Great Barrier Reef Marine Park (as established by the *Great Barrier Marine Park Act 1975*).

3.2.4 Concept of Outstanding Universal Value

For a World Heritage Area to be considered to have Outstanding Universal Value, it must:

- Meet 1 or more of the 10 World Heritage criteria listed in the Guidelines (UNESCO, 2013)
- Meet the conditions of integrity and/or authenticity (noting that authenticity is not relevant to the GBR as a natural area)
- Have an adequate protection and management system.

The GBRWHA has been listed against all four of the natural criteria outlined in the Guidelines (UNESCO, 2013). These being:

Criterion 7: contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance.

**Section 3****Existing Environment**

Criterion 8: be outstanding examples representing major stages of earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features.

Criterion 9: be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals.

Criterion 10: contain the most important and significant natural habitats for *in-situ* conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation.

All World Heritage properties are required to meet the conditions of integrity. This is defined by the Guidelines as “*a measure of the wholeness and intactness of the natural and/or cultural heritage and its attributes*”. An assessment of the integrity of a property is required to determine the extent to which the property:

- Includes all elements necessary to express its Outstanding Universal Value
- Is of adequate size to ensure the complete representation of the features and processes which convey the property's significance
- Suffers from adverse effects of development and/or neglect.

The Statement of Outstanding Universal Value for the GBRWHA (GBRMPA, 2012) concludes that in relation to integrity:

- The integrity of the GBR is “*enhanced by the unparalleled size and current good state of conservation across the area*”
- While a number of natural pressures occur (e.g. Cyclones and crown-of-thorns starfish outbreaks), given the scale of the GBR “*most habitats or species groups have the capacity to recover from disturbance or withstand ongoing pressures*”
- The property is largely intact and includes the fullest possible representation of marine ecological, physical and chemical processes from the coast to the deep abyssal waters enabling the key interdependent elements to exist in their natural relationships
- Effective conservation programs are essential in areas adjacent to the GBR (e.g. coastal catchments) given that some of the key processes of the Reef occur outside its boundaries.

3.2.5 World Heritage attributes of the Great Barrier Reef

The specific heritage attributes of the GBR are numerous and collectively contribute to its Outstanding Universal Value. Examples of some of the heritage attributes described in the Statement of Outstanding Universal Value for the GBRWHA are presented in Table 3-11.



Table 3-11 Key examples of the World and National Heritage attributes for the Great Barrier Reef

World Heritage Listing Criteria	Examples of World and National Heritage Attributes
<u>Criterion 7:</u> contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance	<ul style="list-style-type: none"> ▪ The GBR is one of a few living structures visible from space ▪ From the air the GBR is a vast mosaic pattern of reefs, islands and coral cays, which produce an unparalleled aerial panorama of seascapes comprising diverse shapes and sizes ▪ On many of the cays there are spectacular and globally important breeding colonies of seabirds and marine turtles ▪ Beneath the ocean surface, there is an abundance and diversity of shapes, sizes and colours ▪ Other superlative natural phenomena include the annual coral spawning, migrating whales, nesting turtles, and significant spawning aggregations of many fish species.
<u>Criterion 8:</u> be outstanding examples representing major stages of earth's history	<ul style="list-style-type: none"> ▪ The GBR extends 2,000km along Queensland's coast and is a globally outstanding example of an ecosystem that has evolved over millennia ▪ The area has been exposed and flooded by at least four glacial and interglacial cycles, and over the past 15,000 years reefs have grown on the continental shelf ▪ During glacial periods, sea levels dropped, exposing the reefs as flat-topped hills of eroded limestone - large rivers meandered between these hills and the coastline extended further east ▪ During interglacial periods, rising sea levels caused the formation of continental islands, coral cays and new phases of coral growth ▪ The environmental history of the GBR can be seen in cores of old massive corals ▪ The GBR forms the world's largest coral reef ecosystem, ranging from inshore fringing reefs to mid-shelf reefs, and exposed outer reefs, including examples of all stages of reef development.
<u>Criterion 9:</u> be outstanding examples representing significant ongoing ecological and biological processes	<ul style="list-style-type: none"> ▪ The globally significant diversity of reef and island morphologies reflects ongoing geomorphic, oceanographic and environmental processes ▪ The complex cross-shelf, longshore and vertical connectivity is influenced by dynamic oceanic currents and ongoing ecological processes such as upwellings, larval dispersal and migration ▪ Ongoing erosion and accretion of coral reefs, sand banks and coral cays combine with similar processes along the coast and around continental islands ▪ Biologically the unique diversity of the GBR reflects the maturity of an ecosystem that has evolved over millennia; evidence exists for the evolution of hard corals and other fauna ▪ Globally significant marine faunal groups include over 3,000 species



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**World Heritage Listing
Criteria**

Examples of World and National Heritage Attributes

	<p>of molluscs, over 1,500 species of fish, plus a great diversity of sponges, anemones, marine worms, crustaceans, and many others</p> <ul style="list-style-type: none"> Human interaction with the natural environment is illustrated by strong ongoing links between Aboriginal and Torres Strait Islanders and their sea-country.
<p><u>Criterion 10:</u> contain the most important and significant natural habitats for in-situ conservation of biological diversity</p>	<ul style="list-style-type: none"> The enormous size and diversity of the GBR means it is one of the richest and most complex natural ecosystems on earth, and one of the most significant for biodiversity conservation The GBR contain approximately 400 species of corals in 60 genera, and there are also large ecologically important inter-reefal areas. The shallower marine areas support half the world's diversity of mangroves and many seagrass species The waters also provide major feeding grounds for one of the world's largest populations of the threatened Dugong At least 30 species of whales and dolphins occur, and it is a significant area for humpback whale calving Six of the world's seven species of marine turtle occur in the GBR; as well as the world's largest Green Turtle breeding site at Raine Island, the GBR also includes many regionally important marine turtle rookeries Some 242 species of birds have been recorded in the GBR.

Source: GBRMPA (2012)

Lucas *et al.* (1997) provided the first thorough clarification of the basis on which the GBR was listed as a World Heritage Area (i.e. the GBRWHA's heritage attributes). In their report, Lucas *et al.* examined 29 natural heritage attributes that contribute to the Outstanding Universal Value of the GBRWHA (refer Table 3-12). This report uses the same natural heritage attributes (where they are relevant to the Project).

Table 3-12 The 29 natural heritage attributes of the GBRWHA

Natural Heritage Attributes

1. Aesthetics	16. Hard corals
2. Algae	17. Mangroves
3. Ascidians	18. Marine mammals
4. Birds	19. Marine turtles
5. Bryozoans	20. Molluscs
6. Butterflies	21. Octocorals
7. Crocodiles and terrestrial reptiles	22. Phytoplankton



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Natural Heritage Attributes

- | | |
|--|-----------------------------|
| 8. Crustaceans | 23. Polychaete worms |
| 9. Echinoderms | 24. Proserpine Rock Wallaby |
| 10. Fishes | 25. Seagrasses |
| 11. Flatworms. | 26. Seasnakes. |
| 12. Fringing reefs. | 27. Soft bottom habitats. |
| 13. Geological and geomorphological aspects. | 28. Sponges. |
| 14. Geological aspects of continental islands. | 29. Terrestrial flora. |
| 15. <i>Halimeda</i> banks. | |

Source: Lucas, *et al.* (1997)

3.2.6 World (and National) Heritage attributes relevant to Abbot Point

The Abbot Point CIA (ELA and Open Lines, 2013) included an assessment of the impacts of port development at Abbot Point on World and National Heritage Values. One of the key challenges of that process was to understand how the iconic GBRWHA attributes are expressed at Abbot Point. The Abbot Point CIA concluded that interpreting and applying the iconic attributes of the GBRWHA at a local level is always difficult and subject to interpretation.

The Abbot Point CIA methodology was to use the previous examination by Lucas *et al.* (1997) of the 29 natural attributes that contribute to the Outstanding Universal Value of the GBRWHA and examine these against the technical and scientific information available for the Abbot Point area. Drawing on the wide range of published information about the GBRWHA, incorporating relevant information from the CIA technical studies, and including input from relevant technical specialists, the assessment determined: (i) which heritage attributes are relevant to the project area, and (ii) which attributes were either absent or present at a local level and not important in relation to the GBRWHA as a whole.

The Abbot Point CIA found that 3 of the 29 natural heritage attributes identified by Lucas *et al.* (1997) were identified as being relevant to Abbot Point. These are:

- Aesthetics
- Birds
- Marine mammals.

It is important to note that the Abbot Point CIA also found that “*while a number of other natural heritage attributes are present within the vicinity of the project area (e.g. marine turtles, seagrass, and mangroves), it was considered that they were not present at a scale or value that was relevant to the GBRWHA as a whole. For instance, while a number of marine turtle species are present within the vicinity of the project area, the numbers are very low when compared to important breeding areas within the wider GBR.*”

The expression of the latter two listed attributes, birds, and marine mammals has been described previously in Sections 3.2.1 and 3.2.2. Aesthetic attributes are discussed below.



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Aesthetic attributes

Aesthetic attributes of the GBRWHA are encapsulated in criterion 7 of the World Heritage Convention, which states that World Heritage Properties listed under this criterion “*contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance*”.

A visual impact assessment was undertaken by Cardno Chenoweth (2012) as part of the Abbot Point CIA process to help understand the aesthetic attributes of Abbot Point. The scope of the study was to establish the landscape values of the project area in the context of how these contribute to the attributes of the GBRWHA and determine the extent to which the proposed developments might cumulatively detract from the attributes of the GBRWHA.

Cardno Chenoweth (2012) assessed the aesthetic attributes of Abbot Point against the GBRWHA attributes for criterion 7. The assessment determined that Abbot Point does not encompass areas of exceptional natural beauty, but rather is representative of broad-scale coastal features impacted both by industrial and agricultural development. The fact that Abbot Point is an existing industrial port is relevant to both its current aesthetic attributes and the potential for future development of impact on the aesthetic attributes of the GBRWHA.

A summary of the Cardno Chenoweth (2012) assessment of aesthetic attributes of Abbot Point is provided in Table 3-13.

Table 3-13 Representation of GBRWHA aesthetic attributes at Abbot Point

Criterion 7 Attributes for the GBRWHA	Relative Rating of the Degree to which Abbot Point Expresses or Represents Each Value
<i>The vast extent of the reef and island systems which produces an unparalleled aerial vista</i>	<p>Not expressed at all at Abbot Point</p> <p>There are no vast extents of reef and island systems in the vicinity of Abbot Point, and the distinctive aerial vistas over reefs and lagoons (such as occur at Hook and Hardy Reefs, Low Isles and Ribbon Reef) are not apparent within 90km of the site.</p>
<i>Forested continental islands and coral cays</i>	<p>Minor representation at Abbot Point</p> <p>Three small isolated islands are in the general vicinity of Abbot Point (e.g. 20km to 40km range) - Camp, Holbourne and Middle Islands and, although vegetated, are not ‘rugged’. The nearest coral cay is approximately 300km to the north-west, and the continental Whitsunday Islands (with forested mountain ranges) are 90km to the south-east.</p>
<i>Coastal and adjacent islands with mangrove systems of exceptional beauty</i>	<p>Minor representation at Abbot Point</p> <p>There are mangrove estuarine systems associated with the Don River/Euri Creek estuaries to the east of Abbot Point, and a smaller area of mangroves in Curlewis Bay (Branch Creek) to the immediate west of Mount Luce, but there are no extensive areas of mangroves at Abbot Point <i>per se</i>.</p>



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Criterion 7 Attributes for the GBRWHA	Relative Rating of the Degree to which Abbot Point Expresses or Represents Each Value
<i>The rich variety of landscapes and seascapes including rugged mountains with dense and diverse vegetation and adjacent fringing reefs</i>	<p>Not expressed at all at Abbot Point</p> <p>This combination does not occur at or near the coastline near the Port. There are no rugged mountains or fringing reef systems. The landscape comprises largely flat coastal plain with farmland and little scenic diversity.</p>
<i>Marine fauna and flora in the coral reefs</i>	<p>Minor representation at Abbot Point</p> <p>While there are marine flora and fauna in offshore waters, these are not especially abundant or diverse in their shape, size and colour, nor are they associated with coral reefs.</p>
<i>Breeding colonies of seabirds and great aggregations of over-wintering butterflies</i>	<p>Represented in a way which contributes to overall GBRWHA scenic diversity; but neither outstanding per se nor uniquely expressed at Abbot Point</p> <p>The Caley Valley Wetlands (although outside of the GBRWHA) provides important habitat for migratory shorebirds (Section 3.1.9.2) and the brackish and freshwater sections are important as the most northerly coastal nesting area for Black Swans (not a listed species). Although there are no known seabird breeding colonies, the shorebirds and migratory birds still have World Heritage value and use beaches and intertidal areas for foraging.</p>
<i>Migrating whales, dolphins, dugong, whale sharks, sea turtles, seabirds and concentrations of large fish</i>	<p>Represented in a way which contributes to overall GBRWHA scenic diversity; but neither outstanding per se nor uniquely expressed at Abbot Point</p> <p>Offshore waters feature resident turtle, Dugong and dolphin populations (Bell <i>et al.</i> 2003; Unsworth <i>et al.</i> 2010) and migratory whales can occasionally be seen at long distances, with occasional humpback whales, passing through these waters (Section 3.2.2). Large fish aggregations are not well documented.</p>

3.2.7 Great Barrier Reef Marine Park

The GBRMP encompasses approximately 345,400km² and is a multiple-use area in which a wide range of activities and uses are allowed, including extractive industries. A multiple-use zoning system has been implemented with the aim of minimising impacts and conflicts through providing high levels of protection for specific areas. Zoning designations provide for management and protection of the values of the GBRMP. In designated zones of the GBRMP activities including shipping, aquaculture, tourism, and research (among others) are allowed to occur in a controlled manner. The General Use Zone provides for reasonable use of the GBRMP while still allowing for conservation of these areas.

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In terms of the current environmental health of the GBRMP, The *Great Barrier Reef Outlook Report 2014* (GBRMPA, 2014a) assessed the current condition of all ecosystems within the Region (including mangroves, seagrass, coral reefs, and open ocean), all aspects of the Region's heritage values (including World Heritage values, Outstanding Universal Values, cultural values, and historic places) and their links with other environmental, social, and economic values. The Outlook Report 2014 also examined pressures facing the GBR, current responses to these pressures, and the likely future outlook for the region's values.

Assessments of ecosystem health and biodiversity in the Outlook Report 2014 indicate that the GBR as a whole retains the values and qualities contributing to its Outstanding Universal Value as recognised in its listing as a World Heritage property. The northern third of the GBR region has good water quality and its ecosystems are believed to be in good condition. However, key habitats, species, and ecosystem processes in the central and southern inshore area of the GBR continue to deteriorate, particularly inshore seagrass meadows and coral reefs. The greatest risks to the GBR have not changed since the Outlook Report 2009. Climate change, poor water quality from land-based runoff, coastal development, and some impacts of fishing were identified as the continued major threats to the future vitality and resilience of the GBR.

The Outlook Report 2014 summarises that the impacts of port operations to the marine environment include: clearing and modifying coastal habitats; disturbance, displacement, dredging, disposal and re-suspension of dredged material; injury and death of wildlife; chemical and oil spills; some contribution to marine debris; altered light regimes; diminished aesthetic values; air and noise pollution.

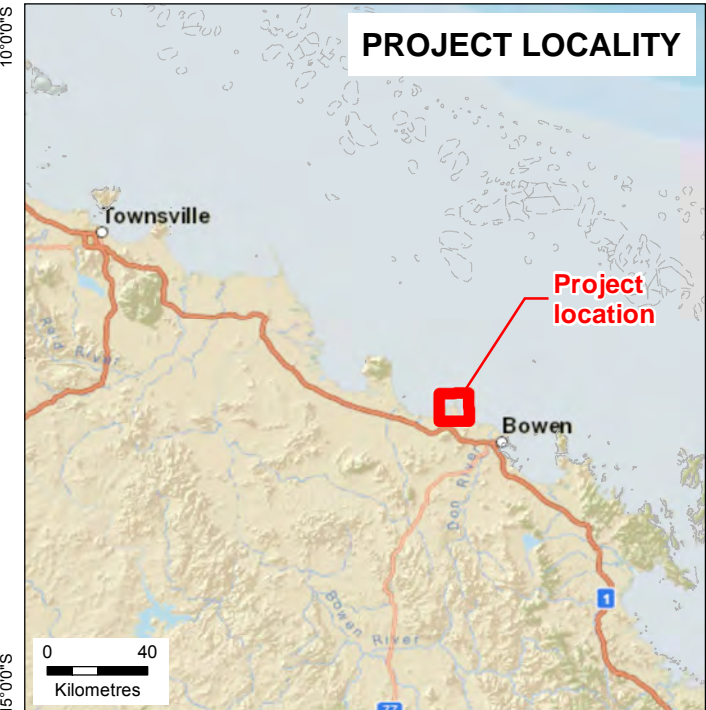
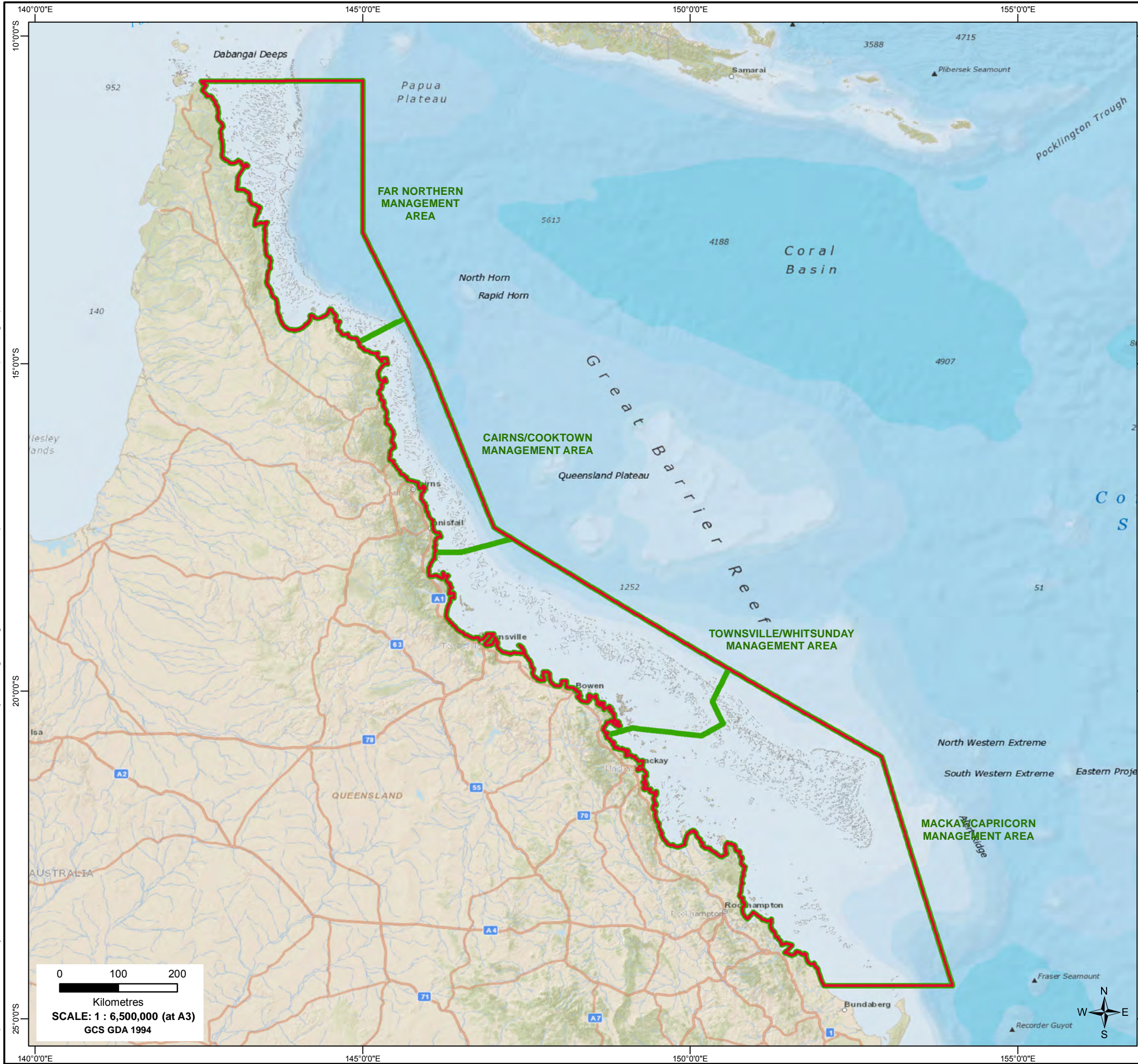
The Outlook Report 2014 also highlights that the specific impacts of dredging and port infrastructure construction are well documented and most severe at the dredging site, but that some impacts (such as turbidity, sedimentation, noise, and disruption of fish habitats) may occur at a distance from dredging and disposal. However, localised impacts of dredging, such as seabed disturbance, transport or re-suspension of contaminants, alteration of sediment movement and changes in coastal processes can be severe. Burial or smothering of plants and animals on the seafloor, degradation of water quality, and loss and modification of habitats are highlighted as the major direct impacts of dredging and disposal of dredged material.

3.2.8 Commonwealth marine areas

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

Within Queensland, the Commonwealth marine area overlaps with the boundaries of the GBRMP and the GBRWHA (refer to Figure 3-27). For the Project and at Abbot Point, the values of the GBRMP are equivalent to those of the Commonwealth marine area. For specific detail on the extent of the Commonwealth marine areas in relation to the GBRMP boundaries refer to Figure 3-39.

\\aubriwpdfs02v\brisbane\Projects\301001\01956 PROJ - Abbot Point Growth Gateway\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0064-1 (GBR region).mxd




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

LEGEND

- Great Barrier Reef Marine Park boundary
- Management Areas of the Great Barrier Reef Marine Park

Source information:
Great Barrier Reef Marine Park Boundary
Australian Government - Great Barrier Reef Marine Park Authority (GBRMPA) 2012

1	12/08/2015	Issued for information	KM	SL			
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 3-39 Great Barrier Reef region							
Figure: 301001-01956-00-GM-SKT-0064							Rev: 1



3.2.9 Conservation objectives

Conservation objectives were identified for each of the MNES in the Cumulative Impact Assessment Report (ELA, 2013). They were developed to reflect the conservation status of each matter and how it is represented at a site-specific and regional level.

The two overarching conservation objectives identified for terrestrial biodiversity are:

1. Gain a better understanding of terrestrial biodiversity at Abbot Point, which will inform conservation planning and management of the project area
2. Contribute to the maintenance of terrestrial biodiversity values across the Abbot Point project area, with the aim of protecting important habitats for listed threatened species.

The two overarching conservation objectives identified for the Caley Valley Wetlands are:

1. Maintain and where possible improve wetland ecosystem processes with a focus on habitat quality and diversity
2. Undertake appropriate wetland ecosystem and habitat monitoring in the Caley Valley Wetlands in order to properly inform adaptive management.

The two overarching conservation objectives identified for the marine environment are:

1. Ensure ongoing use of the marine environment around Abbot Point by a diversity of marine species via the maintenance of a mosaic and diversity of habitats suitable for these species
2. Undertake appropriate marine ecosystem and habitat monitoring in the Abbot Point project area and region in order to properly inform adaptive management actions, which minimise or avoid impacts to marine ecosystem processes within the local environment; and coordinate monitoring activities with broader GBR-wide and/or national programs.

The biophysical and regional conditions required to be maintained to meet the listed conservation objectives are:

- Diversity of inshore marine habitats including seagrass, soft bottom habitats, beaches, and estuarine areas
- Presence of marine species, many of which are threatened and/or migratory
- Presence of higher order predators (e.g. dolphins) indicating functioning food webs
- Presence of migratory shorebird habitat
- Diversity of habitat types ranging from rocky headland and grasslands to eucalypt woodlands
- Riparian areas and freshwater streams
- Connectivity of the terrestrial areas to a large coastal wetland and riparian areas;
- Presence of threatened and other species
- Diverse estuarine, brackish and freshwater wetland zones
- Important foraging, roosting and breeding habitat for resident and migratory shorebirds and other waterbirds
- Presence of threatened species
- Habitat for and presence of amphibians and fish
- Regional water source, providing dry season refugia for birds, aquatic and terrestrial fauna



Advisian

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**Queensland
Government**

Section 3

Existing Environment

- Connectivity with the marine environment and the GBRMP.



4 Environmental Impacts

4.1 Explanatory statement

This section summarises the assessment of potential environmental impacts due to project activities.

The assessment has utilised a risk-based approach as outlined in full in Section 4.2. It has included the preparation of a number of technical assessments which are referenced and included in Volume 3 to the EIS.

Consistent with the approach followed in the preceding discussion of the existing environment, this consideration of environmental impacts is undertaken in two parts:

1. General environmental impacts:

While the primary objective of this assessment has been to understand and assess impacts to the MNES controlling provisions, consideration is also given to the underlying environmental values. Environmental impacts which are indirectly rather than directly relevant to MNES are discussed in Section 4.3. The results of the project environmental risk assessment are also discussed.

2. Impacts to MNES:

The assessment of MNES draws on the assessment of general environmental impacts. It considers both direct and indirect project impacts in the context of the MNES significant impact guidelines (DoE, 2013a).

This section focuses on assessment of the project-specific activities which have potential to significantly impact on Matters of National Environmental Significance. Section 6 discusses the consequential impacts of the Project and also considers cumulative impacts. Project greenhouse gas emissions are considered within the broader and globally contextual discussion presented in Section 7. Socio-economic considerations are considered separately in Section 8.

The following definitions should be kept in mind throughout this Section of the EIS:

- **Direct impacts** - are the impacts occurring within the project footprint and may be temporary (e.g. dredged material pipelines) or permanent (e.g. T0 berth footprint and DMCP footprint)
- **Off-site impacts** - are direct impacts that occur adjacent to the project footprints such as construction and operational dust, noise and artificial lighting
- **Indirect Impacts** - are the impacts arising from project facilities or activities, but with at least one step removed from project activities in terms of cause-and-effect links; an example of an indirect impact would be terrestrial or marine pest or weed introductions.

The impact assessment gives consideration to appropriate measures to avoid and manage environmental impacts. These measures and the overarching approach to environmental management are summarised in Section 5 along with the approach to required offsets for residual environmental impacts.



4.2 Environmental risk approach

4.2.1 Introduction

The guidelines for the EIS require an evaluation of the potential environmental impacts using a risk-based methodology. This section outlines the risk assessment process that was applied to assess potential environmental impacts associated with the following phases of the Project:

- Construction of DMCP
- Dredging pipeline assembly/installation
- Dredging activities
- Post dredging management
- Establishment of the final landform.

The approach is primarily based on the International Standard *ISO 31000:2009: Risk Management - Principles and Guidelines* and draws on a number of guidelines and standards to assist in conducting risk identification and assessment for the EIS, including:

- AS/NZS ISO 31000-2009 Risk management - principles and guidelines
- Handbook 436-2004 - Risk management guidelines
- Handbook 89:2012 - Risk management guidelines on risk assessment techniques
- GBRMP Environmental Assessment and Management Risk Management Framework
- DoE's *Significant Impact Guidelines 1.1* (2013).

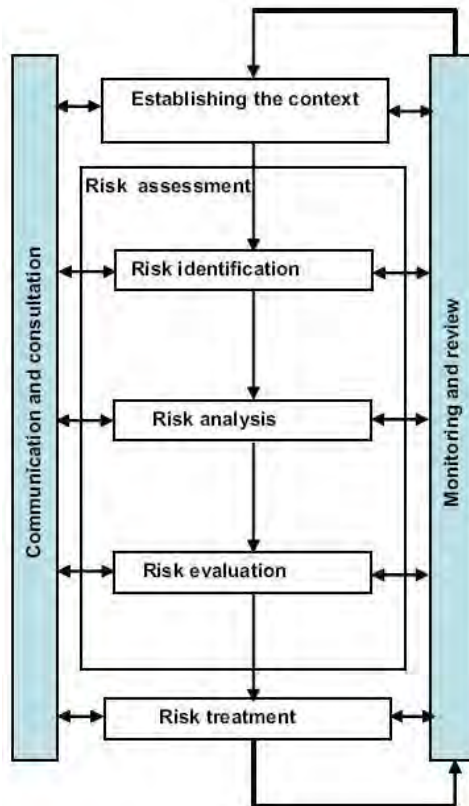
4.2.2 Risk assessment process

Risk assessment is a process that evaluates the likelihood (probability and exposure) and consequences (magnitude) of positive and negative environmental effects occurring as a result of exposure to one or more hazards.

A number of tools are available to identify and assess risks as part of a qualitative (words to describe risks), semi-quantitative or quantitative (numerical) analysis. Regardless of the risk assessment tool that is utilised, they all follow a similar risk management process that is described in AS/NZS ISO 31000 and is shown in Figure 4-1.

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Source: AS/NZS ISO 31000 2009

Figure 4-1 Risk management process

The process involved the following key steps:

- **Context establishment** - Confirm the project description, its environmental setting, policy and regulatory context, stakeholders that may be potentially affected by project activities or interested in the environmental impacts of the proposal and stakeholder values associated with the environmental setting.
- **Risk identification** - Risks were systematically identified and classified by linking them to project phases, project activities, technical assessment areas and controlling provisions (MNES). This step informed the technical study teams in relation to the project risks and allows incorporation of the evaluation of the impacts/risks and their mitigation measures in the respective assessments.
- **Risk analysis and evaluation** - Project-specific risk matrix, consequence and likelihood descriptors were developed in consultation with technical specialists to provide a consistent and project-specific risk rating system across the various technical assessment areas to enable a comparative assessment of risks across all assessment areas. Based on the consequence of the risk and the likelihood of the risk occurring, risks were rated (e.g. extreme, high, moderate, low). This allowed prioritisation of risks and identification of those which required additional mitigation measures to reduce their risk ratings to acceptable levels.
- **Risk treatment/mitigation** - Mitigation measures were identified to reduce the potential for consequences to occur and/or to reduce their severity if they do occur. Risks were re-

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rated (residual risk) taking into consideration the adequacy and effectiveness of the mitigation measures.

4.2.2.1 Establish the context

The risk assessment covered an evaluation of the potential environmental impacts associated with the proposed activities (as described in Volume 2 Section 2 - Project Description) and the development of mitigation measures to avoid or minimise the expected, likely, or potential impacts to as low as reasonably practical. Particular attention was paid to potential impacts related to the relevant EPBC Act controlling provisions for the Project.

4.2.2.2 Identify risks

The process of identifying risks has involved various methods to ensure that a comprehensive and credible series of risks, including their causes, consequences and unmitigated consequence ratings, are identified. The process included:

- Outputs from the technical assessments that were undertaken as part of this EIS
- Facilitated workshops that drew upon the skills of the technical specialists who undertook the technical assessments of the Project
- Review of risk registers from similar industry and/or projects.

Lists of project phases and project activities were generated based on the project description to assist in the systematic identification and categorisation of the risks. This method ensured that all potential risks/impacts were considered and identified. The lists used in the risk assessment are shown below:

Project phases:

- Construction of DMCP
- Dredging pipeline assembly/installation
- Dredging
- Post dredging management
- Establishment of the final landform.

Project activities:

- Pipeline assembly
- Offshore dredging activities
- Footprint clearing and topsoil stripping
- Earthworks including embankment preparation
- Traffic movements
- Night work
- DMCP operation
- Return water discharges
- All (to cover the Project's overall impacts).

Relevance to the following MNES controlling provisions were provided for each identified risk:

- Threatened species and ecological communities
- Migratory species



- The GBR World Heritage Property
- The GBR National Heritage Place
- The GBRMP
- Commonwealth marine areas.

4.2.2.3 Analyse risks

Consequence

Following the identification of the risks, an assessment of the unmitigated consequence arising from a proposed activity was undertaken.

Direct and indirect impacts have been defined as outlined in Section 4.1, and the magnitude of potential environmental impacts associated with the Project has been derived from the assessment of:

- The scale and type of impact taking into consideration the nature of the impact and its spatial and temporal scales, i.e. the intensity or severity of the impact and how long the impact will last and the area it will affect.
- The capacity of the environmental values to accommodate the impact taking into consideration the characteristics of the affected environment and its sensitivity to the impact. The assessment of the sensitivity of the affected environment is derived from regulatory requirements, environmental quality standards, iconic or importance of the ecosystem and cultural value systems.

To assist in this process, qualitative consequence descriptors were developed in consultation with technical specialists. Consequences were categorised from 'minor' to 'severe' using the definitions in Table 4-1.

The risk-based approach involved a blend of science (data, models, quality standards etc.), policy, and professional experience, particularly where there are significant risks to highly valued and protected environmental values.



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Table 4-1 Environmental consequence categories

	Insignificant	Minor	Moderate	Major	Severe
Natural environment	Minor consequence, local response. No lasting effects. Low level impacts on biological and physical environment to an area of low significance.	Event contained within site. Minor short-term and reversible damage to area of limited significance. Short-term effects but not affecting ecosystem functions.	Moderate effects on biological or physical environment and serious short-term effect to ecosystem functions (e.g. oil spill impacts on shoreline).	Major off-site release contained or immediately reportable event with very serious environmental effects, such as displacement of species and partial impairment of ecosystem. Widespread medium and some long-term impact.	Long-term irreversible destruction of highly significant ecosystem or significant effects on endangered species or habitats.
Ecology (terrestrial, aquatic, marine)	<p>Minor, no negative or positive impacts to ecological structure and function.</p> <p>Minor degradation of habitat and/or increased disturbance leading to a small and/or short-term reduction in habitat use by fauna/flora, at a</p>	<p>Minor to moderate disturbance to ecological structure and function.</p> <p>Minor degradation of important habitat and/or increased disturbance leading to a small and/or short-term reduction in habitat use by</p>	<p>Moderate disturbance to ecological structure and function.</p> <p>Degradation of important habitat and/or increased disturbance leading to a reduction in habitat use by fauna/flora at a local or regional scale, including threatened</p>	<p>Moderate to major change to ecological structure and function.</p> <p>Degradation of important habitat and/or increased disturbance leading to a temporary and substantial reduction in habitat use by fauna/flora at a regional</p>	<p>Fundamental change to ecological structure and function.</p> <p>Degradation of important habitat and/or increased disturbance leading to a substantial reduction in habitat use by fauna/flora at a regional scale, including</p>



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	Insignificant	Minor	Moderate	Major	Severe
	<p>local scale.</p> <p>No disturbance of threatened ecological communities or species.</p> <p>Recovery expected to occur over a period of months.</p>	<p>fauna/flora at a local scale, including threatened or migratory species.</p> <p>Minimal disturbance of threatened ecological communities or species.</p> <p>Recovery expected to occur over a period of one year.</p>	<p>and migratory species.</p> <p>Minor disturbance of threatened ecological communities or species.</p> <p>Recovery expected to occur over a period of one to three years.</p>	<p>scale, including threatened and migratory species.</p> <p>Moderate disturbance of threatened ecological communities or species.</p> <p>Recovery expected to occur over a period of five years.</p>	<p>threatened and migratory species.</p> <p>Major disturbance of threatened ecological communities or species.</p> <p>Recovery unlikely to occur completely, or to occur over a period of 10+ years.</p>
Hydrology and water quality	<p>No detectable change to surface water quality, hydrology or flow regimes (including no loss or reduction of number and/or volume of dry season remnant pools).</p>	<p>Local, short-term change in surface water quality, hydrology and flow regimes that can be readily remediated.</p>	<p>Widespread and short-term, or local and long-term significant change in surface water quality, hydrology and flow regimes.</p>	<p>Widespread and long-term, or local and permanent significant change in surface water quality, hydrology and flow regimes.</p>	<p>Widespread and permanent significant change in surface water quality, hydrology and flow regimes.</p>

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For risks that are likely to have an impact on MNES, a detailed assessment of the nature and extent of the potential short-term and long-term relevant impacts were conducted in accordance with the MNES *Significant Impact Guidelines 1.1* (DoE, 2013a). Descriptions were provided to indicate the significance levels and whether the impacts were likely to be unknown, unpredictable or irreversible. Assessment against the MNES Significant Impact Guidelines, relevant to the MNES controlling provisions is provided in Section 4.2.3.

Information (e.g. technical data, sources) that were used or needed to make a detailed assessment of the relevant potential impacts were listed in technical assessment reports (refer Volume 3 Appendices). Indication of data confidence level/uncertainty associated with the risk ratings was included in the register.

Confidence level/uncertainty

The treatment of uncertainty in risk assessment is important to provide an understanding of the reliability and confidence in the risk assessment outcomes. The uncertainties may arise from:

- Lack of (historical) information for similar situations
- Lack of clear definition or understanding of the project activities
- Natural variability
- Assumptions required for predictive modelling/forecasting.

Methods to reduce the level of uncertainty normally involve conducting further research/analysis or making conservative assumptions. A balance is required between the effort required to obtain the information and the value the information provides to the decision-making process.

An assessment of confidence level for the risks has been conducted to provide indication of confidence in the risk rating of the potential environmental impacts. The risks are placed in the following categories:

- High confidence
 - Clear definition and understanding of the project activities
 - Several expert investigations/studies
 - Complete and high quality survey data
 - Long-term monitoring results available
 - Modelling conducted and calibration shows good adherence to real occurrences
- Medium confidence
 - Key project activities are defined with gaps in less critical project activities
 - Survey data available from one expert
 - Short-term monitoring results available
 - Modelling conducted but calibration shows occasional aberration from occurrences
 - Available information is reasonably adequate
- Low confidence
 - Unclear project activities or project activities subject to change
 - No survey data

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- No model verification possible
- No modelling conducted
- Available information is considered inadequate.

Likelihood

Likelihood is the probability or frequency of an environmental impact/consequence occurring and considers the probability of the event. The likelihood is predominantly expressed in qualitative terms, as listed in Table 4-2 below:

Table 4-2 Likelihood definitions

Likelihood of Impact Occurring	Definition
Almost Certain	<ul style="list-style-type: none">▪ It is known that the impact will occur, or▪ 95% to 100% chance of occurring.
Likely	<ul style="list-style-type: none">▪ Impact is likely to occur on the Project, or▪ 71% to 95% chance of occurring.
Moderate	<ul style="list-style-type: none">▪ Impact has occurred on a similar Project, or▪ 31% to 70% chance of occurring.
Unlikely	<ul style="list-style-type: none">▪ Given current practices and procedures, this impact is unlikely to occur on the Project, or▪ 5% to 30% chance of occurring.
Rare	<ul style="list-style-type: none">▪ Highly unlikely to occur on the Project, or▪ 0% to 5% chance of occurring.

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4.2.2.4 Evaluate risks

The risk matrix used for the assessment is summarised in Figure 4-2.

		INCREASING CONSEQUENCE →				
		1	2	3	4	5
		Insignificant	Minor	Moderate	Major	Catastrophic
↑ INCREASING LIKELIHOOD	A Almost certain	High	High	Extreme	Extreme	Extreme
	B Likely	Moderate	High	High	Extreme	Extreme
	C Moderate	Low	Moderate	High	Extreme	Extreme
	D Unlikely	Low	Low	Moderate	High	Extreme
	E Rare	Low	Low	Moderate	High	High

Figure 4-2 Risk matrix

The risk matrix applied for the Project is aligned with the risk matrix adopted in the GBRMPA's Environmental Assessment and Management Risk Management Framework. This is considered to be relevant and appropriate for risk ratings for the Project.

The risk levels were measured by combining a particular consequence for an environmental impact and the likelihood of that particular consequence occurring. The risk levels indicate the magnitude of an environmental impact and were used to prioritise the risks to advise the level of mitigation measures required.

Risks were ranked before the risk treatment/mitigation measures (inherent risk) and after the risk treatment/mitigation measures (residual risk). All risks have been identified in the technical assessments reports and compiled in the risk register.



4.2.2.5 Treat risks

Once a potential risk and its associated consequences were identified, the mitigation measures were identified to reduce the potential for consequences to occur and/or to reduce their severity if they do occur. This step involved consideration of the consequence arising from the risk, and applicable mitigation measures that may be implemented, to reduce the potential for these consequences occurring.

Mitigation measures are developed for extreme and high risks as a minimum. However, mitigation measures for moderate and low risks have still been undertaken if the level of effort to undertake a mitigation measure does not disproportionately outweigh the level of risk reduction (As low as reasonably practicable (ALARP) approach).

As low as reasonably practicable

The acceptability of risk depends on the magnitude of the risk, the practicability of the risk reduction methods and the level of risk regarded as 'tolerable'. This introduces the concept of reducing a risk to ALARP. According to AS 2885.1 (Standards Australia 2007), ALARP means the cost of further risk reduction measures is grossly disproportionate to the benefit gained from the reduced risk that would result.

An assessment of what is 'reasonably practicable' requires judgements to be made. To make risks ALARP, opinions of technical experts are considered as well as standards, industry practice, availability of mitigation measures, and sometimes cost-benefit analyses.

For the Project, the identified mitigation measures were assessed for their effectiveness in reducing the unmitigated level of risk through an assessment of their reliability and level of implementation. The proposed mitigation measures are incorporated into the Project EMP and Dredging Management Plan (DMP) as discussed in Section 5.1.

The development of the mitigation measure and assessment of its effectiveness provided an adjusted consequence rating, which was then assessed further with respect to the exposure of the risk and the probability of the consequence occurring, therefore providing the likelihood of an event or incident occurring. The result of this process provided an adjusted risk ranking (consequence and likelihood), as the residual risk.

4.2.2.6 Monitor and review

The risk register was reviewed and revised as necessary during the EIS when additional information became available through technical assessment reports. The risk assessment process will continue to be reviewed and revised throughout all phases of the Project.

Ongoing monitoring and review is essential to ensure the risk assessments that have been conducted remain relevant. Factors and assumptions that were used are subject to change, such as new risks identified, new mitigation measures implemented, existing mitigation measures removed, new consequence identified and so on. These have the potential to alter the risk rankings, either positively or negatively.

Monitoring of the effectiveness of mitigation measures will also be undertaken throughout all phases of the Project. This monitoring will be undertaken through a combination of continuous monitoring (e.g. measuring parameters), and internal and external audits. The Outline EMP and Outline DMP (Volume 3, **Appendix V** and **Appendix W** respectively of this



EIS) are the guiding reference for the frequency and types of monitoring proposed to be undertaken.

4.2.3 Summary

No activities were assessed as having an initial risk level of extreme. Activities which were rated as a “high” initial risk are presented in Table 4-3 for each project phase. The implementation of controls (in the design, construction or operation phase) mitigates all risks to a low or moderate level.

Risks are discussed in more detail in the relevant sub-sections of the following general impacts assessment section.

The full environmental risk register for the Project is included in **Appendix U**.

Table 4-3 Summary of environmental risks

					MNES Relevance				
					Threatened species and ecological communities	Migratory species	Great Barrier Reef World Heritage Property / National Heritage Place	the Great Barrier Reef Marine Park	Commonwealth marine areas
Project Activity	Risk	Initial Risk	Mitigation Measure	Residual Risk					
Construction of DMCP									
Footprint clearing and topsoil stripping	Removal of threatened plants, TECs and habitat for threatened flora	High	Map MNES and design project footprint to avoid and/or minimise impacts	Low	x	x	x		
Earthworks including embankment preparation	Increased dust depositing on plants and dust concentrations affecting fauna	High	Design sets back DMCP footprint from wetland vegetation (habitat) Wet down (for dust control) of stockpiles, working areas and haul roads	Low	x	x	x		
Earthworks including embankment preparation	Increased noise disturbing fauna including migratory shorebirds in wetland	High	Design sets back DMCP footprint from wetland vegetation (habitat). Project design utilised noise modelling results to predict disturbance areas (which are taken into consideration in the 'After treatment risk levels')	Low	x	x	x		
Footprint clearing and topsoil stripping	Increased dust depositing on plants and dust concentrations affecting fauna	High	Design sets back DMCP footprint from wetland vegetation (habitat) Wet down (for dust control) of stockpiles, working areas and haul roads	Low	x	x	x		
Traffic movements	Vehicle strike on fauna including shorebirds or traffic-related disturbance of habitat	High	Use of designated routes and speed limits	Low	x	x	x		
Dredging pipeline assembly/installation									
No high/extreme risks are identified									
Dredging									
No high/extreme risks are identified									

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					MNES Relevance				
Project Activity	Risk	Initial Risk	Mitigation Measure	Residual Risk	Threatened species and ecological communities	Migratory species	Great Barrier Reef World Heritage Property / National Heritage Place	the Great Barrier Reef Marine Park	Commonwealth marine areas
Post dredging management									
DMCP operation	Oxidation of PASS dredged material leading to generation of acidic seepage	High	Dredged material is expected to be self-neutralising Preliminary ASSMP outlines appropriate management measures Development and implementation of final ASSMP	Low	x	x	x		
Establishment of the final landform									
Earthworks including embankment preparation	Increased dust depositing on plants and dust concentrations affecting fauna	High	Design sets back DMCP footprint from wetland vegetation (habitat) Wet down (for dust control) of stockpiles, working areas and haul roads	Low	x	x	x		



4.3 General impacts

4.3.1 Land

4.3.1.1 Landform

The terrain of the proposed DMCP footprint is relatively flat. Construction of the DMCP, specifically the bund walls, will create steeper gradients. The height of the embankment walls will vary between 4m and 7m above existing ground levels. Potential impacts related to changes in topography include altered drainage pathways and increased risk of erosion and sedimentation, which are discussed in Section 4.3.6.2 and Section 4.3.6.3). Aesthetic impacts are discussed in Section 4.6.4.1.

4.3.1.2 Soil

Topsoil

Land disturbance activities will include vegetation clearing, topsoil stripping, soil excavation, stockpiling and rehabilitation. In particular, soil materials will be required for building the DMCP embankments, for erosion and sediment control structures, and for establishing vegetation on rehabilitated areas.

Site clearance and construction will involve earthworks and associated removal of vegetation to create areas for the DMCP and associated infrastructure. This may result in the loss of topsoil quantity and quality through incorrect stripping, prolonged soil exposure and erosion. The topsoil will be stockpiled for use in the revegetation of bund walls. If inappropriately handled and managed, stockpiling of topsoils can damage the topsoil structure, resulting in nutrient leaching and loss of fertility. As noted in Section 3.1.2.3, soils in the DMCP footprint are already very low in fertility, and stripping topsoil will likely dilute nutrients and biological capital when used for rehabilitation. This may affect their efficacy during use in rehabilitation.

Erosion

Soil erosion is a potential risk for the site during construction (following clearing of vegetation and earthworks, as well as stockpiling) and operation of the DMCP (from stormwater runoff). The potential for erosion is a function of both soil and site properties. Emerson dispersion tests undertaken on samples of soils from the site suggest the subsoil materials are not potentially dispersive and are likely to be stable. However, when excavated and used for embankment construction, soil structure will be affected and steep slopes created, which may lead to increased erosion if not managed appropriately.

Soil erosion levels could be increased as a result of poor drainage management (including diversion and concentration of flow), absence of or improper implementation of sediment and erosion controls, and inadequate earthworks contractor training and supervision.

Erosion has the potential to result in:

- Undermining of structures (such as fences and pipeline footings)
- Impacts on the structure of embankments
- Sedimentation of receiving environments
- Associated impacts on flora and fauna.



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A stormwater management plan will be developed and implemented to manage these environmental risks, and a preliminary plan is given in Volume 3 **Appendix N** to this EIS.

Discussion on erosion and subsequent potential impacts on water quality and receiving environments are addressed in more detail in Section 4.3.6.2.

4.3.1.3 Acid Sulfate Soils

As the material which will be disturbed during construction of the DMCPs is not PASS, i.e. has no acid forming potential (refer Section 3.1.2.5) no related impacts are anticipated during construction of the DMCP.

Potential for impact from PASS associated with the dredged material is discussed in Section 4.3.4.4. The inherent neutralising capacity of the material to be dredged, and the conservative strategy for the management of the material onshore results in low risk of impact from acid generation.

4.3.1.4 Contaminated land

Impacts associated with any existing land contamination may occur if construction activities disturb any existing contaminated land (as a result of historical activities), or if project activities (construction, operation and decommissioning) result in land contamination. Impacts associated with contaminated land can affect human health as well as the receiving environment.

As described in Section 3.1.2.4, several areas were identified as having the potential to contain contaminated land, which may be disturbed during construction, including:

- Waste water treatment plant
- Laydown, equipment storage and disposal of construction waste area
- Stockpile of quarry material
- Backfilling of two dams with an unknown material.

The contamination status of these areas is currently unknown, and will require further assessment (refer **Appendix G**).

During construction and operation, a range of project activities may result in potential contamination of land, including:

- Uncontrolled releases of stored chemicals, fuels, oils, lubricants and other hazardous substances as a result of spills, accidents, fires, extreme weather etc.
- Poor waste management practices
- General project activities such as vehicle and equipment operation and maintenance, spraying for weeds and pesticides, solvents and chemicals used in painting and cleaning.

Impacts from contaminated land will only occur if a source, pathway and receptor are present. Table 4-4 summarises the sources, pathways and receptors which affect all phases of the Project including construction, operation and decommissioning.



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Table 4-4 Summary of contaminated land sources, pathways and receptors

Potential Sources	Pathways	Receptors
Historical anthropogenic activities (refer Appendix G for details)	Soil, groundwater and air via overland flow, infiltration/percolation, groundwater flow and volatilisation	Sensitive receiving environments such as Caley Valley Wetlands, Dingo Beach, GBRMP
Project activities (such as uncontrolled releases of chemicals, fuels, oils, lubricants, pesticides, or release of waste products)		Construction/operation workforce

4.3.1.5 Residual risk

The environmental risk assessment (**Appendix V**) has identified and assessed two risks associated with soils and contaminated land in the Project's construction phase. These are summarised in Table 4-5 and Table 4-6.

Neither of these activities had initial impacts rated as high prior to risk treatment. Implementing well-understood, good-practice mitigation measures results in a low final risk level.

Table 4-5 Risk summary - contaminated soils

Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Project Phases: DMCP construction and dredging pipeline installation			
Footprint clearing and topsoil stripping	Inappropriate management of contaminated soils and/or ASS (from underlying soil) leading to land contamination of the site	<ul style="list-style-type: none"> Implement Preliminary ASSMP Develop and implement an appropriate induction package Complete a Detailed Site Investigation to investigate potential existing sources of contaminated land identified in the Preliminary Site Investigation. 	Low
Project Phases: All			
Oil, chemical and waste management	Inappropriate storage and management of oils, chemical and waste leading to a) land and potentially	<ul style="list-style-type: none"> Implement EMP measures on oil, chemical and waste management 	Low



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
	water contamination, and b) reduced landfill space		

Table 4-6 Risk summary - ASS

Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Project Phases: DMCP construction and dredging pipeline installation			
Footprint clearing and topsoil stripping	Inappropriate management of contaminated soils and/or ASS (from underlying soil) leading to land contamination of the site	<ul style="list-style-type: none"> Implement Preliminary ASSMP Develop and implement an appropriate induction package Complete a Detailed Site Investigation to investigate potential existing sources of contaminated land identified in the Preliminary Site Investigation. 	Low
Project Phases: All			
Oil, chemical and waste management	Inappropriate storage and management of oils, chemical and waste leading to a) land and potentially water contamination, and b) reduced landfill space	<ul style="list-style-type: none"> Implement EMP measures on oil, chemical and waste management 	Low

4.3.2 Air quality

An air quality impact assessment has been undertaken by Katestone, and the technical report is included in **Appendix H**.

The key air pollutant associated with construction of the DMCPs is dust. There are three phases of the Project that are likely to have distinctively different propensities to generate dust emissions, namely:

- Construction of the DMCP and embankment (over a duration of approximately three to six months). Activities include DMCP footprint clearing/grubbing, removal of topsoil, embankment subgrade preparation, stockpiling and bulk earthworks for external and internal embankment.



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- Dredging campaign (approximated duration 5 to 13 weeks depending on size of CSD used). Activities include piping dredged material into the DMCP and laydown of dredging pipeline. (For the purposes of the Air Quality Impact Assessment Report, a dredging campaign of 13 weeks was assumed).
- Ongoing storage and beneficial reuse (approximate duration of 1 to 10 years). Activities include reshaping of the area.

Laydown and installation of pipeline may occur concurrently with DMCP construction.

The construction phase of the Project is considered to result in the highest emissions to air (refer to **Appendix H** for details) and therefore will represent the highest potential for impacts related to the Project.

During the dredging campaign, dust emissions are considered to be negligible, as material will be pumped in as a wet slurry and therefore will not generate particulate or other emissions to air.

During long-term management and potential extraction of material from the DMCP, dust emissions may occur as a result of wind erosion of any exposed material surfaces, wheel-generated dust from haul vehicles, excavation of reuse materials and dumping into haul vehicles. However, overall dust emissions from the operation of the DMCP will be substantially lower than estimated for the construction phase.

4.3.2.1 Reference criteria

The main consideration of the air quality assessment was the potential impact of the Project on flora and fauna in the wetland and marine environments. An assessment of air quality impacts on ecology is also provided in Section 4.3.7.

There is limited information available on threshold concentrations and deposition rates to protect wetland and marine environments from air pollutants. Air quality guidelines and objectives for other environmental indicators (such as indicators for human health and amenity) were used as reference values in this assessment where specific indicators were unavailable.

The following regulatory guidelines and policies are relevant to the assessment of impacts on human health, amenity and water quality:

- *Environmental Protection (Air) Policy 2008*
- Department of Environment and Heritage Protection recommended guideline for dust nuisance
- *New South Wales Office of Environment and Heritage impact assessment criteria*
- *Victorian State Environment Protection Policy Air Quality Management design criteria*
- *National Health and Medical Research Council Australian Drinking Water Guidelines*
- *National Water Quality Management Strategy Australian and New Zealand Guidelines for Fresh and Marine Water Quality.*

Details of these regulatory guidelines and policies, and associated reference criteria, are described in the air quality technical report (**Appendix H**) and impacts are further described in Section 4.3.7.



4.3.2.2 Dispersion modelling predictions

Dispersion modelling was conducted to investigate the potential impact of construction and operational activities using the dispersion model Ausplume.

As part of dispersion modelling, the potential effect of deposition of trace substances on water quality in the wetland was assessed. This was conducted using the method detailed in the *Air Toxics Hot Spot Program Guidance Manual for Preparation of Health Risk Assessments* (California Environmental Protection Agency, 2003), using information derived from analyses of soil samples collected from the site in May 2015. Details of these are provided in **Appendix H** (Air Quality Assessment).

The dust emission rates from construction activities have been conservatively calculated to account for uncertainty in the detailed construction process. Predicted dust levels associated with construction of the DMCPs in isolation are shown in Table 4-7. Associated potential impacts to flora and fauna as a result of dust emissions are discussed in Section 4.3.7 and Section 4.5.

The results show the following:

- Predicted concentrations of particulate matter 10 micrometres or less in diameter (PM₁₀) are above the objective of 50µg/m³ for human health⁴ at the edge of both the freshwater and estuarine parts of the Caley Valley Wetlands
- The predicted concentration of PM₁₀ falls with distance from the emission source such that compliance is achieved within, at most, 1,500m of the edge of the wetland (adjacent to the southern boundary of the secondary DMCP), corresponding to approximately 8% of the estuarine area and 17% of the freshwater area
- Predicted concentrations of total suspended particulate (TSP) are above the objective of 90µg/m³ for human health at the edge of the estuarine part of the Caley Valley Wetlands
- The predicted concentration of TSP fall with distance from the emissions source such that compliance is achieved within 300m of the edge of the wetland, corresponding to approximately 2% of the estuarine area
- Compliance with all other relevant objectives and guidelines for dust within the freshwater and estuarine parts of the Caley Valley Wetlands.

Details of predicted levels of trace elements in air and in the freshwater and estuarine parts of the Caley Valley Wetlands are provided in **Appendix H**. All predicted levels of trace elements comply with the relevant reference criteria.

The potential dust emissions associated with the construction of the DMCPs are likely to result in lower levels of dust compared with the existing dust levels associated with the existing T1 coal export terminal and associated Aurizon rail operations located at Abbot Point. Given the prediction of dust levels is conservative, the short duration and proposed mitigation measures will ensure that actual dust levels will be significantly lower than predicted.

⁴ Air quality guidelines and objectives for other environmental indicators (such as indicators for human health and amenity) were used as reference values in this assessment where specific indicators were unavailable – refer **Appendix Q1** for more information.



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Table 4-7 Range of ground-level dust concentrations and deposition rates including background levels at the receptor zones due to construction of DMCP

Pollutant	Averaging Period	Units	Caley Valley Wetlands (Estuarine)			Caley Valley Wetlands (Freshwater)			GBRMP			GBRWHA			Reference Criteria
			L	M	H	L	M	H	L	M	H	L	M	H	
TSP	Annual	µg/m³	0.8	4.4	33.2	0.2	2.3	28.2	57	61	103	56	59	86	90 ^a
PM ₁₀ (6 th highest)	24-hour	µg/m³	2.8	7.1	27.1	1.4	8.7	69	33	40	82	31	43	116	50 ^a
PM _{2.5}	24-hour	µg/m³	1.0	2.6	9.8	0.6	3.1	19.2	1.5	3.9	14.2	1.4	4.9	23.3	25 ^a
	Annual		0.1	0.3	2.5	<0.1	0.2	2.2	0.1	0.5	3.7	0.0	0.2	2.3	8 ^a
Dust deposition	120 days	mg/m²/month	0.8	7.0	63.3	0.1	3.7	66.6	41	47	104	40	44	107	200 ^b

Note: L = lowest; M = median; H = highest

^a *Environmental Protection (Air) Policy 2008* for health and wellbeing

^b Dust deposition threshold for vegetation protection



4.3.2.3 Residual risk

Project air quality impacts have been assessed and mitigated in relation to aquatic, terrestrial and marine ecological values. They are addressed in Sections 4.3.5.1, 4.3.7 and 4.3.8.

4.3.3 Acoustic environment

4.3.3.1 Terrestrial noise

A terrestrial noise assessment (**Appendix J**) was undertaken for the Project. The assessment included:

- Development of relevant noise criteria/thresholds
- Noise modelling of existing and project construction/operation scenarios
- Assessment of the extents of ecologically sensitive areas in which the developed criteria were predicted to be exceeded.

Terrestrial noise assessment criteria

There are no current government policies or other widely accepted guidelines as to noise levels or thresholds of relevance for terrestrial fauna, partly because the effects of noise on most fauna species are poorly understood (Larkin *et al.*, 1996; Brown, 2001; Ocean Studies Board, 2003).

This limited understanding of the effects of noise on fauna is understandable when the following points are considered:

- Responses to noise disturbance cannot be generalised across species or genera
- Studies of one species cannot be extended to other species
- Responses even of individuals within a single species may vary
- Hearing characteristics are species-specific - for example, noise impacts on humans are determined using a frequency weighting filter (A-weighting) which corresponds to human hearing characteristics, determined through laboratory testing; while the frequency-dependent hearing characteristics of fauna cannot be determined in this way
- When studying the effects of noise on fauna, it can be difficult to separate noise effects from other sensory disturbing effects (for example, visual or olfactory cues)
- Experimental research in a laboratory is not always applicable in a natural setting.

Accordingly, the noise assessment has sought to develop appropriate assessment criteria for noise emissions from project activities. A detailed review of published information was undertaken, and this is described in **Appendix J**. Through this review of published information, combined with personal observations and extrapolation presented in the technical report in **Appendix J**, noise criteria and associated likely effects on terrestrial fauna of noise levels experienced at the wetland as a result of the Project have been identified. These are presented in Table 4-8. Although derived predominantly from studies of birds, the nominated thresholds are considered relevant to the terrestrial fauna present in the vicinity of the Project.



Table 4-8 Likely effects on terrestrial fauna as a result of project activities

Disturbance Effect	Steady or Continuous Noise Sources LAeq_(15min) (dBA)	Episodic (Single Event or Short-Term) Noise Sources LAm_{ax} (dBA)	Typical Bird Activities Potentially Impacted
Occasional (alert) - minor impacts on habitat use for most species	50 to 65	45 to 60	Nesting
Frequent (alarm or flight) - moderate impacts on habitat use	65 to 85	60 to 80	Nesting Roosting
Avoidance of area - by most of the population of some species	≥85	≥80	Nesting Roosting Foraging

These thresholds have been utilised in the assessment of potential impacts to MNES - threatened terrestrial and migratory species, and this is discussed further in Section 4.3.7.

Noise modelling predictions

The project model took into account factors including source sound power levels and locations, distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions, including wind effects.

Scenarios were identified with the aim of covering the range of potential noise impacts across the varying stages of the Project.

All scenarios incorporate noise emissions from existing T1 terminal and Aurizon rail operations, thus the 'cumulative' effect of the proposed Project and T1 noise emissions is assessed.

The identified scenarios, relevant to noise-generating project activities were:

- **Existing Scenario:** T1 and rail operations
- **Project Scenario 1:** Topsoil stripping and stock-piling
- **Project Scenario 2:** Embankment subgrade preparation involving removal of unsuitable material to form a competent subgrade for embankment construction
- **Project Scenario 3:** Bulk earthworks for external and internal embankment construction (using material won from onsite borrow areas supplemented by local quarries) and construction of the return water pipeline
- **Project Scenario 4:** DMCP liner installation on internal DMCP batters
- **Project Scenario 5:** Dredging of the seabed within the Port of Abbot Point using a medium to large CSD, relocation of the dredged material via pipeline to the DMCP and pumping return water via return water pipe from the DMCP to an offshore discharge location within the Port of Abbot Point



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- **Project Scenario 6:** Short-term management of placed dredged material within the DMCP (biased towards the southern end of the DMCP closer to the wetland) - assumes that dredging and material placement is complete and is not part of this scenario
- **Project Scenario 7:** Post dredging management and conditioning of the DMCP.

Noise contour plots of existing (i.e. baseline) T1 noise emissions and predicted cumulative noise emission levels from the modelled scenarios have been generated for the Project. Given the significant number of scenarios and model variables that are presented, these have not been replicated here, but can be found in **Appendix J**.

Table 4-9 summarises the percentage of the of the wetland area predicted to exceed likely disturbance thresholds for terrestrial fauna present in the wetland. The table compares the seven modelled project scenarios against the existing T1 operational noise emissions. This indicates that noise from the Project will have either no overall effect or only marginally increase the extent of wetland predicted to exceed the disturbance thresholds (see also Section 4.3.7). This is due to the Project being largely confined within the area previously allocated for T2. The noise contour maps (in **Appendix J**) show that the largest area of the wetland calculated to exceed the disturbance thresholds is attributable to existing rail operations and not the proposed Project.



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Table 4-9 Percentage of the wetland area predicted to exceed disturbance thresholds

Scenario	Threshold Level (dBA)	Percentage of the Wetland above Threshold Level ¹		
		Neutral Weather	Temperature Inversion and no Wind	Temperature Inversion and 3m/s wind
Existing T1 Operational Noise	Alert - 45dBA LAmax	32	32	32
	Alarm/flight - 60dBA LAmax	3	3	3
Existing T1 Operational Noise	Alert - 50dBA LAeq(15min)	3	6	4
	Alarm/flight - 65dBA LAeq(15min)<0.5		<0.5	<0.5
Scenario 1 - Topsoil stripping and stockpiling	Alert - 45dBA LAmax	34	35	36
	Alarm/flight - 60dBA LAmax	3	4	3
Scenario 2 - Embankment preparation	Alert - 45dBA LAmax	34	36	36
	Alarm/flight - 60dBA LAmax	3	4	3
Scenario 3 - Embankment construction	Alert - 45dBA LAmax	34	35	36
	Alarm/flight - 60dBA LAmax	3	3	3
Scenario 4 - DMCP liner installation	Alert - 50dBA LAeq(15min)	3	6	4
	Alarm/flight - 65dBA LAeq(15min)<0.5		<0.5	<0.5
Scenario 5 - Dredging	Alert - 50dBA LAeq(15min)	3	8	5
	Alarm/flight - 65dBA LAeq(15min)<0.5		<0.5	<0.5
Scenario 6 - Management of dredged material	Alert - 45dBA LAmax	33	35	35
	Alarm/flight - 60dBA LAmax	3	3	3
Scenario 7 - Post dredging management	Alert - 45dBA LAmax	34	35	36
	Alarm/flight - 60dBA LAmax	3	3	3

Note 1: Percentage area calculations based on the DEHP mapping of the Caley Valley Wetlands



4.3.3.2 Underwater noise

Underwater noise generated as part of project activities has the potential to impact on marine fauna species, although these impacts will be in the context of existing underwater noise experienced as a result of current port operations. The main underwater noise-generating activities associated with the Project are expected to be dredging activities and the associated supporting vessel movements.

Multiple elements during the dredging process can potentially emit noise into the water column, including vessel propeller operation, inboard engine and pump, underwater pump and pipes, and cutting head digging process. Among these elements, cutting head operations and the vessel propeller are expected to be the dominant noise sources during the sediment excavation process. Typically the noise generated during dredging operation is continuous in nature.

Noise exposure criteria for marine fauna species

The potential impacts of noise on marine fauna species include mortality, hearing damage, masking of communication and other biological important sounds, and alteration of behaviour (Richardson *et al.*, 1995; Hasting and Popper, 2005). In general, underwater noise impacts on marine fauna species may be divided into the following two categories:

3. **Behavioural impacts** - Behavioural responses to noise include changes in vocalisation, resting, diving and breathing patterns, changes in mother-infant relationships, and avoidance of the noise sources.
4. **Physiological effects** - Primarily associated with the auditory system which is likely to be most sensitive to noise. The exposure of the auditory system to a high level of noise for a specific duration can cause a reduction in the animal's hearing sensitivity, or an increase in hearing threshold. If the noise exposure is below some critical sound energy level, the hearing loss is generally only temporary, and this effect is called temporary hearing threshold shift (TTS). If the noise exposure exceeds the critical sound energy level, the hearing loss can be permanent, and this effect is called permanent hearing threshold shift (PTS).

The marine noise associated with dredging activities and supporting vessels is continuous in nature and a low-level emission in comparison to construction activities such as offshore piling and blasting activities. Therefore, the most relevant assessment parameters include sound exposure level (dB re 1JPa.s) and root-mean-square sound pressure level (dB re 1JPa Root Mean Square) in particular.

Table 4-10 outlines the consolidated impact assessment criteria proposed for all significant marine fauna species identified as relevant for the Project (refer Section 4.5). The proposed sound pressure level criteria for behavioural response have been widely used for marine mammal species, as well as for other marine fauna species where there is no relevant established criterion available (McCauley *et al.*, 2012).



Table 4-10 Dredging noise impact assessment criteria

Permanent Hearing Threshold Shift (PTS) or Physical Injury	Temporary Hearing Threshold Shift (TTS)	Behavioural Response
Sound exposure level, dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (Within a 24 hour period)	Sound exposure level, dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (Within a 24 hour period)	Sound exposure level, dB re 1 μPa Root Mean Square (Within a 24 hour period)
215	195	120

Modelling prediction results

The Range-dependent Acoustic Model was used to predict the transmission of the noise from dredging and vessel activities for the Project. The model requires various environmental parameter inputs, including bathymetry, associated seabed properties and a sound speed profile. Details of the model are available in the underwater noise assessment report (refer **Appendix K**).

Modelling scenarios were established to understand the underwater noise impacts in relation to the dredging activities, as well as to the associated supporting vessel movements.

These included:

- Dredging activities
- Supporting vessel (workboat/tug) in anchorage
- Transfer vessel in transit.

The underwater noise contour maps depicting the received sound pressure level predictions for the three modelling scenarios are included in **Appendix K**. Highest noise levels are expected to be generated during dredging activities. The noise contour maps illustrate that:

- Strong transmission loss occurs when the noise propagates towards the water region which exhibits rapid upward sloping seabed in the shoreline directions
- Noise propagation is more efficient towards the open deeper water directions.

The contour maps also demonstrate the relative lower transmission loss for noise propagating along the paths with relatively constant water depth (i.e. in the directions roughly parallel to the shoreline) in comparison to noise propagating along the paths towards the deeper water region. This is because under the condition of very reflective seabed properties, as used in the noise model, the acoustic energy disperses more over the deeper water column which results in lower received noise level than over a shallower water column.

The near-field received sound exposure levels with different exposure time period are predicted for both dredging and supporting vessel noise sources. As an illustration, Figure 4-3 presents predicted sound exposure levels for dredging activities with exposure time periods of 1 hour, 2 hours and 24 hours respectively together with the comparisons against PTS and TTS assessment criterion.



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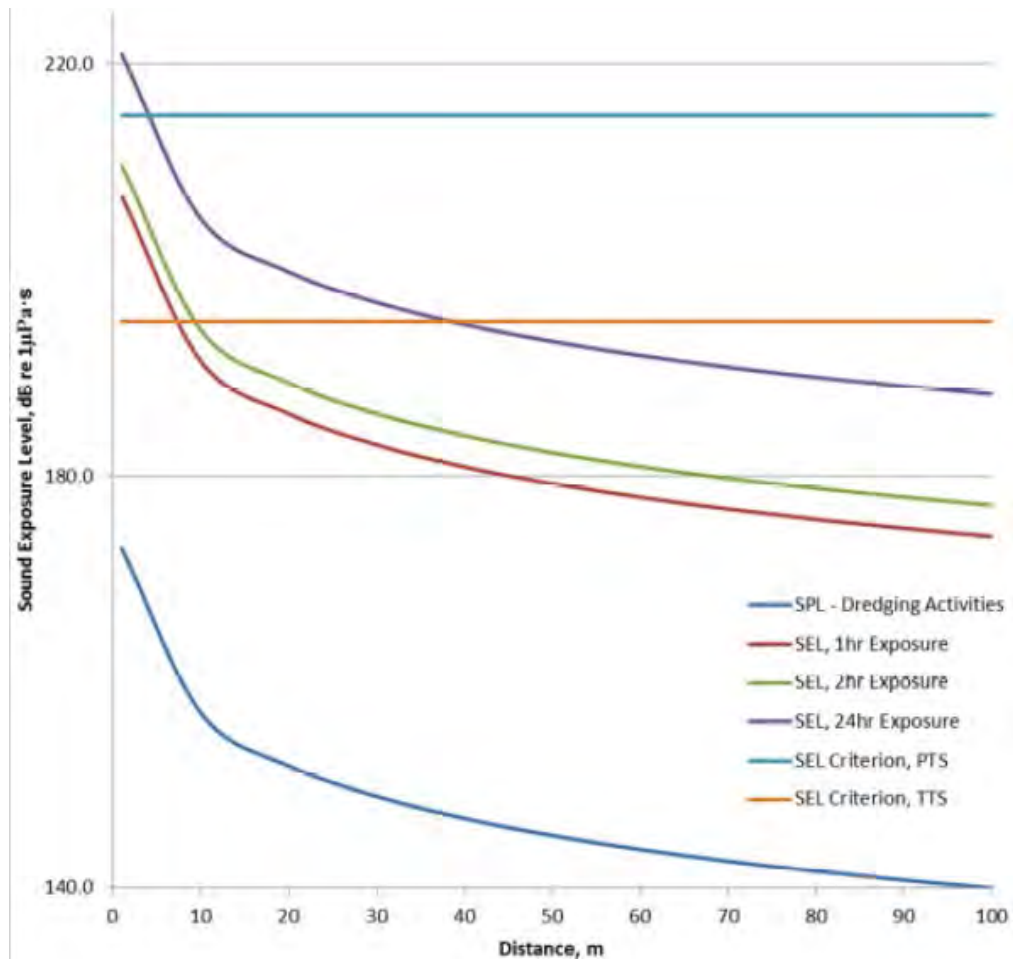


Figure 4-3 Predicted near-field sound exposure level for dredging activities against PTS and TTS criterion



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Zones of noise impact

Zones of hearing damage/threshold shifts (PTS and TTS) and behavioural response impacts for the considered marine fauna species are presented in Table 4-11, based on predicted received sound pressure levels and exposure levels as presented in previously.

For the majority of directions, behavioural response impacts are expected to occur within 3.0km of the dredging activities, and within 1.5km of the supporting vessel movements respectively.

The PTS and TTS impacts are unlikely to occur unless the marine animals are exposed to the noise at very close range to the sources. For example, marine animals will suffer PTS impact if they stay more than two hours within 10m range to the noise sources, and are expected to experience TTS effects if they stay over two hours within 20m range to the supporting vessels and within 40m range to the dredging activities.

Table 4-11 Predicted zones of impact for dredging activities and supporting vessels

Scenarios	Zones of Noise Impact				Behavioural Response
	PTS		TTS		
	Exposure Time				
	< 2hr	> 2hr	< 2hr	> 2hr	
Dredging at T0	Not Occurring	< 10m	< 10m	< 40m	~ 3.0km
Workboat/tug at T0				< 20m	~ 1.5km
Transfer Vessel in Transit					~ 1.5km

As discussed above, marine animals can only experience PTS or TTS impacts if they stay in close proximity to the noise sources (10m to 40m) with long exposure periods (up to more than 2 hours). The seafloor habitat in the area surrounding the dredging footprint is not known to be utilised by marine animals, and is not unique to the Abbot Point region. Marine animals have no habitat or breeding related need to be within 40m of the dredge for any length of time. Marine animals that move to within 40m of the dredging activity will actively move away before any impacts due to underwater noise occur (>2 hours exposure). . Therefore, it is unlikely that PTS or TTS impacts will occur to any assessed marine fauna species as a result of the dredging activities and associated supporting vessel movements. As such, no monitoring and noise mitigation measures are considered as necessary.

The operations of the proposed dredging activities and associated workboat or tug can potentially cause behavioural responses from assessed marine fauna species within a 3.0km range. While megafauna were found on occasion near the project area during targeted surveys, the area and its close surroundings were not used as resting grounds for any assessed marine fauna species. Moreover, the proposed dredging operation is within close



proximity to the existing T1 which can potentially elevate the ambient noise levels in the surrounding waters significantly. Therefore, the disturbance effect caused by the proposed dredging activities to the assessed marine fauna species is expected to be limited.

The noise stress caused by the transfer vessel supporting the dredging operations travelling between Bowen and Abbot Point is only transient in nature, and the consequent disturbance effect to the assessed marine fauna species is expected to be minimal.

4.3.3.3 Residual risk

Project noise impacts have been assessed and mitigated in relation to terrestrial and marine ecological values. They are addressed in Section 4.3.7 and Section 4.3.8 which follow, and represent low risk.

4.3.4 Groundwater

4.3.4.1 Numerical groundwater model

A numerical groundwater flow and (salinity) transport model was developed to simulate the impact of the proposed dredged material on the groundwater receiving environment.

The onshore placement of dredged material will potentially provide a short-term 'pulse' of additional recharge to the underlying groundwater regime. The purpose of the groundwater modelling was to assess the likely impact of saline seepage from the proposed dredged material on the receiving groundwater environments beneath the T2 development area and adjoining industrial land, and also the adjacent wetland and coastal dunes areas.

Full details of the model such as inputs and calibrations are contained in the Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) groundwater technical report (**Appendix L**), while a summary of key inputs is provided below.

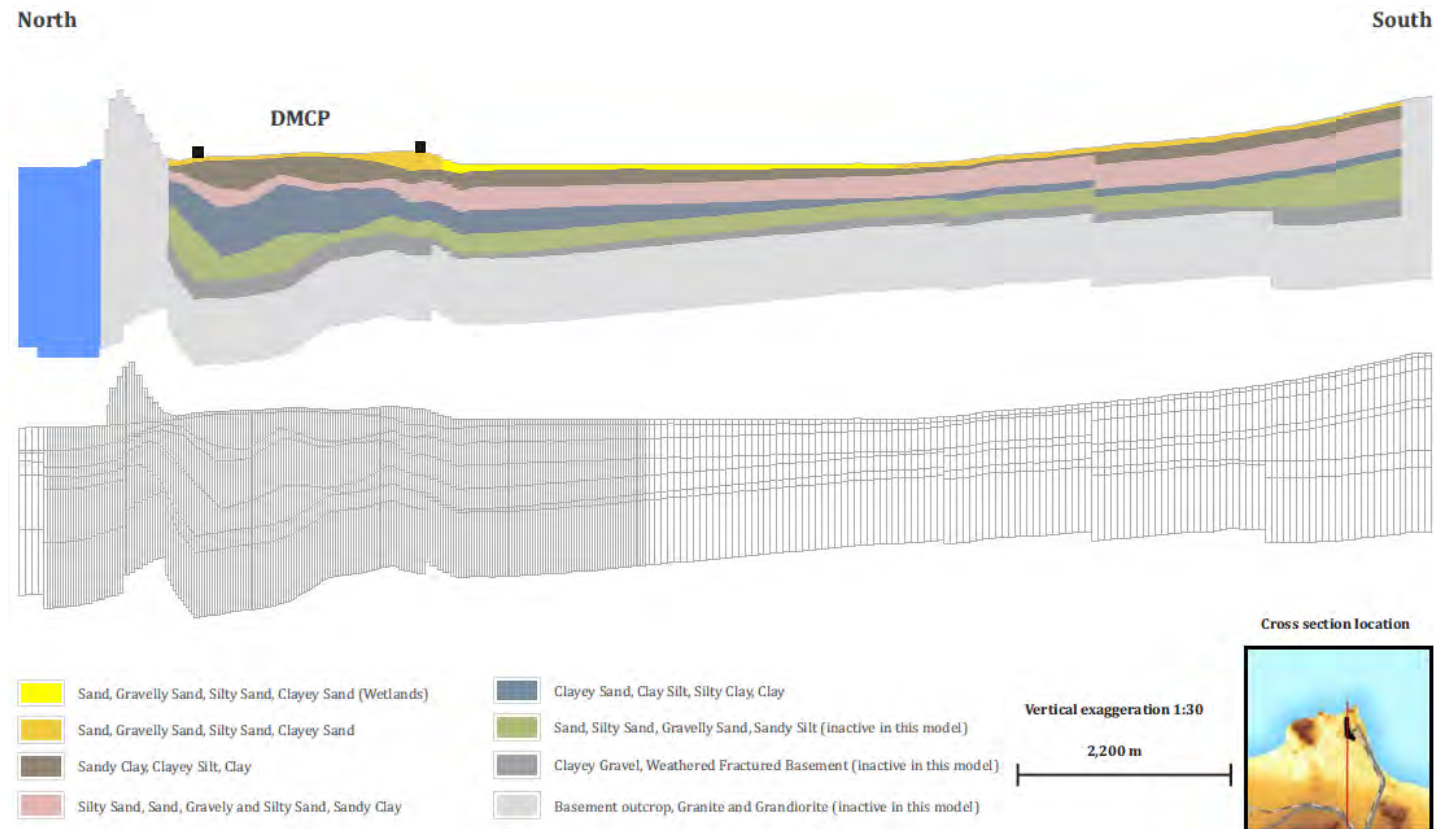
Model layers

Model layers to represent the sub-surface stratigraphic profile were constructed using local geotechnical borehole logs for the Abbot Point area (Connell Hatch, 2009) supplemented with borelogs from the Department of Natural Resources and Mines Groundwater database of registered bores to provide coverage over the entirety of the model domain. These are depicted in Figure 4-4 and described in Table 4-12. DMCP development will intersect the top three layers (Layer 1, Layer 2, Layer 3).



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Source: Reproduced from AGE (2015; **Appendix L**)

Figure 4-4 Model grid cross section - north to south



Table 4-12 Model layers

Model layer	Hydrostratigraphy	Thickness Range (m)
1	Sand, gravelly sand, silty sand, clayey sand, basement geology outcrop, topsoil	1-276
2	Sandy clay, clayey silt, clay	1-23
3	Silty sand, sand, gravelly and silty sand, sandy clay	1-11
4	Clayey sand, clay silt, silty clay, clay	1-27
5	Sand, silty sand, gravelly sand, sandy silt	1-28
6	Clayey gravel, weathered basement fractured rock	1-20
7	Basement geology - granite, granodiorite, diorite (unweathered), siltstone, sandstone	20

Liner

Consistent with the DMCP engineering design, the model also considered the inclusion of the low permeability horizontal flow barrier liner around the inside wall and down through the upper sandy layer (Layer 1) and upper most clay layer (Layer 2), down to the top of the underlying sandy layer (Layer 3). This approach assumed that the upper sand and clay layers were cut off from the DMCP by the liner, making the flow path out of the DMCP through the underlying sand layer (Layer 3). The model used the horizontal flow barrier (HFB) package to simulate the effect of a vertical low permeability liner.

The model was also used to determine the effect of the DMCP on groundwater conditions without the inclusion of a liner.

Time

Climate plays an important part in the groundwater dynamics at the site with very distinct dry and wet seasons. The model was used to assess the impact of climate variability on the impacts with three specific climates. The datasets represented low, average and high rainfall periods respectively.

A transient groundwater model was used to represent the seasonal nature of the wet and dry season in the region and the dynamic nature of water levels within the groundwater system and its connection with the wetland. A transient groundwater model was also required to represent the filling of the DMCP.

Simulation summaries

Table 4-13 represents a summary of the simulation.



Table 4-13 Simulation summary

Simulation	Rainfall	Condition
Layers 1 and 3	Low	End of dredging
Layers 1 and 3	High	End of dredging
Layers 1 and 3	Low	Six months post dredging
Layers 1 and 3	High	Six months post dredging
Layers 1 and 3	Low	One year post dredging
Layers 1 and 3	High	One year post dredging
Layers 1 and 3	Low	Three years post dredging
Layers 1 and 3	High	Three years post dredging

Note: 2001 rainfall data has been used to simulate a 'low' rainfall scenario, while 2012 data has been used for an 'average' scenario, and 2011 data for a 'high' rainfall scenario

4.3.4.2 Groundwater seepage from the DMCP

Table 4-14 shows model predicted groundwater seepage out of the base of the DMCP into the underlying sandy layer (Layer 3). This is represented for the lined DMCP scenario for dry and wet climate conditions. The pulse of groundwater flow in the first week of operation represents the initial filling of the unsaturated zone under the DMCP footprint. Thereafter, from the second week onwards, the predicted seepage rate declines to quasi steady state conditions once this zone becomes saturated.



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Table 4-14 Predicted seepage from DMCP (with horizontal flow barrier liner)

Period (Week)	Seepage Rate (ML/week)	
Week	Low Rainfall Condition	High Rainfall Condition
1	70.3	53.0
2	5.7	4.8
3	5.4	4.6
4	5.2	4.4
5	5.0	4.3
6	4.8	4.2
7	4.7	4.1
8	4.6	4.0
9	4.5	3.9
10	4.4	3.8
11	4.3	3.8
12	4.2	3.7
13	4.2	3.6
Total	127.3	102.2

Maximum predicted seepage out of the proposed DMCP is 10ML/day (70.3ML/week) for a dry climate condition. This declines to around 0.5ML/day at the end of dredging (high rainfall condition).

4.3.4.3 Changes to the groundwater regime due to the DMCP seepage

A key impact on the groundwater regime is increased groundwater levels due to seepage from the DMCP. This results in a temporary mounding of groundwater levels. Outputs of the model are listed in Table 4-15. Details on the full results of modelling are described further in **Appendix L**.

It is noted that the heights of mounding are shown relative to groundwater conditions in a scenario where the DMCP is absent, and thus provided a baseline for determining changes in seepage for each scenario.



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Table 4-15 Extent of temporary groundwater mounding

Simulation	Rainfall	Height of Mounding (m)		Extent of Mounding (m)	
		No HFB1	With HFB1	No HFB1	With HFB1
Layer 1, end of dredging	Low	6.8	6.8	150-300	100-200
Layer 3, end of dredging	Low	7	7	300 - 1,100	300 - 1,100
Layer 1, end of dredging	High	5.5	5.5	100 - 400	150 - 400
Layer 3, end of dredging	High	6	6	300 - 1,150	300 - 1,150
Layer 1, 6 months post dredging	Low	4.5	5	200 - 400	200 - 400
Layer 3, 6 months post dredging	Low	4.5	5	350 - 1,050	400 - 1,050
Layer 1, 6 months post dredging	High	2.5	3.5	150 - 850	200 - 850
Layer 3, 6 months post dredging	High	3	3.5	350 - 800	350 - 900
Layer 1, 1 year post dredging	Low	3	4.5	100 - 600	200 - 650
Layer 3, 1 year post dredging	Low	3	4.5	400 - 1,100	450 - 1,150
Layer 1, 1 year post dredging	High	2	3	50 - 850	250 - 850
Layer 3, 1 year post dredging	High	2	3.5	300 - 700	350 - 900
Layer 1, 3 years post dredging	Low	2	2.5	50 - 400	150 - 650
Layer 3, 3 years post dredging	Low	2	2.5	200 - 1,000	400 - 1,100
Layer 1, 3 years post dredging	High	1	1.5	100 - 600	200 - 850
Layer 3, 3 years post dredging	High	1	1.5	50 - 150	450 - 650

Note: HFB - horizontal flow barrier (i.e. low permeability membrane)

The simulations that include the HFB and that represent the low permeability liner along the DMCP internal batters show less mounding occurring immediately beyond the DMCP footprint in the surficial layer. That is, the lined batters restrict horizontal flow through the upper sandy layer (Layer 1). The seepage flow path from the DMCP is therefore horizontally through the underlying sand layer (Layer 3). Due to an upward head gradient between Layers 3 and 1, water moves upwards into Layer 1 at a rate limited by the intervening upper clayey layer (Layer 2) outside of the DMCP footprint.

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Figure 4-6 and Figure 4-7 show one example model output representing groundwater mounding associated with Layers 1 and 3, end of dredging time period and high rainfall. These figures show the mounding occurs principally within Layer 3 and extends upwards into Layer 1. The extent of this mounding is therefore greater in Layer 3, extending some 300m to 1,150m from the DMCP depending on the rainfall condition.

Post dredging, the lateral extent of mounding predicted outside of the DMCP for Layer 1 increases as the mound gradually flattens and migrates away from the DMCP footprint. This is at its greatest extent 6 months post dredging when the groundwater mound extends some 750m to the east and 850m to the south-east, south of the railway loop.

Within Layer 3, inclusion of the HFB within the model, representing the lined DMCP batters, results in an increased extent of groundwater mounding post dredging. This is due to a greater volume of seepage into Layer 3 as a result of the HFB restricting groundwater flow into Layer 1.

The height of the groundwater mound varies depending on the climate condition simulated. This is a function of different groundwater levels across the model domain for each climate condition. A high climate condition will result in a higher background groundwater level compared to a dry climate condition. The maximum height of groundwater mounding occurs within the DMCP footprint and does not extend above the DMCP operating level.

Outside of the DMCP footprint, the groundwater mound in Layer 1 remains below the ground level, due mainly to evapo-transpiration processes, with no surface expression predicted. The model predicts groundwater mounding in Layer 3 that is higher than the ground surface, but not extending upwards through Layers 2 and Layer 1. This is due to the predicted groundwater level in Layer 3 being confined beneath the upper clayey layer represented as Layer 2 in the model. That is, the groundwater within Layer 3 is pressurised because of the overlying Layer 2 (upper clayey layer) limiting hydraulic connection through these upper sedimentary units. This pressure head within Layer 3 is referred to as a potentiometric surface. The extent of this groundwater potentiometric surface is at its greatest extents at the end of dredging. Figure 4-7 shows the potentiometric surface (not actual physical groundwater levels) in relation to the ground surface. The maximum height of this potentiometric surface above the ground surface is greatest at the end of dredging (3.6m) and declines to 0.5m around 3 years post dredging.

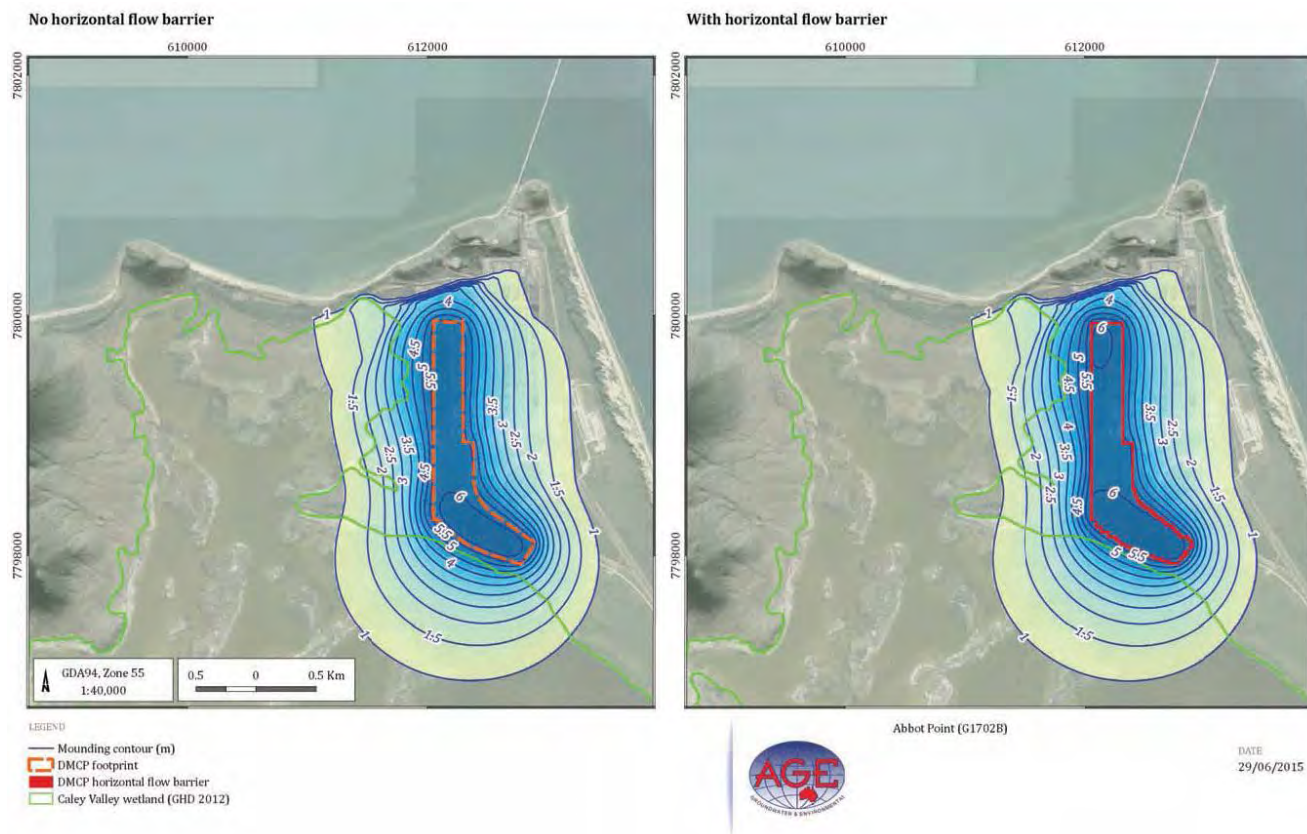
Hence, where the upper clay layer (Layer 2) is present and exists above the lower sandy layer (Layer 3), the groundwater mounding predicted in Layer 3 is not anticipated to result in any surface expression above the ground surface.

While a surface expression of groundwater from the mounding of groundwater caused by seepage is not anticipated, a 'what if' scenario was considered by the groundwater modellers and a reasonable worst-case scenario developed for consideration as an additional input in the modelling of the wetlands by BMT WBM (refer **Appendix L** and **Appendix O**).



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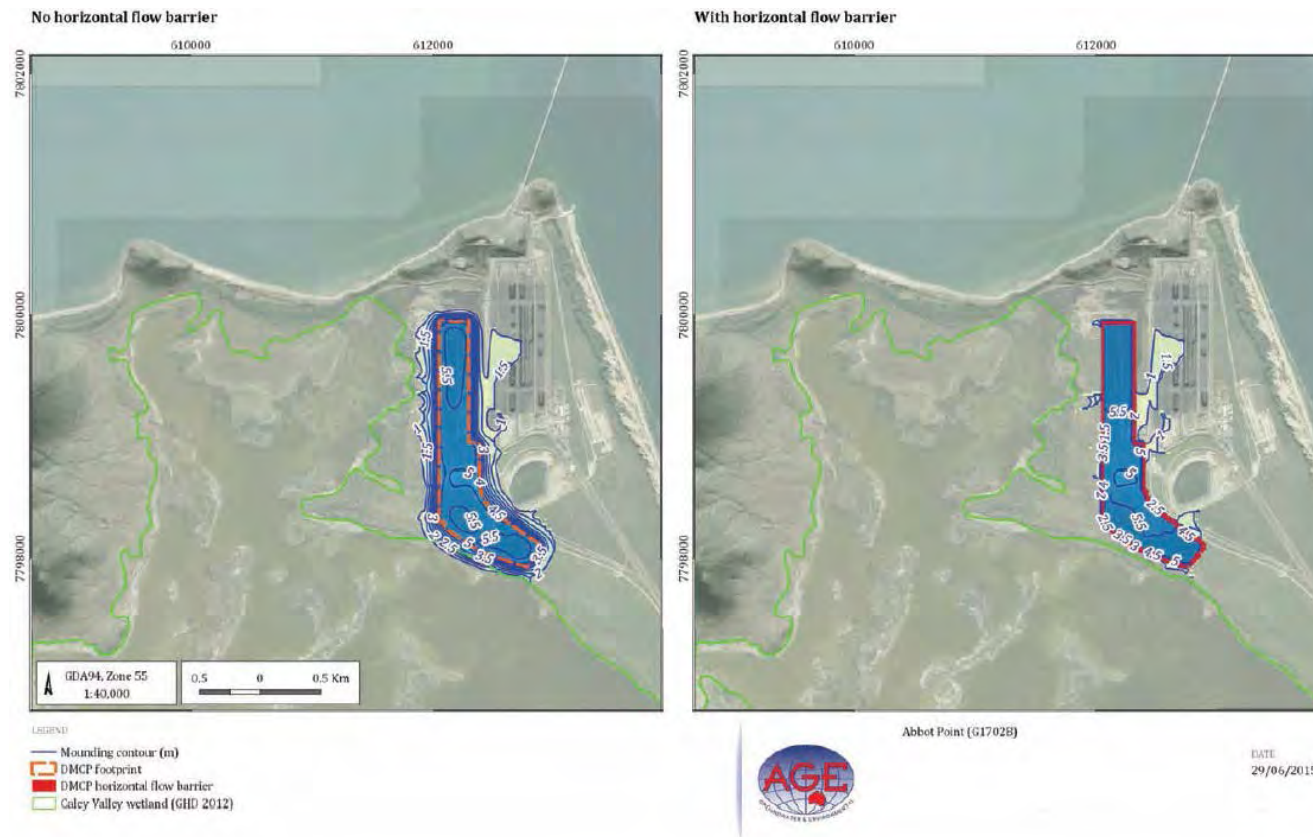
Source: Reproduced from AGE (2015; **Appendix L**)

Figure 4-5 Predicted groundwater mounding - Layer 3, end of dredging, high rainfall



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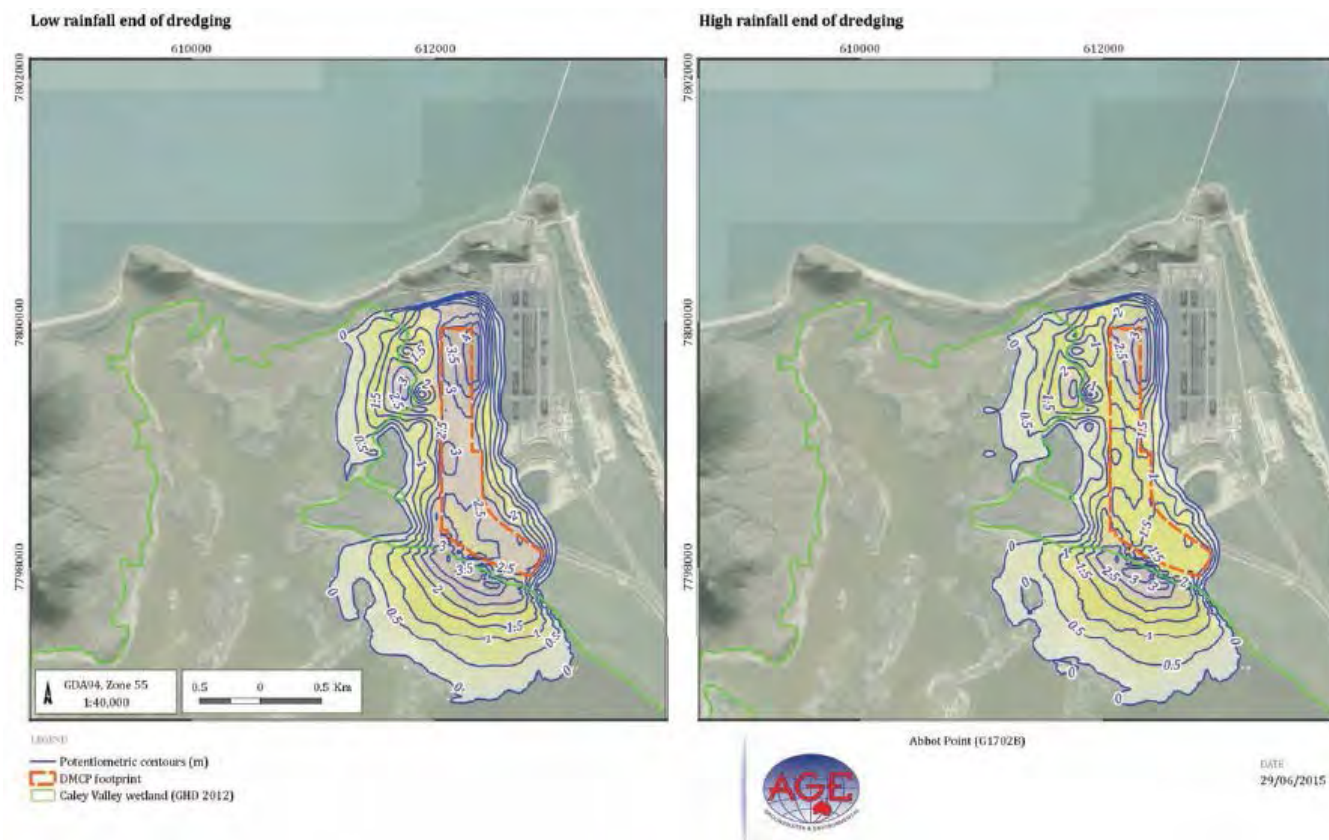
Source: Reproduced from AGE (2015; Appendix L)

Figure 4-6 Predicted groundwater mounding - Layer 1, end of dredging, high rainfall



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Source: Reproduced from AGE (2015; **Appendix L**)

Figure 4-7 Predicted height of groundwater potentiometric surface above ground surface - Layer 3, end of dredging



4.3.4.4 Geochemical characteristics of dredged material

A review of the existing reports in relation to the dredged material sediment quality was undertaken to determine indicative return water quality data that could be expected to be associated with the dredged material. Details of this review are contained in the AGE Groundwater Technical Report (refer **Appendix L**). Golder Associates has prepared a Preliminary Acid Sulfate Soils Management Plan (refer **Appendix X**), which provides more detail on the potential for Acid Sulfate Soils in the dredged material and management measures designed to avoid impacts to groundwater and the nearby Caley Valley Wetlands. These are summarised below.

Potential acid generation

GHD (2012) conducted ASS analysis on samples collected from 69 locations across the area to be dredged. A total of 12 of these locations are within the T0 dredging area, however samples from the adjacent T2 and T3 sites are considered to be representative of the T0 material due to their proximity and similarity of soil characteristics.

The GHD (2012) investigation across the area to be dredged generally indicated the following:

- Soil profiles across the areas to be dredged are generally comprised of about 2m of marine sediments (loose/soft sands, clayey sands and sandy clays) overlying alluvial deposits of firm to very stiff sandy clays.
- Laboratory tests on recovered samples indicated that the marine sediments were PASS with a natural neutralising capacity greater than the acid generating capacity, likely due to the presence of shell and other calcareous materials throughout the sediment. This suggests that these marine sediments are 'self-neutralising'.
- Laboratory tests on recovered samples indicated that the underlying firm to very stiff alluvial deposits are not ASS. ASS management measures are therefore not required for these materials.

GHD (2011) conducted offshore geotechnical investigations for a proposed Multi Cargo Facility about 3km east of the T0 dredging area. This investigation encountered a similar surface layer of marine sediments and these samples may also be considered representative of the material to be dredged. Again ASS testing on the marine sediments from the Multi Cargo Facility indicated that these were self-neutralising PASS.

Whilst the investigation conducted across the T0 dredging area does not meet spatial requirements of Queensland Acid Sulfate Soils Investigation Team, relatively homogenous conditions (across the T0, T2 and T3 dredging area) were encountered and the findings are considered to be suitable to develop an ASSMP for the project.

The available ASS investigation results indicate that the marine sediments offshore of Abbot Point are self-neutralising. The *Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines 2014* (Soil Management Guidelines) have been used in assessing the risk of generating acidity in disturbing the marine sediments and in developing management strategies that avoid environmental harm. Application of the Soil Management



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Guidelines places the Project in the extra high treatment level category due to the acid generating potential and the volume of material to be dredged. A conservative approach was adopted in categorising the dredged material, with the self-neutralising capacity of the dredged material not taken into account.

For ASS disturbance in the extra high level treatment category, the Soil Management Guidelines require a comprehensive environmental management plan to be formulated providing for ongoing management and monitoring of the effects of the disturbance of ASS through the entire construction or operation period of a project. A Preliminary ASSMP (refer **Appendix Y**) has been prepared to address these guideline requirements and to achieve best practice environmental management. With mitigation and management measures in place, the residual risk of environmental harm is expected to be low.

The Preliminary ASSMP also considers the potential for overstated neutralising capacity, including:

- The marine sediments are saturated and / or have very high moisture contents with saltwater filling the pore spaces between the soil particles. The saltwater provides some buffering capacity which may overstate the available neutralising capacity indicated by laboratory tests, in the very long-term as the saltwater will leach out of placed dredged materials.
- As part of the laboratory testing process for ASS, samples are dried and ground. If large particles of shell and coral are not removed prior to grinding, the available neutralising capacity may be overstated as, in the field, these large particles would develop a gypsum coating in the presence of acid and are not a fully available neutralising source.

During operation of the DMCP, placement and associated particle size segregation and subsequent remixing of dredged material will be dependent on the methods and equipment in use by the contractor. The Preliminary ASSMP has considered the effects of:

- Segregation of dredged material due to the predominantly coarser particles (with minor trapped fines) dropping out of suspension close to the dredged material discharge location within the primary DMCP. These materials may form 'beaches' close to the discharge point, with the sediment size tapering to finer materials away from the discharge.
- Shell material is also expected to be deposited non-uniformly due to particle size and density.
- The secondary DMCP is expected to capture the finer particles. It is possible that these fine particles may not have the same neutralising capacity as indicated from offshore sampling and represent the highest risk of producing "pockets" of PASS that may generate future unbuffered acidity when dried.

The risk of dredged materials generating acid (should PASS be present) under saturated conditions during placement is very low as the presence of sufficient oxygen is required to result in acid generation.

In order to prevent and mitigate formation of acid material after completion of dredging, once the saturated conditions recede, the following management measures will be implemented:

- Characterisation/verification testing of the dredged material

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- Placement of a lime guard layer over the base of the secondary DMCP to address potential acid leaching and to precipitate metals from solution, if acid conditions occur
- Placement of crushed limestone at surface water discharge points and monitoring of water quality at these locations
- Groundwater quality monitoring surrounding the ponds.

Should unexpected formation of acid material occur, the following contingency measures would be applied, as relevant:

- Treatment of the material by lime addition and mixing
- Excavation and treatment of the material within the DMCP followed by redistribution and mixing
- Excavation and treatment of the material outside the DMCP followed by redistribution and mixing
- Placement of a limed trench at relevant sections of DMCP embankments
- Treatment of surface water runoff from the DMCP using lime dosing.

Salt

The dredged material slurry will be naturally saline, due to it being marine sediment. Whilst the salinity of the dredged material slurry is currently unknown, it is reasonable to assume that it will have a salinity approximately equal with seawater (~35,400mg/L). Most of this salinity is expected to be present in the liquid fraction (including pore water). However, once flushed with rainwater (over time post dredging), the dredged material will likely have an inherent salinity below seawater salinity.

Total metals and metalloids

Samples collected as part of the GHD (2012a) study were analysed for metals and metalloids, and the results compared against the *NAGD 2009* and the *National Environment Protection (Assessment of Site Contamination) Measure 1999* environmental investigation levels.

The results indicate that there is negligible heavy metal and metalloid concentrations within the dredging area (within likely/potential dredged material), as surface sediments and sediments at depth contained similar low metal and metalloid concentrations.

Organic compounds

Samples were analysed for BTEX, organochlorine pesticides, organophosphorous pesticides, polychlorinated biphenyls, total cyanide and TPH. Excluding TPH, the results for all samples had concentrations either less than the NAGD screening levels or the practical quantification levels (PQL), suggesting there are no contaminant substances at levels of environmental concern in the material to be dredged. Concentrations of TPH were less than the NAGD screening levels, though low concentrations were detected in some surface samples. Further laboratory analysis suggested that the TPH concentrations were due to natural vegetative oils present in surface sediments.

Polycyclic aromatic hydrocarbons were also measured and, similar to the TPH results, all had concentrations less than the NAGD screening levels, though low concentrations were

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detected in some surface samples. The detected polycyclic aromatic hydrocarbons concentrations may be due to some anthropogenic sources.

Seawater salinity

During the wet season the average salinity of seawater around Abbot Point ranged from 33,400mg/L to 34,700mg/L, compared to 36,700mg/L to 37,400mg/L during the dry season. Dredging is proposed to take place immediately following the wet season (when water will be slightly diluted), and concluding before the start of the next wet season (when waters will be more concentrated). On this basis, an average seawater salinity value of 35,400mg/L has been assumed in the modelling assessment.

Dredging return water quality within the DMCP

The supernatant (overlying water in the DMCP) or seepage from the dredged material contained in the DMCP is assumed to be saline, comparable to seawater concentration, and most likely more turbid. Based on the sediment characterisation analysis of material to be dredged, returned seawater would be of suitable quality for return to the marine environment after a suitable time.

Following completion of dredging, and depending upon the residence time of the supernatant water and time of year (i.e. wet season or dry season), water within the DMCP may be subject to evapo-concentration, whereby minerals such as calcium carbonate (CaCO_3) begin to precipitate out. Evapo-concentration of any retained seawater would likely only occur over a prolonged period during the dry season when the DMCP is not subject to rainfall input,. The potential for this is minimised through expected infiltration, drainage of material and limiting of residence time.

Groundwater seepage impacts

Information regarding the dredging location indicates that dredged material (as a bulk material) is expected to be non-acid forming, contain low concentrations of metals and metalloids and low concentrations of organic compounds. It is assumed that the slurry pumped into the DMCP will be saline, with a salinity approximating seawater concentration (~35,400mg/L). The wetland receiving environment is saline to hypersaline, with a highly saline shallow groundwater system, which is recharged periodically by seawater inundation (from king tides and storm surges).

Therefore, from an environmental geochemical perspective, the dredged material and resultant seepage would be expected to have a low to negligible impact on the currently saline to hypersaline wetland areas south and west of the DMCP area.

There is the potential for saline groundwater seepage to mound up as a result of the DMCP. However, groundwater levels in Layer 1 are predicted to remain below ground level, and confined in Layer 3 beneath the upper clayey layer (Layer 2), restricting potential for surface expression above the ground surface.

4.3.4.5 Residual risk

The environmental risk assessment (**Appendix U**) has identified and assessed groundwater risks associated with the Project. These are summarised in Table 4-16. The residual risk



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associated with changes to groundwater quality from seepage of potentially contaminated (with metals and/or organic compounds), saline, or acidic (due to exposure and deposition of PASS) dredged material within the DMCP is ranked as 'moderate', requiring monitoring and management.

Table 4-16 Risk summary - groundwater

Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Project Phases: Dredging			
DMCP operation	Dredged material contains metals and metalloids and/or organic compounds; potential adverse impact on groundwater quality	<ul style="list-style-type: none"> 112 metal and metalloids samples and 69 organic compound samples tested. Results low to negligible concentrations, vast majority of sample results below NAGD screening levels - no mitigation measure is proposed. 	Low
DMCP operation	Saline discharge to groundwater from DMCP; potential adverse impact on groundwater quality	<ul style="list-style-type: none"> Groundwater bores adjacent to the wetland have identified groundwater salinity levels 1.5 to 2.5 times seawater concentration. Wetlands are periodically inundated with seawater (king tides and storm surges) and rainfall runoff. Natural variability provides capacity and resilience to deal with temporary seawater. 	Low
DMCP operation	Oxidation of PASS dredged material leads to generation of acidic seepage	<ul style="list-style-type: none"> Dredged material is expected to be self-neutralising Seawater present during the dredging phase has neutralising effect Preliminary ASSMP outlines conservative monitoring, management and contingency measures. 	Low



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Project Phases: Post dredging management			
DMCP operation	Oxidation of PASS dredged material leads to generation of acidic seepage	<ul style="list-style-type: none"> Dredged material is expected to be self-neutralising Preliminary ASSMP outlines conservative monitoring, management and contingency measures. 	Low
DMCP operation	Post dredging operation and management of the DMCP, medium /long-term potential adverse impacts on receiving environment groundwater quality due to rainfall infiltration of stored dredged material (residual salinity, metals etc.)	<ul style="list-style-type: none"> Development and implementation of operation and decommissioning phase groundwater quality monitoring program will allow early detection and alert requirement for remediation. 	Low

The residual risk associated with changes to groundwater quality from seepage of potentially contaminated (with metals and/or organic compounds), saline, or acidic (due to exposure and deposition of PASS) from dredged material within the DMCP is ranked as moderate, requiring monitoring and management.

4.3.5 Marine water quality

The use of a CSD dredge instead of a TSHD operating in overflow mode greatly reduces the amount of sediment predicted to enter the water column as a result of dredging than the impacts assessed and approved as part of the PER for the T0, T2 and T3 Capital Dredging Project (EPBC 2011/6213). No offshore placement of dredged material is proposed, removing a principal point source of dredge sediment from entering the mid-lagoon area of the Great Barrier Reef. Use of a CSD and onshore material recovery greatly reduces potential sources of residual sediment loss to the marine environment. Loss of sediment will occur at the cutter head during active dredging and at the return water discharge point. These sources occur within about 3km from the shoreline and the associated disturbance areas are within the existing active port operational limits at Abbot Point.

Based on the marine sediment quality assessments undertaken across the dredging footprint, sediments realised into the marine environment from the action of the dredge cutter head are not expected to contain organic chemicals, heavy metals, or other potentially harmful chemicals, at concentrations that are of environmental concern or toxic to marine organisms.

The marine water quality in the vicinity of the dredging area is unlikely to be impacted by the release of any contaminant substances from the small quantity of fugitive sediments released at the dredge cutter head. Due to the operational nature of the CSD, changes in

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marine water quality from increases in suspended solids will be short lived and isolated primarily to within a 500m radius of the dredging operations.

As discussed in section 4.3.4.4 the dredged material is PASS in nature. Marine sediments which are disturbed during the dredging activities but not recovered for onshore disposal will remain saturated and will not oxidise. Therefore these residual materials will not generate acid and do not represent a risk to the marine environment.

The management of environmental risks (e.g. turbidity) associated with the dredging activities will be addressed under a separate DMP. An Outline DMP has been prepared and is provided in **Appendix W**.

The changes in water quality near the return water discharge point are also localised and of minor extent and temporary duration. However, potential for impacts due to elevated TSS (including changes in the light environment) are recognised and have been assessed in detail as discussed below.

The monitoring and management of return water during the dredging operation is addressed in the Outline DMP (**Appendix W**).

4.3.5.1 Hydrodynamic modelling approach

Detailed numerical modelling of the dredging and return water activities was undertaken by Royal Haskoning DHV (RHDHV) and is provided in **Appendix N** (Hydrodynamic Model Interrogation Report).

Three dimensional modelling was undertaken using three separate years selected from the last 20 years (RHDHV, 2015). The three separate years were chosen so as to encompass the range of climatic and oceanographic variability in a given year. The three years represented a strong El Nino event (1997) a strong La Nina event (2011) and a neutral year (2007).

Results of the modelling indicate that the plume resulting from the dredging and onshore placement activities is substantially smaller and less intense than for the dredging associated with the offshore placement outlined in previous modelling reports which addressed offshore placement (GHD, 2012b) assessed and approved as part of the PER for the T0, T2 and T3 Capital Dredging Project (EPBC 2011/6213). This difference is attributed to the different dredge type (CSD) and onshore disposal activity proposed for the Project resulting in substantially less mass of material being released into the environment when compared with the dredge type proposed for offshore placement.

The 95th percentile plots of all yearly modelling scenarios were investigated to identify the differences between the background forcing brought about by the different scenarios.

The area of TSS greater than 2.5mg/L due to the dredging is largest in 2007, the neutral El Niño - Southern Oscillation year and smallest in the strong La Nina year. The difference is due to different Metocean conditions (specifically the winds and waves) experienced in these years. The neutral year was subject to the lowest wind and wave energy out of the three years while the La Nina was subject to the highest wind and wave energy.

Higher wind and wave energy results in higher current speeds and increased re-suspension which causes the sediment released by dredging and return water operations to be transported further from the source. The increase in transport results in a reduction in the



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TSS concentrations as it becomes diluted by being transported over a large area. As a result, the material is transported away from the main plume extent and the TSS concentration is more rapidly reduced and therefore the percentile plots do not show such large plume extent.

Based on this interrogation of the 95th percentile plots, the neutral El Niño - Southern Oscillation year is when the largest area of concentrations above 2.5mg/L occurs. The 2007 neutral year represents the worst-case scenario for impacts to the marine habitat. All subsequent figures represented in the section are for the neutral ('worst-case') year only.

The model simulations were then split into two seasons, i.e. the dry season period from 1 May to 31 October and the wet season period from 1 November to 30 April. For the assessment of the potential impact on benthic light availability for seagrasses the model simulations were split in to two seasons, the seagrass growing season (July to December) and the senescence season (January to June).

The TSS in the water column varies depending upon the depth. The TSS concentrations are much higher in the near seabed layer compared to the other modelled layer (Table 4-17). The results presented are solely representative of the seabed layer and are presented as the worst-case.

Table 4-17 Variation in TSS concentrations through the water column at a site 200m away from the dredging area at model data extraction point D02

Model Layer	Median TSS (mg/L)	Mean TSS (mg/L)	Max TSS (mg/L)
Surface	0.8	1.5	12.1
Mid	4.4	5.4	22.3
Bed	13.9	16.1	79.2

To understand the spatial and temporal scale of the plumes associated with the dredging and return water, a number of model outputs are presented to provide an understanding of the spatial and temporal patterns of the dredging plume TSS, bed sedimentation (gross and net) and benthic light (PAR) availability. These include:

- Percentile TSS and sediment deposition plots
- Time series plots from a number of extraction point located at or near sensitive receptors
- Benthic light availability plots.

Specific details of the methods in the hydrodynamic modelling component of this study are outlined in **Appendix N** (Hydrodynamic Model Interrogation Report).

To understand the potential impacts to the primary sensitive receptor (seagrass) a number of different thresholds were developed and applied to the model to predict potential areas or zones of impacts. Specifics of the methods used to develop the thresholds are outlined in **Appendix Q1** (Marine Ecology).

**Section 4****Environmental Impacts****Percentile plots**

Percentile plots do not show an actual dredging plume at any point in time: they are duration-based plots which show statistical summaries of the dredging plume dispersion over the entire dredging period.

95th percentile plots represent conditions that would be expected for 5% of the dredging campaign. The use of 95th percentile outputs reflect, conservatively, conditions which could occur at most on three days (not necessarily consecutively) during the dredging campaign and may be considered as a worst-case scenario. These plots are presented and discussed in **Appendix Q1** (Marine Ecology).

The 80th percentile outputs represent conditions that would be expected for 20% of the dredging campaign. The use of the 80th percentile represents an upper value of an indicator which may cause an impact.

50th percentile outputs, from modelled scenarios, are reported to enable comparison with site median values; the recommended comparative statistic against guidelines for turbidity (ANZECC, 2000). It is considered that 50th percentile results are more likely to represent conditions that could have ecological relevance, representing conditions for at least half the total dredging campaign or approximately three to four weeks duration in this instance. However, for 50% of the time, plumes may exceed the predicted spatial extent of the 50th percentile plots.

Only 80th percentile outputs have been included in this report to represent spatial impact as a result of the Project. The median or 50th percentile plots show very little in terms of the spatial extent of the plume data.

Time series plots

Time history plots have been produced for TSS, bed thickness and daily deposition to demonstrate the variation at varying extraction points over the entire period of simulation. These plots assist interpretation of the variable nature of plumes over the duration of the dredging campaign and provide a means of determining the intensity of the impact over the duration of the dredging.

Light climate

The potential effects on the underwater light climate from suspended particles derived from dredging and return water are investigated for the Project. The objective is to estimate the change in the light attenuation from dredging activities related to background information on light attenuation collected when there are no dredging activities being undertaken.

The seagrasses likely to be impacted by turbid plumes from the dredging activities are the deeper water communities which are dominated by *Halophila* species. The nearshore communities dominated by *Halodule uninervis* are likely to be impacted by the returning water discharges.

Site-specific preliminary light requirements to be used in the modelling exercise for Abbot Point seagrasses were developed by the Centre for Tropical Water and Aquatic Ecosystem Health James Cook University Seagrass Ecology Group TropWATER (McKenna *et al.*, 2015) for the Project.

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The impact assessment requires the development of thresholds which can be applied to the hydrodynamic modelling outputs to produce zones of 'pressure' or zones of cascading impact. The development of the thresholds relies heavily on existing information on the benthic habitats and organisms currently existing in the intertidal and subtidal environments surrounding Abbot Point, their relative susceptibility to increases in suspended sediments in the water column, along with their sensitivity to reductions in benthic light availability and the level of sedimentation brought about by the Project.

Developing thresholds

The direct impacts to the marine habitat of the Abbot Point environment are related to the physical removal of the seabed during dredging. The off-site impacts include those associated with the generation of plumes during dredging and returning waters and include:

- Changes in water quality conditions associated with increases in turbidity and TSS loads in the water column at both the area to be dredged and return water area
- Deposition of mobilised sediments and changes in bed thickness from settlement of suspended sediments within the plume
- Light attenuation associated with plumes in the water column.

The impact assessment requires the development of thresholds which can be applied to the hydrodynamic modelling outputs to produce zones of 'pressure' or zones of cascading impact. The development of the thresholds relies heavily on existing information on the benthic habitats and organisms currently existing in the intertidal and subtidal environments surrounding Abbot Point, their relative susceptibility to increases in suspended sediments in the water column, along with their sensitivity to reductions in benthic light availability and the level of sedimentation brought about by the Project.

Once the ecologically relevant thresholds are developed, the areas of zones are overlaid onto the benthic habitat maps. Estimates of the spatial influence of the activities (zone of influence), the irreversible (zone of high impact) and recoverable losses (zone of moderate impact) of particular habitats can then be measured.

The methods used to develop thresholds for TSS, sedimentation and seagrass benthic light requirements are outlined in **Appendix Q1** (Marine Ecology).

4.3.5.2 Hydrodynamic modelling results**TSS percentile plots**

TSS percentile plots do not show an actual dredging plume at any point in time. These plots are duration based plots which show statistical summaries of the dredging plume dispersion over the entire dredging period. Each plot contains an inset which allows for closer examination of the spatial extent of the TSS data from the return water locations and surrounds for each given percentile metric. The data representations of concentrations of TSS (mg/L) are for the modelled layer closest to the seabed only. This layer contains the highest concentrations of TSS of any layer and represents the greatest extent of plume concentration and extent.

Figure 4-8 depicts the context for the various concentrations of TSS in the water column.

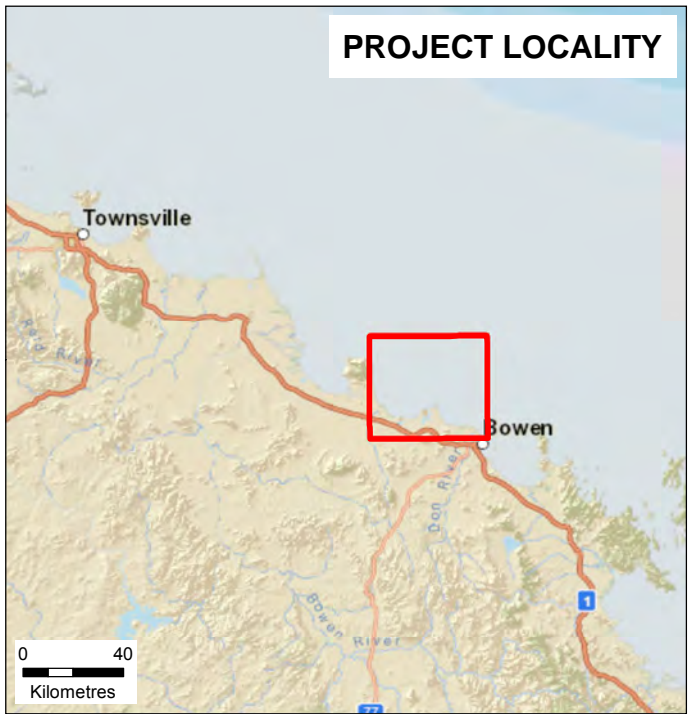
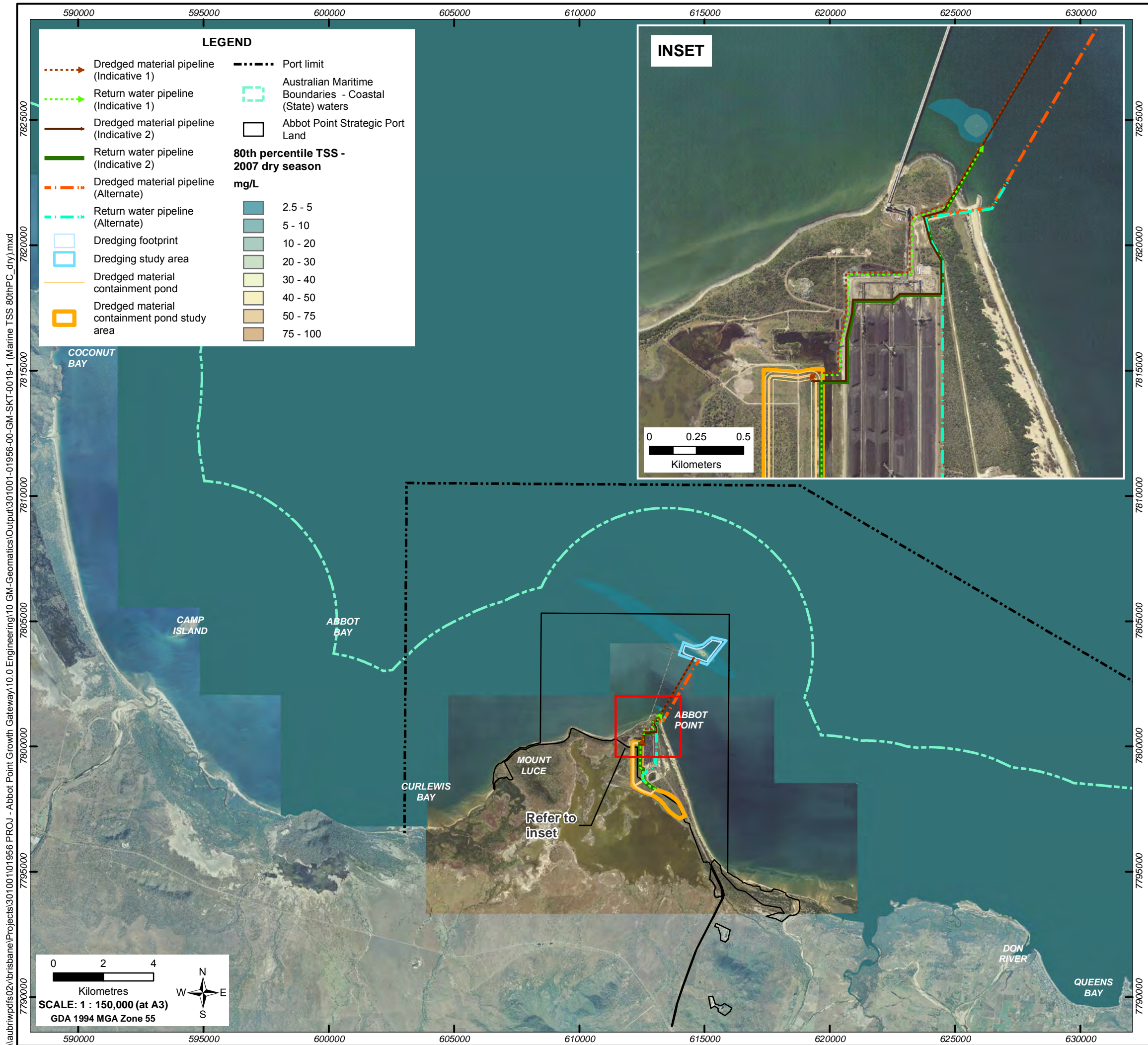


Source: Reproduced from RHDHV (2015; **Appendix N**)

Figure 4-8 Examples of a range of TSS concentrations


The TSS 80th percentile plots for the dry and wet season are presented in Figure 4-9 and Figure 4-10, respectively. The results show that the area impacted by increased TSS >5mg/L is mainly confined to the dredging area in both seasonal scenarios. In the dry season the concentrations of <5mg/L may occur in areas to the north-west from the dredging area approximately 8km distant. In the wet season the extent of the predicted concentrations <5mg/L is reduced compared to the dry season down to a distance of 4.4km from the dredging area. At the return water location the concentrations >5mg/L are confined to an area on the seabed within 100m of the return water for both seasons (refer to Section 4.3.7).

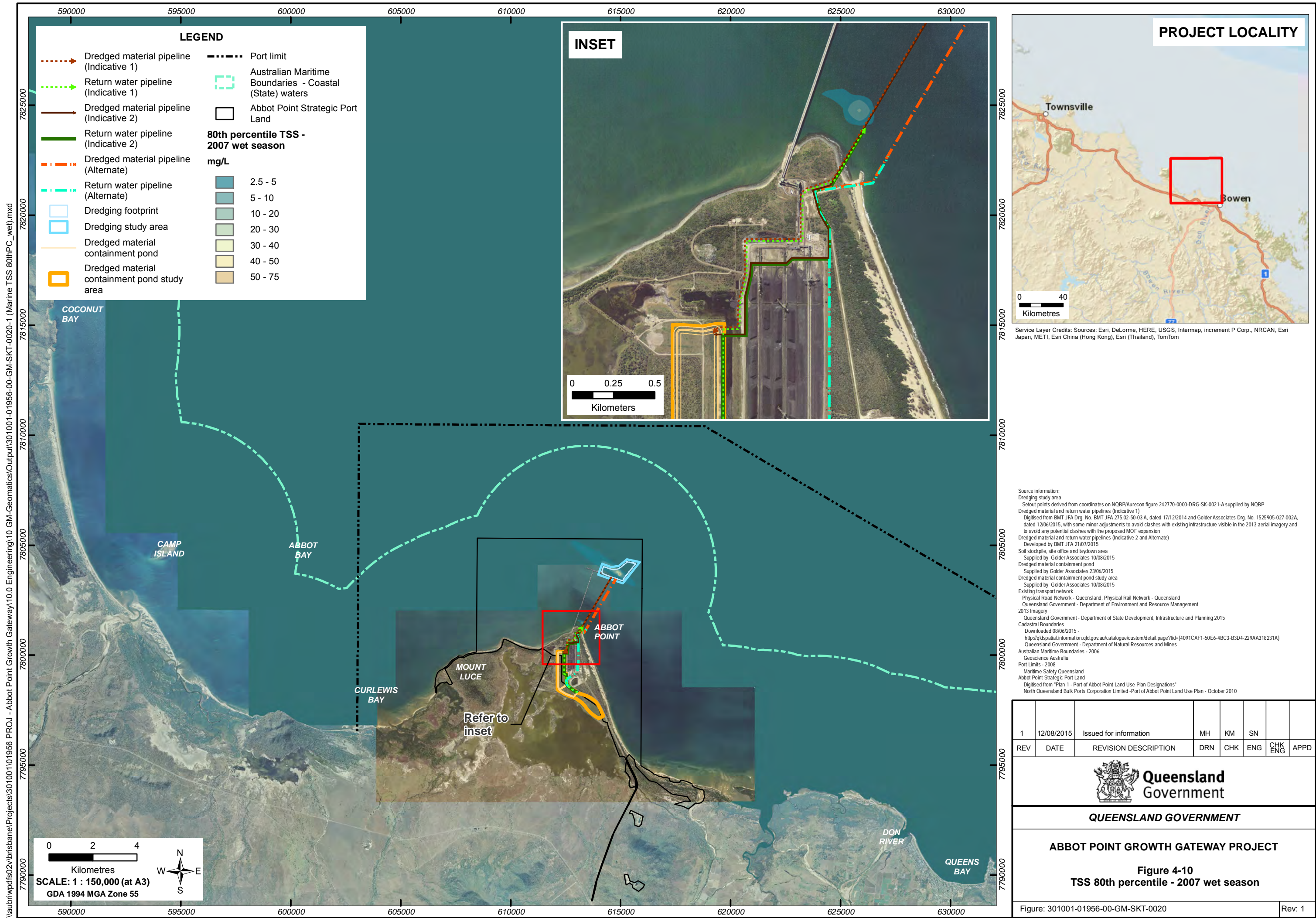
The results show that there is likely to be no interaction between the suspended sediment plumes resulting from the dredging and the return water, the areas with increased TSS remain separate.



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

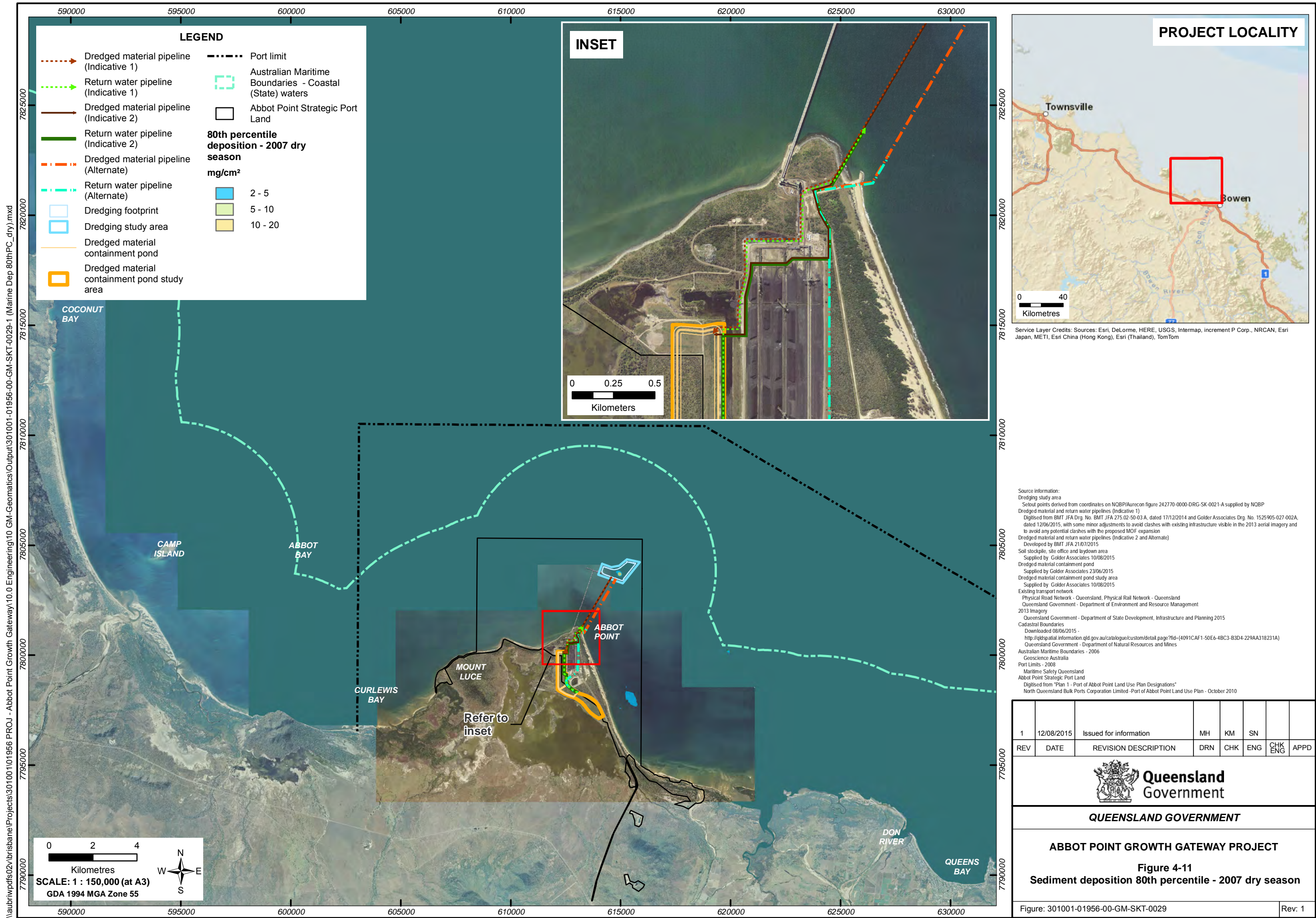
Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOP expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 - [http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=\(4091CA1F1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid=(4091CA1F1-50E6-4BC3-B3D4-229AA318231A))
Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited - Port of Abbot Point Land Use Plan - October 2010

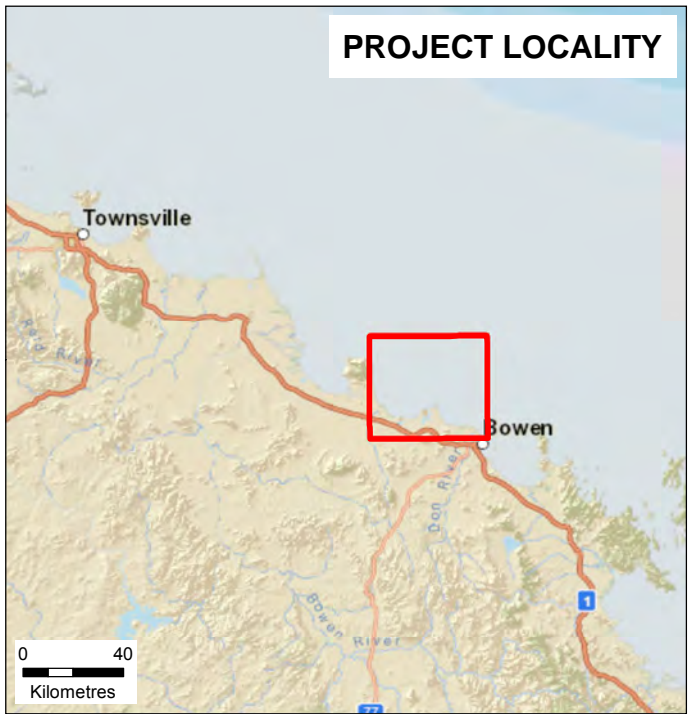
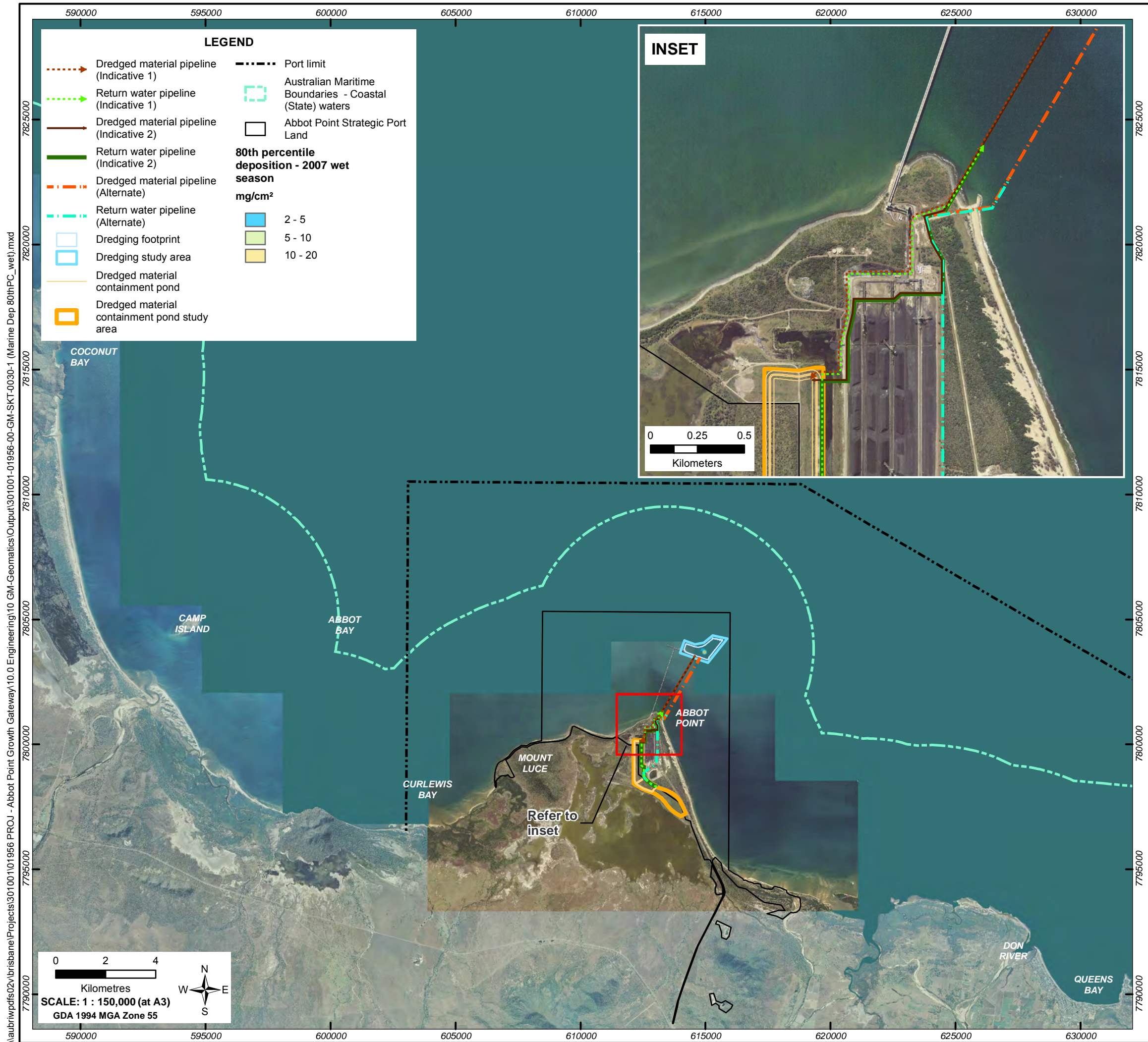
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 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 4-9 TSS 80th percentile - 2007 dry season							
Figure: 301001-01956-00-GM-SKT-0019							Rev: 1



**Sedimentation percentile plots**


The 80th percentile plots for sediment deposition (mg/cm^2) for both the dry and wet season are presented in Figure 4-11 and Figure 4-12 respectively. Each plot contains an inset which allows for closer examination of the sedimentation data from the return water location and surrounds. The results show that the area impacted by the increased sedimentation $>2\text{mg}/\text{cm}^2$ is localised to the dredging area in both season scenarios. At the return water location no areas of sedimentation are predicted to occur based on examination of 80% of the data.





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

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

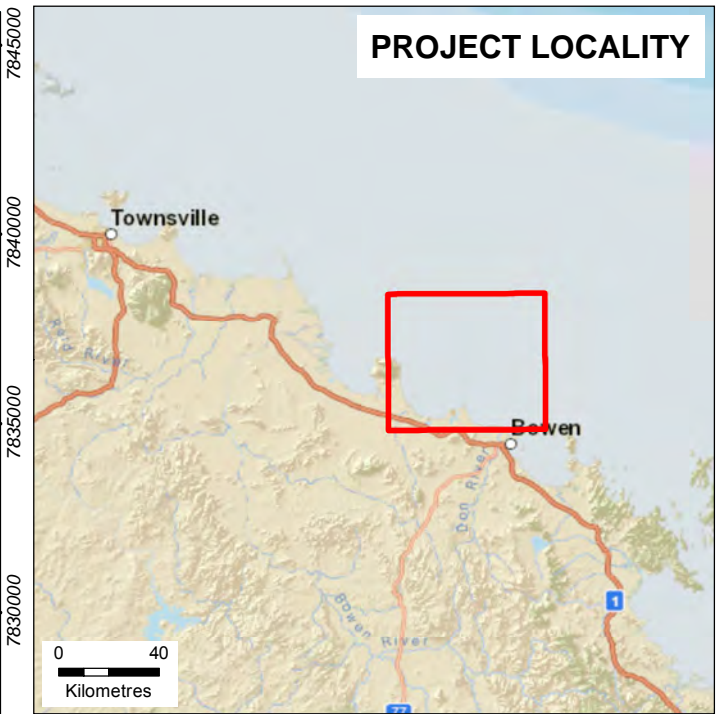
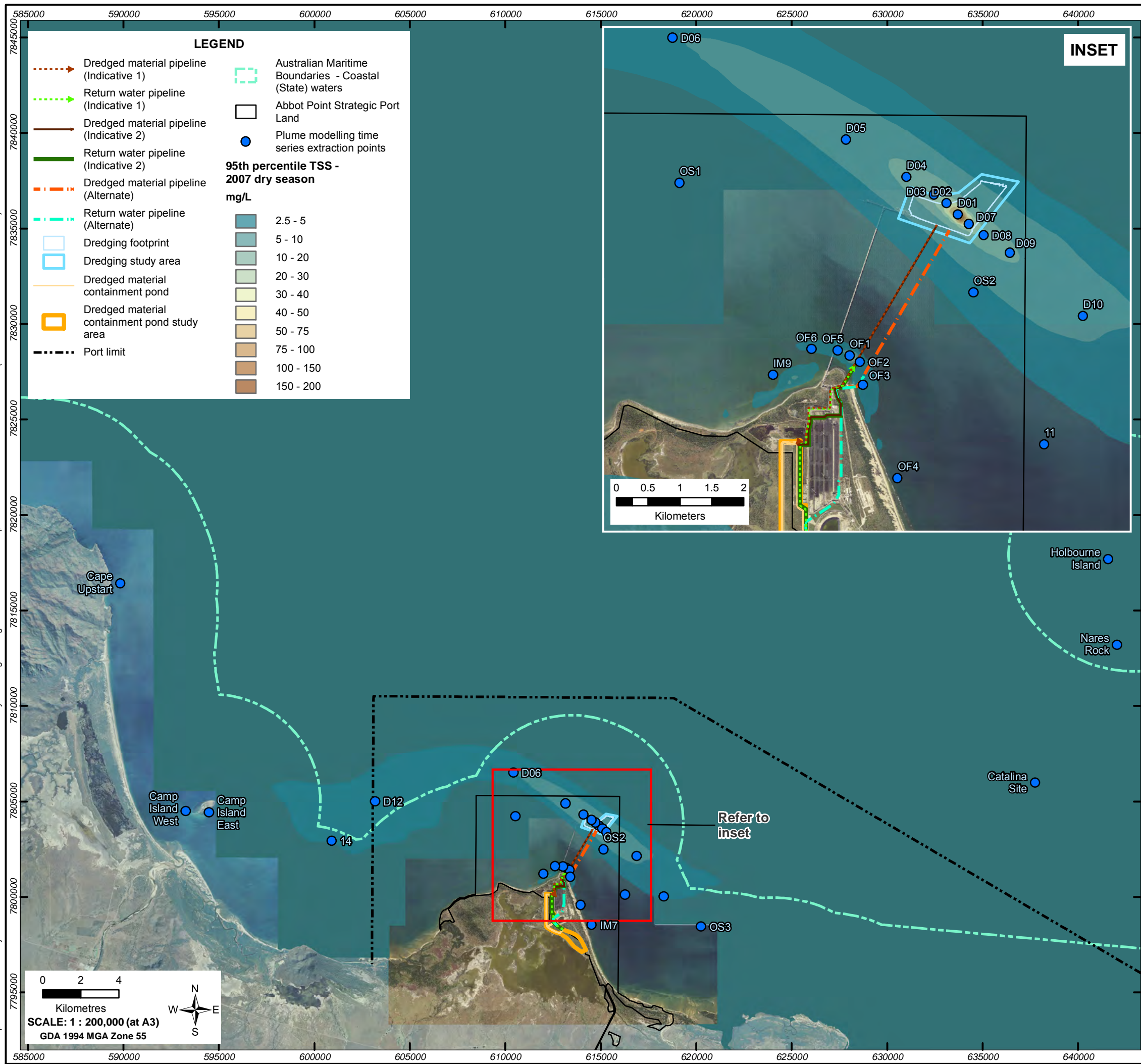
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 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 4-12 Sediment deposition 80th percentile - 2007 wet season							
Figure: 301001-01956-00-GM-SKT-0030							Rev: 1



Extracted time series


TSS, bed thickness and deposition rates data were extracted from the bottom layer of the model simulations at discrete locations (Figure 4-13). The data from these points provide more detailed information on the characteristics of the dredging plume and plume from the return water at different distances from the point source of impact. Several extraction points were also chosen to represent locations of sensitive receptor sites identified in surveys of the marine habitat. Additional sites representing the closest coral communities to the dredging activities (Camp Island) and the Catalina plane wreck site are also added.

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Figure 4-13 Locations of plume modelling time series extraction points							
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Time series data for TSS, bed thickness and sediment deposition rates for several sites of interest are presented here. For more details on all-time series locations refer to **Appendix Q1** (Marine Ecology). The sites presented here are:

- Dredging transect site D04 (1km north-west from centre of T0 dredging footprint)
- Dredging transect site D09 (1km south-east from centre of T0 dredging footprint)
- Discharge Point site OF2 (200m from discharge point)
- Camp Island East (19.2km west of centre of T0 dredging footprint).

The summary statistics for predicted TSS (mg/L) at each of the sites listed above are provided in Table 4-18.

Table 4-18 Summary statistics of time series TSS dredging and return water data from all extraction points

Site	Mean	Median	Minimum	Maximum	80 th Percentile	95 th Percentile
D04	3.5	3.0	0.4	14.5	5.0	7.6
D09	2.3	1.9	0.00	10.8	3.6	6.2
OF2	1.0	1.0	0.00	4.9	1.5	2.1
Camp Is. East	0.3	0.3	0.00	2.0	0.5	0.7

The TSS concentrations at the seafloor 1km to the north-west of the centre of T0 dredging footprint (D04) during dredging are predicted to peak at 14.5mg/L toward the end of the dredging period (Table 4-18 and Figure 4-14). For 50% of the time (median) the benthic biota in this area will experience elevations of around 3mg/L above background. The sedimentation rate ranges between 50mg/cm² and -150mg/cm² which are in response to a cycle of deposition and then re-suspension of dredged sediments linked to the daily tidal cycle and associated currents at the seafloor. This is reflected in the very small amount of sediment build up (bed thickness) which peaks at less than 0.25mm toward the end of the dredging campaign. These results would not be detectable beyond the natural seabed dynamics.

The TSS concentrations at the seafloor 1km to the south-east of the centre of T0 dredging footprint (D09) during dredging are predicted to peak at 10.8mg/L toward the end of the dredging period (Table 4-18 and Figure 4-15). For 50% of the time (median) the benthic biota in this area will experience elevations of around 1.9mg/L above background. The sedimentation rate ranges between 35mg/cm²/day and -120mg/cm²/day which are in response to a cycle of deposition and then re-suspension of dredged sediments linked to the daily tidal cycle and associated currents at the seafloor. The amount of sediment that is deposited and stays on the seafloor (bed thickness) peaks at less than 0.2mm toward the end of the dredging campaign. These results would not be detectable beyond the natural seabed dynamics.

The TSS concentrations at the seafloor 200m to the south-west of the return water discharge point are predicted to peak at 4.9mg/L (Table 4-18 and Figure 4-16). For 50% of the time



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(median) the benthic biota in this area will experience elevations of around 1.0mg/L above background. The sedimentation rate ranges between 2mg/cm²/day and -100mg/cm²/day which is in response to a cycle of deposition and re-suspension of dredged sediments linked to the daily tidal cycle and associated currents at the seafloor. This is reflected in the very small amount of sediment build up (bed thickness) which peaks at less than 0.02mm. These results would not be detectable beyond the natural seabed dynamics.

The TSS concentrations at the seafloor 200m to the east of Camp Island, 19.2km from the centre of the T0 dredging footprint are predicted to peak at 2mg/L (Table 4-18 and Figure 4-17). For 50% of the time (median) the benthic biota in this area will experience elevations of around 0.3mg/L above background. The sedimentation rate ranges between 2.5mg/cm²/day and 6mg/cm²/day which are in response to a cycle of deposition and re-suspension of dredged sediments linked to the daily tidal cycle and associated currents at the seafloor. The amount of fine sediment that is deposited for any length of time (>2 days) before being re-suspended is less than 0.006mm. The concentrations of TSS and sedimentation and the depth of bed thickness predicted to occur at Camp Island would not be discernible from background levels.



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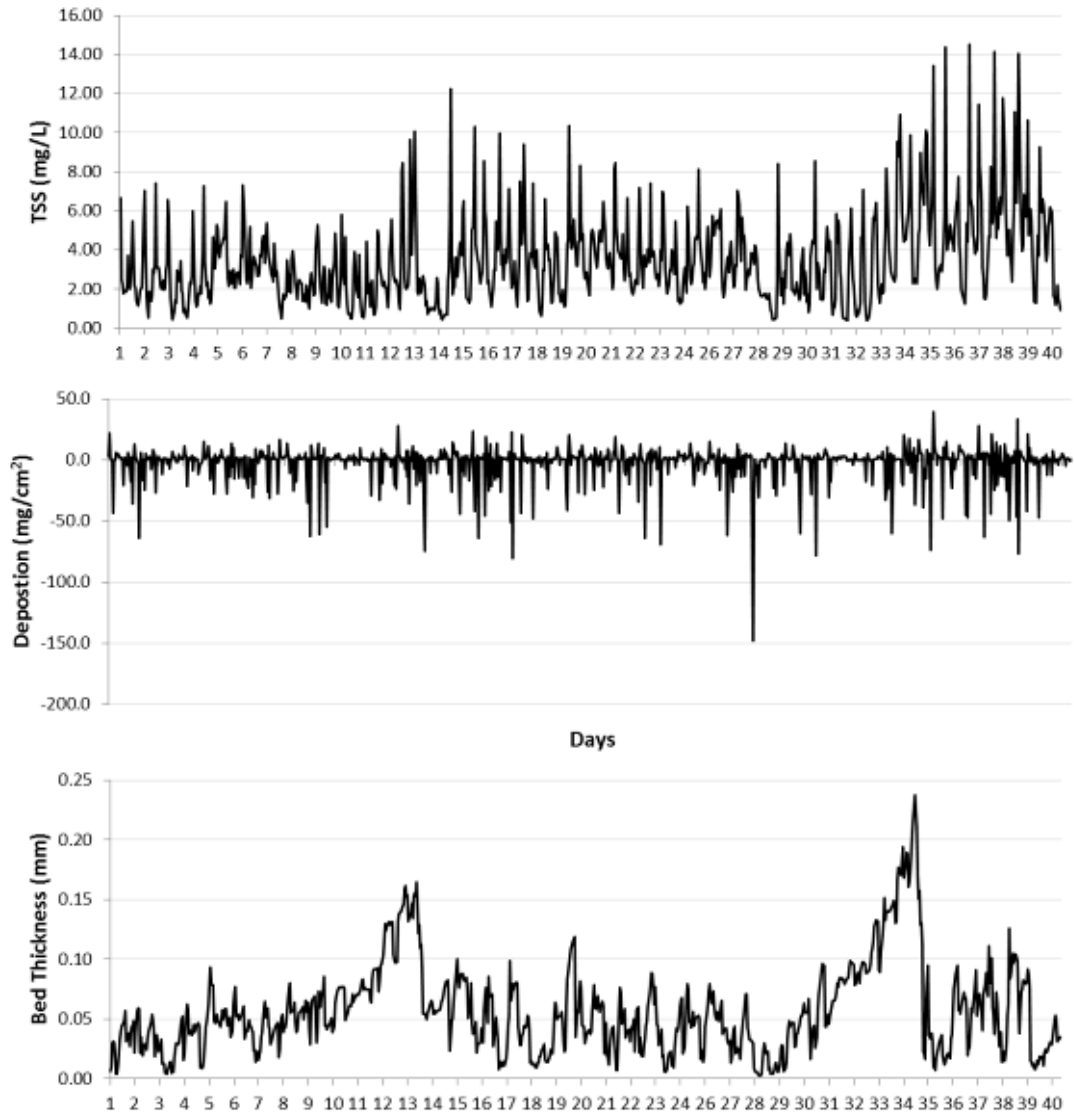


Figure 4-14 TSS (mg/L), bed thickness (mm) and sediment deposition (mg/cm²) from extraction point D04 during the dry season scenario only



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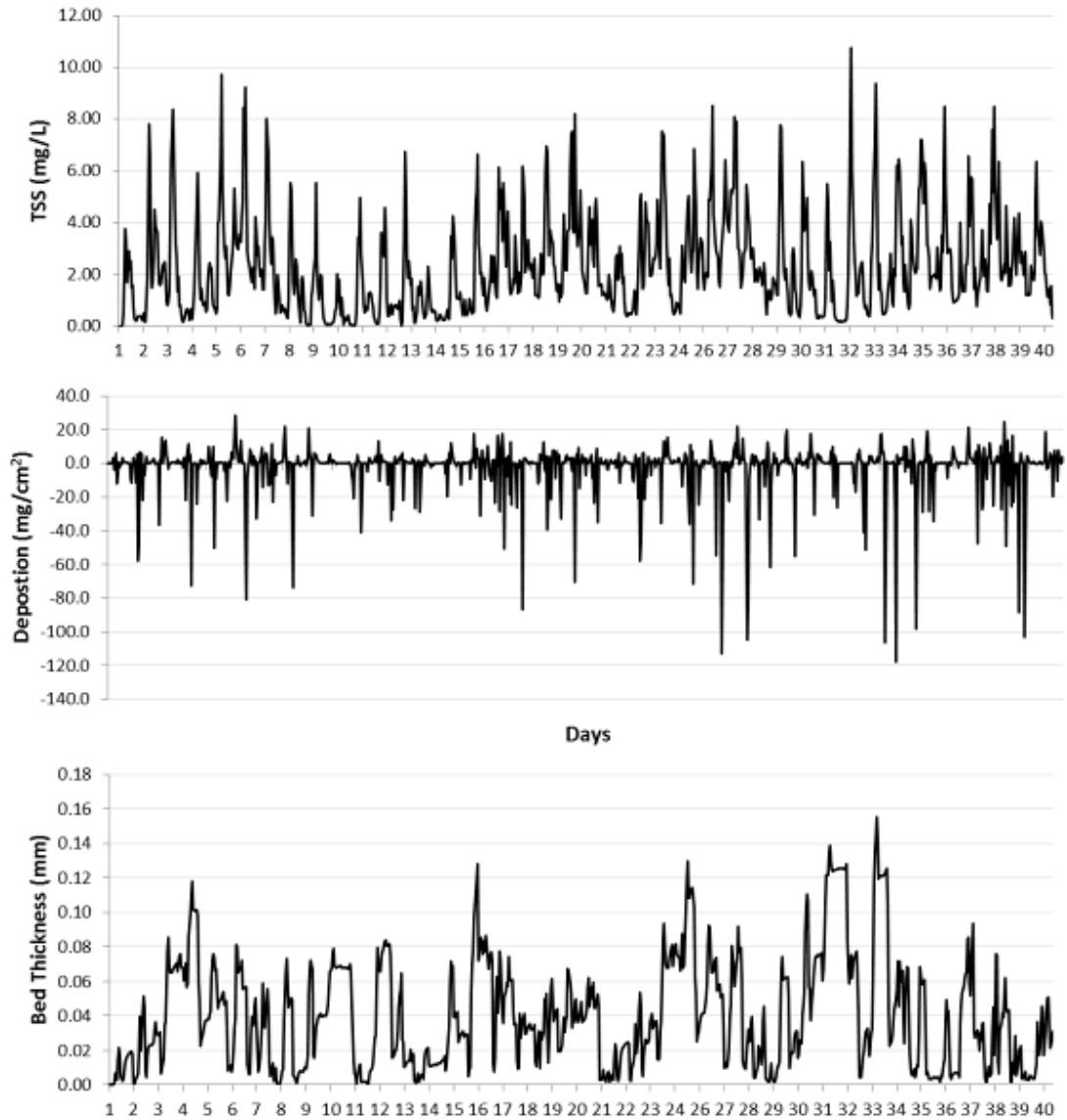


Figure 4-15 TSS (mg/L), bed thickness (mm) and sediment deposition (mg/cm²) from extraction point D09 during the dry season scenario only



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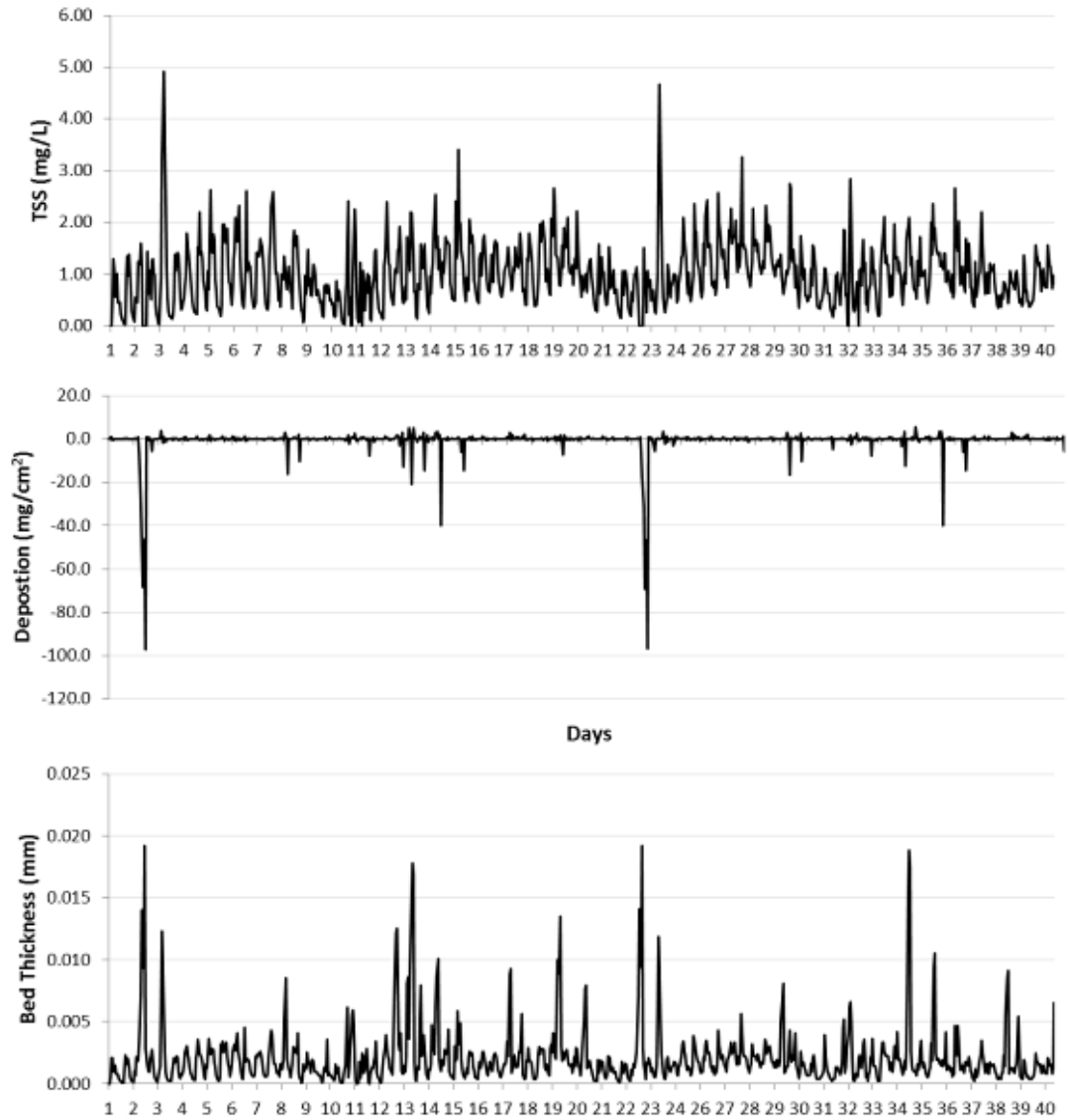


Figure 4-16 TSS (mg/L), bed thickness (mm) and sediment deposition (mg/cm²) from extraction point OF2 during the dry season scenario only



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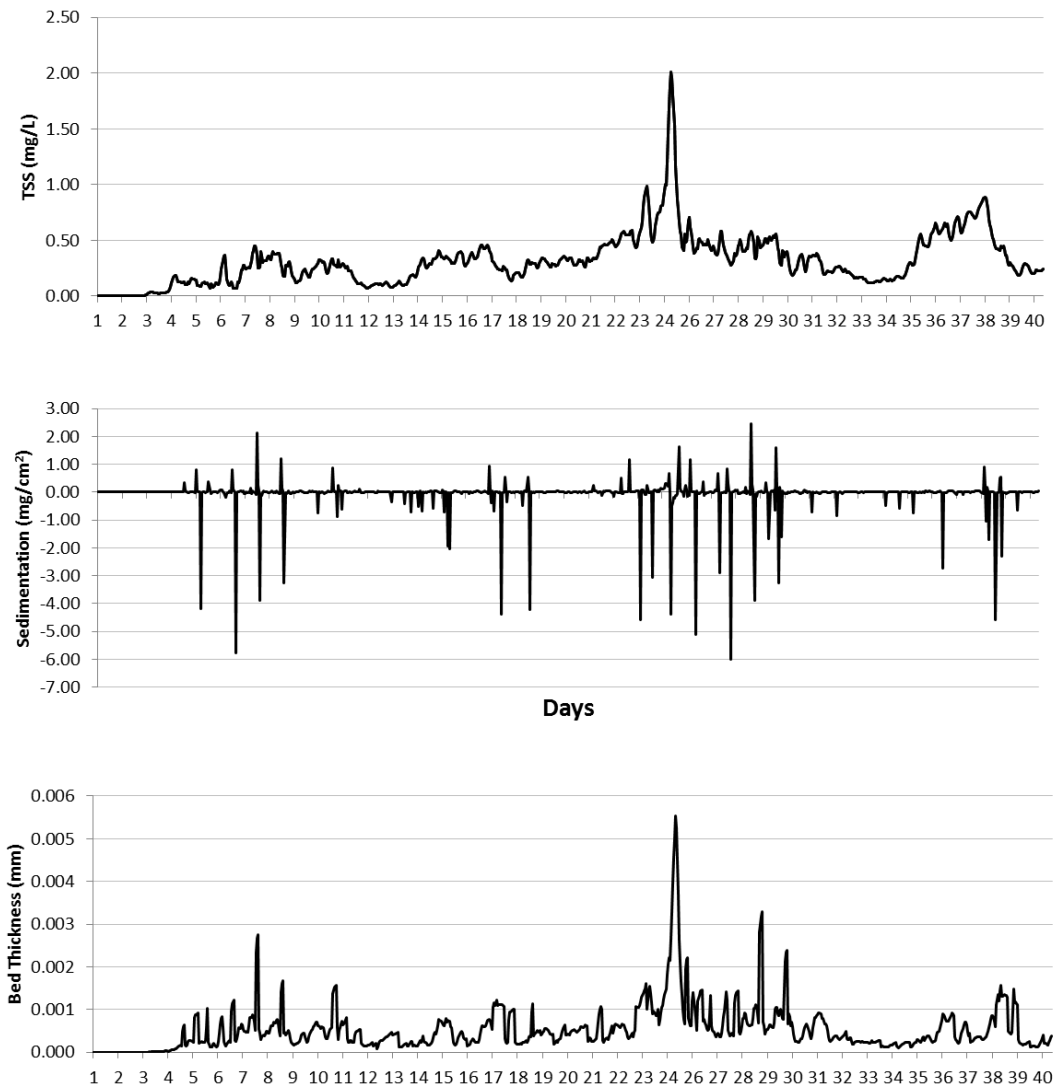


Figure 4-17 TSS (mg/L), bed thickness (mm) and sediment deposition (mg/cm²) from extraction point located at Camp Island East during the dry season scenario only

4.3.5.3 Application of thresholds

TSS

The zones of high and moderate impact and the zone of influence are based on the intensity durations and frequency of TSS thresholds (as defined in **Appendix Q1**) for the dry and the wet seasons are presented in Figure 4-18 and Figure 4-19 respectively.

The zone of high and moderate impact and the zone of influence are defined below.



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The **zone of high impact** for this assessment is contained wholly within the berth pocket dredging footprint only, where seafloor will be directly removed.

The zone of moderate impact encompasses areas where the benthic community will experience short events of low TSS (median) occurring on many occasions and short events of high TSS values (95th percentile) on a few occasions.

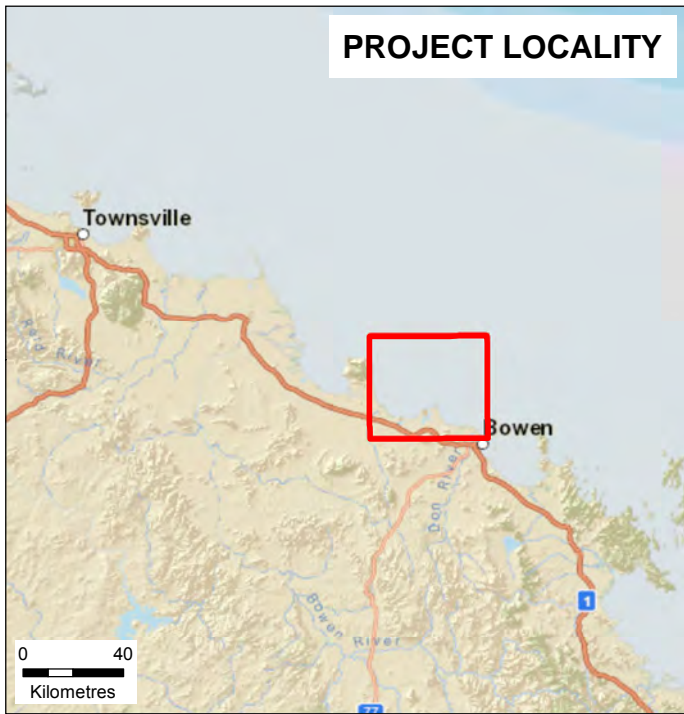
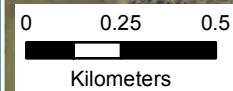
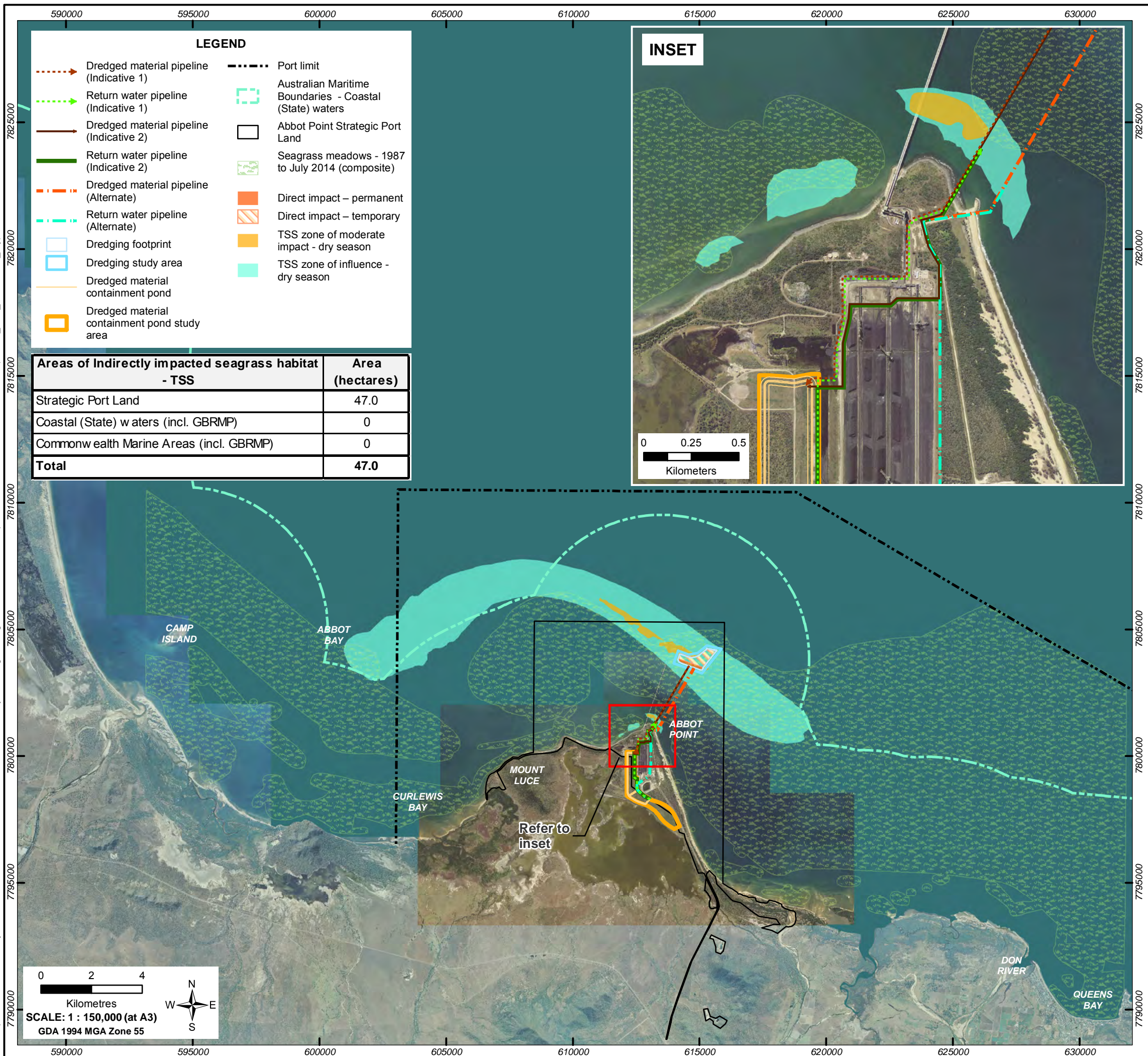
The zone of moderate impact in the dry season (Figure 4-18) due to dredging activities is larger than the wet season zone and extends approximately 4km to the north-west of the footprint. This represents an off-site impact on 46.7ha of potential seagrass habitat due to the dredging operations. The zone of moderate impact due to the returning water is a small area surrounding the end of the return pipe and represents a temporary impact to 0.25ha of potential seagrass habitat.

Seagrass abundance and growth at Abbot Point is greatly reduced in the wet season (seagrass senescence season). No impacts on seagrass are predicted to occur within this season due to elevated TSS. For comparative purposes, the zone of moderate impact in the wet season (Figure 4-19) due to dredging activities is limited to the dredging footprint and a small area to the north-west of the footprint. The zone of moderate impact due to the returning water is a small area surrounding the return water itself.

The **zone of influence** for this assessment is defined as any instance where the bottom surface layer TSS concentration in a given model cell exceeds 5mg/L at any time for 1 hour duration.


The zone of influence in the dry season extends approximately 14km to the west and 5km to the east of the T0 dredging footprint. In the wet season this zone is reduced in area and extent, extending approximately 9km to the west and approximately 4km to the east.

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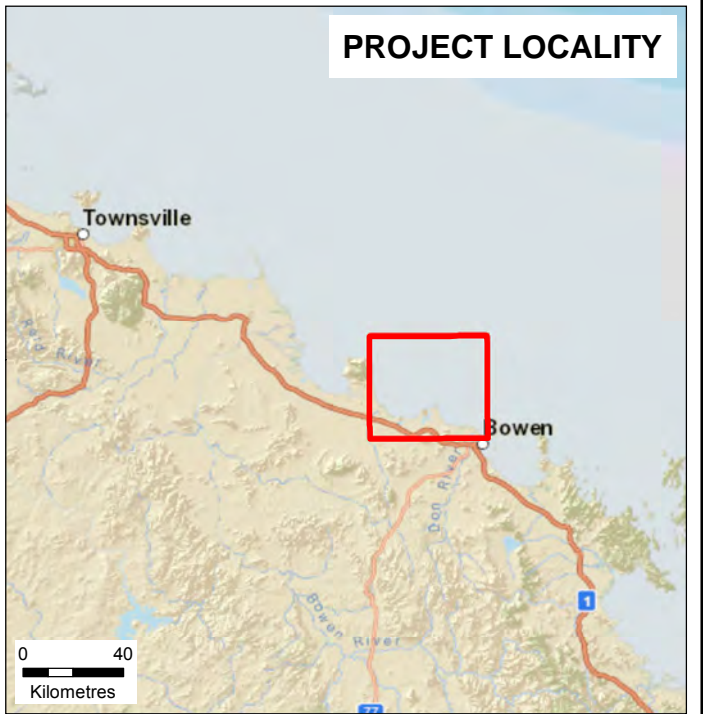
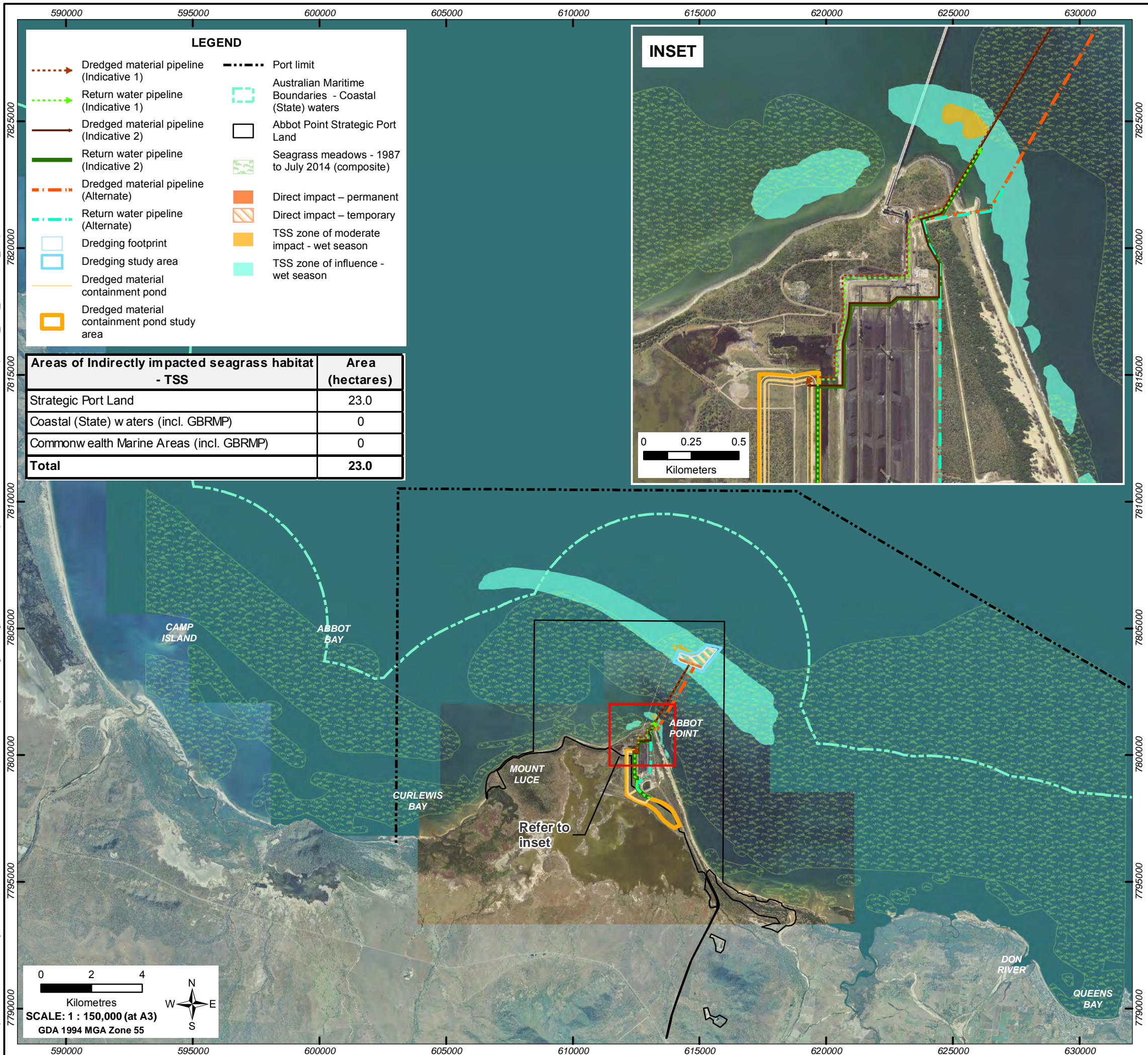


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Figure 4-18 TSS thresholds - 2007 dry season							
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Figure 4-19							
TSS thresholds - 2007 wet season							
Figure: 301001-01956-00-GM-SKT-0028							Rev: 1



Sedimentation

The GBRMPA (2010) water quality guideline trigger values for sedimentation (deposition) rates are a maximum mean annual sedimentation rate of $3\text{mg}/\text{cm}^2/\text{day}$ and a daily maximum of $15\text{mg}/\text{cm}^2/\text{day}$. Sensitive receptors such as coral communities within this zone are predicted to experience deposition conditions which may cause sub-lethal impacts only. These threshold values were applied to the model to predict the extent of a zone of moderate impact for both seasons. These thresholds are also used to predict the impact of elevated prolonged sedimentation rates on seagrass communities. This is a conservative approach because seagrass communities are considered more resilient to elevated and prolonged sedimentation rates than coral communities.

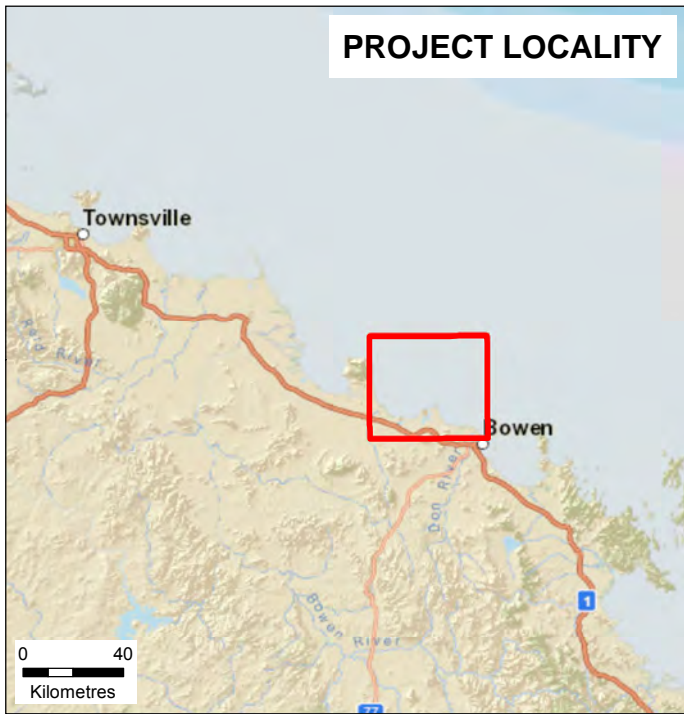
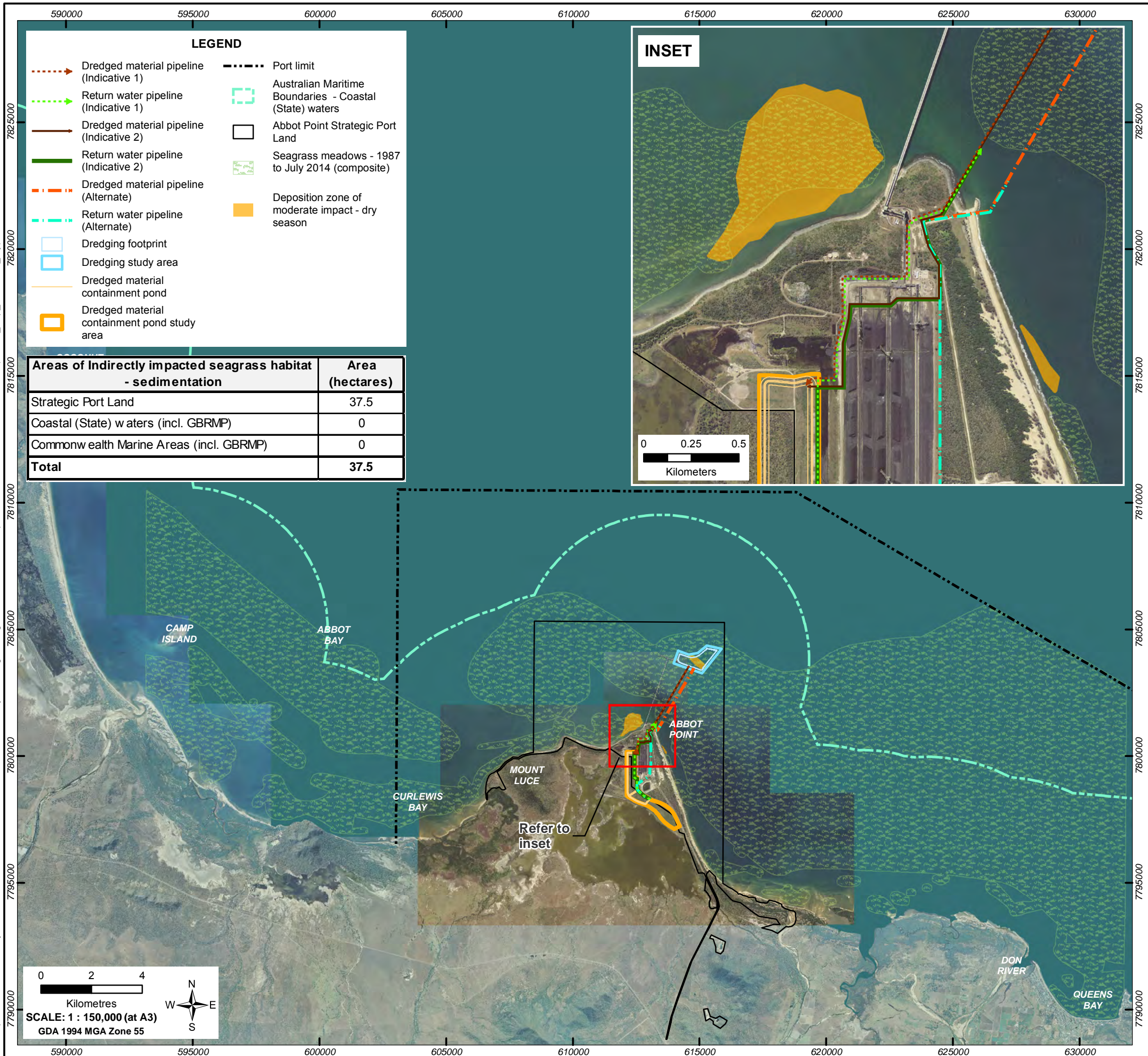
The maximum mean annual sedimentation rate upper limit of $3\text{mg}/\text{cm}^2/\text{day}$ was applied across the period of the dredging campaign and not over the entire year; which represents a highly conservative approach to the application of this annual rate.

Based on these thresholds Figure 4-20 and Figure 4-21 show the zone of moderate impact based on the daily sedimentation rate and maximum daily sedimentation rate for the dry and wet season respectively.

In the dry season (Figure 4-20) the GBRMPA (2010) sedimentation rate thresholds are exceeded within the dredging area only and do not extend beyond the footprint. In the return water area there is a large zone of moderate impact extending 1.5km to the west of the returning water location, in the sheltered area adjacent to the Abbot Point headland and as per the TSS concentrations. A smaller zone of moderate impact is predicted to occur 1.2km to the south of the returning water location. The zones of moderate impact in the dry season intersect with known seagrass habitat. These represent a potential, off-site sub-lethal impact to 4.16ha of seagrass habitat due to the dredging operations and 33.37ha due to the returning water operation.

In the wet season (Figure 4-21) the GBRMPA (2010) thresholds are only exceeded within the dredging area and in a 250m diameter patch 1.2km west of the returning water location in the sheltered area. The abundance and growth of seagrass in the wet season (sea grass senescence season) is limited and no impacts on this habitat are predicted due to dredging activities or returning water. For seasonal comparative reasons the zone of moderate impact in the wet season is presented.

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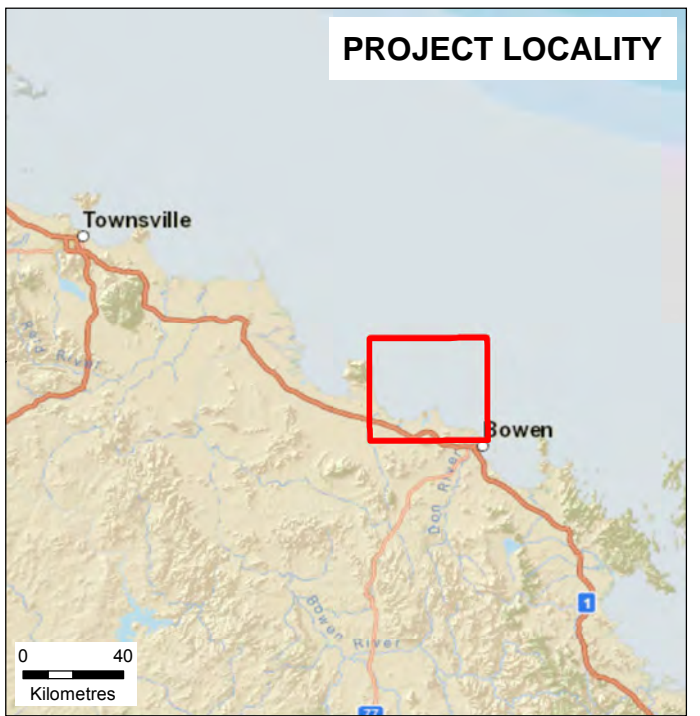
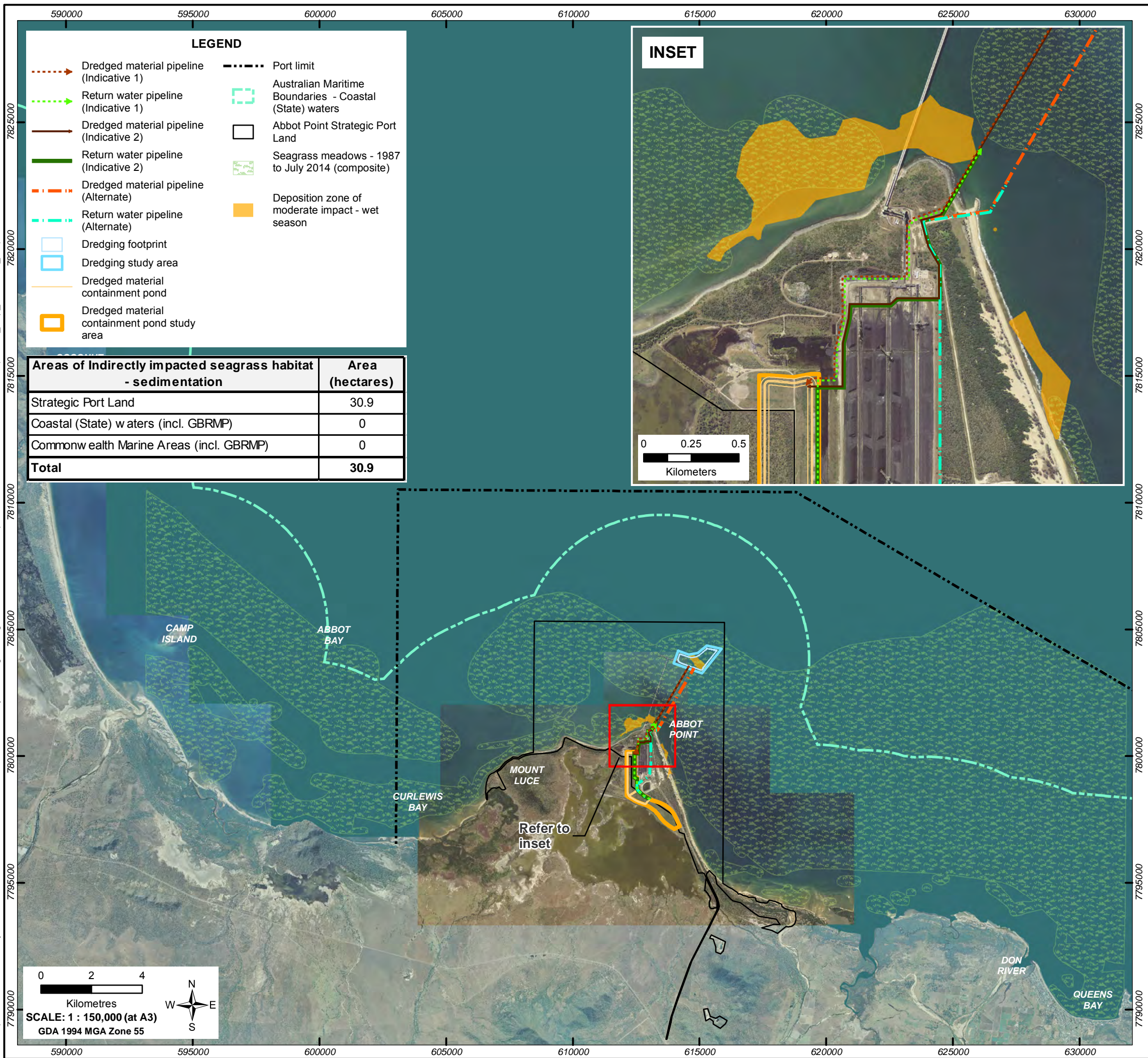


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Figure 4-20 Sedimentation thresholds - dry season 2007							
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Figure 4-21 Sedimentation thresholds - wet season 2007							
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4.3.5.4 Residual risk

Project marine water quality impacts have been assessed and mitigated in relation to marine ecological values. They are addressed in Section 4.3.8.

4.3.6 Wetland hydrology, water quality and aquatic ecology

4.3.6.1 Water quality parameters and sensitive receptors

The key potential water quality parameters relevant to the Project are shown in Table 4-19. Water quality parameters relevant to the Project may be derived from a range of sources, including stormwater runoff and dredge DMCP waters (refer to the Preliminary Stormwater Management Plan, **Appendix Y**), dust (refer to the Air Quality Technical Report, **Appendix H**) and groundwater (refer to the Groundwater Technical Report, **Appendix L**). Potential impacts to aquatic ecological receptors are described in the following sections.



Table 4-19 Potential water quality parameters relevant to the Project

Project Water Quality Parameters	Key sensitive Receptors	Project Sources	Relevant Project Component
Sediments and nutrients	<ul style="list-style-type: none"> Aquatic macrophytes Aquatic invertebrates Fish 	<ul style="list-style-type: none"> Stormwater runoff 	<ul style="list-style-type: none"> Construction phase - clearing and earthworks
		<ul style="list-style-type: none"> DMCP waters 	<ul style="list-style-type: none"> Operation phase - overtopping of DMCP
		<ul style="list-style-type: none"> Dust 	<ul style="list-style-type: none"> Construction phase - clearing and earthworks
Low pH waters and metals/metalloids	<ul style="list-style-type: none"> Aquatic macrophytes Aquatic invertebrates Fish 	<ul style="list-style-type: none"> Stormwater runoff from any exposed ASS 	<ul style="list-style-type: none"> Construction phase - clearing and earthworks
		<ul style="list-style-type: none"> Acidic groundwater 	<ul style="list-style-type: none"> Construction and operation phase - modifications to groundwater hydrology
Saline waters	<ul style="list-style-type: none"> Aquatic macrophytes (particularly salt couch) 	<ul style="list-style-type: none"> Stormwater runoff 	<ul style="list-style-type: none"> Operation phase - seepage through embankment intercepted by stormwater
		<ul style="list-style-type: none"> DMCP waters 	<ul style="list-style-type: none"> Operations phase - seepage through
Hydrocarbons	<ul style="list-style-type: none"> All aquatic components 	<ul style="list-style-type: none"> Construction machinery 	<ul style="list-style-type: none"> Construction phase - clearing and earthworks

4.3.6.2 Construction phase impacts

Stormwater impacts

Topsoil and sediments will be disturbed during construction of the facility. Potential impacts to aquatic flora and fauna and their habitats exist if these sediments were to enter adjacent wetland areas via surface water runoff. Increased suspended solids can cause smothering of sessile macroinvertebrates, clogging of fish gills, and modifications to habitats. Submergent macrophytes, which are sensitive to light limitation, have been recorded in the wetland basin during wet periods (GHD, 2009f).



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If the wetland is dry and there is no runoff during the construction phase, there is negligible risk of sediments being transported into adjacent wetland habitats. In flow periods there is a greater likelihood that sediment will be mobilised but it will then be mixed with the naturally turbid catchment runoff.

Sediment and erosion control measures will be developed and implemented to mitigate potential impacts of sediments entering the adjacent wetland, consistent with the measures identified in the Preliminary Stormwater Management Plan (refer **Appendix Y**).

Accidental release of chemicals and hydrocarbons

The accidental release of contaminants, such as fuels and chemicals associated with machinery operation, pose a risk to adjacent wetland ecosystems. Many of these chemicals are toxic to aquatic macroinvertebrates and fish. Although unlikely, major spillages of hazardous substances have the potential to cause floral and faunal mortality and morbidity in affected areas. However, damaged communities are likely to fully recover over a period of months, given that appropriate clean-up strategies would be implemented. Mitigation measures will be required to ensure that water leaving the work sites will be of similar quality to that of receiving waters and that contaminants do not leave the site.

Acid Sulfate Soils

Section 4.3.1.3 notes the absence of PASS materials in areas to be disturbed during DMCP construction, while Section 0 discusses the low potential for acid water seepage from the dredged material.

On this basis, it is considered that there is a low risk of ASS to cause impacts to aquatic ecosystems within the wetland basin or wider wetland.

Dust deposition

Earthmoving and other construction activities will disturb soils and generate dust, which can disperse and settle in the adjacent wetland (refer Air Quality assessment - Section 4.3.2 and **Appendix H**). The dust represents a potential source of sediment and other airborne contaminants to the wetland. The air quality assessment undertaken by Katestone (refer **Appendix H**) indicates that:

- Dust generated by construction would largely be limited to wetland areas within close proximity to the construction area. The predicted dust concentrations would be highly unlikely to result in high suspended sediment concentrations or sediment deposition within the wetland (relative to natural variability), particularly when appropriate management measures are applied.
- Trace metal and metalloid concentrations in dust at sites within the wetland met relevant environmental protection guideline levels.

The implementation of appropriate dust suppression measures (as included in the Outline EMP, **Appendix V**) will ensure that detectable impacts to aquatic flora and fauna due to dust emissions are unlikely to occur.

**Section 4****Environmental Impacts****Direct aquatic habitat and fauna loss**

The development footprint of the DMCP does not contain wetland vegetation or habitats. All land within the DMCP footprint and surrounds has been previously cleared and currently supports pasture grassland and, in the context of the wider catchment, has limited contribution to the habitat values and quality of the wetland and does not in itself support high ecological wetland values. On this basis no direct loss or fragmentation of aquatic habitat, vegetation and fauna will occur as a result of the Project.

The development footprint of the DMCP is comprised exclusively of terrestrial habitats (primarily pasture grasses and non-remnant *Melaleuca* woodland). Terrestrial lands surrounding the Caley Valley Wetlands provide a range of functional roles to aquatic ecosystems, particularly in the context of controlling sediment and other catchment pollutants inputs in runoff. The removal of terrestrial lands as a result of DMCP construction and operation therefore has the potential to indirectly affect wetland values, if inappropriately managed. However, no threatened, migratory or otherwise notable aquatic fauna or aquatic flora species are known or likely to occur in the wetland.

Weeds and feral animals

As described in terrestrial ecology section (Section 4.3.7), the Project footprint and immediate surrounds is heavily degraded by previous land uses. As a result, weeds are prevalent throughout the area. The highly dynamic hydrological regime of the basin and high salinities prevent the establishment of most weed species within the wetland. Weed invasion is currently restricted to terrestrial lands above the inundation zone of the basin and adjacent to the estuarine plains. In particular the noxious weeds *Parkinsonia*, prickly acacia and rubber vine are widespread throughout terrestrial lands within and surrounding the wetland (BMT WBM, 2012).

The construction of the DMCP and the frequent vehicle movements associated with the Project may allow weeds to spread within the project area. Furthermore, new weed species may be introduced into the project area by construction machinery or topsoil/mulch sourced from elsewhere, or other vectors such as runoff or aerial dispersal.

The Abbot Point area presently contains a number of feral animals including feral pigs, rabbits, red fox, black rat, house mouse, common starling, cane toad and eastern gambusia (BMT WBM, 2012). BMT WBM (2012) considers that feral cats, common myna and Asian house geckoes are also likely to occur in the area.

Construction activities will change the habitat values of the project area for feral species, with potential flow-on effects to adjacent areas. In the short-term, habitat loss within the project area could lead to displacement of feral fauna, and an increased abundance of more mobile species in adjacent areas (possibly including areas adjacent to the wetland). Resource (i.e. food and habitat) limitation is likely to prevent a medium to long-term increase in abundance of feral animal species in adjacent areas.



4.3.6.3 Operation and post dredging phase impacts

The operation of the DMCP will involve the following three phases:

- Operation of the DMCP during dredging works
- Post dredging management of the DMCP, which will involve active management and monitoring of remaining water and solids in the DMCP over an approximately six month period
- DMCP final landform for reclamation, which will involve the reconfiguration of the DMCP to manage solids and the embankment to enable the reinstatement of the pre-DMCP landform stormwater hydrology.

The key potential impacting processes from a wetland ecology perspective are:

- Modifications of surface water and groundwater hydrology into the wetland due to operation of the DMCP
- Increased loads of sediment, salt and other contaminants due to operation of the DMCP.

Potential impacts to the wetland are considered below.

Local stormwater management

Stormwater from the DMCP will contain sediments, saline water and other contaminants that will require management to minimise the risk of water quality impacts to the wetland. The Preliminary Stormwater Management Plan (refer **Appendix Y**) describes the stormwater management issues during the operational phases, as follows:

- Operation of the DMCP - erosion of the earth walls, stormwater runoff from the sub-catchments of the DMCP, over-topping of the DMCP, lateral seepage through the embankment
- Post dredging management - stormwater runoff from the outer embankment wall
- DMCP final landform for reclamation - stormwater runoff from the DMCP footprint.

The stormwater management plan describes proposed activities wherein runoff from local drainage catchments is to be diverted around the DMCP embankment via artificial drains before discharging into the wetland basin adjacent to the proposed works area. From a volumetric perspective, the quantity of surface runoff entering the wetland basin should not increase (in fact it should decrease given that any rain falling onto the DMCP will be captured within the embankment bunds and pumped externally along with return seawater). Additionally, the quality of the runoff should not change significantly providing that there is no substantial change to use of the land within the sub-catchment being diverted.

The main issue of consideration for the wetland is the concentration of flow associated with the diverted stormwater. The more concentrated rates of runoff may cause localised effects within the wetland basin, including scour and erosion of some sections at the end of the diversion channels, and associated impacts on benthic habitat, vegetation and species. The concentrated flows may also result in localised sedimentation, as sediment runoff from the diverted sub-catchment would settle relatively quickly once discharged into the expansive wetland basin area. Given the sensitivities of salt couch grassland and to a lesser extent samphire saltmarsh to altered hydrology (and salinity); it is likely that there will be short-term localised impacts to these communities. As the management intent is to restore



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pre-disturbance stormwater hydrology, long-term effects to wetland communities are not expected.

Another possible impact would be any minor spills and contamination within the diverted sub-catchments, which may have potential impacts on water quality and ecology. It is expected that an appropriately developed and implemented stormwater management plan could mitigate most impacts from sub-catchment contamination.

Long-term impacts to aquatic flora and fauna communities are not expected in areas where habitat conditions (i.e. substrate types, water quality or sediment quality conditions) are not altered. Highly localised but long-term changes to aquatic flora and fauna communities could occur in areas where stormwater management works cause scour and erosion. Erosion and sediment control measures are outlined in the Preliminary Stormwater Management Plan (refer **Appendix Y**).

Horizontal seepage of DMCP waters

Lining of the DMCP internal walls will result in negligible seepage of DMCP water through the embankments. Any horizontal seepage that occurs through the embankments will be intercepted by the stormwater drains to be constructed around the perimeter of the DMCP. As per the stormwater management strategy, the volume of seepage water (expected to be small) will be discharged at nominated locations to the natural/existing drainage network, and interact with adjacent surface waters in the wetland basin.

It is possible that the saline waters at the toe drain discharge locations, if in significant quantities, could result in highly localised changes to adjacent wetland vegetation in affected areas. In this regard, it is possible that salt tolerant samphire communities could replace salt sensitive saltcouch in affected areas. Any such change would be temporary (i.e. times scales measures in months to years), highly localised (i.e. immediately downstream of discharge point), and is unlikely to affect the functionality of aquatic habitats within the wetland. In addition, given their limited extent with the area and the wider region, it is not expected they provide significant buffers to local water quality entering the wetland.

Based on this assessment, any potential salinity impacts to wetland habitats will be temporary and no threatened aquatic species will be affected.

Vertical seepage of DMCP waters

As the base of the DMCP is to be unlined, vertical seepage to the underlying aquifer will occur. The salinity of water seeping from the DMCP will be equivalent to seawater. The degree to which seepage from the DMCP could affect the hydrology and water quality of adjacent receiving environments will depend on the vertical exchange of groundwater between the wetland and the underlying aquifer as well as any change to regional groundwater flows that may occur as a consequence of additional recharge from the DMCP.

Wetland hydrology scenarios have been developed to assess potential changes to wetland hydrology and water quality (refer **Appendix O** for details). These incorporated regional groundwater estimations based the groundwater flow modelling undertaken by AGE Consultants (refer **Appendix L**).

The key parameter of interest in terms of seepage of DMCP water is salinity.

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The results of the wetland hydrology scenarios for the realistic case show no discernible changes to water depth (magnitude of change is less than 5mm) and within the range of variability experienced throughout the wetland. Likewise, the results show minor changes to salinity (refer **Appendix O**) for sites located upstream and downstream of the Caley Valley Wetlands, while changes predicted for sites within the wetland are small (less than 1ppt). Salinity change is greatest for the below-average climate condition and least for the above-average climate scenario. This highlights that the degree of salinity impact is sensitive to catchment rainfall particularly. The predicted changes are within the broad range of variability measured at the wetland.

To further investigate potential impacts on the wetland, the worst-case (hypothetical) scenario was simulated for the three climatic conditions. The results show minor changes to salinity for sites located upstream and downstream of the wetland. The greatest change to salinity would be experienced adjacent and to the west of the DMCP, where salinity is estimated to increase by 3ppt above background conditions under below-average climatic conditions. At other sites within the wetland further from the DMCP, the salinity above background would be less than 2ppt in some locations and less than 1ppt in others for a majority of the time. The results illustrate that under such a worst-case scenario, salinity above background is small when compared to the range of natural (seasonal) variations of salinity experienced by the wetland.

A hypothetical simulation of a 'forced' surface water expression of DMCP seepage was also undertaken. Though this situation is not predicted to occur, it was undertaken to understand potential impacts of an extreme 'worst-case' scenario in which seepage reported via surface water flow, directly to the wetland. The results show minor changes to salinity for sites located immediately upstream and downstream of the discharge location to the Caley Valley Wetlands. The greatest change to salinity would be experienced adjacent to the DMCP, where salinity is estimated to increase by 3ppt above background conditions, under below-average climatic conditions. Resulting salinity above background is small when compared to the range of natural (seasonal) variations of salinity experienced by the wetland. For instance, salinity measurements available for the northern part of the wetland near the DMCP indicate variable conditions with a median of 2ppt, 90th percentile of about 12ppt and higher (infrequent) measurements of between 20ppt and 35ppt.

The results of the realistic and worst-case wetland hydrology scenarios indicate that persistent detrimental impact on aquatic flora and fauna within the 'wetted' sections is not expected to occur due to operation of the DMCP.

On the basis of the wetland hydrology scenarios investigated and knowledge of the existing wetland environment, changes to wetland hydrology and water quality as a consequence of DMCP operation is expected to have a relatively inconsequential impact on the local hydrology and water quality of this part of the wetland, even when considering seasonal influences on hydrology. It is possible that highly localised minor to moderate level water quality and hydrological effects could occur directly adjacent to the bund wall of the DMCP, particularly if the wetland basin is dry or water levels are low at the time of works.

Any impacts to aquatic communities are expected to be short-term, with rapid recovery occurring in the next wet season following the completion of works. This is based on the following:



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- The limited duration of the seepage (i.e. during and shortly after the Project) would limit any ongoing, chronic impacts to wetland hydrology, water quality and aquatic ecology in receiving environments
- Long-term impacts to wetland habitat and conditions are not expected as a result of the works (i.e. major changes to sediment types, sediment quality, benthic processing etc.)
- Aquatic vegetation and fauna species within the wetland basin experience great variation in hydrology and water quality conditions, and have adaptations that allow them to survive rapid changes in water levels, seawater salinity and moderately elevated turbidity (i.e. they are resistant to change).

DMCP overflows during extreme weather events

An assessment of the impacts of storm events has been undertaken taking into account the DMCP design criteria for stormwater retention (as outlined in the Preliminary Stormwater Management Plan in **Appendix Y**).

The salinity of supernatant ponding within the DMCP will be equivalent to 35ppt which is the generally accepted average for seawater. During storm events up to and including the 20 year ARI 72 hour duration event, rainfall occurring over the surface of the DMCP will be contained. Assuming instantaneous and complete mixing between seawater and fresh (rain) water, the salinity of supernatant above dredged material would decrease in response to rainfall. For the 20 year ARI rainfall depth of 0.45m, the DMCP salinity is estimated to be 24ppt (a dilution of about 30%), and for the 100 year ARI approximately 21ppt (a dilution of about 40%).

For long duration storms occurring over a continuous three month period, a portion of the DMCP supernatant could exceed the available storm capacity. The rainfall depth over longer duration wet season rainfall conditions for a 20 year ARI (up to 1.4m) could theoretically reduce DMCP salinity to 15ppt if it was to fall over a short period. However, it is assumed that over the wet season period, dredging operations would maintain the MOL by balancing the return water and dredge delivery discharge streams. On that basis, the DMCP salinity during a sustained high rainfall period would be closer to background seawater salinity.

During dredging, the water level within the DMCP will be maintained to a prescribed MOL to ensure there is appropriate freeboard for the return water and extreme rainfall events. For rainfall events exceeding the storm capacity allocated within the DMCP, overflows released through a spillway could occur during the operational phase of the Project.

In the event that spills from the DMCP occur, the impact on the wetland would be highly localised (within tens to hundreds of metres of the proposed spillway location). The duration of spills from the DMCP could therefore be expected to range from a few hours during a short duration storm up to several days during long duration (wet season) periods.

Overall, the potential impact on the wetland arising from DMCP overflows is expected to be minor on the basis that:

- Overflow is not expected for design rainfall events of up to the 20 year ARI for either short or long duration rainfall events. Rainfall captured by the DMCP would be stored by the additional storage allowance for extreme weather conditions.



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- Although the rainfall depth for short duration rainfall events with an ARI of 50 or 100 years for example is greater, their likelihood of occurrence is much smaller than that allowed for by the DMCP design.
- Not all supernatant water captured by the DMCP would be discharged to the wetland; only a portion of supernatant and rainwater above the spillway level may be discharged.
- Although the salinity of overflow water from the DMCP may vary between 20ppt and 35ppt as outlined above, the wetland basin would likely be in flood or partially full during overflow and the salinity of the receiving environment will be freshwater or slightly brackish.

Impacts on hydrology and water quality are unlikely to occur, except perhaps at highly localised spatial scales (i.e. in the immediate vicinity of the spillway, measured in metres to tens of metres). Overflows from the DMCP are expected to be readily diluted and dispersed under such weather conditions.

4.3.6.4 Residual risk

The environmental risk assessment (**Appendix U**) has identified and assessed the aquatic ecology risks associated with the Project as summarised in Table 4-20.

Table 4-20 Risk summary - aquatic ecology

Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Project Phases: Construction of the DMCP			
Footprint clearing and topsoil stripping	Direct loss of wetland vegetation leading to loss/impairment of functional values supported by the wetland	<ul style="list-style-type: none"> ▪ Establish a vegetated buffer (50m to 300m) ▪ Implement measures to ensure no unintended clearing outside approved footprint. 	Low
Footprint clearing and topsoil stripping Earthworks including embankment preparation	Increased sediment and nutrient loading into the wetland due to construction activities leading to degradation/loss of aquatic habitats, flora and fauna	<ul style="list-style-type: none"> ▪ Implement sediment erosion controls ▪ Establish a buffer between the site works and the wetland (50m to 300m). 	Moderate
Footprint clearing and topsoil stripping	Accidental contaminant spills (hydrocarbons) leading to degradation/loss of aquatic flora and fauna	<ul style="list-style-type: none"> ▪ Implement standard measures to minimise the likelihood of spillage ▪ Implement standard clean-up measures. 	Moderate



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Earthworks including embankment preparation	Disturbance of ASS leading to acid waters and increased metals in surface water runoff, leading to degradation/loss of aquatic flora and fauna	<ul style="list-style-type: none"> Minimise disturbance to topsoil Undertake liming where necessary. 	Low
Footprint clearing and topsoil stripping Earthworks including embankment preparation	Introduction of new weeds during construction, or establishing habitats preferred by weed species, leading to modifications to aquatic vegetation	<ul style="list-style-type: none"> Establish a vegetated buffer (50m to 300m) Implement measures to ensure no unintended clearing outside approved footprint Implement weed monitoring and weed control measures. 	
Footprint clearing and topsoil stripping	Creation of habitat conditions favouring feral and pest animals, resulting in impacts to wetland flora and fauna	<ul style="list-style-type: none"> Undertake rehabilitation of disturbed areas Implement standard house-keeping measures 	Low
Footprint clearing and topsoil stripping	Loss of vegetated buffer to the wetland, resulting in adverse effects to water quality ecosystem services	<ul style="list-style-type: none"> Undertake rehabilitation of disturbed areas. 	Moderate
Project Phases: Dredging and post dredging management			
DMCP operation	Seepage of saline dredge water to areas supporting salt couch (intolerant of prolonged waterlogging and high salinity), leading to loss of vegetation and impairment of functional values supported by the wetland	<ul style="list-style-type: none"> Install stormwater discharge points remote from large salt couch meadows Rehabilitate any affected areas post operation. 	Moderate
DMCP operation	Seepage of saline dredge water directly to the wetland but not into salt	<ul style="list-style-type: none"> None necessary. 	Low



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
	couch areas, leading to increased saline waters within the wetland		
DMCP operation	Overflow of DMCP resulting in waters discharging to the wetland, resulting in scour and possibly loss of littoral vegetation	<ul style="list-style-type: none"> Implement erosion and sediment control measures and design principles, including installation of suitable erosion protection or energy dissipater immediately downstream of the spillway. 	Low
Project Phases: Dredging pipeline assembly/installation, dredging, post dredging management and establishment of the final landform			
DMCP operation	Accidental contaminant spills (hydrocarbons) leading to degradation/loss of aquatic flora and fauna	<ul style="list-style-type: none"> Implement standard measures to minimise the likelihood of spillage Implement standard clean-up measures. 	Moderate

4.3.7 Terrestrial ecology

A Terrestrial Ecology Technical Report has been prepared for the Project and is attached at **Appendix P1**. Technical memorandums have also been prepared to support the Terrestrial Ecology Technical Report, namely:

- **Appendix P2** - provides additional information on the pipeline alignment options and soil stockpile and laydown area
- **Appendix P3** - provides additional information on the pipeline alignment options specific to shorebirds
- **Appendix P4** - provides discussion on updated dust modelling results⁵ as they relate to terrestrial ecology assessment

Impacts resulting from the proposed Project can be broadly grouped into the following categories:

- Direct impacts of construction activities within the project area
- Off-site and indirect impacts of construction activities and operations adjacent to the project area (water quality, noise, dust, light vehicle movements and human activities)
- Ongoing human presence

⁵ Following finalisation of the Terrestrial Ecology Technical Report, refined dust modelling results became available. This technical memorandum has been developed to assess any potential implications of the updated modelling with regards to terrestrial ecology. The latest modelling results have been included in the EIS.



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- Periodic and short-term operational use (works within the DMCP to support transfer or beneficial reuse of dredged material once dried, and restoration of final landform.

The project area, including the pipeline alignments, is highly disturbed and consists primarily of non-remnant vegetation, with some patches of regrowth and very small patches of remnant *Corymbia-Melaleuca* woodland. There is a relatively low potential for fragmentation of landscape habitat features, due to the location of the project area adjacent to an existing industrialised section of the Port of Abbot Point.

Clearing vegetation to establish the DMCP and temporary pipeline alignment will reduce vegetative cover and result in the loss of some habitat for fauna dependent on those habitats (i.e. cause direct impacts). These disturbed areas are potential habitat for one MNES species, the Squatter Pigeon, which is discussed in detail in Section 4.4.6.1. The predominantly cleared and grassy habitat supports a range of common species for which there is abundant alternative habitat within the local landscape.

No wetlands or watercourses will be directly impacted by the Project. Indirect impacts of the Project on water quality have been assessed by BMT WBM (2015) and found to be minor. Impacts of the Project on the habitat or lifecycle of native species have been assessed in detail in relation to wetland birds, including threatened and migratory shorebird species within the adjacent Caley Valley Wetlands (Section 4.4).

Mitigation measures to protect MNES species and their habitats in the surrounding landscape and the SEVT threatened ecological community are commonly applied measures that will also protect habitats for non-MNES species and communities. These measures are incorporated into the Outline EMP (**Appendix V**).

The Project has a number of unavoidable adverse impacts (e.g. vegetation clearance) and a number of other potential adverse impacts (e.g. mortality of threatened species through vehicle strike) that can be avoided or minimised through appropriate management and mitigation measures. The assessment has assumed a worst-case scenario where all habitat within the DMCP, temporary pipeline alignments and soil stockpile/laydown area (94ha in total) will be removed, reclaimed or otherwise lost. The focus for mitigation and management measures to be implemented during the Project is to minimise impacts on threatened and migratory fauna and communities adjacent to the project area. Where it is possible to protect these values within the development footprint, relevant management measures are presented.

4.3.7.1 Residual risk

The environmental risk assessment (**Appendix U**) has identified and assessed risks to terrestrial ecology associated with the Project as summarised in Table 4-21.



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Table 4-21 Risk summary - terrestrial ecology

Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Project Phases: Construction of DMCP			
Footprint clearing and topsoil stripping	Removal of threatened plants, TECs and habitat for threatened flora	<ul style="list-style-type: none"> Map MNES and design project footprint to avoid and/or minimise impacts. 	Low
Footprint clearing and topsoil stripping Earthworks including embankment preparation	Increased dust depositing on plants and dust concentrations, affecting fauna	<ul style="list-style-type: none"> Design sets back DMCP footprint from wetland vegetation (habitat) Wet down (for dust control) of stockpiles, working areas and haul roads. 	Low
Footprint clearing and topsoil stripping Earthworks including embankment preparation	Increased noise, disturbing fauna including migratory shorebirds in the wetland	<ul style="list-style-type: none"> Design sets back DMCP footprint from wetland vegetation (habitat) Project design utilised noise modelling results to predict disturbance areas (which are taken into consideration in the 'After treatment risk levels') 	Low
Footprint clearing and topsoil stripping Earthworks including embankment preparation	Human activity disturbing fauna including migratory shorebirds in the wetland	<ul style="list-style-type: none"> Design sets back DMCP from wetland vegetation (habitat) Restrict access to this zone during works. 	Low
Earthworks including embankment preparation	Disturbance of ASS	<ul style="list-style-type: none"> Design mitigation included undertaking soil testing and development of preliminary ASS Management Plan (Testing indicates soils are non-PASS) Final ASS management Plan to be developed and implemented. 	Low



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Traffic movements	Vehicle strike on fauna including shorebirds or traffic-related disturbance of habitat	<ul style="list-style-type: none"> Enforce speed limits on vehicles Ensure use of designated routes. 	Low
Night work	Disturbance of fauna or wetland habitat by light spill	<ul style="list-style-type: none"> Use directional lighting Design sets back DMCP footprint from wetland vegetation (habitat). 	Low
Project Phases: Dredging pipeline assembly / installation			
Pipeline assembly	Indirect effects on SEVT TEC from pipeline installation and removal	<ul style="list-style-type: none"> Implement weed and pest control measures Implement fire mitigation strategies Ensure appropriate mark off of areas to be cleared. 	Low
Footprint clearing and topsoil stripping	Disturbance of fauna and indirect impacts from clearing for pipeline alignment establishment	<ul style="list-style-type: none"> Select alignment that is already mostly cleared Ensure appropriate mark off of areas to be cleared Undertake a pre-clearance survey. 	Low
Project Phases: Dredging			
DMCP operation	General disturbance of fauna from human presence and DMCP operation activities	<ul style="list-style-type: none"> Design sets back DMCP footprint from wetland vegetation (habitat). 	Low
Nightwork	Disturbance of fauna or wetland habitat by light spill	<ul style="list-style-type: none"> Design sets back DMCP footprint from wetland vegetation (habitat) Use directional lighting. 	Low
Traffic movements	Vehicle strike on fauna including shorebirds or traffic-related disturbance of habitat	<ul style="list-style-type: none"> Enforce speed limits on vehicles Ensure use of designated routes. 	Low
Project Phases: Post dredging management			



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Traffic movements	Vehicle strike on fauna including shorebirds or traffic-related disturbance of habitat	<ul style="list-style-type: none"> Enforce speed limits on vehicles Ensure use of designated routes. 	Low
Earthworks including embankment preparation	Modification of surface water and groundwater flows from DMCP embankments	<ul style="list-style-type: none"> DMCP design minimises changes to existing surface water flows Development and implementation of Stormwater Management Plan. 	Low
Earthworks including embankment preparation	Embankment failure, leading to spill of dredged material onto adjacent ecological values	<ul style="list-style-type: none"> Use accepted engineering design principles and onsite project management of construction works. 	Low
Project Phases: Establishment of the final landform			
Earthworks including embankment preparation	Increased dust depositing on plants and dust concentrations, affecting fauna	<ul style="list-style-type: none"> Design sets back DMCP footprint from wetland vegetation (habitat) Wet down (for dust control) of stockpiles, working areas and haul roads. 	Low
Earthworks including embankment preparation	Increased noise disturbing fauna including migratory shorebirds in the wetland	<ul style="list-style-type: none"> DMCP set back from wetland vegetation (habitat). 	Low
Earthworks including embankment preparation	Human activity disturbing fauna including migratory shorebirds in the wetland	<ul style="list-style-type: none"> DMCP set back from wetland vegetation (habitat) Restrict access to this zone during works. 	Low
Traffic movements	Vehicle strike on fauna including shorebirds or traffic-related disturbance of habitat	<ul style="list-style-type: none"> Enforce speed limits on vehicles Ensure use of designated routes. 	Low



4.3.8 Marine ecology

A Marine Ecology Technical Report has been prepared for the Project and is attached at **Appendix Q1**. A technical memorandum (**Appendix Q2**) has also been prepared to support the Marine Ecology Technical Report, and provides additional information on the pipeline alignment option immediately south and adjacent to the existing MOF.

Impacts to marine ecology values are directly relevant to MNES and are discussed in detail in Section 4.5.4. They can be grouped into the following categories:

- Marine habitat impacts
- Underwater noise
- Vessel collision
- Artificial lighting
- Introduced marine species.

Marine habitat loss or modification has potential to be caused by direct or off-site impacts of dredging and return waters. The direct impact of the Project is the removal of habitat from within the dredging footprint, while off-site impacts may include a decline in water quality associated with dredging activities and return waters and/or a decline in habitat area caused by smothering or other degradation of habitats.

Mitigation measures to protect MNES species and their habitats will also protect habitats for non-MNES species and communities. Mitigation measures have been incorporated into the Outline DMP contained in **Appendix W**. Where relevant, mitigation measures have been developed with guidance from:

- The DEHP's *Humpback Whale Recovery Plan 2005 - 2010*
- Environment Australia's *Recovery plan for marine turtles in Australia*
- *National System for the Prevention and Management of Marine Pest Incursions Guidelines*.

4.3.8.1 Residual risk

The environmental risk assessment (**Appendix U**) has identified and assessed risks to marine ecology associated with the Project as summarised in Table 4-22.



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Table 4-22 Risk summary - marine ecology

Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Project Phases: Dredging pipeline assembly / installation			
Pipeline assembly and installation	Injury or mortality of marine fauna due to boat traffic	<ul style="list-style-type: none"> Implement a Vessel Traffic Management Plan. 	Low
Pipeline assembly and installation	Direct impact to benthic ecology due to pipeline laying on seafloor	<ul style="list-style-type: none"> Ensure that proposed pipeline route intersects less than 0.5ha of potential seagrass habitat Ensure that pipeline is anchored securely to seafloor where appropriate. 	Low
Pipeline assembly and installation	Introduction of marine pests and diseases	<ul style="list-style-type: none"> Undertake a detailed risk assessment procedure consistent with the <i>National System for the Prevention and Management of Marine Pest Incursions Guidelines</i> (to deal with the risk associated with introduction of Introduced Marine Species; IMS). 	Low
Pipeline assembly and installation	Displacement of fauna from habitat due to underwater noise	<ul style="list-style-type: none"> None necessary because: <ul style="list-style-type: none"> Noise modelling undertaken based on the proposed dredge and support vessels predict no displacement of marine fauna in relation to dredging activities Pipeline installation underwater noise will be much less than the noise associated with dredging. 	Low



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Project Phases: Dredging			
Offshore dredging activities	Injury/mortality of fauna due to dredging	<ul style="list-style-type: none"> Implement standard measures to minimise the likelihood of spillage Implement standard clean-up measures. 	Low
Offshore dredging activities	Direct impact to benthic ecology due to removal of habitat	<ul style="list-style-type: none"> Restrict dredging to locations specified on approved drawings. 	Low
Offshore dredging activities	Smothering of benthic ecology in areas adjacent to dredging (sediment plume drift)	<ul style="list-style-type: none"> None necessary because: <ul style="list-style-type: none"> Use of the CSD dredge means sediment deposition is limited to areas within the dredging footprint and within 50m to 100m of the footprint Predicted bed thickness is not considered sufficient to impact upon the benthic ecology (<5mm deep). 	Low
Offshore dredging activities	Mobilisation of sediment resulting in turbidity plumes potentially affecting light-dependent species, filter feeders and having potential flow-on effects to higher trophic groups	<ul style="list-style-type: none"> Use of CSD type dredge reduces mobilisation of fine sediment, dredging duration is limited (6 to 13 weeks) Implement Outline EMP. 	Low
Offshore dredging activities	Displacement of fauna from habitat due to underwater noise	<ul style="list-style-type: none"> None necessary because: <ul style="list-style-type: none"> Noise modelling undertaken based on the proposed dredge and support vessels predict no displacement of marine fauna from dredging activities. 	Low



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Offshore dredging activities	Lighting impacts on marine fauna behaviour	<ul style="list-style-type: none"> ▪ Ensure light spill is minimised ▪ Ensure that dredging activities occur well offshore from nesting turtles and turtle hatching areas. 	Low
Offshore dredging activities	Release of contaminants into the water (wastes/chemical spill from dredge or tender vessels)	<ul style="list-style-type: none"> ▪ Implement waste and pollution management plans. Mitigation measures will include: <ul style="list-style-type: none"> – All domestic, toxic, and hazardous wastes, oils and petroleum hydrocarbons, empty drums and other containers, and any other waste materials will be collected, handled, stored, and disposed of in accordance with existing Port of Abbot Point waste management policies and procedures – Any materials or objects dropped onto the seabed will be recovered. 	Low
Offshore dredging activities	Introduction of marine pests and diseases	<ul style="list-style-type: none"> ▪ Implement a detailed risk assessment procedure consistent with the <i>National System for the Prevention and Management of Marine Pest Incursions Guidelines</i>. 	Low



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Project Activity	Event Description / Potential Impact	Mitigation Measures / Risk Treatment	Final Risk Level
Offshore dredging activities	Mobilisation of sediment resulting in changes to chemical signature of water (nutrients, pH, heavy metals and metalloids)	<ul style="list-style-type: none"> The sediment released into the water column by the action of dredging is of a quality suitable for ocean disposal. 	Low
Return water discharges	Smothering of benthic ecology in areas adjacent to dredging (sediment plume drift)	<ul style="list-style-type: none"> The fines sediments released are quickly dissipated and drift away from the discharge point. Sediments may collect in areas to the west of Abbot Point; however, the predicted bed thickness is not considered sufficient to impact on the benthic ecology (<5mm) Implement Outline EMP. 	Low
Return water discharges	Mobilisation of sediment resulting in turbidity plumes potentially affecting light-dependent species, filter feeders and having potential flow-on effects to higher trophic groups	<ul style="list-style-type: none"> The fines sediments released are quickly dissipated and drift away from the discharge point Implement Outline EMP 	Low
Return water discharges	Mobilisation of sediment resulting in changes to chemical signature of water (nutrients, pH, heavy metals and metalloids)	<ul style="list-style-type: none"> Implement an ASSMP for the dredged sediments Implement Outline EMP, which includes monitoring sites for a range of chemical and physicochemical water quality parameters at nearby sensitive receptors beyond the discharge point. 	Low



4.4 Impacts on Matters of National Environmental Significance - threatened and migratory species and threatened ecological communities (terrestrial)

Impact assessment has been undertaken for the following terrestrial MNES that are known or may occur within the project area and within the broader terrestrial environments of the Abbot Point area:

- EPBC Act listed migratory shorebirds
- EPBC Act listed migratory birds
- EPBC Act listed threatened species
- EPBC Act listed TEC - SEVT of the Brigalow Belt (north and south) and Nandewar Bioregions.

A Terrestrial Ecology Technical Report has been prepared for the Project and is attached at **Appendix P1**. Technical memorandums have also been prepared to support the Terrestrial Ecology Technical Report:

- **Appendix P2** - provides additional information on the pipeline alignment options and soil stockpile and laydown area
- **Appendix P3** - provides additional information on the pipeline alignment options specific to shorebirds
- **Appendix P4** - provides discussion on updated dust modelling results⁶ as they relate to terrestrial ecology assessment.

4.4.1 Approach to impact assessment

This assessment of potential project impacts to the threatened and migratory species and TECs has:

- Considered the risk identified within the Project's environmental risk register as relevant to the MNES controlling provisions of the threatened and migratory species and TECs
- Assessed the potential project impacts to threatened and migratory species and TECs values based on the significant impact guidelines (DoE, 2013a).

The following sections provide a description of the risk assessment and impact assessment processes, the identified project activity impacts informed by specialist technical reports, the species and communities within and adjacent to the project area, intended impact mitigation and management measures to avoid or minimise potential impacts on MNES, and an assessment of the likely residual impacts of the Project on terrestrial threatened and migratory species and TECs.

⁶ Following finalisation of the Terrestrial Ecology Technical Report, refined dust modelling results became available. This technical memorandum has been developed to assess any potential implications of the updated modelling with regards to terrestrial ecology. The latest modelling results have been included in the EIS.

**Section 4****Environmental Impacts****4.4.2 Risk assessment**

A risk assessment approach has been applied to assess potential environmental impacts associated with the Abbot Point Growth Gateway Project. The approach is described in detail in Section 4.1.

The risk assessment examined all project activities to identify those that may have an adverse impact on MNES, ensuring that the detailed assessment of impacts on MNES accounted for all potentially impacting activities.

Those activities with a moderate or greater unmitigated risk are further considered in relation to significance of impacts to MNES. For threatened and migratory terrestrial species and threatened ecological communities the relevant activities are:

- Onshore construction and operational activities that may disturb threatened and migratory species in the Caley Valley Wetlands (adjacent to the project area) through noise, light and dust generation
- Onshore construction and operational activities that may indirectly impact on threatened and migratory species as a result of changes to the quality of habitat within the wetland through the addition of sediment, nutrients and other contaminants in stormwater
- Alterations in surface water and groundwater conditions from the presence of the DMCP with consequent impacts on wetland habitats for threatened and migratory species
- Indirect impacts associated with weed and pest introduction to the wetland which may degrade habitat quality for threatened and migratory species.

A summary of the residual terrestrial ecology risks of the activities associated with each phase of the Project, dredge- and return water pipeline installation, offshore dredging and return water discharging are included in Section 4.3.7.1. The full environmental risk register provided in **Appendix U** highlights the relevance of each activity (and associated risk) to MNES.

4.4.3 Assessment of significance

Potential impacts on listed species that are known, likely or have the potential to occur within the Abbot Point area were given detailed consideration in the impact assessment, provided in full in **Appendix P1**. The species' ecology was described, potential impacts within the project area and adjacent areas were considered, mitigation and management measures were developed and residual impacts and outcomes were assessed. The impact assessment was conducted in a manner consistent with the EIS Guidelines published by DoE in June 2015 (DoE, 2015b).

Migratory shorebirds are often treated as a group for impact assessment purposes, as they can be ecologically similar and may occupy similar habitats. Where possible, species-specific habitat requirements were considered, particularly for those species for which the site is considered important habitat (according to EPBC Act policy statement 3.21 - DEWHA, 2009a). Patterns in the utilisation of the Caley Valley Wetlands among key shorebird species were given detailed consideration when assessing the potential significance of off-site impacts of the Project.

Section 527E of the EPBC Act defines impacts as:

- Events that are a 'direct consequence of the action', or

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- Events that are an 'indirect consequence of the action', including impacts which are associated, to a major extent, with that action.

There are several concepts which are commonly applied under the EPBC Act to assess the significance of impacts on MNES. These are defined in the MNES *Significant Impact Guidelines 1.1* (DoE, 2013a). In accordance with these guidelines, the assessment of listed threatened species and ecological communities is presented within the context of the following key concepts:

- Habitat critical to the survival of a species or ecological community
- An important population; this relates particularly to species listed as 'vulnerable' under the EPBC Act. Impacts on species listed as 'endangered' or 'critically endangered' are considered in relation to 'population'.

The meaning of these two concepts is defined below.

WHAT IS HABITAT CRITICAL TO THE SURVIVAL OF A SPECIES OR ECOLOGICAL COMMUNITY?

Habitat critical to the survival of a species or ecological community refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species or ecological community.

WHAT IS AN IMPORTANT POPULATION OF A SPECIES?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity
- Populations that are near the limit of the species range.

Source: DoE, 2013.

The assessment of impacts on listed migratory species are presented within the context of the following concepts:

- Important habitat
- Ecologically significant proportion of the population.

The meaning of these two concepts is defined below.

WHAT IS IMPORTANT HABITAT FOR A MIGRATORY SPECIES?

An area of 'important habitat' for a migratory species is:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species*
- Habitat that is of critical importance to the species at particular life-cycle stages*



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- c. *Habitat utilised by a migratory species which is at the limit of the species range*
- d. *Habitat within an area where the species is declining.*

WHAT IS AN ECOLOGICALLY SIGNIFICANT PROPORTION?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

Source: DoE (2013)

As described in Section 3.1.9.2, there are 19 migratory shorebirds that are known, likely or have potential to occur at Abbot Point. The Caley Valley Wetlands (adjacent to the project area) is considered to represent important habitat for migratory shorebirds, supporting 15 species, and is habitat for ecologically significant proportions of the populations of 3 migratory bird species, namely: Latham's Snipe *Gallinago hardwickii*, Sharp-tailed Sandpiper *Calidris acuminata*, and Red-necked Stint *Calidris ruficollis*.

A further 16 migratory (non-shorebird) bird species are known, likely or have potential to occur in the Abbot Point area. An ecologically significant proportion of the Eastern Great Egret *Ardea modesta* population (>1%) occurs in the Caley Valley Wetlands (CDM Smith, 2013a). Survey results of BAAM (2012) also indicate that the wetland provides important habitat for an ecologically significant proportion of the species, and that sections of the wetland adjacent to the project area are utilised by the species.

Eastern Curlew *Numenius madagascariensis* and Curlew Sandpiper *Calidris ferruginea* inhabit Caley Valley Wetlands and are migratory shorebird species that have been recently listed under the EPBC Act as critically endangered. This listing was not current at the time of the referral determination and they are considered here as migratory species. However, the level of impact assessment is not diminished as a result as they are assessed equally with threatened and migratory species present.

Survey results indicated that the Caley Valley Wetlands supports ecologically significant populations of the Caspian Tern *Hydroprogne caspia*, although use of the wetland adjacent to the project area appears to be limited (BAAM, 2012). BMT WBM (2012) also reported more than 300 Little Terns feeding adjacent to the Open Pan Zone of the wetland (6km west of the project area), and 50 Little Terns *Sterna albifrons* including nests on a sand spit in the wetland's Intertidal Zone. The wetland therefore has potential to support an ecologically significant proportion of the Little Tern population.

The wetland is also habitat for an ecologically significant proportion of the endangered Australian Painted Snipe *Rostratula australis* (no longer listed as migratory under the EPBC Act).

There are no further threatened or migratory species for which the terrestrial environments of Abbot Point represent important habitat or support ecologically significant proportions of their populations.



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Habitat for the vulnerable Squatter Pigeon *Geophaps scripta scripta* occurs within and surrounding the project area, although the area is not considered to represent significant habitat for the species.

No occurrences of the SEVT threatened ecological community will be directly disturbed by Project infrastructure or activities.

Each of these matters is discussed further in relation to the specific impacts of the Project in Section 4.4.7.

4.4.4 Potential impacts of the Project

If left unmanaged, the proposed action has the potential to result in impacts on ecologically sensitive features including MNES during construction and operations. Potential impacts associated with each phase of the Project are described in the following sections. Mitigation measures that will be implemented to minimise impacts of the Project specific to MNES are incorporated within the Outline EMP (**Appendix V**).

Impacts resulting from the proposed Project have been grouped as described in Section 4.1 (direct, indirect, off-site) and this section includes a description of impacts associated with ongoing human presence as well as works within the DMCP to support transfer or beneficial reuse of dredged material once dried.

Overall, the analysis has concluded that the majority of impacts resulting from the Project will be associated with the construction of the DMCP and associated earthworks. Placement of dredged material into the beneficial reuse area will be a short-term activity, occurring over a period of 5 to 13 weeks.

Any impacts associated with the placement of dredged material will have been preceded by construction of the DMCP (i.e. vegetation clearing will have occurred prior to the dredging being undertaken). The dredging activities will not have any impacts on terrestrial MNES, However, the construction of the DMCP and temporary pipelines may have indirect impacts on terrestrial MNES.

Accordingly, the following sections are focused on the construction of the DMCP and temporary pipelines, which have the potential to indirectly impact MNES. Potential impacts are primarily limited to:

- Generation of dust and PASS from the dredged material after drying
- Noise during the construction of DMCP embankments and associated earthworks
- Disturbance from lighting of the development area at night, to support 24 hour construction activities
- Abnormal events from the risk of embankment failure or seepage into the wetland and/or groundwater.

4.4.4.1 Construction phase impacts

If not appropriately mitigated, the construction phase of the Project is likely to result in impacts on ecologically sensitive features of the environment, primarily through vegetation clearing and works associated with the construction of the proposed DMCP and temporary pipelines. Construction activities with potential for significant impacts on MNES include:

- Vegetation clearance



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- Fragmentation and edge effects
- Excavation
- Placement of fill
- Vehicle movements
- Dust emissions
- Light emissions
- Construction noise
- Alterations to surface water hydrology and quality
- Alterations to ground water hydrology and quality
- Waste disposal
- Increased human presence and activity.

Vegetation clearing

Clearing vegetation to establish the DMCP and temporary pipeline alignment will reduce vegetative cover and result in the loss of some habitat for fauna dependent on those ecosystems (i.e. cause direct impacts). Table 4-23 indicates the proposed extent of clearance of each vegetation community in the development footprint, shown in Figure 3-26. For the purposes of the current assessment, a conservative approach has been adopted and it is assumed that all vegetation within the footprint will be removed. Given that only one pipeline alignment will be chosen from the three and to remain conservative, the calculation of the total area takes into account the alignment that requires the greater area to be cleared. As is shown in Table 4-23, the total area to be cleared for the Project is approximately 94 ha.



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Table 4-23 Aerial extent of clearing of vegetation communities in the project area from ELA and DEHP habitat mapping

Habitat Types	Associated Regional Ecosystems (RE)	Disturbed by DMCP (ha)	Soil Stockpile/Laydown Area (ha)	Pipeline Alignments (ha)			Total Area Disturbed (ha)
				Indicative 1	Indicative 2	Alternate	
Grass, weeds, other	Non-Remnant	50.57	18.6	0 ²	0 ²	0 ²	69.17
Woodland	Regrowth 11.2.5	23.14	0	0	0	0	23.14
Woodland	11.2.5	0.86	0	0	0	0	0.86
Foredune	11.2.2	0	0	0.05	0.05	0.15	0.15

¹ The pipeline alignment includes a variety of land forms, including car parks, laydown areas, settlement ponds and roads. Some of these may comprise non-remnant vegetation in small patches

² The pipeline alignments include a variety of land forms, including car parks, laydown areas, settlement ponds and roads. Some of these may comprise non-remnant vegetation in small patches.



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A reduction in vegetation cover can reduce the available shelter, nesting, breeding and foraging habitat for MNES fauna (threatened and migratory species). Although there are no threatened flora species known or likely to occur in the project area, a number of threatened and migratory bird species are known, likely to or could potentially occur (Section 3.2.1). Fauna species with narrow habitat preferences may be impacted more than others and may be subject to adverse impacts such as increased competition for limited resources which may result in a reduction in local populations.

No direct clearing of TECs is expected for construction of the DMCP or the temporary pipeline alignment. SEVT TEC occurs adjacent to the eastern beach, and is within approximately 5m (Indicative 2 or Alternate alignment) to 50m (Indicative 1 alignment) from project infrastructure, depending on the proposed pipeline alignment. The narrow range of this TEC makes it vulnerable to local extinction through direct removal and adverse edge effects (e.g. competition from weeds). The temporary pipeline alignment is planned to coincide with an existing roadways, to ensure that no clearing or other disturbance to this vegetation community occurs.

Should the temporary pipeline alignment involving a 5m setback from the SEVT be chosen, additional management measures as outlined in the technical memorandum attached at **Appendix P2** should be considered.

Fragmentation and edge effects

There is a relatively low potential for fragmentation of landscape habitat features, due to the project area being located adjacent to an existing industrialised section of the Port of Abbot Point. However, the relevance, extent and severity of impacts from fragmentation (e.g. weeds, fire, increased exposure to wind and barriers to movement of fauna) needs to be considered for each species or community. Most of the threatened and migratory species are birds for which the presence of the DMCP and temporary pipeline alignments are unlikely to comprise a significant barrier to movement.

Edge effects associated with clearing vegetation and site disturbance are important at Abbot Point due to the prevalence of several exotic weed and feral animal species that might be introduced into new areas or increase in extent (e.g. *Lantana*, *Parkinsonia*, rabbits, pigs, rats and cane toads). In addition, the risk of ignition and spread of fire is increased through the use of machinery and equipment that generate sparks, use of flammable chemicals and changes to the structure or composition of vegetation.

Excavation

The Project's design identifies the use of excavation only in relation to establishing the DMCPs, and proposes that excavation depth will be to a level of RL 3.0m. Existing levels onsite range from RL 2.5m to 5.5m. The DMCP capacity for the storage of dredged material will be achieved through construction of embankments (to a height of RL 9m), i.e. DMCPs will be largely above-ground rather than excavated into the ground. The most serious potential adverse impacts from excavation include:

- Disturbance of ASS or PASS soils, resulting in acid generation which then can indirectly impact MNES species and communities through degradation and loss of vegetation and important habitats
- Entrapment of fauna in open trenches, resulting in injury or death.

**Section 4****Environmental Impacts****Placement of fill**

Establishment of the DMCP will involve a substantial amount of placement of fill. Direct impacts include:

- Direct smothering of vegetation comprising important habitat for MNES fauna species, resulting in degradation or loss
- Direct smothering and destruction of nests and/or unfledged young of MNES bird species (resulting in injury or death).

Indirect impacts include smothering of vegetation, habitats or nests from sediments lost from the embankment walls if they are not adequately stabilised (e.g. with vegetation or geotextile), particularly during the wet season but also during any extended period of strong winds.

Vehicle movements

During construction, a large number of vehicles and heavy plant will enter, traverse and exit the project area, to clear vegetation, construct the DMCP, construct embankments and complete other activities. Direct impacts from vehicle and plant movements on MNES species and communities include:

- Damage or destruction of vegetation or fauna habitat by traversing these areas
- Interference/perturbation of MNES fauna through noise generated by machinery, affecting feeding, roosting, breeding or nesting behaviour
- Damage or destruction of SEVT vegetation and fauna habitat through smothering from dust generated by vehicles traversing the project area
- Fauna strike.

Indirect impacts include:

- Introducing and/or spreading weeds or feral animals carried on or in vehicles, resulting in deterioration or loss of SEVT vegetation and important fauna habitat.

Dust emissions

Project activities have the potential to generate dust emissions, most of which will be temporary during construction. The main sources of dust will be:

- Dust lift-off from exposed surfaces such as stockpiles and other exposed areas
- Construction of the embankments, including moving, dumping and shaping material
- Vegetation and soil clearing of the land
- Wheel-generated dust from the haul roads created for the construction phase.

Excessive deposition of dust on leaves of plants can suppress growth and photosynthesis and result in reduced habitat quality for fauna. High levels of airborne dust particles can irritate the respiratory systems of fauna and potentially result in ingestion of dust-coated seeds and other foods.

Excessive deposition of dust on open water bodies may also degrade water quality, and overall habitat quality for fauna. Wetland habitats surrounding the project area may be particularly vulnerable. High levels of dust settling in permanent or ephemeral waterways or picked up in tidal or stormwater runoff may flow through to the shore and reduce nearshore water quality of the GBRWHA.

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During construction, dust lift-off from exposed surfaces is more likely to occur after periods of hot, dry weather, particularly under strong winds. The placement and drying of dredged material within the DMCP is not expected to be a factor in the generation of dust, due to the moisture within sediments and the formation of a crust on the surface layers of dredged material.

Katestone Environmental (2015; **Appendix H**) identified several 'sensitive receptor zones' surrounding the Project site, including the Caley Valley Wetlands (freshwater and estuarine), the GBRMP and the GBRWHA. These sensitive receptors will potentially be affected by dust emissions from construction if relevant air quality objectives are exceeded. In particular, the technical report noted that effects on plants from dust deposition may occur where the maximum monthly rate of deposition exceeds 200mg/m²/day for a 120 day rolling average. This is relevant to the construction phase of the Project given the anticipated construction timeframe of three to six months.

There is limited information available on the potential for dust to irritate the respiratory systems of fauna, and there are no guidelines for the avoidance of impacts on fauna. In lieu of such guidelines, human health guidelines provide some reference criteria which are likely to be conservative for the purposes of environmental assessment. These criteria are:

- TSP - 90µg/m over an annual averaging period
- PM₁₀ - 50µg/m over a 24 hour averaging period
- PM_{2.5} - 8µg/m over an annual averaging period and 25µg/m a 24 hour averaging period.

Katestone (2015) undertook dispersion modelling to predict dust concentrations and deposition rates generated by Project construction activities (with and without existing background dust) in the freshwater and estuarine sections of the Caley Valley Wetlands. The modelling assumed the application of standard dust management practices such as the wetting of soil stockpiles and haul roads.

Maximum dust deposition levels were predicted to be below the vegetation criterion of 200mg/m²/day (Katestone, 2015). Impacts of dust deposition on vegetation including TECs and wetland flora supporting MNES are therefore not anticipated as a result of construction works. Results of the dispersion modelling in relation to dust concentrations and human health criteria were varied.

Assessment of the impacts of dust generated by the Project on threatened and migratory birds is provided in Sections 4.3.2, 4.4.7 and 4.4.8.

Light emissions

Artificial light can affect both nocturnal and diurnal animals by disrupting natural behaviour, with quality of light (e.g. wavelength, colour), intensity and duration of exposure potentially evoking different responses. Impacts from increased light levels include disorientation from or attraction toward artificial sources of light; mortality from collisions with structures; and effects on light-sensitive cycles of species (e.g. breeding and migration for fauna and flowering in plants). An artificial increase in lighting can also influence the abundance and behaviour of predators.

The presence and intensity of artificial light within the project area will temporarily increase during the construction phase and vary according to the type of work being undertaken. Construction of the DMCP embankments will occur for at least 12 hours a day, seven days a



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week, and may be extended up to 24 hours a day, seven days a week, if required to achieve Project schedules. The placement of dredged material will occur at night as part of a 24 hour work cycle. The disturbance footprint and surrounding areas will therefore be subject to artificial lighting for a period of several months during construction phases of the Project. Some ongoing lighting may also be required to support long-term management of the dredged material.

Lighting will be provided by mobile light towers which provide directional lighting from a mast extending a maximum of approximately 10m in height. Lights towers will generally comprise either four or six directional metal halide (or equivalent) lights ranging from 1,500 to 12,000 watts. Lights are adjustable and will be directed towards the area of construction activities to provide approximately 100 lux of illumination.

Some spillage of light to adjacent areas will be inevitable, with the area affected being determined by the height, intensity and orientation of lights used. Manufacturers specifications indicate that for lights oriented directly at the ground from above, ambient light levels are expected to be similar to background levels at a distance of approximately 60m from the source. For lights that are oriented towards construction activities (away from the wetland), the distance over which light spill is anticipated will be significantly reduced.

In this context, any effects from artificial lighting are most likely to be contained primarily within the buffer area between the DMCP embankments and the wetland, which is a minimum of 50m at the southern edge of the DMCP and up to 300m in other locations. Mitigation and management measures will be applied as detailed in the Outline EMP (**Appendix V**). Potential impacts associated with light emissions will be temporary and are unlikely to be significant. However, there is potential for them to act cumulatively with other impacts (e.g. noise) to disturb shorebirds from wetland habitats immediately adjacent to the project area. These impacts are described in Section 4.4.7.

Construction noise

Noise levels greater than existing ambient levels are expected within and adjacent to the project area during construction of the DMCP and temporary pipeline alignment, during the dredging operations (expected to occur over 5 to 13 weeks) and at stages during long-term management of the dredged material. Sources of noise are likely to consist of noise in short, intense pulses from mobile plant equipment, and more prolonged noise, with consistent vibration, pitch and volume from generators and pumps. Additional noise from vehicles will also be generated.

Both steady continuous and single noise events have the potential to lead to impacts on fauna. SLR (2015) noted the following key thresholds for potential impacts on shorebirds:

- 60dBA LA_{max} for single noise events
- 65dBA LA_{eq} for steady continuous noise.

These thresholds are likely to be conservative in relation to potential impacts on migratory shorebirds and the Australian Painted Snipe and provide an indication of the noise levels which may cause alarm.

SLR (2015) modelled the predicted distribution of cumulative noise (which includes that produced by existing operations at T1) under three different weather conditions (neutral, inversion and inversion with a south-east wind) for seven stages of the Project.



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The results of noise modelling indicated that:

- Noise exceeding the thresholds will extend into the Caley Valley Wetlands for some Project stages (including for activities such as topsoil stripping, embankment preparation and construction, and during the management of dredged material)
- There is only minor variability predicted in the distribution of noise contours in response to differing weather conditions.

Construction noise is expected to elicit some response from MNES utilising the wetland and may therefore have an impact (particularly on behaviour and possible localised shifting of more noise-sensitive species and individuals away from the sources of noise). There is no potential for impact on MNES utilising the wetland during DMCP liner installation and dredging of the sea bed, as the model outputs predicted that noise created by the Project during these stages would be confined to the project area, not the Caley Valley Wetlands.

As construction of the DMCP may occur during the period when migratory shorebirds visit the Caley Valley Wetlands, an assessment of impacts of noise on migratory shorebirds is provided in Section 4.4.7 and for other MNES where relevant.

Alterations to surface hydrology

Changes to hydrology (e.g. through installation of embankments that comprise obstacles to surface flows or additional stormwater runoff) can potentially impact the extent of catchments, runoff characteristics, intensity of flood flows and stability of waterways. Elevated levels of erosion transport of sediments across the Caley Valley Wetlands may result in reduced biodiversity in affected areas. Sediment runoff into aquatic habitats can cause increased turbidity, decreased oxygen levels, reduced light penetration, changes in channel morphology and altered sediment composition in substrates. In addition, interference with flows may alter the local wetting and drying regime, including water heights, flow paths, retention times and ponding. Such changes can have flow-on effects on aquatic habitats, resulting in their loss or alteration and a reduction in the quality and/or quantity of important food sources.

Results of hydrological modelling indicate that there will be minimal impact of the Project on surface water quality (BMT WBM, 2015). Under the worst-case modelled scenario, changes in salinity of up to 3ppt may occur within the wetland adjacent to the project area; however, such changes are insignificant when compared to the range of natural (seasonal) variations of salinity experienced by the wetland (BMT WBM, 2015).

The key infrastructure components of the Project that may impact the hydrology of surface waters of the wetland include the DMCP and associated infrastructure for managing stormwater. However, this influence has been assessed to be low and localised in relation to factors that may influence terrestrial ecology values (BMT WBM, 2015). As the Project does not involve the construction of infrastructure within the Caley Valley Wetlands, there is unlikely to be any impact on hydrological function of the wetland. With the application of standard mitigation and management measures as have been included in the Outline EMP (**Appendix V**), and its sub-plan: Preliminary Stormwater Management Plan (**Appendix Y**), impacts from stormwater releases will be localised and small in scale.

**Section 4****Environmental Impacts****Alterations to ground water quality, movement and storage**

Construction and operational activities can have adverse impacts on groundwater in and adjacent to the project area, including water movement and aquifer storage. If impacts on ground water quality and availability are substantial, this can have significant impacts on the health of dependent ecosystems, including SEVT TEC and wetland habitats of threatened and migratory species.

The acid sulfate potential of the dredged material has been assessed by Golder Associates (2015a) for the Project. On the basis of laboratory tests undertaken on marine sediments, it has been considered that the dredged material will be self-neutralising and will be actively managed in accordance with an approved ASSMP (refer to **Appendix X**).

Excavation activities during construction may intersect groundwater and expose ASS, resulting in acidification of ground water. Golder Associates (2015a) investigated material underlying the site and found that no PASS were present. No management of ASS will be required.

Liquid and solid waste disposal

Inappropriate disposal of liquid and solid wastes, including spills and leaks from transfers (fuel, chemicals) and inadequate storage could result in point-source contamination of surrounding land, including wetland, SEVT TEC and habitats of threatened and migratory species. Direct adverse impacts include contamination of vegetation (resulting in degradation or loss of SEVT and habitats), toxic effects on MNES fauna (from contact, inhalation or ingestion) or indirect impacts on threatened and migratory species from habitat loss. Direct adverse impacts on surface and groundwater quality are also possible from spills and leaks.

With the application of standard mitigation and management measures as have been included in the Outline EMP (**Appendix V**), impacts from liquid and solid waste disposal will be avoided or localised and small in scale. Accordingly these impacts are not considered further in analysis of impacts on MNES in Sections 4.3.2, 4.4.7 and 4.4.8.

Increased human presence and activity

Increased activity by people within the project area and surrounds has the potential to disturb fauna, with wetland birds roosting or foraging in adjacent areas being particularly vulnerable. This may be associated with aggregations of workers during certain construction or operational activities or use of adjacent areas during breaks. Impacts can include disruption to foraging and roosting efficiency or deterring birds from using particular areas (resulting in a reduction in habitat availability). Vehicles deviating from established access roads can also damage habitats (indirect impact on threatened and migratory species) or kill or damage birds on impact (direct impact, vehicle strikes).

Mitigation measures have been proposed to reduce off-site disturbance of fauna from increased human presence and vehicles.

**Section 4****Environmental Impacts****4.4.4.2 Potential impacts from the ongoing presence of infrastructure**

After completion of construction, the ongoing presence of infrastructure can continue to have potential for adverse direct and indirect impacts on TECs and threatened and migratory fauna. The key continuing risks are from:

- Dust emissions (e.g. blow-off from inadequately stabilised embankments and access roads)
- Erosion of embankments, access roads or other areas of ground disturbance, resulting in substantial transfer into sensitive habitats by surface flows.

With the application of standard mitigation and management measures as proposed in the Outline EMP (**Appendix V**), impacts from the ongoing presence of infrastructure is expected to be localised and small in scale. Accordingly these impacts are not considered further in analysis of impacts on MNES.

4.4.4.3 Potential impacts from periodic and short-term operational use

After construction of the new onshore facility, periodic short-term operational use will occur, including:

- Deposition of dredged material into the DMCP and removal or relocation of fill once sediments have settled and return waters have been discharged
- Periodic release of stormwater in retention ponds
- Periodic maintenance work on the embankments, DMCPs and pipework
- Removal of DMCP and establishment of the final landform.

Any future projects that require the use of the dredged material will be subject to an appropriate level of impact assessment as required under relevant Commonwealth and State legislation.

Operational activities will involve vehicle movements, earth works, dust emissions, noise/vibration emissions and increased human presence and activity. All of these increase the risk of adverse direct and indirect impacts on threatened and migratory species (e.g. vehicle strike and interference with behaviour) and degradation of habitats of MNES species and TECs (e.g. introduction and spread of weeds and feral animals). The nature of these potential impacts is described in Section 4.4.7 and will be reflective of impacts during the operational phases.

As mentioned previously, potential impacts arising from the placement of dredged material will be primarily limited to:

- Dust and PASS from the dredged material after drying
- Noise during the dredging and pumping activity
- Abnormal events from the risk of embankment failure or seepage to wetland and/or groundwater.

Mitigation measures have been considered as part of the relevant technical reports assessing these matters. With the implementation of suitable measures, the potential risk of impacts from these matters is considered low.

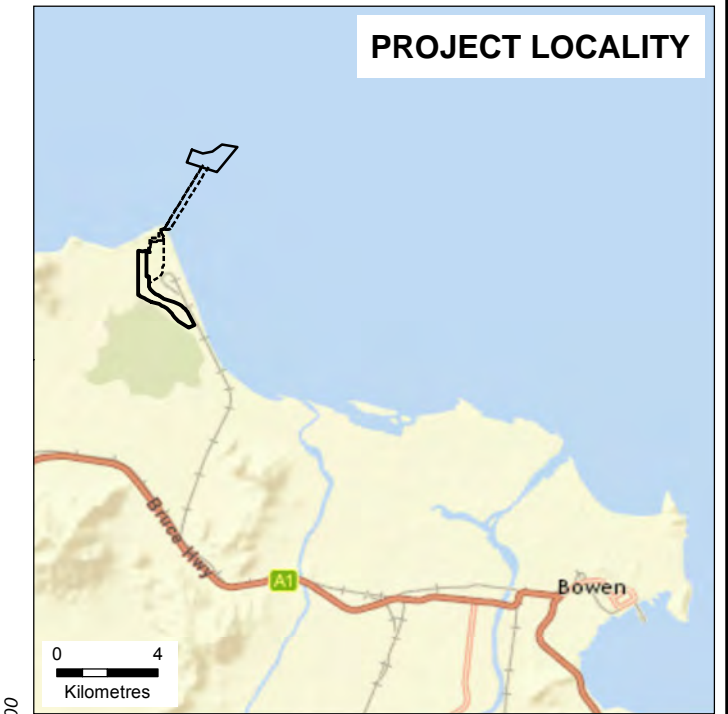


4.4.5 Assessment of impacts on threatened ecological communities

4.4.5.1 Semi-Evergreen Vine Thicket Threatened Ecological Community at Abbot Point


The SEVT of the Brigalow Belt is listed nationally as endangered under the EPBC Act. There is no SEVT within the footprint of the DMCP or the pipeline alignments. A strip of vegetation mapped as SEVT (RE 11.2.3) occurs along the eastern beach dune system and is located approximately 5m (Indicative 2 or Alternate alignment) to 50m (Indicative 1 alignment) from project infrastructure, depending on the proposed pipeline alignment (Figure 4-22).

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Source information:
Dredging study area
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Dredged material containment pond study area
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Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
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Regional ecosystems
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Figure 4-22							
Remnant vegetation (including vegetation mapped as Semi-Evergreen Vine Thicket) in the vicinity of the project area							
Figure: 301001-01956-00-GM-SKT-0088							Rev: 1

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Three separate assessments of SEVT vegetation at Abbot Point have been undertaken between 2009 and 2014. These communities have been generally assessed to be in good condition. However, some areas were recorded as heavily invaded by Rubber Vine (*Cryptostegia grandiflora*) and were in poor condition (GHD, 2009b).

Impacts of the Project on Semi-Evergreen Vine Thicket Threatened Ecological Community

As no SEVT TEC occurs within the project area, the potential impacts of the Project on this vegetation community would be indirect in nature and associated with the potential for introduction and or spread of weeds, and the risk of accidental fire.

Weeds are a key threat to SEVT leading to impacts through:

- Direct competition with established plants
- Restricting native plant regeneration through competition.

The Project has the potential to introduce new weeds and exacerbate existing weed problems, thereby reducing the quality of SEVT. Mitigation and management measures to reduce the potential impacts of weeds as have been included in the Outline EMP (**Appendix V**).

Fire is considered a general threat to SEVT communities and RE 11.2.3 in particular is considered to be a fire-sensitive ecosystem (TSSC 2001). While the moisture holding capacity of SEVT communities does provide some protection from fire, the impacts of fire can include:

- A reduction in the extent (total area) of SEVT
- Loss of biodiversity
- Loss of connectivity between patches of SEVT and other vegetation communities;
- Loss of soil and nutrients
- The promotion of weeds and the encroachment of exotic grasses.

Fire protection is also reduced when the buffering effect of surrounding fire-adapted native vegetation has been removed. Areas at most risk of impacts from fire include those surrounded by exotic pasture species as these produce higher fuel loads than native pasture species. In addition, smaller patches of SEVT are more susceptible to fire than larger patches, due to them having a greater exposed edge length (McDonald, 2010).

Management measures to reduce fire risk are recommended.

Mitigation and management measures

Based on the above analysis, impacts of the Project on SEVT are expected to be minor, with indirect impacts associated with establishment of the pipeline alignments that are temporary and short-term in nature. Mitigation measures have been established to minimise impacts on the TEC, as outlined below:

- Areas to be cleared within the project area will be surveyed, marked out and authorised by an appropriate person prior to clearing to ensure no areas of SEVT TEC are inadvertently disturbed
- All high risk materials (e.g. imported soil) should be certified as weed-free prior to acceptance onsite

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- Soil and fill material from weed-affected areas within the Project should not be transported to clean sites within the project area
- Flammable materials should be stored correctly to avoid spills
- Fire prevention measures should be employed, which may include fitting spark arresters to equipment, avoiding where practicable the use of spark-generating machinery and equipment on all total fire ban days, and restricting employee smoking to specific areas
- Development areas should be provided with adequate firefighting equipment.

These measures are consistent with the National Recovery Plan for the “Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions” ecological community (McDonald, 2010) and are considered adequate to avoid significant impacts on the SEVT TEC.

Residual impacts and outcome

There are no direct impacts on SEVT TEC from the Project, and indirect impacts have been assessed as minor. Therefore, the overall impact on SEVT TEC is unlikely to be significant. Management measures for weed and fire control will be implemented to manage those potential impacts. Offsets are not considered necessary.

4.4.6 Assessment of impacts on threatened species

This section assesses impacts of the Project on one threatened species (Squatter Pigeon) known to occur within the Abbot Point area. The remaining threatened species are also migratory or resident shorebirds and are addressed in Section 4.4.7.

4.4.6.1 Squatter Pigeon at Abbot Point

The Squatter Pigeon is a medium-sized ground-dwelling pigeon listed as vulnerable under the EPBC Act. The 2010 Action Plan for Australian Birds (Garnett *et al.*, 2011) downgraded the species to near threatened (per the 2000 action plan, Garnett and Crowley, 2000) as there have been no recent declines and the species persists at numerous sites across a broad distribution. The International Union for Conservation of Nature Red List Guidelines (BirdLife International, 2012) categorise the Squatter Pigeon as of least concern and state that the species has a very large range and does not approach the thresholds for listing as vulnerable for range or population size criteria.

The Squatter Pigeon occurs on the inland slopes of the Great Dividing Range, and is distributed from the dry tropics of central Queensland to the Border Rivers Region of northern New South Wales near Glen Innes. The estimated extent of occurrence is approximately 440,000km² (DoE, 2015a). The estimated total population of the species is considered to be of low reliability as no systematic surveys have been undertaken. However in 2000, there were estimated to be approximately 40,000 breeding birds (Garnett and Crowley 2000). Given the Squatter Pigeon’s ubiquitous nature and relative abundance, the population is thought to be stable at present. It is also thought this species occurs as a single, contiguous (i.e. inter-breeding) population (DoE, 2015a).

At Abbot Point the Squatter Pigeon has been observed regularly in small numbers (Ecoserve, 2007; GHD, 2009a; BAAM, 2012). Sightings have occurred in several habitat types, including adjacent to the existing terminal, in coastal areas near Dingo Beach and in



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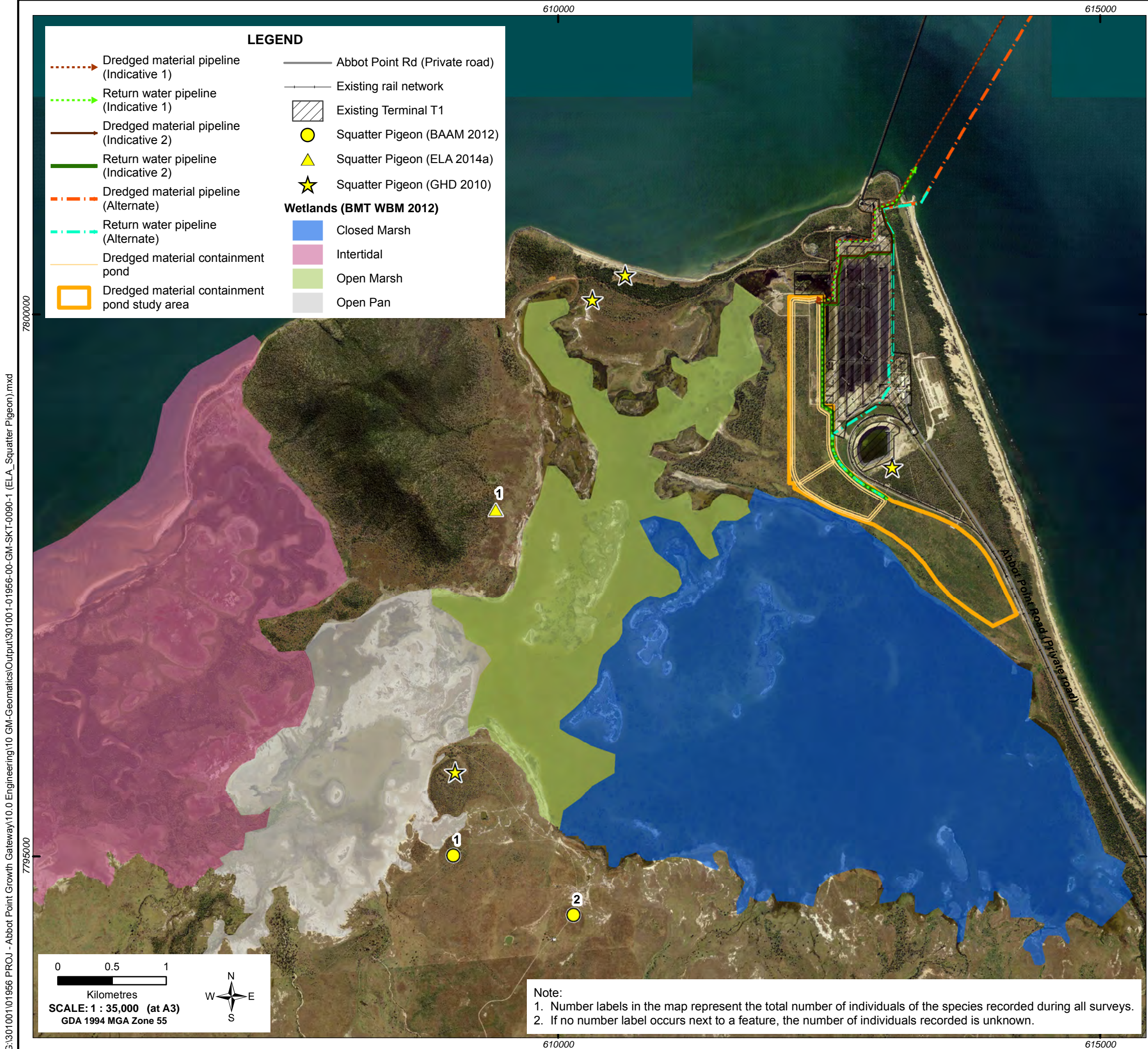


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woodlands on the south-western margins of the study area. There are no recorded sightings within the project area (Figure 4-23).



PROJECT LOCALITY

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Queensland Government - Department of State Development, Infrastructure and Planning 2015
Caley Valley Wetland wetland zones
BMT WBM 2012
Squatter Pigeon Sightings
BAAM 2012, ELA 2014, GHD 2010

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Figure 4-23

Map showing the location of Squatter Pigeon sightings across the study area

Figure: 301001-01956-00-GM-SKT-0090Rev: 1

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Given the Squatter Pigeon is listed as vulnerable under the EPBC Act, it is relevant to understand whether the broader Abbot Point area supports an 'important population' of the species in undertaking this impact assessment. No populations have been identified as being important to the long-term survival of the Squatter Pigeon, nor have areas of critical habitat been determined (DoE, 2015a). The species is thought to interbreed across its entire geographic range, and it is a habitat generalist that uses both remnant and disturbed areas.

Within the Abbot Point region, the Squatter Pigeon has been observed in five of eight fauna surveys between 2007 and 2014. These records have been distributed across a variety of habitats. Overall, it is considered that the Squatter Pigeon population at Abbot Point is small and does not meet the criteria for an important population or habitat critical to the survival of the species (as defined in the *Significant Impact Guidelines 1.1*) for the following reasons:

- The species is ubiquitous in this part of its geographic range
- The species is not restricted by habitat availability in the Abbot Point area or within the region (this is particularly the case because the species is a habitat generalist)
- The numbers recorded at Abbot Point are small and the species is neither rare nor disjunct from the broader population (which occurs across a large range)
- It is not at the edge of the range of the species and is therefore not important in terms of range expansion and recovery
- Given the above, there is no evidence to suggest the individuals found at Abbot Point are important in terms of maintaining genetic diversity.

4.4.6.2 Potential impacts of the Project on the Squatter Pigeon

Project impacts that have been identified as being relevant to the Squatter Pigeon are as follows:

- Habitat loss resulting from clearing of vegetation or smothering during fill placement
- Mortality or injury resulting from fauna strike (vehicles), entrapment (excavation) or collisions with structures
- Reduced breeding success from destruction of ground nests
- Reduction in habitat quality resulting from fragmentation and edge effects due to clearing of vegetation (weeds and pests).

Habitat loss

The Project will require some clearing of vegetation within the development footprint, which may lead to a loss of habitat for the Squatter Pigeon. Approximately 94ha of habitat suitable for the Squatter Pigeon will be disturbed by the Project within the DMCP, pipeline alignments and soil stockpile/laydown area. This loss is unlikely to be significant in relation to the Squatter Pigeon, as habitat availability does not appear to be a limiting factor for the species.

Displacement from areas that are subject to development within the project area is unlikely to lead to decline, as individuals are expected to readily move to other nearby areas both within the study area and in the region more broadly. The following factors are relevant to the assessment of potential impacts:

- The species has been recorded within a variety of habitats at Abbot Point and does not appear to be more associated with or restricted to areas that are subject to development
- Habitat at Abbot Point is similar to that available throughout the region

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- The species is a habitat generalist, and is known to occur within both disturbed and remnant areas.

Furthermore, the number of individuals recorded at Abbot Point is considered to be relatively small and unlikely to comprise an important population of the species (BAAM, 2012).

Despite this, measures to minimise vegetation clearing and the associated loss of habitat for the Squatter Pigeon within the project area are recommended, as this will minimise the level of impact on local individuals and is part of good environmental practice.

Mortality, including destruction of nests

The proposed development, particularly during the construction phase, will result in an increase in the number of vehicles and other machinery using the project area. The Squatter Pigeon is known to freeze in its position when danger approaches, making it susceptible to mortality during habitat clearing and as a result of vehicle and other machinery strike during construction and operation.

Squatter Pigeons are ground nesting and the chicks are capable of only short flights when they depart the nest (DoE, 2015a). Mortality or injury of chicks from entrapment in excavated ground is therefore possible.

Specific measures to manage and mitigate the risk of Squatter Pigeon strike are recommended and are discussed below.

Reduced habitat quality

Clearing of vegetation for development of the Project has the potential to fragment the landscape, which may also reduce the viability of an area by increasing the occurrence and severity of 'edge effects'. Of these edge effects, an increase in the accessibility for pest animals is most likely to be an issue for the Squatter Pigeon.

Feral animals are a recognised threat to the Squatter Pigeon due to predation (by cats and dogs) and competition for foraging resources (from species such as rabbits; DoE, 2015a). Management of pest species has been identified as beneficial to the Squatter Pigeon.

4.4.6.3 Mitigation and management measures

Based on the above analysis, impacts from the Project on the Squatter Pigeon and its habitat are expected to be minor, reflective of the species' generalist nature, tolerance of disturbed areas and the availability of suitable habitat across the region. Despite this, the proposed development is still expected to have some level of impact on the Squatter Pigeon. Therefore, measures to address the following identified impacts will be implemented in order to minimise the level of impact on local individuals.

Habitat loss

The Project will require some clearing of vegetation within the project area and this may lead to a loss of habitat for the Squatter Pigeon.

The following general requirements will therefore be adopted:

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- Restrict clearing to the minimum required footprint that enables the construction and operation of the DMCP and pipeline infrastructure, and ancillary soil stockpiles, laydown and site office areas
- Survey and mark areas to be cleared to ensure no additional habitats are inadvertently disturbed; and undertake progressive rehabilitation of areas that are no longer needed for ongoing operations (e.g. construction laydown areas).

Mortality and nest disturbance

Construction activities will involve an increase in vehicles and machinery and this may lead to an increased occurrence of Squatter Pigeon mortality through direct strike or entrapment of chicks in excavated areas. This is particularly relevant for the Squatter Pigeon due to its behavioural trait to freeze in response to danger. Additional vehicle and machinery equipment across the project area and placement of fill materials may also destroy active Squatter Pigeon nests on the ground.

The following specific measures will be implemented to address these potential impacts:

- Personnel operating vehicles in and adjacent to the project area should be made aware of the presence of the Squatter Pigeon and the potential for it to be encountered on the vehicle tracks, particularly those that are not formed roads in woodlands.
- Qualified personnel should conduct thorough pre-clearance surveys of the project area prior to vegetation clearance to flush out individuals and determine the location of any nests. Particular attention should be given to areas of short, dry, grass tussocks and under bushes and fallen logs. If nests are located, translocation of the eggs/young should be conducted by qualified personnel to a suitable nearby habitat, if appropriate.

Reduced habitat quality

Pest species management has been an important part of the ongoing management of the wetland environment at Abbot Point. Whilst primarily geared towards enhancing the wetland habitat values and decreasing existing threats to shorebirds and turtle nesting, pest management measures will also benefit the Squatter Pigeon.

4.4.6.4 Residual impacts and outcome

As discussed above, the overall impacts of the Project on the Squatter Pigeon are unlikely to be significant. However, a range of mitigation measures should nonetheless be implemented to manage any minor impacts and facilitate the ongoing use of the project area by the species. Offsets are not considered necessary.



4.4.7 Assessment of impacts on migratory shorebird species and the Australian Painted Snipe

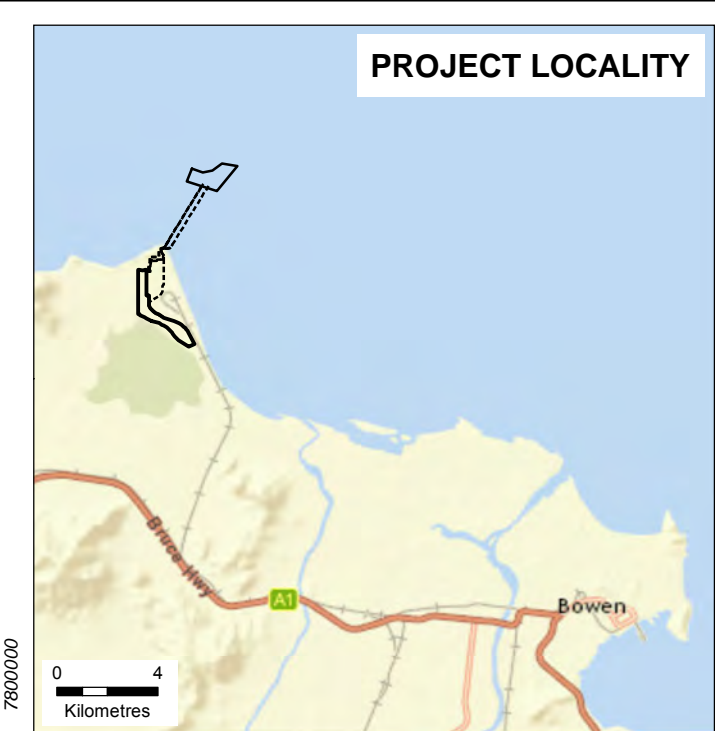
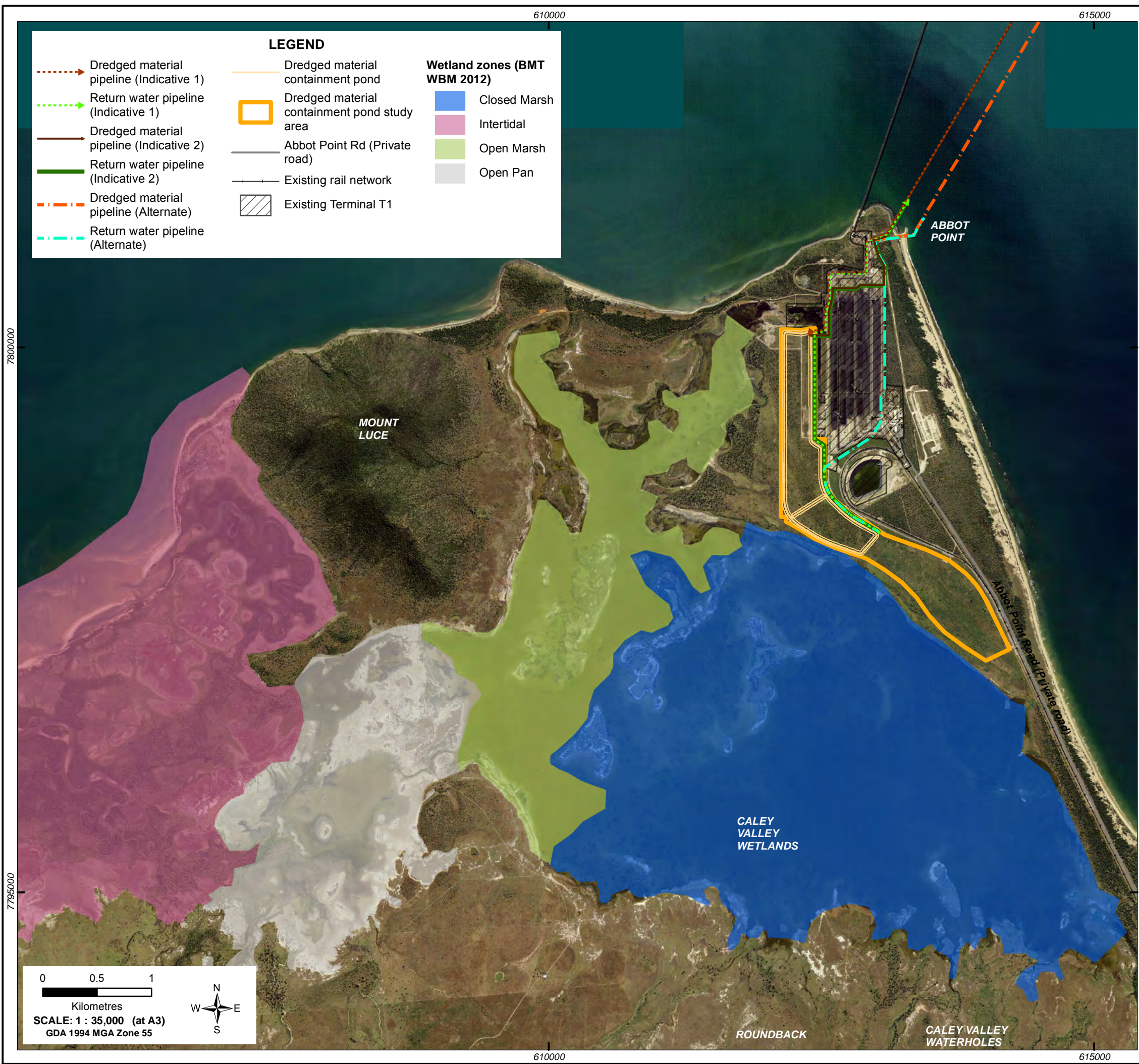
Preliminary note: Although the Australian Painted Snipe is listed as threatened species but not migratory shorebird under the EPBC Act, it is assessed with migratory shorebirds due to its use of the same habitat and its exposure to the same threats.

4.4.7.1 Shorebirds relevant to the impact assessment

Migratory shorebirds


Figure 4-24 is a map of the wetland habitat types within Caley Valley Wetlands referred to in the following discussions of relevant migratory shorebird species.

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Figure 4-24 Map showing functional zones within the Caley Valley Wetlands							
Figure: 301001-01956-00-GM-SKT-0089							Rev: 1

**Section 4****Environmental Impacts***Eastern Curlew*

In Australia, habitat includes intertidal mud and sand flats for feeding, and sand bars and spits for roosting at high tide. Threats to the species in Australia include human disturbance, habitat degradation, hydrological changes and invasive plants (TSSC 2015a). Disturbance to pre-migratory Eastern Curlews can affect their ability to migrate to the northern hemisphere to breed during the Australian winter.

Surveys during 2012 recorded low numbers, except during December 2012 when 34 individuals were counted at high tide within the Open Pan Zone of the wetland, 4km west of the project area. The species prefers estuarine environments within the wetland and has not been observed immediately adjacent to the project area. BMT WBM (2012) noted individuals from a 2006 survey roosting on Dingo Beach 500m from the project area.

Habitat preferences of the Eastern Curlew for areas located away from the project area make the species of low susceptibility to off-site project impacts. Oldland *et al.* (2009) suggest the Eastern Curlew is more sensitive to human-related disturbance than other shorebird species, with a minimum buffer distance of 126m from people recommended. All sightings of Eastern Curlew at the wetland have been recorded at distances of 500m from the project area. However, given this species is now listed as critically endangered and has been recorded within the broader Abbot Point area, it is included in the assessment of off-site and indirect impacts from the Project.

Curlew Sandpiper

In Australia, foraging habitat includes intertidal mudflats and non-tidal wetlands. Roosting occurs on sand spits, wetlands, lagoons and sometimes on mangroves (TSSC, 2015b). In Australia, threats to the species include human disturbance, habitat degradation, hydrological changes and invasive plants (TSSC, 2015b). The species is also threatened by wetland degradation in East Asia along its migratory route.

There are two Wildlife Online records of the Curlew Sandpiper from the Caley Valley Wetlands. Eight to ten individuals were also observed by BMT WBM (2012) in the Closed Marsh of the wetland, approximately 2.5km south-west of the project area. There were no sightings of the species during the BAAM (2012) surveys. The species appears to be an infrequent visitor to the Caley Valley Wetlands, and there is no evidence to suggest that areas adjacent to the project area are preferred habitat. However, given this species is listed as critically endangered and has been recorded within the broader Abbot Point area, a conservative approach has been adopted and it is included in the assessment of off-site and indirect impacts from the Project.

Red-necked Stint

The Red-necked Stint is the smallest shorebird in Australia and is listed as migratory under the EPBC Act. The species was found in significant numbers at Abbot Point during 2012. The BAAM (2012) wet season survey found the species restricted to the Open Pan Zone and western edge of the freshwater areas. This survey found a total of 134 birds on the western edge of the palustrine area in the north-western section of the Closed Marsh and 1,088 individuals foraging in the Open Pan Zone. During this survey period, Red-necked Stints were observed to be foraging in large flocks with other shorebird species, mainly

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sandpipers. The diversity of habitats at the wetland allows the Red-necked Stint to use the muddy shallows of the Open Pan Zone as well as the edges of the main wetland basin.

The BAAM (2012) dry season survey found 47 Red-necked Stints on the south-western edge of the Open Marsh Zone. This finding potentially adds to the relevance of Caley Valley Wetlands as an important habitat for migratory shorebirds. Red-necked Stints arrive in Australia from August (possibly July) with most from early September. Almost all have arrived in Australia by November. They begin the return to breeding grounds from late February through to April although a few remain until May (DoE, 2015a). The 47 Red-necked Stints counted on the site in late June 2012 were most likely young birds, which had not migrated to breed and were spending the northern hemisphere summer in Australia.

While most Red-necked Stints observed at the Caley Valley Wetlands have been located more than 500m from the project area, the species is likely to occasionally utilise habitats in closer proximity to the Project. Given that a significant proportion of the flyway population utilise the wetland, the species is included in the assessment of off-site and indirect impacts.

Sharp-tailed Sandpiper

The Sharp-tailed Sandpiper is a small to medium sized shorebird listed as migratory under the EPBC Act. The species has been found in significant numbers at Abbot Point. The BAAM (2012) survey found the Sharp-tailed Sandpiper in large numbers adjacent to the project area, although the population halved between the February and March survey periods. This was possibly related to the large amount of rain that fell between surveys (151mm). The Sharp-tailed Sandpiper forages in shallow water across wetland fringes and much of this foraging habitat disappeared as a result of the substantial post-rain rise in water level. Notably the species was found in almost equal numbers in the Open and Closed Marsh zones. Conversely the numbers of Sharp-tailed Sandpiper recorded in March in the Open Pan Zone increased as the raised water level improved.

The habitat mosaic that makes up Caley Valley Wetlands is conducive to the foraging and roosting behaviours of the Sharp-tailed Sandpiper. The species feeds opportunistically on the mosaic of different habitat types, such as intertidal mudflats on bare wet mud or sand, and in shallow water (all provided by the wetland).

The June 2012 BAAM survey found one Sharp-tailed Sandpiper on the western edge of the Open Marsh. That is, there was little evidence of a local population of young birds that had not migrated to breed in the northern hemisphere. Typically in Queensland, Sharp-tailed Sandpiper numbers are very low in winter (Queensland Wader Study Group records). The species was also found in large numbers in both November and December in the Lake and Open Pan sections of the wetland. The species is included in the assessment of off-site and indirect impacts from the Project, due to its demonstrated use of habitat adjacent to the project area.

Latham's Snipe

Latham's Snipe is a medium sized shorebird and the largest species of snipe found in Australia. The species is listed as migratory under the EPBC Act. Abbot Point is considered important habitat for Latham's Snipe. The threshold for a site to be considered an 'important habitat' for Latham's Snipe is records of greater than 18 individuals. There were 36 records of Latham's Snipe from the BAAM (2012) wet season surveys. Twenty seven birds were

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sighted in a single field survey, with the estimated number of individuals (accounting for those that were present but not observed) being more than double this at 63 birds. The higher estimate is commensurate with standard surveying practice for Latham's Snipe, and is necessary to account for the difficulties involved with surveying this species given their cryptic appearance and behaviour. This species was also recorded in the November and December 2012 dry season surveys (two birds in each survey).

The mosaic of habitat types within the Caley Valley Wetlands is conducive to Latham's Snipe, in terms of its foraging and roosting preferences and its cryptic nature. The sensitivity of the species makes the Closed Marsh Area of the wetland important because the fringing sedges allow the birds to move and forage under cover. The species utilises salt couch on the margins of wet areas, unlike most migratory shorebirds.

Within the study area, Latham's Snipe moves between the Open and Closed Marsh zones (foraging areas of mud in each zone). The common element in both zones is the presence of low dense vegetation. The species is therefore included in the assessment of off-site and indirect impacts from the Project.

Common Greenshank

The Common Greenshank is a heavily built shorebird listed as migratory under the EPBC Act. The species has been found in significant numbers at Abbot Point. BAAM (2012) found the Common Greenshank in all surveys except June, with numbers commonly ranging from 30 to 40 individuals. The species was also observed in low numbers by BMT WBM (2012). While a solitary individual was observed along a transect of the eastern wetland adjacent to the project area, the species was much more abundant along the western edge of the Northern Marsh, the central Closed Marsh and the Open Pan habitats. While not common in sections of the wetland adjacent to the project area, the species is included in the assessment of off-site and indirect impacts.

Marsh Sandpiper

The Marsh Sandpiper is a medium sized shorebird listed as migratory under the EPBC Act. The species has been found in significant numbers at Abbot Point. BAAM (2012) recorded the Marsh Sandpiper during each of its surveys, with highest numbers of 26 individuals during November 2012. The species was also observed by BMT WBM (2012) in the Closed Marsh. While a transect by BAAM (2012) identified two individuals adjacent to the project area, the species was more abundant in the central and southern sections of the Closed Marsh, and the Open Pan of the wetland. While not common in sections of the wetland adjacent to the project area, the species is included in the assessment of off-site and indirect impacts.

Australian Painted Snipe

The Australian Painted Snipe is listed as endangered under the EPBC Act. The species occurs in shallow freshwater and brackish wetlands, and is most common in eastern Australia. The species has undergone a severe decline since the 1950s and in particular during the past 26 years, due to loss and degradation of wetland habitats. Specific threats to habitats include changes to hydrology affecting water depth and agricultural modifications associated with cattle trampling, nutrient enrichment and increased cropping (TSSC, 2013).

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Abbot Point is considered important habitat for the Australian Painted Snipe. The species has been found in unusually high numbers in 2012, representing 1.8% of the total population of the species. The three Australian Painted Snipe recorded in the BAAM (2012) wet season survey were flushed in short and relatively sparsely vegetated edge habitat flooded with shallow fresh water on the southern fringe of the Closed Marsh Zone. In the BAAM (2012) dry season surveys, 24 individuals were observed equally in the Open and Closed Marsh zones of the wetland. It is notable that within the Open and Closed Marsh zones the Australian Painted Snipe was located very broadly across all areas, from the northern most section of the Open Marsh to the southern edge of the Closed Marsh.

BAAM (2012) recorded that the species was present in family groups during the June survey. The only group observed well prior to flushing included two juvenile birds that were noticeably smaller than the attendant adult, suggesting recent breeding activity, most likely on the wetland itself (although breeding elsewhere and subsequent movement to the wetland cannot be discounted). Australian Painted Snipe are known to breed in the Caley Valley Wetlands; a clutch of eggs collected on 9 April 1978 in the Caley Valley Wetlands is catalogued in the Australian National Wildlife Collection (Atlas of Living Australia, 2012). The breeding season at Abbot Point is likely to extend from February to September, with nesting most likely over the period from March to May.

The location and numbers of the Australian Painted Snipe found in the study area are presented in Section 3.2.1. Unlike other species, some precise record locations are available (rather than transect locations). The data indicates there is habitat utilised by the Australian Painted Snipe located adjacent to the project area. The species is therefore included in the assessment of off-site and indirect impacts from the Project. As with Latham's Snipe, the species utilises salt couch (on the margins of wet areas), unlike most migratory shorebirds.

4.4.7.2 Potential project impacts

Section 4.3 provides detailed descriptions of the direct and indirect impacts relevant to the Project. Of these impacts, those that have been identified as being relevant to the migratory shorebird species (including the key species where a significant population is present: Latham's Snipe, Sharp-tailed Sandpiper; and Red-necked Stint) and the Australian Painted Snipe are as follows:

- Mortality or injury resulting from fauna strike (vehicles), entrapment (excavation) or collisions with structures
- Off-site and indirect disturbance associated with:
 - Construction noise
 - Dust
 - Increased human activity
 - Lighting
 - Changes stormwater runoff regime
 - Changes to the groundwater regime.



Mortality or injury

The proposed development, particularly during the construction phase, will result in an increase in the number of vehicles and other machinery using the project area. Vehicles and large structures have the potential to increase bird mortality through direct strikes.

The risk of increased mortality through migratory shorebirds and the Australian Painted Snipe striking structures is considered to be minor given that Abbot Point is used by these shorebirds for feeding and roosting rather than as an EAA flyway staging or flyover area.

While the risk of vehicle strike is also considered low, there is increased potential for this to occur during construction when vehicles and machinery may be operating within and around habitat areas. Management of this potential impact is therefore recommended.

The current project design identifies the use of excavation to establish the DMCPs. Entrapment in open excavations may pose a risk to injured birds and other fauna.

Specific measures to manage and mitigate the risk of strike on migratory shorebird and the Australian Painted Snipe have been included in the Outline EMP (**Appendix V**).

Construction noise

Increased noise associated with construction within the project area has the potential to cause localised shifting of noise-sensitive species and individuals away from the sources of noise, thereby disrupting feeding and roosting. Studies of waterbird responses to various types of noise disturbance indicate that the following key thresholds for potential impacts on shorebirds would apply at Abbot Point (SLR, 2012; SLR, 2015):

- 60dBA for single noise events
- 65dBA for steady continuous noise.

These criteria are general in nature, and site-specific factors may contribute to higher or lower criteria under certain circumstances. For example, Hicks *et al.* (1987) found that Sooty Terns and Common Noddies on Michaelmas Cay in the GBR were far more likely to take flight from seaplanes that were taking off than those that were landing. Generally foraging birds show a greater tolerance to noise than roosting or nesting birds. For an ongoing construction project, avoidance of otherwise suitable foraging and roosting habitat is a potential mode of disturbance, which could lead to overcrowding in alternative habitats or reduced foraging efficiency.

In order to minimise off-site and indirect impacts of the Project (including noise) on wetland values, the DMCP was set back 50m at a minimum from the wetland as part of the project design. SLR (2015) modelled the predicted distribution of cumulative noise (which includes that produced by existing operations at T1) across the Abbot Point area for seven stages of the Project under three different weather conditions. These conditions were:

- Neutral - 10°C, 70% humidity, D Pasqual Stability Class and 0 m/s wind speed
- Inversion - 10°C, 90% humidity, F Pasqual Stability Class and 0 m/s wind speed
- Wind-enhanced - 10°C, 90% humidity, F Pasqual Stability Class and 3 m/s wind speed from a south-east direction.

These stages and their relevant noise criterion for shorebird disturbance are summarised below:



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- Topsoil stripping and stockpiling (60dBA LA_{max})
- Embankment subgrade preparation (60dBA LA_{max})
- Embankment construction (60dBA LA_{max})
- DMCP liner installation (65dBA LA_{eq})
- Dredging of the seabed (65dBA LA_{eq})
- Management of dredged material in the DMCP (60dBA LA_{max})
- Post dredging management of the DMCP (60dBA LA_{max}).

The results of noise modelling indicate that:

- Noise exceeding the criteria for shorebird disturbance will extend into shorebird habitats of the Caley Valley Wetlands for some Project stages as summarised in Table 4-24 and presented in Figure 4-25 to Figure 4-31
- There was little variability predicted in the distribution of noise contours in response to different weather conditions.

For each modelled project stage, a single contour was adapted from the three weather conditions modelled, with the selected contour being that which had the maximum overlap with the wetland. This approach provided an estimate of the maximum extent of noise where disturbance is anticipated under a variety of weather conditions. While this method will overestimate the area affected by noise at any given point in time, changes in weather conditions can occur rapidly (in less than an hour) and the response of shorebirds to changes in the noise regime from varying weather conditions may take longer (days or weeks). Such a conservative approach is also most appropriate for the purpose of impact assessment.

Predicted cumulative noise contours (incorporating noise from the existing T1 operations) are based on either single noise events (dBA LA_{max}; Figure 4-25 to Figure 4-27, Figure 4-30 and Figure 4-31) or steady continuous noise (dBA LA_{eq}; Figure 4-28 and Figure 4-29). The results indicate that construction activities are predicted to produce single noise events above the disturbance criterion for some areas overlapping with and adjacent to the Project's development footprint. Steady continuous noise is not predicted to be generated above the disturbance criterion across most of the Project's development footprint. Modelling of DMCP liner installation and dredging stages of the Project indicates that continuous noise will mostly be generated by the existing operations of the T1 facility, and largely contained within the T1 site boundary. Further details of the noise modelling results are provided in **Appendix J**.



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Table 4-24 Summary of the area of wetland habitat for shorebirds enclosed by the modelled 60/65 dBA contour for various stages of the Project's construction and operations

Project Stage	Latham's snipe and Australian Painted Snipe Predicted area of wetland habitat enclosed by 60 dBA LAmax or 65 dBA LAeq contour (ha) ¹	Other Migratory shorebirds Predicted area of wetland habitat (excluding salt couch) enclosed by dBA LAmax or 65 dBA LAeq contour (ha) ²
Topsoil stripping and stockpiling	21.2	14.9
Embankment subgrade preparation	21.9	15.0
Embankment construction	16.0	10.0
DMCP liner installation	0.0	0.0
Dredging of the sea bed	0.0	0.0
Management of dredged material in the DMCP	12.2	6.4
Post dredging management of the DMCP	1.7	0.5

¹ Relevant to assessment of impacts on Latham's Snipe and Australian Painted Snipe. These species may utilise salt couch on the margins of wet areas.

² Relevant to assessment of impacts on other migratory shorebirds, for which salt couch does not represent important habitat. The mixed salt couch and samphire community has been included as habitat.

Construction noise above the criteria at which disturbance of shorebirds may be expected was predicted to extend into the wetland for some construction phases of the Project and for the management of dredged material during and after dredging. Noise levels above the criteria were not predicted to extend into the wetland during DMCP liner installation and dredging stages of the Project.

Construction and management stages of the Project have the potential to impact on shorebird behaviour in a small part of the wetland (up to 0.4% of wetland area) through localised shifting of noise-sensitive species and individuals away from the sources of noise. Further assessment of the potential for such impacts is discussed for key shorebird species in Section 4.4.7.4, taking into account species-specific ecological requirements and habitat utilisation in the affected parts of the wetland.

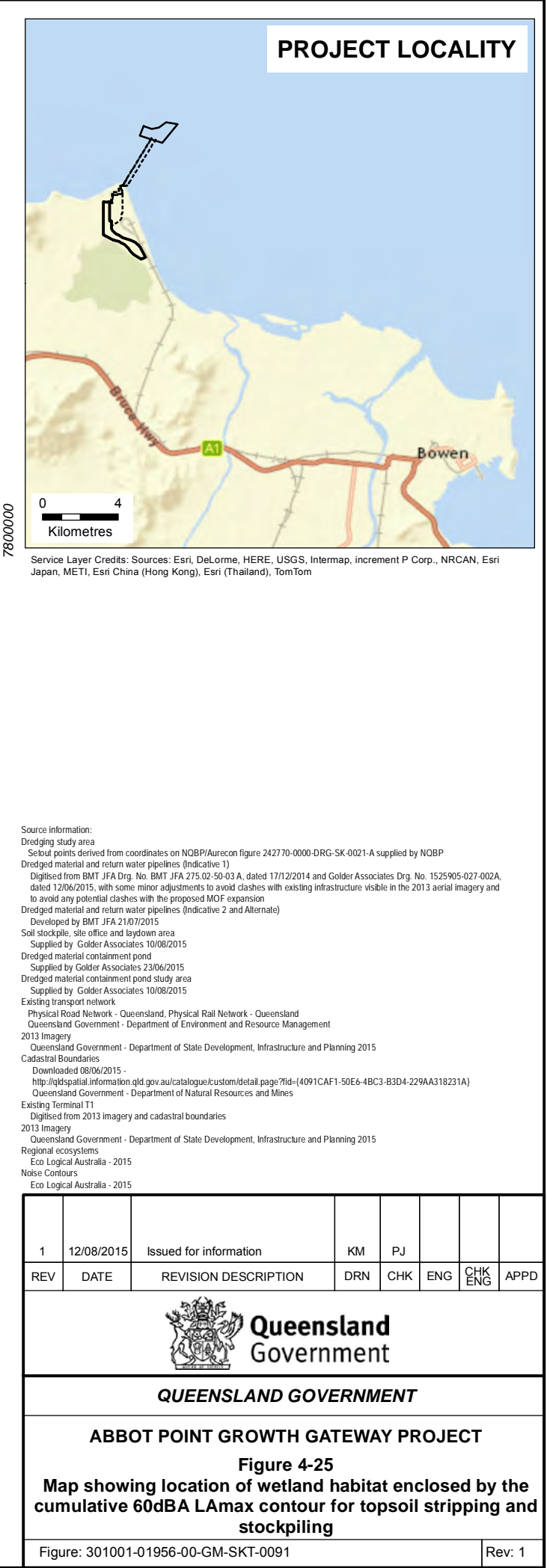
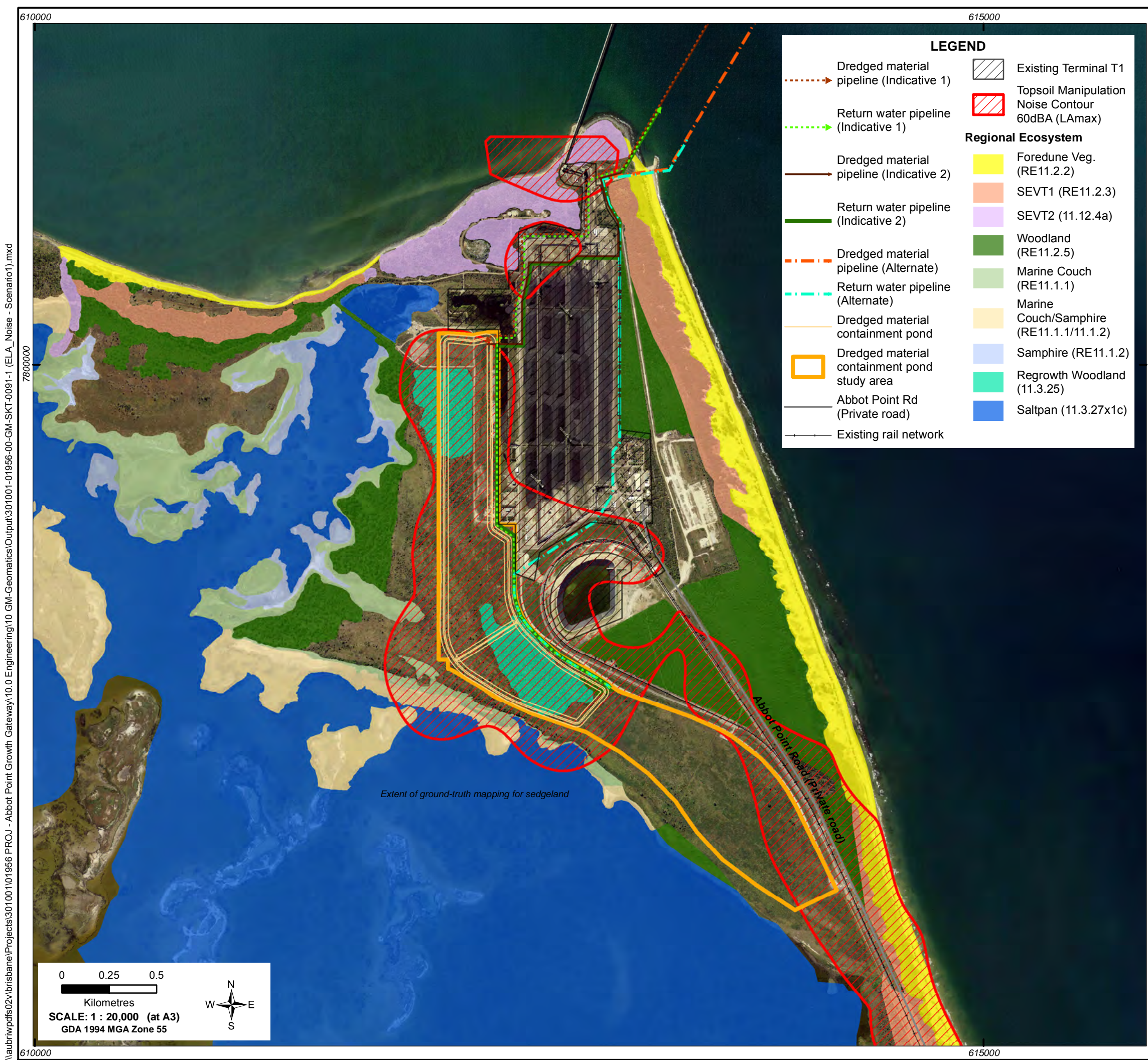
There is also the potential for impacts to shorebirds at the Abbot Point eastern beach as a result of noise generated during the construction, operation and dismantling of the pipelines in that area. Potential impacts were assessed as being relatively minor (refer **Appendix P3**), for the following reasons:



Section 4

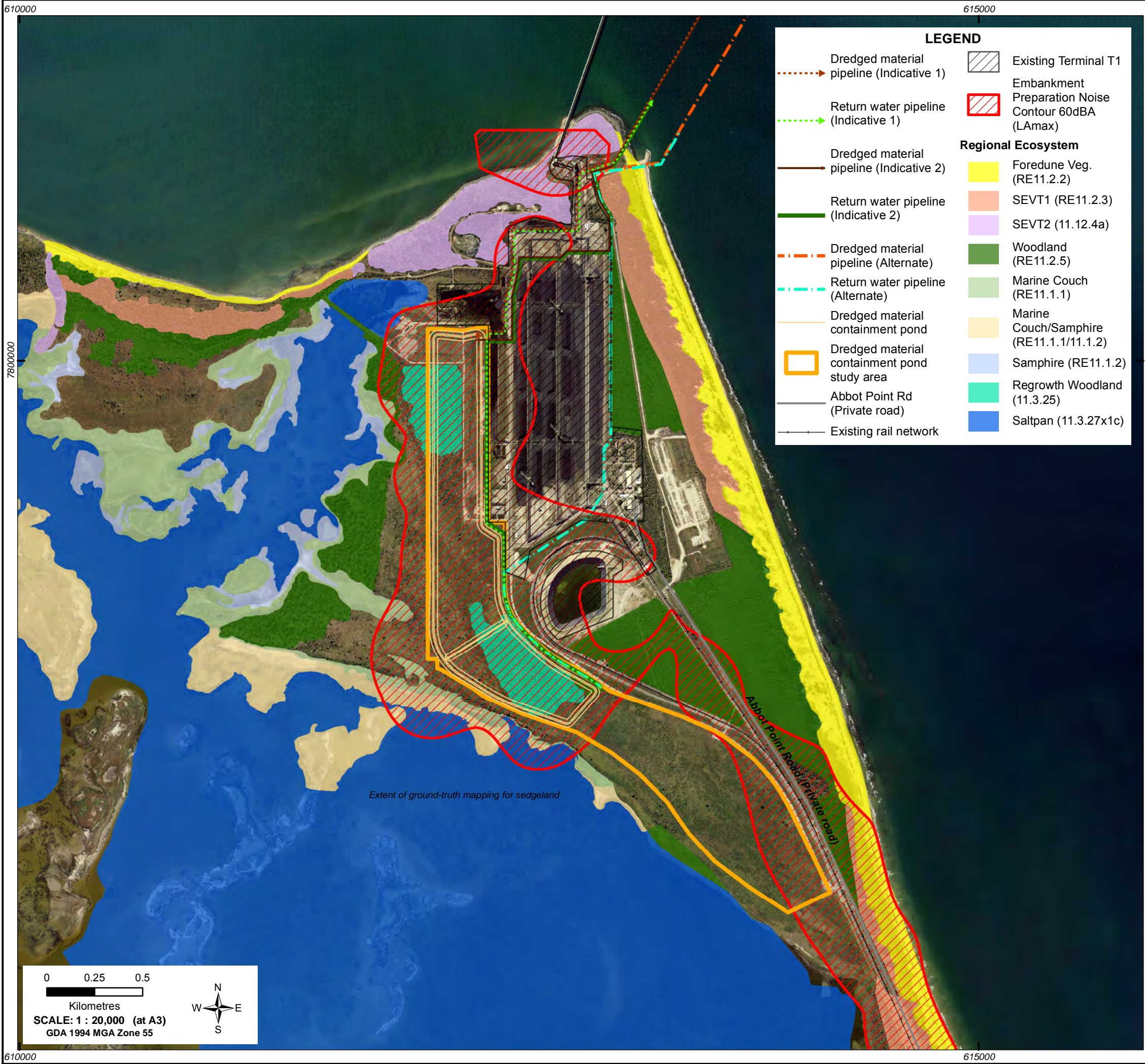
Environmental Impacts

- The eastern beach of Abbot Point is approximately 6.5km in length, with the section of coastal foreshore to be disturbed by the pipeline alignment (once selected) representing a small fraction of this habitat.
- Direct disturbance will occur within a 12m corridor, and indirect disturbance of birds could be expected within a distance of approximately 100m either side of the selected pipeline alignment.
- The pipelines will be in place for approximately three to four months, and will be removed following the completion of dredging. Ongoing impacts following the removal of pipelines are unlikely, with a rapid recovery of disturbed areas expected.
- Environmental values to be affected by the works are widespread throughout the Abbot Point region and are likely to be in better condition (less disturbed) further south along the eastern beach (where works are not proposed).



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PROJECT LOCALITY

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0 4 Kilometres

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
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ABBOT POINT GROWTH GATEWAY PROJECT

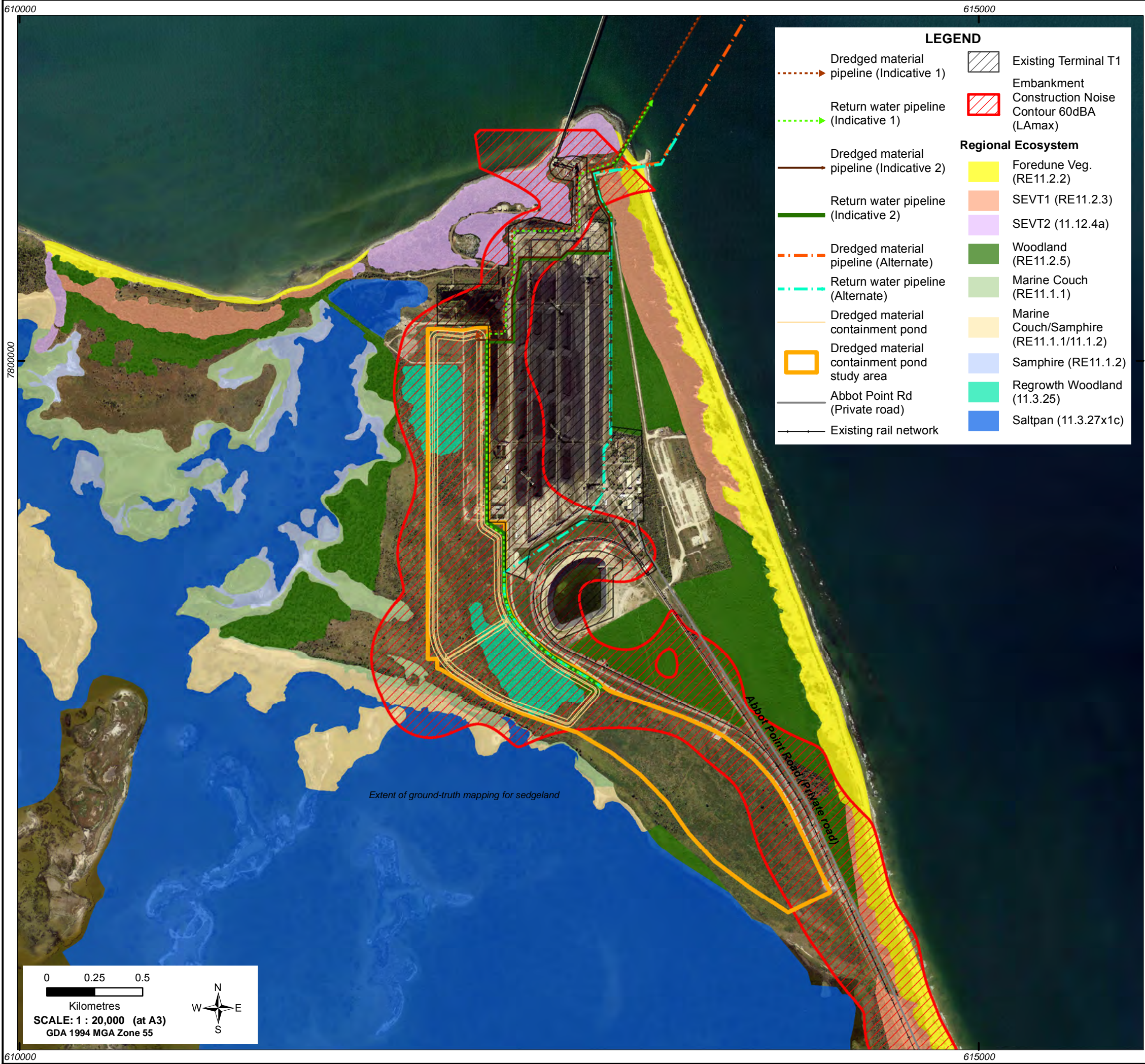
Figure 4-26

Map showing location of wetland habitat enclosed by the cumulative 60dBA LAmix contour for embankment subgrade preparation

Figure: 301001-01956-00-GM-SKT-0092 Rev: 1

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Dredged material containment pond
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Dredged material containment pond study area
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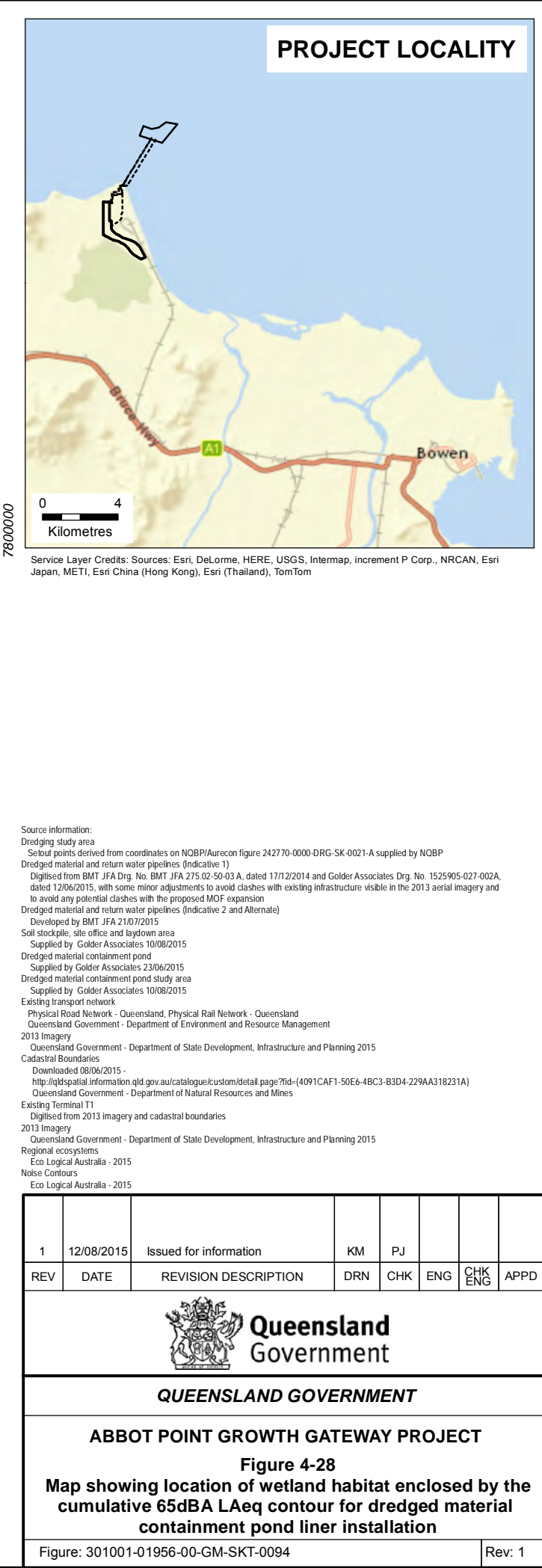
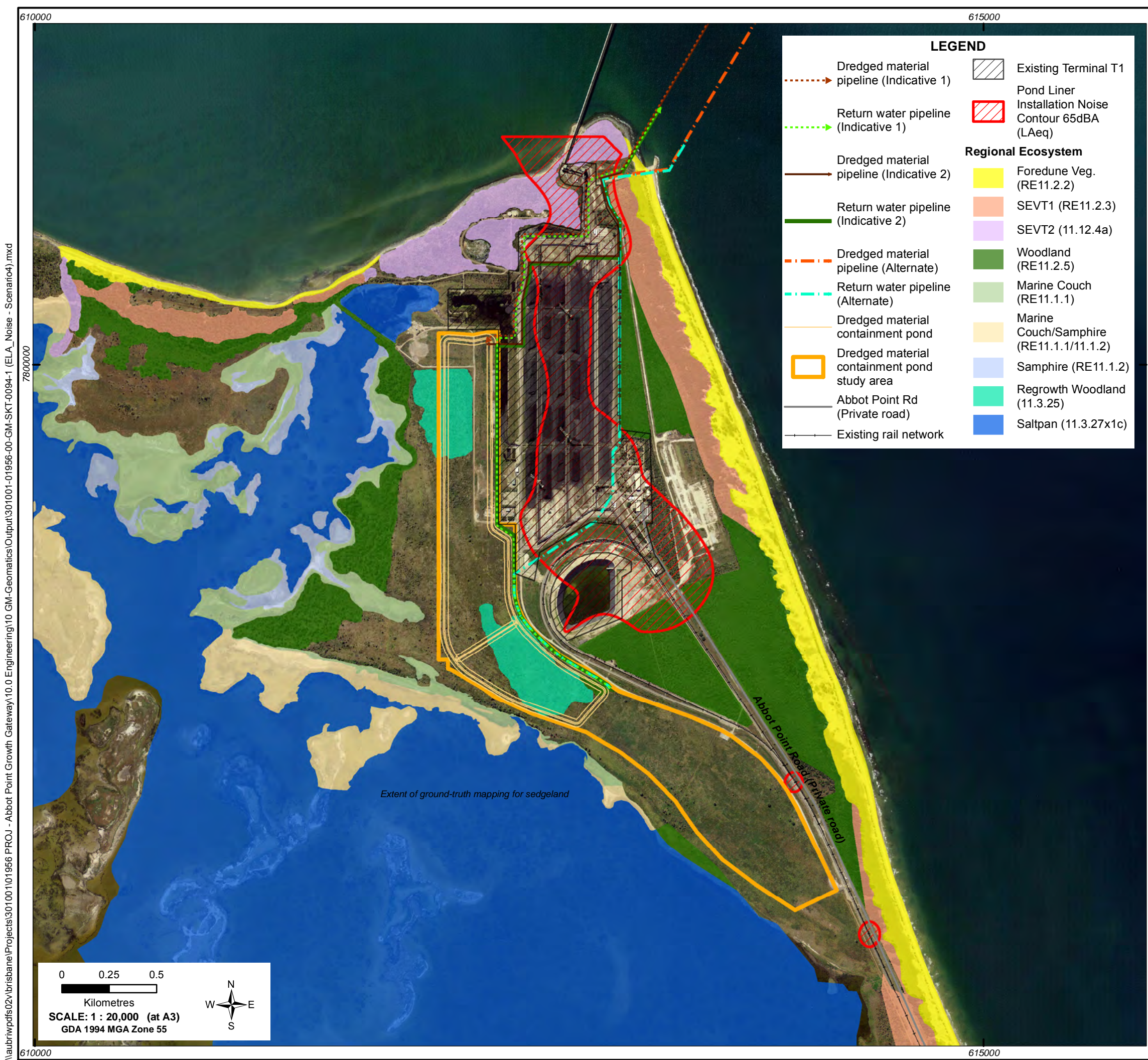
ABBOT POINT GROWTH GATEWAY PROJECT

Figure 4-27

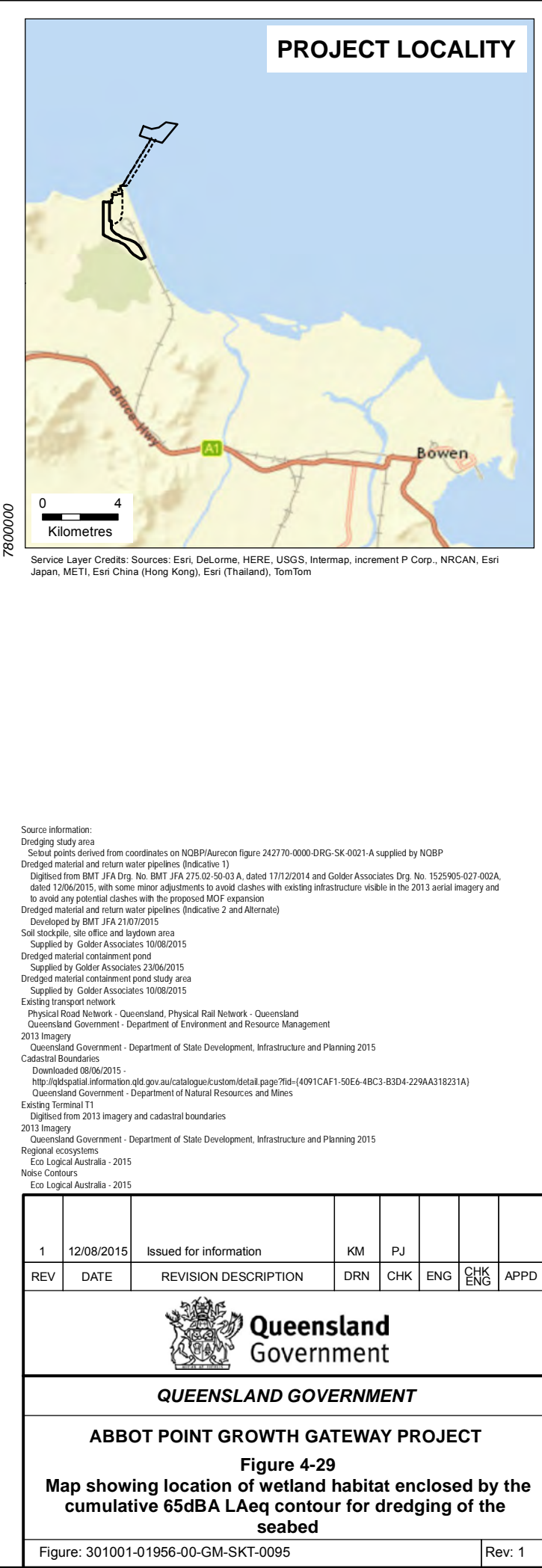
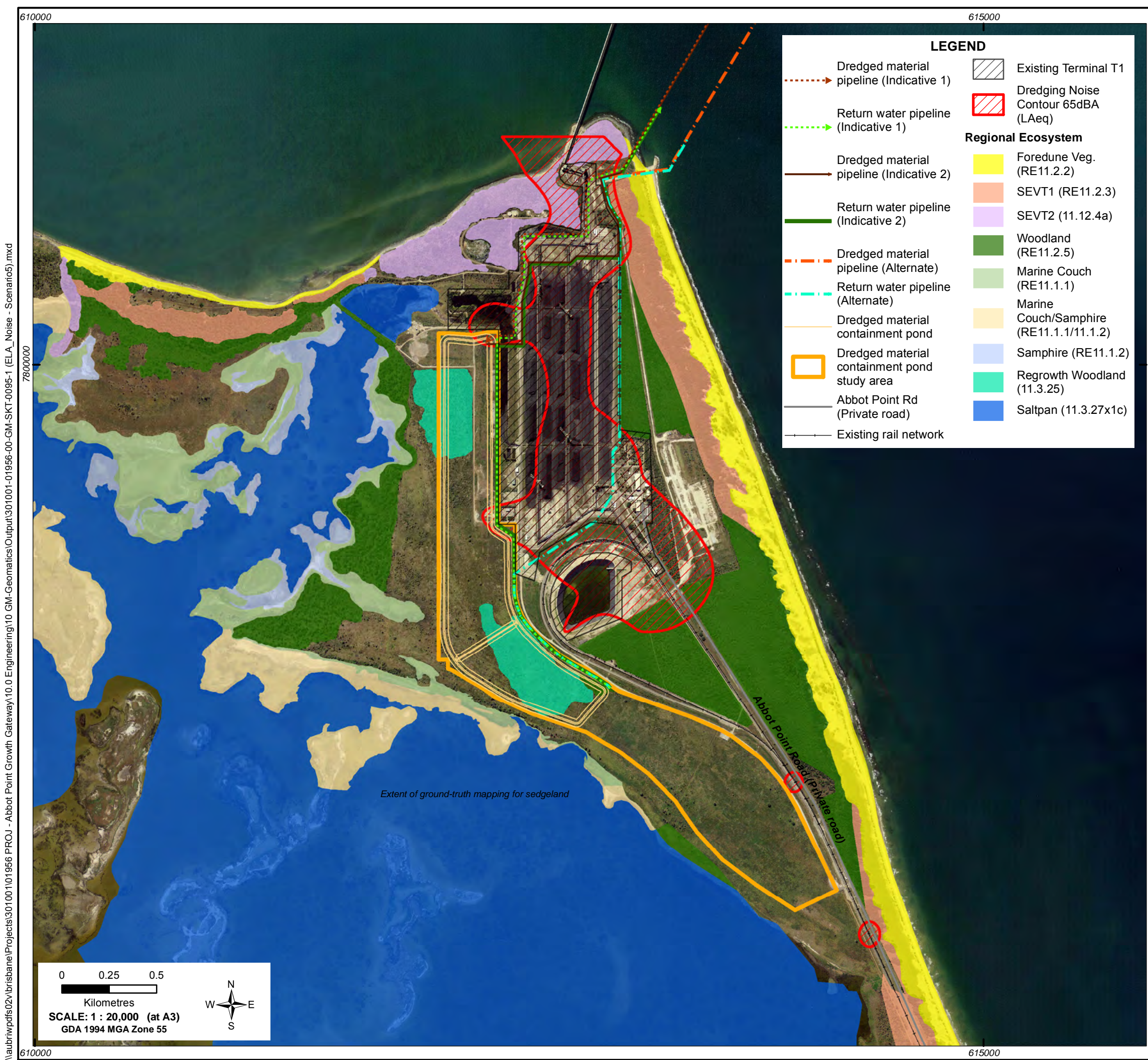
Map showing location of wetland habitat enclosed by the cumulative 60dBA LAmox contour for embankment construction

Figure: 301001-01956-00-GM-SKT-0093 Rev: 1

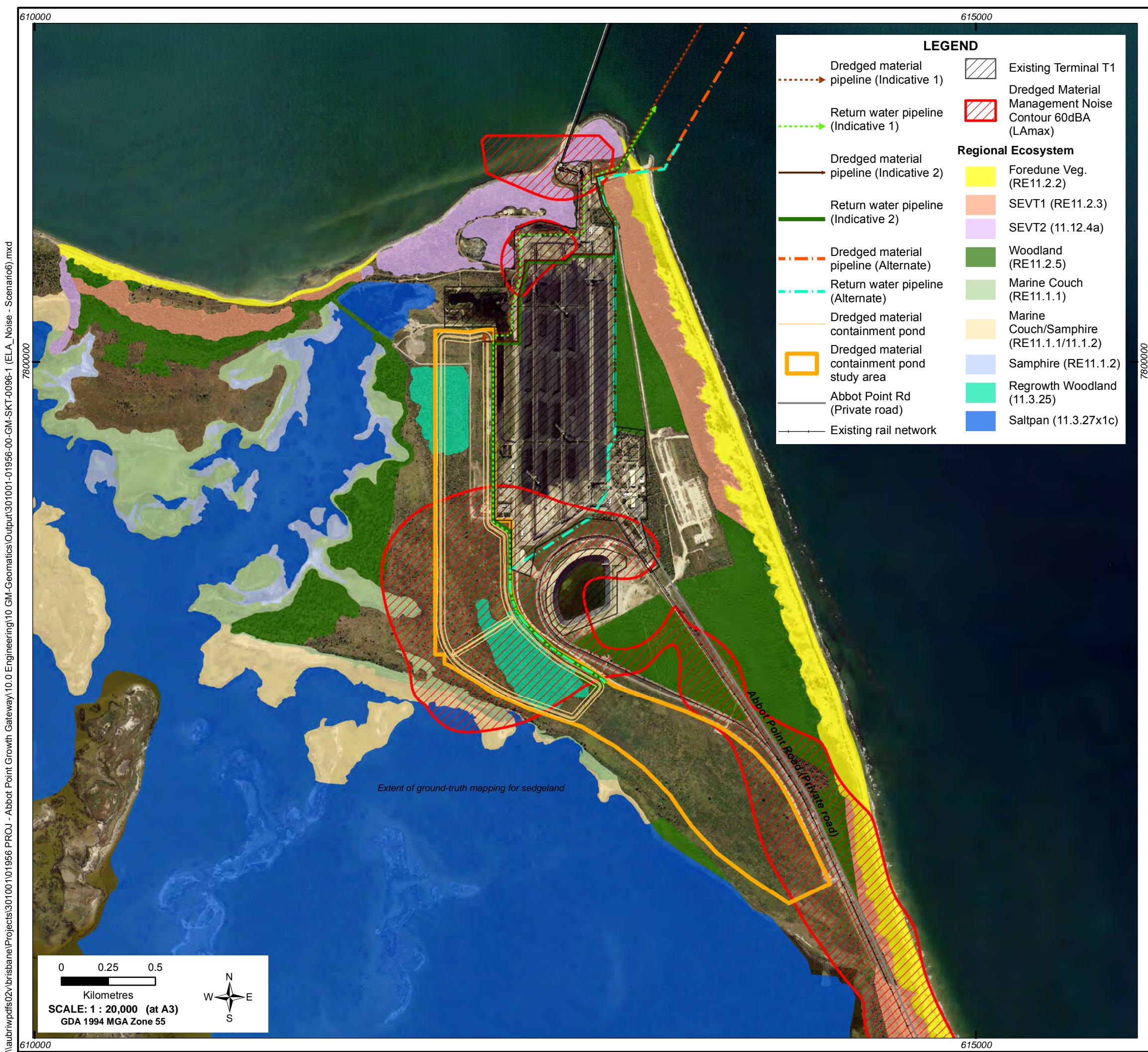
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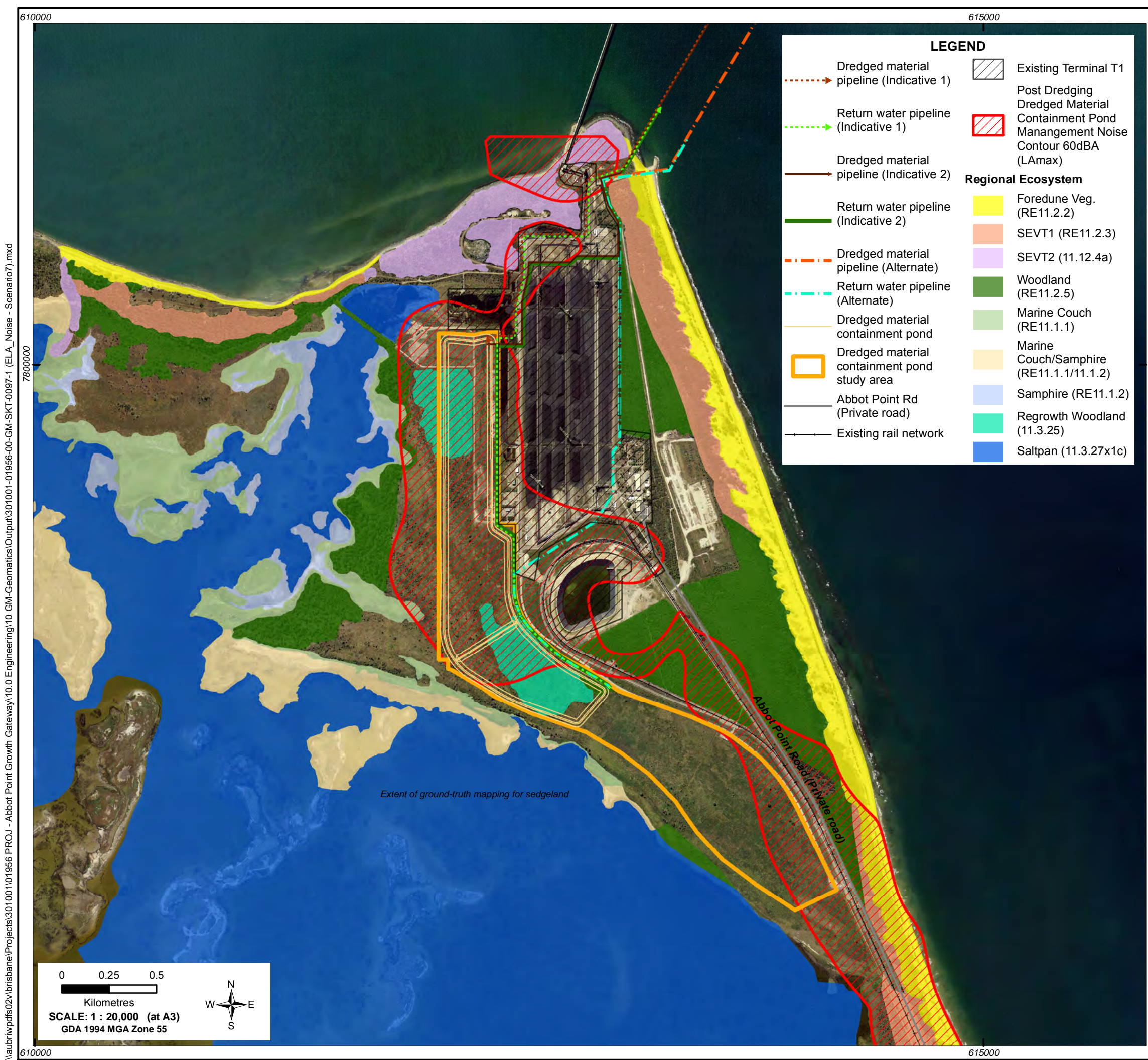
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QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 4-30							
Map showing location of wetland habitat enclosed by the cumulative 60dBA LAm_{ax} contour for management of dredged material within the dredged material containment pond							
Figure: 301001-01956-00-GM-SKT-0096							Rev: 1



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QUEENSLAND GOVERNMENT							
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Figure 4-31							
Map showing location of wetland habitat enclosed by the cumulative 60dBA LMax contour for post dredging management of the dredged material containment pond							
Figure: 301001-01956-00-GM-SKT-0097							Rev: 1



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Dust

Katestone (2015) undertook dispersion modelling to predict dust concentrations and deposition rates generated by Project construction activities (with and without existing background conditions) in the Caley Valley Wetlands. The modelling assumed the application of standard dust management practices such as the wetting of soil stockpiles and haul roads (see **Appendix H** for full report).

Maximum dust deposition levels were predicted to be below the vegetation criterion of $200\text{mg/m}^2/\text{day}$. Impacts of dust deposition on wetland flora habitats for shorebirds are therefore not anticipated as a result of construction works.

Results of the dispersion modelling in relation to dust concentrations and human health criteria were varied. The $\text{PM}_{2.5}$ criteria were not exceeded for 24 hour or annual exposure. This is a positive result, as $\text{PM}_{2.5}$ is known to cause greater respiratory problems than the other criteria modelled.

However, the modelled PM_{10} result was predicted to exceed the human health criterion of $50\mu\text{g/m}$ for a distance of approximately 1,500m into the wetland, corresponding to approximately 5.9% of the wetland. The TSP result also exceeded the relevant human health criterion of $90\mu\text{g/m}$ for a distance of 300m into the wetland, corresponding to approximately 0.7% of the wetland.

The human health criteria for sensitive receptors (e.g. residential development) are assessed against ambient air quality objectives such as those contained within the *Environmental Protection (Air) Policy 2008* or the *National Environment Protection Measure for Air*. However, the potential impacts of dust on construction workers onsite are typically assessed against Workplace Exposure Standards for Airborne Contaminants published by Safe Work Australia. These are less stringent than the ambient air standards, with the Workplace Exposure Standard for rouge dust being $10,000\mu\text{g/m}^3$ (at ambient conditions) over an eight hour average (compared with the ambient air objective of $50\mu\text{g/m}^3$ for a 24 hour average).

Neither of the above-mentioned approaches to assessing risks to human health from dust were developed with migratory shorebirds or the Australian Painted Snipe in mind. The criteria used in the modelling are considered to be conservative when applied to human health and can be assumed to be conservative for the purposes of assessing impacts on the environment. However, there is a moderate to high degree of uncertainty in assessing the significance of the predicted exceedance of PM_{10} and TSP dust emissions from the Project, and compliance with criteria for $\text{PM}_{2.5}$.

The impact of dust particle inspiration on the health of wild birds is not well-understood. It has been suggested that birds, moving about their environment and taking up the large amounts of oxygen required for flight, could be utilised as sensitive monitors of air quality. However, there are many distinct differences (morphologic, physiologic, and mechanical) between the bird's lung-air-sac respiratory system and the mammalian broncho-alveolar lung, which hinder the transferability of dust exposure impacts on humans, to birds.

Some of the major adverse health effects of particle exposure in humans are decreased lung function, altered muco-ciliary clearance, chronic obstructive pulmonary disease, asthma, and increased mortality. Although they have different respiratory systems, the physiological impacts of short-term and chronic dust exposure for birds and humans are similar. As such, the exposure of migratory birds to dust and associated small-particles, even for short periods

**Section 4****Environmental Impacts**

of time, may have adverse impacts on lung function and the capacity for long-distance movements.

An assessment of the available information indicates that dust produced by construction phases of the Project is likely to have a minor impact on migratory shorebirds and the Australian Painted Snipe, for the following reasons:

- Modelled dust concentrations meet human health criteria for two of the three parameters assessed
- Dust concentrations are likely to comply with Workplace Exposure Standards of Work Safe Australia for construction workers onsite (not modelled in this assessment)
- The human health criteria modelled are conservative and are generally applied to activities involving long-term exposure (e.g. residential development)
- The 302ha of wetland habitats where the PM₁₀ criterion is predicted to be exceeded is equivalent to approximately 5.9% of the Caley Valley Wetlands
- The 34ha area of wetland habitats where the TSP criterion is predicted to be exceeded is equivalent to approximately 0.7% of the Caley Valley Wetlands
- Actual dust concentrations will be reduced below those of the modelled results, through the implementation of dust management strategies exceeding those assumed in the air quality model such as:
 - Avoiding earthworks during unfavourable conditions
 - Consideration of the use of hydraulically applied tackifier (polymer agents) and organic mulch to exposed areas and stockpiles that will not be used or accessed for long durations, and haul roads with low traffic volumes
 - Designation of appropriate maximum speed limits during construction
 - Erection of physical barriers such as bunds and/or wind breaks around long-term stockpiles.
- Shorebirds are mobile and are unlikely to stay continuously within any areas of the wetland; and any exposure to dust is therefore highly unlikely to be continuous
- Construction stages of the Project may be conducted during periods when the wetland is dry or shorebirds are not present
- Construction activities and therefore the generation of dust may not be conducted continuously
- Dust deposition rates are below the thresholds at which impacts on wetland vegetation would occur
- Water quality (and consequently shorebird prey) is unlikely to be affected by dust deposition.

However, there is a moderate to low degree of certainty relating to the assessment of impacts of dust on shorebirds. Therefore, a further analysis of potential impacts of dust (and other modes of disturbance) is provided for key shorebird species in Section 4.4.7, utilising species-specific data on habitat utilisation.

**Section 4****Environmental Impacts****Increased human activity**

Increased activity by people within the Abbot Point area has the potential to disturb migratory shorebirds and the Australian Painted Snipe.

The major consequence of irregular disturbance is a potential shift to alternative feeding or roosting sites. The time and energy costs as a result of disturbance can be more damaging than permanent habitat loss.

In the case of sustained disturbance, migratory shorebirds and Australian Painted Snipe may be deterred from using certain areas through avoidance, thereby marginalising some areas of habitat. The result of this avoidance and corresponding displacement may mean that additional pressure is placed on other areas of the wetland. This effect would be more pronounced when water levels and therefore available feeding resources in the wetland are low.

The response of shorebirds to disturbance varies among species. Glover *et al.* (2011) determined the distance at which shorebirds would take flight after being disturbed. Of those species relevant to this assessment, these distances are:

- Red-necked Stint - 18.75m
- Sharp-tailed Sandpiper - 20.20m
- Latham's Snipe - 18.63m.

Oldland *et al.* (2009) also described the distance at which shorebirds flee from people, with the following distances for those species present at Abbot Point:

- Latham's Snipe - 19m
- Eastern Curlew - 126m.

These data suggest that there is variability in the response of shorebird species to disturbance, and that the area of terrestrial land between the project area and wetland habitats (minimum of 50m) is likely to mitigate the risk of disturbance for all but the most sensitive of shorebird species. Indeed, in most sections of the wetland fringe, this area of impact exceeds 150m. Management of this area during construction and operations will focus on minimising human activity, so that the area can act as a buffer for disturbance to shorebirds.

It should also be noted that alert responses to disturbance (e.g. freezing or cessation of foraging) occur at distances greater than those at which a flight response is initiated (Paton *et al.*, 2000). This would particularly be the case for Latham's Snipe and the Australian Painted Snipe, which are known to be sensitive to disturbance.

Increased activity within the buffer area between the wetland and project area could lead to disturbance and reduce the habitat availability for migratory shorebirds and the Australian Painted Snipe. Managing access to the wetland is recommended for reducing the potential impacts of disturbance, particularly at the southern end of the DMCP, where the buffer is at its narrowest (approximately 50m).

It is also noted that disturbance to shorebirds on the eastern beach associated with the construction, operation and dismantling of the pipeline may occur. However, it is considered that any potential impacts will be minor, as described previously, due to the localised and

**Section 4****Environmental Impacts**

short-term nature of works, and availability of habitat given the length of the beach comparative to the proposed area of disturbance.

Lighting

The project area will be lit at night during construction phases and work may continue 24 hours a day if required to meet Project construction schedules. Lighting is required for operational and safety reasons to facilitate works such as the construction of DMCP embankments and placement of dredged material within the DMCP.

Like noise and other forms of human disturbance, increased light levels at night can be expected to affect different shorebird species in different ways. Potential impacts include disruption of natural feeding and resting behaviours, increased visibility of shorebirds to predators and increased levels of general disturbance. At least some species may benefit from increased light conditions, as they are visual feeders and are more active foragers on well light nights or in areas adjacent to industrial development.

The project area is located within a port industrial precinct and immediately adjacent to the existing T1 operating coal terminal. In this context, lighting from the Project will add to that which is already present within an existing industrial landscape. There have been extensive previous studies of the predicted impacts of industrial light produced by proposed port developments at Abbot Point. These include the Abbot Point CIA (ELA and Open Lines, 2012) for a multi-user port facility, and the T0 EIS (CDM Smith, 2013a).

The Abbot Point CIA predicted that direct light spill into the Caley Valley Wetlands from development of the T0, T2 and T3 coal terminal facilities would be approximately 0.5ha. The T0 EIS identified direct light spill of 0.2ha onto a turtle nesting beach during construction of a marine offloading area, and an increase in the night time sky glow of the Abbot Point region. Collectively, these studies indicate that the magnitude of light impacts from extensive development activities at the port can be expected to be relatively small, in comparison with the scale of the Caley Valley Wetlands (5,154ha).

Night time construction activities will be supported by mobile and directional light towers which have an illumination footprint of approximately 60m from the source (when facing directly down towards the ground). Lights will only be used to produce sufficient light required for safety and operational purposes, and will be directed away from the wetland, towards the work area. In this context, direct light spill from the Project is anticipated to be contained within the area of terrestrial land between the wetland and project area. This area of off-site impacts is a minimum of 50m and greater than 150m (but up to 300m) along the majority of the wetland fringe and will act as a buffer from direct impacts within the project area.

Impacts from light on migratory shorebirds and the Australian Painted Snipe are therefore assessed to be low. There is a high degree of certainty associated with this assessment.

Changes to stormwater and groundwater regime

Hydrological and groundwater modelling has predicted that there will be no impact of the Project on elements of the wetland environment important to migratory shorebirds and the Australian Painted Snipe (AGE, 2015; BMT WBM, 2015). Existing groundwater levels are

**Section 4****Environmental Impacts**

approximately 2.2m to 5.4m below existing ground level (AGE, 2015), with mixed fresh and saline waters from dredged material unlikely to affect existing groundwater quality or function.

Changes in water quality within the wetland are expected to be minimal (less than 2ppt of salinity in the eastern bund area). Changes to the hydrology of the wetland margins utilised by shorebirds are also not expected. In the event of an extreme weather event leading to emergency stormwater discharge, impacts will be localised and mitigated by the large amount of water flowing naturally through the wetland, given the magnitude of a rainfall event that would trigger a stormwater discharge requirement.

4.4.7.3 Mitigation and management measures

The following mitigation and management measures will be implemented to reduce as far as possible the effects of the Project on the bird habitats of the Caley Valley Wetlands. The short duration of the Project, the setback of project infrastructure from the wetland, and the proposed mitigation and management measures address threats for shorebirds identified by the *Draft Wildlife Conservation Plan for Migratory Shorebirds*.

Mortality or injury

While mortality of migratory shorebirds and the Australian Painted Snipe through structural or vehicular strike is not considered likely, it is recognised that construction and operational activities may lead to some level of impact.

The following specific measures will be implemented to address this potential impact:

- Personnel operating vehicles in and adjacent to the project area should be made aware of the presence of migratory shorebirds and Australian Painted Snipe and the potential for individuals to be encountered
- Appropriate speed limits should be sign-posted, included in staff inductions and enforced
- Vehicles to be limited to traversing approved roads and tracks
- No unauthorised access by vehicles unless required for construction, operation, maintenance or inspections.

Construction noise

The following specific measures should be implemented to address the potential impact of construction noise during construction of the DMCP:

- Use of plant with efficient muffler design
- Vehicles, plant and equipment to be maintained in accordance with manufacturer's specifications
- Adjustment of reversing alarms on plant to limit the acoustic range to the immediate danger area
- Plant and equipment of appropriate size/capacity for the task to be used
- Use of quieter engines and newer, quieter equipment where practicable.

However, even with the application of these requirements some spill of noise above criteria which can be expected to result in disturbance is likely to occur.

**Section 4****Environmental Impacts****Increased human activity**

The extent of shorebird alert and alarm responses to anthropogenic disturbance should be minimised through restricted access to designated areas of the wetland and the buffer between the DMCP and wetland. However, in the event that access is essential, it is likely that any area subject to disturbance would remain in close proximity to the project area (for most species, less than 50m from the edge of the development). Onsite personnel should be made aware of the presence of migratory shorebirds and Australian Painted Snipe and avoid wandering into the wetland areas or adjacent beach habitats.

Lighting

The following mitigation measures will be applied to reduce the impact of Project lighting on shorebirds:

- Use of directional lighting and shrouds to protect the Caley Valley Wetlands from direct light
- Use of mobile light towers which can be moved and adjusted to provide lighting for construction purposes, while minimising lighting of unused areas
- Maintenance of a buffer area between construction lighting and the Caley Valley Wetlands (between 50m and 300m).

Changes to stormwater and groundwater regime

Hydrological and groundwater modelling has predicted that there will be no impact of the Project on elements of the wetland environment important to shorebirds (AGE, 2015; BMT WBM, 2015). Changes in water quality within the wetland are expected to be minimal (less than 2ppt of salinity in the eastern bund area). Changes to the hydrology of the wetland margins utilised by shorebirds are also not expected. In the event that the fuse plug is utilised for an emergency stormwater discharge, impacts will be localised and mitigated by the large amount of water flowing naturally through the wetland, given the magnitude of the rainfall event.

4.4.7.4 Results of impact assessment on key migratory shorebird species and the Australian Painted Snipe

This section extends the assessment of project impacts on migratory shorebirds, as a group, and the Australian Painted Snipe to consider impacts on key shorebird species. Sighting records and ecological characteristics are examined for each species to assess susceptibility to potential off-site and indirect impacts discussed above. Species with similar sighting records and/or ecology have been discussed together to avoid repetition. The objective of the analysis is to reduce uncertainty in the assessment of potential impacts by examining:

- Evidence of habitat utilisation by key species within the wetland areas susceptible to off-site and indirect impacts
- Behavioural traits that may reduce or increase the susceptibility of key species to off-site impacts.

**Key migratory shorebirds***Eastern Curlew and Curlew Sandpiper*

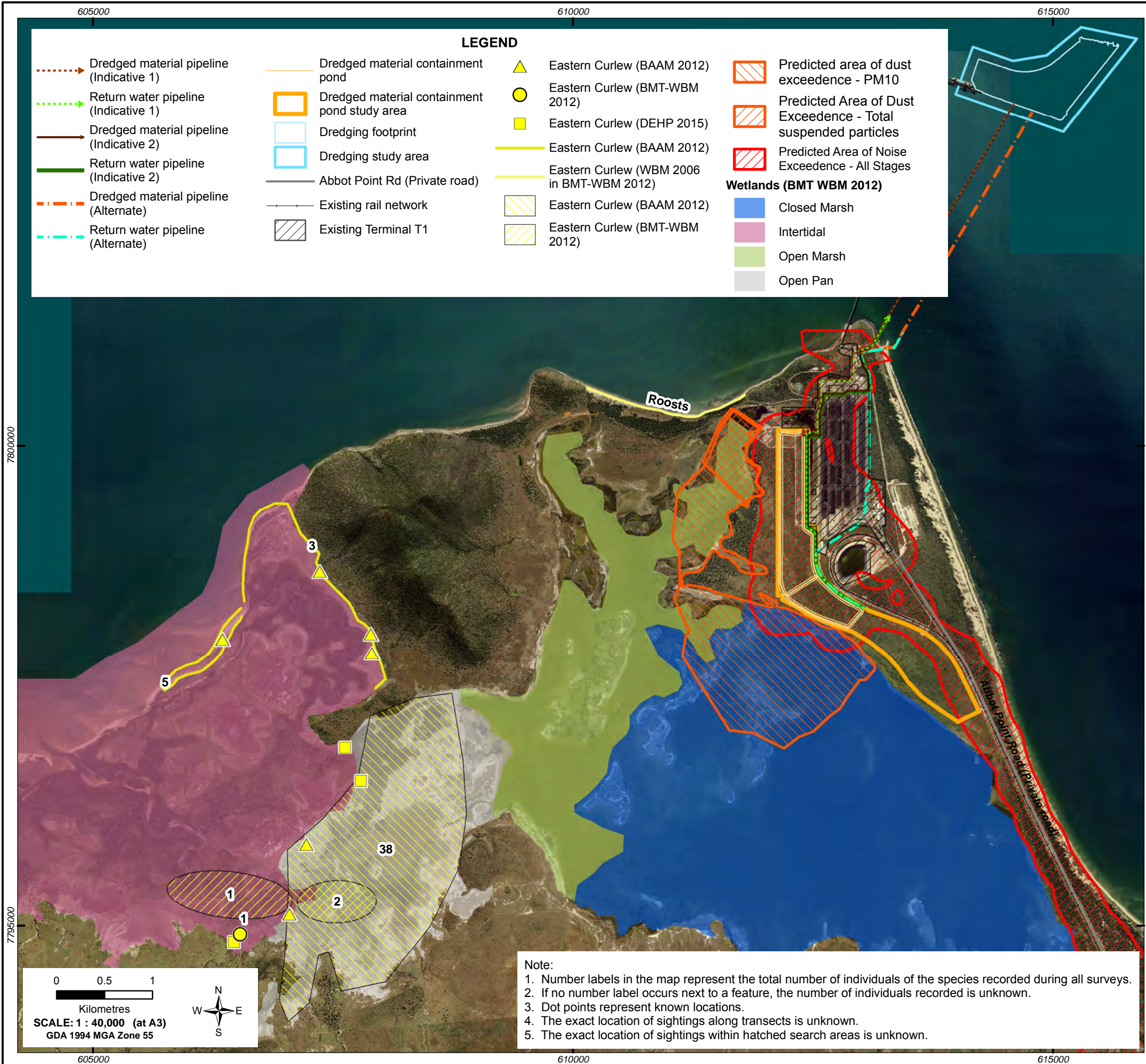
The Eastern Curlew utilises estuarine sections of the Caley Valley Wetlands, including the Open Pan and Intertidal zones. These habitats are located at least 3km west of the project area and are highly unlikely to be influenced by project activities. The species has also been recorded roosting on Dingo Beach approximately 500m from the project area (BMT WBM, 2012). However, the roosting habitat is located well beyond (approximately 335m) the predicted location of noise and dust criteria contours, and is screened by remnant SEVT and woodland vegetation (Figure 4-32). Accordingly, no disturbance of the roost sites utilised by the Eastern Curlew is anticipated.

While estuarine and coastal sections of the Caley Valley Wetlands are utilised by the Eastern Curlew, the Project is not located in close proximity to feeding or roosting habitats of the species and several management and mitigation measures will be implemented to avoid off-site impacts in these areas. In this regard, there is a high degree of certainty that impacts of the Project (either directly or indirectly) on the species are unlikely.

The Curlew Sandpiper was sighted by BMT WBM (2012) in the central section of the Closed Marsh approximately 2km south-west of the project area. The species was not recorded by BAAM (2012) during their extensive surveys of the wetland in 2012. The species has not been recorded within the predicted location of noise and dust criteria contours adjacent to the project area (Figure 4-33).

The Curlew Sandpiper appears to be an infrequent visitor to the Caley Valley Wetlands. There is no evidence to suggest that wetland habitats adjacent to the project area are preferred by the species, although they may be suitable at certain times of the wetland's seasonal and ephemeral wetting and drying cycle. Several management and mitigation measures will be implemented to avoid off-site and indirect impacts in these areas. There is a moderate to high degree of certainty that impacts of the Project (either directly or indirectly) on this species are unlikely.

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PROJECT LOCALITY

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

Source Information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
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<http://oldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={4091CAF1-50E6-4BC3-B3D4-229AA318231A}>
Queensland Government - Department of Natural Resources and Mines
Existing Terminal T1
Digitised from 2013 imagery and cadastral boundaries
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Caley Valley Wetland wetland zones
BMT WBM 2012
Eastern Curlew Sightings
BAAM 2012, BMT WBM 2012, DEHP 2015
Predicted dust and noise exceedance
Eco Logical Australia - 2015

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ABBOT POINT GROWTH GATEWAY PROJECT

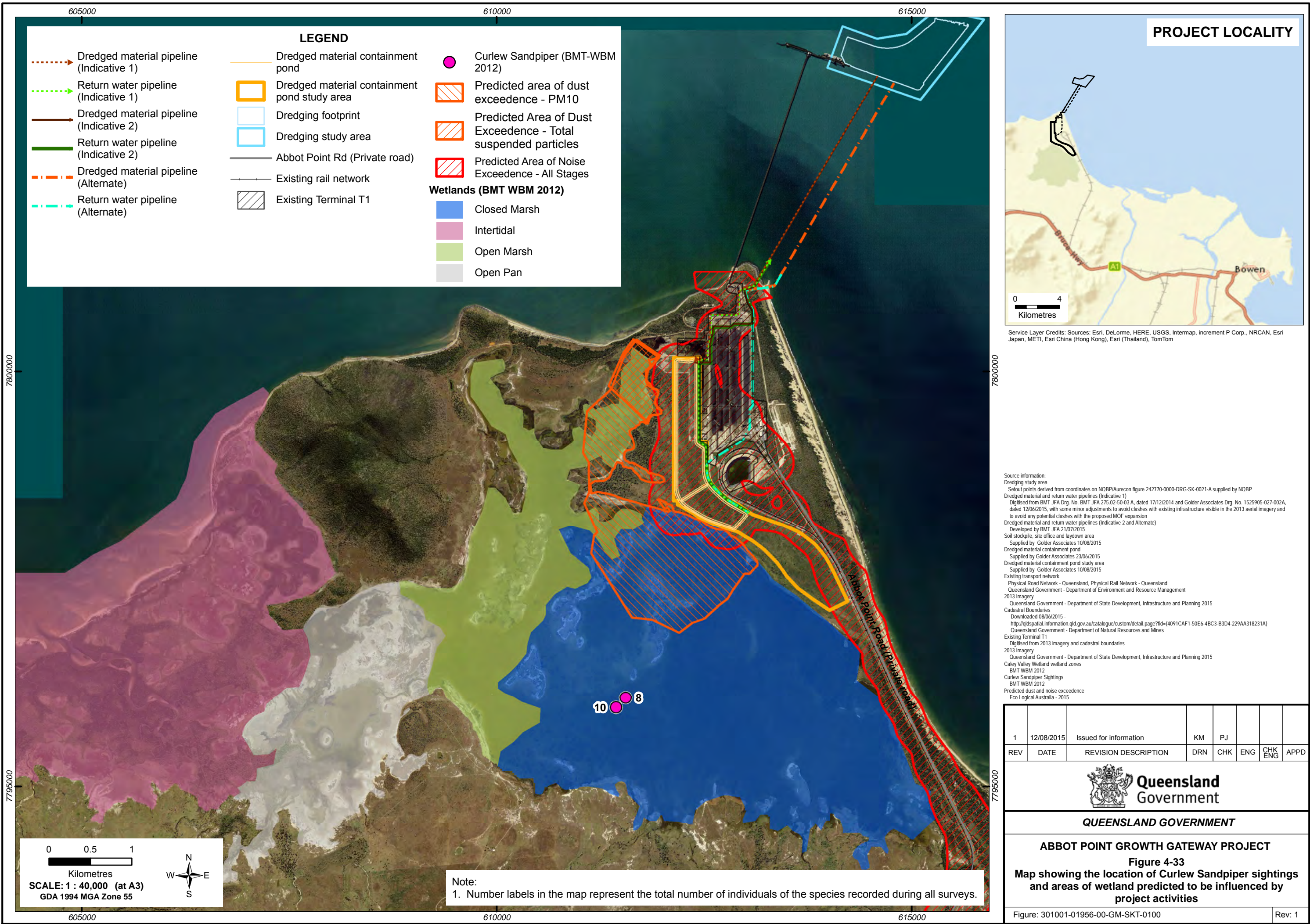
Figure 4-32

Map showing the location of Eastern Curlew sightings and areas of wetland predicted to be influenced by project activities

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Latham's Snipe

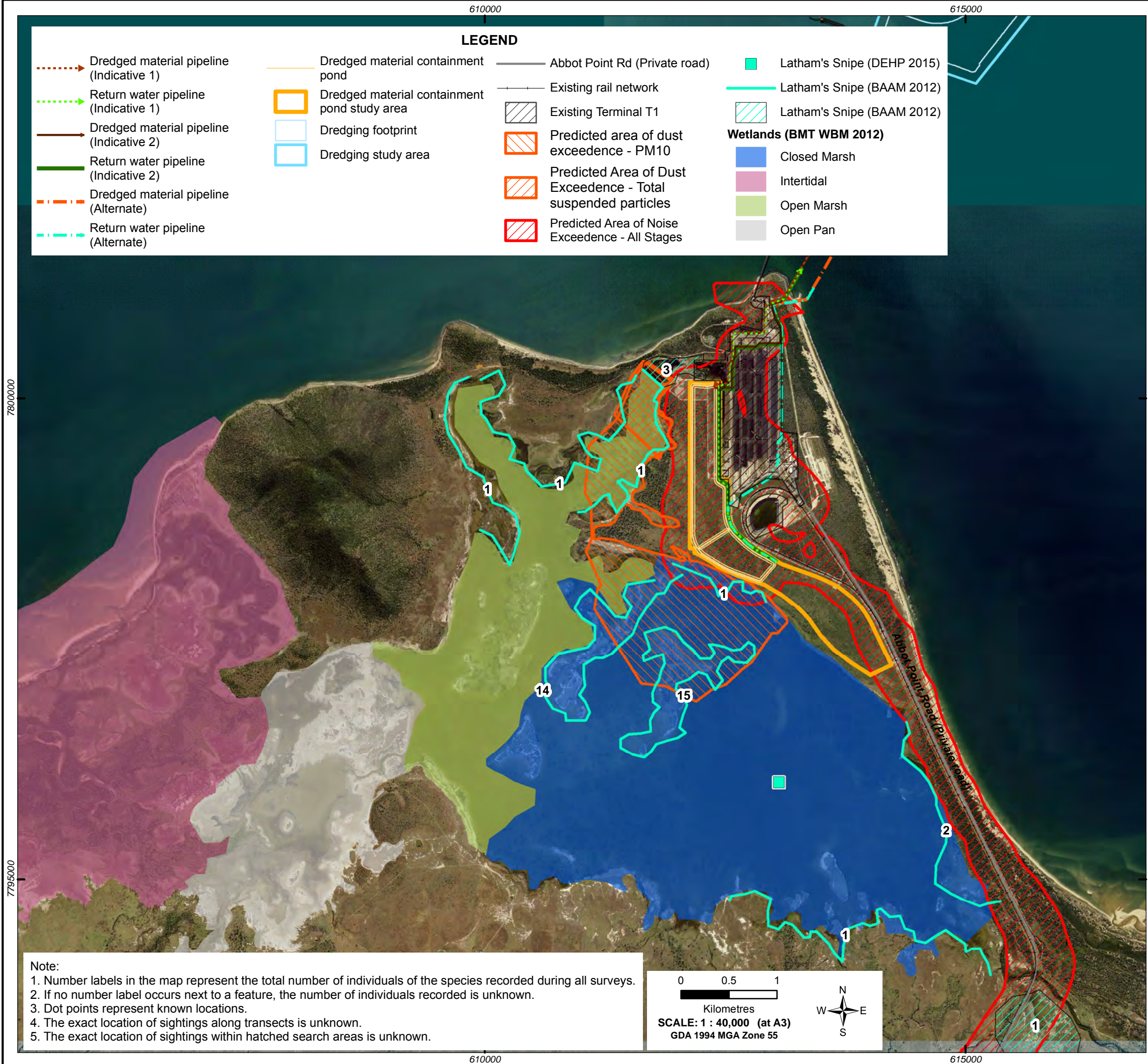
Latham's Snipe has been sighted throughout eastern sections of the Caley Valley Wetlands, utilising a range of habitats within the Open and Closed Marsh zones. Latham's Snipe is likely to have been recorded in the area where off-site impacts from noise and dust are possible (Figure 4-34). There is some uncertainty about this, as the sightings data are from transects rather than points of observation.

Unlike the other key shorebird species considered in this assessment, the preferred habitat of Latham's Snipe includes grasslands (including marine couch) where they occur at the water's edge and are not dense. Such habitats occur closest to the project area, and would be suitable for Latham's Snipe at times when the wetland is full of water. Therefore, the species (along with the Australian Painted Snipe) has the greatest area of suitable habitat that may be influenced by off-site and indirect impacts from the Project. Latham's Snipe has been demonstrated to utilise a variety of habitats throughout the eastern Caley Valley Wetlands, most likely in response to the location of suitable habitat during various stages of the wetland's wetting and drying cycle.

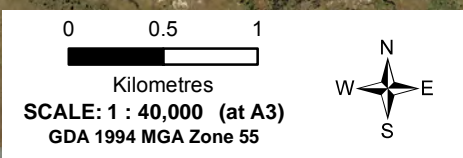
The sighting records and habitat use for Latham's Snipe indicate that the species utilise wetland habitats adjacent to the project area, and therefore has the potential to be impacted by the Project. However, these impacts are considered unlikely to be significant for the following reasons:

- The project area does not contain habitat for the species, so the potential impacts are from disturbance (i.e. off-site and indirect impacts).
- The strip of terrestrial land between the project area and the wetland (where off-site impacts on fauna could generally be expected) is not preferred habitat for the species, beyond the height of wetland inundation (Figure 4-34).
- The area of habitat that may potentially be disturbed by noise/dust/light is small (21.9ha or 0.4% of the wetland for noise; 302ha or 5.9% of the wetland for PM₁₀ dust and 34ha or 0.7% of the wetland for TSP) relative to the total area of habitat available and demonstrated to be used by the species.
- Construction activities that will generate the disturbances will be in place for a short period of time (~3 months), less than Latham's Snipe's entire migratory season and may occur outside of the season entirely.
- Ecological values supporting foraging behaviour (e.g. macroinvertebrates) and roosting (e.g. vegetation complexes and wetland areas) are very unlikely to be degraded by construction activities and will still be available to the species following the period of temporary disturbance.
- Numerous management and mitigation measures will be implemented to keep disturbance to a minimum.
- Latham's Snipe is highly mobile and can move to other areas for foraging and roosting if disturbed.
- Shorebirds have been shown to become habituated to noise within other port settings (e.g. at the Port of Brisbane).

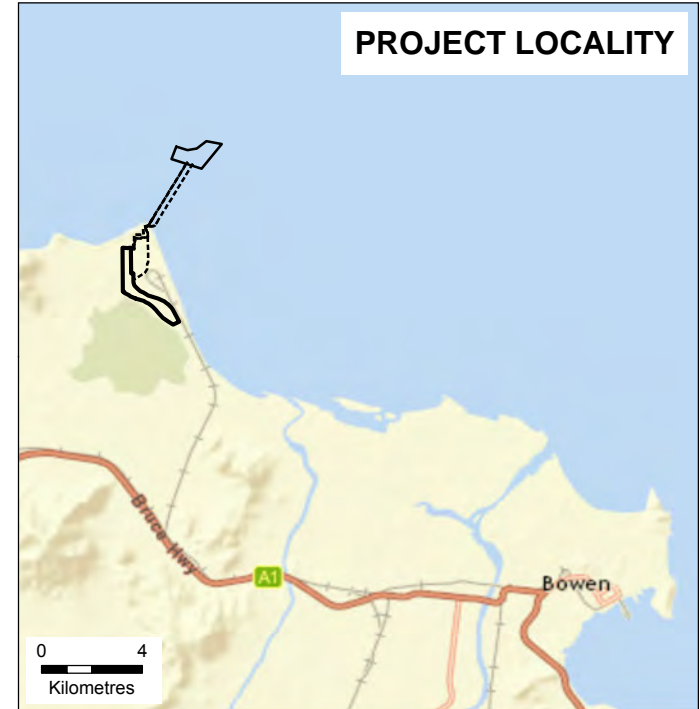
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Note:
1. Number labels in the map represent the total number of individuals of the species recorded during all surveys.
2. If no number label occurs next to a feature, the number of individuals recorded is unknown.
3. Dot points represent known locations.
4. The exact location of sightings along transects is unknown.
5. The exact location of sightings within hatched search areas is unknown.




PROJECT LOCALITY



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Source Information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
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REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 4-34							
Map showing the location of Latham's Snipe sightings and areas of wetland predicted to be influenced by project activities							
Figure: 301001-01956-00-GM-SKT-0101							Rev: 1

**Section 4****Environmental Impacts***Red-necked Stint, Common Greenshank and Marsh Sandpiper*

The Red-necked Stint has been sighted in large numbers within the Caley Valley Wetlands, and utilising a range of habitats including the estuarine Open Pan Zone, coastal beaches, Lake Caley and the southern wetland fringe. There are two records of the species relevant to the assessment of off-site and indirect impacts of the Project (Figure 4-35). The first is a single individual observed near the noise contour at the northern extent of the Open Marsh Zone. The exact location of the sighting is unknown, and 90% of the sighting area extends beyond the noise contour, where noise less than that likely to cause disturbance is predicted to occur. A second record of 10 individuals along the eastern beach is also relevant to the assessment of project impacts, due to the intersection of this area by the temporary pipeline alignment.

The Common Greenshank has been sighted within the Caley Valley Wetlands, utilising a range of habitats including the Open Pan, Open Marsh and Closed Marsh Zones. The species has been recorded along the south-eastern fringe of the wetland, including areas where existing rail noise extends to the wetland fringe (Figure 4-36). There are 14 confirmed sightings of the Common Greenshank adjacent to the project area, within the modelled contours for PM₁₀ dust, and one confirmed sighting within the modelled noise contours.

The Marsh Sandpiper has been sighted within the Caley Valley Wetlands, and utilising a range of habitats including the Open Pan, Open Marsh and Closed Marsh Zones. The species appears to have a preference for the Closed Marsh Zone, with extensive sightings around Lake Caley and the southern wetland fringe 1.5km south of the project area (Figure 4-37). There are 10 confirmed sightings adjacent to the project area, within the modelled contours for PM₁₀ and TSP dust and noise.

The sighting records and habitat use of the Red-necked Stint, Common Greenshank and Marsh Sandpiper indicate that these species may use an area in the vicinity of the project area and therefore have the potential to be impacted by the Project. However, these impacts are considered unlikely to be significant for the following reasons:

- The project area does not contain habitat for the species, so the only potential impacts are from disturbance (i.e. off-site impacts)
- The area of terrestrial land between the project area and wetland is not preferred habitat for the species, given the observed patterns of wetland use (Figure 4-35 to Figure 4-37)
- The area of habitat that may potentially be disturbed by noise/dust/light is small (15ha or 0.3% of wetland for noise; 302ha or 5.9% of the wetland for PM₁₀ dust and 34ha or 0.7% of the wetland for TSP) relative to the total area of habitat available and shown to be used by the birds
- Construction activities that will generate the disturbances will be in place for a short period of time (~3 months, which is less than an entire migratory bird season) and may occur outside the season entirely
- Ecological values supporting foraging behaviour (e.g. macroinvertebrates) and roosting (e.g. vegetation complexes and wetland areas) are very unlikely to be degraded by construction activities and will still be available to the species following the temporary disturbance period
- Numerous management and mitigation measures will be implemented to keep disturbance to a minimum

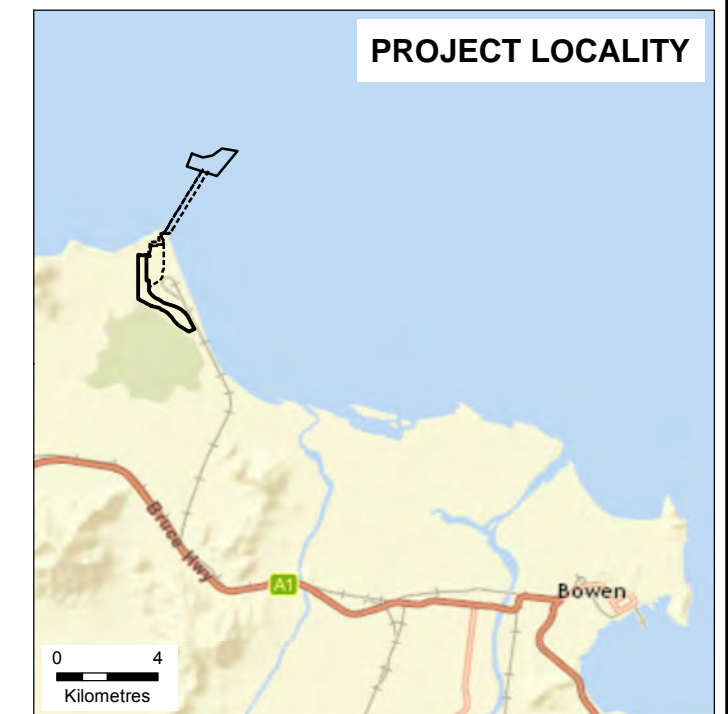
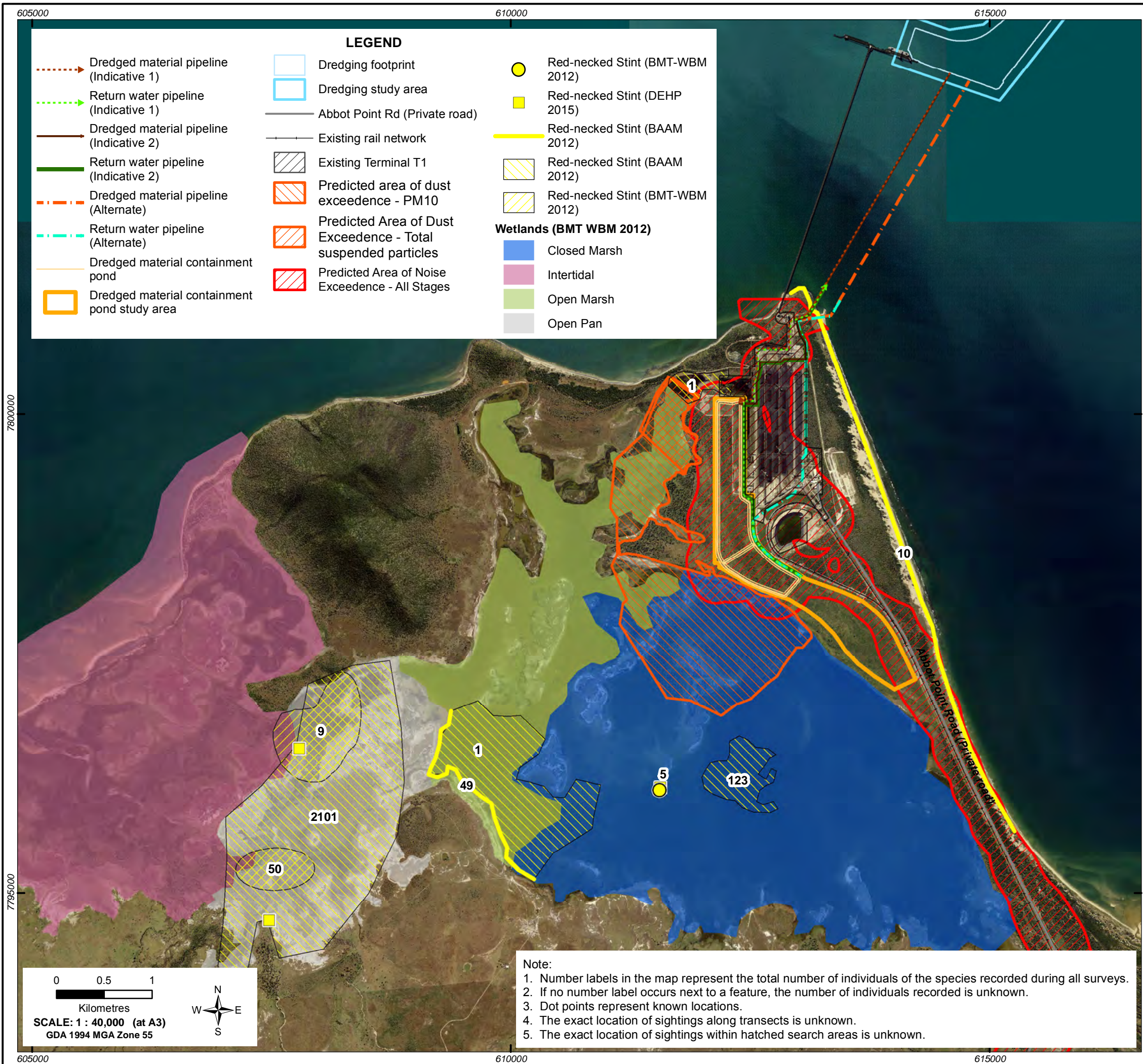


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Environmental Impacts

- The species are highly mobile and can move to other areas for foraging and roosting if disturbed
- Shorebirds have been shown to become habituated to noise in other port settings (e.g. at the Port of Brisbane).

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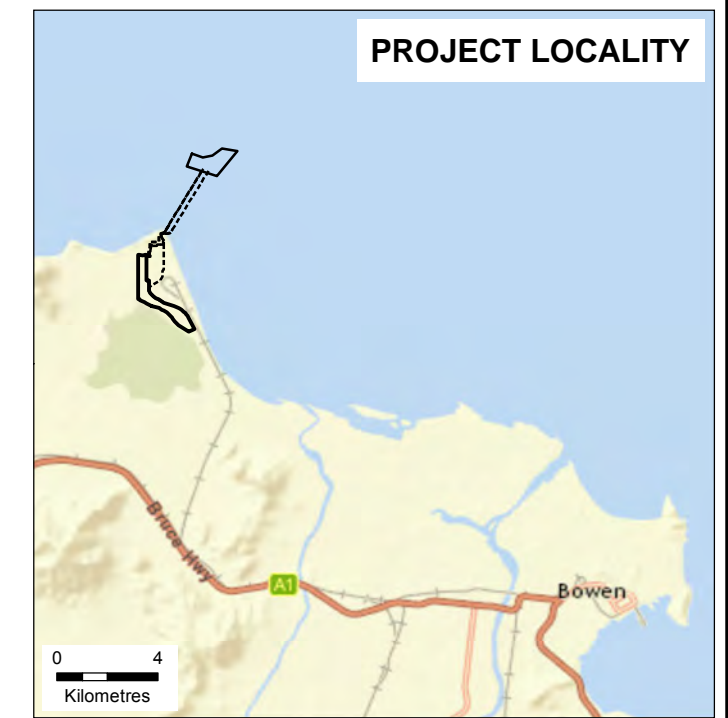
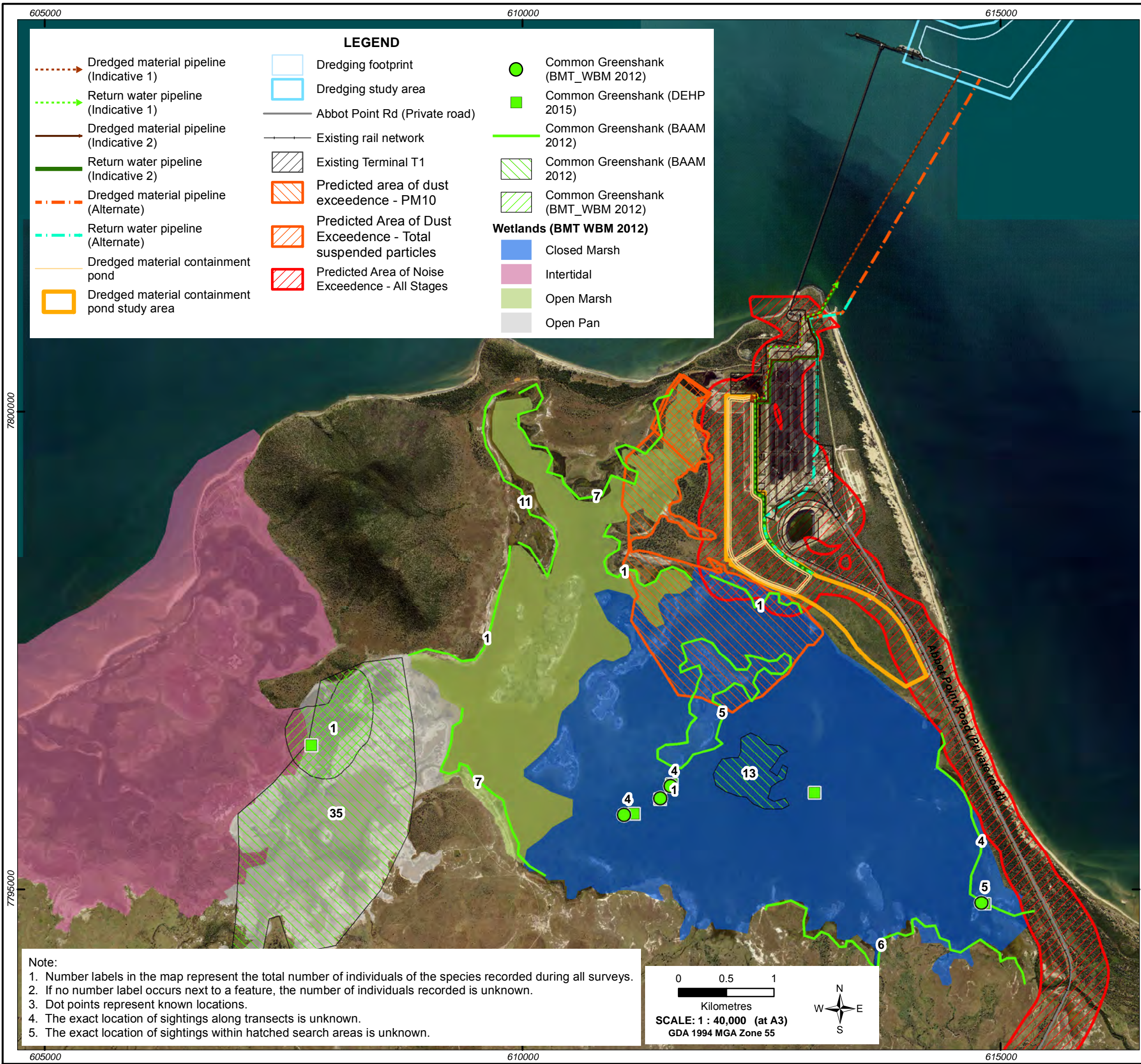


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Soil stockpile, site office and laydown area
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Dredged material containment pond
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Dredged material containment pond study area
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Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
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Cadastral Boundaries
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Queensland Government - Department of Natural Resources and Mines
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Digitised from 2013 imagery and cadastral boundaries
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Caley Valley Wetland wetland zones
BMT WBM 2012
Red-necked Stint Sightings
BAAM 2012, BMT WBM 2012, DEHP 2015
Predicted dust and noise exceedence
Eco Logical Australia - 2015

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QUEENSLAND GOVERNMENT								
ABBOT POINT GROWTH GATEWAY PROJECT								
Figure 4-35								
Map showing the location of Red-necked Stint sightings and areas of wetland predicted to be influenced by project activities								
Figure: 301001-01956-00-GM-SKT-0103								Rev: 1

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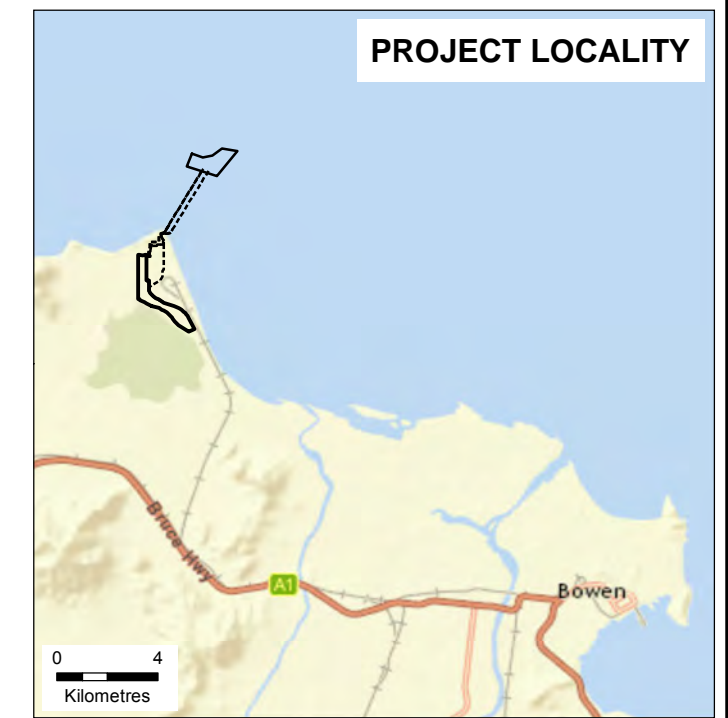
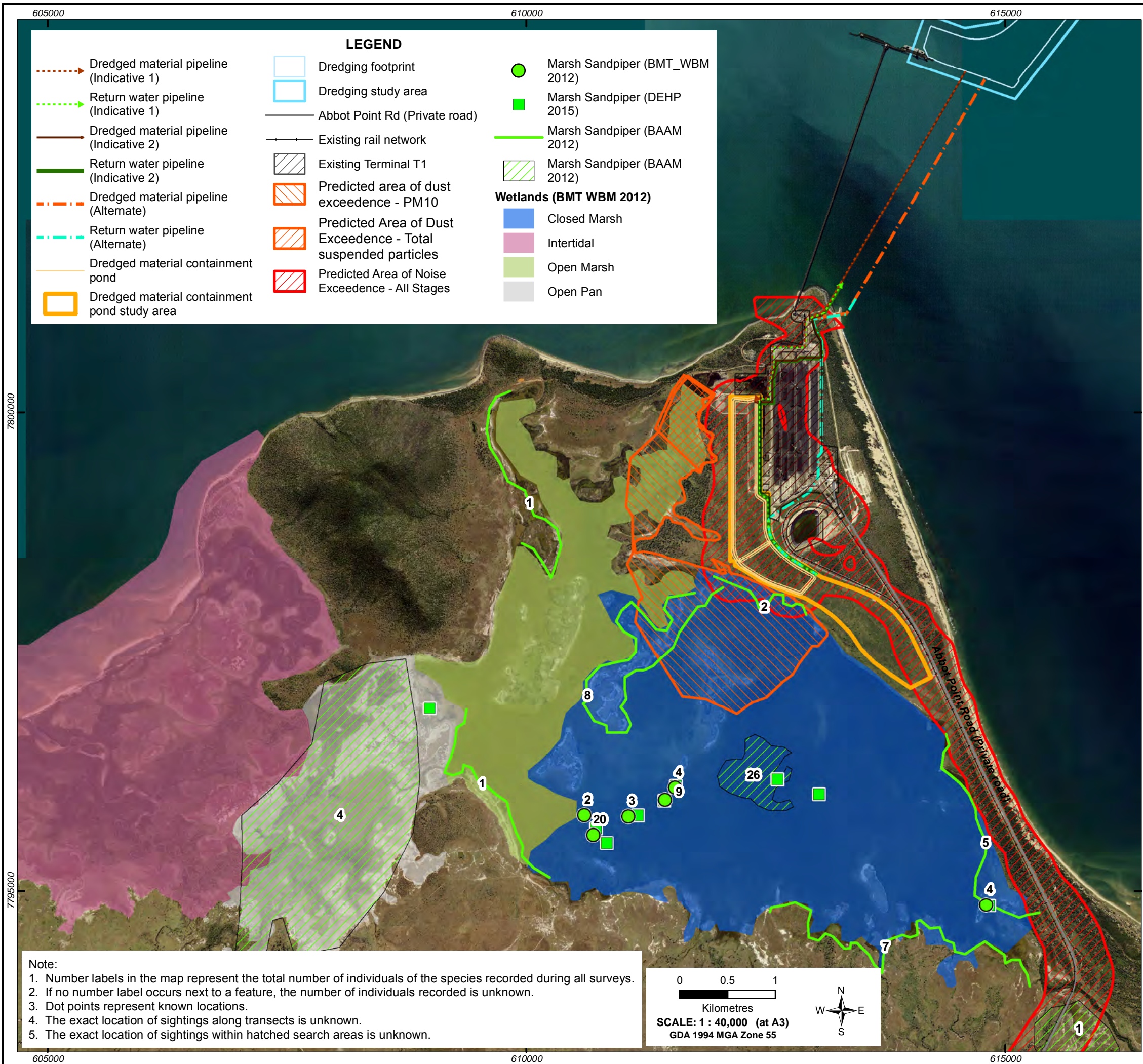


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Source Information:
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Existing Terminal T1
Digitised from 2013 imagery and cadastral boundaries
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Caley Valley Wetland wetland zones
BMT WBM 2012
Common Greenshank Sightings
BAAM 2012, BMT WBM 2012, DEHP 2015
Predicted dust and noise exceedence
Eco Logical Australia - 2015

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QUEENSLAND GOVERNMENT								
ABBOT POINT GROWTH GATEWAY PROJECT								
Figure 4-36								
Map showing the location of Common Greenshank sightings and areas of wetland predicted to be influenced by Project activities								
Figure: 301001-01956-00-GM-SKT-0104								Rev: 1

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Source Information:
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Queensland Government - Department of State Development, Infrastructure and Planning 2015
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Queensland Government - Department of Natural Resources and Mines
Existing Terminal T1
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2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Caley Valley Wetland wetland zones
BMT WBM 2012
Marsh Sandpiper Sightings
BAAM 2012, BMT WBM 2012, DEHP 2015
Predicted dust and noise exceedence
Eco Logical Australia - 2015

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REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD	
QUEENSLAND GOVERNMENT								
ABBOT POINT GROWTH GATEWAY PROJECT								
Figure 4-37								
Map showing the location of Marsh Sandpiper sightings and areas of wetland predicted to be influenced by project activities								
Figure: 301001-01956-00-GM-SKT-0105								Rev: 1



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Environmental Impacts

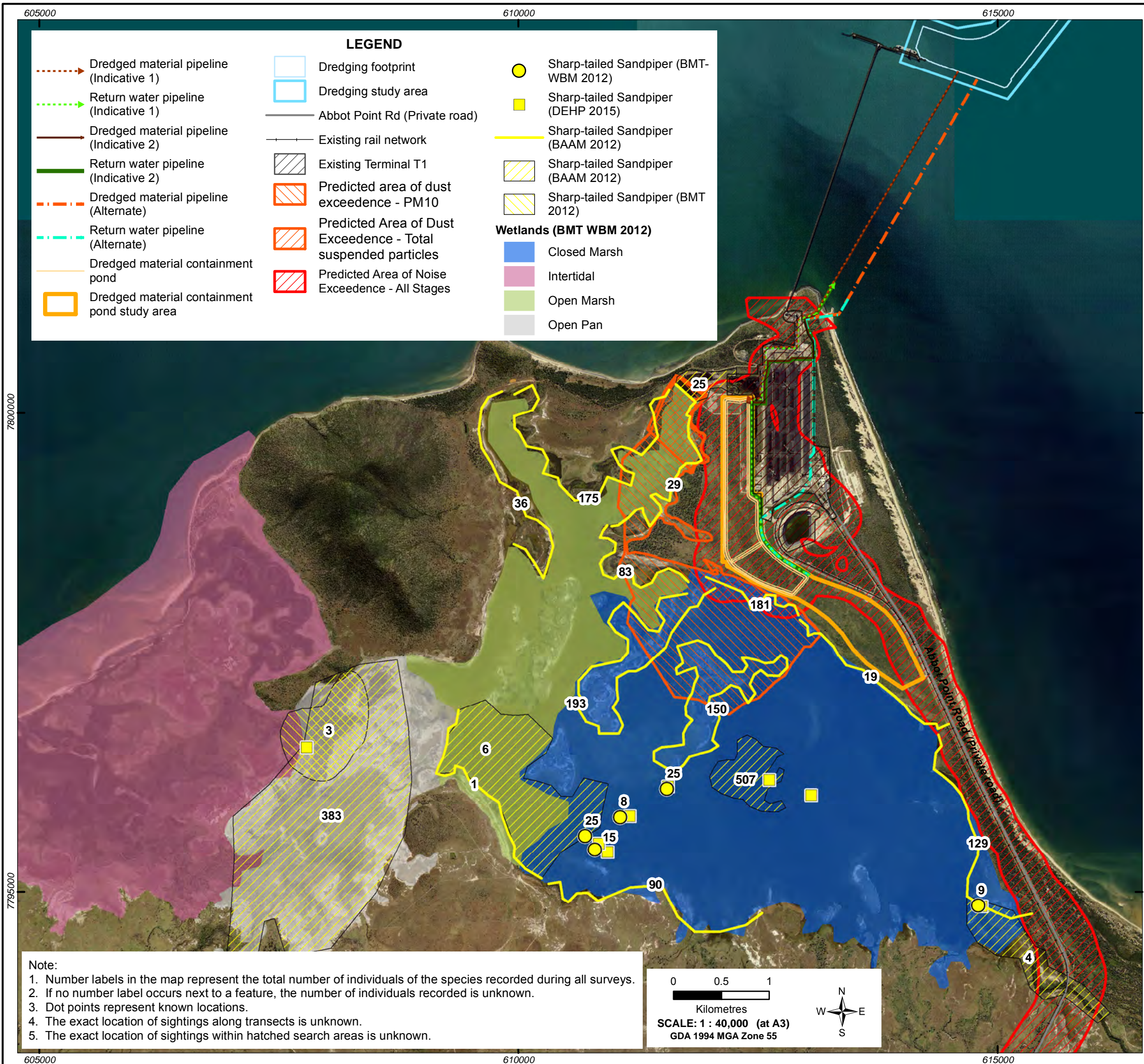
Sharp-tailed Sandpiper

The Sharp-tailed Sandpiper has been sighted in large numbers within the Caley Valley Wetlands, and utilising a range of habitats including the Open Pan, Open Marsh and Closed Marsh zones. The species has been recorded along the entire eastern fringe of the wetland, including habitats adjacent to the project area (Figure 4-38).

There are some sightings of large numbers of the Sharp-tailed Sandpiper along transects adjacent to the project area. While there is some uncertainty about the location of sightings due to data being from transects rather than points, it is likely that the species has been recorded within the area enclosed by modelled PM₁₀ dust and noise contours, where off-site impacts may occur. However, off-site and indirect impacts of the Project on the Sharp-tailed Sandpiper are considered unlikely to be significant for the following reasons:

- The project area does not contain habitat for the species, so the only potential impacts are from disturbance (i.e. off-site impacts)
- The area of terrestrial land between the project area and wetland is not preferred habitat for the species, given the observed patterns of wetland use (Figure 4-38)
- The area of habitat that may potentially be disturbed by noise/dust/light is small (15ha or 0.3% of wetland for noise; 302ha or 5.9% of the wetland for PM₁₀ dust and 34ha or 0.7% of the wetland for TSP) relative to the total area of habitat available and shown to be used by the birds
- Construction activities that will generate the disturbances will be in place for a short period of time (approximately three months, which is less than an entire migratory bird season) and may occur outside the season entirely
- Ecological values supporting foraging behaviour (e.g. macroinvertebrates) and roosting (e.g. vegetation complexes and wetland areas) are very unlikely to be degraded by construction activities will still be available to the species following the temporary disturbance period
- Numerous management and mitigation measures will be implemented to keep disturbance to a minimum
- This species is highly mobile and can move to other areas for foraging and roosting if disturbed
- Shorebirds have been shown to become habituated to noise in other port settings (e.g. at the Port of Brisbane).

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PROJECT LOCALITY

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Dredged material containment pond study area
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Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management

2013 Imagery
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Queensland Government - Department of Natural Resources and Mines

Existing Terminal T1
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2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015

Caley Valley Wetland wetland zones
BMT WBM 2012

Sharp-tailed Sandpiper Sightings
BAAM 2012, BMT WBM 2012, DEHP 2015

Predicted dust and noise exceedence
Eco Logical Australia - 2015

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ABBOT POINT GROWTH GATEWAY PROJECT

Figure 4-38

Map showing the location of Sharp-tailed Sandpiper sightings and areas of wetland predicted to be influenced by project activities

Figure: 301001-01956-00-GM-SKT-0106

Rev: 1

**Section 4****Environmental Impacts****Australian Painted Snipe**

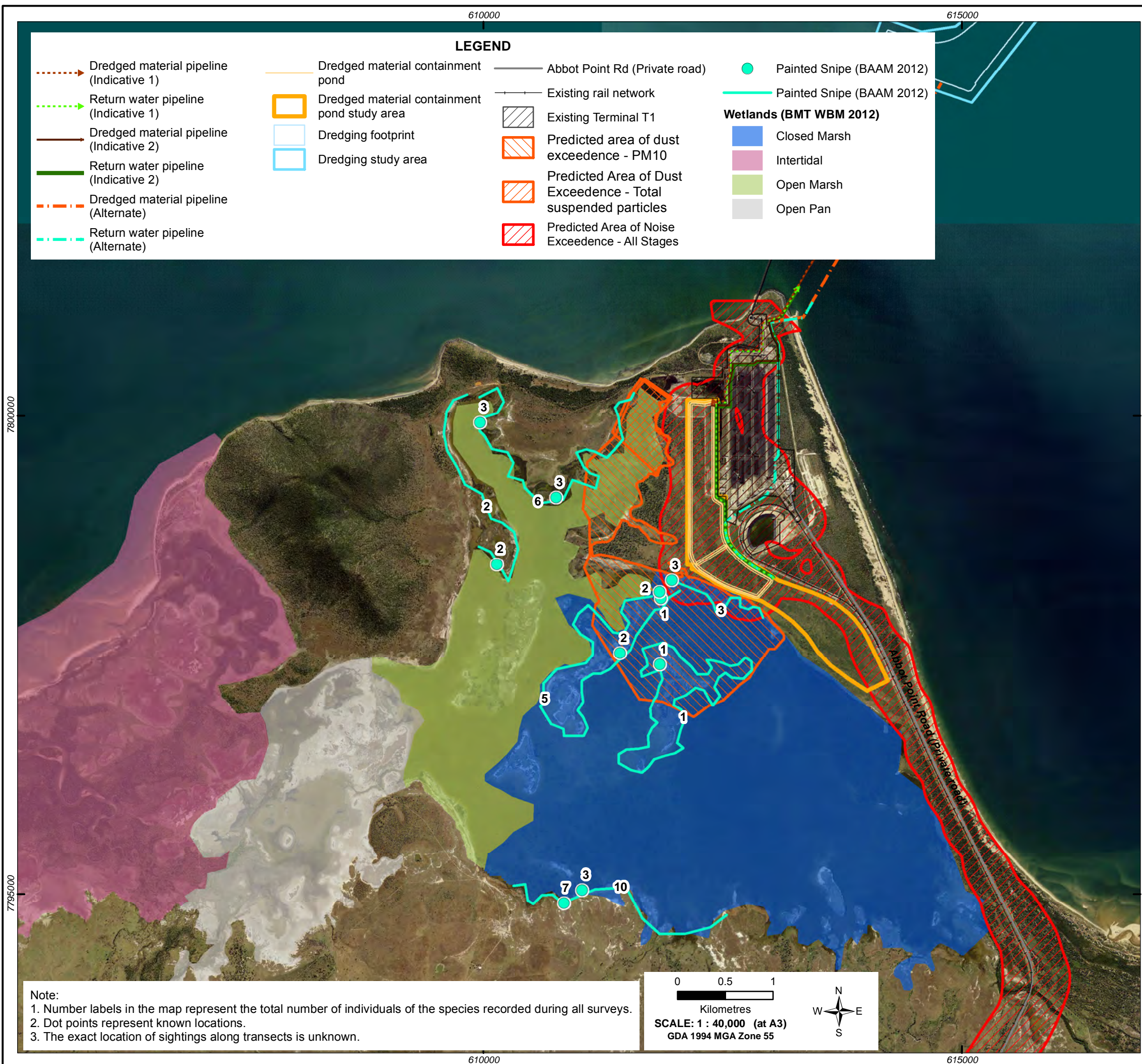
The Australian Painted Snipe has been sighted throughout eastern sections of the Caley Valley Wetlands, utilising a range of habitats within the Open and Closed Marsh zones. The species has been sighted on nine occasions adjacent to the project area (Figure 4-39), and to the north, south and west of the project area. Sightings data for the Australian Painted Snipe include point locations, with a number of confirmed sightings occurring within the area where predicted noise and dust contours extend (potential for off-site impacts).

Unlike the other key shorebird species considered in this assessment, the preferred habitat of the Australian Painted Snipe includes grasslands (including marine couch) where they occur at the water's edge and are not dense. Such habitats occur closest to the project area, and would be suitable for the species at times when the wetland is full of water. Therefore the Australian Painted Snipe, along with the Latham's Snipe, has the greatest area of suitable habitat that may be influenced by off-site and indirect impacts from the Project. The species has been demonstrated to utilise a variety of habitats throughout the eastern Caley Valley Wetlands, most likely in response to the location of suitable habitat during various stages of the wetland's wetting and drying cycle.

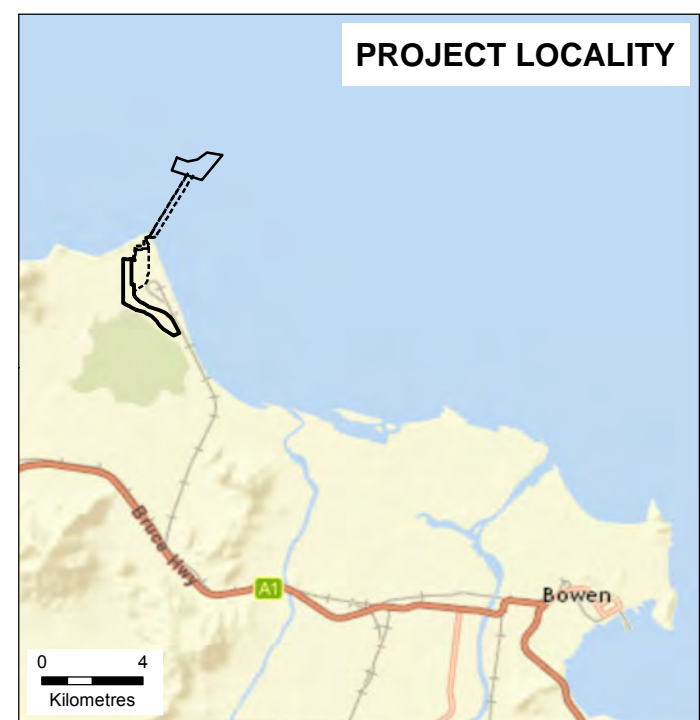
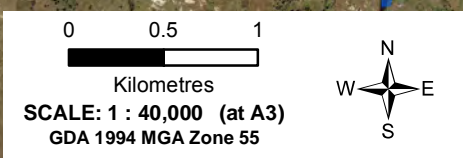
The sighting records and habitat use for the Australian Painted Snipe indicate that the species utilises wetland habitats adjacent to the project area, and therefore has the potential to be impacted by the Project. However, these impacts are considered unlikely to be significant for the following reasons:

- The project area does not contain habitat for the species, so the potential impacts are from disturbance (i.e. off-site and indirect impacts)
- The strip of terrestrial land between the project area and the wetland (where off-site impacts on fauna could generally be expected) is not preferred habitat for the species, beyond the height of wetland inundation (Figure 4-39)
- The area of habitat that may potentially be disturbed by noise/dust/light is small (21.9ha or 0.4% of the wetland for noise; 302ha or 5.9% of the wetland for PM₁₀ dust and 34ha or 0.7% of the wetland for TSP) relative to the total area of habitat available and demonstrated to be used by the species
- Construction activities that will generate the disturbances will be in place for a short period of time (~3 months)
- Ecological values supporting foraging behaviour (e.g. macroinvertebrates) and roosting (e.g. vegetation complexes and wetland areas) are very unlikely to be degraded by construction activities and will still be available to the species following the period of temporary disturbance
- Numerous management and mitigation measures will be implemented to keep disturbance to a minimum
- The Australian Painted Snipe is highly mobile and can move to other areas for foraging and roosting if disturbed
- Shorebirds have been shown to become habituated to noise within other port settings (e.g. at the Port of Brisbane).

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Note:
1. Number labels in the map represent the total number of individuals of the species recorded during all surveys.
2. Dot points represent known locations.
3. The exact location of sightings along transects is unknown.



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Queensland Government - Department of Natural Resources and Mines
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2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Caley Valley Wetland wetland zones
BMT WBM 2012
Australian Painted Snipe Sightings
BAAM 2012
Predicted dust and noise exceedence
Eco Logical Australia - 2015

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 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 4-39							
Map showing the location of Australian Painted Snipe sightings and areas of wetland predicted to be influenced by project activities							
Figure: 301001-01956-00-GM-SKT-0102							Rev: 1

**Section 4****Environmental Impacts****4.4.7.5 Residual impacts and outcome**

The overall impacts of the Project on migratory shorebirds and the Australian Painted Snipe are expected to be minimal, for the following reasons:

- The project area does not contain habitat for migratory shorebirds or the Australian Painted Snipe, so the only potential impacts are from disturbance
- The area of terrestrial land between the project area and wetland is not preferred habitat for any species and will effectively act as a buffer from direct impacts within the disturbance footprint
- The area of habitat that may potentially be disturbed by noise/dust/light is small (up to 0.4% of wetland for noise; and 5.9% of the wetland for PM₁₀ dust and 0.7% of the wetland for TSP) relative to the total area of habitat available and shown to be used by the birds
- Construction activities that will generate the disturbances will be in place for a short period of time (~3 months, which is less than an entire migratory bird season) and may occur outside the season entirely
- Ecological values supporting foraging behaviour (e.g. macroinvertebrates) and roosting (e.g. vegetation complexes and wetland areas) are very unlikely to be degraded by construction and will still be available to the species following the temporary disturbance period
- Numerous management and mitigation measures will be implemented to keep disturbance to a minimum
- Shorebirds are highly mobile and can move to other areas for foraging and roosting if disturbed
- Shorebirds have been shown to become habituated to noise in other port settings (e.g. at the Port of Brisbane).

However, a range of mitigation measures should nonetheless be implemented to manage any minor impacts and facilitate the ongoing use of the study area by the species. Mitigation measures as included in the Outline EMP (**Appendix V**) will be sufficient to maintain impacts within acceptable levels. Offsets are not considered necessary.

4.4.8 Assessment of impacts on migratory birds (non-shorebirds)**4.4.8.1 Non-shorebird migratory birds relevant to the impact assessment**

Assessment of the significance of migratory birds (non-shorebirds) at Abbot Point (ELA, 2015) indicates that important habitat is present, or an ecologically significant proportion of the species has been recorded, for the following species:

- Eastern Great Egret *Ardea modesta*
- Caspian Tern *Hydroprogne caspia*
- Little Tern *Sternula albifrons*.

Impacts of the Project on these species and their habitat are provided in the following sections.

The overall impacts of the Project on the other migratory species are not likely to be significant. However, the range of mitigation measures outlined in the Outline EMP (**Appendix V**) will be generally applicable to other migratory species and will further reduce impacts. Offsets are not considered necessary.

**Section 4****Environmental Impacts****Eastern Great Egret**

The highest number of Eastern Great Egrets was found during the BAAM (2012) dry season survey when 386 individuals were recorded. Approximately a third of these birds were recorded around the edges of the Closed Marsh Zone with the remainder on the eastern edge of the Open Marsh. An estimate indicated that the number of Eastern Great Egrets present within the wetland during this time was 583 individuals.

Based on these numbers, the Caley Valley Wetlands provides important habitat for the Eastern Great Egret. The numbers recorded by BAAM (2012) indicate that the Caley Valley Wetlands supports $\geq 0.1\%$ of the estimated Australian population of the species and is therefore an ecologically significant proportion.

The species is found throughout the wetland system in a variety of habitats. Surveys of the foreshore adjacent to the project area have demonstrated a presence of the species within this section of the wetland.

It is unlikely that the Eastern Great Egret uses the Caley Valley Wetlands as breeding habitat. Both the BAAM (2012) wet and dry season surveys found no evidence of Eastern Great Egret nests. This observation is consistent with the Australian distribution of Eastern Great Egrets and the indication that the species' main breeding areas are in the top end of the Northern Territory.

The ephemeral nature of the Caley Valley Wetlands suggests that it would provide optimum feeding habitat primarily during favourable wet conditions. During other times, Eastern Great Egrets are likely to move in search of other water bodies and are therefore not solely reliant upon the Caley Valley Wetlands for all non-breeding activities.

Given the overlap in habitat use between the Eastern Great Egret and migratory shorebirds generally, the impact assessment issues and ongoing management requirements are similar. In summary:

- There will be no direct disturbance to Eastern Great Egret habitat from construction of the Project
- Off-site impacts from construction, including noise, lighting and increased human presence are likely to be minor. The management and mitigation provisions described for the Caley Valley Wetlands, migratory shorebirds and the Australian Painted Snipe can be considered appropriate for also addressing impacts on the Eastern Great Egret.

Caspian Tern

The Caspian Tern is listed as migratory under the EPBC Act. The species is gregarious when breeding, though single nesting does occur. Outside of breeding, the Caspian Tern occurs mostly singly or in small groups. Occasional larger groups of 30 or more birds are seen, often at rich fishing areas or at nightly roost sites, where they may roost with other Terns. The species may also aggregate into flocks on migration (DoE, 2015a).

Within Australia, the Caspian Tern has a widespread occurrence and can be found in both coastal and inland habitat. It is found in all States and Territories of Australia. In Queensland, this species is widespread in coastal regions from the southern Gulf of Carpentaria to the Torres Strait, and along the eastern coast. It has been recorded in the western districts,



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especially the Lake Eyre Drainage Basin, north-west to the Gulf Country north of Mount Isa and Cloncurry, there are also scattered records for central Queensland (DoE, 2014i).

The Caspian Tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks.

The greatest number of Caspian Terns was found during the BAAM (2012) dry season survey. In the four day survey period from 26 to 29 June BAAM recorded 204 individuals. The majority of individuals were recorded in the Open Marsh Zone to the west of the project area. During all survey periods, individuals have been sighted at numerous sites throughout the wetland.

Based on these numbers, the Caley Valley Wetlands provides important habitat for the Caspian Tern. The numbers recorded by BAAM (2012) indicate that the Caley Valley Wetlands supports $\geq 0.1\%$ of the estimated Australian population of the species and is therefore an ecologically significant proportion.

The ephemeral nature of the Caley Valley Wetlands suggests that it would provide optimum feeding habitat primarily during favourable wet conditions. During other times populations are likely to move in search of other water bodies and are therefore not solely reliant upon the Caley Valley Wetlands for all non-breeding events.

Given the overlap in habitat use of the Caley Valley Wetlands, the impact assessment issues and ongoing management requirements relating to the Caspian Tern are generally the same as for migratory shorebirds and the Australian Painted Snipe (Section 4.4.7). In summary:

- No direct disturbance of the wetland will occur from the Project, and off-site and indirect impacts will be minor in magnitude and scale
- Avoidance, mitigation and management measures would reduce the potential off-site and indirect impacts on this species.

The provisions described for the Caley Valley Wetlands, migratory shorebirds and the Australian Painted Snipe can be considered appropriate in addressing impacts on the Caspian Tern.

Little Tern

The Little Tern is listed as migratory under the EPBC Act. In Australia, the species is comprised of a breeding population (for which there are two subpopulations) and a migratory population from Asia which does not breed in Australia. The Australian breeding population estimate is 3,000, but the reliability of this estimate is low (DoE, 2015a).

Within Australia, Little Terns inhabit sheltered coastal environments, including lagoons and estuaries, ocean beaches and coastal environments with sandbanks and sand spits where roosting and nesting occurs. Foraging occurs mainly on fish in shallow waters of estuaries, coastal lagoons and lakes, often close to breeding colonies or close to shore. The species in Australia is comprised of individuals that are resident, or wholly or partly migratory. Threats to the species include degradation of coastal habitats and high rates of breeding failure from natural and human-related events.

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BMT WBM (2012) reported more than 300 Little Terns feeding adjacent to the Open Pan Zone of the wetland (6km west of the project area), and 50 Little Terns including nests on a sand spit in the wetland's Intertidal Zone. BAAM (2012) recorded 48 Little Terns within the Open Marsh Zone of the wetland in March and 2 individuals in December of that year. It is likely that the species uses the wetland in moderate numbers on an irregular basis.

There is some difficulty in calculating the presence of an ecologically significant proportion of the population for the species, as migratory and resident populations overlap in their geographic range. However, at the numbers recorded by BMT WBM (2012), the wetland is considered likely to support an ecologically significant proportion of the Little Tern population.

The ephemeral nature of the Caley Valley Wetlands suggests that it would provide optimum feeding habitat primarily during favourable wet conditions. During other times populations are likely to move in search of other water bodies. The wetland is also likely to support nesting Little Terns on adjacent beaches of the region.

Given the overlap in habitat use of the Caley Valley Wetlands, the impact assessment issues and ongoing management requirements relating to the Little Tern are generally the same as for migratory shorebirds and the Australian Painted Snipe (Section 4.4.7).

The key findings of the impact assessment in relation to the Little Tern and potential impacts on the Caley Valley Wetlands are:

- The Caley Valley Wetlands is likely to support an ecologically significant proportion of the Little Tern population and provides important habitat for this species
- Key habitats where aggregations of 50+ individuals have been recorded are located well west of the project area, outside of the influence of project activities
- Avoidance, mitigation and management measures would reduce the potential impacts on this species.

The provisions described above for the Caley Valley Wetlands, migratory shorebirds and the Australian Painted Snipe can be considered appropriate in addressing impacts (including residual impacts) on the Little Tern.

4.4.9 Summary

The project area (where onshore development works are proposed) is highly disturbed by existing industrial activity and consists primarily of non-remnant vegetation, with some patches of regrowth. The Squatter Pigeon is the only threatened species likely to utilise habitats within the project area. The pipeline alignments from the DMCP to the Coral Sea are approximately 5m (Indicative 2 or Alternate alignment) to 50m (Indicative 1) from project infrastructure, depending on the proposed pipeline alignment.

Several other MNES are known to occur adjacent to the project area and are relevant environmental values for the assessment of off-site impacts of the Project. These values are mostly associated with the Caley Valley Wetlands and surrounding coastal foreshores, which provide important feeding and roosting habitat for several species of migratory shorebirds, including three nationally important populations. The endangered Australian Painted Snipe also utilises these habitats.

Potential impacts of the Project on MNES were assessed in accordance with the EPBC Act and associated guidelines, with consideration of relevant conservation plans, recovery plans



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and threat abatement advice where they exist. Consideration was given to the impacts of vegetation clearing, habitat fragmentation, earthworks, vehicle movements, dust and light emissions, construction noise, waste disposal, increased human presence and the alterations to surface hydrology, water quality and ground water. Impacts associated with ongoing management and periodic use of the DMCP, following the completion of construction works, were also assessed.

The assessment identified there would be no direct impact of the Project on the SEVT TEC from vegetation clearing activities. Management measures are recommended to reduce the risk of indirect impacts from fire, weeds and pests. Similarly, impacts on threatened flora species are not expected as there are no such species known or predicted to occur within the project area or surrounding areas.

While there have been a small number of Squatter Pigeon sightings within the Abbot Point region, potential impacts on the species were assessed to be low. The Squatter Pigeon is ubiquitous in this part of its geographic range and the species is not restricted by habitat availability, as it is a habitat generalist. While the Project involves the disturbance of approximately 94ha of potential Squatter Pigeon habitat, it is unlikely to be utilised by large numbers of individuals and Abbot Point is not an important location for the species in terms of range expansion and recovery. Mitigation measures are proposed to reduce impacts on Squatter Pigeon.

The Caley Valley Wetlands was assessed as important habitat for migratory shorebirds under relevant Commonwealth guidelines. Fifteen migratory shorebird species and the Australian Painted Snipe have been recorded at the site, and for three species, an ecologically significant proportion of the population utilises the wetland's habitats. There will be no direct disturbance of the Caley Valley Wetlands from the Project. Assessment of impacts on the wetland and shorebirds was therefore focussed on off-site and indirect impacts on habitat associated with lighting, noise, dust, human disturbance, hydrology, ground water and water quality.

A buffer area of land between 50m and 300m will be established between the project site and the Caley Valley Wetlands. This will buffer the wetland from direct impacts associated with the DMCP, and will be subject to off-site impacts from noise, dust and light. This width of the buffer is greater than the distance at which a flight response has been recorded for most migratory shorebird species. Impacts of lighting the construction site at night are also likely to be completely contained within the buffer area. An analysis of sightings data for all shorebird species was completed, with habitat preferences across the wetland mapped to inform a detailed impact assessment.

Modelling of dust deposition and concentrations produced by earthworks indicates that sediment deposition will be below the criterion at which impacts on vegetation can be expected. Predicted dust concentrations within the wetland were below relevant criteria for human health for one of the three variables modelled. In the absence of dust concentration guidelines for fauna such as shorebirds, human health criteria are expected to be conservative for EIA purposes. While there is some uncertainty about the interpretation of modelled dust concentrations for the protection of shorebird health, on balance, the assessment concluded that impacts from dust are unlikely to be significant. Measures in place to protect the health of workers onsite are likely to also be sufficient for shorebirds utilising the adjacent wetland.

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Noise created by all stages of the Project's construction and operation were modelled, with criteria for the disturbance of fauna mapped in relation to the Caley Valley Wetlands. A maximum of 21.9ha (0.4% of the wetland) of shorebird habitat was predicted to overlap with the disturbance criteria when conservatively plotted for all weather scenarios and Project Stages together. However, impacts on shorebirds were assessed to be unlikely, when the factors affecting the influence of noise were further considered. These include habitat preferences of species, the timing of various construction stages, the ephemeral nature of the wetland (with wetland edge habitats often dry), the availability of similar habitat nearby and the potential for, and evidence of, habituation to noise from existing port and rail activities. Modelling of hydrology and water quality indicated that there would be no impact from the Project on wetland habitats.

Several mitigation and monitoring measures were recommended to further reduce impacts on migratory shorebirds. Overall off-site impacts of the Project on migratory shorebirds and the Australian Painted Snipe were assessed to be low, with no net residual impact. Therefore, offsets are not required.

The assessment was expanded to consider impacts on migratory waterbird species for which an ecologically significant proportion of the population is present (Great Egret, Little Tern and Caspian Tern). The assessment concluded that impacts would be insignificant and that mitigation measures in place for shorebirds would be sufficient to address those on migratory waterbirds.

4.5 Impacts on Matters of National Environmental Significance - threatened and migratory species (marine)

A Marine Ecology Technical Report has been prepared for the Project and is attached at **Appendix Q1**. A technical memorandum (**Appendix Q2**) has also been prepared to support the Marine Ecology Technical Report, and provides additional information on the pipeline alignment option immediately south and adjacent to the existing MOF.

The impacts and potential impacts relating to the Project have been assessed for each EPBC Act listed threatened or migratory species that is 'known to occur', 'likely to occur' or 'potentially occur' using endangered, vulnerable or migratory criteria from the *Significant Impact Guidelines 1.1* (DoE, 2013a). The species assessed which are known to occur at Abbot Point are listed in Table 4-25.



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Table 4-25 EPBC Act listed species assessed against potential impacts

Common name (<i>Scientific name</i>)	EPBC Act Status	Likelihood of Occurrence
Mammals		
Humpback whale (<i>Megaptera novaeangliae</i>)	V, M	Known
Indo-Pacific Humpback dolphin (<i>Sousa chinensis</i>)	M	Known
Australian Snubfin dolphin (<i>Orcaella heinsohni</i>)	M	Known
Dugong (<i>Dugong dugon</i>)	M	Known
Reptiles		
Green turtle (<i>Chelonia mydas</i>)	V	Known
Flatback turtle (<i>Natator depressus</i>)	V	Known
Hawksbill turtle (<i>Eretmochelys imbricate</i>)	V	Known
Loggerhead turtle (<i>Caretta caretta</i>)	E	Known
Olive Ridley turtle (<i>Lepidochelys olivacea</i>)	E	Known
Sharks and rays		
Giant manta ray (<i>Manta birostris</i>)	M	Known

4.5.1 Approach to impact assessment

The impact assessment uses two approaches. Initially, a risk-based assessment is undertaken to identify specific project activities which need to be assessed in more detail and mitigation and management measures outlined. Subsequently, each threatened and migratory species is assessed using the *Significant Impact Guidelines 1.1* (DoE, 2013a).

This assessment of potential project impacts to the threatened and migratory species and TECs has:

- Considered the risk identified within the Project's environmental risk register as relevant to the MNES controlling provisions of the threatened and migratory species and TECs
- Assessed the potential project impacts to threatened and migratory species and TECs values based on the significant impact guidelines.

The following sections describe the risk assessment and impact assessment processes, a description of the identified project activity impacts informed by specialist technical reports, more detailed description of the species and communities within and adjacent to the project area, intended impact mitigation and management measures to avoid or minimise potential



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impacts on MNES, and an assessment of the likely residual impacts of the Project on threatened and migratory marine species and TECs.

4.5.2 Risk assessment

A risk assessment approach has been applied to assess environmental impacts associated with the Project. The approach is described in detail in Section 4.1.

The risk assessment broadly examined all project activities to flag those activities with potential to have an adverse impact on all MNES, ensuring that the subsequent detailed assessment of impacts on MNES accounted for all potentially impacting activities.

It should be noted that the assessed environmental risk ratings are not a direct reflection of the level of risk to relevant MNES. However, they are relevant for consideration in the subsequent assessment of the significance of project impacts to MNES.

Those activities with a moderate or greater unmitigated risk are further considered in relation to significance of impacts to MNES. For threatened and migratory marine species, the relevant activities are:

- Offshore dredging and dredged material dewatering that causes the mobilisation of sediment, resulting in turbidity plumes and potentially affecting light-dependent species, filter feeders and having potential flow-on effects to higher tropic groups, including marine mammals.
- Dredge and support vessels generating underwater noise and potential collision impacting on with marine fauna.
- Artificial lighting during the dredging campaign potentially impacting on turtle nesting or hatchling emergence
- Dredging resulting in the mechanical removal of benthic communities inhabiting the seabed within the dredging footprint, including seagrass.

A summary of the residual marine ecology risks (after mitigation) of the activities associated with each phase of the Project, dredge- and return water pipeline installation, offshore dredging and return water discharging are included in section 4.3.8.1. The full environmental risk register provided in **Appendix U** highlights the relevance of each activity (and associated risk) to MNES.

4.5.3 Significant impact guidelines

The assessment of potential impacts of the Project to MNES refers to the Australian Government's *Matters of National Environmental Significance - Significant Impacts Guidelines 1.1* (DoE, 2013a). Significant impact criteria relevant to the assessment of potential impacts to listed threatened and migratory marine species are described in Table 4-26.

**Section 4****Environmental Impacts****Table 4-26 Significant impact criteria for endangered, vulnerable and migratory species****Critically Endangered and Endangered Species**

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population
- Reduce the area of occupancy of the species
- Fragment an existing population into two or more populations
- Adversely affect habitat critical to the survival of a species
- Disrupt the breeding cycle of a population
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
- Introduce disease that may cause the species to decline
- Interfere with the recovery of the species.

Vulnerable Species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of an important population of a species
- Reduce the area of occupancy of an important population
- Fragment an existing important population into two or more populations
- Adversely affect habitat critical to the survival of a species
- Disrupt the breeding cycle of an important population
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- Introduce disease that may cause the species to decline
- Interfere substantially with the recovery of the species.

Migratory species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.



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The guideline defines key concepts which are relevant to the impact assessment associated with EPBC Act listed threatened species and listed migratory species including:

- A population of a species
- An invasive species
- Habitat critical to the survival of a species or ecological community
- An important population of a species
- Important habitat for a migratory species
- An ecologically significant proportion
- A population of a migratory species.

The definition for each of these concepts is provided in the guideline (DoE, 2013a) and Advisian (2015; **Appendix Q1**).

4.5.4 Potential impacts of the Project

Key potential impacts to the marine environment which may have impacts on threatened and migratory species associated with the Project include:

- Impacts associated with the potential mobilisation of ASS from PASS in the dredged material
- Impacts to marine fauna associated with underwater noise
- Impacts to marine fauna associated with vessel collision
- Impacts of artificial lighting on nesting of marine turtles
- Introduction of marine pests
- Impacts to marine habitat due to water quality decline from the suspended sediments from dredging and DMCP return waters, which includes a reduction in benthic PAR due to increases in suspended sediments from dredging and DMCP return waters.

Each of these potential impacts is described further below. Water quality decline and associated habitat loss or degradation caused by dredging and return water discharge are considered to be the potential impacts of most significance for the Project. As such these impacts are treated in more detail than other potential impacts.

4.5.4.1 Potential Acid Sulfate Soils

As discussed in Section 4.3.4.4 the dredged material is PASS in nature. The PASS sediments do not pose a risk to the marine environment during dredging as they will remain saturated.

4.5.4.2 Underwater noise

An assessment of the potential impacts of underwater noise on marine fauna was undertaken (SLR, 2015). On the basis of the information provided, this assessment has found that:

- Marine animals can only experience PTS or TTS impacts if they stay in close proximity to the noise sources (10m to 40m) with long exposure periods (up to more than 2 hours) which is considered an unrealistic scenario.
- It is unlikely that the noise generated by the proposed dredging activities and associated supporting vessel movements will cause physical injuries or hearing damage (including

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PTS and/or TTS) to any assessed marine fauna species which have potential to occur in the study area.

- The proposed dredging activities and associated supporting vessel movements can potentially cause behavioural responses from assessed marine fauna species within a 3.0km range. However, the consequent disturbance is expected to be limited, considering the ecological characteristics of assessed marine fauna species, as well as the existing ambient noise environment in the study area.
- The noise stress caused by the transfer vessel supporting the dredging operations which travels between Bowen and Abbot Point is only transient in nature and the consequent disturbance effect to the assessed marine fauna species is expected to be minimal.

On the basis of the results of this assessment study, no specific noise monitoring and/or mitigation measures were recommended.

4.5.4.3 Vessel collision

The pipeline establishment, dredging, placement and discharge of return water are not likely to result in mortality or injury to marine fauna. The CSD type dredge is stationary and no offshore placement of dredged material will occur. The key strategies for management and mitigation to avoid vessel collision with marine fauna are based on the following:

- Restrict CSD dredging to locations specified on approved drawings
- Visual monitoring for marine fauna presence in immediate vicinity of dredge
- Planing hull work vessels will be speed limited within the operational port area of the Port of Abbot Point, i.e. the area outside of the GBRMP.

Therefore, it is considered unlikely that vessel collisions with marine fauna will occur.

4.5.4.4 Artificial lighting

Nesting of marine turtles including Green Turtles and Flatback Turtles on the coastal beaches near to Abbot Point has been recorded. Nesting generally occurs between the high water mark and foredune. Marine turtles show high site fidelity to nesting beaches and return to nest on their natal beaches with a high degree of precision (Limpus *et al.*, 1984). Artificial lighting/light pollution (e.g. from the proposed facility) can result in avoidance of nesting beaches by marine turtles and can impact on the ability of hatchlings to orientate after leaving the nest (Witherington and Martin, 1996; Pendonely, 2005; Limpus, 2008).

Lighting cues are known to be critical in allowing hatchlings to find their way from the nest to the ocean (i.e. to lighter areas in the absence of artificial lighting). Increased hatchling mortality from disorientation, heat exhaustion or increased levels of predation on hatchlings may result (Limpus, 2008). In effect, avoidance of beaches with artificial lighting results in habitat loss (Witherington and Martin, 1996).

Dredging will occur over 3km to the north-west of Abbot Point Beach where turtles are found to nest. Any lighting associated with the dredging activities is too far away to adversely impact upon nesting or hatchling emergence. Impacts due to any shoreline lighting during the hatching season will be managed to ensure turtle hatchlings which emerge during December and January are not adversely impacted upon.

The key strategies for management and mitigation to avoid impacts of artificial lighting on nesting turtles are based on the following:



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- Minimal direct light spill onto the Abbot Point turtle nesting beach and nearshore marine environment during and immediately before/after the turtle nesting and hatching season
- Maximise the efficiency of port operations such that the number of ships at anchor and associated light spill are kept to a minimum
- Minimising artificial light requirements.

4.5.4.5 Introduced marine species

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

The outcomes of the risk assessment will determine whether or not an IMS vessel inspection is required prior to the vessel or immersible equipment mobilisation to site.

If these procedures are adhered to it is unlikely IMS will be introduced as a result of the project activities.

4.5.4.6 Marine habitat

Details of the methods used to understand the potential impacts to the marine ecology offshore from Abbot Point are discussed in detail in **Appendix Q1** (Marine Ecology).

Habitat loss or modification can be caused by direct or off-site impacts of dredging and return waters. The direct impact of the Project is the removal of habitat from within the dredging footprint, while off-site impacts may include a decline in water quality associated with dredging activities and return waters and/or a decline in habitat area caused by smothering or other degradation of habitats.

The majority of the marine environment at Abbot Point is characterised by open seabed habitat. This habitat supports small patches of benthic macroinvertebrate communities (see Section 3.1.9.1. No coral reef complexes of high biodiversity have been identified with the port limits. The nearest fringing reefs are at Camp Island, Holbourne Island and Nares Rock.

Based on surveys by TropWATER between 1987 and July 2014, the primary sensitive receptor (and habitat) which is likely to be impacted upon by the dredging activities in the Abbot Point area is seagrass. In terms of marine habitat, the potential impacts from the Project are focused on the seagrass habitat loss only.

The approach used to predict the potential impacts on the marine habitat due to project activities utilises:

- Hydrodynamic modelling plots (as presented in Section 4.3.5.1)
- Developing of thresholds for TSS, sedimentation and benthic light
- Application of thresholds to modelling outputs.

**Section 4****Environmental Impacts****Benthic light thresholds**

Baseline light availability contours and the change in contours during dredging for the seagrass growing seasons (for nearshore and offshore seagrasses) during the neutral scenario year (worst-case) are presented in Figure 4-40 and Figure 4-41 respectively. The plots also show the extent of seagrass habitat from surveys between 1987 and July 2014. The nearshore $3.5\text{mol/m}^2/\text{day}$ and the offshore $1.5\text{mol/m}^2/\text{day}$ baseline contours are represented as a blue line while the post dredging $3.5\text{mol/m}^2/\text{day}$, while the $1.5\text{mol/m}^2/\text{day}$ contours are shown as a dotted blue line. The area of change between the dotted line and the solid line for each of the light requirement values interrogated is shaded orange and represents the zone of moderate impact where seagrass communities may suffer non-lethal off-site impacts during the Project.

The change in nearshore light climate due to elevated TSS from the returning waters in the seagrass growing season may result in the temporary impact (zone of moderate impact) to 8.9ha of potential seagrass habitat. The locations where the nearshore light climate contour changes is limited to small patches near the discharge point and further afield on Clarke Shoal and to the west of the discharge point.

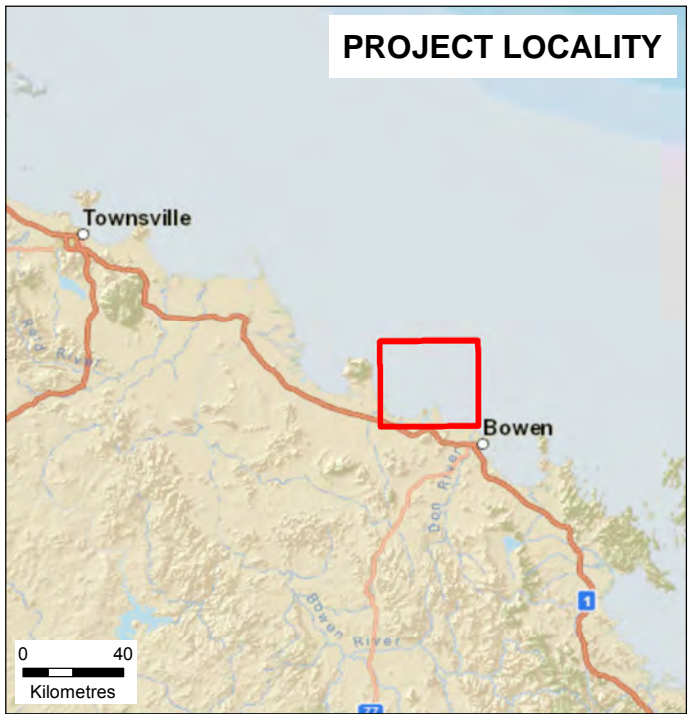
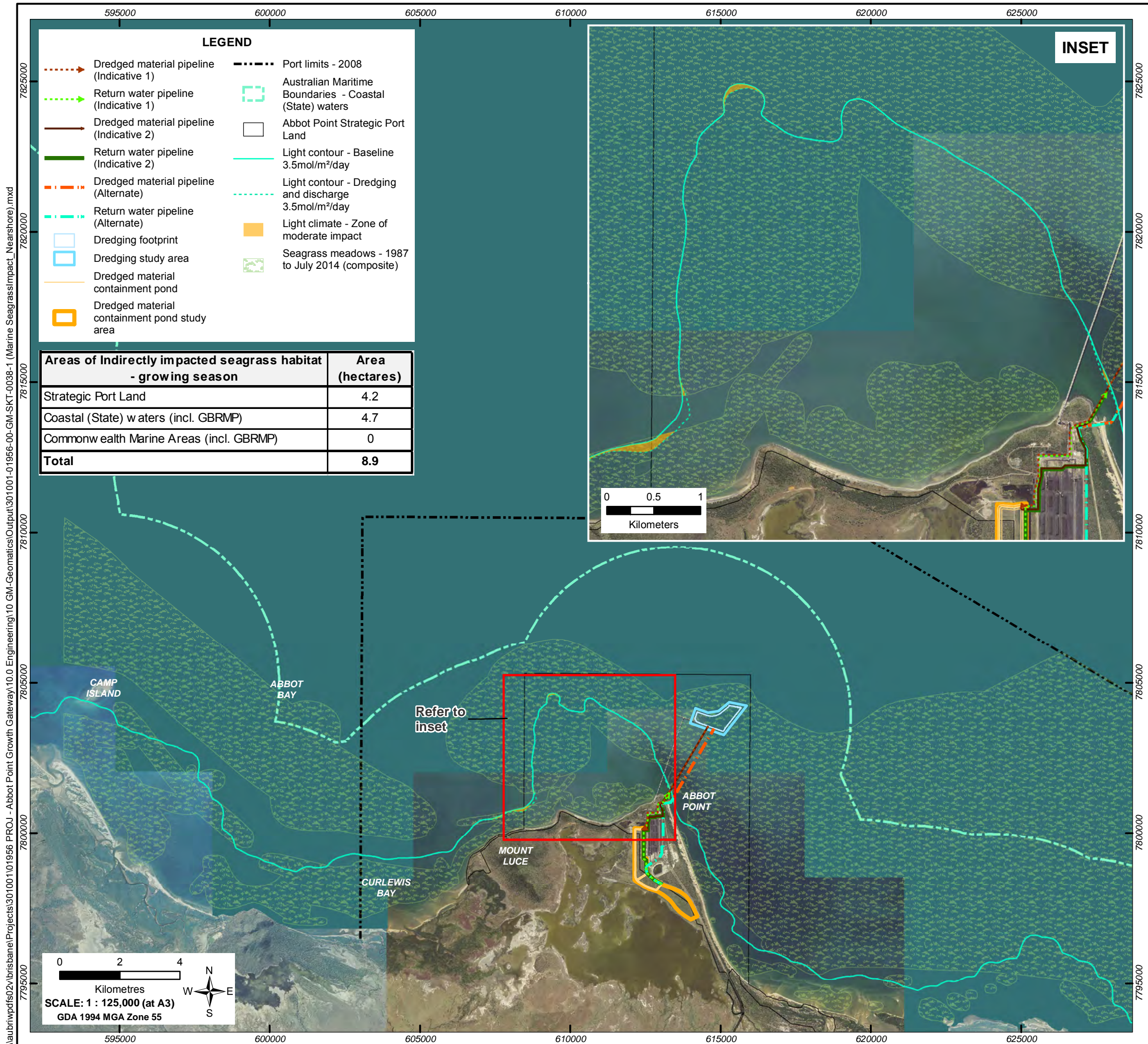
The change in offshore light climate due to elevated TSS from the returning waters in the seagrass growing season may result in the temporary impact (zone of moderate impact) over 1,181ha of potential seagrass habitat (Figure 4-42), based on conservative numerical modelling of the marine area. The locations where the offshore light climate contours changes are primarily to the south-east up to 8km distant from the T0 dredging area. The impacts to the light climate due to dredging appear to be confined to an area that is at the outer limit of the mapped offshore seagrass distribution, indicative of minimum requirements. The intra-annual (within a year) variation of seagrass growth as measured in April and September 2013 indicates the outer boundary of the offshore seagrass community changes significantly at this outer boundary.

The intra-annual variation of seagrass growth as measured by the long-term monitoring program at offshore seagrass monitoring blocks indicates the seagrass is present or absent in these blocks based on the seasonal survey period (Figure 4-43). It is unlikely that marine fauna such as turtles and dugong would rely heavily on such a sparse and ephemeral offshore seagrass habitat which occurs along the outer edge of the light requirement boundary.

The zone of moderate impact due to changes in the seagrass light requirement in the growing season represents an off-site non-lethal temporary impact to 1,182ha of offshore and 8.9ha of potential inshore seagrass habitat.


Long-term monitoring has found that seagrass biomass and distribution at Abbot Point is generally lowest during the late senescence season (April/May) and greatest in the late growing season (October/November; McKenna *et al.*, 2014). Impacts resulting from light reductions during the senescence season are unlikely to be on the same magnitude as the impacts on seagrass due to a reduction in light climate during the growing season.

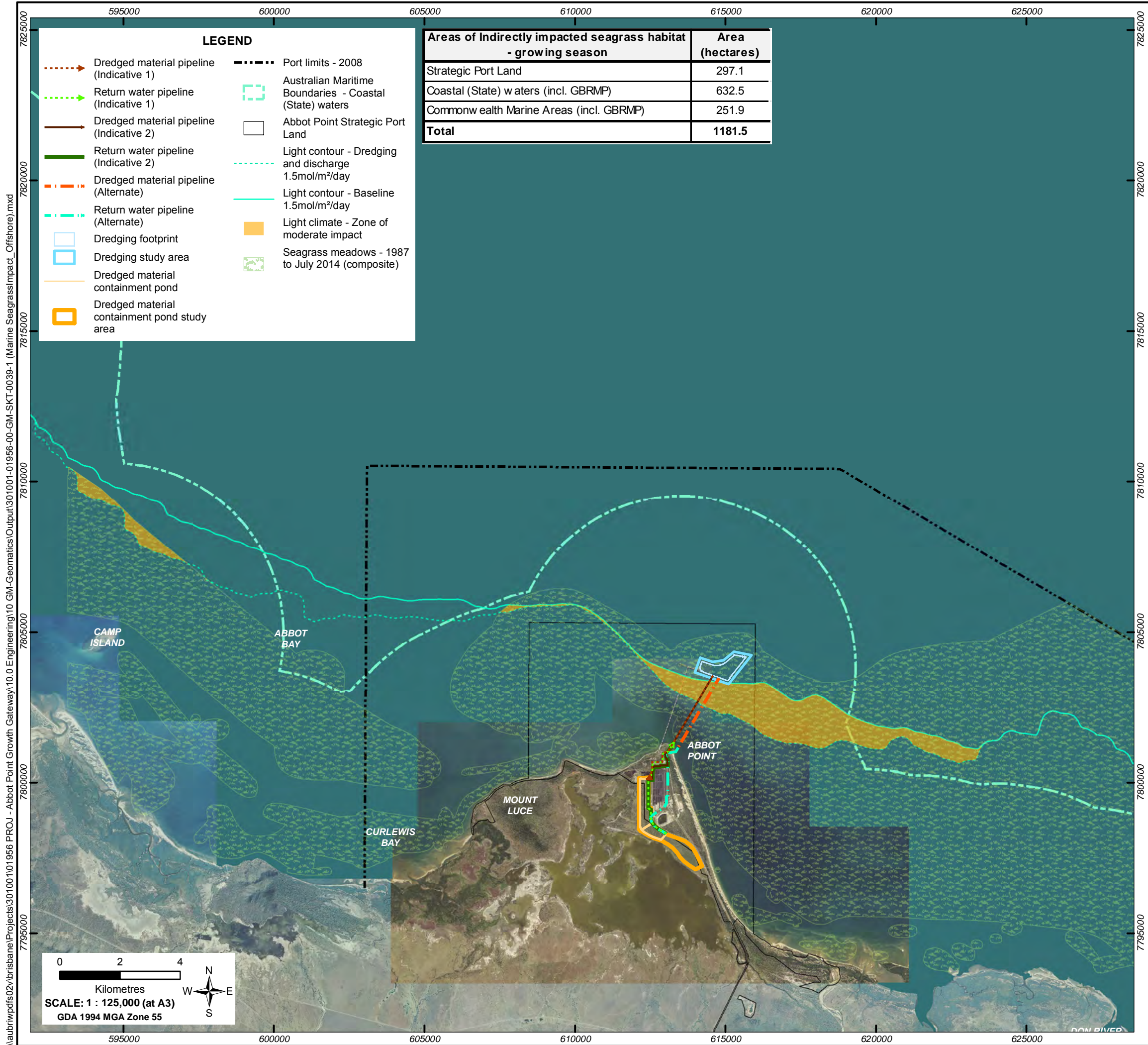
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Service Layer Credits: Sources: Esri, DeLorme, HERE, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOP expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
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Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited - Port of Abbot Point Land Use Plan - October 2010

1	12/08/2015	Issued for information	MH	KM	SN		
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 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 4-40							
Potential impacts to nearshore seagrass benthic light availability during seagrass growing season							
Figure: 301001-01956-00-GM-SKT-0038							Rev: 1



LEGEND

Dredged material pipeline (Indicative 1)

Return water pipeline (Indicative 1)

Dredged material pipeline (Indicative 2)

Return water pipeline (Indicative 2)

Dredged material pipeline (Alternate)

Return water pipeline (Alternate)

Dredging footprint

Dredging study area

Dredged material containment pond

Dredged material containment pond study area

Port limits - 2008

Australian Maritime Boundaries - Coastal (State) waters

Abbot Point Strategic Port Land

Light contour - Dredging and discharge 1.5mol/m²/day

Light contour - Baseline 1.5mol/m²/day

Light climate - Zone of moderate impact

Seagrass meadows - 1987 to July 2014 (composite)

Areas of Indirectly impacted seagrass habitat - growing season	Area (hectares)
Strategic Port Land	297.1
Coastal (State) waters (incl. GBRMP)	632.5
Commonw ealth Marine Areas (incl. GBRMP)	251.9
Total	1181.5

PROJECT LOCALITY

Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOP expansion
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Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
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ABBOT POINT GROWTH GATEWAY PROJECT

Figure 4-41

Potential impacts to offshore seagrass benthic light availability during seagrass growing season

Figure: 301001-01956-00-GM-SKT-0039

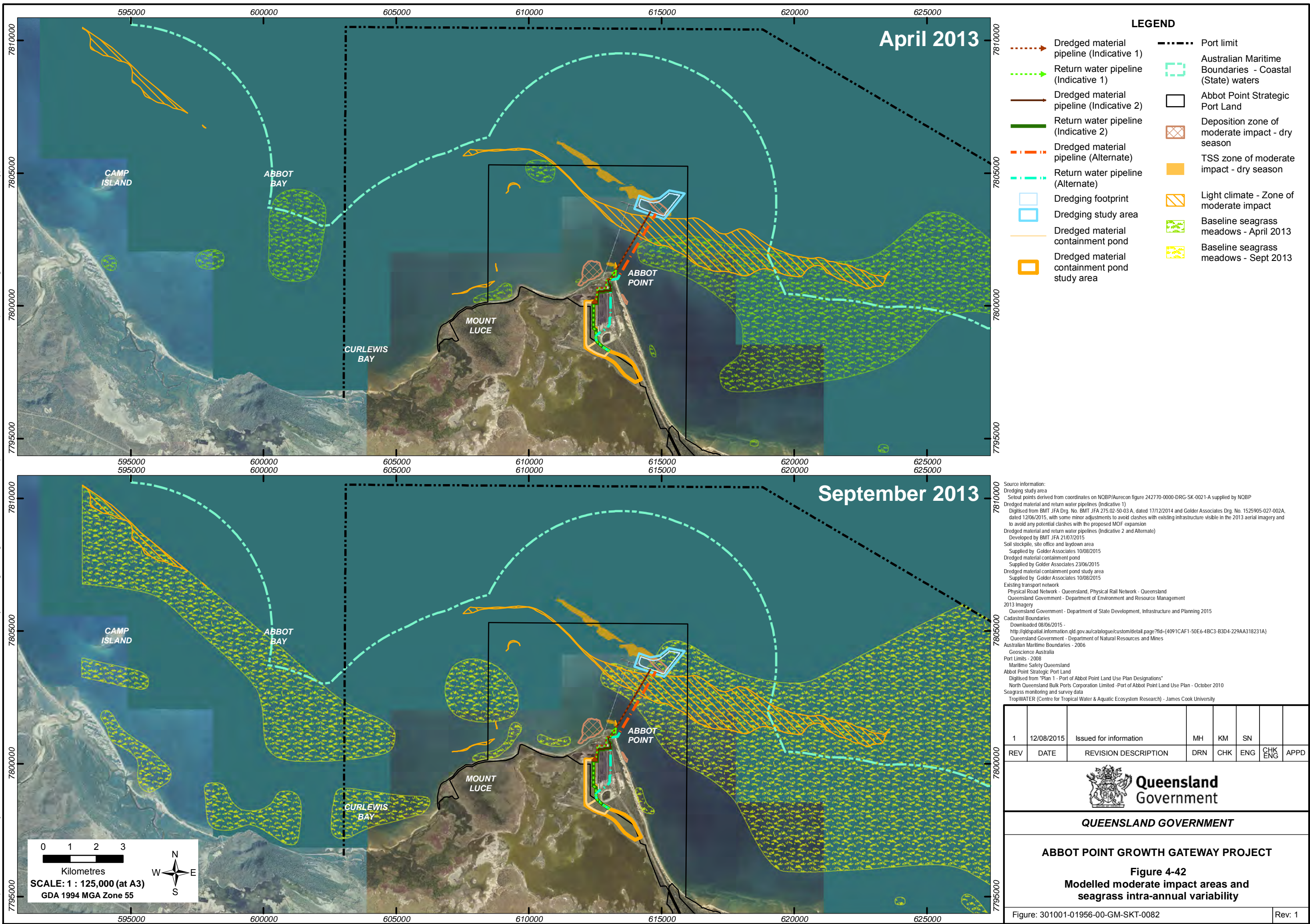
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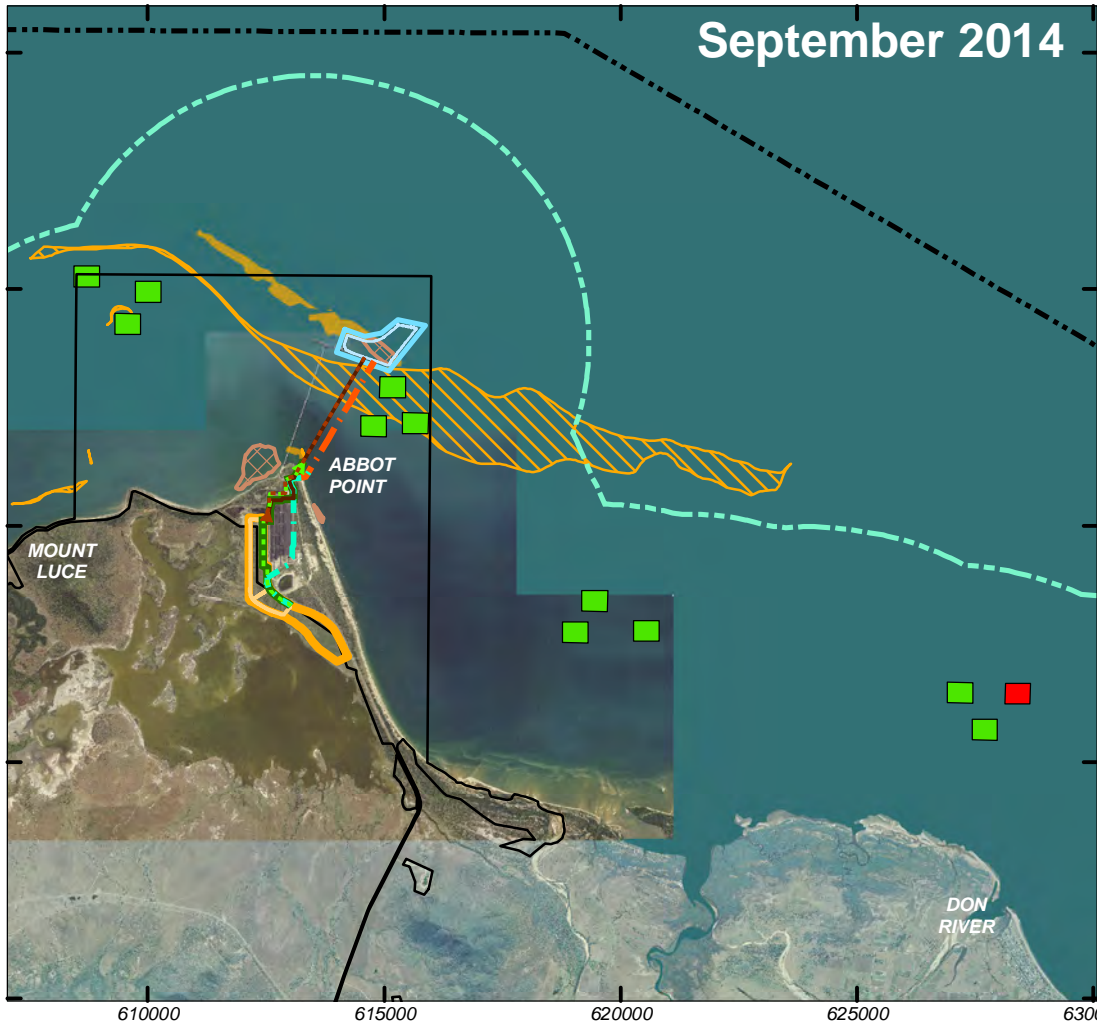
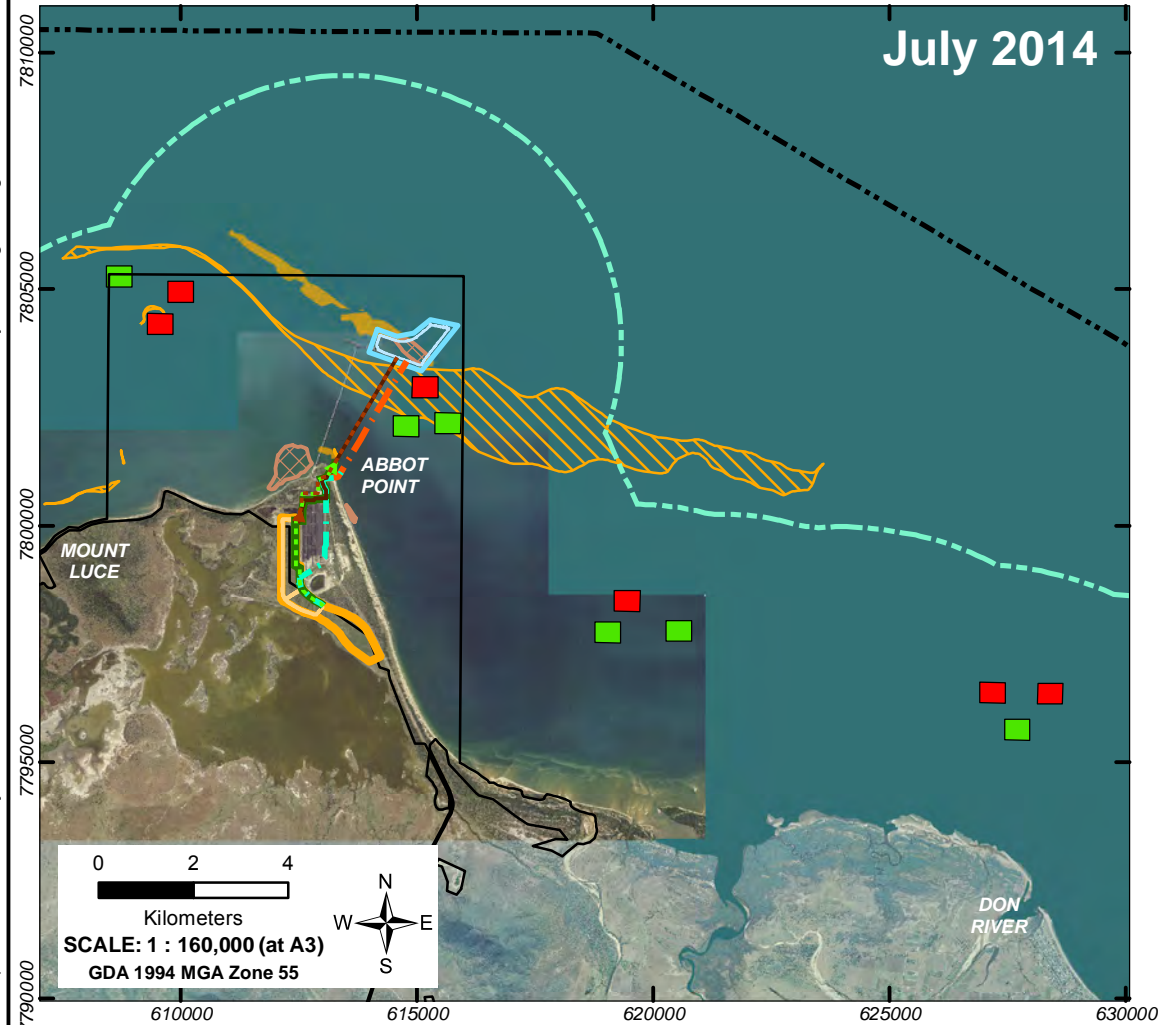
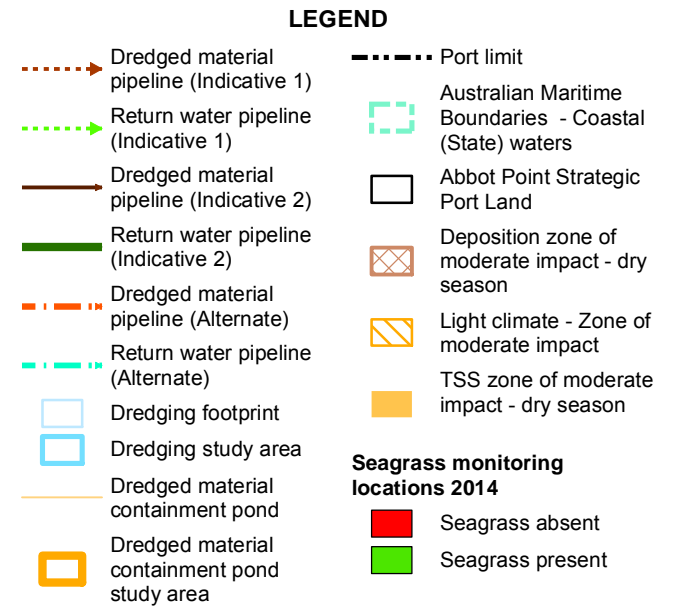
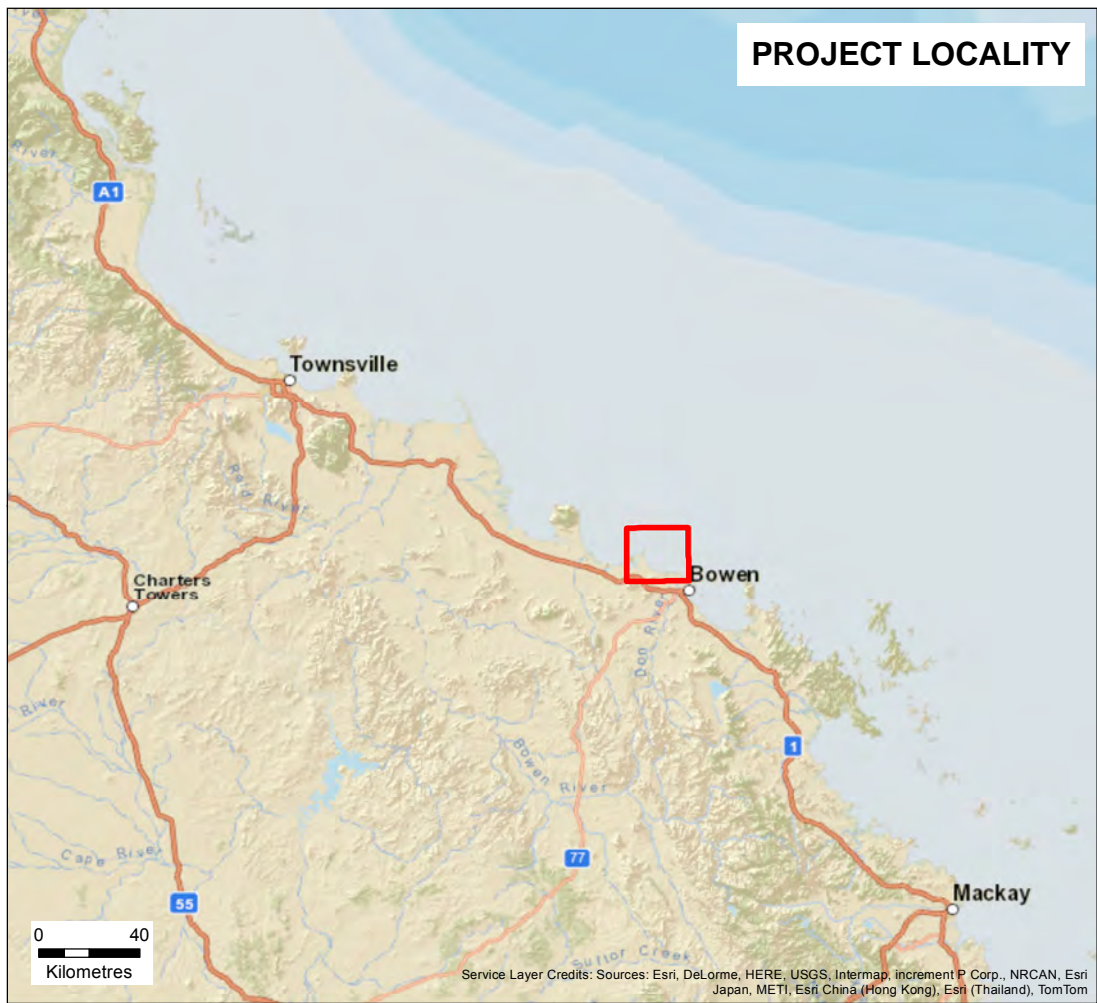
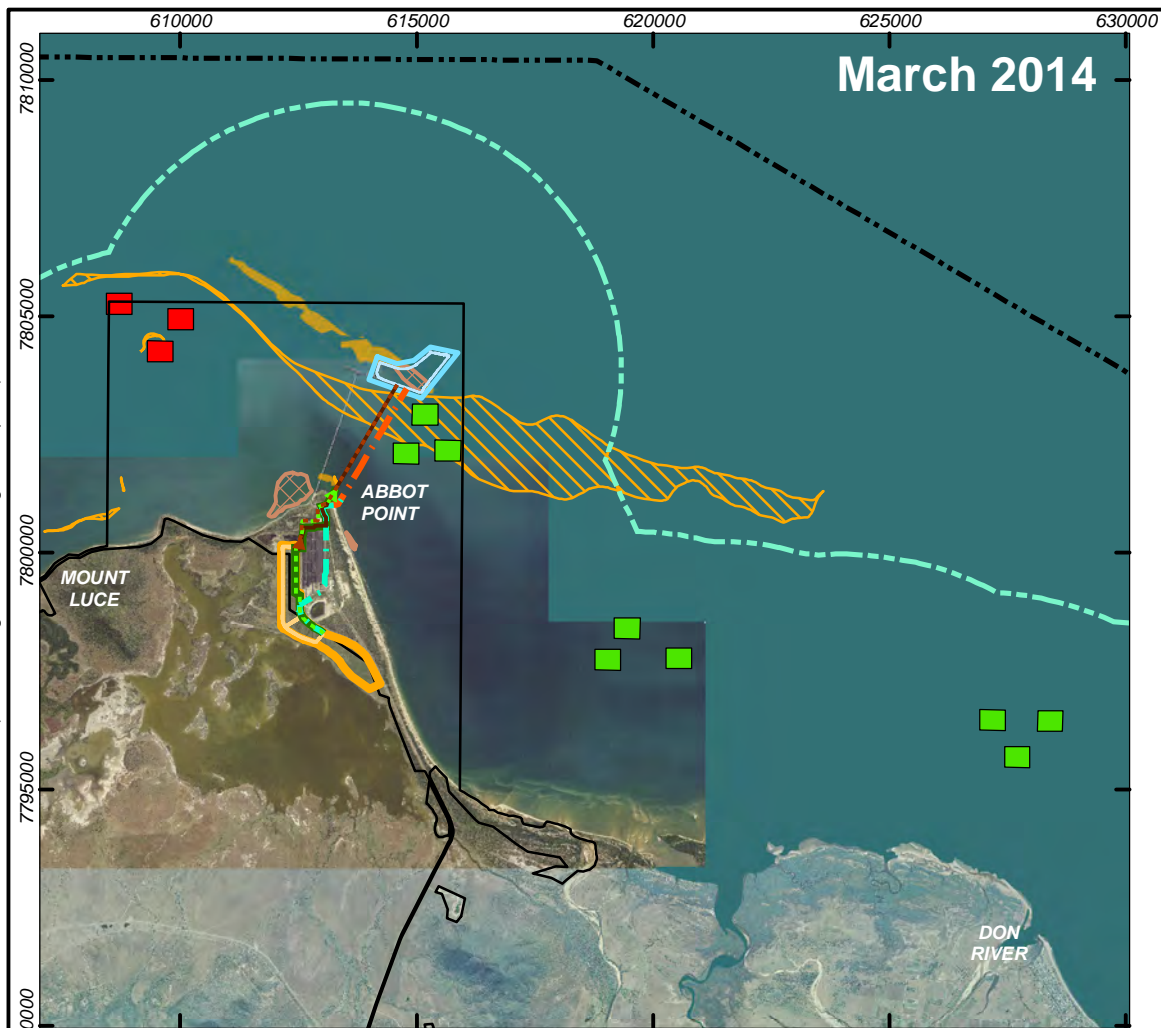
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Source information:
Dredging study area
Setout points derived from coordinates on NOBPAurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
Dredged material and return water pipelines (Indicative 2 and Alternate)
Developed by BMT JFA 21/07/2015
Soil stockpile, site office and laydown area
Supplied by Golder Associates 10/08/2015
Dredged material containment pond
Supplied by Golder Associates 23/06/2015
Dredged material containment pond study area
Supplied by Golder Associates 10/08/2015
Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
Queensland Government - Department of State Development, Infrastructure and Planning 2015
Cadastral Boundaries
Downloaded 08/06/2015 -
<http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={4091CAF1-50E6-4BC3-B3D4-229AA318231A}>
Queensland Government - Department of Natural Resources and Mines
Australian Maritime Boundaries - 2006
Geoscience Australia
Port Limits - 2008
Maritime Safety Queensland
Abbot Point Strategic Port Land
Digitised from "Plan 1 - Port of Abbot Point Land Use Plan Designations"
North Queensland Bulk Ports Corporation Limited - Port of Abbot Point Land Use Plan - October 2010
Seagrass monitoring and survey data
TropWATER (Centre for Tropical Water & Aquatic Ecosystem Research) - James Cook University

1	12/08/2015	Issued for information	MH	KM	SN		
REV	DATE	REVISION DESCRIPTION	DRN	CHK	ENG	CHK ENG	APPD
 Queensland Government							
QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 4-43							
Modelled moderate impact areas and seagrass intra-annual variability at offshore monitoring blocks							
Figure: 301001-01956-00-GM-SKT-0086							Rev: 1

**Section 4****Environmental Impacts****Summary of seagrass impacts - direct**

Permanent direct losses of seagrass habitat will occur due to dredging of the T0 berth pocket, where the depth of water would be increased to -21m LAT. Temporary direct losses of seagrass habitat will occur due to the dredging of the T0 apron area (where the depth of water would be increased to -18.5m LAT) and the laying of dredged material pipelines on the seafloor where seagrass habitat exists (Figure 4-44).

Permanent direct losses in the berth pocket

The total area of potential seagrass habitat mapped since 1987 represents an area of 27,757.4ha. The deepwater seagrass communities in the dredging footprint are best described as sparse and ranging from 1% to 5% percentage cover (light cover category) of the seabed. The distribution of the seagrass habitat in more recent surveys (2013 and 2014) show the extent of the actual seagrass communities that may be present during the project execution is much reduced, especially in deepwater areas in and surrounding the dredging footprint Figure 4-45.

Surveys in September 2013 found 7.3ha of a light cover (1% to 5%) seagrass community growing in the T0 berth pocket footprint area. The most recent surveys undertaken in December 2014, found no seagrass growing in the T0 berth pocket footprint.

Based on a composite of seagrass distribution since 1987, which indicates the entire seabed in the berth pocket area contains potential seagrass habitat, the dredging of the berth pockets for T0 will permanently remove 10.5ha of potential seagrass habitat or approximately 0.04% of the available mapped habitat in the Abbot Point region (Figure 4-44).

Temporary direct losses along the pipeline route and in the apron area

Surveys over the last 20 years also show that the seabed habitat in the apron areas has supported seagrass at some stage (Figure 4-45). The depth of the apron area at present ranges between -17.0m LAT to -18.5m LAT. Seagrass was found in the deeper waters beyond the apron dredging footprint -18.5 LAT in 2008, 2013 and 2014. Based on a composite of seagrass habitat distribution surveyed 1987, the dredging of the T0 apron area will remove 50.5ha of potential seagrass habitat.

The removal of sediment via dredging of the T0 apron area is unlikely to cause permanent loss of seagrass habitat. The benthic light environment after dredging will not alter significantly from the existing light environment and seagrass is found growing in adjacent, deeper lower light environment. Sediment characteristics of the resulting seabed immediately after dredging will not be unlike the current seabed sediment characteristics. After a short period (<4 growing seasons) via bioturbation and the deposition of local sediments the apron area seabed will be similar to the existing seabed and provide no obstacle to the re-establishment of a seagrass community. Transfer of seeds from the extensive seagrass community growing in surrounding habitat (and from far field habitat) is likely to occur over successive growing seasons. The seagrass habitat in this area is expected to recover within 5 years. More details on the sediment characteristics of the seafloor after dredging is found in **Appendix Q1** (Marine Ecology Technical Report).

The pipeline diameter (delivery and return water) is assumed to be 1.0m to 1.2m. A 0.5m buffer zone on either side of the pipeline is assumed, which allows for some movement of the pipeline during operation. There are two pipeline alignments considered (Figure 4-44);

**Section 4****Environmental Impacts**

dredged material and return water pipeline (Indicative 1) and dredged material and return water pipeline (Alternate). The Indicative alignment is assessed in detail in the Marine Ecology Technical Report (**Appendix Q1**) and the Alternate pipeline alignment is assessment in detail in the Alternative Shoreline Pipeline Corridor Impact Assessment (**Appendix Q2**). A summary of the marine environmental impact assessment for both pipeline routes is provided below.

The laying of the **indicative** dredged material delivery pipeline on the seabed between the LAT to the T0 dredging footprint will traverse across <0.5ha of potential seagrass habitat. The return water pipeline extends out to -4m LAT and crosses no areas found to have seagrass habitat.

The **indicative** return water pipeline will cross the intertidal region near the Abbot Point headland to the north of the existing MOF (Figure 4-44). The dredged material pipeline will run parallel to the return water pipeline.

Both pipelines will traverse a rocky beach before entering the water, crossing a subtidal rocky reef habitat. A high abundance of red and green algae has been previously recorded on the rocky reef habitat in this area (Rasheed *et al.*, 2005). The impact of the pipelines on the macroalgae growing on the rocky reef habitat is expected to be temporary and confined to the width of the fixed pipelines plus a 0.5m buffer. The subtidal rocky habitat is not limited to this area and extends for several kilometres to the south of the MOF.

Considering the extensive areas of this habitat that exist along this stretch of coastline any disruption to the foraging activity or impacts to food supply due to the temporary pipeline is likely to be minimal.

The beach environment where the pipelines will traverse is rocky and exposed and is not proposed to be disrupted. Immediately offshore from the beach is a large rocky reef which extends from above the low tide water mark well into the subtidal region. The main concentrations of turtle nesting are known to occur on the preferred sandy beaches to the south of the MOF.

Total temporary losses of seagrass habitat during the seagrass growing season for the pipeline and return water pipeline represent <0.5ha of potential seagrass habitat (Figure 4-45).

The **alternate** pipeline route does not traverse across habitat that contains seagrass, corals, macroalgae or any other habitat until 300m offshore in water of greater than 5m deep. The impacts on seagrass communities from the alternative pipeline route are similar in magnitude to the existing route (<0.5ha) (refer Figure 4-44 and Figure 1 in **Appendix Q2**)

The **alternate** pipeline traverses the beach adjacent to a rock wall which forms the outer barrier of the MOF. The beach where the pipeline traverses is considered less than optimal habitat for turtle nesting. More suitable habitat for turtle nesting (and therefore hatching) occurs 100m to the south of the MOF and extends for several kilometres along Abbot Beach.

The hydrodynamic conditions at the alternate discharge point are similar to the current location. The lack of any sensitive habitat near the alternative return water discharge point means that no additional impacts to marine habitat are predicted due to the change in return water discharge location.

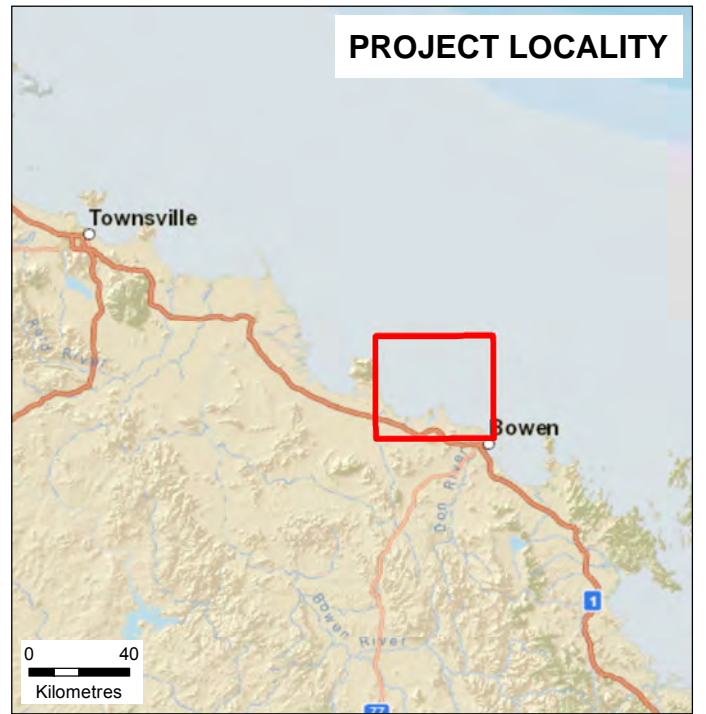
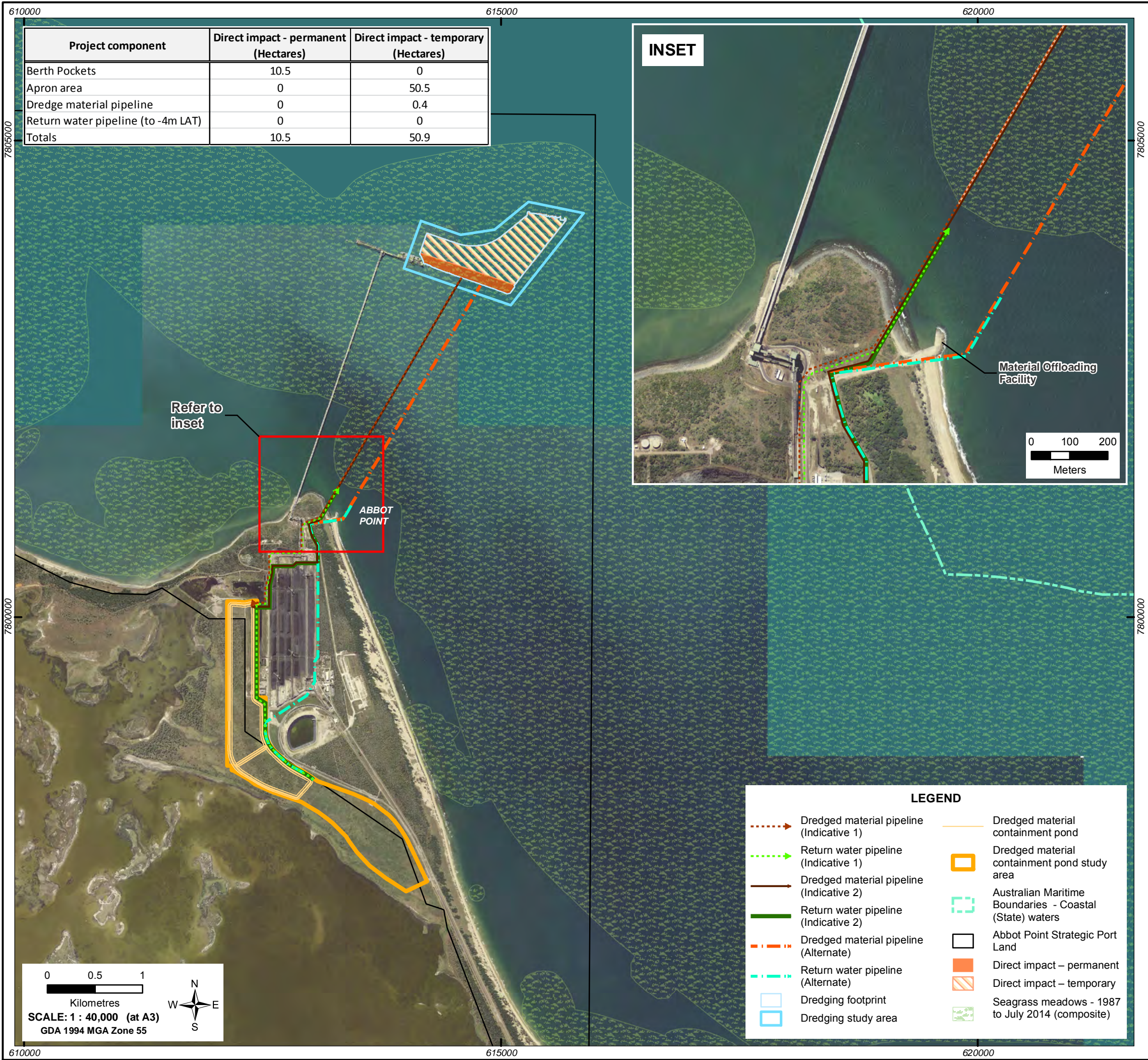


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In summary, no impacts to the marine habitat or marine fauna that may utilise this area are predicted due to the **alternate** pipeline route. The impacts on seagrass communities from the alternate pipeline route are similar in magnitude to the existing route (<0.5ha) The construction, operation and decommissioning of the alternate pipeline will be managed as per the Outline DMP which is designed to minimise other impacts to the habitat and marine fauna due to these activities.

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Source information:
Dredging study area
Setout points derived from coordinates on NOBP/Aurecon figure 242770-0000-DRG-SK-0021-A supplied by NOBP
Dredged material and return water pipelines (Indicative 1)
Digitised from BMT JFA Drg. No. BMT JFA 275.02-50-03 A, dated 17/12/2014 and Golder Associates Drg. No. 1525905-027-002A, dated 12/06/2015, with some minor adjustments to avoid clashes with existing infrastructure visible in the 2013 aerial imagery and to avoid any potential clashes with the proposed MOF expansion
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Existing transport network
Physical Road Network - Queensland, Physical Rail Network - Queensland
Queensland Government - Department of Environment and Resource Management
2013 Imagery
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Cadastral Boundaries
Downloaded 08/06/2015 -
[http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?tid=\(4091CAF1-50E6-4BC3-B3D4-229AA318231A\)](http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?tid=(4091CAF1-50E6-4BC3-B3D4-229AA318231A))
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QUEENSLAND GOVERNMENT							
ABBOT POINT GROWTH GATEWAY PROJECT							
Figure 4-44							
Areas of seagrass habitat impacted by the dredged material delivery pipeline, dredging footprints and return water pipeline							
Figure: 301001-01956-00-GM-SKT-0040							Rev: 1

**Summary of seagrass impacts - off-site****Off-site impacts due to elevated TSS**

Based on the TSS thresholds applied to the modelling outputs two zones of moderate impact are predicted to occur in the vicinity of the returning waters and the dredging footprint. During the dry season (seagrass growing season) the off-site impacts of elevated TSS from the dredging area and return water will result in an off-site impact on 46.7ha and 0.3ha respectively - a total of 47.0ha.

Off-site impacts due to elevated sedimentation rates

Based on the GBRMPA (2010) sedimentation thresholds applied to the modelling outputs two zones of moderate impact are predicted to occur in the vicinity of the return water point and the dredging footprint. During the dry season (seagrass growing season) the off-site impacts of elevated sedimentation rates from the dredging area and return water will result in an off-site impact on 4.2ha and 33.4ha respectively - a total of 37.5ha.

Off-site impacts due to bed thickness

There are no losses of seagrass habitat predicted to occur based on the threshold bed thickness value of >10mm. The highest bed thickness found outside the T0 dredging area is predicted to occur in the vicinity of extraction point D02 and D03 which recorded a maximum of 1.65mm and 0.7mm, respectively.

Off-site impacts due to a reduction in benthic light availability

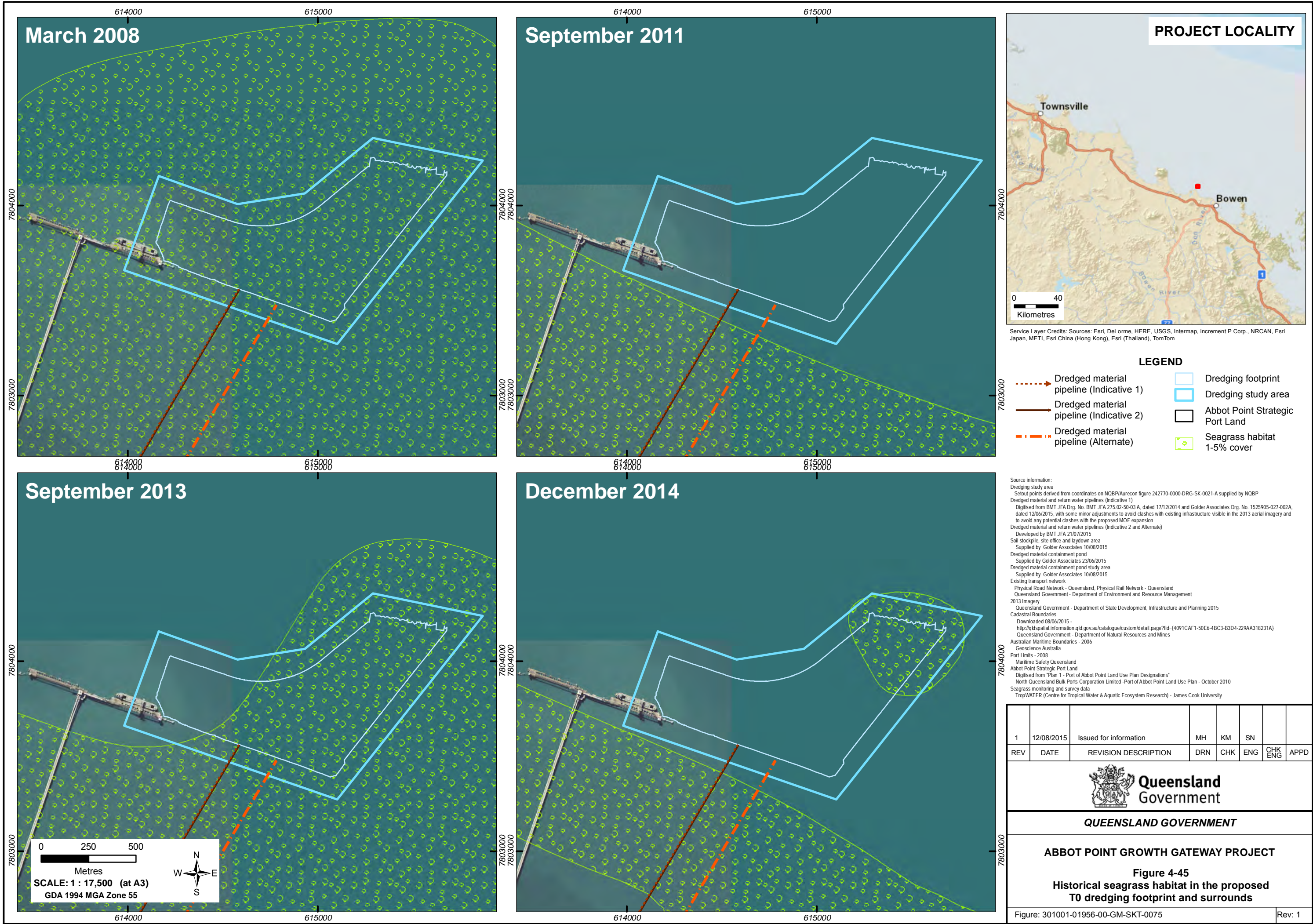
The change in offshore light climate due to elevated TSS from dredging in the seagrass growing season may result in the temporary impact (zone of moderate impact) to 1,182ha of potential seagrass habitat. The locations where the changes to the offshore baseline light climate due to elevated TSS from dredging are primarily to the southeast up to 8km distant from the T0 dredging area. The change in offshore light climate due to elevated TSS from the returning waters in the seagrass growing season may result in the temporary impact (zone of moderate impact) to 8.9ha of potential inshore seagrass habitat.

This represents an off-site impact on potential seagrass communities due to changes in the light climate at the seafloor in the seagrass growing season for a total of 1,190.4ha. This represents <4.3% of the available seagrass habitat surveyed since 1987 that may be temporarily impacted during the dry season project activities.

Long-term monitoring has found that seagrass biomass and distribution at Abbot Point is generally lowest during the late senescence season (April/May) and greatest in the late growing season (October/November; McKenna *et al.*, 2014). Impacts resulting from light reductions during the senescence season are unlikely to be on the same magnitude as the impacts on seagrass due to a reduction in light climate during the growing season.

Potential off-site impacts to benthic communities as a result of project activities are expected to be temporary. Plume influences on light attenuation are considered comparable to observed inter-seasonal variability. As such, the effects of the plume on light availability are not predicted to result in detectable losses of seagrass or have detectable impacts on potential seagrass habitat.

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4.5.5 Assessment of impacts on threatened and migratory species

4.5.5.1 Humpback Whales (vulnerable, migratory)

Humpback Whales within the Abbot Point area

The observations of Humpback Whales within Abbot Point only during September suggest a transitory, opportunistic use of this area as a resting habitat as they migrate south to their feeding grounds in the Antarctic. The protected coastline and variable water depths at Abbot Point may provide a refuge environment for some whales; however, others were observed to swim past the area (GHD, 2009d).

The Humpback Whale Recovery Plan provides an indicative map of aggregation areas for the species in Australia (see Figure 3-23). Abbot Point is located towards the northern extent of an aggregation area which has been mapped for the Whitsunday region. However, the Recovery Plan notes that these boundaries are indicative only and there is inherent variability in the movement of the species. This, combined with the environmental suitability modelling, suggests that Abbot Point is not an important aggregation area and is not identified as such in the Humpback Whale Recovery Plan (DEHP, 2005) or the Smith *et al.* (2012) study.

Importance of Abbot Point Humpback Whale population and habitat

Abbot Point appears to provide a transitory area for some Humpback Whales migrating to and from their breeding grounds within the northern GBR. Known core aggregation areas for Humpback Whales closest to Abbot Point occur further south off the Mackay coast in the Whitsunday region and in Hervey Bay.

Based on the available information, it is considered unlikely that Abbot Point supports an important Humpback Whale population or habitat critical to the survival of Humpback Whales. While Abbot Point is located towards the northern extent of the aggregation area identified in the Whitsunday region (DoE, 2014b), these areas have been mapped to provide a broad indication of the extent of aggregation areas and the information available for Abbot Point is not suggestive of a significant or important aggregation area. The number of individuals observed within the project area (14) is very low considering the population estimate for the east coast population in 2010 was approximately 15,000 (Noad *et al.*, 2011). Of the 14 individuals observed, only 4 (2 adults and 2 calves) were sighted within the shallow coastal waters of Clark Shoal. The relevance of Abbot Point to the Humpback whale is likely to be that of a migratory path north and south which supports opportunistic resting or feeding within the relative protection of its shallow coastal waters during the southern migration.

Significant impact criteria (vulnerable species)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

-
- **Lead to a long-term decrease in the size of an important population of a species**

No significant impact likely - Abbot Point is not recognised as supporting an important population of Humpback Whales. Dredging activities are temporary and short-term, relatively close to shore and the



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dredge is effectively stationary during operation (there will be no dredge movements to offshore dredged material relocation grounds) reducing the likelihood of vessel interactions with whales. The residual risk of boat strike is low.

▪ **Reduce the area of occupancy of an important population**

No significant impact likely - Humpback Whales migrate through the area and numbers are seasonally high between July and October. Mothers with calves have been observed resting in the area in low numbers and are thought to use the area opportunistically. The area is not known to support significant habitat for the species and is not identified as an aggregation or breeding area. Therefore, given the inshore location of the project area and the dredging methodology, it is considered unlikely that the Project will reduce the area of occupancy (particularly migration pathways) for Humpback Whales utilising the area.

Predicted underwater noise levels from the dredging vessel (the loudest source of noise relating to the Project) are expected to be highly localised (<3km as a conservative estimation) and of short duration. PTS and TTS thresholds are highly localised (< 10m and between 10 to 60m respectively) and have long exposure times. It is unlikely that Humpback Whales would be within 60m of the stationary dredging operations.

Given the large distribution range of Humpback Whales and small area of the Project it is considered unlikely that underwater noise will have a measurable impact to individuals using the project area. The residual risk of underwater noise is low

▪ **Fragment an existing important population**

No significant impact likely - Humpback Whales are highly mobile and the Project would not create any barriers to the migration routes of individuals.

▪ **Disrupt the breeding cycle of an important population**

No significant impact likely - It is considered that Abbot Point does not support an important population. Humpback Whales migrate through the project area for the purposes of reaching their calving grounds and/or returning to feeding grounds after calving. The Project will not create any barriers to that migration.

▪ **Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline**

No significant impact likely - The Project will not modify, destroy, remove, isolate or decrease the availability of habitat important to Humpback Whales. As discussed above, that area is not known to support habitat that is considered important to the survival of the species.

▪ **Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat**

No significant impact likely - It is considered unlikely that the Project will introduce an invasive species that will cause the species to decline. Relevant management measures will be in place, in accordance with Australian legislation, that minimise the likelihood of introduced species (e.g. from ballast water) being introduced into Australian waters. The residual risk of the introduction of marine

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pests in low.

- **Introduce disease that may cause the species to decline**

No significant impact likely - It is considered unlikely that the Project will introduce a disease to the population that will cause the species to decline. Management measures will be in place that is consistent with the requirements of Australian legislation. The residual risk of the introduction of disease is low.

- **Interfere substantially with the recovery of the species**

No significant impact likely - The Project is unlikely to interfere with the recovery of the species, or the objectives or recovery actions outlined in the Humpback Whale Recovery Plan (DEHP, 2005). The east coast population is recovering at a rate of approximately 10% per annum. Mitigation measures incorporated within the DMP which are consistent with the recovery plan include vessel speed limits to reduce vessel strike. Based on these findings and management measures, activities associated with the Project are unlikely to have an impact on this recovery rate, and there are no barriers to the continued use of the area by Humpback Whales.

4.5.5.2 Inshore dolphins (Australian Snubfin and Indo-Pacific Humpback Dolphin)

Inshore dolphins within the Abbot Point area

Surveys for marine megafauna within the Abbot Point area were undertaken between 2008 and 2009 (GHD, 2009d). A total of 50 transects and 42 spot sites were surveyed over 9 months between June/July 2008 to June 2009. Surveys were not completed during January to March due to unsafe weather conditions.

Indo-Pacific Humpback and Snubfin Dolphins were observed in the waters offshore of Abbot Point during the survey. Key results from the survey included:

- A total of 112 Indo-Pacific Humpback Dolphin sightings were recorded during survey months except for April and October, with the highest frequency of observations occurring in May and September in water depths of between 4.5 and 19.5m
- A total of 20 Snubfin Dolphin sightings were recorded in June/July, September and October, in water depths between 9 and 13m
- A mixed pod of Snubfin and Indo-Pacific Humpback Dolphin were recorded on one occasion.

It is not known whether the Abbot Point area supports breeding individuals as no calves or breeding behaviour has been observed within the area, and it is not known if the dolphins observed are residents or transients that occasionally use the area.

Importance of Abbot Point inshore dolphin populations and habitat

There are no population estimates for either the Australian Snubfin or Indo-Pacific Humpback Dolphin within the Abbot Point area, nor are there any confirmed national estimates for the two species. Studies of Queensland coastal locations (as discussed above) including Townsville, Gladstone/Port Alma and the Great Sandy Strait have indicated that:



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- Populations of these species are generally small, usually with less than 100 individuals in any one location
- Recent studies indicate that these small populations can be relatively disconnected due to geographic isolation and genetic separation
- Studies indicate that both species show a level of site fidelity, with evidence of female philopatry in Indo-Pacific Humpback Dolphins
- There is currently very little published information on the scale of movement between habitats and between regions along the coast.

Detailed studies have not been undertaken within the Abbot Point area to determine whether these population characteristics are also true for the Australian Snubfin and Indo-Pacific Humpback Dolphins observed at Abbot Point. In the absence of such information, a precautionary approach needs to be applied and populations of both dolphin species at Abbot Point need to be considered as potentially disconnected, small (<100) and potentially genetically distinct. The conservation importance of Australian Snubfin and Indo-Pacific Humpback Dolphins in a local context should therefore be considered as high.

However, the lack of regional and national population data for both species makes it difficult to understand the importance of the population of Australian Snubfin and Indo-Pacific Dolphins in a broader context. In terms of the impact assessment of the Project on these species, it is assumed the population of Australian Snubfin and Indo-Pacific Dolphins at Abbot Point is important and management and mitigation measures put in place will ensure the residual impact on these species is low.

Indo-Pacific Humpback Dolphin (migratory)

Significant impact criteria (migratory species)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

No significant impact likely - Indo-Pacific Humpback Dolphins inhabit shallow coastal, estuarine, and occasionally riverine habitats, in tropical and subtropical regions. The species usually occurs close to the coast, generally in depths of less than 20m. Indo-Pacific Humpback Dolphins have been recorded in the project area, with 112 individuals recorded during the survey period. Dredging activities are temporary and short-term, and the dredge is effectively stationary during operation. There will be no dredge movements to offshore dredged material relocation grounds reducing the likelihood of vessel interactions with Indo-Pacific Humpback Dolphins. The residual risk of boat strike is low.

Underwater noise levels predicted by the modelling may cause a behavioural response where the dolphins may move further away from activities. Due to the short-term nature of the project activities, the impacts from the Project are not likely to cause a permanent relocation of the population. The amount of potential seagrass habitat removed permanently (10.5ha) is considered a very small proportion (<0.04%) of the total available potential seagrass habitat that exists in the Abbot Point region. The residual risk of underwater noise is low.



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The direct and off-site impacts of the Project are not likely to modify, destroy or isolate an area of important habitat for Indo-Pacific Humpback Dolphins.

- **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**

No significant impact likely - It is considered unlikely that the Project will introduce an invasive species that will cause the species to decline. Relevant management measures will be in place, in accordance with Australian legislation, that minimise the likelihood of introduced species (e.g. from ballast water) being introduced into Australian waters. The residual risk of the introduction of marine pests is low.

- **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species**

No significant impact likely - Dredging activities are temporary and short-term; the dredge is effectively stationary during operation, restricted to the dredging areas offshore. There will be no dredge movements to offshore dredged material relocation grounds reducing the likelihood of vessel interactions with Indo-Pacific Humpback Dolphins. The residual risk of boat strike is low.

Underwater noise levels predicted by the modelling may cause a behavioural response in close proximity of the dredging activities; dolphins may move further away from activities. Due to the short-term nature of the project activities, the impacts from the Project are not likely to cause a serious disruption in the lifecycle of an ecologically significant proportion of the population of a migratory species. The residual risk of underwater noise is low.

Australian Snubfin Dolphin (migratory)

Significant impact criteria (migratory species)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

The Australian Snubfin Dolphin usually inhabits shallow coastal waters less than 20m deep and is often associated with tidal riverine and estuarine systems, enclosed bays and coastal lagoons (Corkeron *et al.*, 1997; Jefferson, 2000; Parra, 2006). Within Australia, the dolphin species co-exists with coastal development, including extensive port facilities such as the Port of Brisbane and Cleveland Bay, Townsville (Hale *et al.*, 1998; Parra, 2006). The understanding of important habitat for the Australian Snubfin Dolphin indicates that they are very limited.

Australian Snubfin Dolphins have been recorded in the project area, with 20 individuals recorded during the survey period, found in areas with water depths of between 9 and 13m. The direct and off-site impacts of the Project are not likely to modify, destroy or isolate an area of important habitat for Australian Snubfin Dolphins. The amount of potential seagrass habitat permanently removed (10.5ha) is considered a minute proportion (less than 0.04%) of the total available potential seagrass habitat that exists in the Abbot Point region.



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Declines in water quality caused by dredging and returning waters may affect these species at a highly localised level for a short duration. The residual risk of impacts to habitat and water quality is low.

- **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**

No significant impact likely - It is considered unlikely that the Project will introduce an invasive species that will cause the species to decline. Relevant management measures will be in place, in accordance with Australian legislation, that minimise the likelihood of introduced species (e.g. from ballast water) being introduced into Australian waters. The residual risk of the introduction of marine pests is low.

- **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species**

No significant impact likely - Dredging activities are temporary and short-term, the dredge is effectively stationary during operation. There will be no dredge movements to offshore dredged material relocation grounds reducing the likelihood of vessel interactions with Australian Snubfin Dolphins. The residual risk of boat strike is low.

Underwater noise levels predicted by the modelling may cause a behavioural response where the dolphins move further away from activities. Literature suggests this species of dolphin can co-exist with coastal development, including extensive port facilities such as the Port of Brisbane and Cleveland Bay, Townsville (Hale *et al.*, 1998; Parra, 2006). Due to the short-term nature of the project activities the impacts from the Project are not likely to cause a serious disruption of the lifecycle of an ecologically significant proportion of the population of a migratory species. The residual risk of underwater noise is low.

4.5.5.3 Dugong (migratory)

Dugongs within the Abbot Point area

Surveys for marine megafauna within the Abbot Point area were undertaken between 2008 and 2009 (GHD, 2009d). Results from the surveys included:

- Observations of 24 Dugongs including 16 adults, 1 juvenile and 3 calves
- Individuals were largely associated with seagrass meadows containing *H. uninervis* and *H. spinulosa*
- Individuals were observed in water depths between 2.5m and 14m throughout the waters of the existing port facilities
- Individuals were found to be present throughout most of the year (observed in June/July, August, September, October, December and April).

The presence of Dugongs within Abbot Point is likely to be strongly influenced by the abundance and health of seagrass meadows. Seagrass within the Abbot Point area is naturally variable as a result of seasonal and inter-annual changes in environmental factors (i.e. rainfall, cyclonic events and flooding). A detailed description of the distribution and abundance of seagrass at Abbot Point is provided in the Section 3.1.9.1.

**Section 4****Environmental Impacts****Importance of Abbot Point Dugong population and habitat**

Abbot Point was identified as an area of low conservation importance for Dugongs in the Southern GBR (Grech and Marsh, 2007). Other areas in the southern GBR are known to support more significant populations of Dugongs than Abbot Point including:

- Upstart Bay and Edgumbe Bay to the north-west and south-east of Abbot Point support variable, but on occasion significant populations of Dugongs (>150 individuals) and are therefore considered to be of higher conservation value
- Cleveland Bay, located 140km to the north of Abbot Point, as identified by DoE (2014s) has recorded population estimates of up to 400 individuals during aerial surveys (Preen, 1999)
- Hervey Bay, over 750km to the south-east of Abbot Point, has recorded some of the largest population estimates in the southern GBR, with over 1,000 individuals recorded during aerial surveys.

Dugongs are known to travel short and long distances between food sources. The distance between the DPAs of Upstart Bay and Edgumbe Bay is approximately 80km. There is potential for individuals to move between these areas in search of foraging habitat. It is likely that these individuals would use the seagrass habitat within Abbot Point and immediate surrounds for foraging. Abbot Point may therefore provide an opportunistic feeding area for Dugongs as they travel between the two DPAs.

Given the available information, it is considered unlikely that the Abbot Point area supports locally important Dugong habitat or an ecologically significant proportion of the dugong population in Australia. This conclusion is supported by the following factors:

- Abbot Point has been previously identified as an area of low conservation importance for Dugongs in the southern GBR, based on reef wide, long-term data (Grech and Marsh, 2007)
- Seagrass distribution and abundance is naturally highly variable in the Abbot Point area, with the most recent surveys recording reduced areas (when compared to 2008) of low density, patchy areas of seagrass (McKenna and Rasheed, 2014), indicating seagrass abundance in the Abbot Point area is not stable or currently present in high abundance
- Dugongs recorded in the Abbot Point area are likely to be transient individuals, moving between the more important areas of Cape Upstart to the north and Edgumbe Bay to the south and have, to date, not been recorded in significant abundances in the Abbot Point area
- Abbot Point is not at the limit of the distribution range of dugongs along the east coast of Australia
- Abbot Point is not known to provide any critical breeding, feeding or resting habitat for Dugongs in the local or regional area.



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Significant impact criteria (migratory species)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

No significant impact likely - The Project will result in a permanent loss of 10.5ha of potential seagrass habitat within the dredged berth area. The amount of potential seagrass habitat permanently removed is considered a minute proportion (less than 0.04%) of the total available potential seagrass habitat that exists in the Abbot Point region. The residual risk of habitat loss is low. Dredging activities are temporary and short-term; the dredge is effectively stationary during operation. There will be no dredge movements to offshore dredged material relocation grounds reducing the likelihood of vessel interactions with Dugongs. The residual risk of boat strike is low. Underwater noise levels predicted by the modelling may cause a behavioural response where Dugongs move further away from activities. The residual risk of underwater noise is low.

- **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**

No significant impact likely - It is considered unlikely that the Project will introduce an invasive species that will cause Dugong species to decline. Relevant management measures will be in place, in accordance with Australian legislation, that minimise the likelihood of introduced species (e.g. from ballast water) being introduced into Australian waters. The residual risk of the introduction of marine pests is low.

- **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species**

No significant impact likely - Abbot Point was identified as an area of low conservation importance for Dugongs in the southern GBR (Grech and Marsh, 2007). Other areas in the southern GBR are known to support more significant populations of Dugongs than Abbot Point. The closest area to support significant populations is 140km from the project area. Abbot Point is not known to provide any critical breeding, feeding or resting habitat for Dugongs in the local or regional area. The area of potential seagrass habitat to be temporarily impacted by the Project is a small proportion of that potentially available in Abbot Point. Seagrasses in the area are sparse and ephemeral. The residual risk of habitat loss is low.

Dredging activities are temporary and short-term; the dredge is effectively stationary during operation which reduces the potential for vessel strike. There will be no dredge movements to offshore dredged material relocation grounds reducing the likelihood of vessel interactions with Dugong. The residual risk of boat strike is low.

Underwater noise levels predicted by the modelling may cause a behavioural response where Dugongs move further away from activities. The residual risk of underwater noise is low.



4.5.5.4 Marine turtles

Loggerhead and Olive Ridley turtles (endangered)

Loggerhead Turtles within the Abbot Point area

There is suitable foraging habitat for Loggerhead Turtles present in the waters offshore of Abbot Point. Two Loggerhead Turtle adults were observed in waters surrounding Abbot Point during December 2008, between 3 and 10m depth (GHD, 2009d). CDM Smith (2013b) has also reported Loggerhead Turtles to be associated with the rocky reef that extends ~2.5km south of the MOF.

The importance of the Abbot Point Loggerhead Turtle population and habitat are discussed (together with the Olive Ridley Turtle) below.

Olive Ridley Turtles within the Abbot Point area

Olive Ridley Turtles have previously been confirmed to be present at Abbot Point, although sightings of this species in the GBRMP are rare (GHD, 2009e; GBRMPA, 2014a). The importance of Abbot Point to the Olive Ridley Turtle population and habitat are discussed with Loggerhead Turtles below.

Importance of Abbot Point to Loggerhead and Olive Ridley Turtle populations and habitat

Abbot Point has not been identified as an area of high conservation importance for Loggerhead or Olive Ridley Turtles in the GBR and the area is not considered to represent habitat critical to the survival of any of these three species. This is due to:

- The very low number of Loggerhead and Olive Ridley Turtles sighted in the area
- Absence of any nesting activity for these species in the area.

There are no formal nesting records for any of these two turtle species in the Abbot Point area. Existing records for these three endangered turtle species indicate that the coastal and offshore waters near Abbot Point support only small numbers of foraging individuals of Loggerhead and Olive Ridley Turtles. The Abbot Point area is not listed under the breeding areas considered critical for any of these species under the Recovery Plan for Marine Turtles in Australia (Environment Australia, 2003).



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Table 4-27 Loggerhead and Olive Ridley Turtles - impact criteria

Significant Impact Criteria (Endangered Species)	Loggerhead Turtle	Olive Ridley Turtle
Lead to a long-term decrease in the size of a population	<p>No significant impact likely - Low numbers of Loggerhead Turtles have been recorded foraging and/or within the vicinity of the project area. There are no Loggerhead Turtle nesting sites known within the project area or its vicinity.</p> <p>Abbot Point has not been identified as an area of high conservation importance for Loggerhead Turtles as is not known to support an important population.</p> <p>As Loggerhead Turtles are widely distributed and choose a wide variety of tidal and subtidal habitat as foraging areas, it is unlikely the short-term and localised dredging activities associated with the Project will contribute to a decrease in the population size.</p> <p>The Project may have some short-term, localised impacts on water quality during dredging and will only directly impact <0.04% of the available seagrass habitat in the area. These impacts are unlikely to cause a long-term decrease in the population. The residual risk of habitat loss is low.</p> <p>Vessel collision is not considered likely as the dredging vessel will be stationary during dredging, onsite for a short period of time and turtles are highly mobile and able to avoid slow moving vessels. The residual risk of boat strike is low.</p>	<p>No significant impact likely - There are no dense nesting aggregations of Olive Ridley Turtles in Australia. Olive Ridley Turtles have previously been confirmed to be present at Abbot Point, although sightings of this species in the GBRMP are rare.</p> <p>Abbot Point has not been identified as an area of high conservation importance for Olive Ridley Turtles as is not known to support a population.</p> <p>The Project may have some short-term, localised impacts on water quality (which may impact upon seagrass growth and survival) during dredging and will only directly impact <0.04% of the available seagrass habitat in the area. These impacts are unlikely to cause a long-term decrease in the population. The residual risk of habitat loss is low.</p> <p>Vessel collision is not considered likely as the dredging vessel will be stationary during dredging, onsite for a short period of time and turtles are highly mobile and able to avoid slow moving vessels. The residual risk of boat strike is low.</p>
Reduce the area of occupancy of the species	<p>No significant impact likely - Low numbers of Loggerhead Turtles have been recorded foraging and/or within the vicinity of the project area. The project area is not known to support a population of Loggerhead Turtles.</p>	<p>No significant impact likely - The area is not known to support a population of Olive Ridley Turtles.</p> <p>Impacts, if any, to the species are expected to be short-term and localised to the dredging area. Such</p>



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**Significant
Impact Criteria
(Endangered
Species)**

Loggerhead Turtle

Olive Ridley Turtle

impacts will not reduce the area of occupancy of the species.

The Project may have some short-term, localised impacts on water quality during dredging, to the small numbers that forage in the area, but these impacts are unlikely to cause a long-term decrease in the population.

The Project will only have a permanent impact on <0.04% of the available seagrass habitat in the area. These impacts are unlikely to cause a long-term decrease in the population. The residual risk of habitat loss is low.

No significant impact likely - The Project may have some short-term, localised impacts on water quality during dredging, to the small numbers of turtles that forage in the area, but these impacts are unlikely to cause a long-term decrease in Loggerhead or Olive Ridley Turtle populations. The Project will directly impact on <0.04% of the available seagrass habitat in the area. Off-site impacts on seagrass communities will be temporary and recoverable. The residual risk of habitat loss is low.

Predicted underwater noise levels from the dredging vessel (the loudest source of noise relating to the Project), are expected to be highly localised. The maximum distance that may cause behavioural changes in megafauna is 3km (as a conservative estimation) and for a short duration PTS and TTS thresholds are highly localised (< 10m and between 10 to 60m respectively) and have long exposure times.

Given the large distribution range of Loggerhead and Olive Ridley Turtles and the small area of the Project; it is unlikely underwater noise will have a significant impact to individuals using the project area. The residual risk of underwater noise is low.

**Fragment an
existing
population into
two or more
populations**

No significant impact likely - Marine turtles are highly mobile and the Project would not create any barriers to the movement of individuals.



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**Significant
Impact Criteria
(Endangered
Species)**

Loggerhead Turtle

Olive Ridley Turtle

**Adversely affect
habitat critical
to the survival
of a species**

No significant impact likely - The majority of foraging habitat (seagrass and bare sedimentary habitats) at Abbot Point is unlikely to be impacted by the Project.

The seagrass habitat within the dredging footprints will be directly impacted by removal. The Project will have a permanent impact on <0.04% of the available seagrass habitat in the region. Considering the low number of Loggerhead Turtles observed at Abbot Point this seagrass removal is unlikely to have a significant impact. The residual risk of habitat loss is low.

There is no Loggerhead Turtle population recorded as endemic to Abbot Point and no nesting activity or critical breeding areas for this species in the region.

No significant impact likely -

Foraging habitat (shallow rocky and coral reefs) is unlikely to be impacted by the Project.

The widespread distribution of this species and lack of nesting areas in Abbot Point and eastern Australia make it unlikely individuals or populations will be significantly impacted by the Project.

There is no Olive Ridley Turtle population at Abbot Point.

**Disrupt the
breeding cycle
of a population**

No significant impact likely - The species is not known to nest in the Abbot Point region and therefore the Project is not considered to disrupt the breeding cycle of the population.

No significant impact likely - The species is not known to nest in the Abbot Point region and therefore the Project is not considered to disrupt the breeding cycle of the population.

**Modify, destroy,
remove, isolate
or decrease the
availability or
quality of
habitat to the
extent that the
species is likely
to decline**

No significant impact likely - Abbot Point has not been identified as an area of high conservation importance for Loggerhead Turtles.

Low numbers of Loggerhead Turtles have been recorded foraging and within the vicinity of the project area. There are no Loggerhead Turtle nesting sites known within the project area or its vicinity.

The majority of foraging habitat (seagrass and bare sedimentary habitats) is unlikely to be impacted by the Project. Loggerhead Turtles forage on seagrass beds, among other benthic habitats. Removal of the seagrass in the dredging

No significant impact likely - The area is not known to support a population of Olive Ridley Turtles. Off-site impacts will not reduce the availability of habitat to the species.

The Project may have some short-term, localised impacts on water quality during dredging, to the small numbers that forage in the area, but these impacts are unlikely to cause a long-term decrease in the population

Foraging habitat (shallow rocky and coral reefs) is unlikely to be impacted by the Project.



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**Significant
Impact Criteria
(Endangered
Species)**

Loggerhead Turtle

Olive Ridley Turtle

footprints may modify the foraging habitat within the dredging footprint. The Project will have a direct impact on <0.04% of the available seagrass habitat in the region. As Loggerhead Turtles are widely distributed and choose a variety of tidal and subtidal habitat as foraging areas, it is unlikely the small area of this direct impact will have any impact that would cause the species to decline. The residual risk of habitat loss is low.

The Project may have some short-term, localised impacts on water quality during dredging, to the small numbers that forage in the area, but these impacts are unlikely to cause a long-term decrease in the population. The residual risk to water quality is low.

**Result in
invasive
species that are
harmful to a
critically
endangered or
endangered
species
becoming
established in
the critically
endangered or
endangered
species' habitat**

No significant impact likely - It is considered unlikely that the Project will introduce an invasive species that will cause Loggerhead or Olive Ridley species to decline. Relevant management measures will be in place, in accordance with Australian legislation, that minimise the likelihood of introduced species (e.g. from ballast water) being introduced into Australian waters. The residual risk of the introduction of marine pests is low.

**Introduce
disease that
may cause the
species to
decline**

No significant impact likely - It is considered unlikely that the Project will introduce a disease to the population that will cause Loggerhead or Olive Ridley species to decline. As per introduced species above, management measures will be in place that are consistent with the requirements of Australian legislation. The residual risk of the introduction of disease is low.

**Interfere with
the recovery of**

No significant impact likely - There is a recovery plan in place for marine turtles in Australia. Whilst the area supports some foraging habitat for both species, it is



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**Significant
Impact Criteria
(Endangered
Species)**

Loggerhead Turtle

Olive Ridley Turtle

the species

not considered critical habitat for the survival and recovery of either species. The Project will have a direct impact on upon <0.04% of the available seagrass habitat in the region. Habitat usage for foraging appears low and no nesting has been observed, particularly in comparison to other areas in the region. Mitigation measures incorporated within the Outline DMP which are consistent with the recovery plan include vessel speed limits and artificial light abatement strategies. Based on these findings and management measures, the Project is not expected to interfere with the recovery of either species. The residual risk of habitat loss is low.

Flatback, Green and Hawksbill turtles (vulnerable)

Flatback Turtles within the Abbot Point area

Abbot Point has not been identified as a key nesting or inter-nesting area for Flatback Turtles. However, evidence of Flatback Turtle use of the area has been recorded on numerous occasions.

Previously, Bell (2003) has undertaken marine turtle nesting and foraging surveys in the vicinity of port facilities at Hay Point, Abbot Point and Lucinda. The Mackay and District Turtle Watch Association (2012) have identified that approximately 30 to 100 Flatback Turtles nest annually across approximately 30 beaches in the Mackay region, each female laying approximately three times in a season.

A recent marine fauna survey (GHD, 2009d) observed turtles within the coastal waters of Abbot Point, including 10 observations of Flatback Turtles within 1.2m and 12m. No turtles were observed within the dredging footprint. Turtle nesting was also recorded in the area with a total of four tracks recorded in November and seven in December 2008. The tracks were not distinguishable between Flatback and Green Turtles.

CDM Smith (2013b) undertook surveys of turtle nesting sites in December 2012/January 2013 over a walking transect extending for 6km south from the existing MOF located south of Abbot Point. Evidence of limited marine turtle nesting was recorded in December 2012, with 11 sets of tracks recorded over the transect length. Six tracks could be attributed to a specific species, with five of these being Flatback Turtles. Both the December and January surveys indicated a concentration of marine turtles (including Green Turtles, Loggerhead Turtles and Flatback Turtles) associated with the rocky reef that extends ~2.5km south of the MOF.

Hof and Bell (2014) undertook aerial surveys in December 2014 and reported that Flatback Turtle nesting occurs along the majority of the Whitsunday-Burdekin-Townsville coastline with higher density nesting on mainland coastal beaches including Rita Island (51 tracks), Paradise Bay (22 tracks) and Abbot Point (21 tracks) respectively. Wunjunga Beach was also found to support regionally high density nesting of Flatback Turtles. A regional density

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of 185 Flatback and Green Turtle nesting attempt tracks were recorded in this survey, with the majority identified as Flatback Turtles (Hof and Bell, 2014).

Importance of Abbot Point Flatback Turtle population and habitat

Flatback Turtles are known to nest in the Abbot Point area and are also likely to forage within the project area. There are no identified critical habitat areas for Flatback Turtles in Queensland (Environment Australia, 2003).

Nesting is known to occur along the Queensland coast between Bundaberg in the south and northwards to Torres Strait. The main nesting sites occur in the southern GBR at Peak, Wild Duck and Curtis Island (DoE, 2014i). The level of nesting observed at Abbot Point for Flatback Turtles is considered to be 'low-density' when compared with other known turtle rookeries in Queensland, such as Wild Duck Island known to support 20 nesting Flatback Turtles per night (during an average year). As the nesting beach adjacent to Abbot Point is considered to be 'low density', it is not likely to be important or critical to the survival of Flatback Turtles populations in Queensland, but is likely to be ecologically important to individual turtles that return to this nesting beach in future. At a regional scale, the Abbot Beach has been identified as for medium significance for Flatback Turtle nesting (Hardy and Stoinescu, 2012).

Green Turtles within the Abbot Point area

Baseline and targeted turtle surveys have previously been undertaken within the Abbot Point area (Bell, 2003; GHD, 2009d; CDM Smith, 2013a; Hof and Bell, 2014).

A baseline turtle population dynamics study was undertaken in 2003 to identify areas of turtle nesting and foraging within Hay Point, Abbot Point and Lucinda Port areas (Bell, 2003). The 12 month study, including 336 search hours and 1 night of nesting turtle survey (for Abbot Point to Gloucester Island), identified the following results of relevance to the Abbot Point area:

- Three potential Green Turtle nesting tracks were recorded along the beach between Euri Creek and the existing coal loading facility at Abbot Point
- Four Green Turtles (three juveniles and one adult) were caught and released in the creek systems and associated protected coastal flats from Euri Creek to the mouth of the Don River
- Captured and released Green Turtles were in areas where low-density seagrass beds existed
- A single adult Green Turtle was recorded approximately 150m offshore and adjacent to the Abbot Point coal loading facility
- The Green Turtles identified in the Abbot Point area are thought to be associated with the southern GBR genetic stock
- More recent marine fauna surveys (GHD, 2009d) observed turtles within the coastal waters of Abbot Point including 76 observations of Green Turtles within water depths of between 1.1m and 14.9m, but no turtles were observed within the dredging footprint
- Turtle nesting was also recorded in the area with a total of four tracks recorded in November and seven in December 2008, although the tracks were not distinguishable between Flatback and Green Turtles.

CDM Smith (2013b) undertook surveys of turtle nesting sites over a walking transect extending for 6km south from the existing MOF located south of Abbot Point. The beach and

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adjacent foredunes were examined for nesting turtle tracks on 19/20 December 2012 and 29 January 2013. The suitability of beach habitat for turtle nesting was also determined. A summary of the results is provided below:

- Evidence of limited marine turtle nesting was recorded in December 2012, with 11 sets of tracks recorded over the transect length
- Tracks were found at southern most extent of transect indicating that nesting may occur further south of the survey area
- Three sets of tracks appeared to result in a successful nesting attempt
- Six tracks could be attributed to a specific species: five being Flatback Turtles and one being a Green Turtle
- Two examples of hatchling emergence were recorded but could not be attributed to a specific species
- The first tracks were located 2.2km south of the MOF and others within the stretch of beach 1.4km south of this
- No evidence of nesting or hatching emergence was recorded in January 2013; however, ex-Tropical Cyclone Oswald occurred a week prior to the survey and may have impacted hatchling emergence through high inundation levels
- Both the December and January surveys indicated a concentration of marine turtles (including Green Turtles, Loggerhead Turtles and Flatback Turtles) associated with the rocky reef that extends ~2.5km south of the MOF - an indicative estimate of 16 to 25 turtles using this area was made.

Most recently, in December 2014, an aerial survey (using a Robinson 44 rotating wing helicopter) of turtle nesting track data and predator activity was undertaken over the Whitsunday-Burdekin-Townsville region (between Euri Creek and Magnetic Island; Hof and Bell, 2014). Data were supported by ground-truthed nesting data collected by community groups. Key findings of the survey included:

- Flatback and Green Turtle nesting occurs along the majority of the Whitsunday-Burdekin-Townsville coastline
- Higher density nesting occurs on mainland coastal beaches including Rita Island (51 tracks), Paradise Bay (22 tracks) and Abbot Point (21 tracks) respectively
- Wunjunga Beach was found to support regionally high density nesting of Flatback Turtles
- A regional density of 185 Flatback and Green Turtle nesting attempt tracks were recorded, with the majority identified as Flatback Turtles
- Predator tracks (primarily pig) were identified on mainland coastal beaches at Abbot Bay, Abbot Point, eastern Cape Upstart, Rita Island, Bowling Green Bay/eastern coast of Cape Cleveland, AIMS beach and Paradise Bay
- Overlapping turtle nesting and predator activity indicative of 'hot spots' for further investigation included Rita Island, the eastern beaches of Cape Cleveland particularly Paradise Bay, Abbot Bay including Abbot Point.

Importance of Abbot Point Green Turtle population and habitat

Abbot Point has not been identified as a key nesting or inter-nesting area for Green Turtles. The Abbot Point area is not considered a major nesting rookery in Queensland and therefore is not critical to the survival of Green Turtle populations. Abbot Point is within the region considered by the GBRMPA as a high priority foraging area (Upstart Bay to Midge Point; Dobbs *et al.*, 2007).

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There is no known critical or important habitat for Green Turtles present within the Abbot Point area or region, as defined in the Recovery Plan for marine turtles in Australia (Environment Australia, 2003).

Abbot Point is known to provide foraging and nesting habitat for Green Turtles. CDM Smith (2013b) identified the Abbot Point area as having “*nesting habitat suitable with appropriate beach access and access to the supra-littoral zone for marine turtles. Not a known turtle rookery but low density nesting previously recorded or highly likely*”. During their surveys in December 2012/January 2013 they identified parts of the supra-littoral area which contained Coastal She-Oak as potentially compromising nesting success due to its extensive and dense root systems prohibiting digging. High abundances of Green Turtles have not previously been recorded in the area.

The level of nesting observed at Abbot Point for Green Turtles is considered to be ‘low-density’ when compared with other known turtle rookeries in Queensland, such as North-West Island which is known to support approximately 700 nesting Green Turtles (over a two-week period in 1999). Given that the nesting beach adjacent to Abbot Point is considered to be ‘low density’, it is not likely to be critical to the survival of Green turtle populations in Queensland. However, Bell (2003) states that the Abbot Point area provides an important mainland nesting habitat in North Queensland. It is likely to be ecologically important to individual turtles that return to this nesting beach in future as marine turtles show fidelity to their natal nesting beaches. In addition, these low density nesting areas may make important reproductive contributions, particularly if they produce a disproportionate number of female hatchlings compared to island beaches with higher nesting densities (CDM Smith, 2013a). At a regional scale, the Abbot Beach has been identified as low significance for Green Turtle nesting and medium significance for Flatback Turtle nesting (Hardy and Stoinescu, 2012). However, the site should be considered as locally important due to the points raised above.

Areas of seagrass and algal communities that occur within the inshore and offshore areas of Abbot Point provide foraging habitat for Green Turtles. The area is within a region identified as ‘high priority’ foraging habitat for Green Turtles within the GBRMP. The region extends from Upstart Bay to Midge Point, and covers a total area of 765.9km² (Dobbs *et al.*, 2007).

Hawksbill Turtles within the Abbot Point area

Previous marine fauna surveys undertaken at Abbot Point (GHD, 2009d) observed turtles within the coastal waters of Abbot Point including 3 observations of Hawksbill Turtles within water depths of 3m. No turtles were observed in the dredging footprint.

Importance of Abbot Point Hawksbill Turtle population and habitat

There is no known critical or important habitat (as defined in the Recovery Plan for Marine Turtles in Australia, Environment Australia, 2003) for Hawksbill Turtles present within the Abbot Point area or region. There is no known nesting in the area. No nesting activity is recorded from the Abbot Point region and only one Hawksbill Turtle nesting event has been recorded in the last 70 years in the GBR south of Princess Charlotte Bay (Limpus, 2009).

The Hawksbill turtle may potentially use the project area for foraging. Areas of seagrass and algal communities that occur within the inshore and offshore areas of Abbot Point provide foraging habitat for Hawksbill Turtles.



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Table 4-28 Flatback, Green and Hawksbill Turtles - significant impact criteria

Significant impact criteria (vulnerable species)	Flatback Turtle	Green Turtle	Hawksbill Turtle
Lead to a long-term decrease in the size of an important population of a species	<p>No significant impact likely - Low numbers of Flatback and Green Turtles have been recorded foraging and nesting within the project area; however, the area is not known to support a regionally important population. The Project may have some short-term localised impacts during dredging and returning water to the small numbers that forage in the area, but these impacts are unlikely to cause a long-term decrease in the population.</p> <p>Vessel collision is not considered likely as the dredging vessel will be stationary during dredging, onsite for a short period of time and turtles are highly mobile and able to avoid slow moving vessels. The residual risk of boat strike is low.</p>	<p>No significant impact likely - Hawksbill Turtles have been recorded foraging in the project area, but do not nest in the area. Turtles occurring in the vicinity of the Project do not constitute a geographically distinct regional population or local population that occurs within a particular bioregion.</p> <p>The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in this species.</p> <p>Vessel collision is not considered likely as the dredging vessel will be stationary during dredging, onsite for a short period of time and turtles are highly mobile and able to avoid slow moving vessels. The residual risk of boat strike is low.</p>	
Reduce the area of occupancy of an important population	<p>No significant impact likely - Flatback and Green Turtles are widely distributed throughout the region and in tropical Australia. The Project would not reduce the area of occupancy of the species in any ecologically meaningful way.</p> <p>The Abbot Point area is not considered a major nesting rookery in Queensland, as the level of nesting is considered ‘low density’ and therefore is not critical to the survival of Green or Flatback Turtle populations.</p> <p>Abbot Point is within the region considered by GBRMPA as a high priority foraging area for Green Turtles (Upstart Bay to Midge Point).</p> <p>Off-site impacts on water quality are</p>	<p>No significant impact likely - There is no known critical or important habitat (as defined in the Recovery Plan for Marine Turtles in Australia, Environment Australia 2003) for Hawksbill Turtles present within the Abbot Point area or region.</p> <p>There is no known nesting in the area. No nesting activity is recorded from the Abbot Point region and only one Hawksbill turtle nesting event has been recorded in the last 70 years in the GBR south of Princess Charlotte Bay (Limpus, 2009).</p> <p>The Hawksbill Turtle may potentially use the project area for foraging. Areas of seagrass and algal</p>	



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**Significant
impact criteria
(vulnerable
species)**

Flatback Turtle

Green Turtle

Hawksbill Turtle

expected to be short-term and localised to the dredging area and returning water location. Such impacts will not reduce the area of occupancy of the species. The residual risk to water quality is low.

Predicted underwater noise levels from the dredging vessel (the loudest source of noise relating to the Project), are expected to be highly localised. The maximum distance that may cause behavioural changes in megafauna is <3km (as a conservative estimation) and for a short duration. PTS and TTS thresholds are highly localised (<10m and between 10 to 60m respectively) and require long exposure times.

Given the large distribution range of Flatback and Green Turtles and the small area of the Project it is unlikely underwater noise will have a significant impact to individuals using the project area. The residual risk of underwater noise is low.

Impacts of lighting on nesting activities are expected to be small due to the low numbers of Green Turtles recorded to nest in this area. The residual risk of lighting is low.

communities that occur within the inshore and offshore areas of Abbot Point provide foraging habitat for Hawksbill turtles.

The majority of foraging habitat (seagrass and algal communities) is unlikely to be impacted by the Project. The Project will have a direct impact on <0.04% of the available seagrass habitat in the region. Hawksbill Turtles forage on seagrass beds, among other benthic habitats. The residual risk of habitat loss is low.

**Fragment an
existing
important
population**

No significant impact likely - Marine turtles are highly mobile and the Project would not create any barriers to the movement of individuals.

**Adversely affect
habitat critical
to the survival
of a species**

No significant impact likely - The seagrass habitat within the dredging footprints will be directly impacted by removal. The Project will have a direct impact on <0.04% of the available seagrass habitat in the region. Given the low number of Green and Flatback Turtles

No significant impact likely - There is no known critical or important habitat for Hawksbill Turtles present within the Abbot Point area or broader region.



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**Significant
impact criteria
(vulnerable
species)**

Flatback Turtle

Green Turtle

Hawksbill Turtle

observed at Abbot Point this is unlikely to have a significant impact. The residual risk of habitat loss is low.

There is no known critical or important habitat for Green Turtles present within the Abbot Point project area or region, as defined in the Recovery Plan for marine turtles in Australia (Environment Australia, 2003). Abbot Point is known to provide foraging and nesting habitat for Green Turtles. However, high abundances of Green Turtles have not previously been recorded in the area.

**Disrupt the
breeding cycle
of an important
population**

No significant impact likely - The Abbot Point area is not considered a major nesting rookery in Queensland, as the level of nesting is considered 'low density' and therefore is not critical to the survival of Green or Flatback Turtle populations. Green and Flatback Turtles nest annually on Abbot Point beach to the east of the existing terminal. The turtle nesting period is from early November to March. Peak hatching is triggered by temperature conditions and generally occurs in December and January. Dredging will occur over 3km to the north-west of Abbot Point beach where turtles are found to nest; any plume will not impact on the nesting beach area or surrounds. The use of a CSD will further reduce impacts as turtles are less likely to be caught (sucked) into the dredge head compare to the TSHD type dredge. Impacts due to lighting during the hatching season will be managed to ensure turtle hatchlings which emerge during December and January are not adversely impacted upon. The residual risk of lighting is low

No significant impact likely - This species is not known to nest in the Abbot Point region; the Project is not considered to disrupt the breeding cycle of the population.

Modify, destroy,

No significant impact likely - Foraging and nesting habitat will be impacted



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Significant impact criteria (vulnerable species)	Flatback Turtle	Green Turtle	Hawksbill Turtle
remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	(direct loss and disturbance) through modification and/or removal by the development Project and dredging activities. Habitat in the project area is not generally considered as optimal in comparison with other areas in the region. The amount of potential seagrass habitat permanently removed (10.5ha) is considered a minute proportion (less than 0.04%) of the total available potential seagrass habitat that exists in the Abbot Point region. This loss is unlikely be of sufficient scale to cause the species to decline, as other suitable (more optimal) habitat is available in the wider Abbot Point region to the north and south. The residual risk of habitat loss is low.		
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	No significant impact likely - It is considered unlikely that the Project will introduce an invasive species that will cause turtle species to decline. Relevant management measures will be in place, in accordance with Australian legislation, that minimise the likelihood of introduced species (e.g. from ballast water) being introduced into Australian waters. The residual risk of the introduction of marine pests is low.		
Introduce disease that may cause the species to decline	No significant impact likely - It is considered unlikely that the Project will introduce a disease to the population that will cause turtle species to decline. As per introduced species above, management measures will be in place that are consistent with the requirements of Australian legislation. The residual risk of the introduction of disease is low.		
Interfere substantially with the recovery of the species	No significant impact likely - There is a recovery plan in place for marine turtles in Australia. Whilst the area supports some foraging habitat for all three species, it is not considered critical habitat for the survival and recovery of any of these species. Habitat usage for foraging appears low and no nesting has been observed, particularly in comparison to other areas in the region. The Project will have a direct impact on <0.04% of the available seagrass habitat in the region. Mitigation measures incorporated within the Outline DMP, which are consistent with the recovery plan, include vessel speed limits and artificial light abatement strategies. Based on these findings and management measures, the Project is not expected to interfere with the recovery of these species. The residual risk of habitat loss is low.		



4.5.5.5 Giant Manta Ray (*Manta birostris*)

Giant manta rays within the Abbot Point area and importance for population and habitat

Two Giant Manta Rays were opportunistically recorded during the marine megafauna surveys that occurred at Abbot Point from 2008 to 2009 (Figure 3-23). These were observed to be feeding over relatively shallow habitats of 2.6m to 7m depth. However, the project area is not considered an aggregation site or an area that contains breeding or important feeding areas for the Manta Ray.

Significant impact criteria (migratory species)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- **Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species**

No significant impact likely - The Giant Manta Ray is commonly encountered in small groups, near the surface around offshore islands and reefs in the pelagic environment feeding on plankton. Abbot Point is located in a nearshore turbid environment not likely to be an important feeding or aggregation area for Giant Manta Rays. The residual risk of habitat loss is low.

-
- **Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species**

No significant impact likely - It is considered unlikely that the Project will introduce an invasive species that will cause the species to decline. Relevant management measures will be in place, in accordance with Australian legislation, that minimise the likelihood of introduced species (e.g. from ballast water) being introduced into Australian waters. The residual risk of the introduction of marine pests or disease is low.

-
- **Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) or an ecologically significant proportion of the population of a migratory species**

No significant impact likely - Abbot Point is not an important feeding or aggregation area for Giant Manta Rays. Two Giant Manta Rays were observed opportunistically feeding during surveys in 2008 and 2009. This number is low, indicating this area is not an important area of habitat for Giant Manta Rays, which are more commonly found in the pelagic environment. Dredging activities will be temporary and short-term, and the dredge is effectively stationary during operation. There will be no dredge movements to offshore dredged material relocation grounds reducing the likelihood of vessel interactions with Giant Manta Rays. The residual risk of boat strike is low.

Underwater noise levels predicted by the modelling may cause a behavioural response where the Giant Manta Rays may move further away from activities. The residual risk of underwater noise is low.



4.5.6 Summary

The project area is located adjacent to the GBRMP and Commonwealth marine areas. However, analysis of the values present indicates that the project area does not constitute a unique or important contribution to these sites beyond being part of the overall range of habitats and ecological zones represented.

Abbot Point's port limits are known to provide habitat for a number of threatened species, with additional species likely or potentially occurring:

- One threatened marine mammal species (Humpback Whale)
- Three migratory marine mammal species (Australian Snubfin Dolphin, Indo-Pacific Humpback Dolphin and Dugong)
- Five threatened marine turtle species (Green, Hawksbill, Olive Ridley, Loggerhead and Flatback Turtles).

The project area does not support important populations of any of these species and does not contain habitat critical to the survival of these species. The project area has not been identified in recovery plans for Marine Turtles or Humpback Whales. As such, the Project is not likely to result in a significant impact on a listed threatened or marine migratory species.

However, in line with the recovery plans for these species, mitigation measures incorporated within the Project EMP and DMP including vessel speed limits and artificial light abatement strategies, the Project is considered unlikely to interfere with the recovery of these species.

The Project is expected to have temporary and permanent impacts to the marine environment at Abbot Point. Where low or moderate impacts have been identified, mitigation measures are provided to minimise effects to the project area and adjacent waters. With the implementation of the Outline DMP no residual significant impact to MNES is expected.

4.6 Impacts on Matters of National Environmental Significance - World and National Heritage

The Project is located both within and adjacent to the GBRWHA. The boundaries and heritage attributes of the area are the same as those for the National Heritage Place, and as such it is appropriate to assess the EPBC Act controlling provisions of World and National Heritage together.

As a World Heritage Area, the GBRWHA is recognised under the *World Heritage Convention* as having Outstanding Universal Value. The concept of Outstanding Universal Value is defined in the *Operational Guidelines for the Implementation of the World Heritage Convention* (UNESCO, 2013) as “cultural and/or natural significance, which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity”.

**Section 4****Environmental Impacts****4.6.1 Approach to impact assessment**

As outlined in Section 3.2.3 and Section 3.2.6, the Abbot Point CIA found that 3 of the 29 natural heritage attributes identified by Lucas *et al.* (1997) were identified as being relevant to Abbot Point. These are:

- Aesthetics
- Birds
- Marine mammals.

It is important to note that the Abbot Point CIA also found that “*while a number of other natural heritage attributes are present within the vicinity of the project area (e.g. marine turtles, seagrass and mangroves)*”, it was considered that “*they were not present at a scale or value that was relevant to the GBRWHA as a whole*”.

This assessment of potential project impacts to the GBRWHA has:

- Considered the risk identified in the Project’s environmental risk register as relevant to the MNES controlling provisions of the GBRWHA and National Heritage Place
- Focussed on the previously identified key World Heritage attributes that are present at Abbot Point and potentially impacted by the Project
- Assessed the potential project impacts to World Heritage values based on the significant impact guidelines, and assessed relevant additional matters of:
 - Water Quality of the GBR (consistent with the Reef 2050 Plan)
 - Habitat important for the conservation of biological diversity in a World Heritage property (specifically sea-grass impacts).

Consequential (and related) impacts associated with the T0 Terminal construction and operation are separately discussed in Section 6.

4.6.2 Risk assessment

A risk assessment approach has been applied to assess environmental impacts associated with the Project. The approach is described in detail in Section 4.1.

The risk assessment broadly examined all project activities to flag those activities with potential to have an adverse impact on all MNES, ensuring that the subsequent detailed assessment of impacts on MNES accounted for all potentially impacting activities.

It should be noted that the assessed environmental risk ratings are not a direct reflection of the level of risk to relevant MNES. However, they are relevant for consideration in the subsequent assessment of the significance of project impacts to MNES.

Those activities with a moderate or greater unmitigated risk are further considered in relation to significance of impacts to MNES. For World and National Heritage, the relevant activities are:

- Offshore dredging and dredged material dewatering that causes the mobilisation of sediment, resulting in turbidity plumes and potentially affecting light-dependent species, filter feeders and having potential flow-on effects to higher tropic groups, including marine mammals.
- Dredging resulting in the mechanical removal of benthic communities inhabiting the seabed within the dredging footprint, including seagrass.



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- Onshore construction activities such as earthworks that may increase sediment and nutrient loading into Caley Valley Wetlands, and subsequently to the marine environment.
- Onshore construction activities such as earthworks that may directly disturb migratory shorebirds in the Caley Valley Wetlands through noise, light and dust generation, or impact on the quality of habitat within the wetland through the addition of sediment and nutrients in stormwater. Potential indirect impacts of these activities are associated with weed and pest introduction to the wetland which may degrade habitat quality.
- Alterations in surface water and groundwater conditions from the presence of the DMCP with consequent impacts on wetland habitats.
- Accidental contaminant spills (hydrocarbons) that may enter the wetland and impact water quality and degrade habitat for wetland birds.

These activities are examined in detail in the marine, aquatic and terrestrial ecology technical reports (**Appendices D, H and I** respectively) to determine the likelihood of there being significant residual impacts on the GBRWHA as a result of project activities in accordance with significant impact guidelines.

4.6.3 Significant impact guidelines

The *Significant Impact Guidelines 1.1* (DoE, 2013a) identify that an action is likely to have a significant impact on the World Heritage values of a declared World Heritage property if there is a real chance or possibility that it will cause:

- One or more of the World Heritage values to be lost
- One or more of the World Heritage values to be degraded or damaged, or
- One or more of the World Heritage values to be notably altered, modified, obscured or diminished.

The guidelines provide an extensive (but not exhaustive) list of impacts by which to assess whether an action is likely to have a significant impact on natural heritage values of a World Heritage property as follows:

Impact on the values associated with geology and landscape in such a way as to:

- Damage, modify, alter or obscure important geological formations in a World Heritage property
- Damage, modify, alter or obscure landforms or landscape features, for example, by excavation or infilling of the land surface in a World Heritage property
- Modify, alter or inhibit landscape processes, for example, by accelerating or increasing susceptibility to erosion, or stabilising mobile landforms, such as sand dunes, in a World Heritage property
- Divert, impound or channelise a river, wetland or other water body in a World Heritage property
- Substantially increase concentrations of suspended sediment, nutrients, heavy metals, hydrocarbons, or other pollutants or substances in a river, wetland or water body in a World Heritage property.

Impact on Biological and Ecological Values in such a way as to:

- Reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property



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- Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property
- Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property, and
- Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property.

Each World Heritage value is assessed against the relevance to the project area and if relevant the scale of potential impacts on these values are presented in Table 4-29.

Table 4-29 World Heritage Values and potential project-related impacts

World Heritage Value	Relevance to Project Area	Potential Impacts on GBRWHA Values
Geology and landscape		
Damage, modify, alter or obscure important geological formations in a World Heritage property	Not applicable	
Damage, modify, alter or obscure landforms or landscape features, for example, by excavation or infilling of the land surface in a World Heritage property	Not applicable	
Modify, alter or inhibit landscape processes, for example, by accelerating or increasing susceptibility to erosion, or stabilising mobile landforms, such as sand dunes, in a World Heritage property	Not applicable	
Divert, impound or channelise a river, wetland or other water body in a World Heritage property, and	Not applicable	
Substantially increase concentrations of suspended sediment, nutrients, heavy metals, hydrocarbons, or other pollutants or substances in a river, wetland or water body in a World Heritage property	Dredging and return water release sediments into the water column	Section 4.6.4.2
Biological and ecological Values		
Reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property	Birds, Marine mammals and seagrass	Section 4.6.3 Section 4.6.4 Section 4.6.4.3



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World Heritage Value	Relevance to Project Area	Potential Impacts on GBRWHA Values
Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property	Seagrass	Section 4.6.4.3
Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property, and	Birds, marine mammals and seagrass	Section 4.6.3 Section 4.6.4 Section 4.6.4.3
Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property	seagrass	Section 4.6.4.3

4.6.4 Assessment of impacts on World and National Heritage

4.6.4.1 Aesthetic attributes

Within the context that Abbot Point is not considered to encompass areas of exceptional natural beauty (Cardno Chenoweth, 2012), impacts on the aesthetic attributes of the GBRWHA may arise from the potential for the Abbot Point Project to influence the community appreciation of the landscape within the region. Potential impacts to superlative natural phenomena are discussed below in relation to bird and marine mammals.

The Project will involve the use of a stationary CSD, dredged material pipeline to the DMCP, and a return water pipeline to the marine environment. All activities will be undertaken within port limits or coastal areas adjacent to the existing port terminal. The impact on visual amenity arising from the Project is assessed to be minor due to the following factors:

- There are no mainland close-range views, and offshore views at close-range are limited to occasional boating use. These views are from within designated port limits waters and the shipping channel where views currently include the existing port and trestle
- There are no residential areas nearby with views of the project area
- The proposed infrastructure is limited to a temporary and stationary dredge plant and pipelines
- Project elements will only be in place for short periods of time
- Potential impacts are considered to be minor, and in keeping with the existing visual amenity, uses and community expectations.

4.6.4.2 Birds

The terrestrial ecology technical report (ELA, 2015 - **Appendix P1**) addresses impacts of the Project on waterbirds within the Caley Valley.

Lucas *et al.* (1997) noted that areas of international importance for migratory shorebirds located both adjacent to and within the World Heritage Area are important natural heritage



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attributes of the GBRWHA. Whilst the Caley Valley Wetlands is not located within the World Heritage Area, it is a significant aggregation site for migratory shorebirds and other waterbirds.

Relevant aspects of the Caley Valley Wetlands in the context of assessing potential impacts on World Heritage values associated with birds include (ELA and Open Lines, 2012):

- Location of the wetland adjacent to the World Heritage Area, allowing connectivity between the two, which is an important ecological process (Criterion 9 of UNESCO, 2013)
- The presence of threatened species such as the Australian Painted Snipe, which contribute to the *in situ* conservation of diversity (Criterion 10 of UNESCO, 2013).
- Aggregations of large numbers of birds over the wet season and summer months can be considered superlative natural phenomenon (Criterion 7 of UNESCO, 2013).

Connectivity

The project area is located outside of the Caley Valley Wetlands and there will be no modification or alienation of the wetland as a result of Project construction activities. While there will be some clearing of grazing land adjacent to the wetland, this will not result in significant fragmentation of the landscape or influence the existing connectivity between the wetland and adjacent parts of the GBRWHA. Project activities will not alter the existing hydrological function of the wetland, which contributes to its ecological value as waterbird habitat.

Threatened species

The continued presence of threatened waterbird species at the Caley Valley Wetlands is an important objective in maintaining the *in situ* conservation of diversity and associated World Heritage Values. The wetland is important habitat for several migratory and resident shorebird species and supports populations of birds that are ecologically significant. Additionally, some species are observed irregularly at the wetland in small numbers, and contribute to local diversity and species richness when they are present.

A detailed assessment of the impacts of the Project on threatened and migratory bird species was provided in Section 3.2 and Section 4.3.7. The assessment concluded that there will be no direct impacts of the Project on the habitats of waterbird species utilising the wetland. While off-site impacts are possible from noise, dust and light, the magnitude of these impacts, even when considered cumulatively with those of other projects, are temporary and are considered to be low and not significant from an EPBC Act perspective. Measures in place to reduce impacts on threatened species utilising the wetland will also benefit species that are common and contribute to World Heritage values.

Bird aggregations

The ephemeral nature of the Caley Valley Wetlands and seasonal migration of shorebirds to the region creates significant variability in the number and species of waterbirds present. Large parts of the wetland can remain dry and largely devoid of waterbird activity for many continuous months. However, the onset of wet seasonal conditions, combined with the arrival of migratory shorebirds, can create a significant aggregation of waterbirds with in excess of 48,000 individuals (BAAM, 2012). Many resident species breed during this time,

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building nests in a variety of wetland-dependent habitats such as sedges, reeds and floating vegetative masses.

The Project will not affect the values of the Caley Valley Wetlands in relation to the aggregation of a significant number of waterbirds. While it is possible that construction works will be undertaken during a period when the wetland is full and migratory shorebirds are present, there will be no direct impact or disturbance of the wetland habitats. Off-site impacts from dust, noise and light may temporarily influence the behaviour of waterbirds on the eastern fringe of the wetland, but the area affected (5.9% for PM₁₀ dust and 0.7% for TSP dust, up to 0.4% for noise) is small in comparison with the entire wetland complex (5,154ha). The Project will not influence the connectivity of waterways feeding into the wetland, which is an important driver of wetland conditions and resultant aggregations of birds following periods of high flow into the wetland.

4.6.4.3 Marine mammals

The Marine Ecology Technical Report (WorleyParsons, 2015a; **Appendix Q1**) addresses the impacts of the Project on marine mammals within the GBRWHA.

Based on available information, Abbot Point is not considered to support local or regionally important populations of Humpback Whales or Dugong. For Australian Snubfin or Indo-Pacific Humpback Dolphin there are no population estimates for the Abbot Point area, nor are there any confirmed national estimates for the two species. The lack of regional and national population data for both species makes it difficult to understand the importance of the population of Australian Snubfin and Indo-Pacific Dolphins in a broader context. Therefore, further detailed studies are required in order to understand whether Abbot Point provides important habitat or supports an ecologically significant proportion of the populations of these species.

However, impacts to marine mammals are not expected to be significant at either a local or GBRWHA scale due to:

- The short-term nature of the dredging for the Project
- The use of a stationary CSD eliminating the risks of vessel strike and greatly reducing both noise and sediment suspension
- The application of mitigation measures, including visual monitoring for marine fauna in immediate vicinity of the dredge.

4.6.4.4 Great Barrier Reef water quality**Offshore activities**

The proposed short-term (5 to 13 weeks) dredging program has been designed to minimise the potential for increases in sediment loads to the GBRWHA in line with the actions of the Reef 2050 Plan.

This has been achieved by adopting a dredging method that limits fugitive sediments entering the surrounding environment and transporting the dredged material to the DMCP for future beneficial use. The fugitive sediments from the dredging process have been assessed as suitable for ocean disposal, and do not contain contaminants or nutrients that would adversely impact on the marine environment.

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The current Project uses a CSD which draws sediments as a slurry into a pipeline and are then pumps this via the pipeline to the DMCP. The majority of sediments settle within the DMCPs and the remaining seawater is returned to the ocean. Return water from the DMCP will contain a proportion of suspended fine sediment which has been shown to quickly disperse within the receiving environment and within close proximity to the discharge point, where TSS levels are consistent with ambient conditions.

With all reasonable mitigation measures in place, the dredging process and return water from the DMCP will contribute approximately 16,680t of fine sediment to the marine environment at Abbot Point. To place the predicted sediment from the Project into a larger local context, the Burdekin and Don River catchments are currently estimated to contribute a combined 4,203,000t per year of TSS to the GBRWHA in this region (Kroon *et al.*, 2010).

The Reef 2050 Plan (Commonwealth of Australia, 2015) identifies dredging as a point source threat to GBRWHA water quality, and specifically references the support of on-land disposal or land reclamation for capital dredged material at Abbot Point as an action of the Plan. An objective of the Plan (WQ02) in relation to port activities is:

Over successive decades the quality of water in or entering the Reef from all sources including industrial, aquaculture, port (including dredging), urban waste and stormwater sources has no detrimental impact on the health and resilience of the Great Barrier Reef.

The Outlook Report 2014 (GBRMPA, 2014a) found the direct and flow-on effects of port activities, including dredging and the disposal of dredged material, generally occur in areas that are already under pressure from an accumulation of impacts. It also found that port activities have a significant localised effect, posing a relatively lower threat to the health of the broader World Heritage Area compared to, for example, the broad-scale impacts from land-based runoff. This is reflected in the current assessment which has determined that the impacts of the Project on the marine environment at Abbot Point do not exceed established criteria for significant residual impact at this location, and subsequently there no requirements for the provision of offsets under the EPBC Act.

The Reef 2050 Plan states that while offsets are focused on addressing residual impacts associated with development actions, net benefits are focused on delivering actions beyond offset actions which will restore or improve the GBR to a good condition. The purpose of net benefits is to enhance the condition of MNES, including the Reef's Outstanding Universal Value.

As such, the provision of a net benefit fund for actions that improve GBRWHA water quality via sediment management actions in the Burdekin and Don River catchments is proposed to ensure that the outcomes of the Project are consistent with the objectives and targets of the Reef 2050 Plan.

The relationship between project impacts, offsets and the goal of achieving a net benefit for GBRWHA water quality is discussed further in Section 5.2.

Onshore activities

As described in Section 3.1.9.3, the Caley Valley Wetlands provides a range of ecosystem services that support the Outstanding Universal Value of the GBRWHA. In particular, the wetland plays a key role in regulating catchment flows and pollutants from its catchment before discharging into the GBRWHA, and also contributes to fish biodiversity and fisheries

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values of the GBRWHA at a local scale. These ecosystem services are supported by coastal wetlands throughout the GBRWHA region.

The Project is not expected to result in significant effects to any of the local expressions of the Outstanding Universal Value of the GBRWHA at even highly localised spatial scales. Taking into account EPBC Act *Significant Impact Guidelines 1.1* (DoE, 2013a), significant residual impacts to the World Heritage Area aquatic ecological values supported by the wetland are not expected.

4.6.4.5 Seagrass

Lucas *et al.* (1997) identified seagrass areas as one of the 29 attributes that contribute the Outstanding Universal Value of the GBRWHA. The Abbot Point CIA found that *“while a number of other natural heritage attributes are present within the vicinity of the project area (including seagrass) it was considered that they were not present at a scale or value that was relevant to the GBRWHA as a whole”* (ELA and Open Lines, 2012).

However, given the presence and focus on seagrass meadows in previous assessments, further examination in relation to the World Heritage values of seagrass at Abbot Point has been undertaken.

The Marine Ecology Technical Report (**Appendix Q1**) details the characteristics of seagrass communities at Abbot Point and assesses impacts for seagrass as a result of the Project.

Seagrass distribution and abundance is naturally highly variable in the Abbot Point area, with the most recent surveys recording reduced areas (when compared to 2008) of low density, patchy areas of seagrass (McKenna and Rasheed, 2014). This indicates seagrass abundance in the Abbot Point area is not stable or currently present in high abundance.

Recent surveys found the seagrass communities growing in the dredging berth pocket footprint area were low density and patchy. Based on this, the proposed dredging of 10.5ha of this seafloor in the berth pockets is unlikely to have an adverse impact on marine ecosystem health, functioning or integrity.

Potential impacts of dredging outside of the dredging footprint to benthic communities are expected to be temporary. Plume influences on light attenuation are considered comparable to observed inter-seasonal variability. As such, the effects of the plume on light availability are not predicted to result in detectable losses of seagrass or have detectable impacts on potential seagrass habitat. Elevated sedimentation is not predicted to occur outside the dredging footprint.

Any temporary loss of potential seagrass habitat is likely to be reflected only at the local scale on the basis that Abbot Point does not provide high value seagrass habitat. Benthic habitats within the project area are not considered to have any unique ecological values compared to other areas of the GBR or Abbot Point.

Impacts to listed marine species (threatened and migratory) are assessed in Section 4.5. No significant direct or indirect impacts to MNES (which include rare, endemic or unique plant or animal populations or species) or other species that occur in the GBRWHA are expected to occur as a result of the Project.

Though the loss of 10.5ha of potential sparse and ephemeral seagrass habitat (less than 0.04% of the total available potential seagrass habitat in the Abbot Point region) is likely, the



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Project is not predicted to fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property that rely on seagrass.

The assessment of the impacts of the Project on marine ecology (Marine Ecology Technical Report, **Appendix Q1**) concludes that there are no significant residual impacts predicted for the Project on MNES within the GBRWHA and subsequently there is no requirement for environmental offsets under the EPBC Act. However, there are particular actions recommended in the Reef 2050 Plan to reduce impacts on GBR ecosystem health and restore reef resilience and ecosystem health (EHA18) with a target of ensuring key direct human related activities are managed to reduce cumulative impacts and achieve a net benefit for the Reef (EHT4).

Specifically, the Reef 2050 Plan states that while offsets are focused on addressing residual impacts associated with development actions, net benefits are focused on delivering actions (above and beyond offset actions) which will restore or improve the GBR to a good condition. The purpose of net benefits is to enhance the condition of MNES, including the Reef's Outstanding Universal Value.

As such, the provision of a net benefit fund for actions that improve GBRWHA water quality is proposed to ensure that the outcomes of the Project are consistent with the objectives and targets of the Reef 2050 Plan. This includes sediment management actions in the Burdekin and Don River catchments, with consequent benefits for seagrasses through a reduction in suspended solids in the nearshore marine environment.

The relationship between project impacts, offsets and the goal of achieving a net benefit for seagrasses within the GBRWHA is discussed further in Section 5.2).

4.6.4.6 Integrity

The Statement of Outstanding Universal Value for the GBRWHA (Lucas *et al.*, 1997) concludes (among other things) that:

- The integrity of the Reef is sound and is *“enhanced by the unparalleled size and current good state of conservation across the area”*
- Given the scale of the GBR *“most habitats or species groups have the capacity to recover from disturbance or withstand ongoing pressures”*.

It is considered highly unlikely for the integrity of the GBRWHA as a whole to be impacted by the Project. Given the scale of the GBR, it is not considered likely that the size of the Project alone would influence the integrity of the Reef. Rather, integrity would be more likely affected by a multitude of large-scale developments (particularly in greenfield sites) along substantial areas of the coast. This supports the expansion of Abbot Point as an existing industrial port as an appropriate way to increase export capacity and minimise impacts.



4.6.5 Summary

The Abbot Point CIA found that three of the 29 natural heritage attributes identified by Lucas *et al.* (1997) were identified as being relevant to Abbot Point. These included:

- Aesthetics
- Birds (including those present within the adjoining Caley Valley Wetlands)
- Marine mammals.

A risk assessment process was adopted to broadly examine all project activities to identify those activities with potential to have moderate or greater risk of impacting the natural heritage attributes of the GBRWHA.

These risks have been examined in detail in the marine, aquatic and terrestrial ecology technical reports to determine the likelihood of there being significant residual impacts on World Heritage values as a result of project activities in accordance with the relevant significant impact guidelines. In particular, the assessments focussed on the previously identified key World Heritage attributes present at Abbot Point and potentially impacted by the Project, as well as addressing water quality as an important factor of marine habitat quality, and seagrass values as a supporting habitat for a range of species.

The following points summarise the outcomes of the assessments based on technical reports for MNES and habitats supporting MNES that were undertaken specifically for the Project, and the results of previous assessments at Abbot Point:

- Potential impacts on aesthetics are considered to be minor, and in keeping with the existing visual amenity, uses and community expectations of Abbot Point
- There will be no modification or alienation of bird habitat within the Caley Valley Wetlands as a result of Project construction activities, and the Project will not fragment the landscape or influence the existing connectivity between the wetland and adjacent parts of the GBRWHA
- Project activities will not alter the existing hydrological function of Caley Valley Wetlands, which contributes to its ecological value as waterbird habitat
- Impacts to marine mammals are not expected to be significant at either a local or GBRWHA scale due to the short-term nature of the Project's dredging activities, the use of a stationary CSD and the application of mitigation measures to avoid contact with marine fauna
- The proposed short-term (5 to 13 weeks) dredging program has been designed to minimise the potential for increases in sediment loads to the GBRWHA in line with the goals of the Reef 2050 Plan
- With all reasonable mitigation measures in place, the dredging process and return water from the DMCP will contribute 16,680t of fine sediment to the marine environment at Abbot Point
- The current assessment has determined that the impacts of the Project on the marine environment at Abbot Point do not exceed established criteria for significant residual impact at this location, and subsequently there are no requirements for the provision of offsets under the EPBC Act
- The provision of a net benefit fund for actions that improve GBRWHA water quality via sediment management actions in the Burdekin and Don River catchments is proposed to ensure that the outcomes of the Project are consistent with the objectives and targets of the Reef 2050 Plan

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- Recent surveys found the seagrass communities growing in the dredging berth footprint area were low density and patchy, and as such the proposed dredging of 10.5ha of this seafloor is unlikely to have an adverse impact on marine ecosystem health, functioning or integrity
- The assessment of the impacts of the Project on marine ecology concludes that there are no significant residual impacts predicted for the Project on MNES within the GBRWHA and subsequently there is no requirement for environmental offsets under the EPBC Act
- The Reef 2050 Plan includes a target of ensuring key direct human related activities are managed to reduce cumulative impacts and achieve a net benefit for the Reef
- The provision of a net benefit fund is proposed for actions to ensure the outcomes of the Project are consistent with the objectives of the Reef 2050 Plan - this includes through implementation of sediment management actions in the Burdekin and Don River catchments to reduce suspended solids in the nearshore marine environment.

Overall the impacts from the Project on the values of the GBRWHA Area and National Heritage Place are localised and are mostly temporary in nature. With the proposal to achieve a net benefit for water quality and seagrass in the region, overall it is considered highly unlikely for there to be a loss of Outstanding Universal Value or decline in integrity of the GBRWHA as a result of the Project.

4.7 Impacts on Matters of National Environmental Significance - Great Barrier Reef Marine Park

The GBRMP encompasses approximately 345,400km² and is a multiple-use area in which a wide range of activities and uses are allowed, including extractive industries. A multiple-use zoning system has been implemented with the aim of minimising impacts and conflicts through providing high levels of protection for specific areas. Zoning designations provide for management and protection of the values of the GBRMP. In designated zones of the GBRMP, activities including shipping, aquaculture, tourism and research (among others) are allowed to occur in a controlled manner. The General Use Zone provides for reasonable use of the Marine Park while still allowing for conservation of these areas.

Dredging associated with the Project will occur within the operational port limits, which are excised from, but adjacent to, the Marine Park (refer to Figure 3-27).

4.7.1 Approach to impact assessment

This assessment of potential project impacts to the Marine Park has:

- Considered the risk identified within the Project's environmental risk register as relevant to the MNES controlling provisions of the GBRMP
- Assessed the potential project impacts to Marine Park values based on the significant impact guidelines, including consideration of assessed relevant matters of:
 - Nutrients and sediments from runoff
 - Increase sediments as a result of dredging activities
 - Noise and physical impacts to threatened and migratory species
 - Supporting terrestrial habitat that may be modified.

Consequential (related) impacts associated with T0 construction and operation are separately discussed in Section 6.



4.7.2 Risk assessment

A risk assessment approach has been applied to assess environmental impacts associated with the Project. The approach is described in detail in Section 4.1.

The risk assessment broadly examined all project activities to flag those activities with potential to have an adverse impact on all MNES, ensuring that the subsequent detailed assessment of impacts on MNES were accounted for in all potentially impacting activities.

It should be noted that the assessed environmental risk ratings are not a direct reflection of the level of risk to relevant MNES. However, they are relevant for consideration in the subsequent assessment of the significance of project impacts to MNES.

Those activities with a moderate or greater unmitigated risk are further considered in relation to significance of impacts to MNES. Those activities identified as potentially impacting on the Marine Park are:

- Offshore dredging and dredged material dewatering that causes the mobilisation of sediment, resulting in turbidity plumes and potentially affecting light-dependent species, filter feeders and having potential flow-on effects to higher tropic groups, including marine mammals.
- Dredging resulting in the mechanical removal of benthic communities inhabiting the seabed within the dredging footprint, including seagrass.
- Onshore construction activities such as earthworks that may increase sediment and nutrient loading into Caley Valley Wetlands, and subsequently to the marine environment.
- Onshore construction activities such as earthworks that may directly disturb migratory shorebirds in the Caley Valley Wetlands through noise, light and dust generation, or impact on the quality of habitat within the wetland through the addition of sediment and nutrients in stormwater. Potential indirect impacts of these activities are associated with weed and pest introduction to the wetland that may degrade habitat quality.
- Alterations in surface water and groundwater conditions from the presence of the DMCP with consequent impacts on wetland habitats.
- Accidental contaminant spills (hydrocarbons) that may enter the wetland and impact water quality and degrade habitat for wetland birds.

These activities are examined in detail in the Marine, Aquatic and Terrestrial Ecology technical reports (appendices **D**, **H** and **I** respectively) to determine the likelihood of there being significant residual impacts on the Marine Park as a result of project activities in accordance with the significant impact guidelines.

4.7.3 Significant impact guidelines

The *Significant Impact Guidelines 1.1* (DoE, 2013a) identify that an action is likely to have a significant impact on the environment of the GBRMP if there is a real chance or possibility that the action will:

- a) Modify, destroy, fragment, isolate or disturb an important, substantial, sensitive or vulnerable area of habitat or ecosystem component such that an adverse impact on marine ecosystem health, functioning or integrity in the GBRMP results



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- b) Have a substantial adverse effect on a population of a species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution
- c) Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological health or integrity or social amenity or human health
- d) Result in a known or potential pest species being introduced or becoming established in the GBRMP
- e) Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, or social amenity or human health may be adversely affected
- f) Have a substantial adverse impact on heritage values of the GBRMP, including damage or destruction of an historic airplane wreck.

The Project has been assessed against the significance criteria. Table 4-30 provides the relevant cross-references to the individual assessment aspects.



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Table 4-30 Significant impact criteria and potential impacts on the GBRMP

Significant Impact Criteria	Relevance to Project	Potential Impacts on GBRMPA values
Modify, destroy, fragment, isolate or disturb an important, substantial, sensitive or vulnerable area of habitat or ecosystem component such that an adverse impact on marine ecosystem health, functioning or integrity in the GBRMP results.	Seagrass Benthic communities Caley Valley Wetlands	Section 4.7.4
Have a substantial adverse effect on a population of a species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution.	Marine mammals	Section 4.7.4.2 and Section 4.7.4.7
Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological health or integrity or social amenity or human health.	Seagrass Caley Valley Wetlands	Section 4.7.4.3
Result in a known or potential pest species being introduced or becoming established in the GBRMP.	Marine pests	Section 4.7.4.4
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, or social amenity or human health may be adversely affected.	Marine contamination	Section 4.7.4.5
Have a substantial adverse impact on heritage values of the GBRMP, including damage or destruction of an historic shipwreck.	Catalina wreck	Section 4.7.4.6



4.7.4 Assessment of impacts on the Great Barrier Reef Marine Park

4.7.4.1 Habitat and ecosystem components

Offshore activities

Dredging will occur outside the Marine Park and stochastic plume modelling (incorporating deep ocean current circulation) indicates that sediment migration will be highly localised from the dredging site and will not significantly affect the Marine Park. The proposed use of a CSD significantly reduces the extent of plume generated during dredging, with the majority of fine sediment being pumped ashore for settling and treatment. There will be no disposal of dredging spoil in the Marine Park.

Seagrass distribution and abundance is naturally highly variable in the Abbot Point area, with the most recent surveys recording reduced areas (when compared to 2008) of low density, patchy areas of seagrass (McKenna and Rasheed, 2014), indicating seagrass abundance in the Abbot Point area is not stable or currently present in high abundance.

Recent surveys found the seagrass communities growing in the dredging berth pocket footprint area (which is located outside the Marine Park) were low density and patchy. Based on this, the permanent removal of 10.5ha of this seafloor in the berth pockets is unlikely to have an adverse impact on marine ecosystem health, functioning or integrity. It amounts to less than 0.04% of the total available potential seagrass habitat in the Abbot Point region.

Potential indirect impacts to benthic communities as a result of project activities are expected to be temporary and may extend into the Marine Park. Plume influences on light attenuation are considered comparable to observed inter-seasonal variability. As such, the effects of the plume on light availability are not predicted to result in detectable losses of seagrass or have detectable impacts on potential seagrass habitat. Elevated sedimentation is not predicted to occur outside the dredging footprint.

Onshore activities

As described in Section 3.1.9.3, the Caley Valley Wetlands provides a range of ecosystem services. In particular, the wetland plays a key role in regulating catchment flows and pollutants from its catchment before discharging to the marine environment, and also contributes to fish biodiversity and fisheries values at a local scale. These ecosystem services are supported by coastal wetlands throughout the Marine Park.

The Project is not expected to result in significant marine ecosystem health, functioning and integrity impacts at even highly localised spatial scales. Significant residual impacts to aquatic ecological values supported by the wetland are not expected.

The project area is located outside of the Caley Valley Wetlands and there will be no modification or alienation of the wetland as a result of Project construction and operation activities. While there will be some clearing of grazing land adjacent to the wetland, this will not result in significant fragmentation of the landscape or influence the existing connectivity between the wetland and the Marine Park. Project activities will not alter the existing hydrological function of the wetland, which contributes to its ecological value as waterbird habitat.



4.7.4.2 Marine mammals

As described in Section 3.2.2.1, Abbot Point provides a transitory area for small numbers of Humpback Whales migrating to and from their breeding grounds within the northern GBR. Known core aggregations areas for Humpback Whales closest to Abbot Point occur over 100km to the south, off the Mackay coast in the Whitsunday region.

The Abbot Point area supports varying abundances of Australian Snubfin and Indo-Pacific Dolphins. The small population present may be disconnected from other populations in the region which may indicate the habitat in the project area may be of high importance for this species (Section 3.2.2.2).

Abbot Point has been identified as an area of low conservation importance for Dugongs in the southern GBR (Section 3.2.2.3). Dugongs recorded in the Abbot Point area are likely to be transient individuals, moving between the more important areas of Cape Upstart to the north and Edgumbe Bay to the south. Abbot Point is not known to provide any critical breeding, feeding or resting habitat for Dugongs in the local or regional area.

Seagrass distribution and abundance is naturally highly variable in the Abbot Point area. The offshore seagrasses present in the T0 dredging footprint and surrounds are highly dynamic with the most recent surveys recording reduced areas of low density, patchy areas of seagrass; indicating seagrass abundance in the footprint and surrounds is not stable or currently present in high abundance. The seagrass community in this area is likely to be growing at a depth that is at the boundary of their light requirements.

The direct loss of potential seagrass habitat within the T0 berth pocket dredging footprint (outside the GBRMP) is considered a very small proportion of the available offshore seagrass habitat at Abbot Point (less than 0.04%). Off-site impacts to the offshore seagrasses within the Marine Park, if occurring, are likely to be temporary in nature. It is unlikely that marine mammals would rely heavily on such a sparse and ephemeral offshore seagrass habitat.

4.7.4.3 Air and water quality

Offshore activities

There are no potential sources of air quality impacts from the Project for the Marine Park.

Dredging will occur outside the Marine Park and stochastic plume modelling (incorporating deep ocean current circulation) indicates that sediment migration will be highly localised from the dredging site and will not significantly affect the Marine Park. The proposed use of a CSD significantly reduces the extent of plume generated during dredging, with the majority of fine sediment being pumped ashore for settling and treatment. There will be no disposal of dredging spoil in the Marine Park.

Potential indirect impacts to benthic communities as a result of project activities are expected to be temporary and may extend into the Marine Park. Plume influences on light attenuation are considered comparable to observed inter-seasonal variability. As such, the effects of the plume on light availability are not predicted to result in detectable losses of seagrass or have detectable impacts on potential seagrass habitat. Elevated sedimentation is not predicted to occur outside the dredging footprint.



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Onshore activities

Earthmoving and other construction activities will disturb soils and generate dust, which can disperse and settle in the adjacent wetland. The dust represents a potential source of sediment and other contaminants to the wetland.

If appropriately managed, dust generated by construction would largely be limited to wetland areas within close proximity to the construction areas. The predicted dust concentrations would be highly unlikely to result in high suspended sediment concentrations or sediment deposition within the wetland and have been assessed as unlikely to significantly impact on threatened and migratory birds that may be present in the wetland during the construction period.

Topsoil and sediments will be disturbed during construction of the DMCP. Potential impacts to the Caley Valley Wetlands' water quality are possible without appropriate mitigation. Sediment and erosion control measures will therefore be developed and implemented to mitigate potential impacts of sediments entering the adjacent wetlands, as described in the Stormwater Management Plan (refer **Appendix Y**).

The exposure of ASS is not expected; however, an ASSMP (**Appendix X**) will be in place to detect and manage any potential impacts to avoid downstream effects on the wetland.

Overflow and/or seepage of DMCP water to the wetland have been assessed as potentially resulting in some very localised impacts with no broader impacts on wetland water quality or wetland-dependent species.

The accidental release of contaminants, such as fuels and chemicals associated with machinery operation, pose a risk to adjacent wetland ecosystems. Mitigation measures will be required to ensure that water leaving the work sites will be of similar quality to that of receiving waters and that contaminants do not leave the site.

4.7.4.4 Marine pests

Although highly unlikely, there is potential for invasive species to be introduced to the project area as a result of project activities.

The Project dredging vessels will adhere to the Australian mandatory ballast water reporting system. High risk ballast water exchange is not accepted at Abbot Point. Mandatory ballast water management arrangements are implemented by the Australian Quarantine and Inspection Service.

As a result of adherence to these requirements, and additional requirements outlined in the Outline DMP there is low to no risk that project activities will introduce marine pests to the Marine Park.

4.7.4.5 Marine contamination

No offshore placement of dredged material will occur. Returning waters from the DMCP will have elevated TSS. The returning suspended sediments are not expected to contain any organic chemicals, heavy metals or other potentially harmful chemicals. Surface waters in the vicinity of the discharge point will be periodically tested for these chemicals as part of the discharge waters monitoring program (refer to the Outline DMP in **Appendix W**).

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Based on the marine sediment quality assessments undertaken in the dredging footprint, sediments realised into the marine environment from the action of the dredge cutter head are not expected to contain organic chemicals, heavy metals, or other potentially harmful chemicals.

4.7.4.6 Heritage values

The Project is not likely to directly or indirectly impact on the heritage values of the Marine Park. Access to any historic ship wrecks would not be altered. The Project is therefore not likely to substantially adversely impact on the heritage values held by the Marine Park.

The Catalina Plane wreck, located 32km from the T0 dredging footprint, has been declared a Maritime Cultural Heritage Protection Special Management Area. No impacts to this important site are predicted to occur as a result of the Project.

4.7.4.7 Noise and physical impacts to threatened and migratory species

The use of a stationary dredge and the placement of dredged material onshore limits the physical impacts on threatened and migratory species that inhabit the area. The dredging will be undertaken outside the Marine Park. Underwater noise generated by the dredging operations is expected to be highly localised and unlikely to have measurable impacts to individual species using the project area. With the implementation of the Outline DMP no significant residual impact to threatened and migratory species is expected.

4.7.5 Summary

Dredging will occur within the restricted port limits and with the placement of material onshore, the likelihood of the proposed action impacting on other park users, including the tourist and fishing industries in the area, is low.

No significant direct or indirect impacts to cetaceans or other species that occur in the Marine Park or adjacent onshore areas are expected to occur as a result of the Project.

The proposed dredging method is designed to limit increases to sediment loads and associated water quality impacts in the GBRMP. Erosion control measures will be implemented to minimise the potential for sediment to enter the Caley Valley Wetlands during construction and operation of the DMCP.

Return waters from the DMCP will contain higher than natural levels of suspended solids. The sediments will quickly disperse. TSS concentrations within 100m of the discharge point (and well within the port limits outside the Marine Park) will return to natural levels as measured during baseline water quality studies.

Air quality influences from the offshore component of the Project are restricted to emissions generated from dredge operation and these have been assessed as not having adverse impacts on local air quality. The potential for dust generation during earthworks for the construction of the DMCP will be managed onsite, and dust is not predicted to have a significant effect on vegetation, water quality or birds within the Caley Valley Wetlands.

Overall, there are no predicted significant residual impacts of the Project on the values of the Marine Park.



4.8 Impacts on Matters of National Environmental Significance - Commonwealth marine areas

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

Within Queensland, the Commonwealth marine area overlaps with the boundaries of the GBRMP and the GBRWHA (refer to Figure 3-1). For the Project and at Abbot Point, the values of the GBRMP are equivalent to those of the Commonwealth marine area.

Consequential impacts of related and associated Projects (e.g. T0 Terminal construction and operation) are separately discussed in Section 6.

4.8.1 Approach to impact assessment

This assessment of potential project impacts to the Commonwealth marine area has:

- Considered the risk identified within the Project's environmental risk register as relevant to the MNES controlling provisions of the Commonwealth marine area
- Assessed the potential project impacts to Commonwealth marine area values based on the significant impact guidelines, including consideration of assessed relevant matters of:
 - Nutrients and sediments from runoff
 - Increased sediments as a result of dredging activities
 - Noise and physical impacts to threatened and migratory species
 - Increased shipping.

4.8.2 Risk assessment

A risk assessment approach has been applied to assess environmental impacts associated with the Project. The approach is described in detail in Section 4.1.

The risk assessment broadly examined all project activities to identify those activities with potential to have an adverse impact on all MNES, ensuring that the subsequent detailed assessment of impacts on MNES accounted for all potentially impacting activities.

It should be noted that the assessed environmental risk ratings are not a direct reflection of the level of risk to relevant MNES. However, they are relevant for consideration in the subsequent assessment of the significance of project impacts to MNES.

The project activities assessed to represent a moderate or greater unmitigated risk of impacting on the Commonwealth marine area is offshore dredging and dredged material dewatering. This activity causes the mobilisation of sediment, resulting in turbidity plumes, potentially affecting light-dependent species, filter feeders and having potential flow-on effects to higher tropic groups, including marine mammals.

These activities are examined in detail in the Marine Ecology and Hydrodynamic Modelling Reports (**Appendices D and F** respectively) to determine the likelihood of there being significant residual impacts on the Commonwealth marine area as a result of project activities in accordance with the significant impact guidelines.



4.8.3 Significant impact guidelines

The *Significant Impact Guidelines 1.1* (DoE, 2013a) identify that an action is likely to have a significant impact on the Commonwealth marine area if there is a real chance or possibility that the action will:

- Result in a known or potential pest species becoming established in the Commonwealth marine area
- Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results
- Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution
- Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health
- Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected
- Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.

The Project has been assessed against the significance criteria. Table 4-31 provides the relevant cross-references to the individual assessment aspects. The results of the overall impact assessment are summarised in Section 4.8.4.



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Table 4-31 Significant impact criteria and the potential project impacts on Commonwealth marine areas

Significant Impact Criteria	Project Relevance	Potential Project Impacts to Commonwealth Marine Areas
Result in a known or potential pest species becoming established in the Commonwealth marine area.	Marine Pests	Section 4.8.4.1
Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results.	Seagrass Benthic communities	Section 4.8.4.2
Have a substantial adverse effect on a population of a marine species or cetacean including its lifecycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution.	Marine mammals	Section 4.8.4.3
Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health.	Seagrass	Section 4.8.4.4
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected.	Marine contamination	Section 4.8.4.5
Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.	Catalina wreck	Section 4.8.4.6



4.8.4 Assessment of impacts on the Commonwealth marine area

4.8.4.1 Marine pests

Although highly unlikely, there is potential for invasive species to be introduced to the project area as a result of project activities.

The project dredging vessels will adhere to the Australian mandatory ballast water reporting system. High risk ballast water exchange is not accepted at Abbot Point. Mandatory ballast water management arrangements are implemented by the Australian Quarantine and Inspection Services.

As a result of adherence to these requirements, and additional requirements outlined in the Outline DMP there is low-to-no risk that project activities will introduce marine pests to the Commonwealth marine area.

4.8.4.2 Habitat and ecosystem components

Dredging will occur outside the Commonwealth marine area and stochastic plume modelling (incorporating deep ocean current circulation) indicates that sediment migration will be highly localised from the dredging site and will not significantly affect the Commonwealth marine area. The proposed use of a CSD significantly reduces the extent of plume generated during dredging, with the majority of fine sediment being pumped ashore for settling and treatment. There will be no disposal of dredging spoil in the Commonwealth marine area.

Seagrass distribution and abundance is naturally highly variable in the Abbot Point area, with the most recent surveys recording reduced areas (when compared to 2008) of low density, patchy areas of seagrass (McKenna and Rasheed, 2014), indicating seagrass abundance in the Abbot Point area is not stable or currently present in high abundance.

Recent surveys found the seagrass communities growing in the berth pocket dredging footprint (which is located outside the Commonwealth marine area) were low density and patchy. Based on this, the permanent removal of 10.5ha of the seafloor in the berth pockets is unlikely to have an adverse impact on marine ecosystem health, functioning or integrity.

Potential indirect impacts to benthic communities as a result of project activities are expected to be temporary and may extend into the Commonwealth marine area. Plume influences on light attenuation are considered comparable to observed inter-seasonal variability. As such, the effects of the plume on light availability are not predicted to result in detectable losses of seagrass or have detectable impacts on potential seagrass habitat. Elevated sedimentation is not predicted to occur outside the dredging footprint.

4.8.4.3 Marine mammals

As described in Section 3.2.2.1, Abbot Point provides a transitory area for small numbers of Humpback Whales migrating to and from their breeding grounds within the northern GBR. Known core aggregations areas for Humpback Whales closest to Abbot Point occur over 100km to the south, off the Mackay coast in the Whitsunday region.

The Abbot Point area supports varying abundances of Australian Snubfin and Indo-Pacific Dolphins. The small population present may be disconnected from other populations in the

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region which may indicate the habitat in the project area may be of high importance for this species (Section 3.2.2.2)

Abbot Point has been identified as an area of low conservation importance for Dugongs in the southern GBR (Section 3.2.2.3). Dugongs recorded in the Abbot Point area are likely to be transient individuals, moving between the more important areas of Cape Upstart to the north and Edgum Bay to the south. Abbot Point is not known to provide any critical breeding, feeding or resting habitat for Dugongs in the local or regional area.

Seagrass distribution and abundance is naturally highly variable in the Abbot Point area. The offshore seagrasses present in the T0 dredging footprint and surrounds are highly dynamic with the most recent surveys recording reduced areas of low density, patchy areas of seagrass. The impacts on the seagrass habitat in the dredging footprint located outside the Commonwealth marine area are considered minor when the extent of similar deepwater seagrass habitat in the wider region is considered

The off-site impacts to the seagrass habitat from fugitive dredged sediments are in deeper water areas where the density and abundance of seagrass community is known to fluctuate between seasons and years, and quickly re-establish after natural disturbances. Off-site impacts to the offshore seagrasses within the Commonwealth marine area, if occurring, are likely to be temporary in nature. It is unlikely that marine mammals would rely heavily on such a sparse and ephemeral offshore seagrass habitat.

4.8.4.4 Air and water quality

Air quality influences from the offshore component of the Project are restricted to emissions generated from dredge operation and these have been assessed as not having adverse impacts on local air quality.

Dredging will occur outside the Commonwealth marine area and stochastic plume modelling (incorporating deep ocean current circulation) indicates that sediment migration will be highly localised from the dredging site and will not significantly affect the Commonwealth marine area. The proposed use of a CSD significantly reduces the extent of plume generated during dredging, with the majority of fine sediment being pumped ashore for settling and treatment. There will be no disposal of dredging spoil in the Commonwealth marine area.

Potential indirect impacts to benthic communities as a result of project activities are expected to be temporary and may extend into the Commonwealth marine area. Plume influences on light attenuation are considered comparable to observed inter-seasonal variability. As such, the effects of the plume on light availability are not predicted to result in detectable losses of seagrass or have detectable impacts on potential seagrass habitat. Elevated sedimentation is not predicted to occur outside the dredging footprint.

4.8.4.5 Marine contamination

No offshore placement of dredged material will occur. Returning waters from the DMCP will have elevated TSS. The returning suspended sediments are not expected to contain any organic chemicals, heavy metals or other potentially harmful chemicals at levels of environmental concern. Surface waters in the vicinity of the discharge point will be periodically tested for these chemicals as part of the discharge waters monitoring program (refer to the Outline DMP in **Appendix W**).

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Based on the marine sediment quality assessments undertaken in the dredging footprint, sediments realised into the marine environment from the action of the dredge cutter head are not expected to contain organic chemicals, heavy metals, or other potentially harmful chemicals.

4.8.4.6 Heritage values

The Project is not likely to directly or indirectly impact upon Commonwealth marine area heritage values. Access to any historic ship wrecks would not be altered. The Project is therefore not likely to substantially adversely impact upon the heritage values held by the Commonwealth marine area.

The Catalina Plane wreck, located 32km from the T0 dredging footprint, has been declared Maritime Cultural Heritage Protection Special Management Area. No impacts to the heritage values of this important site are expected to occur as a result of the Project.

4.8.4.7 Increased shipping

Shipping numbers associated with the project are low. The potential for introduction of marine pests is discussed above (Section 4.8.4.1). Increased shipping impacts of related projects are discussed in Section 6.

4.8.5 Summary

Dredging will occur within the restricted port limits and with the placement of material onshore within the DMCP outside the Commonwealth marine area. Return waters from the DMCP will contain higher than natural levels of suspended solids. The sediments will quickly disperse. TSS concentrations within 100m of the discharge point (and well within the port limits outside the Commonwealth marine area) will return to natural levels as measured during baseline water quality studies. Off-site impacts to deepwater ephemeral seagrass habitat in the Commonwealth marine area are likely to be temporary in nature.

No significant direct or indirect impacts to cetaceans or other species that occur in the Commonwealth marine area or adjacent onshore areas are expected to occur as a result of the Project.

Air quality influences from the offshore component of the Project are restricted to emissions generated from dredge operation and these have been assessed as not having adverse impacts on local air quality.

Overall, there are no predicted significant residual impacts of the Project on the values of the Commonwealth marine area.



5 Abbot Point Growth Gateway Management Approach and Offsets

5.1 Environmental management approach

To address the EIS Guidelines, a risk-based approach to environmental management has been adopted for the Project. This approach is based on the requirements of the international standard *AS/NZS ISO 14001:2004 Environmental Management Systems* and is closely tied to the environmental risk assessment that was undertaken for the Project (refer Section 4.1).

As part of the overall risk process (based on *ISO 31000:2009: Risk Management - Principles and Guidelines*), management and ongoing monitoring of the potential impacts and effectiveness of the proposed mitigation measures will be undertaken throughout all phases of the Project. The environmental risk assessment systematically identified and classified potential environmental impacts by linking them to project phases, project activities, technical assessment areas and controlling provisions (MNES) and collated them in an environmental risk register. The impacts identified in the register were derived from the technical studies and are discussed Section 4.1. Mitigation measures were identified to reduce the potential for consequences to occur and/or to reduce their severity if they do occur.

This section provides an overview of the Project's environmental management framework developed to ensure that environmental mitigation measures, monitoring and reporting requirements are implemented at appropriate stages of development.

5.1.1 Management plans

To ensure the planning and delivery of the Project is responsibly and effectively managed with respect to the protection of environmental values (including MNES), a number of management plans will be prepared, each in general accordance with the ISO14001 specification for an environmental management system. At present, the following plans are envisaged as being required, and will be developed in further consultation with relevant regulators:

1. Outline EMP
2. Outline DMP
3. Construction Environmental Management Plan (CEMP)
4. Operational Environmental Management Plan (OEMP)
5. Final DMP.

The first two outline plans are included as appendices to this EIS and will be used to inform the public and regulators of the Proponent's intentions, and to assist with the further planning and engineering design for the Project. The Outline EMP and Outline DMP are related and should be read as companion documents.

The Outline EMP (refer **Appendix V**) provides for the management and monitoring of the:

- Design and construction of the DMCP
- Management of the DMCP before and after placement of dredged material



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- Reuse (including any treatment that may be required) of dredged material, post-placement in the DMCP.

The Outline DMP (refer **Appendix W**) provides for the management and monitoring of:

- Dredging
- Placement of dredged material in the DMCP
- Return of water from the placement operation to the sea.
- It is anticipated that a CEMP and OEMP will ultimately be prepared in place of the Outline EMP, and be required as conditions of approval (should the Project be approved under the EPBC Act).

It is expected that the CEMP and OEMP will be required to be submitted and accepted by DoE (along with any relevant State regulators) prior to commencement of construction and operation, respectively. It is also anticipated that a final DMP would be required as a condition of approval and will to be submitted and accepted by DoE (along with relevant State regulators) prior to commencement of dredging.

Figure 5-1 illustrates this overall environmental management framework. The figure also depicts the main stages of the Project and the organisations which will be responsible for environmental management. The Queensland DSD is responsible for implementation of the Outline EMP and the Outline DMP to manage potential environmental impacts during the Project's planning and design phase. Responsibilities are further discussed in Section 2 of the Outline EMP that is provided in **Appendix V** of the EIS.



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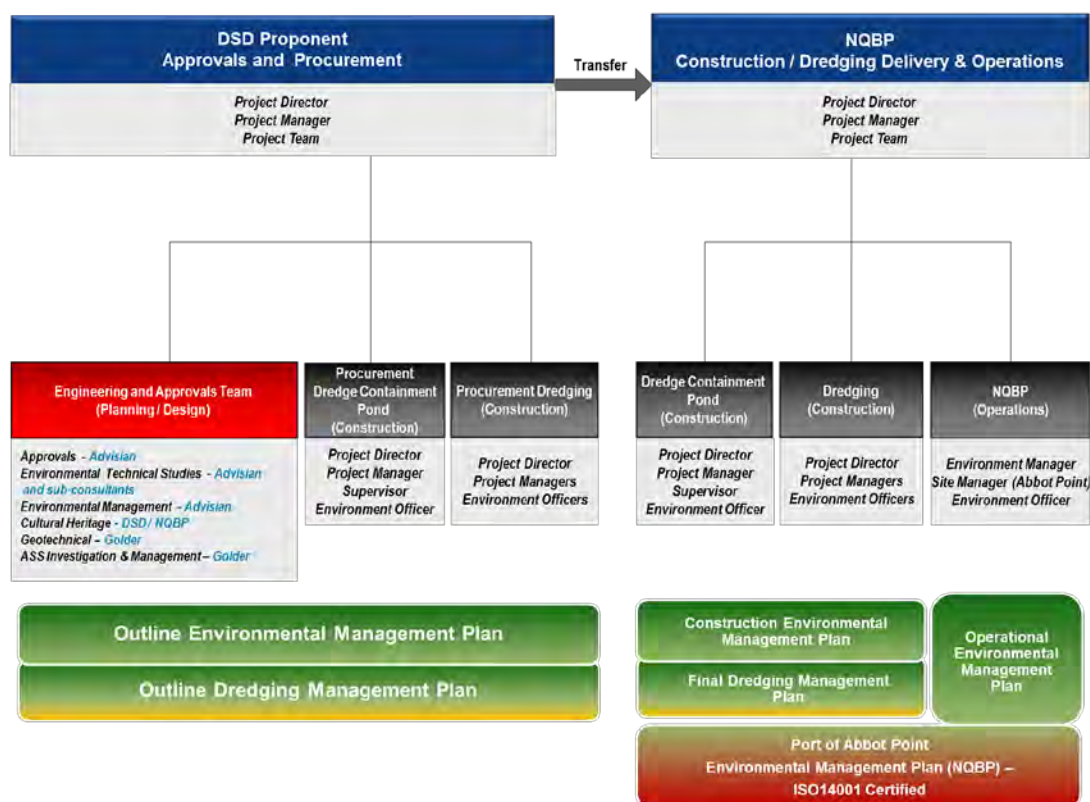


Figure 5-1 Environmental management framework and responsibilities

5.1.2 Outline Environmental Management Plan

The main remits and requisites of the Outline EMP (**Appendix V**) are to:

- Assist to achieve and demonstrate compliance with environmental legislation
- Provide a framework to ensure the environmental risks associated with the Project are properly managed during design, construction and operation
- Establish management plans for all relevant environmental aspects including, control strategies, objectives and targets, responsibilities, monitoring, corrective actions and reporting to minimise environmental harm and demonstrate planned approach to achieve environmental compliance
- Ensure that environmental management detail is captured, documented and implemented throughout all stages of the Project
- Set out the following elements of the DoE Guidelines requirements for management approaches:
 - Consolidated list of mitigation measures to prevent, minimise or treat relevant potential impacts on protected matters
 - Description of mitigation measures and an assessment of the expected or predicted effectiveness of the mitigation measures
 - Statutory or policy basis for the mitigation measures
 - The name of the agency responsible for endorsing or approving each mitigation measure or monitoring program



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- Identification of level of risk associated with potential impacts.
- Identify and develop environmental management strategies and, where appropriate, mitigation measures as supporting information to accompany State Government approval applications including the Material Change of Use application under the APSDA Development Scheme
- Provide construction contractors with environmental requirements and to guide the development and implementation of work method statements/Job Safety and Environmental Analysis and measures to ensure environmental compliance
- Retain flexible management approaches including enabling the addition or adoption of management measures as the project scope, design, construction methodology and approval conditions evolve
- Be compatible with future Construction and Operation EMPs as well the DMP.

The proposed mitigation measures for the Project that are provided in the Outline EMP have been documented in the form of environmental management tables. The elements covered in the Outline EMP are as follows:

- Ecology (flora and fauna)
- Water quality management
- Land management
- Noise and vibration management
- Air quality management
- Waste management
- Cultural heritage management
- Community engagement
- Emergency response
- Acid Sulfate Soils
- Erosion and sediment control
- Containment risks management
- Monitoring and inspection plan
- Compliance audits
- Incident reporting and complaints
- Records management.

Mitigation measures have been developed using guidance from a range of statutory and policy instruments, including but not limited to:

- *Environmental Protection (Air) Policy 2008*
- *Environmental Protection (Noise) Policy 2008*
- *Environmental Protection (Water) Policy 2008*
- *Environment Protection Regulation 2008*
- *State Planning Policy - July 2014*
- *State Planning Policy—state interest guideline: Water quality August 2014*
- *Treatment and management of soils and water in acid sulfate soil landscapes* (July 2011, Western Australia - Department of Environment and Conservation)
- *Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines -Version 3.8*
- *DEHP Guideline: Managing contaminated land under the Sustainable Planning Act 2009*
- *DEHP Guideline for Contaminated Land Professionals (2012)*



- *Land Protection (Pest and Stock Route Management) Act 2002*
- *Ecoaccess noise guideline: planning for noise control*. Queensland Department of Environment and Resource Management

The Outline EMP refers to specific management plans proposed to meet the environmental objectives, targets and/or performance criteria that may be developed. They provide direction and background information on how a specific issue/aspect can be managed and monitored to achieve the objectives. These plans include:

- Dust management plan
- Acid Sulfate Soils management plan
- Erosion and sediment control plan
- Water quality management plan
- Weed and pest management plan
- Construction fire management plan
- Vegetation clearing and rehabilitation plan
- Groundwater management plan.

The mitigation measures that will be applied are predicted to be effective in achieving environmental objectives, targets and performance criteria in that they are commonly applied and accepted measures for impact reduction.

The Outline EMP also establishes audit protocols as well as reporting and monitoring requirements. These procedures are outlined in Section 4 of the Outline EMP provided in **Appendix V**.

Some preliminary management plans have already been prepared in support of this EIS and to guide engineering design for the management of PASS and stormwater. These are provided in the following appendices:

- **Appendix X** - Preliminary ASS Assessment and Management Plan
- **Appendix Y** - Preliminary Stormwater Management Plan.

5.1.3 Outline Dredging Management Plan

The Outline DMP (refer **Appendix W**) supports the implementation of Australian and Queensland Government requirements for dredging, onshore management of marine sediments and discharge of return water to the sea.

Core objectives in developing the Outline DMP for the Project were to:

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

The elements covered in the Outline DMP are as follows:



- Marine water quality
- Marine and terrestrial flora
- Acid Sulfate Soils
- Surface water
- Groundwater
- Waste
- Air quality
- Noise
- Hazardous materials management and emergency preparedness.

The Outline DMP also establishes protocols for training, complaint management, incident reporting, compliance monitoring, auditing, documentation and reporting, as outlined in Section 10 of the Outline DMP provided in **Appendix W**.

The mitigation and management measures documented in the Outline DMP are commonly implemented measures for dredging operations, deemed commensurate to the risks identified, and are therefore expected to be effective in addressing identified potential impacts. This is reflected in the downgrading of identified risk to the lowest possible level after proposed mitigation measures have been applied.

The Outline DMP contains a marine water quality and seagrass monitoring plan, which also includes a proposed approach to adaptive management of the operation. This will allow for implementation of alternative management and mitigation measures should the proposed measures be found to be less effective than anticipated.

5.1.4 Cost of environmental mitigation

The Outline EMP (refer **Appendix V**) and the Outline DMP (refer **Appendix W**) set out the management and mitigation measures to be undertaken to prevent, minimise or treat the potential environmental impacts of the Projects identified in the EIS. Where possible and practicable, environmental risks and effects have been designed out of the Project and management and mitigation measures have been built into the Project design process.

The full extent of measures required to mitigate or compensate for the relevant impacts of the Project will be settled and given effect through the EIS decision making process. The estimated cost (concept design confidence level) of these mitigation and compensatory measures is \$7.2 million.



5.2 Environmental Offsets

5.2.1 EPBC Act offsets policy

The EPBC Act Environmental Offsets Policy (Commonwealth of Australia, 2012) requires environmental offsets to compensate for the residual adverse impacts of an action. Offsets counterbalance the impacts that remain after avoidance and mitigation measures. Under the Policy offsets are only required if residual impacts are significant (other than for the GBRWHA).

The overarching principles that are applied in determining the suitability of offsets under the EPBC Act are that suitable offsets must:

1. Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment the subject of the significant residual impacts
2. Be built around direct offsets but may include other compensatory measures
3. Be in proportion to the level of statutory protection that applies to the protected matter
4. Be of a size and scale proportionate to the residual impacts on the protected matter
5. Effectively account for and manage the risks of the offset not succeeding
6. Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)
7. Be efficient, effective, timely, transparent, scientifically robust and reasonable
8. Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

Direct offsets are described as those actions that provide a measureable conservation gain for an impacted protected matter and under the Policy they are required to represent a minimum of 90 per cent of the offset requirement for any given impact. Other compensatory measures may be considered when they constitute greater than 10% of the offset where:

- It can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offset package, or
- Scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter, for example, in the case of some poorly understood ecosystems in the Commonwealth marine environment.

Criteria for research and education programs that may represent "other compensatory measures" as part of an offset package are provided in the Offset Policy.

5.2.2 Net Benefit

The strategies for management of the GBRWHA set out in the Reef 2050 Plan (Commonwealth of Australia 2015) to improve the Outstanding Universal Value of the GBRWHA are incorporated into the EPBC Act EIS decision making process. In accordance with the Reef 2050 Plan, in making decisions about management and protection of the World



Heritage Area, decision makers will have regard to (amongst other things) the principle of delivering a net benefit to the ecosystem, in that:

- Decisions are underpinned by the principles of ecologically sustainable development, including the precautionary principle
- Impacts are avoided and residual impacts mitigated
- Offsets are considered only where impacts cannot be avoided or mitigated
- Actions that restore ecosystem health and resilience - delivering an overall improvement in the Reef's condition - are fostered.

A requirement to achieve a net benefit through offsetting impacts that cannot be avoided or mitigated within the GBRWHA does not rely on the assessment of the impact as “significant” through application of the significant impact guidelines for MNES (Commonwealth of Australia 2013). Specifically, the EIS guidelines state that *The EIS must demonstrate how the proposed action will provide a net benefit for water quality in the Great Barrier Reef World Heritage, consistent with The Reef 2050 Long-Term Sustainability Plan (2015).*

5.2.3 Offset requirements

5.2.3.1 Marine environment

Water quality

Avoidance and mitigation measures are the primary strategies for managing the potential significant impacts of the Project.

Avoidance of potentially significant impacts to the GBRWHA associated with dredging and offshore placement of dredged material is an important feature of the Project. Using a CSD, the dredged material will be pumped on land to the DMCP. As the material settles, excess water is returned to the ocean and carries with it a quantity of suspended sediment. This is a short-term operation that will continue until dewatering of the dredged material has been achieved.

The dredging process itself will disturb currently stable seafloor sediments, making fugitive fine silt and clay components of the sediment in particular, available for re-suspension by wave energy within the marine environment. Heavier fractions are expected to remain localised and be consolidated within seabed matrix.

While the use of CSD technology and onshore reuse of dredged material reduces as far as possible the impact of the Project on marine water quality, a conservative total estimate of approximately 9,938t of fine silt and clay may become available for re-suspension following principally through the dredging activity, but also partially through the dewatering activities. In comparison with the previously approved, and now discontinued, capital dredging project at Abbot Point where offshore disposal of dredged material was intended, the Project is predicted to contribute significantly less resuspendable fine silt and clay sediment to the GBRWHA.

To place the predicted 9,938t of sediment generated by the Project in context, currently the Burdekin River and Don River catchments are estimated to contribute a combined 4,203,000t per year of Total Suspended Sediments (TSS) to the GBRWHA in this region

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(Kroon *et al.*, 2010). Hence the fine sediment generated by the Project would represent a less than 0.25% increase to the sediment from these catchments.

While there are no long-term or significant residual impacts on the marine environment predicted from the quantity or quality of sediment generated by the proposed dredging and dewatering processes, the contribution of fine sediment available for re-suspension by wave energy within the GBRWHA is a negative impact of the Project that cannot reasonably be mitigated further.

The Proponent is committed to achieving a net benefit to the GBRWHA through its proposed offset strategy in accordance with the targets and objectives of the Reef 2050 Plan (Commonwealth of Australia, 2015). It will do this by undertaking or contributing to an action that results in a reduction of the amount of sediment entering the GBRWHA from local catchments (i.e. the Burdekin River and Don River catchments) by a quantity greater than the fine sediment generated by the Project.

Seagrass

In the marine environment, seagrass communities form an important component of the marine ecosystem in nearshore environments throughout the GBRWHA. While seagrasses are currently mostly absent from the dredging footprint area and where they are present it is at low densities (1% to 5% cover), seagrasses have historically been present at locations across the dredging footprint area. Dredging for the establishment of the T0 berth pockets will deepen these areas of the sea floor to depths that are likely to permanently preclude recolonisation by seagrasses from an area of approximately 10.5ha.

The sparse and ephemeral seagrass present at the dredge location is not considered to represent important habitat for migratory and threatened species that rely on seagrasses for foraging (e.g. Dugong and marine turtles), and no significant residual impacts to these species are predicted from removal of this habitat. Mitigation and management measures will be in place to reduce the risks of harming marine mammals and marine turtles during the dredging process, and no significant residual impacts to these species are expected during the 5 to 13 week dredging campaign.

The shallower disturbed areas would retain their potential as seagrass habitat, with only temporary impacts predicted and potential for recolonization by seagrass and other benthic marine biota over time (<5 years). These shallower areas would include the apron dredging footprint and immediate adjacent area, and the temporary pipeline location. Seabed characteristics and light regimes are not predicted to change sufficiently as a result of the project to preclude the affected areas from recovery, and no significant residual impacts for MNES are predicted.

It is recognised however, that the permanent loss of 10.5ha of potential seagrass habitat as a result of the Project is a negative impact in relation to 'habitat important for the conservation of biological diversity in a World Heritage property' that cannot be mitigated. In order to provide a net benefit to the GBRWHA from the Project, an offset action that ensures project outcomes are consistent with the objectives and targets of the Reef 2050 Plan is warranted.

Marine fauna



No significant residual impacts are predicted for marine fauna as a result of the proposed activities. As a result, no offsets are required for marine mammals and marine turtles.

5.2.3.2 Terrestrial environment

With the implementation of a range of mitigation and management measures, terrestrial and aquatic ecology impact assessment predicts no significant residual impacts on MNES as a result of the construction and operation of the DMCP and the land-based components of the associated pipelines. The land-based project components are confined to already disturbed port lands and are temporary features. Consequently, no offsets are proposed in relation to the land-based components of the Project for threatened species, migratory species and threatened ecological communities.

5.2.4 Relationship between EPBC Act offsets and Queensland offsets

The Queensland *Environmental Offsets Act 2014* (Offsets Act) requires an environmental offset to counterbalance a significant residual impact of a prescribed activity on a prescribed environmental matter.

Dredging is a prescribed environmental activity as:

- a) It is an ERA subject to requiring an Environmental Authority under the Queensland *Environmental Protection Act 1994* (EP Act)
- b) Under section 207 of the Queensland *Environment Protection Act 1994*, a condition imposed on an Environmental Authority or draft Environmental Authority may require or otherwise relate to an environmental offset (an environmental offset condition).

Seagrass is a prescribed environmental matter under the Offsets Act in that under the Environmental Offsets Regulation 2014 a marine plant within the meaning of the *Fisheries Act 1994* is a Matter of State Environmental Significance.

The Offsets Act seeks to promote coordination with Queensland offsets policies and the requirements of the Australian Government providing that to avoid duplication between jurisdictions, the Queensland Government can only impose an offset condition in relation to a prescribed activity if the same, or substantially the same impact, and the same, or substantially the same, matter has not been the subject of assessment under Commonwealth legislation, including the EPBC Act.

The Project has been declared a controlled action and is subject to assessment via an EIS under the EPBC Act. The EIS Guidelines and Statement of Reasons for the assessment approach indicate that the relevant matters to be assessed under the EPBC Act are: World Heritage properties, National Heritage Places, listed threatened species and communities, listed migratory species, Commonwealth marine areas and GBRMP. Assessment of the project impacts to World Heritage values includes the following matters:

- Water quality of the GBR (consistent with the Reef 2050 Plan)
- Habitat important for the conservation of biological diversity in a World Heritage property (specifically seagrass impacts).

There are direct links between the targets and actions as set out in the Reef 2050 Plan for water quality and [amongst other things] the productivity of fish habitats such as (Commonwealth of Australia, 2015):

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“Improving the quality of water entering the World Heritage Area is pivotal in supporting the Reef’s values as well as in maintaining its fundamental contribution to the wider Australian community through tourism and food production. It builds resilience in areas which support significant biodiversity and species of conservation concern such as turtles and Dugongs, and drive fisheries productivity. It is also likely to reduce the frequency of future crown-of-thorns starfish outbreaks, with one line of evidence suggesting these are driven by elevated concentrations of nutrients. Actions include implementing innovative management approaches through the Reef Trust for improving water quality. 2020 targets for water quality are in line with the Reef Water Quality Protection Plan and include up to a 50% reduction in anthropogenic end of catchment loads of sediment by 2025.”

Accordingly, it is considered that the Australian Government’s assessment of the impacts of the Project under the EPBC Act EIS process assesses:

- Substantially the same impact as the impact for MSES, i.e.: the loss of seagrass as a resource for all reliant species in relation to biological diversity and ecological values (including for MNES species), and the loss of seagrass as habitat for a specific suite of species, that is those species subject to commercial fisheries (MSES), and
- Substantially the same matter, i.e seagrass as a resource for all species within the GBRWHA ecosystem, and specifically for MNES species, and seagrass as a fisheries resource (MSES).

On this basis, there would be no requirement to provide any further offset for seagrass under Queensland legislation.

The links between the conservation of seagrass and water quality indicate that an offset that focuses on the improvement of regional nearshore water quality will subsequently improve the quality, quantity and resilience of seagrass communities for all dependent species.

5.2.5 Proposed offset strategy

Both the EPBC Act Environmental Offsets Policy (Commonwealth of Australia, 2012) and the Queensland Offsets Act recognise the difficulty in achieving meaningful direct offsets for some ecological communities, and the EPBC Act Offsets Policy specifically indicates that direct offsets may not sufficiently benefit some poorly understood ecosystems in the Commonwealth marine environment.

A range of direct seagrass and other marine plant offset actions and research activities have been investigated for the Project. However, the preferred objective of providing predominantly (90%) direct actions under both jurisdictions limits the acceptability of these activities.

Seagrasses occur in locations where physical, chemical and biological conditions are suitable. The factors affecting seagrass growth and distribution are a complex relationship between depth, light, temperature, nutrients, substratum type and wave action, and seagrass cannot be reliably re-established or directly enhanced without improving the conditions for seagrass distribution and/or growth. While other factors are not able to be manipulated, direct benefits can be achieved through water quality improvements that reduce water turbidity to improve light penetration in existing and potential seagrass habitat where light is a limiting factor.



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An offset activity that improves water quality by reducing sediment reaching the marine environment from the Burdekin and/or Don River catchments would provide a net benefit for seagrass habitat in the region, with concomitant benefits for [among other species] marine mammals, marine turtles and commercial and non-commercial fish species.

The Reef 2050 Plan indicates that work to decrease land-based runoff in the GBRWHA waters is well advanced and under the *Reef Water Quality Protection Plan* significant efforts have been made by landholders, regional natural resource management organisations, agricultural industry bodies, conservation groups and government agencies to implement improved land management practices throughout the Reef catchments in order to decrease the flow of nitrogen, pesticides and sediments to the Reef.

It is proposed to provide a net benefit for water quality and seagrass in the GBRWHA by contributing net benefit/offset funds to actions being delivered under the existing framework that implements the strategies set out in the Reef 2050 Plan via the Reef Trust, and by ensuring that those actions are delivered in the catchments that influence marine water quality and nearshore ecosystems in the region.

Table 5-1 provides an assessment of this strategy against the overarching principles that are applied in determining the suitability of offsets under the EPBC Act.

Table 5-1 Proposed offset strategy responses to the overarching EPBC Act offset principles

Principle	Proposed Offset Strategy
Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environmental law and affected by the proposed action	The Proponent is committed to achieving a net benefit to the GBRWHA through its proposed offset strategy in accordance with the targets and objectives of the Reef 2050 Plan (Commonwealth of Australia, 2015), by undertaking or contributing to an action that results in a reduction of the amount of sediment entering the GBRWHA from local catchments (i.e. the Burdekin River and Don River catchments) by a quantity greater than the fugitive resuspendable fine sediment generated by the Project.
Be built around direct offsets but may include other compensatory measures	Opportunities for delivering direct offsets for seagrass are limited in that seagrasses occur in locations where physical, chemical and biological conditions are suitable. Many of the factors required for seagrass establishment cannot be manipulated and direct offsets such as those achieved through rehabilitation or restoration of ecosystems in terrestrial environments are not possible in the marine environment. Therefore it will be necessary to indirectly offset seagrass loss through other means.



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Principle	Proposed Offset Strategy
	It is proposed to provide a net benefit for the GBRWHA by contributing net benefit/offset funds to actions being delivered under the existing framework that implements the strategies set out in the Reef 2050 Plan via the Reef Trust, and by ensuring that those actions are delivered in the catchments that influence marine water quality and nearshore ecosystems, including seagrass meadows, in the region.
Be in proportion to the level of statutory protection that applies to the protected matter	The offset metric for the contribution of net benefit/offset funds is yet to be established.
Be of a size and scale proportionate to the residual impacts on the protected matter	The offset metric for the contribution of net benefit/offset funds is yet to be established.
Effectively account for and manage the risks of the offset not succeeding	Projects funded by Reef Trust build on, but do not duplicate, existing Australian and Queensland Government programs and actions being delivered across the reef regions by natural resource management bodies, industry, landholders and the community. Under these circumstances, the risks of not achieving the intended water quality improvement goals are low.
Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action)	Consultation with and between the relevant government agencies is ongoing to ensure that all matters are appropriately offset. It is intended to achieve the required net benefits and conservation outcomes for project impacts without duplication between jurisdictions.
Be efficient, effective, timely, transparent, scientifically robust and reasonable	It is assumed that projects funded by the Reef Trust mechanism would achieve these requirements to the satisfaction of DoE.
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	It is assumed that projects funded by the Reef Trust mechanism would achieve these requirements to the satisfaction of DoE.

Reef Trust has been developed as a mechanism by which net benefit/offset funds can be pooled to achieve Reef 2050 strategies through targeting specific residual impacts on the GBR by development activities. The Phase Two Reef Trust investments released in 2015 focus on reducing nitrogen and sediment runoff through changes to management practices in the cane and grazing industries.



While there is currently no metric available for determining the value of water quality offsets through financial settlement, there are predictive costs for 'per hectare' and 'per kilometre' treatment and remediation works on degraded lands, waterways and erosion gullies within GBR catchments, and a reasonable understanding of how much sediment can be retained through successful treatment. Thompson *et al.* (2012) found that the benefits of successful gully treatment actions are compounding, with expected annual sediment loss from treated gullies able to be expressed as annual sediment retention from a single action. Such considerations will be important in the formulation of a suitable offset metric for the Project.

Net benefit or offset is likely to be readily achieved for the Project, and options for this are currently being explored and discussed with both the Australian and Queensland Governments.

5.2.6 Offset delivery strategy

The assessment of the impacts of the Project on marine ecology (WorleyParsons, 2015a) and terrestrial ecology (ELA, 2015) conclude that there are no significant residual impacts predicted for the Project on MNES within the GBRWHA or adjacent habitats and subsequently there is no requirement for environmental offsets under the EPBC Act. However, unavoidable impacts within the GBRWHA must be addressed to ensure there is a net benefit from the Project on the Outstanding Universal Values of the World Heritage Area in accordance with the Reef 2050 Plan.

While onshore placement of dredged material and the use of a CSD have significantly reduced potential impacts to the marine environment from projects previously proposed at Abbot Point, the residual impacts of the Project within the GBRWHA are:

- Approximately 9,938t of fine silt and clay, from the material dredged, is estimated to be released to the marine environment at Abbot Point from the dredging process and return water from the DMCP
- The 10.5ha berth pocket footprint will cease to be potential seagrass habitat, once dredging has deepened this area.

The Reef 2050 Plan recommends actions to reduce impacts on GBR ecosystem health by avoiding, mitigating or offsetting impacts on marine and coastal ecosystems (including seagrass meadows) to restore reef resilience and ecosystem health, with a target to ensure that key direct human-related activities are managed to reduce cumulative impacts and achieve a net benefit for the Reef.

To ensure that the Project aligns with the objectives and targets of the Reef 2050 Plan, it is proposed to provide an offset/net benefit fund for actions that improve GBRWHA water quality and nearshore environments through regional sediment management actions, with consequent benefits for seagrass through a reduction in suspended solids in the nearshore marine environment. It is likely that the sediment management actions will be delivered by Reef Trust, a mechanism developed by the Australian Government specifically for this purpose.



6 Consequential and Cumulative Impact Assessments

6.1 Introduction

This Section considers impacts of activities external to the Project, giving specific regard to:

- The environmental impacts of consequential and related projects
- The cumulative impacts of the Project in concert with other activities, from existing, approved and proposed projects, which have the potential to impact additively.

6.1.1 Consequential impacts and related projects

Consequential impacts are defined as those which result from further actions which are facilitated to a large extent by the Project.

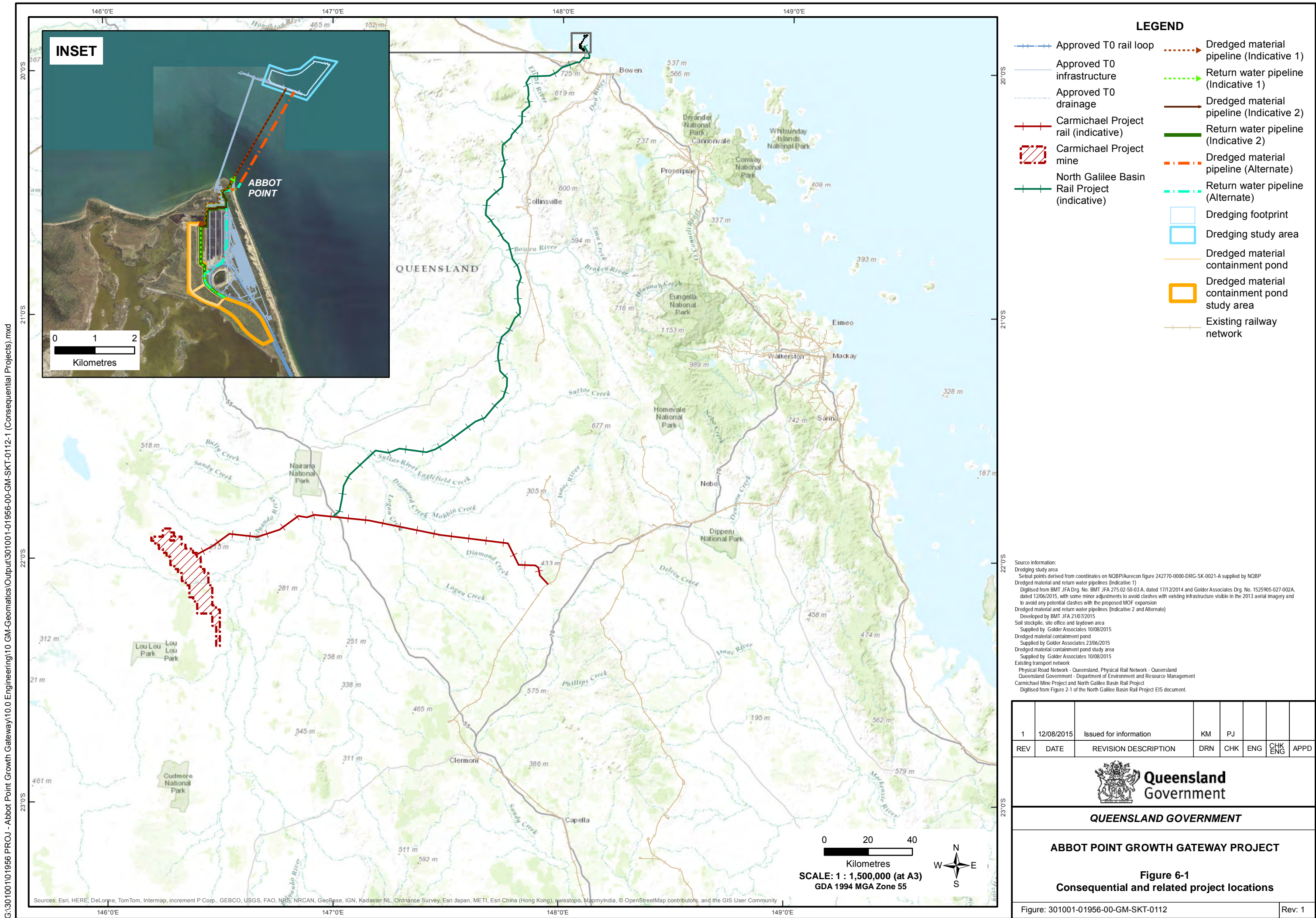
The Project will facilitate:

- The development of T0 by Adani Abbot Point Terminal Pty Ltd, which will provide further export capacity at the Port of Abbot Point
- Increased shipping movements through Abbot Point (through the additional throughput as a result of T0 development)
- The NGBR project, on the basis that this Project would not proceed without the T0 project being developed to allow export of transported product through the Port of Abbot Point.

The Project is related to the Carmichael Mine development proposed by Adani. The impacts of the Carmichael Mine are described in its EIS (GHD, 2012g). The impacts associated with the shipping of coal exported from T0 are also described in the Adani Abbot Point T0 EIS (CDM Smith, 2013a).

The locations of each of the projects relative to the Abbot Point Growth Gateway Project are shown in Figure 6-1.

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6.1.2 Cumulative impacts

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones (IFC, 2013).

The cumulative impact assessment, as presented in Section 6.3, considers the following developments in the vicinity of the Project which have potential to impact additively with the Project:

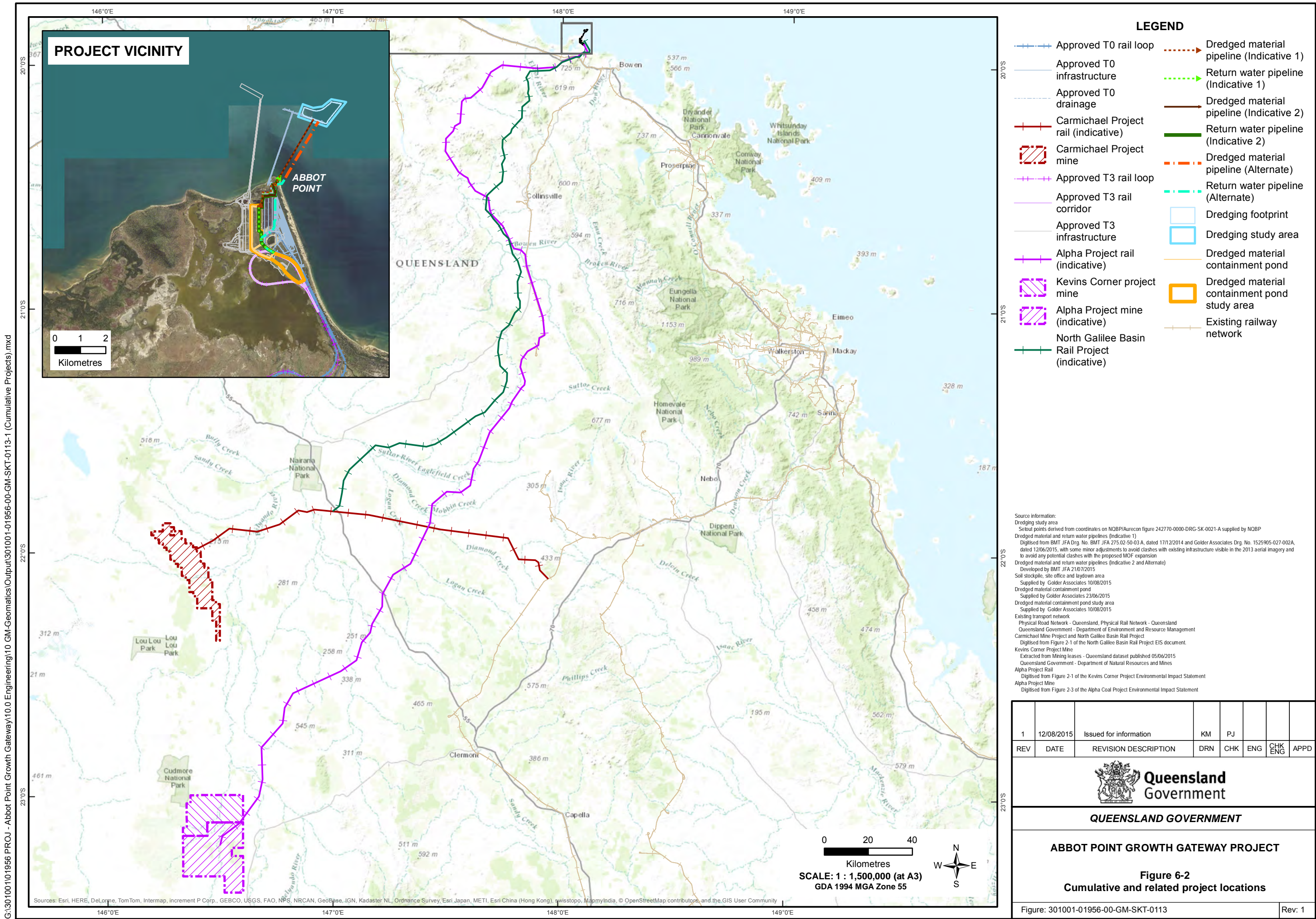
- North Galilee Basin Rail (NGBR) project (port end of the rail development only)
- Abbot Point T0 project
- Abbot Point T3 project
- Alpha Coal and Rail Project (port end of rail development only).

For the purposes of the cumulative assessment, the relevant extents of the listed rail developments (NGBR and Alpha Coal Rail) are the Caley Valley Wetlands and lands to the north of the defined boundary of the wetland. This has been determined on the basis of the Project's impacts which could potentially be increased in concert with the rail development activities.

For the purposes of the cumulative assessment, existing activities at Abbot Point (e.g. operations of the existing T1) are part of the environmental baseline for the Project. These have been considered in the assessment of the Project's impacts (Section 4) so are not separately addressed here.

Locations of the listed development proposals are shown in Figure 6-2.

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6.2 Impacts of consequential and related projects

6.2.1 Scope of assessment

Consequential impacts are defined as those which result from further actions which are made possible or facilitated by the Project. The Project facilitates:

- The NGBR development
- The Adani Abbot Point T0 development
- Increased shipping resulting from the T0 development.

The impacts of the related Carmichael Mine development proposed by Adani are also considered.

The location of each of the listed developments relative to the Project is shown in Figure 6-1.

Each of these projects has been assessed and approved under the EPBC Act. The impacts of each of these projects are described below for each of the following:

- Habitat for listed threatened species and ecological communities
- Habitat for listed migratory species
- The World Heritage values of the GBR World Heritage property
- The National Heritage values of the GBR World Heritage Place
- The GBRMP
- The environment in the Commonwealth marine area.

Impacts are described in terms of potential impacts on MNES that have been identified relevant to each of the projects in their approvals documentation. Detail is also provided on potential impacts related to increased shipping activity associated with these projects. The consequential impacts associated with the shipping of coal exported from T0 for the projects are explicitly dealt with by the Adani Abbot Point T0 project. The information provided below is drawn from publicly available information developed by Adani for these projects and the Australian Government DoE in the assessment of these projects.

6.2.2 Activities and impacts

6.2.2.1 North Galilee Basin Rail project

Project details

The NGBR project proposed by Adani involves the construction and operation of a rail corridor of approximately 310km in length, including standard gauge rail and associated infrastructure, from approximately 70km east of Adani's proposed Carmichael Mine, to the Port of Abbot Point.

Adani prepared an EIS for the project (GHD, 2013a) and additional information to the EIS (GHD, 2014) which was approved with conditions under the EPBC Act (EPBC 2013/6885) on 23 September 2014. The controlling provisions for the project are:

- World Heritage properties
- National Heritage places
- Listed threatened species and communities
- Listed migratory species

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- Commonwealth marine areas
- GBRMP.

The project EIS identified construction commencement in 2014; however, it is understood that construction associated with the project may commence in 2015.

Potential significant impacts to Matters of National Environmental Significance

The NGBR EIS (GHD, 2013a) states that while there is no direct intersection by the NGBR project, the GBRWHA is a controlling provision for the project due to the potential for indirect impacts as a result of the hydrological connection of the watercourses crossed by the preliminary investigation corridor and the GBRWHA. At its closest point the GBRWHA lies within 500m of the northern-most part of the final rail corridor near the Port of Abbot Point.

Maximum disturbance limits conditioned for the project for potentially impacted terrestrial MNES for the NGBR project are:

- SEVT of the Brigalow Belt (North and South) and Nandewar Bioregions threatened ecological community – 56ha
- Natural grasslands of the Queensland central highlands and the northern Fitzroy Basin threatened ecological community – 133ha
- Brigalow (*Acacia harpophylla*) dominant and co-dominant threatened ecological community – 195ha
- Habitat for the endangered Australian Painted Snipe – 46ha
- Habitat for the vulnerable Black-Throated Finch – 1,836ha
- Habitat for the vulnerable Squatter Pigeon (southern) – 1,362ha along rail alignment and 4km south-east of the project area
- Habitat for the vulnerable Ornamental Snake – 421ha
- Habitat for the vulnerable Koala – 2,048ha
- Habitat for the vulnerable Black Ironbox – 175ha
- Habitat for the endangered King Bluegrass – 263ha
- Habitat for the vulnerable Bluegrass - 354ha

In addition, in investigations for other projects at Abbot Point, the Caley Valley Wetlands has been identified as a significant habitat for waterbirds in the context of the OUV of the adjacent GBRWHA (Section 3.1.9.2) and in the provision of ecosystem services that benefit the GBRWHA (Section 3.1.9.3).

Residual impacts to Matters of National Environmental Significance

Conditions of the project's approval include the requirement to develop and implement a Biodiversity Offset Strategy to compensate for unavoidable impacts on MNES. The offsets were required by the approval conditions to be consistent with the Queensland Government's *Galilee Basin Strategic Offset Strategy*.

EPBC Act approval conditions for the NGBR project (Conditions 4 and 5) require the development of management plans to adaptively manage and mitigate the impacts on the Australian Painted Snipe. This plan is also likely to have benefits for migratory shorebirds and waterbirds more generally.

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The NGBR project is conditioned to implement a Biodiversity Offset Strategy and to execute the project in accordance with project approvals and commitments. Impacts of the project to MNES are to be avoided, minimised, mitigated and/or offset as conditioned to avoid significant residual impacts.

6.2.2.2 Adani Abbot Point Terminal 0 project**Project details**

The Abbot Point Coal T0 project, proposed by Adani will provide a new stand-alone coal export facility at the Port of Abbot Point for export of up to 70Mtpa of coal, principally from the Carmichael Mine in the Galilee Basin. Adani prepared an EIS for the project (CDM Smith, 2013a) which was approved with conditions under the EPBC Act (2011/6194) on 10 December 2013. The controlling provisions for the project are:

- World Heritage properties
- National Heritage places
- Listed threatened species and communities
- Listed migratory species
- Commonwealth marine areas
- GBRMP.

The project EIS identified construction commencement in 2013; however, it is understood that construction associated with the project may commence in 2015 or later.

Potential significant impacts to Matters of National Environmental Significance**Shipping**

The project EIS (CDM Smith, 2013a) explicitly deals with consequential impacts associated with shipping for the export of coal from T0. The EIS identifies that at operational throughput of 70Mtpa (phases 1 and 2) the project will result in 560 additional ship calls to the Port of Abbot Point. The EIS further identifies that during the project's construction phase; approximately 12 major deliveries will be made to site through shipping.

The assessment made for the EIS considers potential shipping-related impacts that may be facilitated by the project including:

- Potential increase in ship groundings and vessel collisions including potential spill risks
- Potential for marine invasive species to be introduced, including through ballast water
- Potential impacts associated with the management of waste, including quarantine waste
- Potential increase in vessel strikes on marine species
- Potential impacts on marine species associated with underwater noise
- Potential impacts on marine turtles associated with changes to the light horizon
- Potential disturbance of marine habitat associated with anchorages.

The EIS describes safety measures which target shipping within the GBR region including:

- Zoning to enable development of areas of specific protection in the GBRMP
- Application of pilotage requirements in designated areas of the GBR and port areas
- Development of robust safety and response systems

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- Enhancement of navigational aides
- Development of an auditable Ship Reporting System
- Development of defined pilotage regimes.

The EIS describes systems currently in place for shipping management in the region including the Great Barrier Reef and Torres Strait Vessel Traffic Service (REEFVTS), which includes a mandatory Ship Reporting System (REEFSRS) and monitoring and surveillance systems, including radar, Automatic Identification Systems, Automated Position Reporting via Inmarsat-C and Very High Frequency Reporting. The EIS highlights information indicating that in recent history whilst ship movements have increased in the GBR region, there has been a decrease in the number of groundings and collisions by commercial shipping vessels. The EIS attributes this to the improved safety management measures described above.

The EIS outlines measures that will be implemented to manage potential impacts associated with marine invasive species and the management of wastes, including ensuring that all vessels meet the highest possible quarantine standards, that all ballast and biofouling measures are adhered to as per the *Quarantine Act 1908* and ensuring that all ship waste is disposed appropriately and in accordance with waste disposal procedures (CDM Smith, 2013a).

Due to the distance of shipping activities from known habitats of marine turtles, the EIS indicates that no impacts to these habitats are expected to be caused by project-associated shipping light. Similarly the EIS identifies that underwater noise generated by shipping is unlikely to impact listed threatened or migratory marine species. Management measures identified in the EIS to minimise the risk of vessel strike during construction and operation include restriction of the speed of vessels in shallow waters and operations being undertaken in accordance with port rules for the Port of Abbot Point.

The EIS identified preliminary investigations that had been undertaken regarding future potential anchorage locations, including multi-criteria analysis undertaken to determine appropriate locations. The EIS indicated that further assessment of the need for and location of potential anchorage locations would be undertaken by MSQ.

Each of the potential impacts and proposed management measures identified in the project EIS were considered in the assessment of the project's potential impacts on MNES (discussed below). Further detail regarding shipping related impacts is provided at Section 6.3.3.5.

Facility construction and operation

The T0 EIS found the project will not have a significant direct or indirect impact to marine MNES and marine habitats. Some aspects of the construction and operation of T0 may impact upon the immediate project area (but not on MNES) include:

- Increased underwater noise and vibrations generated through piling activities during construction and operation
- Increase deposition of sediments on the southern side of the MOF
- Increased lighting as a result of construction activities (short-term) and operational activities (long-term) adjacent to a low density turtle nesting beaches
- Increased risk of introduction of pest species into the marine environment through increased vessel movements.



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The potentially impacted terrestrial MNES and areas affected by the Adani Abbot Point T0 project are:

- Habitat for the vulnerable Squatter Pigeon (southern) - 67ha at Abbot Point
- Habitat for migratory shorebirds and the endangered Australian Painted Snipe - no clearing of habitat and minimal predicted off-site impacts
- Habitat for important populations of migratory non-shorebirds (Caspian Tern, Little Tern, Great Eastern Egret) - no clearing of habitat and minimal predicted off-site impacts.

In addition, in investigations at Abbot Point for other projects, the Caley Valley Wetlands was identified as a significant habitat for waterbirds in the context of the Outstanding Universal Values of the adjacent GBRWHA (Section 3.1.9.2) and in the provision of ecosystem services that benefit the GBRWHA (Section 3.1.9.3). There are no predicted adverse impacts on the Caley Valley Wetlands from the Adani Abbot Point T0 project.

Residual impacts to Matters of National Environmental Significance

The recommendation report for the project developed by DoE in support of the decision on approval of the action (DoE, 2013b) identifies significant residual impacts that the department considers will occur as a result of the action, including on:

- GBRWHA and National Heritage place
- Listed threatened marine turtle species, in particular the Green and Flatback turtles.

The recommendation report identifies that the DoE considers that all of the potential impacts identified by Adani (i.e. *“including increased lighting on a known nesting beach for EPBC listed Green and Flatback Turtle species; impacts to aesthetic values from increased shipping numbers in the Great Barrier Reef World Heritage Area; increased pollutants such as coal dust, chemical toxins, total suspended solids; alteration to physical qualities of benthic habitats and communities; and, chemical contamination”*) will lead to long-term degradation of the marine environment and, as such, the DoE considers that the project will have significant residual impacts to the GBRWHA and listed Green and Flatback Turtle species' foraging, nesting and traversing habitat.

Further, the recommendation report reflects the DoE's consideration that the impacts of the action will be suitably compensated through requirements for offsets for all unavoidable residual significant impacts. The report's recommendations are reflected in the conditions of the EPBC Act approval for the project, requiring the implementation of a Marine Offset Strategy (conditions 29 through 37 of the project approval).

The DoE recommendation report also sets out a requirement for submission of a Terrestrial Management Plan for impacts associated with the land-based construction and operation activities of the project to effectively define, avoid, adaptively manage and mitigate impacts to the following protected matters:

- Semi-Evergreen Vine Thicket of the Brigalow Belt (North and South) and Nandewar Bioregions
- Squatter Pigeon
- Australian Painted Snipe
- Listed migratory bird species.

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This plan must include management of water-related impacts for the Caley Valley Wetlands and light impacts on the Caley Valley Wetlands and the marine environment, including nesting beaches for listed turtle species.

6.2.2.3 Carmichael Coal Mine and Rail project**Project details**

The project consists of an open-cut and underground coal mine with a yield of 60 million tonnes per annum and a 189-kilometre railway line. The locations of the infrastructure components of the project are shown on Figure 6-1 and Figure 6-2. The mine is located in the Galilee Basin, 160 km north-west of Clermont. The railway line runs from the mine to Moranbah, where it will join the existing Goonyella rail system, which connects to coal terminals at the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point.

Potential significant impacts to Matters of National Environmental Significance

The terrestrial ecology assessment of impacts for the Project EIS (**Appendix P**) notes that the potentially impacted terrestrial MNES and areas affected by the Carmichael Coal Mine and Rail project common to terrestrial MNES impacts of the Project are:

- Removal of habitat for the vulnerable Squatter Pigeon (southern) - 12,421ha at the mine site and along the rail alignment; no impact at Abbot Point
- Removal of habitat for the non-migratory non-shorebird Eastern Great Egret - 320ha at the mine site and along the rail alignment not representing sites supporting a significant proportion of the population; no impact on Caley Valley Wetlands
- Removal of habitat for the migratory non-shorebird Caspian Tern - 17ha; no impact on Caley Valley Wetlands.

Residual impacts to Matters of National Environmental Significance

As part of the Biodiversity Offset Strategy required for the project, approval conditions require offsetting of Squatter Pigeon habitat impacted at the mine site. The offsets were required by the approval conditions to be consistent with the Queensland Government's *Galilee Basin Strategic Offset Strategy*.

Impacts of the project to MNES are to be avoided, minimised, mitigated and/or offset as conditioned to avoid significant residual impacts.

6.2.3 Impact assessment

The NGBR, Abbot Point T0 and Carmichael Coal Mine and Rail projects have all been subject to environmental assessment under Australian and Queensland environmental legislation and have been approved with conditions to manage and protect matters of national and State environmental significance. Where significant residual impacts are predicted for MNES, offset actions have been conditioned for affected matters. Approval of the projects, subject to conditions, indicates that the consequential impacts of the Project on MNES have been thoroughly assessed and determined to be acceptable.



6.3 Cumulative impacts

6.3.1 Assessment approach

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones (IFC, 2013).

The approach to the cumulative impact assessment relevant to the Project involves:

- Definition of the basis for assessment of cumulative impacts relevant to the project activities (Section 6.3.2)
- Identification of relevant activities, external to the Project, which, considering temporal and spatial boundaries, have potential for additive impacts
- Assessment of the risk of the cumulative project and external activities (Section 6.3.3).

It is notable that the Abbot Point CIA (ELA and Open Lines, 2013) developed in 2012/2013 for the Abbot Point Working Group (the proponents of projects then proposed at Abbot Point; Adani, BHP Billiton, GVK Hancock and NQBP) provided a comprehensive assessment of potential cumulative impacts arising from the respective projects. Since the finalisation of that assessment, BHP Billiton's proposed T2 project is now not progressing, and the Capital Dredging Project for Terminals 0, 2 and 3 has been abandoned by NQBP. The Abbot Point CIA is a useful reference document to the cumulative impact assessment described herein, albeit that it is noted that generally cumulative impacts described below will be of lesser significance than those of the Abbot Point CIA, due to the reduction in scale, and amendment of type of development proposed at the port.

6.3.2 Basis of the assessment

Threats to environmental values of the GBR that are relevant firstly to the Project and also to those projects that may act to impact on those values cumulatively in a spatial sense, are derived from the assessment of risks associated with local and regional threats to the Reef's ecosystem and heritage values undertaken for the *Great Barrier Reef Outlook Report 2014*. These are:

- Disposal of dredged material
- Artificial light
- Dredging
- Exotic species
- Vessel strike
- Vessel waste discharge
- Noise pollution
- Spill - small
- Atmospheric pollution
- Damage to seafloor.

Threats to terrestrial values of national environmental significance that are associated with local and regional impacts of the Project and relevant for consideration in a cumulative sense are derived from the Project's environmental risk register (**Appendix U**) and categorised to a scale consistent with the GBR risks. They are defined as:

- Wetland water quality degradation

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- Land clearing and habitat loss
- Wildlife disturbance.

6.3.3 Relevant external projects and activities

The impacts of the following activities have been considered cumulatively with those of the Project as they have the potential to have overlapping spatial and temporal impacts with the Project and may therefore require consideration in a cumulative context:

- Development and associated dredging and disposal increased shipping from:
 - Abbot Point T0 Project
 - Abbot Point T1 (existing)
 - Abbot Point T3 (proposed)
- The proposed NGBR project (limited to the port end of the rail line)
- The Alpha Coal and Rail Development (limited to the port end of the rail line).

Locations of the listed development proposals are shown in Figure 6-2.

While the Project will result in minimal increases in shipping, it is acknowledged that it facilitates the development of T0 which in conjunction with the proposed T3 will lead to increased shipping.

Each of these external activities is initially considered individually (Sections 6.3.3.1 to 6.3.3.5). Section 6.3.3.6 considers the relevance of each of the identified external developments (and increased shipping) in relation to the potentially common threat categories.

Where additive impacts are identified, these relevant threats are relevant for subsequent consideration in the cumulative impact assessment (Section 6.3.4).

6.3.3.1 Adani Abbot Point Terminal 0 project**Project details**

This project is described for consequential impacts in Section 6.2.2.2. Infrastructure components of the project are shown on Figure 6-2. It is understood that there will be no earthworks or marine infrastructure construction for this project that will occur concurrently with the Project.

Potential significant impacts to Matters of National Environmental Significance

Potentially impacted marine environmental values affected by the Adani Abbot Point T0 project that are common to marine MNES impacts of the Project are:

- Local water quality from return water discharges from onshore placement
- Local water quality from dredging
- Loss of seagrass habitat via dredging of berth pockets
- Vessel strike
- Vessel waste discharge
- Spills into the marine environment.

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None of the impacts on the local marine environment listed above when considered cumulatively will have a significant impact on MNES. The CIA found that:

- It is unlikely the marine environment and marine fauna species will be significantly impacted by the Abbot Point projects
- There is unlikely to be loss in the Outstanding Universal Value or decline in the integrity of the GBRWHA (either Reef-wide or locally).

Routine shipping in the GBR presents no substantive risk to the environment, and the forecast increase in shipping presents minimal risk if managed accordingly.

The impacts of increased shipping that would be related to or associated with the project are discussed in Section 6.3.3.5.

The potentially impacted terrestrial MNES and areas affected by the Adani Abbot Point T0 project that are common to terrestrial MNES relevant to the Project at Abbot Point are:

- Habitat for the vulnerable Squatter Pigeon (southern) - 67ha at Abbot Point
- Habitat for migratory shorebirds and the endangered Australian Painted Snipe - no clearing of habitat and minimal predicted off-site impacts
- Habitat for important populations of migratory non-shorebirds (Caspian Tern, Little Tern, Great Eastern Egret) - no clearing of habitat and minimal predicted off-site impacts.

In addition, during investigations at Abbot Point for other projects, the Caley Valley Wetlands was identified as a significant habitat for waterbirds in the context of the Outstanding Universal Values of the adjacent GBRWHA and in the provision of ecosystem services that benefit the GBRWHA. There are no predicted adverse impacts on the Caley Valley Wetlands from the Adani Abbot Point T0 project.

Residual impacts to MNES

The recommendation report for the project developed by DoE in support of the decision on approval of the action (DoE, 2013b) identifies significant residual impacts that the department considers will occur as a result of the action including on:

- GBRWHA and National Heritage place
- Listed threatened marine turtle species, in particular, the Green and Flatback Turtles.

The recommendation report identifies that the DoE considers that all of the potential impacts identified by Adani (*"including increased lighting on a known nesting beach for EPBC listed Green and Flatback Turtle species; impacts to aesthetic values from increased shipping numbers in the Great Barrier Reef World Heritage Area; increased pollutants such as coal dust, chemical toxins, total suspended solids; alteration to physical qualities of benthic habitats and communities; and, chemical contamination"*) will lead to long-term degradation of the marine environment and, as such, the DoE considers that the project will have significant residual impacts to the GBRWHA and listed Green and Flatback Turtle species' foraging, nesting and traversing habitat.

However, the recommendation report reflects DoE's consideration that the impacts of the action will be suitably compensated through requirements for offsets for all unavoidable residual significant impacts. The report's recommendations are reflected in the conditions of the EPBC Act approval for the project, requiring the implementation of a Marine Offset Strategy (conditions 29 through 37 of the project approval).



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The DoE recommendation report also sets out a requirement for submission a Terrestrial Management Plan for impacts associated with the land-based construction and operation activities of the project to effectively define, avoid, adaptively manage and mitigate impacts to the following protected matters:

- Semi-Evergreen Vine Thicket of the Brigalow Belt (North and South) and Nandewar Bioregions
- Squatter Pigeon
- Australian Painted Snipe
- Listed migratory bird species.

This plan must include management of water-related impacts for the Caley Valley Wetlands and light impacts on the Caley Valley Wetlands and the marine environment, including nesting beaches for listed turtle species.

The Adani Abbot Point T0 project must be executed in accordance with project approvals and commitments.



6.3.3.2 Alpha Coal rail development

Project details

The Alpha Coal rail development, proposed by GVK Hancock will construct and operate a coal mine near Alpha in Central Queensland, as well as a supporting rail link between the mine and Abbot Point. GVK Hancock developed an EIS (Hancock Prospecting Pty Ltd, 2010) and supplementary EIS for the project (Hancock Prospecting Pty Ltd, 2011) which was approved with conditions under the EPBC Act (2008/4648) on 23 August 2012.

For the purposes of cumulative impact assessment relevant to the Abbot Point Growth Gateway Project, only the port end of the rail development, in the vicinity of the Project, is considered relevant.

The controlling provisions for the project are:

- World Heritage properties
- National Heritage places
- Listed threatened species and communities
- Listed migratory species.

The EPBC Act approval has effect until 1 September 2053.

The locations of the infrastructure components of the project are shown on Figure 6-2. It is understood that there will be no earthworks or other significant construction activities for the project at Abbot Point that will occur concurrently with the Project.

Potential significant impacts to Matters of National Environmental Significance

The potentially impacted terrestrial MNES and areas affected by the Alpha Coal rail development common to terrestrial MNES impacts of the Project at Abbot Point are:

- SEVT of the Brigalow Belt (North and South) and Nandewar Bioregions TEC -14ha
- Habitat for the vulnerable Squatter Pigeon (southern) - approximately 211ha at Abbot Point
- Habitat for the endangered migratory shorebirds and the Australian Painted Snipe - 113ha within the Caley Valley Wetlands.

In addition, during investigations at Abbot Point for other projects, the Caley Valley Wetlands was not identified as a significant habitat for waterbirds in the context of the Outstanding Universal Values of the adjacent GBRWHA and in the provision of ecosystem services that benefit the GBRWHA.

Residual impacts to Matters of National Environmental Significance

As part of the Biodiversity Offset Strategy required for the project, approval conditions require offsetting of SEVT, Squatter Pigeon and wetland habitats. The offset requirement for Squatter Pigeon is related to the total habitat loss for the Project including the mine and rail line (6,348ha). The offsets were required by the approval conditions to be consistent with the Queensland Government's *Galilee Basin Strategic Offset Strategy*. In addition, a research fund is to be established for EPBC listed threatened fauna, including the Squatter Pigeon (southern).

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Impacts of the project to MNES are to be avoided, minimised, mitigated and/or offset to as conditioned to avoid significant residual impacts.

6.3.3.3 Abbot Point Terminal 3 project**Project details**

The Abbot Point T3 project, proposed by GVK Hancock involves construction of a coal terminal at Abbot Point (T3) comprising of offshore infrastructure (including jetty structure and berths) and onshore infrastructure (including coal stockpiles and associated infrastructure). GVK Hancock developed Preliminary Documentation for the project (GHD, 2012b) which was approved with conditions under the EPBC Act (2008/4468) on 4 October 2012. The controlling provisions for the project are:

- World Heritage properties
- National Heritage places
- Listed threatened species and communities
- Listed migratory species
- Commonwealth marine areas.

The EPBC Act approval has effect until 1 September 2053.

The locations of the infrastructure components of the project are shown on Figure 6-2. It is understood that there will be no earthworks or other significant construction activities for the project at Abbot Point that will occur concurrently with the Project.

Potential significant impacts to Matters of National Environmental Significance

The potentially impacted terrestrial MNES and areas affected by the Abbot Point T3 project that are common to terrestrial MNES impacts of the Project at Abbot Point are:

- SEVT of the Brigalow Belt (North and South) and Nandewar Bioregions TEC - 1.7ha
- High value habitat for the vulnerable Squatter Pigeon (southern) - 174.4ha of eucalypt woodland and non-native grassland
- Habitat for migratory shorebirds and the endangered Australian Painted Snipe - 28ha within the Caley Valley Wetlands
- Seagrass communities as habitat for marine migratory species - 0.1ha
- Intertidal beach habitat for migratory marine reptile species - 0.5ha
- The impacts of increased shipping within the GBRWHA through the operation of the T3 facility (discussed in Section 6.3.3.5).

During investigations at Abbot Point for other projects, the Caley Valley Wetlands was identified as a significant habitat for waterbirds in the context of the Outstanding Universal Values of the adjacent GBRWHA and in the provision of ecosystem services that benefit the GBRWHA.

Residual impacts to Matters of National Environmental Significance

The approval for the project required the development and implementation of a Biodiversity Offset Strategy to offset unavoidable residual impacts on MNES (including TECs and habitat for listed threatened or migratory species).

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Impacts of the project to MNES are to be avoided, minimised, mitigated and/or offset as conditioned to avoid significant residual impacts.

6.3.3.4 North Galilee Basin Rail project**Project details**

See the discussion at Section 6.2.2.1 for details of this project.

For the purposes of cumulative impact assessment relevant to the Abbot Point Growth Gateway Project, only the port end of the NGBR development is considered relevant.

Potential cumulative significant impacts to Matters of National Environmental Significance

The potentially impacted terrestrial MNES and areas affected by the NGBR project that are common to terrestrial MNES impacts of the Project at Abbot Point are:

- SEVT of the Brigalow Belt (North and South) and Nandewar Bioregions TEC - approximately 33ha at Abbot Point
- Habitat for the vulnerable Squatter Pigeon (southern) - approximately 300ha at Abbot Point
- Habitat for migratory shorebirds and the endangered Australian Painted Snipe - 45.6ha at Abbot Point
- Habitat for important populations of migratory non-shorebirds (Caspian Tern, Little Tern, Great Eastern Egret) - 45.6ha at Abbot Point 4km south-east of the project area.

In addition, during investigations at Abbot Point for other projects, the Caley Valley Wetlands was identified as a significant habitat for waterbirds in the context of the Outstanding Universal Values of the adjacent GBRWHA (Section 3.1.9.2) and in the provision of ecosystem services that benefit the GBRWHA (Section 3.1.9.3). Around 45.6ha of the Caley Valley Wetlands would be affected by the NGBR project.

Residual cumulative impacts to Matters of National Environmental Significance

Conditions of the project approval include the requirements to develop and implement a Biodiversity Offset Strategy to compensate for unavoidable impacts on MNES. The offsets were required by the approval conditions to be consistent with the Queensland Government's *Galilee Basin Strategic Offset Strategy*.

EPBC Act approval conditions for the NGBR project (Conditions 4 and 5) require the development of management plans to adaptively manage and mitigate the impacts on the Australian Painted Snipe. This plan is also likely to have benefits for migratory shorebirds and waterbirds more generally.

The NGBR project is conditioned to implement a Biodiversity Offset Strategy and to execute the project in accordance with project approvals and commitments. Impacts of the project to MNES are to be avoided, minimised, mitigated and/or offset as conditioned to avoid significant residual impacts.



6.3.3.5 Shipping

As noted previously, the Project will, of itself, result in minimal increases to shipping movements. However it is acknowledge that the project is related to the proposed T0 project which (as discussed in Section 6.2.2.2) will result in consequential impacts associated with shipping of coal exports. These are discussed below in the context of broader shipping impacts to the GBR.

A variety of commercial ships trade in the GBR region including: cruise ships; general cargo and container ships; petroleum, gas, chemical and liquid tankers; and bulk commodities ships, typically referred to as 'bulk carriers'.

Abbot Point is currently a coal export port and has been in operation since 1984. It is expected to remain a coal export port into the future. As such, the ships calling at the port are exclusively bulk carriers. Bulk carriers are sizeable vessels (>100m length) comprising a number of large, commodious, single-deck holds into which the loose, bulk cargo is loaded.

The proposed action of dredging berth pockets and apron for the development of T0 at Abbot Point will facilitate an increase in the number of vessels using the Port, as will the T3 development proposed by GVK Hancock.

Potential impacts from increased shipping associated with terminal development (and associated dredging activities) from Abbot Point have been extensively studied. Table 6-1 provides an analysis of the studies, which have been undertaken to date and the conclusions reached by each assessment/study.



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Table 6-1 Investigations of shipping related impacts

Project Name and Reference	Assessment Scope	Conclusion of Increased Shipping Impacts on MNES
<p>Abbot Point Coal T0 (EPBC 2011/6194)</p> <p>CDM Smith (2013)</p>	<p>The EIS documentation for the approved development of the Abbot Point Coal T0 (Adani) provides a detailed assessment of potential impacts in relation to increased shipping during operations of T0. Cumulative and consequential impacts are also addressed, including shipping. The EIS details:</p> <ul style="list-style-type: none"> Current vessel numbers and the types of vessels using the existing port facilities Projected vessel numbers and types during operation Shipping routes to be utilised within the port and commonwealth waters. <p>The EIS assesses the potential impact of increased shipping in relation to:</p> <ul style="list-style-type: none"> The introduction of marine invasive species Ship groundings in the GBR Vessel collisions and related impacts. Vessel strikes on marines species Ballast water management arrangements - including the Australian Quarantine Inspection Potential spill risks Increased marine underwater noise on marine species Changes to the light horizon and impacts on marine turtles 	<p>The EIS concluded that there would be no significant risk associated with increased shipping activities as a result of the development of T0 if appropriate management measures are in place.</p> <p>Management measures proposed included standard, stringent regulatory measures currently required throughout Queensland and the GBRMP. These include measures to minimise potential impacts (collisions, groundings and pest introduction) associated with shipping including the REEFVTS, pilotage systems, quarantine and biosecurity measures. These measures have, to date, reduced the rate of major incidents within the GBRMP (although shipping rates have increased during the corresponding periods) and ensured the pest free status of many areas including Abbot Point.</p> <p>A Marine and Shipping Management Plan, covering all construction and operation activities, must be developed by the proponent as required by the approval conditions for the project. This is to ensure the protection of MNES.</p>



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Project Name and Reference	Assessment Scope	Conclusion of Increased Shipping Impacts on MNES
	<ul style="list-style-type: none"> Acute and chronic impacts of coal dust Potential use of the GBRWHA and GBRMP for offshore anchorage of ships and trans-shipping activities Additional marine transport activities. 	
Abbot Point Coal T3 (EPBC 2008/4468) Hancock Coal Infrastructure Pty Ltd (2012)	The Preliminary Documentation for the approved development of Abbot Point Coal T3 details the indirect impacts associated with increased shipping (Section 6 and 9 of the Preliminary Documentation).	<p>The assessment concluded that given the limited number of ship movements and the current level of control and management of shipping within the World Heritage Area, this small increase in ship numbers would not result in a significant impact.</p> <p>The conditions attached to the approval of this project require a Heritage Management Plan to ensure the protection and long-term conservation of the GBRWHA. The Heritage Management Plan must consider the impacts of shipping.</p>
Abbot Point T0, T2 and T3 Capital Dredging Project (EPBC 2011/6213) GHD (2012)	The PER documentation for the approved Abbot Point T0, T2 and T3 Capital Dredging project (NQBP) addresses the potential for cumulative and consequential impacts that may occur. It is recognised that the primary consequential impact to be associated with the approved capital dredging works is an increase in shipping visitation at Abbot Point. The PER documentation refers to the impact assessment work for increased shipping undertaken in the Abbot Point CIA (ref below).	Potential impacts arising from the related impacts of increased shipping through the capital dredging program of Abbot Point are to be managed through an Environmental Management Framework (as proposed in the CIA and to be implemented through the port master plan).



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Project Name and Reference	Assessment Scope	Conclusion of Increased Shipping Impacts on MNES
Abbot Point CIA ELA and Open Lines (2013)	<p>The Abbot Point CIA provides an assessment of the potential cumulative impacts arising from the proposed expansion of coal export facilities at the Port of Abbot Point.</p> <p>Shipping was addressed through a comprehensive analysis of risks at a Reef-wide scale and at Abbot Point, supported by a detailed technical report to review the environmental implications associated with GBR shipping activities (PGM Environment, 2012).</p> <p>The CIA further provides recommendations to manage the risks to the GBRWHA from shipping. These provide a set of best practice shipping requirements that recognise the sensitivity of the marine environment of the GBRWHA. The responsibility for implementing these recommendations lies both with government agencies and industry.</p>	<p>A set of standards was recommended through the CIA (in particular, cooperative adaptive management measures for shipping-relating impacts at Abbot Point). These recommendations were provided to ensure the risk of serious incidents involving vessels calling at the port would be minimised.</p>
Great Barrier Reef Shipping. Review of environmental implications PGM Environment (2012)	<p>The Great Barrier Reef Shipping Report, which was commissioned to inform the Abbot Point CIA. It provides forecasts of shipping increases over the next 20 years. In detail, the report examines the potential environmental risks from commercial shipping within the context of current and future maritime regulation and management.</p>	<p>The overall findings of the PGM Environment (2012) report were that:</p> <ul style="list-style-type: none"> ▪ Impacts associated with routine shipping present no substantive risk to the environmental values of the GBR ▪ The forecast increase in shipping in and of itself, presents minimal risk if managed appropriately ▪ The impacts and risks to the GBR from shipping are extremely well managed and these management



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Consequential and Cumulative Impact Assessments

Project Name and Reference	Assessment Scope	Conclusion of Increased Shipping Impacts on MNES
		<p>measures are improving over time to address the increased shipping volumes and related risks</p> <ul style="list-style-type: none"> The management of shipping in the GBR is favourably comparable to the highest standards in other parts of the world.
<p>North-East Shipping Management Plan</p> <p>Australian Maritime Safety Authority (2014)</p>	<p>The plan deals with shipping management in the GBR, Torres Strait and Coral Sea region. The report references a series of studies undertaken to inform shipping management in the region, including the Great Barrier Reef Shipping Study (PGM Environment, 2012) produced as part of the Abbot Point CIA.</p>	<p>The Plan sets out current and future management arrangements for shipping including:</p> <ul style="list-style-type: none"> Pilotage Shipping channels Vessel tracking system Oil spill response Port State Control to detain vessels of an unacceptable standard Anchorage management Pollution discharges and waste.
<p>Reef 2050 Long-Term Sustainability Plan</p>	<p>Provide an overarching strategy for management of the GBR. The Plan coordinates actions and guides adaptive management to 2050. It addresses the findings of the Outlook Report 2014</p>	<p>The Plan aims to build the GBR's resilience by improving water quality, maintaining biodiversity, ensuring port development and shipping has minimal impact on the Reef.</p>



Current shipping activities at Abbot Point

Abbot Point has been exporting coal as its primary commodity for 30 years (since 1984). The number of vessels using the port has gradually increased since the Port became operational in order to respond to the increase in coal availability and overseas demand. Vessel calls at Abbot Point have increased from 119 in the 2002/03 financial year to 289 ships in 2013/14. The noticeable decrease in vessel calls in 2010/11 was due to extreme natural weather events, primarily Tropical Cyclone Yasi in January 2011, which disrupted both mine production and port throughput. As is seen in the years following Cyclone Yasi, the general trend in vessel calls to Abbot Point has gradually increased over time to match the capacity within the existing terminal (T1).

The types of vessels, which currently access the Port, include:

- Handimax (40,000 to 60,000DWT)
- Panamax (60,000 to 90,000DWT)
- Small Capesize (90,000 to 130,000DWT).

This mix of vessel types is expected to continue to use the Port for some time to come; however, over time it is likely that there will be an increase in the larger vessels.

Vessel forecast for Abbot Point

Forecasts for shipping activities at Abbot Point have been examined in a number of previous reports in relation to terminal developments and associated dredging programs (Table 6-1).

A review of this material indicates that the Abbot Point CIA forecast vessel calls at the port to increase to 1,640 by 2032. This forecast assumed that at least three new terminals (T0, T2 and T3) would proceed to construction and operation by 2020. A revision of the previous forecast has been undertaken in accordance with scope of the cumulative impact assessment described at Section 6.3.3.6, based upon:

- A mix of vessels sizes increasing to more Panamax sizes in the future
- Two future terminal developments (T0 and T3)
- Historical coal export volumes and likely predicted trends
- Actual global demand levels and fluctuations due to cyclical economic conditions
- Industry resourcing capabilities
- Typical terminal throughput characteristics.

The result of this review show that a more realistic current forecast of 600 to 700 vessel calls by 2020 can be anticipated. Once all three terminals T1 (existing) and T0 and T3 are at full operation, total vessels calls of 1,200 are predicted (Figure 6-3).

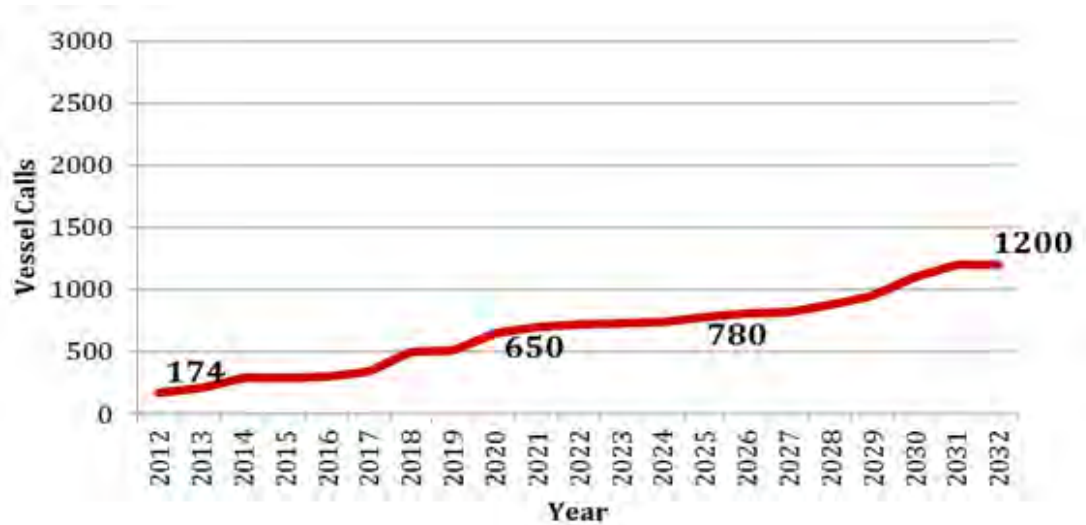
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Figure 6-3 Port of Abbot Point ship forecasts, 2012 to 2032

This forecast represents an average of less than four ship movements per day in 2020 increasing to around six or seven when the terminals are at full capacity.

Global shipping trends indicate that vessel call numbers in the future will also be influenced by an overall increase in average ship size and individual cargo capacities. There will be an increase in the percentage of Panamax and Cape Size vessels. This trend is expected to occur throughout the industry as the export size increases leading to efficiencies in overall shipping movements.

Threats and potential impacts of increased shipping

Potential impacts resulting from the forecasted increase in shipping at Abbot Point has been addressed through a number of previous environmental assessments for terminal developments and proposed dredging projects at the Port. In particular, the Abbot Point CIA (ELA and Open Lines, 2012) undertook an extensive and detailed impact assessment for potential shipping impacts as a result of terminal development at Abbot Point (Section 13 of the CIA), including an analysis of impacts to MNES.

A set of standards was recommended through the CIA (in particular adaptive management measures within the proposed Environmental Management Framework; EMF) for shipping related impacts at Abbot Point. These recommendations were provided to ensure the risk of serious incidents involving vessels calling at the Port would be minimised. The recommendations were also set out with a view to recognising the sensitivity of the marine environment of the GBRWHA and setting a new standard for shipping measures within the reef. The analysis further concluded that many of the necessary measures to address risk in line with greater shipping in the GBR can only be developed, implemented and enforced at a GBR and industry wide level by relevant agencies such as Marine Safety Queensland (MSQ), Australian Maritime Safety Authority (AMSA) and GBRMPA. Importantly, many of these measures have subsequently been included in the *North-East Shipping Management Plan* (NESMP) developed by AMSA and which came into effect in 2014.

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A summary of potential impacts from shipping are provided below. Related cumulative impacts are discussed in Section 6.3.3.6. Both abnormal/low likelihood and normal events are considered. Abnormal or low likelihood events include groundings and collisions, oil spills and the introduction of marine pests.

These impacts are not associated with routine shipping operations but are instead the potential consequences of accidents, which may be brought about by factors relating to issues such as crew competency or poor quality vessels. The likelihood of these impacts occurring, particularly in relation to Abbot Point shipping, is considered to be low for a number of reasons:

- There is comprehensive management of shipping activities within the GBR, including mandatory use of the REEFVTS system and implementation of the NESMP
- Palm Passage (through which approx. 92% of current Abbot Point ship movements are made) is a well declared and easily navigated open water channel
- Abbot Point is an open water port which is easily navigated on both approach and departure, and does not have an inner port shipping channel
- There are no incidences of grounding or collisions on record for arrival/departure vessels at the Port to date.

Threats associated with normal shipping operations include the following key issues:

- Underwater radiated noise (wildlife disturbance)
- Atmospheric emissions (atmospheric pollution)
- Lighting from ships (artificial light)
- Marine fauna strike (vessel strike)
- Introduction of marine pests (exotic species)
- Anchorages (damage to seafloor).

Ship groundings and collisions

Environmental damage that may occur due to ship groundings and/or collisions includes degradation or loss of habitat (marine and terrestrial) and physical impact damage from the ship itself (e.g. to a coral reef). Potential environmental impacts may occur through:

- Physical damage to seabed features, particularly coral reefs due to impact
- Spills or discharges of chemicals, sewage and grey water
- Generation of debris, e.g. ship wreckage and lost cargo and fittings
- Pollution potential of the cargo on board, e.g. herbicides or pesticides
- Loss of oil from bunkers or cargo, particularly heavy fuel oil or heavy crude.

In the worst-case scenario, grounding may cause substantial, and possibly irreversible, direct damage to substratum and benthic biota. Coral reefs are particularly sensitive to ship groundings and may take decades to regenerate. Recovery of impacted coral reefs may be hampered by biocide-based anti-fouling coat debris scraped from the hull during grounding.

Spills or discharges (resulting from groundings and/or collisions) can lead to pollution and environmental damage to benthic substrates, beach and nearshore terrestrial environments and the species that inhabit these environments. Habitat loss, degradation and physical harm to fauna (e.g. feathers coated in oil) are potential outcomes of significant collisions and/or groundings. The loss of large quantities of oil into the marine environment is the major concern associated with shipping, both within the GBR and globally.

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It is important to note that the impacts of a grounding or collision are highly dependent on the severity and location of the incident. A minor, short-term grounding on a muddy bank or an unplanned but impact-free interaction between a tug and another vessel are unlikely to cause any serious impacts to the environment. However, a serious grounding that causes damage to a coral reef could be locally significant. Furthermore, direct impacts of groundings and ship collisions will be highly localised, whereas indirect impacts resulting from release of oil, cargo and other substances can be more widespread.

Vessel quality

Ships which are not designed, built, maintained and operated to requisite standards, particularly with respect to safe navigation and protection of the marine environment, present an increased likelihood of being involved in an environmental or other incident, and/or an increased likelihood of significant consequences in the event of an incident.

Pertinent aspects of ship quality related to safe navigation and protection of the marine environment include:

- Competent, suitably qualified and experienced ship's crew, who are unaffected by fatigue
- Observation of applicable navigation standards
- Age of ship and history of breakdowns
- Correct fit and operation of navigation safety and collision avoidance equipment
- Correct fit and operation of marine pollution prevention equipment, including oily water separators, sewage treatment plants, garbage management equipment, ballast water treatment systems (when mandatory) and processes (e.g. ballast water exchange), and anti-fouling coatings.

Vessel quality has a direct effect on the integrity of a ship, and particularly in the case of incidents such as groundings or collisions, can strongly influence the severity of the outcome. Inadequate maintenance of a ship may also lead to inadvertent leaks of oil or other waste substances.

Vessel quality of ships transiting the GBR and through Abbot Point is maintained via port state controls administered by AMSA and ship vetting procedures conducted by individual companies. Ship vetting refers to the process used to carry out a risk assessment on the acceptability of a particular vessel for the carriage of a cargo for ocean transport. It is an in-depth assessment of a ship's quality and suitability for a task.

Ship vetting generally uses a risk matrix approach, based on many sources of information to determine a vessel's risk rating. Risk ratings are based on a number of risk factors, including:

- Flag risk (determined by statistical assessment, casualty and incident performance associated with the particular flag)
- Class risk (determined by statistical assessment, casualty and incident performance associated with the particular ship class)
- Number of changes of flag, class, owner or manager
- Vessel's history, berth reports, terminal reports
- Port State Control performance (including particular attention to multiple deficiencies and/or detentions over a period of time)
- Vessel's age.

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In the case of RightShip (the mostly widely used vetting system in Australia), the rating is in the form of 'stars', from one (highest risk) to five (lowest risk).

The Abbot Point CIA (ELA and Open Lines, 2012) states that the proponents for the terminal developments at Abbot Point are committed to the process of ship vetting as part of their transport supply chain operations.

Crew competency

Competent, suitably trained and properly rested crews are essential for safe navigation and operation of ships in accordance with accepted practices, while also being capable of responding to emergencies or potential critical incidents in a timely and effective manner.

All aspects of ship navigation, including facets related to protection of the marine environment, are predicated upon ships being crewed by competent, experienced seafarers, with performance unhampered by fatigue.

Recently, there have been some notable shipping incidents in which human factors were a major cause including the grounding of the *Shen Neng 1*. Declining crew competencies have been identified as a potential threat to safe navigation in Australian waters (by AMSA) and globally (by the International Maritime Organisation).

Periodic checks by port and flag State authorities and shipping company managers should be conducted to ensure crews have appropriate competencies and skills, and display proper management of work hours and fatigue.

Oil spills

Oil spills from ships can occur due to grounding and collision, ship structural failure or equipment failure.

The impact of oil spills depends on the amount and type of oil entering the marine environment, and its persistence. In the case of inadvertent loss of oil, the amount lost to the marine environment is usually small, and not likely to present a significant pollution event. However, loss of large quantities of oil due to ship groundings or collisions is the major concern, particularly in sensitive environments such as the GBR.

Once oil enters the sea it spreads, some of it evaporates, while other components enter the seawater as water-accommodated fractions (i.e. dissolved and dispersed droplets). Oil spills affect the marine and nearshore coastal environment in many ways. The severity of the impact depends on the type and quantity of oil, the season and weather, the type of shoreline, the type of waves and tidal energy in the area of the spill and sensitivity of the environment/species exposed to the oil. Depending on conditions, oil spills may be diffuse and widespread or concentrated and localised, which in turn affects the extent and severity of impact.

Similarly to groundings or collisions, the impacts of oil spills are highly dependent on the severity and location of the incident. A minor spill that is quickly managed is unlikely to cause any serious impacts to the environment. However, a large oil spill resulting from a ship grounding or collision could have serious effects. Unlike grounding and collisions, which have highly localised direct impacts, the impacts from major oil spills can be widespread, depending on the dispersive nature of the spill.

**Section 6****Consequential and Cumulative Impact Assessments****Underwater noise**

Large ships generate broadband noise that can radiate throughout the underwater marine environment. The radiated noise spectrum from merchant ships is typically in the range of 20Hz to 500Hz with tonal peaks at around 50Hz. Low frequency acoustic energy propagates well in marine waters, particularly the deep oceans, and ships' low frequency noise components contribute significantly to the amount of low frequency ambient oceanic noise, particularly in regions with heavy ship traffic.

Low frequency broadband noise from shipping is of potential concern as it may impede use of the acoustic spectrum by marine fauna, particularly cetaceans. This concern centres upon the possibility that such noise may:

- Mask echolocation vocalisations or communications
- Acoustically mask predators or prey
- Lead to separation of calves from mothers
- Alienate the animals from preferred aggregation areas or migration pathways, if intense and localised.

Release of ship-sourced atmospheric emissions

Ships emit exhaust gases and particulates from propulsion machinery and auxiliaries as fuel is consumed. Atmospheric emissions include pollutants and greenhouse gases (GHGs). Atmospheric emissions from ships that are of particular interest are: nitrogen oxides; volatile organic compounds; sulfur dioxide; carbon dioxide; carbon monoxide; and particulates (pollutant).

GHGs have global scale effects, as opposed to direct local or regional effects, and are of national and international concern. As such, GHGs generated by ships in the GBR region do not pose any intrinsic local human or pollutant risk, instead indirectly contributing to climate change and its subsequent impacts.

However, ship-sourced nitrogen oxides are recognised at regional scales as an atmospheric pollutant of concern, and the most critical component of the ship atmospheric exhaust in terms of coastal areas. The control of nitrogen dioxide is important because of its role in the atmospheric formation of ozone, the principal component of smog, as well as being a GHG. Nitrogen oxides contribute to 'acid rain' via precipitation, and is responsible for dry deposition of acidic material. Nitrogen oxides are toxic in their own right and can provoke lung irritation and damage at sufficient concentrations.

Lighting from ships

Ships emit light from a variety of sources at night. These include compulsory navigation lighting as required by the Convention on the International Regulations for Preventing Collisions at Sea, with the actual configuration dependent upon ship size and type and activity engaged upon, particularly whether underway or at anchor. In addition to mandatory lighting, the Convention on the International Regulations for Preventing Collisions at Sea also encourage ships to maximise upper deck illumination as a means of enhancing a ship's visual presence, intended to reduce collision risks.

Ships anchoring overnight display two or three white lights of relatively low intensity. Ships also shine masthead obstruction lights, have floodlighting and washlighting (i.e. subdued,



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low angle lighting) on upper deck areas to permit safe working and movement at night, and radiate light from internal living and working areas.

Artificial lighting has the potential to impact marine fauna through a range of processes including (GHD, 2012a):

- Disorientation
- Attraction/repulsion
- Alteration in foraging and breeding behaviours
- Change competition and predation.

Each of these processes has the potential to affect a species' ability to use habitat for feeding, resting or reproduction. As such, artificial lighting can influence the biodiversity of the area it affects. The impact of artificial lighting is species-specific and varies in accordance with light intensity, spectral context (i.e. wavelength) and colour. Conditions such as moon phase and cloud cover can also affect the degree of influence of artificial lighting.

Aquatic invertebrates and fish are known to aggregate at artificial light sources and other marine fauna species may be attracted to these areas due to the increase in prey availability. This may lead to a disruption of ecosystem processes and an overall reduction in foraging habitat value for some marine fauna within a specific area. Alterations in habitat value can lead to an increase in foraging range and localised reduction in species abundance.

Disruption of turtle hatchling movements by artificial lighting from ships anchored close to inshore may also occur when hatchling turtles reach the water. Lights on ships may cause confusion to newly hatched turtles in the water as they have been observed swimming towards vessel lights and then circling the vessels (GHD, 2012a).

Marine fauna strike

Ship strike can be defined as a collision between a vessel and a marine species causing either injuries or death to the marine animal and/or damage to the vessel and sometimes to its passengers (International Whaling Commission, 2006). Ship strikes occur anywhere that vessels and marine fauna distributions overlap, mostly within coastal zones; however, there have been reports of high seas collisions.

Ship strike injuries to marine animals can result in fauna mortality or severe, but non-fatal injuries.

Globally, ship strike is an acknowledged risk for marine species particularly larger marine mammal species, such as whales, dolphins, Dugongs and also reptiles such as turtles. These species appear particularly vulnerable due to their use of surface environments to breathe and feed. Fish (including sharks and rays) and other marine species appear less at risk.

Internationally, Australia does not register as a high risk fauna strike area due to the low intensity of shipping (International Whaling Commission, 2006). Areas of high risk identified by the Ship Strikes Working Group include locations such as the Straits of Malacca, Singapore and Florida, and the English Channel, all of which are relatively narrow routes with very high frequency shipping where interactions are more likely to occur.

Within the GBR, commercial shipping presents a potential risk, primarily to Humpback Whales (*Megaptera novaeangliae*) and this risk increases proportionally as the whale

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population continues to recover and grow. Smaller and medium sized fauna such as turtles and Dugongs appear more at risk from small higher speed boats in areas of high recreational boating traffic such as the Hinchinbrook Island area, Cleveland Bay (within the GBR), Hervey Bay and Moreton Bay further south.

Australia has been reporting vessel fauna strikes through their International Whaling Commission Country Reports since 2006. During the five years between 2006 and 2010 (inclusive) there were eight reported vessel strikes of Humpback Whales in Queensland waters. Not all incidents were reported as fatal and notably; six were caused by non-commercial vessels with the remaining two vessel types unspecified. On an annual basis, this represents <0.05% of the estimated east coast Humpback Whale population (estimated at 15,000 in 2010, Noad *et al.*, 2011).

Introduction of marine pests

Introduced marine pests are marine plants or animals that are not native to Australia that have been introduced by human activities such as shipping. They have the potential to significantly impact marine industries and the environment. Introduced marine pests are known to be introduced or translocated by a variety of vectors, including ballast water, biofouling, aquaculture operations, aquarium imports, marine debris and ocean current movements.

A feature of bulk carrier operations is the use of significant quantities of ballast water, primarily as a cargo substitute for those ships arriving empty to take on cargo at a terminal. By extension, bulk carriers in the GBR ports individually and collectively discharge significant quantities of ballast water. The discharge of high-risk ballast water in Australian ports or waters is prohibited under the *Quarantine Act 1908*. All ballast water that does not fit into the categories below is defined as 'high-risk':

- Fresh potable water sourced from a municipal water supply, with supporting documentation
- Ballast water that has been exchanged at an approved location (mid-ocean) by an approved method
- Ballast water of which at least 95% was taken up in mid-ocean
- Ballast water of which at least 95% was taken up inside Australia's territorial sea.

Australia is sensitive to the risks posed by invasive marine species, as they pose major ecological, economic and social risks.

Anchor damage

Anchoring is fundamental to the general safe management of commercial vessels in and around port areas and is a standard component of all seaport operations worldwide. Merchant ships anchor routinely in designated areas around ports along the coastal margins of the GBR region while awaiting entry into those ports. Ships may also anchor outside these areas as an emergency or safety measure in the event of loss of steering or propulsive power.

Poorly designed and sited anchorages may present environmental risk by:

- Presenting collision risk for ships moving to or from the associated port or sailing on approved or customary routes past the port/anchorage

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- Being located in an area where damage to significant bottom features (e.g. Seagrass beds or coral reef) is unavoidable or an unnecessary risk of occurrence
- Being located in an area of significant habitat for inshore dolphins, Dugongs or turtles such that operations within the anchorage, including the movement of ships and harbour support craft, may degrade that habitat or introduce inordinate risk of vessel strike
- Being located in close vicinity to turtle nesting areas, such that ship lighting and other disturbances may adversely affect turtles.

Ships at anchor also present a potential source of environmental contamination, including components such as biocide in anti-fouling coatings and diesel auxiliary exhaust emissions.

Ships normally anchor in areas of soft sediments (e.g. mud and sand), as these provide the best holding ground. Seagrass meadows are generally not used for anchorage, except in an emergency, as seagrasses do not possess the anchor holding qualities of soft sediments and nor do they occur at the depths required for ship anchoring. Ships will also avoid anchoring on reefs.

Anchoring has a direct physical impact on the seafloor, but the area affected is restricted to the fall of the anchor and that length of anchor cable, which lies across the seafloor. The anchor itself will only disturb a few square metres, although the cable (i.e. chain) may extend up to 100m or along the seafloor, dependent upon depth and sea conditions. Movement of the vessel on the anchor line, as may occur under the influence of wind, tides and currents, can further exacerbate potential impacts on the seafloor.

The extent of physical disturbance attributable to anchoring varies dependent upon water depth, substratum type, anchor type and size, length of cable, ship size, weather and sea conditions. When the anchor and cable are removed from the seafloor, any depressions remaining typically fill with sediment.

Management measures

In order to effectively address the risks of shipping to MNES, it is appropriate to consider the impacts and consequences within the context of the whole GBR.

Many of the measures that can be employed to reduce impacts from shipping are multi-jurisdictional and require the involvement of both industry and government agencies

Commercial ships calling at Abbot Point operate under a strict management regime administered by both Commonwealth and State based agencies and regulators. Table 6-2 outlines the array of international conventions and associated Australian legislation (Commonwealth and State) that are in place to manage commercial shipping.



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Table 6-2 Conventions and legislation relevant to shipping management

International Convention or Guideline	Commonwealth		Queensland	
	Legislation	Responsible Agency	Legislation	Responsible Agency
<i>International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL)</i>	<i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> <i>Navigation Act 1912</i>	AMSA	<i>Maritime Safety Queensland Act 2002</i> <i>Transport Operations (Marine Pollution) Act 1995</i>	MSQ
<i>International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC 90) + Hazardous and Noxious Substances Protocol</i>	<i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> <i>Navigation Act 1912</i> <i>Protection of the Sea (Powers of Intervention) Act 1981</i>	AMSA	<i>Maritime Safety Queensland Act 2002</i> <i>Transport Operations (Marine Pollution) Act 1995</i>	MSQ
<i>International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention)</i>	No specific legislation, but parallel objectives enacted under <i>Quarantine Act 1908</i>	Australian Department of Agriculture, Fisheries and Forestry	No specific legislation	n/a
<i>International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001 (IAFS Convention)</i>	<i>Protection of the Sea (Harmful Anti-fouling Systems) Act 2006</i> <i>Agricultural and Veterinary</i>	AMSA	No specific legislation	n/a



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International Convention or Guideline	Commonwealth		Queensland	
	Legislation	Responsible Agency	Legislation	Responsible Agency
	<i>Chemicals (Administration) Act 1992</i>			
<i>Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species</i>	No specific legislation, but parallel objectives enacted under <i>Quarantine Act 1908</i> and Australian biofouling management guidelines	Australian Department of Agriculture, Fisheries and Forestry	No specific legislation	n/a
<i>International Convention for the Safety of Life at Sea, 1974 (SOLAS)</i>	<i>Navigation Act 1912</i>	AMSA	<i>Maritime Safety Queensland Act 2002</i> <i>Transport Operations (Marine Safety) Act 1994</i>	MSQ
<i>International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW)</i>	<i>Navigation Act 1912</i>	AMSA	<i>Maritime Safety Queensland Act 2002</i> <i>Transport Operations (Marine Safety) Act 1994</i>	MSQ
<i>Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)</i>	<i>Navigation Act 1912</i>	AMSA	<i>Maritime Safety Queensland Act 2002</i> <i>Transport Operations (Marine Safety) Act 1994</i>	MSQ



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International Convention or Guideline	Commonwealth		Queensland	
	Legislation	Responsible Agency	Legislation	Responsible Agency
<i>International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009</i>	No specific legislation	n/a	No specific legislation	n/a
<i>International Maritime Dangerous Goods Code (IMDG Code)</i>	<i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> <i>Navigation Act 1912</i>	AMSA	No specific legislation	n/a



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On the whole, the various assessments of the risks and impacts from shipping associated with Abbot Point conclude that shipping within the GBR region is highly regulated and managed by a combination of Commonwealth and Queensland agencies, in accordance with international rules and regulations.

In particular, REEFVTS is a key element of the management of shipping within the GBR and the frequency of major incidence within GBR waters has reduced since its implementation. The combination of technology, human interaction and highly regulated entry and departure controls work to ensure that shipping is a fundamentally safe and environmentally benign activity under normal operating conditions.

Shipping presents a number of potential impacts to the marine environment, both within port areas and in the more open waters of shipping lanes. Overall, the PGM Environment (2012) report concluded that impacts associated with routine shipping present no substantive risk to the environmental values of the GBR, and that the forecast increase in shipping, presents minimal risk if managed accordingly. The impacts and risks to the GBR from shipping are well managed and these management measures are improving over time to address the increased shipping volumes and related risks. Additionally, the management of shipping in the GBR is favourably comparable to the highest standards in other parts of the world.

However, as acknowledged in the *Great Barrier Reef Outlook Report 2014* (GBRMPA, 2014a), the predicted increase in shipping in the GBR will increase the likelihood of a major incident as well as the potential for more introduced species to occur. In order to manage this risk, shipping regulation, management and technology needs to continue to improve as ship numbers increase.

Many of the necessary measures to address risk in line with greater shipping in the GBR can only be developed, implemented and enforced at a GBR and industry wide level by relevant agencies such as MSQ, AMSA and GBRMPA.

To better coordinate and implement GBR wide shipping management, AMSA has produced and is implementing the NESMP (AMSA, 2014). The plan deals with shipping management in the GBR, Torres Strait and Coral Sea region and reflects many of the recommendations provided in the GBR Shipping Study (PGM Environment, 2012). The Plan sets out current and future management arrangements for shipping including:

- Pilotage
- Shipping channels
- Vessel tracking system
- Oil spill response
- Port State Control to detain vessels of an unacceptable standard
- Anchorage management
- Pollution discharges and waste.

Vessels entering the Port will be subject to the requirements of the NESMP. Through this comprehensive management of shipping, significant impacts to MNES would be avoided.

6.3.3.6 Relevant threats for cumulative assessment

The relevance of external activities in relation to the defined threats is summarised in Table 6-3 and the discussion which follows. The likelihood of these external activities coinciding with the Project in a temporal sense (i.e. those external project impacts that will



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occur within the same timeframe as impacts identified for the Project) is considered. Where, on this basis, there is no opportunity for cumulative impacts to occur, the relevant risks are not further assessed.

Table 6-3 Overview of relevant additive cumulative impacts of proposed developments

Threats Relevant to the Project	Pose Impacts Additive to the Project					Further Assessed
	NGBR	T0	Alpha (Rail)	T 3	Shipping	
Return water discharges from onshore placement				✓		
Artificial light						✓
Dredging				✓		✓
Exotic species		✓		✓	✓	✓
Vessel strike					✓	✓
Vessel waste discharge					✓	✓
Noise pollution					✓	✓
Spills (small and large chemical)		✓		✓	✓	✓
Atmospheric pollution					✓	✓
Damage to seafloor					✓	✓
Wetland water quality degradation						
Land clearing and habitat loss	✓	✓	✓	✓		✓
Wildlife disturbance						

Disposal of dredged material

While approvals have yet to be obtained, this cumulative assessment assumes that dredging for the T3 project will proceed. It is also assumed that dredged material will be placed onshore, consistent with current government policy for dredged capital material at Abbot Point. Common impacts with the Project are those associated with return water discharge from the onshore placement location to the marine environment for the dewatering period.

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Sensitivity analysis of the hydrodynamic modelling testing undertaken by Royal Haskoning (2014) found the dredging (using CSD and onshore placement) of T0 and T3 footprints in one continuous campaign did not significantly increase the spatial region of high concentrations of TSS from the return waters compared to the dredging of T0 only.

If the dredging of T3 occurs very soon after T0 dredging, the quantity of sediment released into the marine environment via returning water discharge during the dredging of T3 is less than the amount that would be released during the T0 dredging. The impacts on water quality (benthic light availability, sedimentation, extent of plumes, TSS concentrations) on nearshore seagrasses of T3 dredging will therefore be less than those predicted with the T0 dredging. No significant impacts to nearshore or offshore seagrasses are predicted due to returning waters from the singular dredging of T0 or T3 or if the projects were combined.

Artificial light

Artificial lighting is proposed for the Project only during the construction period. Impacts have been assessed as insignificant taking into account existing light sources of the operating coal terminal. None of the identified projects will be occurring onsite during the Project construction period, therefore none are additive to the Project's impacts.

Dredging

While approvals have yet to be obtained, this cumulative impact assessment assumes that dredging for the T3 project will proceed. The dredging components of the Abbot Point Growth Gateway and T3 projects would not occur concurrently; however, there is some permanent loss of potential seagrass habitat and water quality impacts associated with both projects.

Sensitivity analysis hydrodynamic modelling testing undertaken by Royal Haskoning (2014) found the dredging (using CSD and onshore placement) of T0 and T3 footprints in one continuous campaign did not significantly increase the spatial region of high concentrations of TSS from the return waters compared to the dredging of T0 only.

If the dredging of T3 occurs very soon after T0 dredging, the quantity of sediment released into the marine environment during the dredging of T3 is less than the amount released during the T0 dredging. The impacts on water quality (benthic light availability, sedimentation, extent of plumes, TSS concentrations) of T3 dredging will therefore be less than those predicted with the T0 dredging. Any off-site impacts to MNES during the dredging of T3 will not include an area outside of the currently assessed impacts due to T0 dredging. The off-site impacts when T3 dredging is added to the T0 dredging will not result in a larger area of off-site impacts.

The permanent impacts to seagrass removal in the T3 berth pocket footprint will be small compared to the available seagrass habitat in the region (some 10ha or <0.04%) and less than the permanent loss of seagrass predicted due to dredging the T0 berth pocket. The cumulative impact on seagrass habitat due to the permanent removal of potential seagrass habitat in the T0 and T3 berth pockets will be approximately 20ha or <0.08% of the available habitat at Abbot Point.

**Exotic species**

The Project, T0 and T3 projects and increased shipping have potential to introduce marine pests. The effects of any such introductions would be cumulative.

Vessel strike

There are two levels of potential impact with regards to vessel strike.

On a local scale, the issue of vessel strike from dredging, jetty and wharf construction activities has spatial relevance, but the T0 and T3 projects will not be occurring concurrently with the Project, therefore there is no potential for cumulative impacts. It should be noted that Dredging and Construction Management Plans are routinely in place to minimise the potential for vessel strike on marine mammals and turtles.

On a regional scale, there are potential impacts from vessel strike associated with increased shipping - only this aspect of vessel strike is further assessed.

Vessel waste discharge

There are two levels of potential impact with regards to vessel waste disposal.

On a local scale, the issue of vessel waste discharge from dredging, jetty and wharf construction vessels has spatial relevance, but the T0 and T3 projects will not be occurring concurrently with the Project, therefore there is no potential for cumulative impacts. It should be noted that Waste Management Plans are routinely in place to prevent any discharge of waste to the marine environment.

On a regional scale, there are potential impacts from vessel waste discharge associated with increased shipping - only this aspect of vehicle waste discharge is further assessed.

Noise pollution

There are two levels of potential impact with regards to noise pollution (primarily construction noise and shipping noise).

On a local scale, the issue of noise pollution from dredging, jetty and wharf construction activities has spatial relevance, but the T0 and T3 projects will not be occurring concurrently with the Project, therefore there is no potential for cumulative impacts. It should be noted that Dredging and Construction Management Plans are routinely in place to minimise the potential for noise pollution.

On a regional scale, there are potential impacts from noise pollution for wildlife associated with increased shipping.

Spill - small (and large chemical)

The management and mitigation measures as outlined in the appropriate management plans and ministerial conditions will result in the risks of significant spills into the marine environment during dredging and construction of either T0 or T3 being very low. Any spills during dredging and construction will be highly localised, small in nature and would be cleaned up immediately. The level of risk of significant spills for both projects does not increase when both are taken into account cumulatively.



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On a regional scale, there are potential impacts from both small and large spills associated with increased shipping. Only the regional scale impacts from large spills due to increased shipping are further assessed.

Atmospheric pollution

There are two levels of potential impact with regards to atmospheric pollution.

On a local scale, atmospheric pollution from dredging, jetty and wharf construction equipment has spatial relevance, but the T0 and T3 projects will not be occurring concurrently with the Project, therefore there is no potential for cumulative impacts. It should be noted that Dredging and Construction Management Plans are routinely in place to minimise atmospheric pollution during these activities.

On a regional scale, there are potential impacts atmospheric pollution associated with increased shipping - only this aspect of atmospheric pollution is further assessed.

Damage to seafloor

On a regional scale, there are potential impacts from anchor damage associated with increased shipping.

Wetland water quality degradation

Some risks of the project construction and operation of the DMCP impacting on water quality within the Caley Valley Wetlands were assessed as moderate in the Hydrology, Aquatic Ecology and Water Quality report (**Appendix O**), and require specific management measures to ensure that the risks of impacts are minimised. While occurrences of these events were considered to be 'unlikely', there is potential for construction runoff to contribute sediment and nutrients to the wetland. Accidental contaminant spills (hydrocarbons) and seepage of saline DMCP water to the wetland were also identified as potential impacts which could have flow-on effects to habitat quality within the Caley Valley Wetlands.

The short-term construction and operational phases of the Project will occur prior to the development of the other projects at Abbot Point and consequently there would not be concurrent impacts on surface water quality. Any impact of the Project on water quality within the Caley Valley Wetlands would be small in scale, and would be detected and remedied immediately through implementation of the actions set out in the construction and operation EMPs. As such, there is no opportunity for cumulative (or additive) impacts from subsequent projects.

Land clearing and habitat loss

With the exception of increased shipping, each of the projects considered for cumulative impacts propose land clearing which impacts on habitat for one or more important terrestrial species common to the Project.

Wildlife disturbance

On a local scale, the predicted minor and short-term wildlife disturbance from Project construction and operational activities has spatial relevance to the other projects at Abbot Point, but development of the NGBR, T0, Alpha Coal rail and T3 projects will not be



occurring concurrently with the Project and, therefore there is no potential for cumulative impacts. It should be noted that EMPs are routinely in place to minimise the potential for wildlife disturbance.

6.3.4 Cumulative Impact Assessment

Those threats that have been determined to potentially result in impacts that interact spatially and temporally with the predicted impacts of the Project are:

- Exotic species - the potential for introduction of marine pests from the Abbot Point Growth Gateway, T0 and T3 projects to the local marine environment from construction and activities and from increased shipping to Abbot Point resulting from development of the T0 and T3 projects.
- Land clearing and habitat loss - the potential for land clearing and habitat loss to result in significant residual impacts for conservation significant species.

More broadly, those threats associated with increased shipping resulting from the development of the T0 and T3 projects that do not interact directly with predicted project impacts, but which have broader implications for biodiversity and the health of ecosystems and species within the GBRWHA are also addressed here to meet the EIS Guideline requirements. These threats are:

- Exotic species - the potential for increased shipping resulting from the development of the T0 and T3 projects to increase potential for introduction of marine pests within the GBR
- Vessel strike - the potential for increased shipping resulting from the development of the T0 and T3 projects to increase potential for vessel strike on marine mammals and turtles within the GBR
- Vessel waste discharge - the potential for water quality and subsequent impacts for the GBR from vessel waste discharge due to increased shipping resulting from development of the T0 and T3 projects
- Noise pollution - the potential for disturbance to wildlife from increased underwater noise within the GBR due to increased shipping resulting from development of the T0 and T3 projects
- Spills (small and large) - the potential for water quality and subsequent impacts for the GBR from spills due to increased shipping resulting from development of the T0 and T3 projects
- Atmospheric pollution - the potential for air quality impacts within the GBR from atmospheric pollution due to increased shipping resulting from development of the T0 and T3 projects
- Seafloor damage - the potential for anchor damage within the GBR due to increased shipping resulting from development of the T0 and T3 projects.

6.3.4.1 Exotic species

The likelihood of potential impacts to the GBR and the marine environment at Abbot Point from introduced marine pests is substantially reduced now and into the future by a number of factors. These include:

- Regulation under the *Quarantine Act 1908*, which prohibits the discharge of high-risk ballast water in Australian ports

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- A greater proportion of the world bulk carrier fleet has been fitted with International Maritime Organisation-approved ballast water treatment systems
- The Australian Government is proceeding with the development and implementation of Biofouling Management Requirements for all vessels entering Australian waters
- The anchorage of Abbot Point consists of muddy bottom, presenting minimal amenable habitat for the establishment of invasive marine species.

Currently no pest species are known to occur at Abbot Point. All vessels using Abbot Point are currently required to adhere to legislated management requirements.

6.3.4.2 Land clearing and habitat loss**Threatened ecological communities**

The Project will not directly impact on any threatened ecological communities. Temporary pipeline infrastructure will be located approximately 5m (Indicative 2 or Alternate alignment) to 50m (Indicative 1) from a patch of the SEVT of the Brigalow Belt (North and South) and Nandewar Bioregions (depending on the proposed pipeline alignment), and the risks identified for weed introduction and fire management will be managed through the construction and operational management plans in keeping with the Recovery Plan (McDonald, 2010).

There are no direct impacts and there is low risk for indirect impacts of the Project on the SEVT threatened ecological community. There is therefore no potential for the impacts of the Project on the SEVT threatened ecological community to act cumulatively with those of other projects considered in the cumulative assessment.

Squatter Pigeon

There is some potential for impacts of the Project to act cumulatively with those of other projects with regards to Squatter Pigeon. However, this is limited by the very small scale of predicted impacts of the Abbot Point Growth Gateway Project on the Squatter Pigeon. A summary of predicted impacts on the habitat of Squatter Pigeon for projects which may have cumulative impacts is provided in Table 6-4.



Table 6-4 Summary of habitat for the Squatter Pigeon to be disturbed by other projects at Abbot Point

Project	Area of Squatter Pigeon Habitat to be Disturbed (ha)
North Galilee Basin Rail project	Approximately 300
Abbot Point T0 project	67 (remnant and high value regrowth habitat)
GVK Hancock T3 project	174
GVK Hancock Alpha Coal rail development	Approximately 211

All of the projects under consideration for the assessment of cumulative impacts (combined with the Project) involve the disturbance of approximately 752ha of habitat potentially suitable for the Squatter Pigeon at Abbot Point..

Construction stages of the Project will involve the direct disturbance of approximately 94ha of potentially suitable habitat for the Squatter Pigeon. This impact has the potential to act cumulatively with the clearing of 752ha of habitat during construction of the T0, T3, NGBR and Alpha rail developments. However, extensive surveys of these areas have not identified Squatter Pigeon to be present in large numbers (CDM Smith, 2013a; Hancock Coal Infrastructure Pty Ltd, 2012). Additionally, the Abbot Point region is not identified as important habitat for the species (BAAM, 2012).

The cumulative impact of the Project on Squatter Pigeon is therefore considered to be low, for the following reasons:

- The area of potentially suitable habitat to be disturbed by the Project is relatively small when compared with that of other approved projects
- The species is ubiquitous in this part of its geographic range
- The species is not restricted by habitat availability as the species is a habitat generalist
- The numbers recorded at Abbot Point are small and the species is neither rare nor disjunct from the broader population (which occurs across a large range)
- Abbot Point is not at the edge of the species range of the species and is therefore not important in terms of range expansion and recovery.

There is no recovery plan for the Squatter Pigeon; however, there are recognised threats to the species associated with habitat loss and degradation most predominantly through grazing and invasive weeds, and predation by numerous avian and terrestrial predators including the fox and feral cat. Threats associated with weed introduction and feral animals will be managed through the construction and operation management plans.

Migratory shorebirds and Australian Painted Snipe

There is potential for impacts of the Project to act cumulatively with those of other projects located in close proximity to the Caley Valley Wetlands for migratory shorebird species. A summary of potential impacts of other projects on the habitat of migratory shorebirds and the Australian Painted Snipe is provided in Table 6-5.



Table 6-5 Potential impacts of approved projects on migratory shorebird and Australian Painted Snipe

Project	Summary of Impacts on Shorebirds and Their Habitat	Location of Impact in Relation to Project
North Galilee Basin Rail Project	Disturbance to 45.6ha of wetland habitats during construction (disturbance limit for Australian Painted Snipe) Ongoing disturbance during train operations	Located approximately 4km south-east of the project area near the entrance of Saltwater Creek
Abbot Point T0 Project	No direct disturbance of wetland habitats Minimal off-site and indirect impacts from noise, dust, light and stormwater runoff	Located 500m to 1,000m east of the project area
GVK Hancock T3 Project	Direct disturbance to 28ha of the Caley Valley Wetlands Off-site and indirect impacts from noise, lighting, dust and stormwater runoff	Located immediately adjacent to (west of) the project area
GVK Hancock Alpha Coal rail development	Construction of a rail loop involving direct disturbance to 14.5ha of the Caley Valley Wetlands and 99ha of wetland enclosed by rail loop	Located immediately adjacent to (south of) the project area

A total of 88.1ha of the Caley Valley Wetlands will be directly disturbed by infrastructure associated with the NGBR, T3 development and the rail loop of the Alpha Coal project. A combined total of 42.5ha of wetland habitat to be directly disturbed occurs immediately adjacent to the project area, associated with the T3 development and Alpha Coal rail loop. An additional 99ha of wetland will be enclosed by the Alpha Coal rail Loop (indirect impacts). Some of the areas predicted to be subject to off-site and indirect impacts (e.g. noise, dust) from the Project will be directly disturbed by the approved T3 project.

The scale of impacts from the Project on wetland habitats for migratory shorebirds and the Australian Painted Snipe is small in comparison with that of other approved projects. There will be no direct disturbance of shorebird habitat from the Project's development activities, with off-site disturbance associated with noise and dust occurring temporarily during construction. Impacts will be insignificant in magnitude and may not occur at all if works occur outside of the migratory shorebird season, or during a period of dry weather when sections of the wetland adjacent to the project area are dry.

There is a temporal component relevant to the consideration of cumulative impacts. Construction of the NGBR project is likely to commence at the end of 2015, although the schedule for the small part of the rail alignment adjacent to the wetland is unknown. While the GVK Hancock T3 and Kevin's Corner projects are approved, a commencement date for construction works has not yet been announced. It is therefore unlikely that construction of these projects will occur at the same time as the Project.



Cumulative impacts on shorebirds are assessed to be low. The Project involves no direct disturbance to the shorebird habitat, unlike other approved projects in the Abbot Point area. Off-site and indirect impacts are expected to be short in duration (several months) and not occur concurrently with other foreseeable projects.

All projects that impact on migratory shorebirds are assessed through the EPBC Act which enacts Australian Government obligations with regard to:

- The World Heritage Convention (UNESCO)
- The Convention on Biological Diversity (UNEP)
- The Convention on Migratory Species (UNEP)
- The Convention on International Trade of Endangered Species of wildlife fauna and flora (UNEP)
- International migratory bird agreements - Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA), Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), and the East Asian-Australasian Flyway Partnership (EAAFP), administered in Australia by DoE.

Migratory birds (non-shorebirds)

Eastern Great Egret

There is potential for impacts of the Project to act cumulatively with those of other projects located in close proximity to the Caley Valley Wetlands and involving disturbance of habitat from the construction of rail projects. However, only those cumulative impacts on important habitat for the species are likely to be significant. A summary of the potential for such impacts is provided in Table 6-6.



Table 6-6 Potential impacts of approved projects on Eastern Great Egret

Project	Summary of Impacts on Eastern Great Egret	Ecologically Significant Proportion of Population?
North Galilee Basin Rail project	Disturbance to 45.6ha of wetland habitats on the fringe of the Caley Valley Wetlands Ongoing disturbance during train operations	Yes for direct disturbance of Caley Valley Wetlands approximately 4km south-east of the project area near the entrance of Saltwater Creek
Abbot Point Terminal 0 project	No direct disturbance of wetland habitats Minimal off-site and indirect impacts from noise, dust, light and stormwater runoff	No direct disturbance of habitat
GVK Hancock T3 project	Direct disturbance to 28ha of the Caley Valley Wetlands Off-site and indirect impacts from noise, lighting, dust and stormwater runoff	Located immediately adjacent to (west of) the project area
GVK Hancock Alpha Coal rail development	Construction of a rail loop involving direct disturbance to 14.5ha of the Caley Valley Wetlands and 99ha of wetland enclosed by rail loop Ongoing disturbance during train operations	Yes

A total of 88.1ha of the Caley Valley Wetlands will be directly disturbed by infrastructure associated with the NGBR, T3 development and rail loop aspects of the Alpha Coal development. Of this area, 42.5ha are located immediately adjacent to the project area, associated with the T3 development and associated rail loop. An additional 99ha of wetland will be enclosed by the Alpha Coal rail loop (indirect impacts). Some of the areas predicted to be subject to off-site impacts (e.g. noise, dust) from the Project will be directly disturbed by other projects.

The scale of impacts from the Project on wetland habitats used by the Eastern Great Egret is small in comparison with other approved projects. There will be no direct disturbance of habitat from development activities, with off-site disturbance associated with noise and dust occurring temporarily for a period of several months during construction. Impacts may be reduced further if works occur during a period of dry weather when sections of the wetland adjacent to the project area are dry.

The potential for cumulative impacts on the Eastern Great Egret are assessed to be low. The species appears to be a habitat generalist across the Caley Valley Wetlands, utilising a variety of locations within the region. Measures to reduce impacts of the Project on migratory

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shorebirds, will be beneficial to the Eastern Great Egret and will adequately address potential impacts on this migratory species.

Caspian Tern

There is potential for impacts of the Project to act cumulatively with those of other projects located in close proximity to the Caley Valley Wetlands and involving disturbance of habitat from the construction of rail and coal mine projects further inland. However, only those cumulative impacts on important habitat for the species are likely to be significant. A summary of the potential for such impacts is provided in Table 6-7.

A total of 88.1ha of the Caley Valley Wetlands will be disturbed by infrastructure associated with the NGBR, T3 development and rail loop aspects of the Alpha Coal project. Of this area, 42.5ha are located immediately adjacent to the project area, associated with the T3 development and associated rail loop. An additional 99ha of wetland will be enclosed by the Alpha Coal rail loop (indirect impacts). Some of the areas predicted to be subject to off-site impacts (e.g. noise, dust) from the Project will be directly disturbed by other projects.

The scale of impacts from the Project on wetland habitats used by the Caspian Tern is small in comparison with other approved projects. There will be no direct disturbance of habitat from development activities, with off-site disturbance associated with noise and dust occurring temporarily for a period of several months during construction. Impacts may be reduced further if works occur during a period of dry weather when sections of the wetland adjacent to the project area are dry.

The potential for cumulative impacts on the Caspian Tern are assessed to be low. The species appears to be a habitat generalist across the Caley Valley Wetlands, utilising a variety of locations within the area. Measures to reduce impacts of the Project on migratory shorebirds, will be beneficial to the Caspian Tern and will adequately address potential impacts on this migratory species.



Table 6-7 Potential impacts of approved projects on Caspian Tern

Project	Summary of Impacts on Caspian Tern	Ecologically Significant Proportion of Population?
North Galilee Basin Rail project	Disturbance to 45.6ha of wetland habitats on the fringe of the Caley Valley Wetlands Ongoing disturbance during train operations	Yes for direct disturbance of Caley Valley Wetlands approximately 4km south-east of the project area near the entrance of Saltwater Creek
Abbot Point T0 project	No direct disturbance of wetland habitats Minimal off-site and indirect impacts from noise, dust, light and stormwater runoff	No direct disturbance of habitat
GVK Hancock T3 project	Direct disturbance to 28ha of the Caley Valley Wetlands Off-site and indirect impacts from noise, lighting, dust and stormwater runoff	Yes
GVK Hancock Alpha Coal rail development	Construction of a rail loop involving direct disturbance to 14.5ha of the Caley Valley Wetlands and 99ha of wetland enclosed by rail loop Ongoing disturbance during train operations	Yes

Little Tern

There is potential for impacts of the Project to act cumulatively with those of other projects located in close proximity to the Caley Valley Wetlands and involving disturbance of wetland habitat from the construction of rail projects. However, only those cumulative impacts on important habitat for the species are likely to be significant. A summary of the potential for such impacts is provided in Table 6-8.

A total of 88.1ha of the Caley Valley Wetlands will be disturbed by infrastructure associated with the NGBR, T3 development and rail loop aspects of the Alpha Coal project. Of this area, 42.5ha are located immediately adjacent to the project area, associated with the T3 development and associated rail loop. An additional 99ha of wetland will be enclosed by the Alpha Coal rail loop (indirect impacts). Some of the areas predicted to be subject to off-site impacts (e.g. noise, dust) from the Project will be directly disturbed by other projects.

The scale of impacts from the Project on wetland habitats used by the Little Tern is small. There will be no direct disturbance of habitat from development activities, with off-site disturbance associated with noise and dust occurring temporarily for a period of several



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months during construction. Areas to be affected by off-site impacts are not suitable for nesting. Impacts may be reduced further if works occur during a period of dry weather when sections of the wetland adjacent to the project area are dry.

The potential for cumulative impacts on the Little Tern are assessed to be low. It is likely that the species uses the wetland in moderate numbers on an irregular basis, with key areas used for foraging and nesting located away from the project area. Measures to reduce impacts of the Project on migratory shorebirds, will be beneficial to the Little Tern and will adequately address potential impacts on this migratory species.

Table 6-8 Potential impacts of approved projects on Little Tern

Project	Summary of Impacts on Little Tern	Ecologically Significant Proportion of Population?
North Galilee Basin Rail project	Disturbance to 45.6ha of wetland habitats on the fringe of the Caley Valley Wetlands	Yes for direct disturbance of Caley Valley Wetlands approximately 4km south-east of the project area near the entrance of Saltwater Creek
Abbot Point T0 project	No direct disturbance of wetland habitats Minimal off-site and indirect impacts from noise, dust, light and stormwater runoff	No direct disturbance of habitat
GVK Hancock T3 project	Direct disturbance to 28ha of the Caley Valley Wetlands Off-site and indirect impacts from noise, lighting, dust and stormwater runoff	Yes
GVK Hancock Alpha Coal rail development	Construction of a rail loop involving direct disturbance to 14.5ha of the Caley Valley Wetlands and 99ha of wetland enclosed by rail loop Ongoing disturbance during train operations	Yes

Waterbirds

The Caley Valley Wetlands contributes to the World Heritage Values of the GBR. Birds are an important natural heritage attribute of the Abbot Point region, contributing to the connectivity, diversity and superlative natural phenomena that are present across the entire GBRWHA.



The Project will not impact the Caley Valley Wetlands in a manner that will affect its connectivity, diversity or habitat values for the seasonal aggregation of waterbirds. In this context, there will be no impact of the Project on the Outstanding Universal Value of the GBRWHA and therefore there is no potential for cumulative interaction between the Project and other projects at Abbot Point for waterbirds.

6.3.4.3 Risk assessment

Exotic species and land clearing

The risk assessment approach applied to the Project has been applied to the cumulative impact assessment for those potential threats from the considered projects identified as interacting spatially and temporally with the predicted impact of the Project (Table 6-9). These are:

- Exotic species - the potential for introduction of marine pests from the Abbot Point Growth Gateway, T0 and T3 projects to the local marine environment from construction and activities and from increased shipping to Abbot Point resulting from development of the T0 and T3 projects
- Land clearing and habitat loss - the potential for land clearing and habitat loss to result in significant residual impacts for conservation significant species (Squatter Pigeon).



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Table 6-9 Risk assessment for marine pests and habitat loss

Threat		Project Activity	Event description / Potential Impact	Project Residual Risk			Considered Projects				Cumulative Residual Risk			Comments
Introduction of marine pests (exotic species)	Land clearing and habitat loss			Consequence	Likelihood	Project Residual Risk	North Galilee Basin Rail Project	Adani Abbot Point Terminal 0 Project	Alpha Coal Rail Project	Abbot Point Terminal 3 Project	Consequence	Likelihood	Cumulative Residual Risk	
x		Dredging	Marine pest incursion from dredge vessels impacts on marine habitat	Moderate	Unlikely	Low				x	Moderate	Unlikely	Low	A detailed risk assessment procedure consistent with the <i>National System for the Prevention and Management of Marine Pest Incursions</i> Guidelines will be implemented to deal with the risk associated with introduction of introduced marine species (IMS). This procedure will be applied to all vessels and immersible equipment used for the dredging campaign to assess the risk of IMS introduction. The risk assessment will be undertaken prior to the identified vessel and/or immersible equipment engaging in dredging and dredged material placement activities. The objective of the risk assessment is to identify the individual level of IMS threat a contracted vessel or its immersible equipment poses. This allows selection of the most appropriate vessels and immersible equipment and establishment of management measures to mitigate identified threats to an acceptable low level.
x		Temporary pipeline construction and removal	Marine pest incursion from pipeline construction vessels impacts on marine habitat	Moderate	Unlikely	Low				x	Moderate	Unlikely	Low	
x		Jetty and wharf construction	Marine pest incursion from construction vessels impacts on marine habitat	Moderate	Unlikely	Low		x		x	Moderate	Unlikely	Low	
	x	Footprint clearing and offsite impacts during construction and/or operation	Loss of or impacts on Squatter Pigeon habitat	Insignificant	Moderate	Low		x		x	Insignificant	Moderate	Low	<p>The species is not restricted by habitat availability as the species is a habitat generalist</p> <p>The numbers recorded at Abbot Point are small and the species is neither rare nor disjunct from the broader population (which occurs across a large range)</p> <p>Abbot Point is not at the edge of the range of the species and is therefore not important in terms of range expansion and recovery.</p> <p>The other projects are approved and offsets are required where assessment under the EPBC Act has determined that the impacts on the species are significant.</p>



Shipping

For those threats and their risks associated with increased shipping for the GBR it is necessary to take a regional approach to risk assessment. The *Great Barrier Reef Outlook Report 2014* included a comprehensive assessment of risks to the GBR region that included impacts associated with shipping. The assessment included consideration of projected increases in shipping in the region.

The results of the risk assessment for risks to the ecosystem for those threats that the cumulative impact assessment has identified as relevant to increased shipping from the T0 and T3 Projects at Abbot Point are reproduced in Table 6-10.

Damage to the seafloor is a 'medium' ranked threat with 'minor' consequences that is considered to have a likelihood of almost certainly occurring. The description of this threat attributes more broad scale impact with the activity of trawling, although it also states that some areas are affected by anchoring.

Conceptual anchorage areas at Abbot Point for T0 and T3 involve a northern and southern area for vessels. The conceptual anchorages are located in relatively open waters, with a depth of not less than 20m (the majority over 25m), and some 40km from the nearest offshore reef. The conceptual anchorage locations are also clear of known seagrass areas (typically found in water less than 20m LAT). The conceptual anchorage areas therefore pose no risk to either coral reefs or seagrass meadows in the vicinity of Abbot Point.

Table 6-10 Relevant 'risks to the ecosystem' for shipping

Threat	Likelihood	Consequence	Risk
Exotic species: Despite technological improvements for better detection, projected increases in shipping makes the transport and introduction of exotic species likely. The consequence would depend on the species but is likely to be serious in a small area such as adjacent to a marina or port.	Likely	Minor	Medium
Vessel strike: Continuing growth in shipping and recreational boating increases the potential for vessel strikes on wildlife. Surface-breathing animals are most at risk but the impact would not be discernible at the ecosystem level.	Likely	Minor	Medium
Vessel waste discharge: Increases in vessel traffic will mean there is likely to be more vessel-based waste discharge in the future. Effects on biodiversity are anticipated to be minor under current management arrangements.	Almost certain	Minor	Medium



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Threat	Likelihood	Consequence	Risk
<p>Noise pollution: Projected increases in shipping and the continuation of increases in port development and recreational boat ownership mean underwater man-made noise is likely to be more or less continuous in the region. Little is known about the effects of noise on the region's species but evidence from elsewhere indicates that effects can be broad scale with serious consequences close to some sources. Improved understanding of its effects in the region may change the future risk rating of this threat.</p>	Almost certain	Minor	Medium
<p>Spill - large chemical: Although a large chemical spill is unlikely, the effects on biodiversity could be extremely serious and possibly irreversible at a local scale. Consequences would vary depending on the type and amount of spill and are considered major given current management and response plans.</p>	Unlikely	Major	Medium
<p>Spill - large oil: While shipping is projected to increase, recent improvements in management make the potential for a large oil spill unlikely. The physical smothering of plants and animals, combined with oil toxicity and its chemical reactions with water, mean a large spill is likely to have serious and persistent effects for several years.</p>	Unlikely	Major	Medium
<p>Spill - small: Small chemical and oil spills are likely to occur frequently in the region. Projected increases in the number of ships and other vessels are likely to increase the likelihood in the future. There could be some effects on sensitive marine life in the area of the spill, with consequences depending on size and type of spill.</p>	Almost certain	Insignificant	Low
<p>Atmospheric pollution: Projected increases in urban and industrial development are likely to increase the local contribution of atmospheric pollution, including the potential for more frequent impacts from coal dust at</p>	Possible	Minor	Low



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Consequential and Cumulative Impact Assessments

Threat	Likelihood	Consequence	Risk
loading ports. Atmospheric pollution may start to affect some values into the future; however, effects are expected to be only minor. The contribution of gases such as carbon dioxide to climate change is excluded here as this is encompassed under climate change related threats.			
Damage to seafloor: Current levels of trawling activity pose low risk to shallow (<90m) habitats at a Reef-wide scale, given existing protection through zoning, but local effects may be higher in intensely trawled areas. Consequences could increase if trawl fishing effort increases under more favourable economic conditions. Some areas are affected by ship anchoring.	Almost certain	Minor	Medium

Source: Great Barrier Reef Outlook Report 2014

Many of the measures that can be employed to reduce impacts from shipping are multi-jurisdictional and require the involvement of both industry and government agencies.

The Reef 2050 Plan indicates that, at Australia's request, the GBR is designated a 'Particularly Sensitive Area' by the International Maritime Organisation, the first in the world, and that extensive and stringent navigation and pollution prevention controls are in place to manage the threats from shipping. The Plan states that despite increased ship movements through the World Heritage Area, the management measures have substantially reduced the frequency of shipping incidents.

The NESMP addresses increased shipping in the GBR region and in particular the impacts of current and increased shipping on the Outstanding Universal Values of the GBRWHA. It sets out additional measures to be implemented to further reduce risks, including:

- The middle Inner Route (parallel to the Queensland coast between Cairns and Gladstone) and southern area of the GBR will be a major focus with regard to pilotage requirements. Coastal pilotage already operates north of Cairns.
- Increased resources for State port control inspections and further focus on areas related to navigational risk (such as fatigue, passage planning and navigational equipment). This program commenced in 2011 with the phased addition of three new specialist marine surveyors to be based in ports in the north-east region.
- Using emerging ship tracking technology to provide early alerting of ship breakdowns including a 'traffic organisation service'. A new decision support tool has been developed and operators trained. In addition, Automatic Identification System coverage continues to be reviewed to address poor or reduced areas of coverage.
- Working with industry to introduce (ahead of international timelines) the need for ships trading to ports in the region to be equipped with Electronic Chart Display and Information Systems and have bunker oil tanks fitted in protective locations. From July 2015, existing



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tankers over 3,000 gross tonnes will be required to carry these systems and from July 2016 to July 2018 the requirement will apply to cargo ships of 10,000 gross tonnes and above. The Australian and Queensland Governments are working closely with environmental groups and industry bodies to monitor the effectiveness of these risk reduction measures.

With a high level of confidence, it is considered that the cumulative impacts of shipping on the Outstanding Universal Values of the GBRWHA have been comprehensively addressed and are being acted upon by the Australian and Queensland Governments and industry bodies.



7 Greenhouse Gases

The GHG assessment undertaken to inform the EIS is included in **Appendix I** of Volume 3.

7.1 Project greenhouse gas emissions

7.1.1 Sources of emissions

Sources of GHG emissions associated with the Project are summarised in Table 7-1.

Table 7-1 Sources of greenhouse gas emissions

Activity	Source
Vegetation clearance	The release of stored carbon from the cleared vegetation
DMCP construction	Fuel consumption for earthmoving and other equipment, both mobile and stationary
Dredging and dredged material placement	Diesel fuel and heavy fuel oil used to power the dredge, booster pump and ancillary equipment
Lighting	Diesel consumption for lighting towers
Dredged material reuse and DMCP decommissioning	Diesel used for embankment decommissioning and dredged material movement
Site office(s)	Electricity consumption for site office(s)
Construction material	Embodied emissions associated with construction materials for the steel pipeline to transport material from the dredge to the storage area, as well as from the cement to build the embankment for the DMCP
Road transport	Diesel fuel used for: <ul style="list-style-type: none"> ▪ Mobilisation/demobilisation of plant items required for embankment construction ▪ Importation of crushed rock and riprap from the Abbot Point Deco Quarry located on Abbot Point Road approximately 5km from the DMCP site ▪ Delivery of dredging pipelines ▪ Delivery of construction materials (fencing, liner, cement, gypsum) ▪ Movement of the construction workforce ▪ Servicing of the site.



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Greenhouse Gases

7.1.2 Project-related emissions

The results of the GHG inventory for the project emissions are shown in Table 7-2.

Table 7-2 Project-related emissions

Scope	Source	Emissions	Unit
Scope 1	Vegetation clearance	16,927	t CO ₂ -e (Carbon dioxide equivalent)
Scope 1	DMCP construction	25,902	t CO ₂ -e
Scope 1	Dredging and placement	12,292	t CO ₂ -e
Scope 1	Lighting	364	t CO ₂ -e
Scope 1	Storage and decommissioning	28,978	t CO ₂ -e
Scope 1 Total		84,464	t CO₂-e
Scope 2	Electricity	24	t CO ₂ -e
Scope 2 Total		24	t CO₂-e
Scope 3	Embodied emissions	12,656	t CO ₂ -e
Scope 3	Road transport	425	t CO ₂ -e
Scope 3	DMCP construction	1,964	t CO ₂ -e
Scope 3	Dredging and placement	887	t CO ₂ -e
Scope 3	Lighting	28	t CO ₂ -e
Scope 3	Storage and decommissioning	2,197	t CO ₂ -e
Scope 3	Electricity	4	t CO ₂ -e
Scope 3 Total		18,160	t CO₂-e
Scope 1, 3 Total		102,647	t CO₂-e

Scope 1 emissions account for approximately 82% of the total project emissions. The key sources are from earthworks associated with DMCP construction and decommissioning. Scope 2 emissions are minimal and Scope 3 emissions represent approximately 18% of the total Project emissions. The emissions breakdown is shown in Figure 7-1.

Section 7

Greenhouse Gases

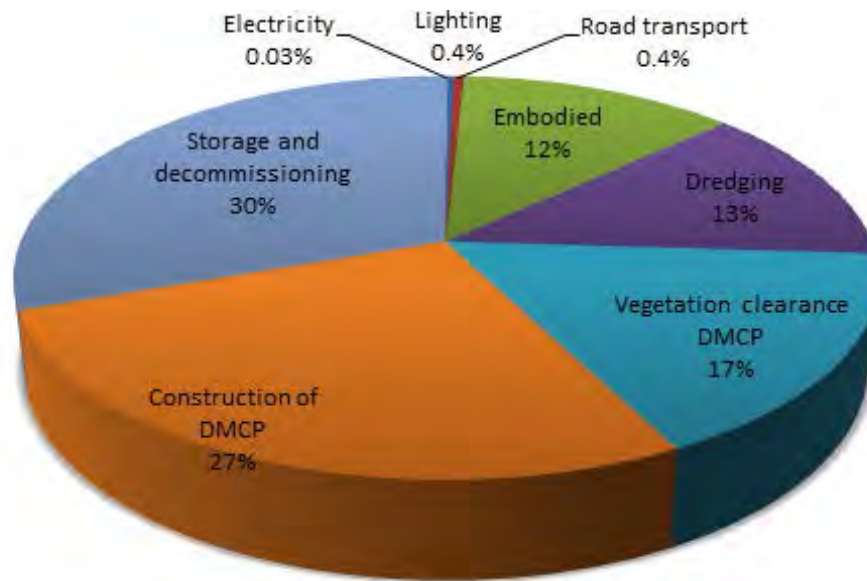


Figure 7-1 Emissions breakdown by key activity

To put the inventory in a larger context:

- At 2012, global GHG emissions were 31,700Mt CO₂-e (carbon dioxide equivalent) (IEA, 2014)
- At 2012, Australian national GHG emissions were 562.7Mt CO₂-e (Kyoto Accounting; Australian Greenhouse Emission Information System)
- At 2012, Queensland's GHG emission is at 134.5Mt CO₂-e (Queensland Government Statistician's Office).

The Project emissions therefore equate to approximately 0.08% of the Queensland's annual emissions and less than 0.02% of Australian's national annual emissions. Australian national annual emissions are less than 2% of the global total aggregated emissions.

7.2 Related project emissions

7.2.1 North Galilee Basin Rail project

The NGBR project proposed by Adani involves the construction and operation of a rail corridor of approximately 310km in length, including standard gauge rail and associated infrastructure, from approximately 70km east of Adani's proposed Carmichael Mine, to Abbot Point.

Adani prepared an EIS for the project (GHD, 2013b) and additional information to the EIS (GHD, 2014) which was approved with conditions under the EPBC Act (EPBC 2013/6885) on 23 September 2014. The controlling provisions for the project are:

- World Heritage properties
- National Heritage places
- Listed threatened species and communities
- Listed migratory species
- Commonwealth marine areas



- GBRMP.

The project EIS identified construction commencement in 2014; however, it is understood that construction associated with the project may commence in 2015.

7.2.2 Carmichael Coal and Rail project

The Carmichael Coal Mine and Rail Infrastructure project, proposed by Adani involves the development of an open-cut and underground coal mine, 189km rail link and associated infrastructure; approximately 160km north-west of Clermont in central Queensland. Adani prepared an EIS for the project (GHD, 2012) and supplementary information to the EIS (GHD, 2013a), which was approved under the EPBC Act (EPBC 2010/5736) on 24 July 2014. The controlling provisions for the project are:

- World Heritage properties
- National Heritage places
- Listed threatened species and communities
- Listed migratory species
- Commonwealth marine areas
- GBRMP
- A water resource, in relation to coal seam gas development and large coal mining development.

The approval has effect until 30 June 2090.

7.2.3 Emissions

The Greenhouse Gas Assessment (**Appendix I**) considered the Australian Jurisdiction GHG emissions from the construction and operation of the related upstream mine, rail and port projects. Emissions for these projects were collated from the relevant EIS and supplementary EIS documents.

The breakdown of the emissions by projects is:

- Carmichael Coal Mine and Rail Project - 1,760,458t CO₂-e/year
- NGBR project - 800,662t CO₂-e/year
- Abbot Point T0 project - 24,617t CO₂-e/year.

A total of 2,585,737t CO₂-e/year was estimated. Assuming a 60 year project life, the total emissions from these related projects are 232,716,297t CO₂-e. This equates to approximately 1.9% of the Queensland's annual emissions, or 0.5% of Australian's national annual emissions and approximately 0.01% of the global total aggregated emissions.

7.3 Global context

In addition to the project emissions and emissions from associated projects presented above, GHG emissions which result from the combustion of coal which will pass through the proposed Abbot Point Coal T0, i.e. 70Mtpa, are presented to provide global context. These are estimated to be 167Mt CO₂ per annum or 10,002Mt CO₂ over a 60 year lifetime. These annual emissions from the combustion of coal (passing through T0) equate to approximately 0.5% of global GHG (based on the 2012 figure).



8 Social and Economic Considerations

8.1 Native Title and cultural heritage

8.1.1 Native Title claimant

The Project is situated within the boundaries of registered native title determination QUD554/2010. The native title determination found the Juru People hold native title rights and interests in land and waters within the Port of Abbot Point and the APSDA.

Kyburra Munda Yalga Aboriginal Corporation holds the native title rights and interests on trust for the Juru People and is the prescribed body corporate for the native title holders under the *Native Title Act 1993*.

The native title determination is subject to a suite of tenures and ILUAs that deal with development at the Port of Abbot Point and in the APSDA. This includes the Port of Abbot Point and APSDA ILUA (QI2011/063). The parties to this ILUA are the Juru People, the State of Queensland, NQBP, the Coordinator-General and Juru Enterprises Limited. It also includes the Juru People and Adani Abbot Point Terminal ILUA (QI2013/036).

8.1.2 Existing cultural heritage context and values

8.1.2.1 Aboriginal cultural heritage

All Aboriginal cultural heritage items, places, areas or archaeological sites in Queensland are protected by the *Aboriginal Cultural Heritage Act 2003* (ACH Act).

There are a number of registered Aboriginal cultural heritage sites and areas at Abbot Point and within the APSDA. These cultural heritage sites and areas are listed on the Aboriginal Cultural Heritage Database and Register, which is established and maintained under the ACH Act. These cultural heritage sites and areas include shell middens and scatters at Dingo Beach, fish traps at Dingo Beach and at Shark Bay, shell middens and hearths at Dingo Beach and a camp on the western edge of the Caley Valley Wetlands basin. The registered Aboriginal cultural heritage sites and areas do not fall within the project area.

8.1.2.2 European cultural heritage

In terms of European cultural heritage, the Catalina plane wreck is of local cultural significance, but is located a significant distance (24km to the east) of the T0 dredging area and will not be affected by the Project.

In April 2015 the Australian Government announced that the Royal Australian Air Force World War II Catalina aircraft wreck located in the GBRMP off Bowen will be protected under new management measures. Specifically, special management areas - or buffer zones - will be placed around the Catalina wreck. Under these new measures, fishing and anchoring will not be allowed within a 1km² area that encompasses the crash site and diving will be restricted.

The new management area is designed to protect maritime cultural heritage in the Marine Park. The Catalina is an example of the iconic Catalina or 'Black Cats' which were active in the western Pacific during World War II for long range bombing, reconnaissance and



rescuing allied personnel. The decision to provide greater protection for the Catalina wreck was prompted by direct requests from the relatives of the servicemen who died. Divers will be able to access the two sites under a GBRMPA permit, for example, to clean away entangled anchors or fishing equipment, or to conduct monitoring or research.

Since this announcement, the new management areas surrounding the Catalina Plane wreck have been enacted. Specific details on the location of the Maritime Cultural Heritage Protection Special Management Area in the Bowen Region can be found at <http://www.gbrmpa.gov.au/zoning-permits-and-plans/special-management-areas/protecting-our-maritime-cultural-heritage>.

8.1.3 Potential cultural heritage impacts and mitigation measures

8.1.3.1 Aboriginal cultural heritage

The cultural heritage management procedures in the Port of Abbot Point and APSDA ILUA will be utilised to address any potential impacts of the project activities on Aboriginal cultural heritage values in both onshore and offshore areas of the Project.

As part of these procedures, site identification surveys have been undertaken by representatives of the Juru People, and management and mitigation strategies are being developed with the Juru People to manage the impact on Aboriginal cultural heritage values when undertaking project activities, including in the area along the eastern beach at Abbot Point.

8.1.3.2 European cultural heritage

The Project is not anticipated to have any direct or indirect impacts on the Catalina plane wreck. As impacts are not expected to occur, no specific mitigation measures are deemed necessary for this aspect of the Project

8.2 Social and economic

This section provides a summary of the findings of the Social Impact Assessment (SIA) Technical Report (**Appendix R**) and Economic Impact Study (**Appendix S**), prepared for the Project. The primary purpose these studies was to:

- Define the local and regional communities likely to be affected by the proposed development
- Understand the existing socio-economic characteristics, conditions and dynamics of communities within the defined study area to provide a practical basis on which to predict potential social impacts
- Identify and evaluate potential impacts on communities and the local and regional economy
- Develop mitigation and management strategies to avoid or minimise potential adverse impacts and maximise benefits to stakeholders and communities.



8.2.1 Methodology

8.2.1.1 Study area

Socio-economic impacts are often not contained within the immediate area of the project components. Generally, the 'area of influence' is determined by:

- The project footprint and its interaction with the immediate neighbouring communities
- The interaction of project activities and the workforce with the nearest urban localities
- The interaction of project activities with the wider region.

The social and economic study area defined for the Project therefore incorporates the communities in the local and regional area that may potentially provide workers, accommodation, social infrastructure and services for the Project.

For the purposes of the SIA, the 'local' study area was defined as the township of Bowen, Bowen township fringe settlements and a number of agricultural settlements between Bowen and Abbot Point (Figure 8-1). The 'regional' study area was defined as the Whitsunday Regional Council Local Government Area (Whitsunday LGA) as the Project will likely be serviced by the wider region in terms of the supply of workers, goods and services (Figure 8-2). Further, the inclusion of the Whitsunday LGA assists in providing context to the socio-economic conditions outside the local community of Bowen.

From an economic perspective, potential impacts and benefits of the Project can be felt more broadly. Therefore, the principal focus of the economic assessment was on regional and State impacts. The 'local' economy was defined as the Whitsunday LGA (and Bowen Statistical Local Area (SLA) where relevant). The 'regional' economy was defined at the Whitsunday, Mackay Regional Council and Isaac Regional Council LGAs level given the potential to source labour, and goods and services in the broader economic context. Reference has been made to the MIW region to indicate instances where the entire region was considered in the assessment.

The project location and Australian Bureau of Statistics (ABS) statistical boundaries applied throughout the social and economic impact assessments, particularly in the baseline assessments, are outlined in Table 8-1.

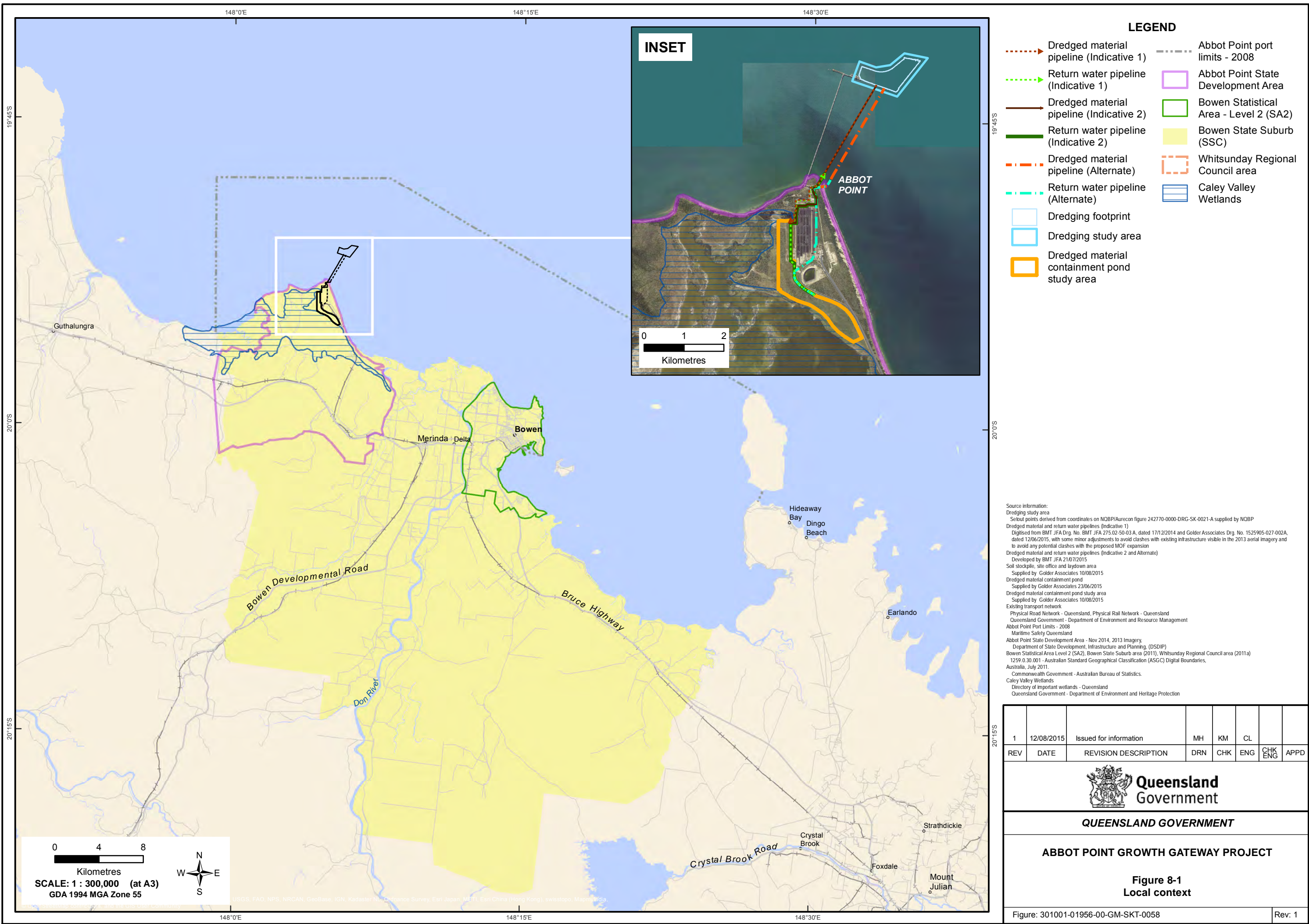
The social and economic baseline profiles were developed predominantly based on ABS Census data. However, the 2011 ABS Census data is now over three years old and as such, does not always adequately capture recent changes in the region associated with the downturn in the mining industry. ABS information was therefore supplemented with more recent data sets prepared by the Queensland Government's Statistician Office (QGSO) which are currently only available at the Statistical Level 2 (SA2), i.e. Bowen township. The discrepancies in geographical boundaries for these two areas should therefore be borne in mind by the reader.

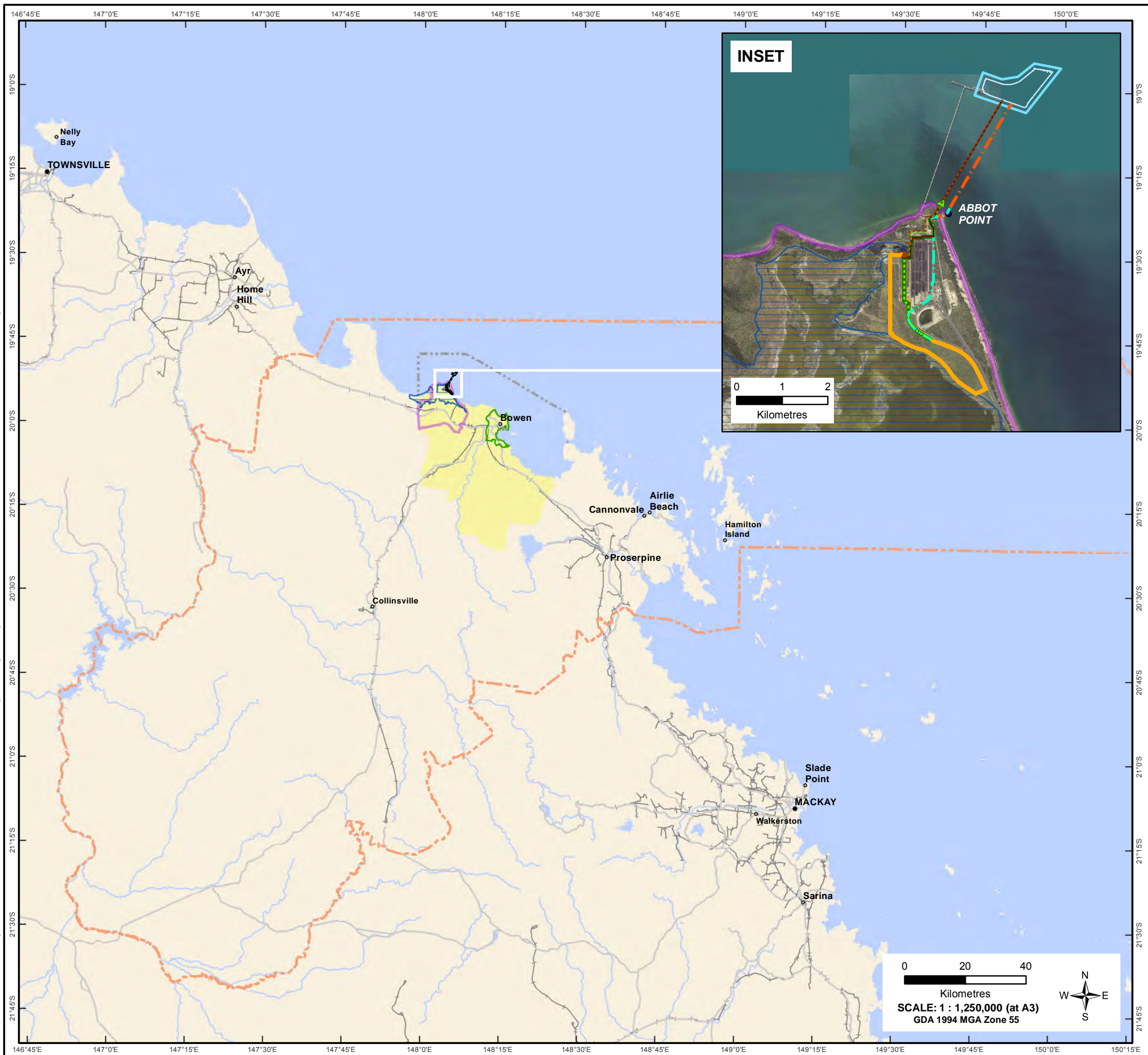


Table 8-1 Statistical boundaries

Study Area	SIA	Economic Impact Study
Local study area	<ul style="list-style-type: none"> ▪ Bowen Sutherland Shire Council - Bowen town centre and broader Bowen area including Merinda and Abbot Point ▪ Substitute - Bowen SA2 - town centre of Bowen 	<ul style="list-style-type: none"> ▪ Whitsunday (R) LGA ▪ Bowen Statistical Local Area (SLA) - The Bowen SLA was selected for the economic impact assessment as it represents a broader area that incorporates Abbot Point, the town of Bowen and Collinsville.
Regional study area	<ul style="list-style-type: none"> ▪ Whitsunday (R) LGA 	<ul style="list-style-type: none"> ▪ Whitsunday (R) LGA ▪ Mackay (R) LGA ▪ Isaac (R) LGA
State	<ul style="list-style-type: none"> ▪ Queensland 	<ul style="list-style-type: none"> ▪ Queensland

\\laubripdfs02v\brisbane\Projects\301001\01956 PROJ - Abbot Point Growth Gateway\10.0 Engineering\10 GM-Geomatics\Output\301001-01956-00-GM-SKT-0058-1 (Social - Local Context).mxd







8.2.1.2 Legislative context

The following Australian Government legislation and guidelines are relevant to managing social impacts of the Project, and were considered in the development of the SIA:

- The Australian Government's EIS Guidelines for the Project dated June 2015
- The EPBC Act.

State and regional policies and plans provide important context on how potential social impacts may influence community development, as well as setting out priorities and existing programs of action. As such, it is important for project developers to align with the overall strategic planning for the communities in which they operate. **Appendix R** provides an overview of the social context relevant to the Project in accordance with Section 3.7.2 of the EIS Guidelines.

8.2.1.3 Scoping

It is understood that issues identified during the assessment process may include both real and perceived issues. That is, impacts that may actually occur, or may be perceived to occur by stakeholders and the community. Both types of impacts are important as each can influence the overall sense of wellbeing as well as decisions made by, and choices perceived to be available to, stakeholders.

Identification of issues during the scoping stage of the SIA included issues perceived by the community as noted in public submissions related to the Abbot Point Port and Wetland Strategy, as well as stakeholder feedback on other infrastructure projects in the same locality. Thus, although not all of the issues considered in the SIA will be realised as a direct result of the Project, it was necessary to evaluate both real and perceived issues as part of the assessment of community or social impacts.

The scoping exercise was based on:

- A review of the project description against the baseline socio-economic conditions of the area
- A review of the public submissions on the Abbot Point Port and Wetland Strategy.

8.2.1.4 Baseline data analysis

The socio-economic baseline assessment considered the existing demographic composition of the local community, current social values and lifestyles, and the existing economic climate. Economic baseline data was also used to develop a regional impact model to assess project impacts.

For each community aspect, the most recent data sets were used, with primary information sources including:

- The ABS Census of Population and Housing (2011) and other ABS data sources
- QGSO regional profiles, population reports and forecasts
- Local council website, State government departments and information sheets
- The Department of Employment's Small Area Labour Markets data, Corelogic RP Data and PriceFinder



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Social and Economic Considerations

- Existing data and reports (for example, relevant SIAs published recently by other proponents in the area - i.e. Adani Mining's NGBR Social Impact Assessment 2013, outcomes of previous community consultation, local and regional planning documents, media etc.)
- Proprietary Economic Associates models.

8.2.1.5 Impact assessment

Social Impact Assessment

The SIA methodology for the Project was evidence-based to facilitate a targeted and logical impact assessment, tailored to the context of the Project's social environment and the issues and concerns likely to be held by the local community. This involved analysing a range of qualitative and quantitative data through secondary research.

In particular, the following was undertaken:

- Validating preliminary issues from the scoping phase through a review of secondary and primary data sources (as listed previously), and based on Advisian's experience on other projects within the study area.
- Assessing potential social impacts and opportunities, both real and perceived, that could occur during project construction and over the longer-term. This included analysing the effects of the Project on the local community, the project workforce, social infrastructure and community values. The cumulative impacts of other projects either planned or in the early stages of development have also been considered where relevant to the impact being assessed.
- Rating and ranking identified impacts and opportunities through a tailored scoring tool to understand the overall magnitude and significance of each issue.

Impacts were assessed against the criteria outlined in the SIA Technical Report contained in **Appendix R**. These criteria were developed in line with the impact assessment guidance provided in the Queensland government's *Social impact assessment - Guideline to preparing a social impact management plan - 2012*.

Negative and positive impacts were ranked according to their:

- Consequence (extent + duration + severity)
- Significance (consequence x probability).

This allowed impacts to be rated as having an overall significance rating of a 'low', 'medium', 'high' or 'very high'. These ratings were applied to both positive and negative impacts. Neutral impacts were not ranked as the impacts are considered negligible and management strategies are not required.

Wherever possible the SIA differentiates between real and perceived impacts, positive and negative, direct, indirect and cumulative impacts, with a particular focus on the relationship between social and economic impacts.

The methodology for assessing cumulative socio-economic impacts was based on the approach outlined in 'The Cumulative Dimensions of Impact in Resource Regions' (Franks *et al.*, 2013). This paper suggests that all impacts have an aspect that is 'cumulative' in nature. As such, cumulative impacts should not be assessed individually, but rather all impacts



should be viewed holistically as having a cumulative element. In this context, the SIA focused on assessing the receiving social environment and receiving entities as a primary point of analysis.

Although a level of regional collaboration (beyond the scope of this EIS) is required to provide an entire assessment, the socio-economic assessment aimed to assess the capacity of the receiving socio-economic environment to adapt to changes, based on the collective of past, present and future activities planned for the area.

Economic Impact Assessment

The Economic Impact Study (**Appendix S**) utilised a regional input-output approach, which provided indicative results relating to the total demand generated by the Project during its construction and operational phases in terms of output, household incomes, employment and value added.

The total economic impact of a particular stimulus or activity comprises the following effects:

- Direct or initial effect: being the stimulus for the economic impact, typically described as the change in sales or contribution to final demand by the stimulus or activity.
- Flow-on effects, comprising production-induced effects and consumption-induced effects, these being:
 - First-round production effects: being those purchases of inputs required from other industry sectors in the economy to produce the additional output generated by the stimulus or activity
 - Industrial support production effects: being those second, third and subsequent-round industrial flow-on effects stimulated by the purchases made in the first round
 - Consumption induced effects: being those purchases made by households upon receiving additional income from labour payments stemming from the production of additional output generated by the stimulus or activity under assessment.

The extent of these impacts can be represented by multipliers calculated in aggregate for various regional, State or national economies. There are commonly four multipliers used to measure impact: output, household income, employment and value added (refer to the Economic Impact Study at **Appendix S** for additional detail).

Two sets of the above multipliers can be generated, namely:

- Type 1 Multipliers, which estimate the direct and production-induced impacts of a stimulus or activity
- Type 2 Multipliers, which estimate the direct, production-induced and consumption-induced impacts of a stimulus or activity.

Type 1 Multipliers were used in the analysis of the Project. Queensland Treasury's preference is for use of only Type 1 Multipliers, given that Type 2 Multipliers typically overstate the extent of consumption-induced impacts of any given stimulus or activity.



8.2.1.6 Mitigation measures

Management strategies were developed in response to the identified social and economic impacts, with an emphasis on mitigating/managing impacts with higher order significance rating.

Measures to mitigate and/or manage potential impacts and enhance opportunities associated with the Project were developed in line with relevant Australian and Queensland Government policies and in accordance with a review of industry good practice, particularly as applied within the Queensland context.

Potential residual impacts were identified by reassessing the impact with the assumption that the proposed mitigation measures had been implemented.

8.2.1.7 Study considerations

As part of undertaking the social and economic impact assessments, a number of particular challenges were encountered. Although every effort was made to overcome the limitations associated with each challenge, the following should be considered by the reader:

- The Abbot Point Port and Wetland Strategy, which proposed onshore dredged material placement, was subject to a public review process and as such, the Project has been designed in response to community concerns. The findings of this desktop study have therefore not been qualified or validated by external stakeholders as the issues are expected to be similar to those previously raised, or have been dealt with as part of the project design. The community perceptions outlined in this document are based on secondary data, and the outcomes of the extensive consultation undertaken as part of the Abbot Point Port and Wetland Strategy. The data reviewed as part of this study is summarised in Section 8.2.1.4.
- This section explicitly excludes preparation of a stand-alone Social Impact Management Plan as this is not a requirement under the EPBC Act. However, a number of mitigation and enhancement strategies and key actions have been proposed to enhance benefits or avoid/mitigate impacts where the magnitude of the impact warrants this.
- The 2011 ABS Census data is now over three years old, and does not adequately capture recent changes in the region associated with the State's economic downturn. Wherever possible, information has been supplemented with more recent data sets or with qualitative data from other sources to provide an updated perspective.

With regard to the economic impact assessment, the regional input-output approach had a number of limitations, which may have resulted in overestimation of impacts, including:

- The absence of capacity constraints such that the supply of each good is perfectly elastic, implying that each industry can supply whatever quantity is demanded of it and there are no budget constraints.
- The assumed linearity and homogeneity of the input function, which implies constant returns to scale and no substitution between inputs. This occurs because the approach assumes inputs purchased by each industry are a function only of the level of output of that industry.
- Each commodity, or type of commodity, is supplied by a single industry sector, implying there is only one method used to produce each commodity and each sector has only a single primary output.



- The assumption that the economy is in equilibrium at given prices and that the economy is not subject to other external influences.
- The additivity assumption suggests the total effect of carrying on several types of production is the sum of the separate effects, which is not a true reflection of economic systems.

Despite these limitations the approach adopted was considered appropriate insofar as the host region and Queensland generally has a mature coal and coal logistics sector. The above limitations are typically most relevant when introducing a wholly new economic driver to a State or regional economy that may result in significant structural change. The Project represents the expansion of coal export operations from one of Queensland's most significant coal ports.

8.2.2 Employment

The Project is expected to result in peak employment numbers of up to 164 FTEs⁷ during construction. Any non-resident workers involved in the construction of the Project are expected to be housed in the Bowen township. Employees will be given freedom of choice to decide where they will reside (e.g. in short-term rental accommodation), depending on their needs and family circumstances.

During construction, a variety of skills will be required, including project managers, project controllers, site and construction supervisors, environment managers, procurement, quality assurance, labourers, tradespeople, machinery operators, engineers, health and safety personnel and administration staff.

During the construction phase, recruitment and management of the workforce will largely be the responsibility of contractors and sub-contractors appointed to undertake dredging and construct the DMCP. As these contractors are not yet appointed, it is not possible to provide accurate details on where the workforce may be sourced. However, the Project contractor will be encouraged to recruit from the local labour market as a priority, before recruiting further afield.

Nominal working hours will be 6am to 6pm, 7 days per week. However, working hours may be extended to 24 hours per day, 7 days per week as required throughout construction to meet project timeframes.

Buses will be provided to transport the workforce from Bowen to and from site, in order to minimise traffic on local roads and manage the risk of fatigue.

⁷ Full Time Equivalent (FTE) is a measure of the total level of staff resources used. The FTE of a full-time staff member is equal to 1.0 (ABS, 2011). The workforce numbers have therefore been calculated based on the total FTE workforce required for construction, which represents 1,800 hours of labour in a single year. The number of workers onsite at any one time could vary depending on the configuration of shifts, which will be determined by the Project's contractor.



8.2.3 Existing environment

8.2.3.1 Community values

The Whitsunday LGA was formed in 2008 following the amalgamation of the Bowen and Whitsunday Shires. The region covers an area of approximately 23,863km² and recorded a total population of 34,211 persons in June 2014, which is expected to grow by an average 1.7% per annum over the next 25 years (QGSO, 2015), slightly lower than the growth rate estimated for Queensland as a whole.

The Whitsunday LGA is considered the 'Gateway to the Great Barrier Reef' and as such, the tourism industry is a key contributor to the economic characteristics of the region. The strategic location of the Whitsunday LGA has also driven the development of its agricultural (horticulture and sugarcane) industry, and in more recent years, growth in mining-related activity, transport related industries, small scale manufacturing and construction industries (Queensland Government, 2012).

Bowen is the commercial, business, service and administrative hub for the northern section of the Whitsunday LGA and is the largest town in the Whitsunday region. Bowen's local economy is based on a nationally significant horticulture industry, commercial fishing, aquaculture and a major salt processing facility (Queensland Government, 2012).

Bowen residents report having a relaxed and healthy rural-coastal lifestyle with many community events and festivals (Bowen Tourism and Business, 2010), community initiatives such as walking groups (Whitsunday Regional Council, 2011) and a wide range of recreational social infrastructure facilities to support such a lifestyle (GHD, 2013c).

The Bowen community also identifies themselves as having strong sense of community and community pride. They value the environment and recognise that it plays a key role in the identification of the region as *"a place where the beach meets the bush"* (Whitsunday Regional Council, 2011).

The Bowen community has stated their desire for the area to grow and develop, but not at the cost of community diversity or by displacing people who already live in the area (through increased costs of living). The Bowen community has previously expressed a preference for workers and their families coming to the area for employment opportunities with the Abbot Point expansion to live in Bowen (rather than at camps) to strengthen the local economy and encourage population stability (CDM Smith, 2013c).

An analysis of recent media suggests that the Bowen community recognises the benefits that the resource industry has brought to its town. In particular, the benefits of employment, more money circulating in town, new infrastructure and growth opportunities for local businesses have all been cited as benefits. However, there are some issues around the resources sector that remain highly emotive and are the source of community protest and media attention. These include impacts of dredging on the GBR and the perceived impact of the Abbot Point expansion on the tourism and commercial fishing industry as well as the nearby Caley Valley Wetlands.

The Caley Valley Wetlands provides 'existence' values to the community. 'Existence' value is the non-use value that people place on simply knowing that something exists, even if they will never see it or use it (BMT WBM, 2015). While the wetland is largely inaccessible to the public, consultation undertaken by BMT WBM (2012) found that community members were

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aware of the wetland and its environmental values, and were particularly concerned about the effects of future development on these values.

The Abbot Point area also has strong Indigenous heritage and was occupied by Indigenous people for many generations, up until early last century. Indigenous use of the Abbot Point area has continued with contemporary land and recreational uses such as fishing and camping (CDM Smith, 2013c). The Juru People maintain strong cultural ties with Abbot Point and the nearby Abbot Beach.

8.2.3.2 Key baseline characteristics

The following provides a summary of the socio-economic baseline characteristics of the study area. Sources of data for the key baseline statistics summarised below are referenced in the social and economic baseline assessments provided in **Appendix R** and **Appendix S** respectively.

Population and demographic profile

Based on the population and demographic profile of the project study area, key considerations for the impact assessment included:

- Bowen has experienced slightly lower growth when compared to the Whitsunday LGA and the State of Queensland in recent years; likely due to the downturn in the mining industry and the delays to the Abbot Point expansion
 - Population projections indicate that growth in Bowen will largely be attributed to development in mining and infrastructure activities, such as upgrades to the Port of Abbot Point
 - Bowen's high proportion of persons aged 45 and over indicates that it is a popular retirement destination for the Whitsunday LGA
 - There is a high proportion of working-age persons living in Bowen and more broadly in the Whitsunday LGA, indicating potential opportunities for resourcing the Project locally
 - Given the relatively high proportion of Indigenous persons living the Bowen community, consultation with traditional owners and members of the Indigenous community will be important to ensure their interests are recognised in the Project.
-
- In June 2014, the population of the Whitsunday LGA was 34,211 people, representing 0.7% of Queensland's total population. At the SA2 level, the population of Bowen was 9,577 people.
 - Between 2011 and 2014, the Bowen SA2 recorded an average annual growth rate of 1.7%, slightly less than the Whitsunday LGA and Queensland average annual growth rate of 1.8% over the same period.
 - Population growth is expected to be solid over the next 25 years with almost 49,700 residents expected to be living in the Whitsunday LGA by 2031, representing an increase of 1.7% per annum (15,489 persons in total).
 - The average annual growth rate in the Bowen SA2 is expected to be 1.6% per annum, resulting in an additional 4,019 persons during the period 2014 to 2036.
 - The area's non-resident population, which reached a peak of just over 700 persons in 2012, was 470 persons in June 2014, or 3.3% of the total FTE population.



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- The non-resident population in Whitsunday (R) (Bowen only)⁸ area is expected to increase to 1,750 persons in 2016, before gradually declining to 530 persons in 2020.
- The median age of the Whitsunday LGA was 38 years, slightly higher than the median age for Queensland which was 36 years.
- In the Whitsunday LGA, there was a higher proportion of both males and females in the working age cohort, with 57% of persons in the 25 - 64 year age group, likely attributed to the labour intensive tourism industry.
- At the SSC level, Bowen's age and gender profile was similar to that of the State, with around 54% in the 25 - 64 year working age cohort in 2011. However, Bowen's high proportion of persons aged 45 and over (43%) indicates that it is a popular retirement destination for the Whitsunday LGA.
- Approximately 7% of the Bowen population (at the SA2 level) identified themselves as being of Aboriginal and/or Torres Strait Islander (Indigenous) origin or both, compared with only 4% in the broader Whitsunday LGA.

Economic profile

Based on the economic profile of the Project study area, key considerations for the Project's impact assessment included:

- The high unemployment rates indicate the potential for a proportion of the workforce to be sourced locally or from within the Whitsunday LGA
- The occupation categories were reflective of the 'agriculture, forestry and fishing' and 'construction' industries with 'labourers' and 'technicians and trades workers' being the most dominant areas of occupation
- Given the high proportion of construction businesses in Bowen (16% in 2013-14), there may be potential to procure some of the Project's goods and services from the local Bowen community
- The costs of living and construction in Bowen and the broader MIW region are generally higher than in Brisbane
- Overall, the MIW region can be characterised as having local and regional economies that are heavily dependent on primary production (agriculture and mining), and as such have generally experienced significant stimulus from major resource sector investment, although much of this stimulus has been concentrated within the MIW region outside of the Whitsunday LGA.

- The size of the labour force in the Bowen SLA increased from 6,298 persons in 2003 to 7,751 persons in 2014, or by approximately 1.9% per annum.
- Over the past 11 years, the resident labour force in the Whitsunday LGA increased from 15,736 persons in 2003 to 20,587 persons in 2014 or by an average of 2.5% per annum. Year-on-year growth was particularly high in 2004 and 2011.
- Between 2011 and 2013, the Whitsunday LGA and Bowen SA2 experienced lower unemployment rates than the State, before a spike in unemployment in 2013-14, likely

⁸ Whitsunday (R) Bowen only comprises the SA2s of Bowen and Collinsville, which cover the area of former Bowen Shire.



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due to the effects of the economic downturn and the scaling back of some construction and mining projects in the region.

- As at March 2015, unemployment rates had continued to rise with Bowen recording a rate of 12.2% and the Whitsunday LGA reaching 9.0%. Notably, unemployment rates for the study area are significantly higher than those recorded for the State, which had an unemployment rate of 6.5% in March 2015.
- Of the Indigenous persons in Bowen within the working age population, 38% were engaged in full-time employment, compared to 33.8% in the Whitsunday LGA.
- The main industries of employment in the Whitsunday LGA in 2011 were 'accommodation and food services' (accounting for 15% of total employment), 'retail trade' (10%) and 'construction' (10%). The high proportion of employment in 'accommodation and food services' and retail trade is reflective of the large tourism industry in the area.
- In 2011, the key industries of employment in the Bowen SSC were 'agriculture, forestry and fishing' employing 15% of the working population, 'construction' (10%), and 'retail trade' (5%). The occupation categories were reflective of the 'agriculture, forestry and fishing' and 'construction' industries with 'labourers' (21.3%) and 'technicians and trades workers' (16.9%) being the most dominant areas of occupation.
- In 2013-14, there were 708 registered businesses in the Bowen SA2, of which 16% serviced the construction industry, followed closely by the agriculture, forestry and fishing industry at 15%. This suggests the community has a relatively high base of construction businesses and/or skills to service the mining industry.
- In 2011, the median household income for persons living in the Bowen SSC and Whitsunday LGA was comparable at \$1,100 per week and \$1,165 per week respectively.
- Conversely, the proportion of households earning over \$1,500 per week was significantly higher in the Bowen SSC (44%) than the Whitsunday LGA (33%) and Queensland (37%). This could be attributed to the higher salaries earned by individuals engaged in the mining and/or construction sector, which were among the dominant industries of employment in Bowen.
- Household incomes among Whitsunday LGA households were below the Queensland average, while household incomes within the broader MIW region were considerably higher, indicating to some extent that residents of the Whitsunday LGA have not benefited from rising incomes associated with resource sector development to the same extent as MIW region households. However, it is assumed that incomes may have potentially decreased in recent years, particularly in Bowen SSC given the recent downturn in the mining industry, and associated increase in unemployment.
- The Bowen community has experienced the positive benefits of the resource industry through the creation of employment opportunities and business growth, and a level of expectation exists in the community about the opportunities that may be associated with the Abbot Point expansion. However, in recent years, the downturn of the mining industry, coupled with the delays to the expansion has resulted in job cuts and business closures, in some instances leading to workers leaving the region in search of employment elsewhere.
- Research suggests that a contingent of the business community in Bowen are likely to have high expectations about opportunities associated with development at Abbot Point, and the associated expansion of inland coal mines that will use the terminals.
- Analysis of gross regional product and regional competitive advantage indicates that the Whitsunday LGA and broader MIW region are likely to experience continued growth and

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competitive advantage within the primary sector (that is, growth in primary industries such as agriculture and mining). Growth in the primary sector is likely to be driven by the mining sector with a number of mining projects in the development pipeline.

- The agriculture, forestry and fishing sector recorded a decline in the working population between 2006 and 2011; this trend is anticipated to continue, although at a slower rate.
- In August 2013, the Queensland Treasury and Trade undertook a survey of regional retail prices of goods and services between Brisbane (comprising Brisbane, Ipswich, Moreton Bay and Redland LGAs) and 27 regional centres⁹. The index assumes that Brisbane = 100. The index number in each centre provides an indication of the relative level of prices compared to Brisbane. The Retail Price Index highlighted that the overall cost of living in the study area relative to Brisbane is 0.4% lower in Bowen, 4.3% higher in Cannonvale, 6.3% higher in Mackay, 22.2% higher in Moranbah, indicating a higher cost of living in the MIW region when compared to Brisbane.
- The construction price index, as reported in the Rawlinson's Australian Construction Handbook, provides an indication of construction costs relative to Brisbane (Brisbane = 100). The construction price index reported for towns within the MIW region including Bowen, Mackay and Whitsunday Islands indicate that construction costs are generally 15% higher than in Brisbane.

Housing and accommodation

In terms of housing and accommodation, key considerations relevant to the Project included:

- A high number of properties being available for rent and purchase
 - High vacancy levels noted in tourism accommodation in Bowen, and significant stock of rental housing available for short-term lease
 - The opportunity therefore potentially exists to utilise existing housing stock to accommodate the project workforce
 - The accommodation needs of seasonal workers and tourists needs to be considered when planning workforce accommodation for the Project
 - The Bowen community's preference for workers and their families to relocate to Bowen to boost the housing market needs to be considered.
- In 2011, home ownership in the study area was slightly lower than Queensland as a whole, where approximately 60% of occupied dwellings were either being purchased or owned outright, compared with around 64% for Queensland.
 - The study area had a higher proportion of rented properties (37% in the Whitsunday LGA and Bowen SSC) when compared with the State average of 33%. This, coupled with the slightly lower rates of home ownership, may be indicative of the transient population in the study area, resulting in people choosing to rent rather than buying a property.
 - Median house prices in Bowen have been relatively stable over the last seven years (2008-2015) hovering close to \$350,000. However, the number of sales has gradually

⁹ Regional centres included: Ayr, Beaudesert, Bowen, Bundaberg, Cairns, Cannonvale, Charleville, Charters Towers, Dalby, Emerald, Gatton, Gladstone, Gold Coast, Gympie, Kingaroy, Longreach, Mackay, Maryborough, Moranbah, Mount Isa, Rockhampton, Roma, Sunshine Coast, Toowoomba, Townsville, Warwick and Weipa.

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declined from 240 houses sold in 2006 to little over 118 houses sold in 2011, before rising slightly again in 2012 (146 houses).

- Median rental prices in Bowen also remained relatively stable at approximately \$350 per week between 2009 and 2013. However, by April 2015 prices had dropped to below \$300 per week, again reflective of economic conditions.
- Rental vacancy rates for Bowen remained relatively low between July 2010 and the end of 2012. However, since January 2013, rental vacancy rates have increased significantly and have fluctuated between 5% and 16%.
- Recent media articles suggest that Bowen is presently being significantly affected by the downturn in the mining sector, as evidenced by the falling purchase and rental prices and increased vacancy rates. Further, Bowen's property market is being negatively impacted by investor uncertainty around the Abbot Point expansion.
- In 2012, the Whitsunday (R) (Bowen only) area had a total of 460 non-resident workers staying in workers accommodation facilities, and a further 275 workers staying in hotels/motels. Desktop research indicates that during this period, the seasonal workforce and tourists in Bowen exacerbated the demand for a range of short-term and/or temporary accommodation options including motels, caravan parks and hostels. More recent data suggests that this pressure had eased by 2014.
- Occupancy rates for hotels, motels and serviced apartments in Bowen SLA peaked in September quarter 2011 at 75.3%, but have since fallen considerably to 38.5% in June 2014.
- The average occupancy rate from September quarter 2010 and June quarter 2014 for hotels, motels and serviced apartments in Bowen SLA (49.6%) was lower than the Whitsunday LGA (55.2%), MIW Region (54.0%) and State average (63.3%), pointing to a potential excess supply of short-term accommodation within the Bowen SLA.
- Within the Bowen SLA, the average number of vacancies per night averaged 100 rooms. This provides a significant vacancy buffer to absorb short-term increases in accommodation demand potentially resulting from the Project.
- Analysis of local and regional industrial property markets indicated that sales volumes in the MIW region were highest in the 2004-2006 period; the median sale price per square metre in the MIW region peaked in 2010, with a significant decline recorded in 2011; and the median sale price per square metre in the Bowen SLA and Whitsunday LGA peaked in 2009 with significant declines recorded in 2010 and 2011.
- Overall, there has been a softening in residential, commercial and industrial property markets across the host regions since 2010, with the number of sales generally declining across all sectors and regions post 2010 and there being a consequent softening of price growth over the same period.

**Community infrastructure and services**

Key considerations for social infrastructure and services included:

- The attraction of Bowen as a retirement destination has resulted in the provision of community infrastructure tailored towards an aging community
 - Some existing systems are already at capacity, particularly water and sewerage infrastructure, and there is latent demand for health services, facilities and aged care
 - Inadequate capacity or resources to cater for medical emergencies in Bowen, with most emergency cases needing to be air lifted to Mackay or Townsville
 - Existing high level of demand for women's and child health services, as well as allied health including physiotherapy, occupational therapy, mental health and family planning.
-
- Bowen is a well-established and liveable seaside community hosting a broad range of community services including a hospital, community childcare, library, swimming pool, skate park and schools including two high schools.
 - Research indicates that, whilst health services in the region are well within capacity to meet the demands generated by the Project, there may be some shortfalls and challenges as a result of cumulative population growth, including:
 - Inadequate capacity or resources to cater for medical emergencies in Bowen, and in most cases emergencies cases are required to be air lifted to Mackay or Townsville.
 - Shortage of nursing staff, particularly when a nurse is required to escort a patient while transferring to Townsville or Mackay - this leaves the local hospital short of staff.
 - Shortage in local General Practitioner services, particularly in Bowen where currently there are eight General Practitioners who are not accepting new patients as they are operating at capacity.
 - Shortage of mental health services in Bowen.
 - Overall challenges in attracting skilled health staff such as doctors and nurses in regional areas.
 - The need for additional Queensland Police Service resources in the region to undertake traffic management and administration.
 - Shortages in Queensland Fire and Rescue Services personnel to respond to fires as they function on a volunteer basis and therefore are not required to respond to fire incidences. Furthermore, they are ill-equipped to respond to emergencies as they are not trained for rescue operations (GHD, 2013c).
 - Population increase in Bowen is expected to result in an increased demand for additional and new community infrastructure such as higher-order community centres, community health services, libraries, fire and rescue and State Emergency Services, housing support and youth services.



8.2.4 Potential social and economic impacts

This section provides a summary of the potential impacts identified as part of the SIA and economic assessment. The level to which each community in the study area will experience the impacts and opportunities outlined below is dependent on their resilience, their ability to adapt to change, and their capacity to capitalise on opportunities. The baseline assessment provided an indication of this, and wherever possible this has been woven into the assessment which follows.

8.2.4.1 Preliminary issues analysis

A review of the social planning context and the socio-economic characteristics of the study area highlighted a range of actual and perceived issues, which have been assessed as part of impact investigations. Issues identified through the initial scoping exercise are identified in Table 8-2.



Table 8-2 Preliminary issues analysis

Issue	Description
Population and demographics	<ul style="list-style-type: none"> Temporary increase in population during construction phase due to presence of a non-resident workforce in the region.
Environment	<ul style="list-style-type: none"> Impacts of dredging and shipping movements on the GBRMP, and consequential impacts on the tourism industry. The environmental impacts of development, particularly impacts on the Caley Valley Wetlands near Abbot Point are a major concern for people locally, nationally and internationally.
Economic	<ul style="list-style-type: none"> Short-term increase in local employment and business opportunities during construction. Increased demand for labour, with consequent potential shortfalls in the labour market and competing demands from local business/industries and the Project over the short-term. Restricted access to commercial and recreational fishing areas during dredging activities (approximately three months).
Housing and accommodation	<ul style="list-style-type: none"> Temporary accommodation in Bowen is sometimes limited due to the tourists and seasonal workers who relocate to Bowen (April to September) particularly caravan parks, hotels, backpackers dwellings. This may be exacerbated by the Project. Potential cumulative impacts on housing availability and affordability over the short-term, with increased demand potentially leading to decreased housing availability and increased housing rents and prices.
Social infrastructure	<ul style="list-style-type: none"> Increased demand on existing social infrastructure services and facilities (i.e. medical and health facilities and services) due to increase in workforce related population.

8.2.4.2 Economic development

As with most large development projects, the primary social benefit of the Project is likely to be direct and indirect job and business opportunities for workers, including those from the local community. The Project is anticipated to have a range of economic benefits including:

- Supporting (in association with a range of other major projects) the export of up to an additional 70Mtpa of largely thermal coal from Queensland, and the generation of royalties associated with those exports
- Generating economic activity within the MIW region within the heavy and civil construction sector, and generating additional employment opportunities
- Generating opportunities for in-region supplies of support services to heavy and civil construction projects (Economic Associates, 2012).



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It is estimated that, at a regional level, the Project will generate positive economic impacts in the MIW region. At this stage of project planning, the Queensland DSD is anticipating project costs to fall within a range, represented by low and high scenarios between \$50 million and \$100 million. This includes capital expenditure on dredging mobilisation; including pipe installation and removal, dredging work and DMCP construction. The project construction costs have been estimated based on concept design and on current market prices. As a tender process is currently being undertaken for the Project, an exact figure cannot be provided to ensure the integrity and accountability of the tender process.

Economic Associates (2015) modelled the potential project expenditures using an input-output methodology to analyse and assess the potential economic impacts of the Project.

Output impacts

Output impacts relate to the overall economic activity generated by project expenditures. As such, output is a measure of activity or turnover of expenditure as opposed to net value.

More specifically, the output impacts of the Project during its construction phase are anticipated to be between (see Table 4.1 of **Appendix S**):

- \$62.60 million, comprising \$50.00 million in direct output and \$12.60 million in indirect output
- \$125.19 million, comprising \$100.00 million in direct output and \$25.19 million in indirect output.

Household income impacts

Household income impacts relate to changes in incomes, predominantly in the form of wages and salaries paid to workers, as a result of the impact generated by the Project. However, it is important to note that workers on engineering construction projects typically move from project to project within a given region. As such, the Project could be considered an addition to the pipeline of project work that these workers might be engaged on, or that might be generating employment demand in the region.

The household income impacts of the Project during its construction phase are anticipated to be between:

- \$9.90 million, comprising \$6.78 million in direct household income, and \$3.12 million in indirect household income
- \$19.80 million, comprising \$13.56 million in direct household income, and \$6.24 million in indirect household income.

Value added impacts

Value added impacts represent the net value of economic activity generated by the construction phase of the Project. Value added represents the combination of remuneration to employees (e.g. wages and salaries) and gross operating surplus of business entities.

Value added impacts of the Project during its construction phase are anticipated to be between:

- \$23.25 million, comprising \$17.49 million in direct value added and \$5.76 million in indirect value added

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- \$46.50 million, comprising \$34.98 million in direct value added and \$11.51 million in indirect value added.

Annual operating impact

Subsequent to the completion of dredging, there will be ongoing costs associated with managing the DMCP. These operating costs are expected to average approximately \$1.25 million per annum over a nominal five year operating period (although the DMCP has been designed to achieve a life of up to 10 years if required). These annual impacts would run for approximately five years, resulting in a total operating cost of \$6.25 million. Specifically, annual operating economic impacts of the Project are estimated at:

- \$1.56 million in output, comprising \$1.25 million in direct output and \$0.31 million in indirect output
- \$0.25 million in household income, comprising \$0.17 million in direct household income and \$0.08 million in indirect income
- Two FTEs
- \$0.58 million in value added, comprising, \$0.44 million in direct value added and \$0.14 million in indirect value added.

Local employment opportunities

The Project is expected to result in peak construction employment numbers of up to 164 FTEs. After the construction phase, operating employment impacts would manifest for approximately five years in the order of two FTEs. It is envisaged that these might not be in the form of new 'jobs', but rather a continued stream of employment opportunity for heavy and civil construction workers and their supply chains that rely on project based work.

Demographic data in the baseline profile indicates that there are likely to be a number of working-age people in the study area with suitable skills for working on the construction of the Project, specifically labourers, technicians and trades workers. Therefore, recruitment is anticipated to include a combination of existing residents of Bowen and those that may choose to relocate to Bowen for the duration of the construction phase. Whilst it is the Queensland DSD's preference to source the majority of the workforce from the local area, it is not possible to estimate the split between the resident and non-resident workers at this stage.

The construction workforce for the Project will be provided by contractors and sub-contractors engaged to undertake the dredging and construction of the DMCP. The Queensland DSD acknowledges that, given the short construction timeframe, the employment opportunities associated with the Project are also short-term and will not provide the local community with sustainable, long-term employment.

However, the Project will facilitate the T0 expansion at Abbot Point, which is a key component to unlocking the coal resources of the Galilee Basin and exporting these resources to the rest of the world. Thus, the Project will indirectly enable employment opportunities through Adani Mining's Galilee Basin projects. These projects, including the Carmichael project, could potentially provide an investment of up to \$21.7 billion in Queensland, and create approximately 9,500 direct jobs and thousands more indirect jobs.

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Desktop research indicates that, whilst additional employment opportunities would be welcomed by the local community, some residents may be concerned that the cumulative workforce requirements for port expansion may impact on the availability of labour to support the local agricultural industry. However, it is anticipated the workforce requirements for each sector will be different enough to ameliorate this potential impact; for example, the agricultural sector tends to recruit unskilled workers, whilst the construction sector generally employs skilled labourers and trades people. It is considered that the project workforce will not adversely impact the availability of seasonal workers, nor affect the retention of existing employees given the short-term and temporary nature of the Project.

Local and regional business opportunities

The Project presents opportunities for local and regional businesses to participate in the procurement process during construction. It is anticipated, given the high proportion of existing construction-related businesses in Bowen and the broader Whitsunday LGA, that a proportion of construction services, materials and inputs could potentially be sourced from within the MIW region, specifically for the construction of the DMCP. This may strengthen the local and regional business profile, potentially building experience in this sector locally over the short-term.

There is, however, a risk that the expectations of local and regional business to benefit from the Project will not be met, particularly if local and regional businesses lack the capacity or experience to tender competitively for works. This will be particularly true for dredging which will be carried out by an experienced dredging contractor and will also occur over a short time period with a quick lead time. This risk may be exacerbated if project procurement processes, including pre-qualification requirements, are not widely understood or are not advertised far enough in advance. Distribution of information and management of expectations will therefore be key to mitigating potential impacts in this regard.

While the existing capacity of local businesses to supply to the Project is unknown, the Queensland DSD recognises the value in supporting local and regional businesses to participate in the Project. Whilst local businesses in the immediate local area, due to their size and nature, may be unable to tender for the Project's main package of work, they do stand to benefit from smaller packages of work further down in the supply chain; for example, earthworks for bund construction and machinery operation and maintenance.

As part of indirect benefits to the region, there is potential that the project workforce may participate in tourism activities in the Whitsunday LGA when off roster (GHD, 2013c).

Proposed enhancement measures

The recruitment strategy for the Project will be based around a local-State-national-international employment hierarchy, i.e. the local labour market will be given first priority for filling job positions, before the possibilities of recruiting further afield are explored.

In order to optimise potential local business opportunities afforded by the Project, the Queensland DSD is committed to providing full, fair and reasonable opportunity to local contractors and suppliers in accordance with the Queensland Government's *Charter for Local Content - opening opportunities for industry - Best Practice Guidelines* (2014).



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As per the above, local content components will be included in tendered works and will be assessed as part of preferred supplier evaluation. Further, the project contractor will be bound to meeting the Project's local content requirements and will be required to prepare a Local Content Plan in accordance with the Queensland Government's Charter for Local Content, reporting on the outcomes of this upon completion of construction.

Table 8-3 provides a summary of the potential benefits and proposed enhancement measures to increase the economic opportunities associated with the Project.

Table 8-3 Economic development - impact and enhancement summary

Potential Impact	Affected Stakeholders	Impact	Proposed Enhancement Measure	Residual Impact
Increased opportunities for local and regional businesses in Bowen and the broader Whitsunday LGA.	<ul style="list-style-type: none"> Local business Regional business Government agencies 	MEDIUM	<ul style="list-style-type: none"> The project contractor will be required to develop and implement a Local Content Plan in accordance with the principles of the Queensland Government's Charter for Local Content. 	MEDIUM
Increased opportunities for local and regional employment.	<ul style="list-style-type: none"> Local community Local business 	MEDIUM	<ul style="list-style-type: none"> The project contractor will be required to develop and implement a Local Content Plan in accordance with the Queensland Government's Charter for Local Content. The Local Content Plan will align with the Project's recruitment hierarchy based on source location (local, regional, State, national, and international). The Local Content Plan will include strategies that encourage participation of under-represented and under-employed groups for appropriate roles/functions. 	MEDIUM



8.2.4.3 Opportunity cost

Alternative uses for the disposal site

Opportunity cost represents the next best alternative to what is being proposed. The opportunity cost is likely to be an economic use associated with port operations. The onshore area predominantly affected is the DMCP, which was designated for an alternative development. Apart from utilising the T2 site for onshore placement of dredged material, discussions between NQBP and the Proponent indicated that there are no short to medium term plans to use the T2 site. Use of the land for dredged material placement is likely to sterilise the land for an economic use for the short-term during the time required for the material within the DMCP to dewater and compact.

As such, the opportunity cost of using the T2 site for onshore placement of dredged material and the subsequent short to medium term sterilisation of that land for an alternative use is unlikely to have a material opportunity cost. This is because there are no immediate plans for alternative use of the land and, as such, it will be retained as vacant Strategic Port Land in the short to medium-term.

Vegetation communities to be impacted

Direct impacts occur predominantly within and immediately adjacent to infrastructure footprints where dredges excavate the seabed. Direct impacts typically involve irreversible loss of benthic habitats and communities, where irreversible is defined as lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less.

The direct impact area covers approximately 61ha, comprising 10.5ha within the berth pocket areas and 50.5ha within the apron areas. Advisian (2015) advised that seagrass coverage in these areas is approximately 5%, which represents 0.5ha of seagrass within the berth pockets and 2.5ha of seagrass within the aprons (refer to Table 8-4). Advisian (2015) also advised that seagrass cover can be expected to return to approximately 5% within the aprons area, while the habitat within the berth pockets would simply be open substrate. The return of seagrass within the aprons indicates that there would be no permanent loss of seagrass within the aprons. The area of seagrass loss would become open seabed, and communities similar to those of surrounding open seabed would be established in the newly open seabed area (offsetting to some extent the loss of ecosystem services provided by the seagrass).



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Table 8-4 Area of direct impacts

	Berth Pockets	Aprons
Total area (ha)	10.5ha	50.5ha
Condition - current	Seagrass at 5% cover	Seagrass at 5% cover
Seagrass cover (ha)	0.5ha	2.5ha
Condition - years 1 to 5 (conservative)	Open substrate	Open substrate
Condition - years 6 to 20	Open substrate	Seagrass at 5% cover

This study derives values based on Costanza *et al.* (1997) which is a meta-analysis of environmental and ecosystem services valuation studies across a range of vegetation communities and habitats in different regions around the world.

The habitat areas anticipated to be impacted by the Project are seagrass meadows and other benthic areas. Costanza *et al.* (1997) reports values for seagrass at approximately \$23,720/ha/annum. This value is based on a range of studies of well-established seagrass meadows. Seagrass coverage in the study area ranges from between 1% and 10%, which represents low levels of seagrass coverage. The Costanza *et al.* (1997) seagrass values must therefore be moderated to reflect the low level of sea grass coverage. This is done based on advice from Advisian (2015) which has calculated the area of seagrass based on total area multiplied by coverage. The Costanza seagrass value is applied to this area of seagrass, with the balance area subject to an alternative measure estimated by Costanza *et al.* (1997) as a general value for coastal marine habitats of ~\$5,065/ha/annum.

The calculation of direct impacts on marine habitat within the berth pockets and aprons assumes the permanent loss of seagrass within the berth pockets, but replaced by open substrate, and a five year loss of seagrass within the aprons.

Based on the parameter values articulated above, the annual value of direct impacts is estimated at:

- Berth pocket: 0.5ha of removed seagrass valued at \$23,720/ha offset by the emergence of an open substrate habitat valued at \$5,065/ha, culminating in an annual loss of ecosystem services of \$9,328
- Aprons: 2.5ha of removed seagrass replaced by open substrate for five years, representing an annual ecosystem services loss of \$46,638 for that five year period.

Based on a test discount rate of 6%, the above reductions in ecosystem services represent a capitalised value of \$155,467 within the berth pockets and \$196,456 within the aprons.



Proposed mitigation measures

Measures to minimise and mitigate impacts to seagrass and other marine plants providing ecosystem services are addressed in the marine ecology assessment of the EIS (refer Section 4.3.8).

Measures to ensure a net positive outcome in relation to environmental impacts to seagrass and other marine plants providing ecosystem services are addressed in Section 5.2. These measures are subject to the requirements of relevant environmental authorities.

8.2.4.4 Community values and lifestyle

Community values can include aspects relating to community lifestyles and aspirations, and also the ability to live in accordance with environmental values and social norms. The Bowen community's values are centred around its relaxed and healthy rural-coastal lifestyle. The natural environment is also highly valued by local residents as are the tourism and recreational opportunities afforded by coastal living, particularly fishing and boating.

Recent media articles suggest that there is a level of uncertainty and anxiety amongst the community about the economic climate should the Abbot Point expansion not go ahead, with members of the Bowen community proclaiming their need for the development:

"We need this to further cement our economic stability by having a good export facility at Abbot Point [Bruce Hedditch, Bowen Business Chamber]" (Validakis, 2013).

The Bowen community has indicated a desire for the area to grow and develop and some residents have expressed that the resource industry, and the subsequent development at Abbot Point, can bring much-needed opportunity to the region:

"Heaven knows we need these sorts of projects to help create jobs, to provide a future for our families, and get towns like Bowen back up and running [Barry Allen - motelier]" (Raggatt, 2014).

Impacts on the environment

Given the nature and small scale of the proposed Project, the natural environment will necessarily undergo a minimal level of change. The identification and significance of such changes are being addressed in other EIS technical studies. However, it is important here to address the perceptions of these impacts within local and regional communities.

There has been significant media attention around the perceived impacts of the dredging on the GBR, and the affect that this will have on the tourism and commercial fishing industries. Further, the community is concerned about the potential impacts of the proposed DMCP on the Caley Valley Wetlands. Due to its inaccessibility, the wetland has limited direct (non-traditional owner related) cultural and provisioning service values in terms of recreation or tourism. However, as stated in Section 8.2.3.1, community members are aware of the wetland and its environmental values, and are particularly concerned about the effects of future development on these values (BMT WBM, 2015).

These concerns were repeatedly raised during public consultation on the Abbot Point Port and Wetland Strategy, with community concerns pertaining predominantly to:

- The siting of the DMCP within the Caley Valley Wetlands

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- Perceived impacts on the GBR and subsequently the tourism industry, due to:
 - Port operations and shipping movements
 - Climate change (Galilee Basin coal mining developments and mined coal combustion)
- Impacts on commercial and recreational fishing.

To address these concerns, and alleviate potential impacts on the values of the wetland, the current Project has located the DMCP outside the Caley Valley Wetlands. This change significantly reduces any potential impacts to the wetland, and may work to potentially alleviate concerns the community has in regard to the perceived degradation of the environmental and cultural significance of the area.

The Queensland DSD acknowledges that the Project will further intensify the port operations in the local area. However, this is somewhat mitigated by the fact that the port is a part of the fabric of the local area and regular port expansion over the past 30 years has been an ongoing occurrence. Further, port expansion will neither encroach on local residential areas, nor affect the rural-coastal characteristics that the Bowen community values. Site topography limits visibility of the coal terminals and DMCP from local homesteads and the Bruce Highway, which is located approximately 10km from the project area.

Tourism impacts

Dredging around the GBRMP has been one of the most controversial environmental issues of recent years, particularly for the Bowen community which perceives that the dredging and shipping activities for Abbot Point may have adverse effects on their tourism industry. More specifically, residents have raised concerns about the long-term health of the Reef, particularly in relation to the perceived impacts of port development and dredging on water quality: *“From a tourism operator’s perspective, my concern is particularly in relation to the quality of the water and the health of the Great Barrier Reef. It’s already declining, but the reef can’t stand any more sediments”* [Alan Grundy, *Explore Whitsundays*] (Carter, 2014).

However, a media analysis identified that not all residents echo these concerns, with the Whitsunday Regional Residents Association indicating that Bowen needs the economic benefit of the expansion and the misguided concerns about dredging will cost locals jobs (Taylor, 2014).

Further, the Bowen Tourism organisation feels that the tourism industry has remained resilient in Bowen’s flailing economy and perceives that any concern for the Reef is not stopping tourists from visiting the area (Smith, 2015).

The UNESCO’s World Heritage Committee recently made the decision not to list the GBR as ‘in danger’, which is a significant reprieve for the Queensland and Australian governments and the Queensland tourism industry (Sturmer, 2015). Whilst the decision flagged concerns about the long-term health of the Reef, the Queensland and Australian governments’ efforts to manage the impacts on the Reef were highly regarded by UNESCO:

“Measures that represent significant progress in responding to key World Heritage Committee requests include commitments toward restoring water quality... restricting major port development in and adjoining the GBR World Heritage Area ... [Australia reversing] its original decision to dump capital dredge[d] material from Abbot Point inside the property and



a permanent ban on dumping of dredged material from all capital dredging projects within the property" (Sturmer, 2015).

The governments' ongoing commitment to maintaining the health of the Reef is further demonstrated in the recent decision not to proceed with the placement of dredged material offshore in the GBRMP as part of the Project.

Commercial and recreational fishing impacts

According to Fisheries Impact Assessment carried out for the Project (**Appendix T**), port activities and commercial and recreational fishing at Abbot Point have co-existed previously, and while the proposed expansion of the port facilities and activities represent a challenge, they can continue to co-exist.

The paramount concern of local commercial and recreational fishermen is the potential and temporary loss of access to fishing grounds - either directly or indirectly. In the case of the Project, loss or modification of fishing access may occur as a result of:

- Plumes associated with dredging
- Previously trawlable ground becoming untrawlable as a result of changes to the seabed from dredging and the presence of pipelines (refer to **Appendix T**).

The proposed dredging activities are limited spatially to Strategic Port Land at Abbot Point (within port limits) and are temporary in nature. As such, any impacts on commercial and recreational fishing are anticipated to be minimal.

Whilst recreational and commercial fishing routinely occurs within port limits, port authorities and the Regional Harbour Master have the power to declare exclusion zones for safety and security reasons. Access to the T0 dredging footprint and immediate surrounds (including the pipeline infrastructure corridor) within port limits, and in close proximity to the existing wharfs and jetty areas for fishing activities, may be controlled during the short dredging campaign.

In the past, the local community have also expressed concern that the dredging and associated dredging plumes will affect fish habitat, specifically seagrass meadows, which are a main food source for dugongs and green turtles and provide nursery habitat for many commercial fisheries species. The offshore seagrasses at Abbot Point typically are of light density, are dynamic in their presence and comprised of pioneering species. Changed access and potential loss of fishing habitat can often result in displacement of fishing effort, with recreational and commercial fishers required to fish in another location and/or in another fishery. Displacement of fishing effort is a potential negative issue for the fishery as a whole as it can result in greater concentrations of fishers in particular areas, thus placing unsustainable pressure on local fish stocks and potentially reducing economic returns for individual fishers.

In addition, given the reliance of local seafood processing and retail businesses on commercial fishing in the Bowen region, any reduction in commercial fishing catch and effort may potentially result in a flow-on impact to these local seafood businesses (refer to **Appendix T**). Further, the loss of commercial fishers to work directly in the mining and construction projects has also been highlighted as a potential flow-on impact that could impact the local seafood industry.



Recreational fishing participation in the Mackay Statistical Division (which includes Bowen) has been increasing over time, with boat ownership also on the rise (refer to **Appendix T**). Recreational fishing and boating are popular and highly valued activities in the local Bowen community, as evidenced through public submissions on Abbot Point Port and Wetland Strategy.

The proposed use of a CSD for dredging activities will limit the dredging plume and subsequently reduce the duration and extent of any associated water quality impacts (e.g. turbidity, re-suspension, light availability etc.). As such, the proposed dredging activities are predicted not to have a significant impact on potential or actual seagrass habitat beyond the direct dredging footprint, and therefore any displacement of fishing effort or flow-on impacts on the local seafood processing and retail businesses is considered unlikely to occur.

Conversely, research undertaken for the SIA indicated that an influx of workers into coastal communities may generate positive impacts for businesses that support recreational fishing activities, particularly bait and tackle businesses and fishing charter operations, as well as potential seafood retailers. As such, the workers associated with the Project may positively impact the local fishing and tourism industry, if workers and their families choose to participate in recreational activities while off roster.

Proposed mitigation measures

Ongoing community engagement will be key to alleviating project-related anxiety and concern amongst local and regional communities. The Queensland DSD will consult with the local community to provide timely and accurate project information, including around potential procurement and employment opportunities.

The Project has considered the community's previous concerns in relation to potential impacts on the environmental values of the area, and has designed significant elements of the Project to address these concerns, which were raised as specific issues regarding prior dredging proposals. Specifically the Project design:

- Minimises the offshore dredging volumes and disturbance areas
- Avoids the Caley Valley Wetlands and associated habitats for conservation significant species
- Utilises a CSD to maximise sediment recovery and limit fugitive sediment entering the marine environment.

Table 8-5 summarises the potential impacts and proposed mitigation measures to manage potential impacts on community values and lifestyle.



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Table 8-5 Community values and lifestyle - impact and mitigation summary

Potential Impact	Affected Stakeholders	Impact	Proposed Mitigation Measure	Residual Impact
Community uncertainty and anxiety around the economic climate in Bowen should the Abbot Point expansion not go ahead.	<ul style="list-style-type: none"> Local community Local business 	MEDIUM	<ul style="list-style-type: none"> Implement proactive community engagement strategies to facilitate the provision of timely and accurate project information. 	LOW
Impacts on the environmental values of communities, associated with the Caley Valley Wetlands near Abbot Point.	<ul style="list-style-type: none"> Local community Local business 	LOW	<ul style="list-style-type: none"> The Outline EMP will be further developed into a CEMP and be implemented to manage potential environmental impacts during construction. Provide regular updates to local communities in regard to mitigation measures and monitoring. 	LOW
Reduced environmental amenity and tourism opportunities due to the perceived impacts on the GBRMP.	<ul style="list-style-type: none"> Local community Regional community Local businesses Regional businesses Government agencies 	MEDIUM	<ul style="list-style-type: none"> Dredging will not occur in the GBRMP. Offshore dredging areas have been minimised. A CSD will be utilised to maximise sediment recovery. 	LOW
Reduced opportunities for commercial and recreational fishing.	<ul style="list-style-type: none"> Local community Local business 	LOW	<ul style="list-style-type: none"> Potential impacts will be managed through the implementation of a DMP, which will be further developed based on the Outline DMP. 	LOW



Housing and accommodation

Historically, regional communities have been concerned that projects with large workforces and/or the cumulative effects from a number of projects have suddenly and significantly altered local housing supply. This has often led to decreased housing affordability and higher living costs, particularly for those not employed in the resources sector (GHD, 2013c).

However, more recently, the downturn in the mining industry has contributed to falling purchase and rental prices and increased vacancy rates in Bowen and the broader Whitsunday LGA. As a result, there is almost an oversupply of housing available for rent or purchase in Bowen:

"With the tomato season happening now, home vacancies would normally be unheard of.... Things will turn around, but it's going to take time," [Mike Lyon, LJ Hooker Bowen] (Lees, 2014).

As mentioned, the Bowen community has identified a preference for workers to live within the community and the town has demonstrated a capacity and willingness to accommodate a growing resident population. With this in mind, non-resident workers involved in the construction of the Project will be encouraged to reside locally in Bowen. Given the current vacancy rates, it is anticipated that this approach may assist in boosting the local housing market.

It is acknowledged that a proportion of the population in Bowen is transient in nature due to the seasonal nature of work opportunities in the agricultural and tourism industry. As such, demand for short-term accommodation, such as hotel, motel or caravan park accommodation is relatively high at certain times of the year. This transient population, coupled with workers for the Abbot Point expansion projects may exacerbate housing availability during peak demand periods for tourism and harvesting, which run from September to April each year (GHD, 2013c). However, it is the Queensland DSD's intention that the construction workforce for the Project will rent houses, units and townhouses for the duration of the Project. Any consultants and/or short-term contractors required to visit the project site during the construction phase are likely to utilise short-term accommodation. However, any potential impact on short-term accommodation is likely to be negligible given the visits will be temporary in nature and will involve a small number of people.

From a cumulative perspective, it is recognised that some local residents may be concerned that a number of proposed projects may commence at the same time, and that the Project's demand for housing may impact cumulatively on housing availability and affordability. Although a number of other projects are proposed to occur at Abbot Point, a review of other proponents' EIS documentation (i.e. Adani Mining's NGBR EIS) indicates that project construction workforces will be accommodated in temporary accommodation camps to reduce impacts on the housing availability and affordability. As such, the likelihood of the Project contributing to cumulative impacts on housing availability and affordability is considered low.



Proposed mitigation measures

The Project is committed to ensuring the construction workforce will not adversely impact on housing and accommodation in Bowen. To reduce any impacts to the accommodation needs of the seasonal agricultural and tourism industries, non-resident workers for the Project will be encouraged to rent houses, units and townhouses for the duration of construction.

Table 8-6 summarises the potential impacts on housing and accommodation, and proposed mitigation measures to manage potential impacts.

Table 8-6 Housing and accommodation - impact and mitigation summary

Impact	Affected Stakeholders	Impact	Mitigation Measure	Residual Impact
Decreased availability of local housing and short-term accommodation in Bowen.	<ul style="list-style-type: none"> Local community Local business 	LOW	<ul style="list-style-type: none"> Non-resident workforce to be accommodated in houses, townhouses or units in Bowen. Vacancy rates of short-term accommodation to be monitored in collaboration with Council for the period of construction. 	LOW
Potential cumulative impacts on housing availability and affordability, potentially leading to housing stress for vulnerable groups.	<ul style="list-style-type: none"> Local community Local businesses 	LOW	<ul style="list-style-type: none"> Work with Whitsunday Regional Council and other proponents in the area to understand housing needs in the area, and monitor the Project's impact on the Bowen housing market. 	LOW

Community infrastructure and services

As previously stated, the Project is expected to result in peak construction employment numbers of up to 164 FTEs. The Project may employ a combination of existing residents in Bowen and those workers who relocate to Bowen for the duration of the construction phase. The contribution of the Project to the population of Bowen cannot be predicted at this stage. However, as the number of workers required is small and temporary in nature, any increase in population is expected to be equal to or less than what has already been factored into population forecasts produced by the QGSO.

Impact on health services

As identified in Section 8.2.3, it is considered that existing social infrastructure and services will likely be able to cope with any additional demands generated by the Project. However,

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health and emergency service providers in Bowen are currently experiencing some shortages, particularly in relation to staff and service provision (i.e. emergency response capabilities, allied health etc.).

These existing shortfalls and challenges to health service provision in the study area are not expected to be further exacerbated by the Project. However, it is possible that the Project may contribute to cumulative impacts on these pre-existing issues. The magnitude of the potential cumulative impacts on the local health services will be dependent on the breakdown of the local and non-local workforce. Should a significant proportion of the project workforce be recruited locally, this will reduce the additional impact on local health services as they would already be accounted for within the local health service catchment.

Impact on traffic

A review of EISs prepared for other projects in the region highlighted the local community's concerns about safety and amenity as a result of increased traffic on local roads. Access to the project site will be exclusively from the Western Access Road via Abbot Point Road. Both roads are private roads which are under the control of NQBP.

From Abbot Point Road, access to the public road network is only via the Bruce Highway/Abbot Point Road intersection. There are no other connections from Abbot Point Road to the public road network. Further, access to the project site does not require use of any local government controlled roads.

The traffic impact assessment undertaken for the Project (WorleyParsons, 2015) found that project-generated traffic will have minimal impact on the traffic and land capacity of the Bruce Highway, and will have no impacts on local roads in and around Bowen township.

8.2.4.5 Proposed mitigation measures

The Queensland DSD will proactively share project information with Whitsunday Regional Council and service providers to ensure they are aware of project timing and workforce forecasts to adequately plan for cumulative increases in population and potential demand for services.

To minimise any potential impacts on the already strained health and medical services, site-related medical issues will largely be dealt with on site by first aid services. Workers will also be required to undertake fit-for-duty health screening prior to employment.

Emergency management planning for the Project is in progress and will involve consultation with emergency services and local and regional disaster management groups. In order to reduce construction workforce-related traffic, a bus service will be provided by the project contractor for local residents commuting from Bowen.

Table 8-7 summarises potential impacts and proposed mitigation measures to manage impacts on community infrastructure and services.



Table 8-7 Community infrastructure and services - impact and mitigation summary

Impact	Affected Stakeholders	Impact	Mitigation Measure	Residual Impact
Increased pressure on existing social infrastructure services and facilities due to potential local population influx.	<ul style="list-style-type: none"> Local community Local business Government agencies 	LOW	<ul style="list-style-type: none"> Proactively share project information with Whitsunday Regional Council and service providers to ensure they are aware of project timing and workforce forecasts to adequately plan for cumulative increases in population and potential demand for services. 	LOW
Increased demand on regional emergency services including fire and rescue, police and ambulance.	<ul style="list-style-type: none"> Local community Local business Government agencies 	LOW	<ul style="list-style-type: none"> Provide first aid services on site for construction workforce. Prepare and implement Emergency Management Plan for the Project. 	LOW
Heightened road safety risk as a result of traffic increases and road conditions during construction.	<ul style="list-style-type: none"> Local community Local business 	LOW	<ul style="list-style-type: none"> The project contractor will provide bus services for local workers commuting from Bowen. Develop a project-wide Traffic Impact Management Plan that addresses traffic-related issues associated with the Project. 	LOW



8.2.4.6 Impact assessment summary

Once mitigation strategies are implemented, the Project will create employment opportunities, business opportunities, and provide a boost to local, regional and State economies.

Over the short-term these opportunities are created directly by the Project, while over the longer term, opportunities relate more to the flow-on effects from the Project providing access to coal mining in the Galilee Basin.

Potential adverse impacts on community infrastructure and services, and any potential housing and accommodation issues, are likely to be avoided through the application of the proposed mitigation measures given the small workforce and temporary nature of the construction phase.

It is expected that the potential impacts on the natural environment can be reduced and managed through the proposed mitigation measures detailed in other sections of the EIS.

Table 8-8 presents a summary of the pre-and post-mitigation impact ratings. While some impacts do not reduce in their significance level (e.g. 'high' to 'medium' or vice versa), the severity level within that rating has changed and is evidenced in the detailed impact assessment.



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Table 8-8 Impact and residual impact summary

Potential Impact	Significance		
	Nature and Extent	Before Mitigation / Enhancement	After Mitigation / Enhancement
Employment and business opportunities			
Increased opportunities for local and regional businesses in Bowen and broader Whitsunday LGA.	Positive <i>Regional</i>	MEDIUM	MEDIUM
Increased opportunities for local and regional employment.	Positive <i>Regional</i>	MEDIUM	MEDIUM
Community values and lifestyle			
Community uncertainty and anxiety around the economic climate in Bowen should proposed development at Abbot Point not go ahead.	Negative <i>Regional</i>	MEDIUM	LOW
Impacts on the environmental values of communities, associated with the Caley Valley Wetlands near Abbot Point.	Negative <i>Local</i>	LOW	LOW
Reduced environmental amenity and tourism opportunities due to the perceived impacts on the GBRMP.	Negative <i>State</i>	MEDIUM	LOW
Reduced opportunities for commercial and recreational fishing.	Negative <i>Local</i>	LOW	LOW
Housing and accommodation			
Potential decrease in availability of local housing and short -term accommodation in Bowen.	Negative <i>Local</i>	LOW	LOW
Potential cumulative impacts on housing availability and affordability, potentially leading to housing stress for vulnerable groups.	Negative <i>Local</i>	LOW	LOW
Community infrastructure and services			
Increased pressure on existing social infrastructure services and facilities due	Negative	LOW	LOW



Potential Impact	Nature and Extent	Significance	
		Before Mitigation / Enhancement	After Mitigation / Enhancement
to potential local population influx.	<i>Local</i>		
Increased demand on regional emergency services including fire and rescue, police and ambulance.	Negative <i>Local</i>	LOW	LOW
Heightened road safety risk as a result of traffic increases and road conditions during construction.	Negative <i>Local</i>	LOW	LOW

8.2.5 Cumulative impacts

Consideration of cumulative socio-economic impacts was applied throughout the social and economic impact assessments. Potential cumulative impacts have been considered in light of the proposed expansion activities at Abbot Point (T0 and T3 expansion projects) and related Adani projects.

While recognising the direct socio-economic impacts of the Project on local and regional communities, it is also important to consider the compounded, or cumulative, impacts of the Project in relation to other development activities occurring or planned for the vicinity.

The cumulative impact assessment was largely quantitative in nature, drawing on desktop information including EISs prepared for other projects in the vicinity, population reports prepared by the QGSO and regional and local government plans and policies. The Economic Impact Study (**Appendix S**) involved quantitative modelling and this data was drawn upon to inform the impact assessment where relevant.

Information considered in the cumulative impacts assessment, included, but was not limited to:

- Location of the project/s
- Project timeframes (including any planned expansions)
- Workforce requirements
- Proposed housing and transportation model for the workforce
- Potential for individually insignificant but cumulatively significant impacts.

Appendix R outlines the impacts where cumulative considerations were accounted for in the impact assessment and subsequent mitigation development.

8.2.6 Socio-economic impact management strategies

A number of mitigation and enhancement strategies were developed as part of the SIA and economic impact assessments to enhance benefits or avoid/mitigate impacts. Table 8-9 provides an overview of the key actions to facilitate implementation of key management strategies identified in Section 8.2.4, to provide greater clarity to stakeholders and community members about the tasks and engagement activities which the Queensland DSD



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proposes to undertake in the further development and implementation of mitigation measures.

The proposed adaptive management strategies have been developed to manage potential adverse social impacts. The management actions use existing frameworks, guidelines, plans and practices, and will continue to be refined as required through the monitoring and reporting process.

Table 8-9 Social impact management actions

Key Actions	Responsibility	Timeframe
Employment and business opportunities		
Engage with relevant stakeholders; including local government, the Industry Capability Network, Supply Nation, Indigenous Business Australia, the Bowen Business Chamber and other business and industry groups focused on economic and business development, to identify local content opportunities.	The Queensland DSD	Procurement phase
Incorporate local content requirements in tender packages to major contractors.	The Queensland DSD	Procurement phase
Prepare tender packages in a manner that optimises local industry opportunities while enhancing Project competitiveness and value for money.	The Queensland DSD	Procurement phase
Publish project procurement opportunities and relevant pre-qualification information on Queensland Government tender website and Industry Capability Network Gateway.	The Queensland DSD	Procurement phase
Prepare a Local Content Plan in accordance with the Queensland Government's Charter for Local Content.	Project contractor	Procurement phase
Community values and lifestyle		
Implement a Communications and Engagement Strategy which outlines approach to stakeholder engagement, key project messages and communication and engagement protocols including tools, activities and grievance mechanisms.	The Queensland DSD to develop Project-wide Stakeholder Engagement Plan. Project contractor will be required to adhere to overarching plan and develop specific	Prior to commencement of construction



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Key Actions	Responsibility	Timeframe
	implementation plans.	
Provide regular updates to local communities in regard to mitigation measures and monitoring.	The Queensland DSD and project contractor	Construction phase
Housing and accommodation		
Engage with State agencies, Whitsunday Regional Council, industry proponents and NGOs to monitor the potential cumulative impacts on the Bowen housing market.	The Queensland DSD	Construction phase
Community infrastructure and services		
Proactively share project information with Whitsunday Regional Council and service providers to ensure they are aware of project timing and workforce forecasts to adequately plan for cumulative increases in population and potential demand for services.	The Queensland DSD	Prior to commencement of construction
Provide first aid services onsite for construction workforce.	Project contractor	Construction phase
Engage with emergency and health services including Queensland Police Service, Queensland Ambulance Service, Queensland Fire and Rescue, Rural Fire Service and State Emergency Services in regard to Emergency Management Plans for the Project.	Project contractor	Prior to commencement of construction
Provide bus services for local workers commuting from Bowen.	Project contractor	Construction phase
Develop and implement a Traffic Impact Management Plan that addresses traffic-related issues associated with the Project.	Project contractor	Construction phase



9 Conclusions

The Abbot Point Growth Gateway Project proposes capital dredging at Abbot Point, and associated placement of dredged material on land, to facilitate development of T0. The Project represents a preferred approach to managing dredged material, and has been designed to avoid the placement of dredged material at sea within the GBRWHA. The siting of the DMCP will also avoid disturbance to the Caley Valley Wetlands.

Potential impacts of the Project on MNES as well as other environmental considerations were assessed in accordance with the EPBC Act and associated guidelines, and the findings are summarised below. Through planning, avoidance and mitigation of impacts, the assessment concludes that no significant residual impacts to MNES will result from the action. A strategy to ensure a net benefit to the GBRWHA from the Project is proposed for the unavoidable loss of potential seagrass habitat and for the fine sediment that would be generated by project activities.

It is considered that the Abbot Point Growth Gateway Project supports the Reef 2050 Plan, and is in compliance with the objectives of the EPBC Act and associated principles of ecologically sustainable development.

9.1 Impact assessment

This EIS includes an assessment of potential impacts associated with project activities, the findings of which are summarised below:

- Assessment of soils within the DMCP footprint suggest soil materials to be disturbed are not likely to be dispersive, and the presence of ASS has been identified as insignificant.
- Risks associated with the disturbance of pre-existing contaminated land (historical) or contamination of land due to project activities is considered to be low.
- Seepage from the DMCP will result in localised and temporary changes to groundwater regimes (groundwater mounding). However, no surface expression is anticipated due to confining clay layers in the area, and effects of evapotranspiration processes. From an environmental geochemical perspective, any seepage would be expected to have a low to negligible impact on the currently saline to hypersaline wetland areas south and west of the DMCP area.
- Results of an ASS investigation undertaken for the Project indicate the absence of AASS and PASS within the upper 5m of soil across the proposed DMCP site. Furthermore, tests of marine sediments from the dredging area indicate that whilst sediments are PASS, they have a neutralising capacity greater than the acid generating capacity. This suggests that sediments are 'self-neutralising' and no related impacts are anticipated from the placement of dredged material into the DMCP.
- Construction of the DMCP will not directly disturb wetland vegetation or habitat, and no direct loss or fragmentation of aquatic habitat, vegetation and fauna associated with the Caley Valley Wetlands will occur as a result of the Project.
- Changes to wetland hydrology and water quality due to seepage are anticipated to have a relatively inconsequential impact, and any impacts to aquatic communities are expected to be short-term, with rapid recovery.

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- The stormwater management strategy seeks to restore pre-disturbance stormwater hydrology following filling of the DMCP, and long-term impacts to aquatic flora and fauna communities are not expected.
- The potential dust emissions associated with the construction of the DMCP may affect a small portion of the wetland, although not to levels predicted to impact on habitat quality. An increase in mitigation measures when conditions require will further reduce dust impacts.
- Noise modelling undertaken for the terrestrial component of the Project indicates that noise from the Project will affect a small portion of Caley Valley Wetlands; however, the effect is not likely to be significant and will be temporary in nature.
- Modelling of underwater noise indicates the behavioural or physiological impacts to marine fauna associated with the dredging and marine support vessels is expected to be minimal.

A number of these findings were used to support the assessment of MNES, which are summarised below.

9.1.1 Matters of National Environmental Significance - Terrestrial

The onshore project area is highly disturbed and consists primarily of non-remnant vegetation, with some patches of regrowth. The Squatter Pigeon is the only threatened species likely to utilise habitats within the project area. While there have been a small number of Squatter Pigeon sightings within in the Abbot Point region, potential impacts on the species were assessed to be low. Mitigation measures are proposed to manage potential impacts on Squatter Pigeon.

The pipeline alignments from the DMCP to the Coral Sea are located approximately 5m (Indicative 2 or Alternate alignment) to 50m (Indicative 1 alignment) from the threatened ecological community (depending on the pipeline alignment). The assessment identified there would be no direct impact of the Project on this community from vegetation clearing activities. Management measures are recommended to reduce the risk of indirect impacts from fire, weeds and pests.

Impacts on threatened flora species are not expected as there are no such species known or predicted to occur within the project area or Abbot Point area.

Species of national environmental significance are known to occur adjacent to the project area and are relevant for the assessment of off-site impacts of the Project. These values are mostly associated with the Caley Valley Wetlands and surrounding coastal foreshores, which provide important feeding and roosting habitat for migratory shorebirds and other migratory birds, including three nationally important populations as well as habitat for the endangered Australian Painted Snipe. The wetland is also notable for large congregations of waterbirds that contribute to the Outstanding Universal Values of the GBRWHA and provide a range of ecosystem services to the GBRWHA.

There will be no direct disturbance of the Caley Valley Wetlands from the Project. A minimum buffer distance of terrestrial land between 50m and 300m will be established between the project area and the Caley Valley Wetlands (mapped regional ecosystems), which will act to substantially buffer the wetland from direct impacts. The results of noise, dust and light modelling for each phase of the Project indicate that the indirect impacts of noise, dust and light are short-term and are unlikely to be significant for resident species or



their habitats. Modelling of hydrology and water quality indicated that there would be no significant or long-term impact from the Project on wetland habitats.

Overall, with avoidance and mitigation measures in place, indirect impacts of the Project on migratory shorebirds, other migratory birds, wetland birds and the Australian Painted Snipe were assessed to be low, with no significant residual impact predicted and no imperative to implement offset measures for species or habitats.

9.1.2 Matters of National Environmental Significance - Marine

The offshore portion of the Project is located adjacent to the GBRMP and Commonwealth marine areas and within the GBRWHA. Analysis of the values and natural heritage attributes present indicates that the project area does not constitute a unique or important contribution to the Marine Park or the Commonwealth marine area beyond being part of the overall range of habitats and ecological zones represented. The Abbot Point area is considered to contribute to the Outstanding Universal Value of the GBRWHA in relation to aesthetic values associated with important marine species and waterbird aggregations within the adjacent Caley Valley Wetlands. While a number of other natural heritage attributes are present within the vicinity of the project area (e.g. marine turtles, seagrass and mangroves), it was considered that they were not present at a scale or value that was relevant to the GBRWHA as a whole.

Abbot Point's port limits are known to provide habitat for a number of threatened or migratory species, the species likely or potentially occurring are:

- One threatened marine mammal species (Humpback Whale)
- Three migratory marine mammal species (Australian Snubfin Dolphin, Indo-Pacific Humpback Dolphin and Dugong)
- Five threatened marine turtle species (Green, Hawksbill, Olive Ridley, Loggerhead and Flatback Turtles).

The project area does not support important populations of any of the threatened or migratory species and does not contain habitat critical to the survival of these species. There are a range of avoidance, mitigation, management and offset measures proposed to manage direct and indirect impacts to individual MNES. In addition, the protection and management of the GBRWHA will not be affected negatively by the project as all activities are occurring within designated port limits and an SDA. Impacts from the Project are localised and are either temporary in nature or will be adequately compensated for through the offset strategy. Overall it is considered highly unlikely for there to be a loss of Outstanding Universal Value or decline in integrity of the GBRWHA as a result of the Project. With the implementation of the Outline DMP no residual significant impact to MNES is expected.

9.1.3 Cumulative impacts

A cumulative assessment relevant to the Project was undertaken to consider activities external to the Project which had potential to produce additive impacts.

Threats for which external activities were determined to potentially result in impacts that interact spatially and temporally with the predicted impacts of the Project are:

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- Exotic species - the potential for introduction of marine pests from the Project, T0 and T3 projects to the local marine environment from construction and activities and from increased shipping to Abbot Point resulting from development of the T0 and T3 projects
- Land clearing and habitat loss - the potential for land clearing and habitat loss to result in significant residual impacts for conservation significant species.

The risk assessment for marine pests and habitat loss determined a low cumulative risk for both these threats taking into account mitigation measures.

More broadly, threats associated with increased shipping resulting from the development of the T0 and T3 projects which do not interact directly with predicted project impacts were considered in order to address the requirements of the EIS Guidelines.

The Reef 2050 Plan indicates that, at Australia's request, the GBR is designated a 'Particularly Sensitive Area' by the International Maritime Organisation, the first in the world, and that extensive and stringent navigation and pollution prevention controls are in place to manage the threats from shipping. The Plan states that despite increased ship movements through the World Heritage Area, the management measures have substantially reduced the frequency of shipping incidents.

The NESMP addresses increased shipping in the GBR region and in particular the impacts of current and increased shipping on the Outstanding Universal Values of the GBRWHA.

With a high level of confidence, it is considered that the cumulative impacts of shipping on the Outstanding Universal Values of the GBRWHA have been comprehensively addressed and are being acted upon by the Australian and Queensland Governments and industry bodies.

9.1.4 Mitigation measures for unavoidable impacts

Offsets/net benefits

Avoidance and mitigation measures are the primary strategies for managing the potential significant impacts of the Project.

The siting of the DMCP outside the Caley Valley Wetlands and the implementation of a range of mitigation and management measures has meant that no significant residual impacts on MNES are predicted to occur as a result of the construction and post-placement operation of the DMCP and the land-based components of the associated pipelines. The land-based project components are confined to already disturbed port lands and are temporary features. Consequently, no offsets are proposed in relation to the land-based components of the Project.

Avoidance of potentially significant impacts to the GBRWHA associated with dredging and offshore placement of dredged material is an important feature of the Project. Using a CSD, the dredged material will be pumped on land to the DMCP.

While the use of a CSD and onshore reuse of dredged material reduces as far as possible the impact of the Project on marine water quality, a total of approximately 9,938t of fine silt and clay sediment available for re-suspension could be generated by dredging and dewatering activities. In comparison with the previously approved, and now discontinued, capital dredging project at Abbot Point where offshore disposal of dredged material was

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intended, the proposed Project is predicted to contribute significantly less fine sediment to the GBRWHA.

To place the predicted 9,938t of sediment generated by the Project in context, currently the Burdekin and Don River catchments are estimated to contribute a combined 4,203,000t per year of TSS to the GBRWHA in this region. The sediment generated by the Project is therefore considered minor in comparison to other sources of sediment in the region.

In the marine environment, seagrass communities form an important component of the marine ecosystem in nearshore environments throughout the GBRWHA. While seagrasses are currently mostly absent from the dredging footprint area and where they are present it is at low densities (1% to 5% cover), seagrasses have historically been present at locations within the entire dredging footprint area. Dredging for the establishment of the T0 berth pockets will deepen these areas of the sea floor to depths that are likely to permanently preclude recolonisation by seagrasses within an approximate area of 10.5ha.

No significant residual impacts for MNES are predicted for areas of mechanical disturbance outside of the berth pocket. Those areas within the dredging apron (dredged to a maximum depth of 1.5m), as well as areas on the edge of the dredging footprint that will be disturbed during dredging, and the locations of the temporary pipelines will be available to be recolonised by seagrass and other benthic biota over time (<5 years)..

The sparse and ephemeral seagrass present at the dredging location is not considered to represent important habitat for migratory and threatened species that rely on seagrasses for foraging (e.g. Dugong and marine turtles), and no significant residual impacts to these species are predicted from removal of this habitat.

It is recognised, however, that the permanent loss of 10.5ha of potential seagrass habitat as a result of the Project is a negative impact in relation to 'habitat important for the conservation of biological diversity in a World Heritage property', and cannot be mitigated. In order to provide a net benefit to the GBRWHA from the Project, an offset action that ensures Project outcomes are consistent with objectives and targets of the Reef 2050 Plan is warranted.

An offset activity that improves water quality by reducing sediment reaching the marine environment from the Burdekin and/or Don River catchments would provide a net benefit for seagrass habitat in the region, with concomitant benefits for [among other species] marine mammals, marine turtles and commercial and non-commercial fish species.

Net benefit/offset options for the Project are currently being explored and discussed with both the Australian and Queensland Governments to ensure the best conservation outcome without duplicating offset requirements between the two jurisdictions.

9.2 Compliance with Reef 2050 Long-Term Sustainability Plan

The strategies for management of the GBRWHA set out in the Reef 2050 Plan to improve the Outstanding Universal Value of the GBRWHA are incorporated into the EPBC Act decision making process.

The Reef 2050 Plan has been developed to provide a long-term plan for sustainable development to protect the Outstanding Universal Values of the GBR. The Plan includes

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measures by the Queensland Government to ensure that development in the GBR coastal zone occurs in an ecologically sustainable manner and that negative impacts on Outstanding Universal Values are avoided.

The Reef 2050 Plan outlines a number of commitments of the Queensland Government. A number of these are relevant to this environmental assessment including:

- Strengthening coastal planning laws based on the best available science, making allowance for expected sea level rise, protecting ecologically important areas such as wetlands and prohibiting development in high-hazard greenfield areas
- Protecting greenfield areas by restricting new port development in and adjoining the Great Barrier Reef World Heritage Area to within current port limits
- Ensuring that any new development inside these port limits is also consistent with the Great Barrier Reef Marine Park Act, the Queensland Marine Parks Act, their regulations and zoning plans
- Meeting the standards required by the EPBC Act for protection of MNES
- Developing a Direct Benefit Environmental Offsets Management Plan to maximise the Reef's health and resilience
- Restricting capital dredging to within the regulated port limits of Gladstone, Hay Point/Mackay, Abbot Point and Townsville
- Prohibiting the sea-based disposal of material into the GBRWHA generated by port-related capital dredging
- Mandate the beneficial reuse of port-related capital dredged spoil, such as for land reclamation in port development areas, or disposal on land where it is environmentally safe to do so
- Supporting on-land placement or land reclamation for capital dredge material at Abbot Point.

The Project involves capital dredging within the priority Port of Abbot Point, and specifically avoids the disposal of dredged material offshore in the GBRWHA. The Project proposes the safe onshore placement of dredged material within the DMCP, where it will be available to be beneficially reused for port development activities in the future. The DMCP will be constructed on already disturbed industrial land, and does not encroach on the Caley Valley Wetlands.

The potential impacts of the Project on MNES have been assessed in accordance with the EPBC Act. The assessment has identified no residual impacts on MNES; however, an offset/net benefit for the GBRWHA is proposed for the permanent loss of potential seagrass habitat and water quality impacts from the Project.

It is considered that the Abbot Point Growth Gateway Project has been planned in accordance with and to meet the objectives of the Reef 2050 Plan.



9.3 Compliance with objectives and requirements of the EPBC Act

9.3.1 Objectives of the Act

The objectives of the EPBC Act, as set in section 3(1) of the Act, are to:

- Provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance
- Promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources
- Promote the conservation of biodiversity
- Promote a cooperative approach to the protection and management of the environment involving governments, the community, landholders and Indigenous peoples
- Assist in the cooperative implementation of Australia's international environmental responsibilities
- Recognise the role of Indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity and
- Promote the use of Indigenous peoples' knowledge of biodiversity with the involvement of, and in cooperation with, the owners of the knowledge.

Many characteristics of the Project fulfil the above objectives. A detailed environmental assessment has been undertaken for the Project to assess potential impacts to MNES, as well as other environmental considerations. No significant residual impacts on MNES as a result of project activities are anticipated.

An offset/net benefit is proposed for the permanent loss of potential seagrass habitat and water quality impacts predicted for the Project. The financial contributions from the Project's offsets will directly support the conservation of the Reef's ecological values, and will likely be delivered through the proposed Reef Trust which is being established to support efforts under the Reef Water Quality Protection Plan. These initiatives involve landholders, regional natural resource management organisations, agricultural industry bodies, conservation groups and government agencies working cooperatively to reduce land-based runoff in the GBRWHA waters.

The Project represents an environmentally sensitive approach to managing dredged material, through the placement of dredged material onshore, enabling its reuse as fill or construction material for future port or other development.

The avoidance of marine disposal of the dredged material and its beneficial reuse is in line with the Protocol to the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972* to which Australia is a signatory. Preventing offshore disposal of capital dredged material in the GBRWHA avoids risk of harm to World Heritage values, which is consistent with the protection of World Heritage places sought by UNESCO's *Convention Concerning the Protection of the World Cultural and Natural Heritage 1972* (World Heritage Convention) to which Australia is a signatory.



9.3.2 Principles of ecologically sustainable development

The principles of ecologically sustainable development, as set out in section 3A of the EPBC Act, are as follows:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- The principle of inter-generational equity - that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making
- Improved valuation, pricing and incentive mechanisms should be promoted.

The Project has been developed with consideration of the above principles. This is portrayed in the Project's following key features:

- Facilitating the development of a port terminal that will provide employment and income security for the region while avoiding impacts related to marine dredge disposal (integration principle)
- Use of a risk-based approach on matters for which uncertainty remains and a worst-case scenario favouring environmental outcomes in the absence of information (precautionary principle)
- Development proposed within an existing port area that has been identified by the Queensland Government as one of five priority port development areas (intergenerational principle)
- Avoidance of capital dredged material marine disposal in the GBRMP and World Heritage Area and the intended use of a CSD will significantly reduce impacts on marine water quality (biodiversity principle)
- DMCP design, management and siting outside the wetland to safeguard the Caley Valley Wetlands (biodiversity principle)
- Creation of opportunity to beneficially reuse dredged material as construction material in the future.

9.3.3 Concluding statement

The incorporation of a range of environmental features in the design of the Project, together with the identification and application of a series of management and mitigation measures to minimise the residual risk to MNES and the proposed offset strategy designed to satisfy both Australian and Queensland Government requirements ensures the Project is unlikely to have a significant adverse impact on MNES. The proponent's commitment to ecologically sustainable development and sensitive design, combined with the positive social and economic benefits of the Project to Bowen and the surrounding region, achieves an appropriate balance between the environmental and socio-economic values of the project site and surrounding area.



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