Port of Townsville Limited

Long-Term Maintenance Dredging Management Plan

for Port of Townsville and Port of Lucinda

2019 – 2029

POT 2128

REVISION 3

PORT OF TOWNSVILLE

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Document Control Sheet

Revision history

Revision No.	Effective Date	Comments
0	17/12/2018	First Published
1	12/03/2019	Administrative update (typos, alignments); modification of Figure 16 layout; addition of Figure 17b; addition of Contingency Planning to Section 5.3
2	11/03/2020	Reformatting and minor administrative updates following first informal review; addition of Social Values to Sections 3 and 12
3	11/09/2020	Update to new Port branding; modification of Section 1 in line with DTMR comments; updates following expiry of Section 19 Deed of Agreement and issue of master plan; addition of new research and monitoring results

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1 INTRODUCTION

Port of Townsville Limited (Port) is a statutory Government Owned Corporation (GOC) established under the *Government Owned Corporations Act 1993* and the *Government Owned Corporations Regulation 2014*. The Port manages both the Port of Townsville and the Port of Lucinda (Figure 1).

Figure 1: Port of Townsville and Port of Lucinda

Under the *Transport Infrastructure Act 1994*, the Port is required to establish, manage and operate efficient port facilities and services. This legislative responsibility extends to the provision of safe navigational access to marine facilities and infrastructure such as harbours, berths and channels under the Port's jurisdiction.

In order to comply with the *Transport Infrastructure Act 1994*, the Port must maintain navigable areas within the Port's jurisdiction to target design depths to the greatest extent possible, which at the Port of Townsville, means regular maintenance dredging activities to remove natural accumulations of sediments within the existing port facilities. The Regional Harbour Master (RHM) declares depth to achieve safety under the *Transport Operation (Marine Safety) Act 1994*. The Port dredges to ensure the efficiency of vessel movements.

The Port of Lucinda does not require maintenance dredging activities to meet the *Transport Infrastructure Act 1994*, due to the naturally deep-water characteristics of the bay in which the 5.6km long jetty and conveyer system sit.

Both the Port of Townsville and the Port of Lucinda are considered World Heritage Ports. Neither are located within the Great Barrier Reef Marine Park (GBRMP), however, both are within the Great Barrier Reef World Heritage Area (GBRWHA), and as such, under Queensland State legislation, require a *Long-Term Maintenance Dredging Management Plan* (as described under the Queensland Government's *Maintenance Dredging Strategy* (MDS)). The Port of Townsville also requires a *Long-Term Monitoring and Management Plan for Maintenance Dredging* under the *Environment Protection (Sea Dumping) Act 1981* as a supporting document for an application for sea placement of maintenance dredge material.

This document – the *Long-Term Maintenance Dredging Management Plan* (LTMDMP), is intended to meet the requirements for both the State and Commonwealth (Cth) long-term maintenance dredging management plans. This document is separated into two schedules for clarity, as different governmental requirements exist at the two World Heritage Area Ports:

- Schedule 1 is for the Port of Townsville (covering both State and Cth requirements for maintenance dredging, sea and land placement); and
- Schedule 2 is for the Port of Lucinda (covering State requirements only – noting that no maintenance dredging or sea/land placement activities occur at this port).

1.1 LTMDMP Context and Framework

The requirement of a LTMDMP has been implemented through the Queensland Department of Transport and Main Road's (DTMR) MDS (DTMR 2016). As part of the Cth Government's *Reef 2050 Plan*, the principles of decision making seeks a standardised LTMDMP framework for all World Heritage Area Ports to follow.

The use of the LTMDMP is expected to provide ports and regulators with a standardised, coherent document that ensures a leading practice, consistent, transparent, and accountable process has been applied to both the selection of maintenance dredging placement options (by ports), and the assessment of such options (by regulators); see Figure 2 which depicts the Long-Term Maintenance Dredging Management Framework.

The requirement for a long-term plan under Cth legislation was implemented under the objectives of the London Convention (*Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matters 1972*) and the *1996 Protocol to the London Convention*. These initiatives aimed to adopt a uniform approach to the placement of dredge material at sea in Australia by way of the Cth *Long-term Monitoring and Management Plan for Maintenance Dredging (LTMMP)*. The Cth LTMMP sets out a framework of specific measures for the management, mitigation and monitoring of the impacts from maintenance dredging and placement activities. The Cth LTMMP also aims at providing ports with the opportunity to make available to the public their role as stewards for the marine environment.

Figure 2: The Long-Term Maintenance Dredging Management Framework (DTMR 2016)

1.2 Objectives

The Port's objectives for this LTMDMP for the Port of Townsville and Port of Lucinda are:

a) Maintaining safe navigation for the continued operation of both Ports;

b) Ensuring the Outstanding Universal Value (OUV) of the GBRWHA and sensitive receptors surrounding both the Port of Townsville and the Port of Lucinda are maintained;

c) Ensuring a transparent and robust long-term planning approach to the management of sediments within port infrastructure;

d) Continuing the long-term proactive and environmentally responsible management approach of maintenance dredging and material placement at the Port of Townsville;

e) Capturing and communicating operational controls for best management; and

f) Supporting local and regional communities, ensuring the health, wellbeing and connectivity to the global market is maintained.

1.3 Scope

This document covers both the Port of Townsville and the Port of Lucinda, as both ports are managed by the Port and both are World Heritage Area Ports.

The Port of Townsville:

Routine maintenance dredging is undertaken regularly, at the Port of Townsville, within the following areas:

- Sea Channel
- Platypus Channel
- Outer Harbour
- Inner Harbour
- Berths 1, 2, 3, 4, 8, 9, 10, and 11
- Townsville Marine Precinct (TMP)
- Ross River
- Ross Creek

Full details for the Port of Townsville can be found in Schedule 1. Section 2.4 outlines the navigational infrastructure and capacity diagrams for the Port of Townsville.

The Port of Lucinda:

Maintenance Dredging is not required at the Port of Lucinda due to the natural characteristics of the bay, including the 5.6km long jetty and conveyor system, which moves sugar from the terminal out to berthed ships, sitting in deep water (~14 metres). Whilst there is no requirement for dredging at this facility, this document outlines the values, considerations, and processes to be undertaken prior to any dredging being approved by both State and Cth Governments.

Full details for the Port of Lucinda can be found in Schedule 2. Section 11.4 outlines the navigational infrastructure and capacity of the Port of Lucinda.

1.4 Review Timeframe and Process

As per the LTMDMP Guidelines, the Port will formally review the document at the end of the first five years (December 2023). This review will include:

- Engaging with stakeholders to discuss how the document is or is not meeting the objectives;
- Updating the document to include any new development approval permits, and reflect any relevant legislation updates;
- Incorporating research and monitoring updates, including any knowledge learnt from programs undertaken;
- Formally reviewing the Port's risk assessment, and updating any developments into the LTMDMP; and
- Incorporating the revised Sediment Sampling and Analysis Plan (SAP), due to be completed by 2022.

The Port also intends to undertake reviews throughout the duration of the lifespan of this document, to ensure any updates, results, or other factors identified which could change the outcomes of this document (e.g. new beneficial reuse options) are incorporated.

1.5 Policy and Regulatory Context

The Port has a number of approvals to undertake maintenance dredging and placement activities within Cleveland Bay, as listed in Table 1.

Table 1: Current Maintenance Dredging Approvals for the Port of Townsville

Permit type	Reverent Legislation	Activity
Sea Dumping Permit No. SD2018/3942	*Environmental Protection (Sea Dumping) Act 1981*	Cth approval for Port of Townsville's placement of maintenance dredge material at sea in the designated and approved Dredge Material Placement Area (DMPA)
Environmental Authority (EA) No. EPPR00771113	*Environmental Protection Act 1994*	State Authority to undertake maintenance dredging in approved areas of the Port of Townsville
Operational Works (Tidal works) No. 1901-9462 SDA	*Planning Act 2016*	State Approval for Port of Townsville's placement of maintenance dredge material at sea in the designated and approved DMPA
Allocation of Quarry Material No. CA0000014	*Coastal Protection and Management Act 1995*	State Approval for Port of Townsville's maintenance dredge material to be placed on land

The Port does not hold any approvals to undertake maintenance dredging or placement activities at, or for, the Port of Lucinda.

1.5.1 Maintenance Dredge and Placement Legislation and Statutory Obligations

The following is the list of legislation and statutory obligations under which the Port currently operates for the purposes of maintenance dredging and placement activities:

International Legislation

1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters, 1972 (London Protocol)

- *Is a global convention aimed at the protection of the marine environment, promoting the sustainable use and conservation of marine resources. Under the Protocol, member nations may allow dumping of particular material, including dredge material, following an assessment of impacts.*
  The Port reports (via the Department of Agriculture, Water and the Environment (DAWE)) sea placed dredge material volumes to the International Maritime Organisation (IMO) each year.

Commonwealth Legislation

Environment Protection (Sea Dumping) Act 1981

- *Implements Australia's obligations under the London Protocol. It applies to all vessels, aircraft and platforms in Australian Waters, and to Australian vessels/aircraft in any part of the sea.*
  The Port is required to seek approval for the placement of dredge material at sea (in the designated DMPA) under this Act, from the DAWE.

National Assessment Guidelines for Dredging (NAGD) 2009

- *Aims to provide a clear set of standards for assessment and permitting of dredge material proposed for sea placement.*
  The Port uses these guidelines in determining the sediment suitability for sea placement development applications for maintenance dredge material to both State and Cth governments.

Environment Protection and Biodiversity Conservation (EPBC) Act 1999

- *Provides a legal framework for the Australian Government to protect and manage internationally and nationally important flora, fauna, ecological communities, and heritage places, (Matters of National Environmental Significance (MNES)).*
  Sea placement of maintenance dredge material for the Port does not trigger a referral under the EPBC, however, all considerations for MNES are incorporated in the Port's Environmental Management System (EMS). Considerations of World Heritage Values are an intrinsic part of the Port's risk assessment, including options and management controls.

Section 19 Deed of Agreement – Research and Monitoring Plan 2015-2020

- The Port entered into an agreement with the Cth DAWE in 2015 under Section 19 of the *Environment Protection* (*Sea Dumping) Act 1981*, to undertake a number of research and monitoring programs in relation to maintenance dredging. This Deed of Agreement expired in July 2020 and a final report provided to DAWE. The Port's current research and monitoring commitments are included in Section 9 of this LTMDMP.

Great Barrier Reef Marine Park Act 1975

- *Is an important piece of Cth legislation in providing long-term protection and conservation of the environment, biodiversity, and heritage values of the Great Barrier Reef (GBR).*
  The Port's operational areas are not within the GBRMP for either the Port of Townsville or the Port of Lucinda; both exclusion zones do however directly abut the park. In 2015, both the Cth GBRMP Regulations and Queensland legislation banned the sea placement of capital dredge material.

Queensland State Legislation

Transport Infrastructure Act 1994, and Transport Infrastructure (Ports) Regulations 2016

- *Aims to establish a regime under which a ports system is provided and can be managed within an overall strategic framework.*

The Port is bound by this Act to establish, manage and operate effective and efficient port facilities and services at both the Port of Townsville, and the Port of Lucinda.

Sustainable Ports Development Act 2015

- *Aims to provide for the protection of the GBRWHA, through management of port-related development in and adjacent to the area.*
  The Port of Townsville has been listed as a Queensland Priority Port, where master port planning is required to optimise the use of infrastructure and address operational, economic, environmental and community relationships as well as supply chains and surrounding land uses (as required under the Actions of the *Reef 2050 Plan*).
  The Port of Lucinda has not been listed as a Priority Port, there are no changes to operational requirements, or the need for master planning (as yet).

Environmental Protection Act 1994

- *Is for the protection of Queensland's environment; with the objective to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development).*
  The Port holds an EA for a number of Environmentally Relevant Activities (ERAs) including ERA16d (maintenance) Dredging >1,000,000t/yr; as covered under this Act.
  The Port does not hold an ERA16d for the Port of Lucinda.

Planning Act 2016, and Regulations 2017

- *Aims to provide for an efficient, effective, transparent, integrated, coordinated and accountable system of land use planning and development assessment to facilitate the achievement of ecological sustainability.*
  The Port is bound by this Act for Development Applications for the placement of maintenance dredge material at sea (Tidal works).

Coastal Protection and Management Act 1995, and Regulations 2017

- *Is to provide for the protection, conservation, rehabilitation and management of the coastal zone, including its resources and biological diversity.*
  The Port is bound by this Act as the operational areas of both the Port of Townsville, and Port of Lucinda, Townsville's channels and placement area (DMPA), and Lucinda's Jetty, all sit within Coastal Management Districts. The Port is required to seek approval for the placement of maintenance dredge material on land (Allocation of Quarry Material) under this Act, to the Department of Environment and Science (DES).

Fisheries Act 1994, and Regulations 2008

- *Is to provide for the use, conservation and enhancement of the communities' fisheries resources and fish habitats.*
  This Act provides the provisions about development offences against Fisheries resources (including unlawful marine plant disturbances) for the *Planning Act 2016*; (penalties for carrying

out development without a permit; and penalties for non-compliance with particular development approvals).

Aboriginal and Torres Strait Islander Heritage and Protection Act 1984

- *Is to protect areas and objects that are of particular significance to Aboriginal and Torres Strait Islander people.*
  The Port has a Cultural Heritage Management Plan registered with the Queensland Department of Aboriginal and Torres Strait Island Partnerships.

Marine Parks Act 2004

- *Is to provide for the conservation of the marine environment (which includes the declaration of marine parks).*
  The Port Limits are not within the Queensland Marine Park, however, the line of port limits and the edge of the DMPA boundary are both directly adjacent to the Marine Park. The Port ensures no impact upon the Marine Park occurs – including when placing maintenance dredge material in the DMPA.

Other Relevant Governance

MDS

- *Launched by the Queensland Government to address the requirements of the Reef 2050 Water Quality Action 16. The MDS aims to provide certainty to the ports industry and wider community that the economic and social contribution of ports is maintained while ensuring the continuing protection of Queensland's environmental assets.*
  The Port has created this document (LTMDMP) to address the requirements of the MDS, for both the Port of Townsville and the Port of Lucinda.

Ports Australia Environmental Code of Practice for Dredging and Dredge Related Material, 2016

- *Sets out a series of environmental principles that Australian ports follow when undertaking dredging, and when reusing, relocating or disposing of dredge material.*
  The Port follows the principles of this Code, given the outstanding ecological values of Cleveland Bay, and the greater GBRMP.

Port of Townsville's DMPA

- The DMPA is legislated over by both Queensland State and Cth legislation. The whole DMPA is defined to be within Australian Waters, and as such is regulated by the Cth DAWE. The section of the DMPA that lies within port limits is considered to be coastal waters, and as such is also regulated by the Queensland Government, under the *Environmental Protection Act 1994* (Figures 3 and 4).

Figure 3: Port of Townsville, Port Limits within Cleveland Bay

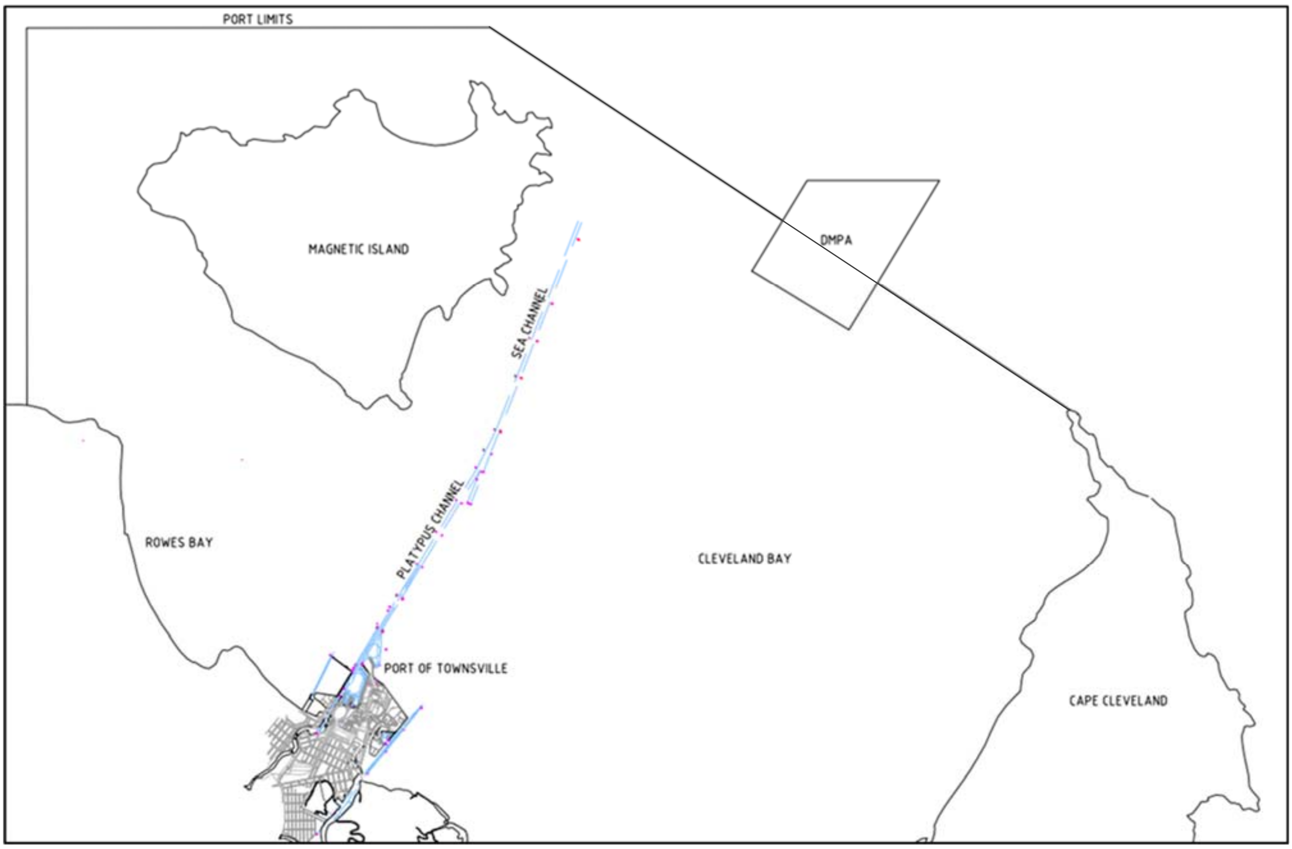
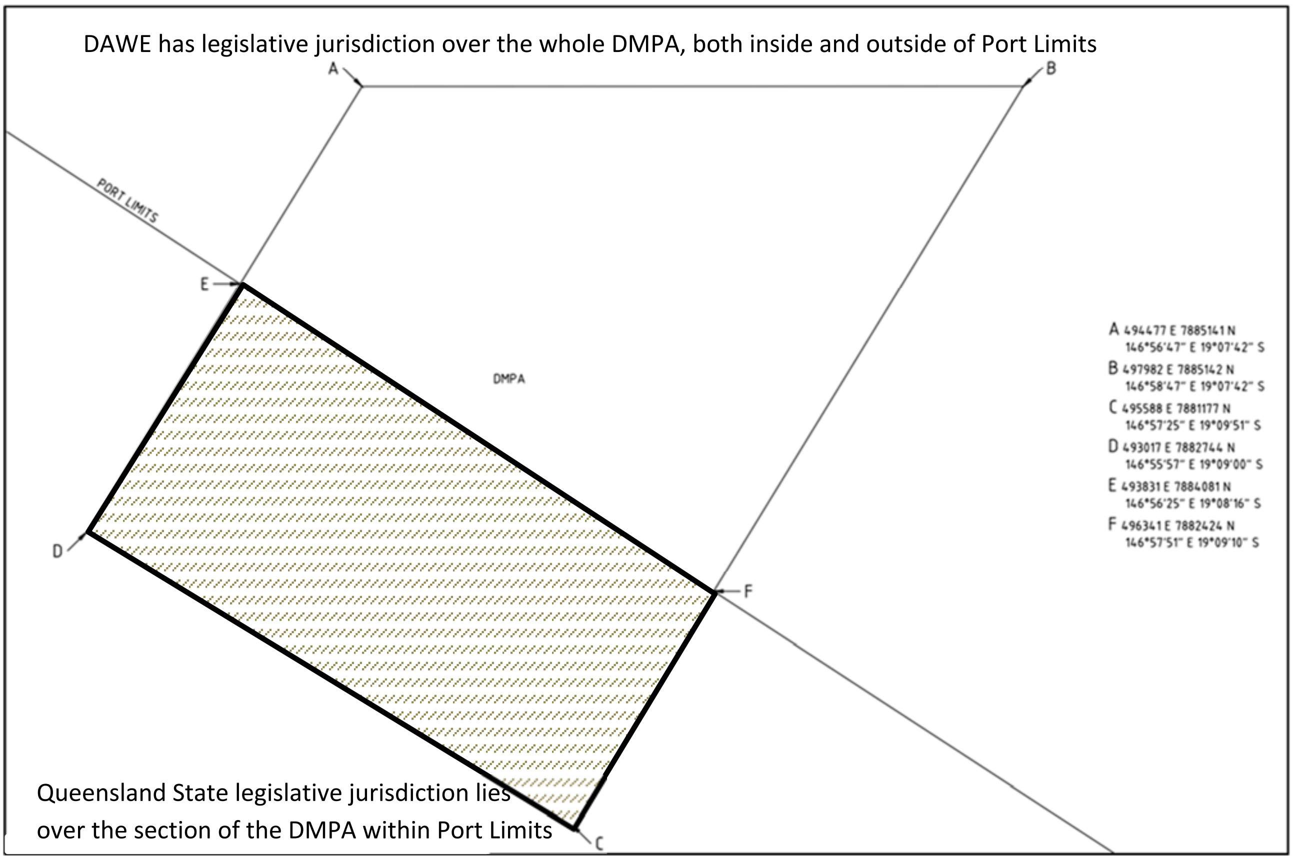


Figure 4: Cleveland Bay Maintenance Dredge Material Placement Area

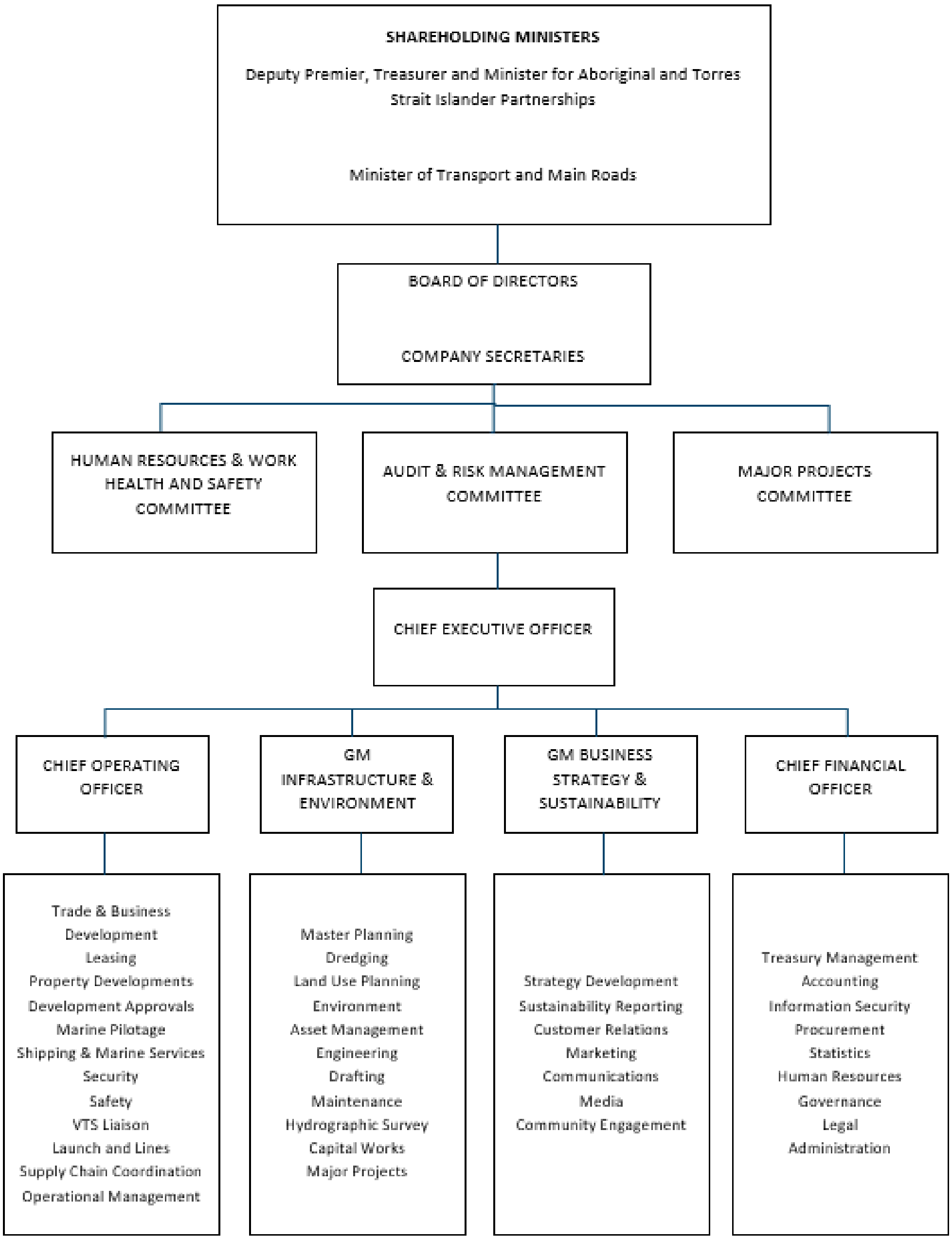


1.5.2 Port Governance

The Port is a GOC established in its current form on the 1 July 2008 as per the *Commonwealth Corporations Act 2001* and the Queensland *Government Owned Corporations Act 1993*. Being a GOC, the Port has two Queensland Shareholding Ministers and a board of directors within its reporting structure. Figure 5 shows the current Port Governance Structure framework.

The Port has a Corporate Governance Manual which details the responsibility for fulfilling the legislative corporate governance obligations that rest with the Directors and Officers of the Port. Please refer to the Port website's Governance page for more detailed information on Corporate Governance, Roles and Responsibilities, and all associated documents, https://www.townsville-port.com.au/about-us/governance/.

Figure 5: Port Governance Structure Flow Chart (as per Port Website 2020)



The Port leases both land and infrastructure to different companies and industries to utilise and operate their businesses from. The responsibilities of Port customers, users, and leaseholders are to:

- Abide by the conditions of their lease;
- Act and undertake their business lawfully (including obtaining all relevant approvals for their work, including ERAs under State legislation);
- Abide by the *Environmental Protection Act 1994*; and
- Report all exceedances of regulated activity to their relevant authority and to the Port.

1.5.3 Stakeholder Consultation

The Port has undertaken stakeholder engagement in the preparation and delivery of this Plan, including undertaking a detailed risk assessment analysis, and public review period. The Port recognises the full public review period was short, however, this document is the culmination of years of research and consultation, including being granted development approvals for maintenance dredging placement on land and at sea by both State and Cth Governments. It should be noted that a full public submission period was a voluntary process undertaken by the Port.

The Port is committed to continuing consultation via the existing pathways of the:

- Technical Advisory and Consultative Committee (TACC);
- Dry Tropics Partnership for Healthy Waters;
- Community Liaison Group (CLG);
- Planning and Environment Working Group (PEWG);
- Port Advisory Body (PAB);
- Townsville Local Marine Advisory Committee (LMAC);
- Ports Australia; and
- Queensland Ports Association (QPA).

Including contact with:

- Maritime Safety Queensland (MSQ);
- The Australian Defence Force (ADF);
- Townsville City Council (TCC);
- North Queensland Conservation Council (NQCC);
- Non-Governmental Organisations (NGO's) and Not-for Profit organisations;
- Commonwealth Scientific and Industrial Research Organisation (CSIRO);
- Australian Institute of Marine Science (AIMS);
- James Cook University (JCU);
- Great Barrier Reef Marine Park Authority (GBRMPA);
- Cth DAWE; and
- The Queensland Government - DES, Department of Agriculture and Fisheries, Department of Natural Resources, Mines and Energy (DNRME) and DTMR.

Review periods for this document which includes detailed stakeholder engagement comprise a formal review at 5 years, and again at 10 years. This document is a living document, in which the addition of new information, research and monitoring results, adaptive management options, and regulatory requirements can be included outside the designated review periods.

SCHEDULE 1 – PORT OF TOWNSVILLE

2 PORT LOCALITY, SETTING AND SHIPPING

2.1 Location and Environmental Setting

The Port of Townsville (19°15’S, 146°50’E) is situated in the centre of the growing city of Townsville, the leading population centre in tropical North-East Queensland, approximately 1,359 kilometres north of Brisbane, Queensland's capital city. The Port is located in the south-west of Cleveland Bay, in between the mouths of Ross River and Ross Creek (Figure 6). Magnetic Island, a continental island located approximately 8km offshore, lies at the northern entrance to the bay.

Cleveland Bay is a naturally broad and shallow bay; it is bounded to the east and west by Cape Cleveland and Cape Pallarenda respectively, which are approximately 26km apart. The bay is north facing, and a naturally turbid water body enhanced by significant sediment loads received from the Burdekin catchment and maintains significant sediment mobility through natural re-suspension. Dominant winds from south to east means the bay is relatively protected from prevailing breezes (Kettle *et al.* 2002).

Figure 6: The Port of Townsville within Cleveland Bay

2.2 Port of Townsville Overview

The Port of Townsville was founded in 1864, born out of the need for a close and obstacle-free access to the harbour by the pastoral industry of the day.

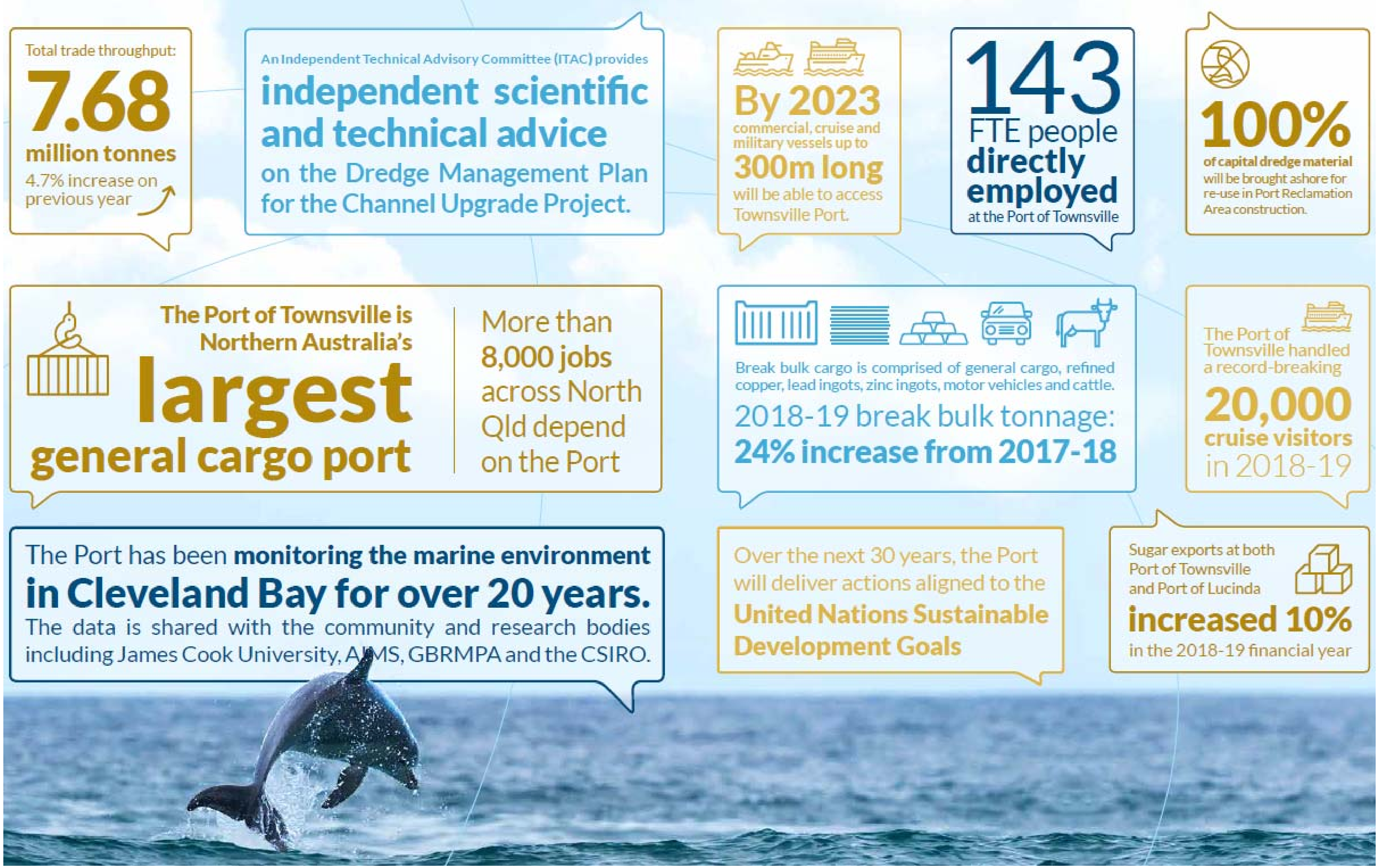
The Port of Townsville currently has eight (8) operational berths which service both imports and exports for Northern Queensland, including (imports) vehicles, fuel, furniture, electrical goods, cement, bitumen and minerals; and (exports) agricultural products, mineral concentrates, sugar, and cattle. The Port of Townsville also maintains an international cruise terminal and is critical to Defence operations (Port website 2020).

2.3 Current and Future Uses

Current uses:

In the 2018-2019 financial year, the Port of Townsville totalled a trade throughput of 7,682,743 tonnes (Port 2019). This volume accounted for Containerised cargo (749,335t), dry bulk (5,150,152t), liquid bulk (1,320,335t), break bulk (462,923t). The Port of Townsville also docked 16 cruise ships with 20,000 passengers and crew; and 14 (combined) Australian, Singapore and United States Defence Force vessels were berthed at the Port. Figure 7 details the 2018/2019 snapshot.

Figure 7: Snapshot for the 2018-2019 Financial Year (2018/2019 Annual Report, Port 2019)



Future uses:

The Port of Townsville was designated as a Priority Port in 2015, under the *Sustainable Ports Development Act 2015*. Under this Act, as a Priority Port, and as a port-related action of the *Reef 2050 Plan*, the Port of Townsville is required to undergo Master Planning. Master Planning is set out to support the sustainable development of critical economic infrastructure, the State's Priority Ports, in a way that will balance growth, job creation, environmental values, and community interests (DTMR, 2018).

DTMR has undertaken Master Planning for the Port of Townsville, with the Draft Master Plan open for public consultation from 5 November to 17 December 2018. Following the consideration of public submissions and the finalisation of the Master Plan, the Queensland Government released the Final Master Plan and the draft Port Overlay for public consultation from 4 November to 16 December 2019. The Final Port Overlay was released in August 2020 and will take effect on 1 February 2021.

Long-term master planning provides a strategic and coordinated approach to managing port-related development and considers issues including marine and land-based impacts, as well as port and supply chain infrastructure optimisation. The master plan also supports opportunities for efficient use of existing capacity through multi-user access arrangements. The Townsville Port Expansion Project (PEP) is a long-term development plan, which will include channel widening, a new outer harbour and associated infrastructure to be constructed by 2040 to meet growing trade demands and increasing ship sizes.

Trade commodities are likely to remain highly diverse due to the catchment and area the Port of Townsville supports. The port continues to promote trading opportunities with international partners to meet Asia's accelerating demand for minerals, energy, agricultural products and tourism experiences. It is likely that containers, fuel and cars will continue to increase in response to the regional population demands. A number of cruise ships were booked over the coming years, but this trade has been heavily impacted due to the COVID19 pandemic.

2.4 Navigational Infrastructure

Routine maintenance dredging is undertaken regularly at the Port of Townsville in order to maintain effective and safe port operations – including shipping. Maintenance dredging occurs within the following areas:

- Sea Channel
- Platypus Channel
- Outer Harbour
- Inner Harbour
- Berths 1, 2, 3, 4, 8, 9, 10, and 11
- TMP
- Ross River
- Ross Creek

Figures 8 and 9 show the areas the Port of Townsville has been granted approvals for dredging, these areas are described as lawful structures, in which maintenance dredging can occur. Figure 9 and Table 2 list the approved depths in which maintenance dredging can occur to. Figure 9 also shows the location of the DMPA, in which the majority of maintenance dredge material is placed. For those areas of the Port in which maintenance dredge material cannot be placed at sea, this material is placed on land, in the areas shown in Figure 10, this includes minor volumes at a local council waste facility, under an agreement with the council.

Figure 8: Lawful Structures within the Port of Townsville (DES Allocation Notice CA0000014)

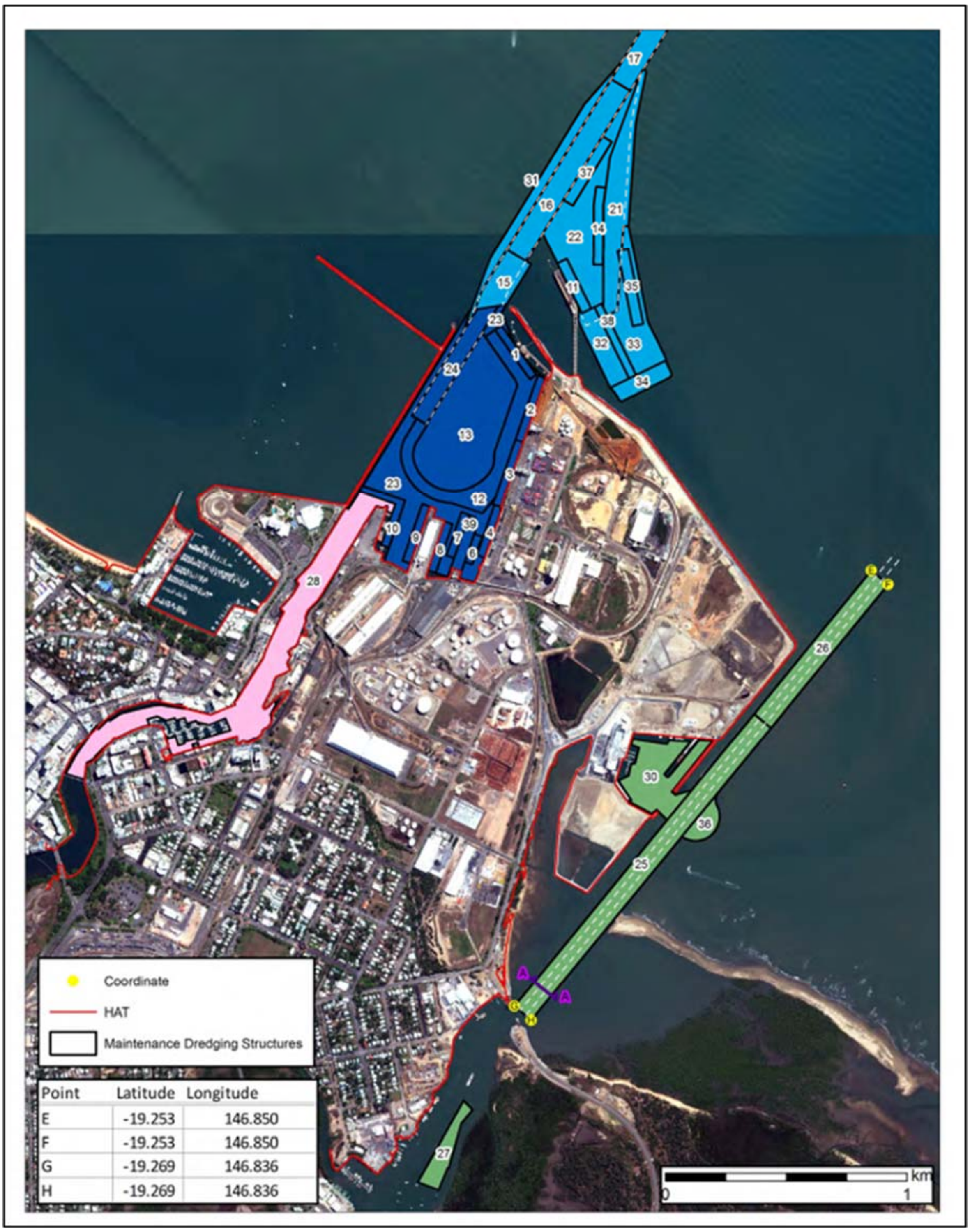
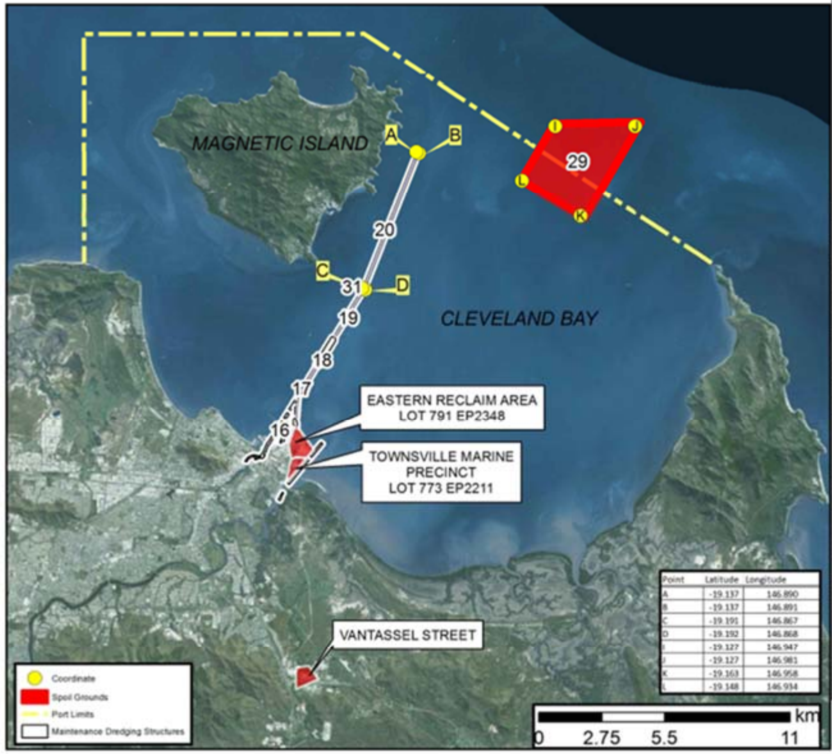


Figure 9: Lawful Structures Within the Port of Townsville and Cleveland Bay (DES Allocation Notice CA0000014)



ID	Description	Design Depth(m, LAT[1])	Design Source
1	Berth 1	-15.7[3]	Section 8 6 (DEH Approvals 803852, 804852)
2	Berth 2	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
3	Berth 3	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
4	Berth 4	-15.7[3]	Section 86 (DEH Approvals 803852, 804852), SPCC01783811
6	Berth 6	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
7	Berth 7	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
8	Berth 8	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
9	Berth 9	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
10	Berth 10	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
11	Berth 11	-14.1	LTDDMP (2008)
12	Inner Harbour Silt Trench	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
13	Inner Harbour Swing Basin	-15.7[3]	Section 86 (DEH Approvals 803852, 804852)
14	Outer Harbour Arrival Channel Silt Trench	-13.4	LTDDMP (2008)
15	Platypus Channel P15-CH1000	-15.7	Section 86 (DEH Approvals 803852, 804852)
16	Platypus Channel CH1000-P13	-13.2	LTDDMP (2008)
17	Platypus Channel P13-CH3500	-12.5	LTDDMP (2008)
18	Platypus Channel CH3500-CH5000	-14.7	Section 86 (DEH Approvals 803900, 1992)
19	Platypus Channel CH5000-P01	-12.5	LTDDMP (2008)
20	Sea Channel	-12.4	LTDDMP (2008)
21	Outer Harbour Arrival Channel	-12.8	LTDDMP (2008)
22	Outer Harbour Basin	-12.8	LTDDMP (2008)
23	Inner Harbour Miscellaneous	-15.7	Section 86 (DEH Approvals 803852, 804852)
24	Inner Harbour Approach	-15.7	Section 86 (DEH Approvals 803852, 804852)
25	Ross River Channel 1[4]	-3.2	Section 86 (DHM Aproval, File 14.9.8)
26	Ross River Channel 2[4]	-2.7	Section 86 (DHM Aproval, File 14.9.8)
27	Ross Harbour	-3.1	Plan T2333
28	Ross Creek	-5.8	Max. Depth June 2009 +0.5m
29	Spoil Ground	n/a	SD2007/0602, Plan P1460/T1076
30	Marine Precinct Stage 1	-3	SPCC00671010
31	Navigation Safety Channel Widening	-12.5	SPDC03347711
32	Berth 12	-15	SPCC02915711
33	Berth 12 Apron	-12.4 to -16	SPCC02915711
34	Berth 12 Batter	-9	SPCC02915711
35	Berth 12 Silt Trench	-13.4	SPCC02915711
36	Marine Precinct Swing Basin	-3	SPCC00671010
37	Outer Harbour Silt Trench	-13.4	SPCC02915711
38	Berth 12 Silt Trench	-13.4	SPCC02915711
39	Berth 6/7 Swing Basin	-15.7	SDA-0514-010086

Typical Channel Section[2] (NTS)

A-A Ross Channel Section (NTS)

NOTES

1. Design depth is the maximum operational requirement including an allowance for short term siltation, "insurance" depth. Due to technical limitations of dredging equipment, it is recognized by State and Commonwealth regulators the design depth may be exceeded by up to 0.5m in some places however best efforts will be made to achieve the design depths stated on this map.

2. The minimum grade likely necessary for batters is 1:4 (approx. 14°).

3. Actual depth of dredging constrained to less than -15.7m by support requirements of adjacent wharf structures.

4. Ross Channel width represents maximum width shown by listed drawings applied uniformly along length.

Horizontal Datum: GDA94
Horizontal Coordinate System: MGA Zone 55

LAWFUL STRUCTURES WITHIN THE PORT OF TOWNSVILLE SHEET 2 OF 2

G1031-02 M

PORT of TOWNSVILLE

Document Set ID: 1372670

Table 2: Approved Design Depths for All Lawful Structures at the Port of Townsville

ID	Location	Design Depth (m, LAT)	Design Source
1	Berth 1	-15.7	Section 86 (DES approvals 803852, 804852)
2	Berth 2	-15.7	Section 86 (DES approvals 803852, 804852)
3	Berth 3	-15.7	Section 86 (DES approvals 803852, 804852)
4	Berth 4	-15.7	Section 86 (DES approvals 803852, 804852), SPCC0178311
5	Berth 5	-15.7	Section 86 (DES approvals 803852, 804852)
6	Berth 6/7	-15.7	Section 86 (DES approvals 803852, 804852), DA0170
8	Berth 8	-15.7	Section 86 (DES approvals 803852, 804852)
9	Berth 9	-15.7	Section 86 (DES approvals 803852, 804852)
10	Berth 10	-15.7	Section 86 (DES approvals 803852, 804852)
11	Berth 11	-14.1	LTDDMP (2008)
12	Inner Harbour Silt Trench	-15.7	Section 86 (DES approvals 803852, 804852)
13	Inner Harbour Swing Basin	-15.7	Section 86 (DES approvals 803852, 804852)
14	Outer Harbour Arrival Channel Silt Trench	-13.4	LTDDMP (2008)
15	Platypus Channel P15 - CH1000	-15.7	Section 86 (DES approvals 803852, 804852)
16	Platypus Channel CH1000 - P13	-13.2	LTDDMP (2008)
17	Platypus Channel P13 – CH3500	-12.5	LTDDMP (2008)
18	Platypus Channel CH3500 - CH5000	-14.7	Section 86 (DES approvals 803900, 1992)
19	Platypus Channel CH5000 – P01	-12.5	LTDDMP (2008)
20	Sea Channel	-12.4	LTDDMP (2008)
21	Outer Harbour Arrival Channel	-12.8	LTDDMP (2008)
22	Outer Harbour Basin	-12.8	LTDDMP (2008)
23	Inner Harbour (miscellaneous)	-15.7	Section 86 (DES approvals 803852, 804852)
24	Inner Harbour Approach	-15.7	Section 86 (DES approvals 803852, 804852)
25	Ross River Channel 1	-3.2	Section 86 (DHM Approval, File 14.9.8)
26	Ross River Channel 2	-2.7	Section 86 (DHM Approval, File 14.9.8)
27	Ross Harbour	-3.1	Plan T2333
28	Ross Creek	-5.8	Max. depth June 2009+0.5m
29	DMPA	N/A	SD2007/0602, Plan P1460/T1076
30	Marine Precinct Stage 1	-3.0	SPCC00671010
31	Navigation Safety Channel Widening	-12.5	SPDC03347711
32	Berth 12	-15.0	SPCC02915711
33	Berth 12 Apron	-12.4 to -16.0	SPCC02915711
34	Berth 12 Batter	-9.0	SPCC02915711
35	Berth 12 Silt Trench	-13.4	SPCC02915711
36	Marine Precinct Swing Basin	-3.0	SPCC00671010
37	Outer Harbour Silt Trench	-13.4	SPCC02915711
38	Berth 12 Silt Trench	-13.4	SPCC02915711
39	Berth 6/7 Swing Basin	-15.7	SDA-0514-010086 (SPD-0914-011170)

Figure 10: Onshore Maintenance Dredge Material Placement Areas (DES Allocation Notice CA0000014)

Port of Townsville Limited Maintenance Dredge Material Placement Areas		
Figure 1.	07/01/2019	Rev 0

PORT of TOWNSVILLE

Figures 11 and 12 are representative of the shape of the Platypus and Sea Channels and Ross River for optimum capacity for vessels entering and exiting the Port of Townsville.

Figure 11: Platypus and Sea Channel Typical Cross Section

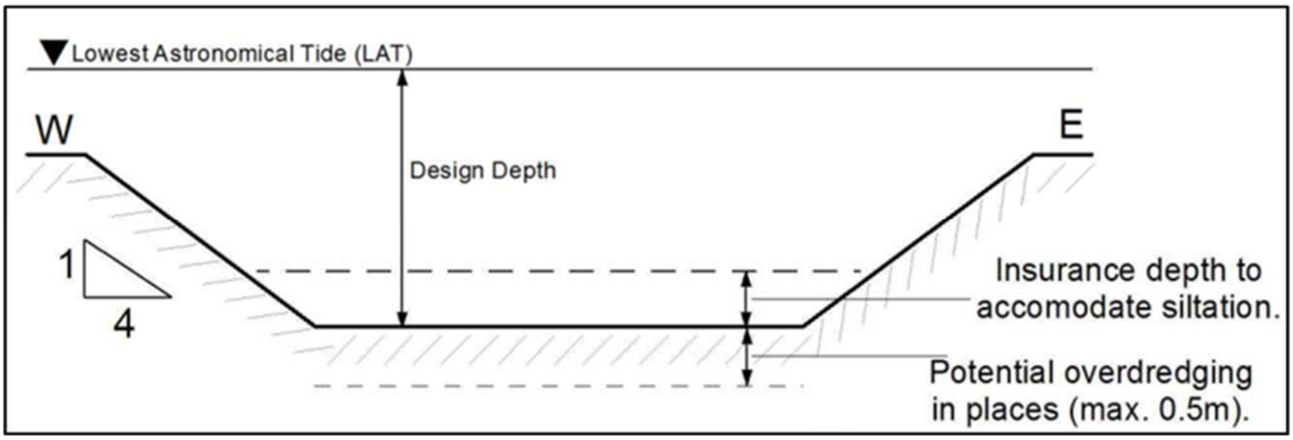
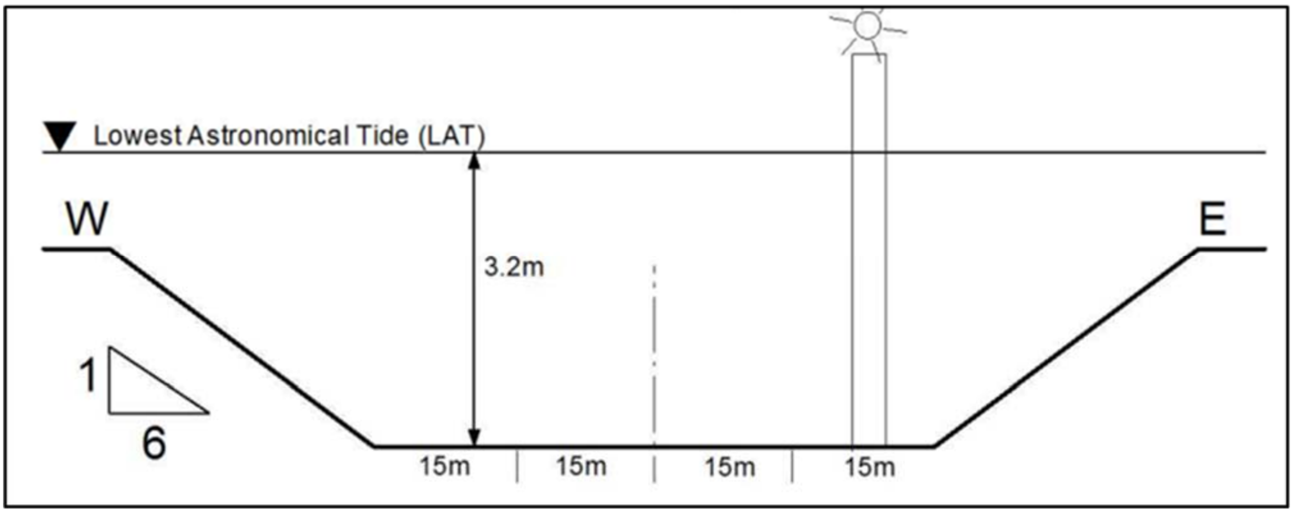


Figure 12: Ross River Channel Cross Section



3 PORT OF TOWNSVILLE ENVIRONMENTAL VALUES

The Port of Townsville has an Environmental and Social Values document (POT 1898) which provides a detailed assessment of the values of Cleveland Bay and is available on the Port of Townsville's website. The following section is a detailed snapshot of the Environmental and Social Values of Cleveland Bay.

3.1 Environment Values

3.1.1 Climate and Coastal Processes

Located within a dry tropical region, Townsville is characterised by a tropical, seasonal wet and dry climate. High humidity and frequent storms, with occasional cyclones, typically occur during the wet season (November to April). The dry season (May to October) produces mild and moderate temperatures. The temperature ranges from a mean maximum of 31.5°C in December to a mean minimum of 13.7°C in July. Relative humidity is highest in the morning and monthly averages range between 60% during September/October and up to 75% in the wet season (peaking in February). Average annual rainfall in Townsville is approximately 1,128mm, with the majority typically recorded during the wet season (December to March).

Cleveland Bay is a relatively low energy wave environment as it is sheltered from the predominant south-east waves by Cape Cleveland. Accumulated sediments make the bay relatively shallow, deepening to only 10 to 11m (below chart datum) along its northern aspect, and averages 2-6m across the bay. The coastline continues to be shaped by the prevailing waves at a slower rate, determined by the generally low energy waves and punctuated by the occasional higher energy cyclone waves that are able to penetrate across the bay onto the shoreline.

The Port of Townsville and surrounding coastal areas have been extensively modified over time. The port lands have been increased significantly by land reclamation and the placement of both maintenance and capital dredge material, dating back to the establishment of the Port in 1864. The surrounding waterways have also been modified. The Ross River has been dammed, along with the installation of three instream weirs, and Ross Creek has been shortened and no longer connects with the Ross River. The Strand Beach is a significant coastal feature located immediately west of the Port. It is a man-made public area which was redeveloped in 2000, with the construction of five beach units separated by artificial rocky headlands, to control the natural long-shore transport of sand. The Strand Beach has large grain-sized imported sands and steep beach fronts, again to minimise the loss of these constructed areas.

Climate change projections indicate that the region's future climate is likely to be characterised by:

- Increased average annual temperature and increased number of days with maxima over 35°C;
- Increased annual potential evaporation, and more drought-like conditions;
- Increased frequency and severity of tropical cyclones;
- Increased average wind speeds; and
- Elevated sea level and increased frequency and height of storm surge.

Careful planning of the potential effects of natural events such as cyclones and floods including predicted climate change risks are a key consideration in port planning, design and operations.

3.1.2 Marine Ecosystem Values of Cleveland Bay

Cleveland Bay supports numerous rich and diverse coastal habitats with varying ecological sensitivities, typically abundant in north-east Australia's coastal wet-dry tropics including:

- Corals which occupy only around 1% of the bay;
- Soft bottom communities, occupying over 85% of the bay;
- Intertidal and subtidal seagrass beds, are present in about 10% of the bay and provide food for the threatened dugong and turtles and are also a nursery for prawns and fish;
- Mangrove and saltmarsh communities, containing twelve species of mangrove and 15 species of saltmarsh, all of which:
  - provide a nursery and shelter for fish, mud crabs and prawns;
  - trap tide-borne sediments and help control coastal erosion; and
  - provide vital protection from strong winds, tidal surges and heavy rainfall associated with cyclones, which occasionally affect this part of Queensland's coastline; and
- Forested, brackish and freshwater swamps.

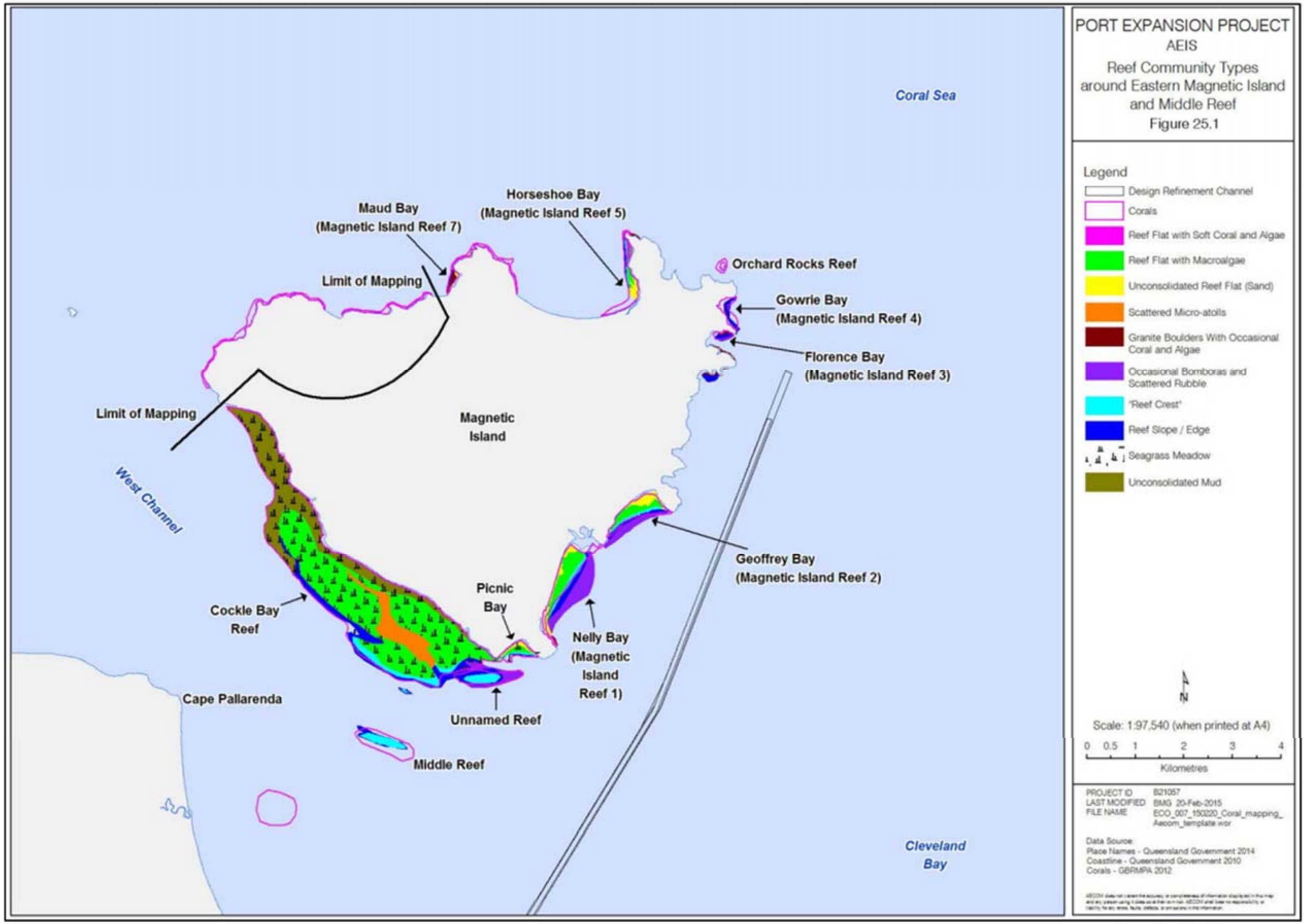
There has been a substantial amount of research on the marine ecology of Cleveland Bay and the surrounding GBR. The following sections provide a brief description of the major aspects of the marine ecosystem values of Cleveland Bay.

Reef Communities

Reef communities comprised of hard corals exist around Magnetic Island, Middle Reef and Virago Shoal located between Magnetic Island and Cape Pallarenda (Figure 13). A large number of hard corals have been recorded in these communities, including extensive areas of *Montipora digitata*. The distribution and abundance of coral species vary in the fringing reefs and is related to the physical characteristics of the substrate and energy environments.

Coral cover, species diversity and aesthetic quality are generally considered higher in the fringing reefs on the northern side of Magnetic Island (Horseshoe Bay) than in other fringing reefs. The Cockle Bay reefs, located on the south-western side of Magnetic Island, are characterised by species that are better adapted to high siltation and turbidity, with a general trend toward decreasing coral density in comparison to reef habitat in Geoffrey Bay, located on the south-eastern side of Magnetic Island (Bell and Kettle 1989). A previous study of the fringing reefs on the south-eastern side of Magnetic Island between Florence Bay (north) and Geoffrey Bay (south) indicates that these areas are qualitatively similar (Mapstone *et al.* 1989). Magnetic Island reefs also show more pronounced depth gradients compared with most other reefs of the GBR due to the high water turbidity in Cleveland Bay.

Figure 13: Reef Communities around Magnetic Island (extract from Port Expansion AEIS, 2016)



Benthic Communities

Soft sediment communities dominate the seabed of Cleveland Bay (Kettle *et al.* 2001). The most common groups of benthic infauna present in the area include polychaetes, sipunculids, bryozoans and crustaceans such as amphipods and tanaids (Cruz Motta and Collins 2004). Benthic communities provide a significant food source for many species of fish, including higher order consumers, which are also targets for recreational fishing.

A number of additional baseline studies have been undertaken as part of the PEP Environmental Impact Statement (EIS) (AECOM 2009) to characterise the benthic environments in and around the Outer Harbour, the entrance channels and at the approved DMPA. These studies characterised sediment type as well as epifauna and infauna communities in these areas – the following is an excerpt from *PEP EIS Section B6 Marine Ecology and Conservation*.

The breakwaters and revetments of the Port provide hard substrates that support a range of algal and sponge dominated communities, as well as corals in more quiescent areas. Video-based surveys suggested that sparse and patchy epibenthic communities (i.e. organisms living on the seabed) occurred throughout the Port and surrounding areas. Mid-shore assemblages were comprised of occasional hydrozoans, sea pens, crinoids and ascidians. Channel assemblages were the most depauperate, with only one feather star (crinoid) recorded. Hydrozoans were the most abundant taxon in the nearshore areas and were much less common in the DMPA, mid- and offshore control areas. Assemblages were dominated by plumulariid and sertularellid stinging hydroids, with occasional alcyonid soft corals, ascidians, and bryozoans.

Epibenthos assemblages in the DMPA were dominated by a type of burrowing goby. Of the 149 fish observed in video transects, 142 (95%) were burrowing gobies, and 124 of these were observed in the DMPA. Sea pens (Pennatulacea) were particularly common at the DMPA, but were only occasionally observed in the mid-shore and Outer Harbour area and absent elsewhere. Bryozoans, sponges, polychaetes, ascidians (sea squirts), echiurans (spoon worms), hydrozoans and alcyoniid soft corals were occasionally observed. The small patches of rock in the DMPA provide habitat for reef-associated taxa such as sea pens, ascidians and some crinoids, and represent areas of locally higher biodiversity in the DMPA. In comparison to the DMPA, epibenthic assemblages were generally similar at other offshore areas, although sea pens and many hard substrate/gravel associated taxa recorded at the DMPA were not observed and very few Alcyonacea soft corals were recorded at the DMPA.

Seagrass Communities

Seagrass meadows occur in parts of Cleveland Bay and provide both important habitat and food resources for a range of species of conservation significance, including dugong and turtles as well as assisting in stabilising sediment and trapping and recycling nutrients (Roelofs *et al.* 2003). With the exception of the DMPA, seagrass is not known to occur in the existing port infrastructure, although shallow water and intertidal seagrass beds can occur nearby (e.g. near the Ross River mouth and along The Strand). Seagrass beds are extensive in the eastern portion of Cleveland Bay, away from almost all of the City’s development. Smaller beds occur across the Strand, Kissing Point, Pallarenda Beach, and some bays fringing Magnetic Island (Wells and Rasheed 2017). The seagrass habitats within this region are of high ecological significance and provide a regionally important foraging habitat for threatened species such as dugongs and turtles and economically important fishery species. The primary locations within Cleveland Bay for seagrasses tend to be in areas that are less than 4m in depth, between the mainland and Magnetic Island, and adjacent to Cape Cleveland (Lee Long *et al.* 1993).

A number of studies of the spatial and temporal distribution of seagrass in Cleveland Bay have been undertaken over the years, but most recently baseline and annual surveys of seagrass, commissioned by the Port, have been undertaken by JCU since 2007. The baseline surveys identified large and continuous seagrass meadows in Cleveland Bay, most commonly in lower intertidal and shallow sub-tidal areas. The best quality shallow seagrass meadows occur as shallow beds near Cape Cleveland, The Strand, Cape Pallarenda and around Magnetic Island. The dominant species in shallow waters include *Halophila ovalis*, *Halodule uninervis*, *Zostera muelleri* and *Cymodocea serrulata*. The reef flats surrounding Magnetic Island support areas of *Thalassia hemprichii*.

The distribution, extent and density of seagrass assemblages in near-shore areas can show great variation over a range of temporal scales (particularly seasonally and inter-annually) in response to variations in a range of environmental factors. In particular, changes in the light availability, that result from wave-driven bed sediment remobilisation and turbidity associated with catchment discharges, are key drivers of temporal change in seagrass meadows (Taylor and Rasheed 2009). Previous surveys found that the near-shore seagrasses had also significantly diminished in biomass over the years since monitoring started. However, the most recent seagrass surveys conducted in Cleveland Bay (Bryant *et al.* 2019) found that the area of seagrasses in Townsville continue to increase from the climate related losses that occurred leading up to 2011 and 2018 was the second largest spatial distribution since annual monitoring began in 2007. Following the February 2019 flood event, seagrass density (biomass) at coastal meadows has not returned to "typical" peak season levels, but the area of meadows is similar to that previously recorded (McKenna *et al*. 2020).

Cleveland Bay, and on occasion the DMPA, contains ephemeral deep-water seagrass beds. These deep-water meadows are typically patchy (non-contiguous, fragmented beds) with a sparse cover and low species richness. The deep-water meadows also show seasonal and inter-annual variability, with the surveys from 2007 to 2016 showing a decline in biomass of these communities. However, the presence of a large deep-water meadow in the October 2019 indicates that later during that year conditions in Townsville were favourable for the germination and seasonal recruitment of Halophila species (McKenna *et al*. 2020). The restricted deep-water meadows suggest that either the light environment has not improved enough, or that some other factor is more influential in meadow recover in deeper habitats (Wells and Rasheed 2017); including those attributed to effects derived from seasonal flooding.

Mangrove Communities

Mangrove communities represent diverse communities growing in the intertidal zone of tropical to temperate coastal rivers, estuaries and bays (Lovelock 2003). They are most extensive in the south-east portion of Cleveland Bay between Sandfly and Cocoa Creeks, and in the Ross River, south of the Port. Smaller, structurally simpler mangrove stands occur in Rowes Bay and at Three Mile Creek. Predominant threats to mangrove ecosystems arise from land use conflicts and local effects on water quality.

The occurrence of particular mangrove species is dependent on environmental factors such as salinity (Sam and Ridd 1998), nutrient availability (Walker and O'Donnell 1981), oxygen levels in the sediment and wave energy (Brinkman *et al.* 1997). At least seven direct studies have been undertaken on the mangroves of Cleveland Bay and twelve species of mangroves have been recorded.

Saltmarsh Communities

Cleveland Bay is also home to over 15 species of saltmarsh species. Saltmarshes are ecologically important habitats, as they link the marine environment to terrestrial, and provide habitat for both marine and terrestrial organisms (Goudkamp and Chin 2006).

Saltmarsh communities tend to occupy the areas of low energy, intermittent, tidal inundation, on sheltered soft substrates, and often occur behind mangrove communities (Creighton *et al.* 2015). Different saltmarsh community types produce different benefits to the ecosystem, including sediment trapping, nutrient cycling, dissipation of wave energy, fish and prawn nurseries, carbon sequestration, and feeding areas for birds (Creighton *et al*. 2015).

Distribution throughout the bay depends on the site microhabitat and seasonal influences from both land and sea direction. Saltmarshes play an important role in the ecosystem by providing organic matter, a rich supply of nutrients, and supporting a great diversity of both marine and terrestrial life (adapted from RIVER Group 2004).

Marine Megafauna

Cleveland Bay is recognised as a key foraging area for the flatback turtle (*Natator depressus*) and a key feeding and nesting area for the green turtle (*Chelonia mydas*) (GHD 2011). The port footprint is not an area of high utilisation for turtles (GHD 2012), however the following marine megafauna species, as listed under the *Nature Conservation (Wildlife) Regulation 2006*, have been observed within proximity of the Port:

Endangered:

- Loggerhead Turtle (*Caretta caretta*);
- Leatherback Turtle (*Dermochelys coriacea*);
- Olive Ridley Turtle (*Lepidochelys olivacea*);

Vulnerable:

- Dugong (*Dugong dugong*);
- Green Turtle (*Chelonia mydas*);
- Hawksbill Turtle (*Eretmochelys imbricate*);
- Flatback Turtle (*Natator depressus*);

Near *Threatened:*

- Australian Snubfin Dolphin (*Orcaella heinsohni*);
- Indo-Pacific Humpback Dolphin (*Sousa chinensis*).

Other commonly sighted native marine fauna in and around the Port of Townsville include humpback whales, saltwater crocodiles, and various species of sea snakes.

The waters of Cleveland Bay are entirely within a Declared Dugong Protection Area (DPA) and dugongs are known to be relatively abundant in the bay. Megafauna monitoring undertaken by GHD for the TMP and Port Expansion Projects, (GHD 2009 and 2012), found that dugongs were found most often in areas with a greater concentration of seagrass in Cleveland Bay; including the meadows near the southern and eastern shores of the bay. Boat-based and aerial marine megafauna surveys have been conducted in Cleveland Bay between 2008 and 2012. Turtles, dugongs, rays, sea snakes and dolphins were observed as part of these surveys. Both the Australian Snubfin Dolphin and the Indo-Pacific Humpback Dolphin were also observed as part of these surveys and were reported to be highly mobile, moving in and out of Cleveland Bay. Both of these near-threatened species are considered to be opportunistic generalist feeders on fish and cephalopods (octopus, squid etc.) from coastal, estuarine and nearshore reef habitats (PEP EIS, Section B6 2009).

Fish and Fisheries

The mangroves, seagrasses, reef and soft bottom benthic communities present in Cleveland Bay provide habitat for a variety of fish species. Fishing for target species is a common practice in Cleveland Bay, undertaken by traditional owner, commercial and recreational fishers within the tidal creeks and estuaries. Prawn trawling, coastal net setting and crab pot fishing occur on a commercial scale, in and beyond Cleveland Bay. The net and crab pot fisheries target species such as Mud Crabs, Barramundi, Threadfin Salmon, Grunter and Flathead.

Fish habitat areas (FHAs) have been established in Cleveland Bay, the Bohle River, and in Bowling Green Bay. These areas provide protection and breeding grounds for target indigenous, recreationally, and commercially important species (including Barramundi, Grunter, Mud Crabs and Prawns). While these species are highly mobile, it is recognised that the loss of important habitats such as for feeding, or breeding, including seagrasses, and reef and benthic habitat, may affect long-term stock levels and abundance. Commercial fishing has been restricted within parts of Cleveland Bay since the implementation of DPAs in 1998. Other limitations are placed on commercial and recreational fishing through the GBRMP boundaries and zoning maps and limited access within identified secure areas for shipping. No major aquaculture facilities are currently operating in the Cleveland Bay area.

Birds

Cleveland Bay is home to over 450 different species of birds, including migratory and coastal species, (DES Wildlife Online 2018). Of the 452 species identified in and around the Townsville Region, 22 species were listed as Endangered or Vulnerable under the State's *Nature Conservation Act 1992*; of these 22 species 3 were listed as Critically Endangered, 8 as Endangered, and 5 as Vulnerable under the EPBC (Table 3).

Table 3: Threatened Bird Species of Cleveland Bay

Species	State Nature Conservation Status	Cth EPBC Status
Red Goshawk *Erythrotriorchis Radiatus*	Endangered	Vulnerable
Beach Stone-Curlew *Esacus magnirostris*	Vulnerable	
Glossy black-cockatoo (northern) *Calyptorhynchus lathami erebus*	Vulnerable	
Major Mitchell's cockatoo *Cacatuidae Lophochroa leadbeateri*	Vulnerable	
Greater Sand Plover *Charadrius leschenaultii*	Vulnerable	Vulnerable
Lesser Sand Plover *Charadrius mongolus*	Endangered	Endangered
Squatter Pigeon (southern subspecies) *Eophaps scripta scripta*	Vulnerable	Vulnerable
Gouldian Finch *Erythrura gouldiae*	Endangered	Endangered
Star Finch (eastern subspecies) *Neochmia ruficauda ruficauda*	Endangered	Endangered
Grey Falcon *Falco hypoleucos*	Vulnerable	
New Caledonian Fairy Tern *Sternula nereis exsul*	Endangered	
Southern Giant-Petrel *Macronectes giganteus*	Endangered	Endangered
Wedge-Tailed Shearwater *Ardenna pacifica*	Vulnerable	
Macleay's fig-parrot *Cyclopsitta diophthalma macleayana*	Vulnerable	
Australian painted snipe *Rostratula australis*	Vulnerable	Endangered
Red Knot *Calidris canutus*	Endangered	Endangered
Western Alaskan Bar-Tailed Godwit *Limosa lapponica baueri*	Vulnerable	Vulnerable
Eastern Curlew Numenius madagascariensis	Endangered	Critically Endangered
Curlew Sandpiper *Calidris ferruginea*	Endangered	Critically Endangered
Great Knot *Calidris tenuirostris*	Endangered	Critically Endangered
Masked Owl (northern subspecies) *Tyto novaehollandiae kimberli*	Vulnerable	Vulnerable
Black-Throated Finch (White-Rumped subspecies) *Poephila cincta cincta*	Endangered	Endangered

The remaining 431 species are listed under the *Nature Conservation Act 1992* as of Least Concern. Of these 431 however, 60 species are listed as Special Least Concern, which (under the *Nature Conservation Wildlife Regulations 2006*), means there is an agreement to protect these species either under:

- The agreement called 'Agreement Between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment' signed in Tokyo on 6 February 1974; or
- The agreement called 'Agreement Between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment' signed in Canberra on 20 October 1986; or
- The convention called 'Convention on the Conservation of Migratory Species of Wild Animals' signed in Bonn on 23 June 1979.

Cleveland Bay has a diverse range of habitats and protected areas which are of regional importance in supporting wading and migratory bird species. Areas of importance in the bay for migratory or coastal bird species are Magnetic Island, The Town Common, the Ross River sandspit, Cape Cleveland and the RAMSAR listed Bowling Green Bay.

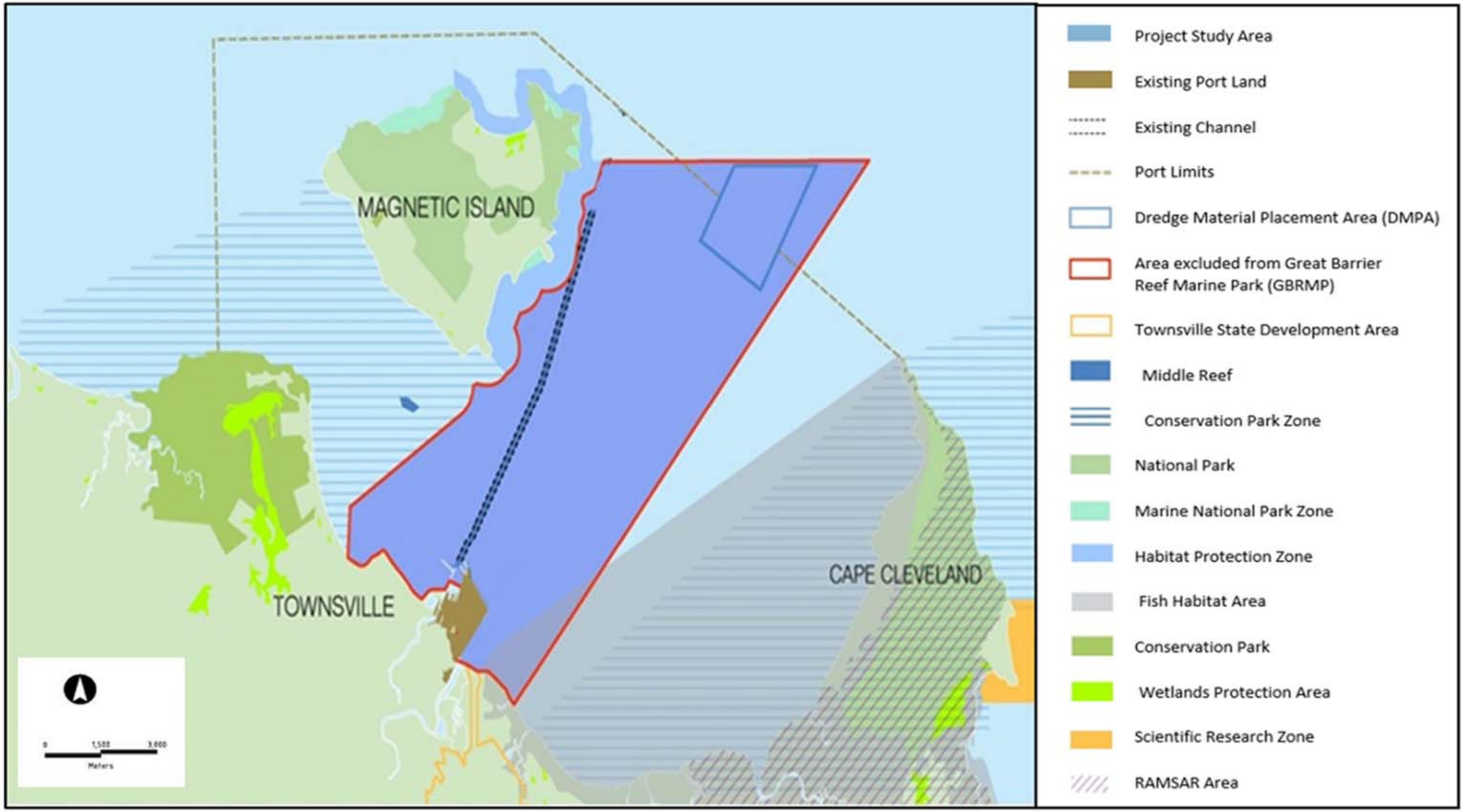
Clear mudflats within the bay provide suitable habitat for Radjah Shelducks, Black-necked Storks, and White Rumped Swiftlets. The Ross River sandspit in the river's mouth supports a nationally significant proportion of several migratory shorebirds – Red-Necked Stint, Lesser Sand Plover, Eastern Curlews; as well as being home to Beach-Stone Curlews, Little Terns, Caspian Terns, Gull-billed Terns, and Silver Gulls. Magnetic Island also provides foraging habitat for migratory shorebirds, like the East Asian – Australasian Flyway (CG report PEP 2017).

A number of targeted bird studies and surveys around the Port of Townsville have been undertaken for a number of projects. These include the Port Access Road project, TMP project, PEP, and most recently the Channel Upgrade (CU) project.

3.1.3 Protected Areas within Cleveland Bay

The Port of Townsville's sea jurisdiction is within the GBRWHA, which is also a national heritage place. However, the Port and its marine infrastructure are in an exclusion zone from the Central region of the Cth GBRMP and the State GBR Coast Marine Park (Figure 14), but some port infrastructure abuts the marine park, e.g. the Sea Channel and the DMPA. Existing shipping channels accessing the Port of Townsville approach within approximately one kilometre of Bremner Point on Magnetic Island.

Figure 14: Coastal Habitats in and around Cleveland Bay



Some of the key conservation areas, as well as other features of the region as shown in Figure 14, include:

- The GBRWHA, a world and national heritage place;
- The GBRMP and the State GBR Coast Marine Park (including a number of different zones of protection) noting the area depicted with a red boundary is the port exclusion zone;
- Declared DPAs, in Cleveland Bay and around Magnetic Island;
- A declared FHA in the east of Cleveland Bay;
- The neighbouring Bowling Green Bay, a RAMSAR listed wetland and major wetland area of significance to migratory and wading birds; and
- Magnetic Island National Park.

3.2 Social Values

Land areas bounding Cleveland Bay contain tangible archaeological evidence for Aboriginal use and occupation and retain significant Aboriginal cultural heritage values. Traditional Owners have expressed a view that both land and sea country remain as a component of the region's Aboriginal cultural landscape. Two local communities, Gurambilbarra Wulgurukaba and Bindal, claim traditional ownership over Cleveland Bay. Recognition of Aboriginal cultural heritage values of the port area have been discussed through consultation with representatives of the Aboriginal parties. The Port is committed to working closely with the Traditional Owners and specific mitigation measures have been embodied in the Cultural Heritage Management Plan registered with the Department of Aboriginal and Torres Strait Islander Partnerships.

Cleveland Bay plays an important role in the daily social and economic life of the population of Townsville and its surrounding areas and impacts on both Townsville's productivity and liveability. The catchments flowing into Cleveland Bay support many different land uses, including grazing on native pastures, residential and associated services, horticulture, industry, mining, defence and tourism (Dry Tropics Partnership for Health Waters 2018). Magnetic Island, particularly, is an internationally acclaimed tourist destination and holiday location for locals. Established in 1864, the Port of Townsville has played a significant role in the development of Townsville and, more broadly, of Northern Queensland. A historic cultural heritage study indicated that there were no listed places of historic European heritage significance in the Port (AECOM 2009).

The area also provides for recreational activities, including bush walking, bird watching, swimming and snorkelling, camping, boating and fishing. The Dry Tropics Partnership for Health Waters (2018) states the "community has strong and enduring connections to the water and relies on the numerous freshwater and estuarine systems, and Cleveland Bay, for its world-class experiences in fishing, diving, boating and swimming".

4 CONSULTATION AND KEY ISSUES

4.1 Long-Term Maintenance Dredging Management Requirements and Associated Issues

Similar to all north facing bays in the GBR Lagoon, Cleveland Bay has naturally high turbidity levels, due to there being a deposition zone as currents flow past the tip of Cape Cleveland; and from regular and sustained resuspension from wind and wave action. This resuspension of sediments is the primary driver for the requirement for and volumes of routine maintenance dredging.

The key issues for the Port of Townsville are the generation of turbidity and its impacts upon the sensitive receptors found in the bay, including those of Magnetic Island.

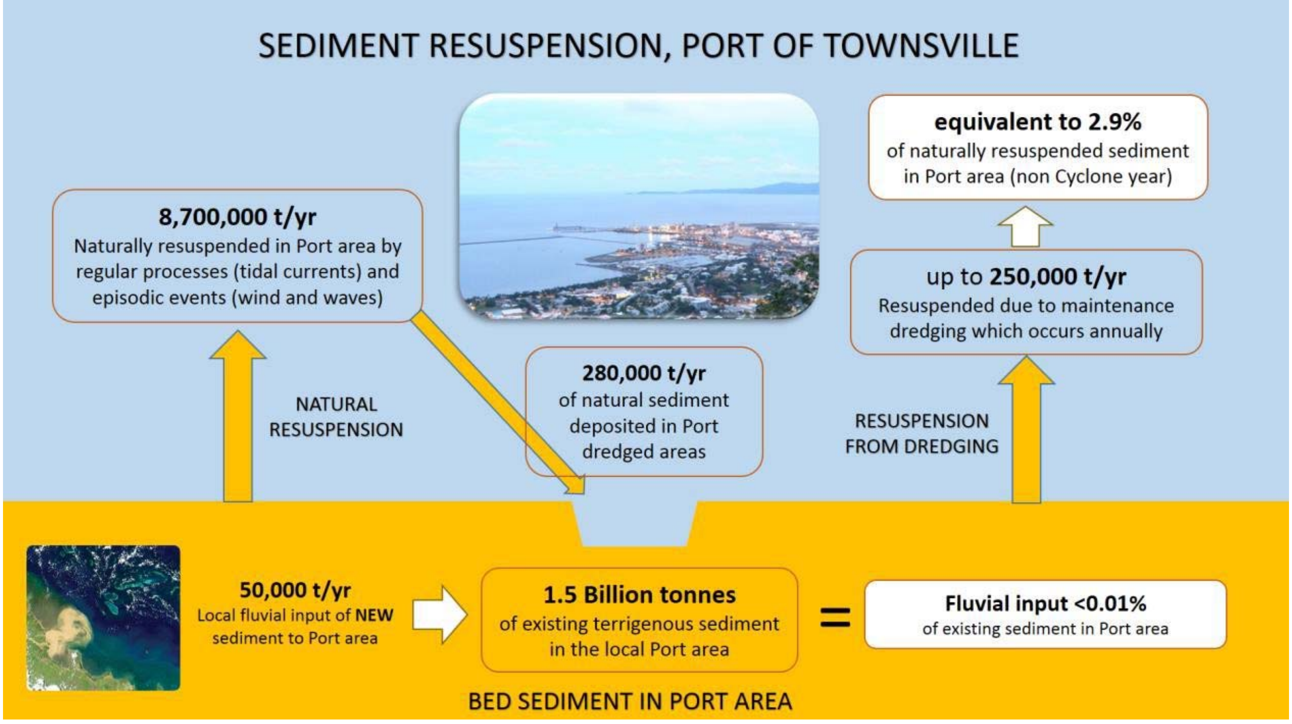
Dredging and material placement, has occurred in Cleveland Bay since the Port was first established in 1864. Historically placement within the bay had occurred near areas of high sensitivity, places like Middle Reef and Cockle Bay, between Magnetic Island and Cape Pallarenda. These areas are shallow and have high resuspension values given their close proximity to shore. This method is no longer practiced, given its negative impact on the environment. The Port uses one placement area, the DMPA, which sits below the 10m contour line to limit resuspension and prevent material from being placed on or near corals and seagrass meadows.

Although Cleveland Bay is a naturally turbid bay, with resuspension occurring on more than a monthly basis throughout the year, many within the community, however, consider this turbidity to be generated by dredging. Dredging at the Port of Townsville occurs generally between a period of five to six weeks. As required, the dredge campaign may be split, depending on the scheduling of the Trailer Suction Hopper Dredge (TSHD) Brisbane and its work along the Queensland coastline, only then the campaigns are between two and three weeks each.

Over many years of sampling, monitoring, and modelling, the Port are confident that turbidity and dredge plumes (including those generated by placement activities) are only ever localised to the vicinity around the dredge, and then only move away to a distance of approximately 800m (from where it was first generated). Jones *et al*. (2020) observed that during maintenance dredging campaigns in Cleveland Bay, the turbidity may increase by 0.6-0.7 times the mean expected values at some of the Magnetic Island bays, but this is between two and five times lower than the effects of natural events caused by wind or waves. This study also included preliminary results of empirical measurements of elevated sediment accumulation rates caused by maintenance dredging using newly re-designed deposition sensors, which indicated that "(1) high suspended sediment concentrations produced by dredging in a low energy water column is conducive to rapid settling and enhanced deposition and (2) the effects are quite localised" (Jones *et al*. 2020).

The Port has also worked with the QPA on a study to address Water Quality Action 17 in the Reef 2050 Long Term Sustainability Plan. BMT WBM Pty Ltd prepared a quantitative sediment budget of the entire GBR and regions surrounding GBR ports, which is available on the Port's website. Comparing the relative mass of sediment resuspended naturally to that from maintenance dredging at a port scale shows that maintenance dredging contributes the equivalent of 2.9% of the annual natural resuspension as depicted in Figure 15 (BMT WBM 2018).

Figure 15: Quantitative Summary of Sediment Resuspension at Port of Townsville (BMT WBM 2018)



Although confidence in both the monitoring and modelling is high, the Port continues to undertake near real-time water quality monitoring of turbidity throughout the year, which includes during dredging and placement activities. This data is available on the Port's website.

4.2 Stakeholder Engagement / Outcomes / Feedback

As mentioned in Section 1.5.3, the Port has undertaken stakeholder engagement in the preparation of this Plan, which included seeking public review and submissions to improve this 10-year Plan.

The public review period resulted in 11 submissions on the Plan, totally 129 lines of comment, with many comments covered by multiple submitters.

Given the comments received through the public submission process, the Port has provided a Gap Analysis Action List for addressing the gaps and issues raised, on its website. This lists the major issues identified, along with the expected timeframes in which the required information will be included in this LTMDMP.

4.3 Accessibility to the Community of Reports and Information

The Port of Townsville website has a page dedicated to long term maintenance dredging in order to host all the associated documents that accompany the LTMDMP.

This page will remain operational for the duration of the Plan, being updated with relevant reviews; ensuring access and currency of reports and data.

5 PORT SEDIMENT CHARACTERISTICS

5.1 Port Sediment

5.1.1 Coastal Processes and Sediment Behaviour

Cleveland Bay is a relatively low energy wave environment as it is sheltered from the predominant south-east waves by Cape Cleveland. Accumulated sediments make the bay relatively shallow, deepening to only 10 to 11m (below chart datum) along its northern aspect, and averages 2-6m across the bay. The coastline continues to be shaped by the prevailing waves at a slower rate, determined by the generally low energy waves and punctuated by the occasional higher energy cyclone waves that are able to penetrate across the bay onto the shoreline.

South-easterly trade winds dominate the North Queensland coastline particularly in the dry season and are the driving force for waves within Cleveland Bay. Water motion within Cleveland Bay is dominated by the effects of refracted south-easterly generated waves (mostly 0.5-1.2m high, 4-6s period) and by semi-diurnal tidal currents, which reach speeds of 15-30cm/s during spring tides.

A combination of the natural swell and wind-driven waves is capable of resuspending bed sediments and producing high turbidity conditions in Cleveland Bay. Wave-induced bed stress is the most significant long-term contributor to sediment resuspension and elevated suspended sediment concentrations within the water column.

North moving long-shore drift also adds to both the volume of sediments in the bay and the volume of sediments being suspended in the water column. Long-shore drift is created by tidal, wind-driven, and three-dimensional currents, which move sediments parallel to the shoreline, moving and resuspending sediment as the currents move north along the inner shelf and coastline. The establishment of the shipping channels (as opposed to on-going dredging and placement) has had the greatest effect on overall turbidity patterns in the Bay; reducing pre-development levels of turbidity in nearshore areas to the west of the Platypus Channel (as a result of the channels catching fine sediment that normally would re-suspend and travel from east to west across the Bay) (BMT WBM 2020).

Within the GBR inner-shelf region natural resuspension of sediment deposits by tidal currents and episodic wave events is the primary contributor to sediment suspended into the water column and it has been estimated that approximately 160 million tonnes of existing bed sediment are naturally resuspended per annum in this region. Low magnitude resuspension occurs regularly due to tidal currents and typical wind/wave conditions, while higher magnitude resuspension occurs episodically due to spring tide and/or high energy wind/wave events (on average 25 events per year lasting for 3 to 4 days though not simultaneous across the entire GBR) (BMT WBM 2018).

The derived GBR inner-shelf natural resuspension quantity is approximately 17-times higher than the input of new sediment from the catchment into the GBR. These natural resuspension processes are also the primary mechanism for sedimentation of port infrastructure. Due to their orientation, the port navigation channels intersect the natural inner- shelf longshore sediment transport pathways. Because they are deeper and calmer than the surrounding seabed and are less exposed to wave and current energy, sediment is more likely to settle and less likely to resuspend in the dredged channels than in adjacent areas of the seabed meaning that the sediment requires removal by maintenance dredging to ensure the dredged areas remain navigable. However, the quantities settling in port facilities and requiring maintenance dredging constitute less than 3% of the sediment being resuspended by currents and waves at a port scale (BMT WBM 2018).

5.1.2 Bathymetry

The seabed of Cleveland Bay, to the offshore boundary that encompasses Magnetic Island, is approximately 325km². Water depths in most of the bay are generally <10m with a large section (closer to shore) <4m (Figures 16a and 16b). Port infrastructure is deeper with the Inner and Outer Harbour, Platypus and Sea Channels all dredged and maintained to varying depths, greater than 10m.

Figure 16a: Bathymetry Chart of Cleveland Bay AUS 827 (2004)

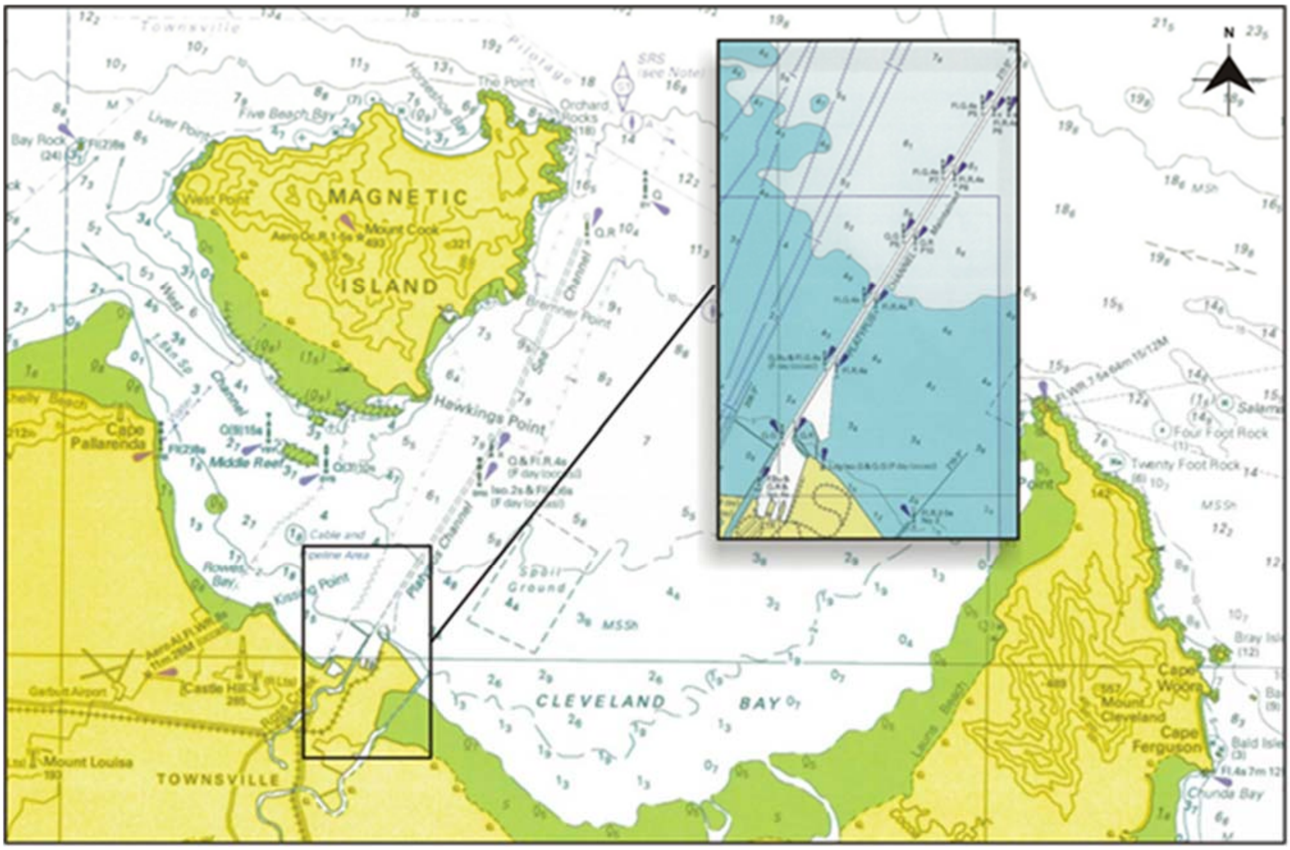
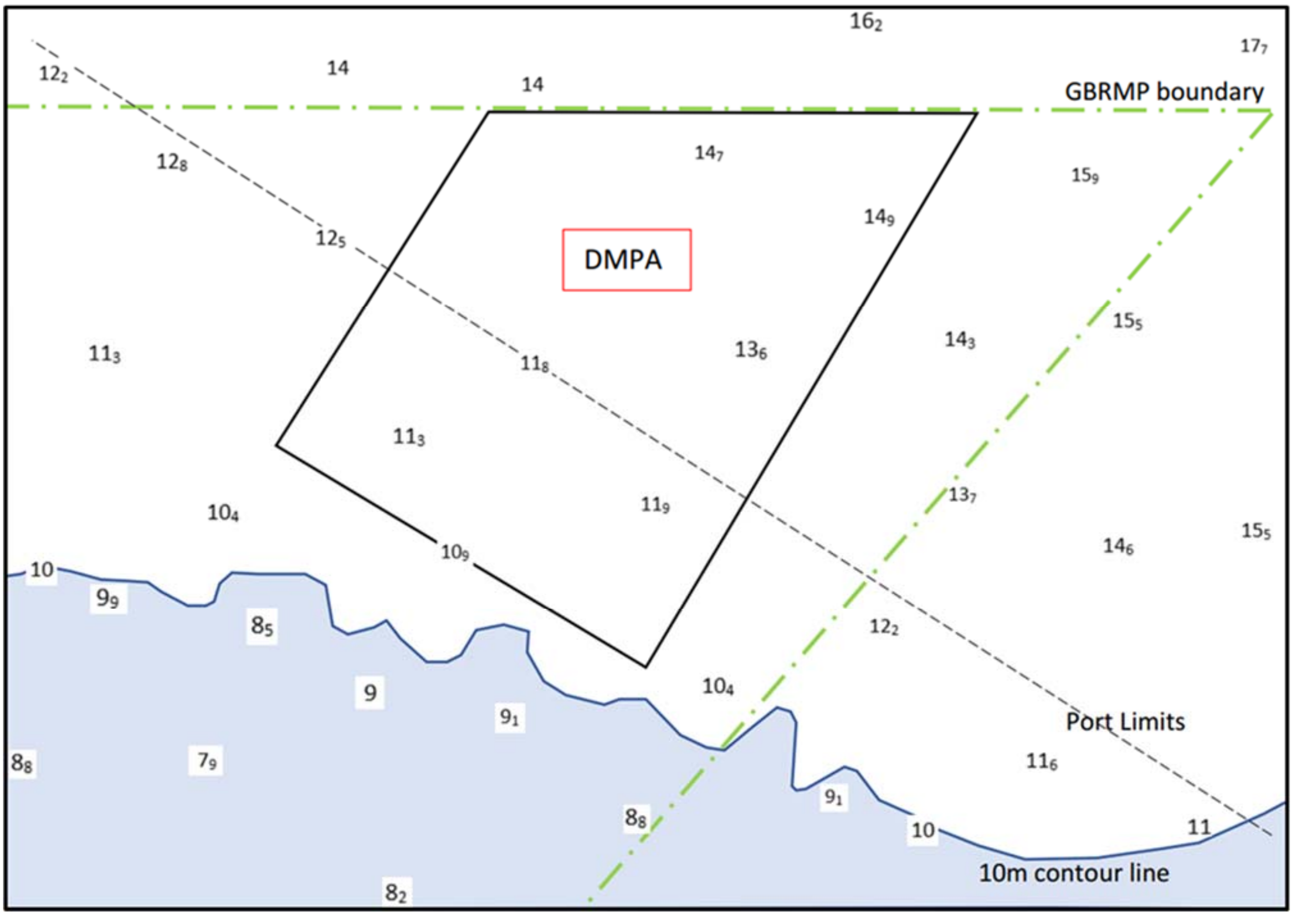


Figure 16b: Bathymetry of the Maintenance Dredge Material Placement Area



5.1.3 Seabed Sediments

The geology of the Townsville Region comprises Quaternary aged alluvium and colluvium sediments underlain by Late-Palaeozoic age granite. Sediments generally in Cleveland Bay are characterised as "slightly gravelly, muddy sand" and have a high content of fine fraction (silts and clay) material (Cruz Motta 2000). The soft, surface sediments are variable and are thought to arise from tidal and seasonal movement of the seabed sediments.

Study and characterisation of marine sediments have been undertaken many times in the history of the Port of Townsville. Every five years a SAP is implemented to assess sediments against the NAGD 2009 for approval for unconfined sea placement by DAWE and the Queensland Government. The Port also undertakes twice-yearly sediment grab sampling to support the findings of the SAP.

Golder Associates in 2008, undertook one study to define the sediments. The following broad material types were identified in the Outer Harbour basin and in the Platypus and Sea Channels:

- A surface layer of recent seabed sediments consisting of a mixture of very soft to soft silty clay to clayey silt with very loose and loose sand to silty sand to clayey sand. Shell fragments and organic materials commonly occur in this layer. The seabed sediments are easily identified by their dark hue and very soft and very loose nature. Preliminary investigations indicate that some of the surface materials are potential acid sulphate soils (PASS) and, due to their soft and compressible nature, are generally unsuitable for use as reclamation fill or as the foundation material for structures.

- A subsurface layer of geologically older stiff to hard clays and sandy clays and medium dense to very dense clayey sands and sands. These materials are much lighter in colour than the seabed sediments. The subsurface material was not identified as PASS and is considered suitable, although not ideal, as reclamation fill.

The surface layer has a thickness of approximately 1m to 1.5m in the Outer Harbour basin. A lesser thickness of the surface layer, typically in the order of 0.5m to 1m occurs in the Platypus and Sea Channels.

Sediment sampling undertaken in early 2017 found (Geochemical Assessments 2017):

- Sediments in the Approach Channels were predominantly muddy with variable sand content and some gravel.
- Sediments in the Outer Harbour were predominantly muds and sandy muds. These sediments overlay clay and densely packed green sands.
- Sediments in the Inner Harbour were predominantly comprised of grey muds, with trace to minor amounts of sand, overlaying green/orange clay or sandy clay.
- Sediment textures in the Ross River, including the TMP, were generally coarser (i.e. gravelly sands) in the up-river sections of the dredge area, and muds and sandy muds near the mouth of the Ross River.

5.1.4 Sediment Sources

Cleveland Bay is located about 50km north of the Burdekin River, about halfway between the Burdekin and Herbert Rivers which provide the dominant sediment supply to the central GBR coast (Belperio 1983; Moss *et al.* 1993). At the coast, bedload sediment (predominantly sand) from these rivers and from the much smaller Houghton and Ross Rivers, moves northwards along the shoreline by long-shore drift processes. During summer floods, suspended loads of mud and fine sand are transported directly onto the inner shelf, where they either accumulate or are adverted back into the tidal mangrove systems which fringe the coastal plain (Belperio 1978 and 1983; Larcombe and Ridd 1994; Larcombe *et al.* 1995). Fabricius *et al.* (2014) demonstrated that river discharges significantly affect marine water clarity in shallow bays of the central GBR region at intra- and inter-annual time scales and that fine river-derived sediments remain available for resuspension for years after floods.

The Cleveland Bay catchment incorporates an area of 1,770km^2 and there are several significant watercourses (Table 4) discharging storm and surface water into Cleveland Bay and supplying some sediment to the beach system and further offshore during floods. The main watercourses, all of which influence Cleveland Bay locally, include:

- Ross River;
- Ross Creek;
- Three Mile Creek;

- Captains Creek;
- Sandfly Creek;
- Alligator Creek;
- Crocodile Creek; and
- Cocoa Creek.

Table 4: Drains and Creeks Discharging to Cleveland Bay (TCC Stormwater GIS Layer)

Cleveland Bay Section	Creeks	Drains
Rowes Bay / Pallarenda	2	12
The Strand	0	12
East of Port to Cape Cleveland	12	-
Ross River / Ross Creek	-	131
Magnetic Island	9	12

The Ross River discharges fine sediment next to the Port and the natural sediment transport processes in Cleveland Bay do allow some of this sediment supply to be transported around the Port and deposited in the Platypus Channel. However, sediment trapping by Ross River dam and other weirs, as well as the relatively small catchment size, limits the significance of this load when compared to the overall nearshore sediment transport which is supplied regionally by Burdekin River (BMT WBM 2018).

5.1.5 Natural Sand Supply

Much of the land in the Cleveland Bay catchment has been cleared or modified of its remnant vegetation (GBRMPA 2014). The sediment yield of Ross River has been estimated at 330,000t/y (Belperio 1983), but this amount fluctuates depending upon climatic conditions and input sources. Changes in catchment drainage due to urbanisation and agriculture may lead to an increase in runoff, and in some cases soil erosion (Pringle 1989). It is noted that Ross River is heavily modified, which impacts the amount of material that is discharged into Cleveland Bay. Persson (1997) assessed anthropogenic activities disrupting the natural hydrodynamics and transport of coarse sediments and the related effect on channel morphology and sediment supply to Cleveland Bay. This study found that the Ross River Dam and three downstream weirs have reduced the delivery of coarse sediments to the coast, but the outcome for finer sediments is different, these smaller, more mobile sediments are kept within the suspension zone and pass over the weirs.

The Strand Beach is a manmade beach which can be considered as a "pocket" beach, except that it has an inadequate volume of sand within the headlands to maintain a beach along the full length of its foreshore. The existing alignment of Rowes Bay is in general far from a state of equilibrium, with respect to zero net movements of sand along the beach. In order for these beaches to remain in equilibrium and not undergo long-term erosion, TCC undertakes an ongoing beach monitoring, and sand re-nourishment project to assist in the rehabilitation of beaches along Rowes Bay and Pallarenda.

5.1.6 Chemical Composition

The sediment chemical composition is variable within Cleveland Bay. Calcium carbonate-rich sediments occur in the western section of the bay close to coral reef colonies formed on the fringes of Magnetic Island and Middle Reef, while the central section of the bay is characterised by terrigenous, muddy sand. Sources of terrigenous sediment to the bay include discharges of sediments from local creeks and rivers, as well as sediment inputs from the east coast long-shore drift (e.g. the Burdekin River) from the eastern section of the bay.

Coastal sediments are generally uncontaminated even with the strong industrial and coastal history of Townsville. Some locations may contain detectable hot spots, albeit below published guideline limits under the NAGD 2009. Due to the nature of the soft sediments, there is potential for acid sulphate soils (ASS) if oxidised. Results from the Port's long-term marine sediment monitoring indicate that the more industrialised areas of Ross Creek, the Port, and Ross River show higher levels of contaminants than the surrounding bay, with Ross Creek, in particular, being an upstream diffuse source of contaminants (Port 2014).

5.1.7 Sources of Contaminants to Water and Sediment

Water quality in the bay is the result of a number of factors, particular the source of incoming waters, which include: the chemical and physical characteristics of historic contamination of water bodies, stormwater discharge and runoff from the wider catchment, groundwater impacts, as well as product handling operations and accidental spillage (both at the Port of Townsville, and from urban and industry inputs upstream of the bay). Townsville is a long-established township with a history of urbanisation and industrial activities in the Ross River and Ross Creek drainage systems.

Contaminants liberated by industrial activities may be transported by stormwater to the end of the catchment, port areas and Cleveland Bay, particularly during the wet season. Areas of potential contaminants in Townsville include refineries, manufacturing and repair facilities, old rail sidings, industrial areas, and urban inputs (including roads). Multiple industrial sites are licensed to discharge waste streams into Cleveland Bay east of Ross River (refineries, sewage treatment plant, meatworks etc.), and several landfills (both operating and rehabilitated) are also present in the Ross River catchment.

All material required to be removed as part of maintenance dredging is tested in accordance with the NAGD 2009. This document is a federal document that is also utilised by State regulators. Material approved for sea placement is placed in an approved DMPA as depicted in Figure 9; other material that cannot be placed at sea is placed on land (Figure 10).

5.1.8 Volumes and Changes in Quality (Over Time)

The volume of maintenance dredging has increased very little since 1988, Table 5 shows the list of dredging approvals granted to the Port since 1988 (including capital and maintenance dredging). The material quality has not changed, only material that has been fully assessed against the NAGD 2009 and approved for sea placement via the SAP from DAWE and the Queensland Government is placed at sea.

An increase in maintenance dredge volumes is predicted for when the PEP staged projects are completed and require maintenance dredging. The predicted volumes also account for the sand removed from the Ross River Channel. Although this material meets the NAGD 2009, this material has traditionally been brought to land (used in some TMP reclamation), as land for onshore placement has become restricted, this material may require sea placement. This material (~140,000m^3 every three years) has now been included in sea placement volumes (Table 6).

Table 5: Commonwealth Dredging Approvals since 1988, for Both Maintenance and Capital Dredging

Permit number	Volume approved for Sea Placement (cubic metres)	Type	Duration
SD2018/3942 23/05/2019	3,700,000m^3 (plus 350,000m^3 cyclone contingency)	Maintenance	6 years
Extension 03/04/2018 SD2016/3322 09/08/2016	Addition of 150,000m^3 1,075,000m^3	Maintenance	12 months 20 months
SD2015/2982 03/08/2015	600,000m^3 (plus 100,00m^3 cyclone contingency)	Maintenance	1 year
SD2012/2223 05/09/2014	600,000m^3 (plus 100,00m^3 cyclone contingency)	Maintenance	1 year
SD2011/1944 30/11/2011	1,303,000m^3	Capital Berth 12	5 years
SD2011/2042 29/09/2011	548,000m^3	Capital Navigational Channels	5 years
SD2011/1943 14/06/2011	96,000m^3	Capital Berths 8 and 10	5 years
3rd Extension 28/03/2013 2nd Extension 19/12/2012 Extension 28/09/2012 SD2007/0602 09/10/2007	2,750,000m^3	Maintenance	3 months 4 months 1 month 5 years
12/12/2002	236,380m^3	Maintenance Inner Harbour Only	1 year
2nd Extension 19/10/2006 Extension 17/02/2006 23/02/2001	3,500,000m^3	Maintenance	1 month 8 months 5 years
12/04/1999	118,000m^3	Maintenance Ross River, Outer Harbour, Berth 11	1 year
Extension 30/05/1997 31/05/2000	500,000m^3 annually	Maintenance	3 months 3 years
31/05/1996	500,000m^3	Maintenance	1 year
24/02/1995	500,000m^3	Maintenance	1 year
21/10/1992	940,000m^3	Capital & Maintenance	1 year
30/04/1990	450,000 tonnes	Maintenance	1 year
31/05/1988	350,000 tonnes & 53,000 tonnes annually	Maintenance	1 year & 3 years

Table 6: Historic and Predicted Maintenance Dredging Volumes (Historic 2007-2018, Predicted 2019-2028)

Year	Historic Volume (m^3)	Year	Predicted Volume (m^3)
2007	117,454		
2008	338,050		
2009	612,284	2019	600,000
2010	55,300	2020	750,000
2011	809,135	2021	550,000
2012	424,950	2022	550,000
2013	369,684	2023	700,000
2014	516,060	2024	550,000
2015	700,000	2025	550,000
2016	353,925	2026	700,000
2017	487,750	2027	550,000
2018	380,000	2028	550,000
Historic volume 5,164,592m^3		**Predicted 10-year volume 6,050,000m^3**	

Noting that between 2007 and 2018 a total of 5,225,000m^3 of maintenance material was approved under four separate sea placement approvals (including four approval extensions), with 5,164,592m^3 of maintenance material being placed at sea. These volumes do not include historic volumes dredged from the Ross River. This material historically has been placed on land.

5.2 Minimisation of Sediment Accumulation and Dredging Needs

Cleveland Bay is 25km wide between the tips of Cape Cleveland and Cape Pallarenda, and 22km long, between the tip of Magnetic Island and land just east of the Ross River (furthest point of land from the outer edge of the bay). The Port maintains two channels for safe navigation of vessels entering and exiting the Port. These two channels are 13km in total length (the Platypus Channel joins the Sea Channel) and are positioned to maximise the use of deep water, this path is the shortest path to deeper water at the edge of the bay.

Sediments that enter the bay, either move in from the south via long-shore drift or are naturally resuspended by the environmental conditions of the bay. A number of studies have been undertaken in regard to reducing the sediment build-up in the channels, as well as in the Outer and Inner Harbours, including for the PEP EIS. The PEP Harbour design was based on both engineering and environmental requirements, including maintenance dredging.

Maintenance dredging relocates sediments which has settled in port infrastructure to the DMPA, which is also situated within the active coastal sedimentary system. This maintains ongoing transport of sediment along natural sediment pathways, with maintenance dredge material gradually re-assimilating into the ambient coastal system from which it originated (BMT WBM 2018).

Minimising sediment from building up within the two channels could only effectively be achieved by installing a permanent sediment barrier, similar to a rock breakwater wall. This would need to run from the Outer Harbour out to beyond port limits; which is not a feasible outcome. Port of Townsville has a narrow approach channel and PEP has a tapered channel to minimise dredge volumes.

The Port has investigated a number of Dynamic Under Keel Clearance Systems (DUKC) similar to that currently used at the Port of Brisbane. The DUKC system is a real-time aid to navigation program that aims to provide up to date channel depths, maximum drafts and tidal windows and can result in a reduction in maintenance dredging.

5.3 Maintenance Dredging and Placement Requirements

The Port is expecting to dredge approximately 6,050,000m^3 over the next 10 years (1 January 2019 to 1 January 2029) at the Port of Townsville. These volumes are the maximum estimates expected and are dependent on climatic conditions, infrastructure priorities of each year as well as the dredge availability and scheduling. Each campaign's indicative volume is estimated in Table 7, however, annual volumes may vary (increase or decrease) in any given year in response to all external factors. However, the total volume of 6,050,000m^3 is unlikely to change.

Table 7: Maintenance Dredge Schedule – Sea Placement 10-year Plan

Year	Maintenance Volume		DMPA	
			Placement in DMPA within Port Limits	Placement in DMPA outside of Port Limits
2019	600,000		300,000	300,000
2020	750,000	Ross River	300,000	450,000
2021	550,000		300,000	250,000
2022	550,000		300,000	250,000
2023	700,000	Ross River	300,000	400,000
2024	550,000		300,000	250,000
2025	550,000		300,000	250,000
2026	700,000	Ross River	300,000	400,000
2027	550,000		300,000	250,000
2028	550,000		300,000	250,000
Total volume required over 10 years = 6,050,000m3			**3,000,000**	**3,050,000**

**See Figure 3 for Port Limits boundary line over the DMPA.*

The volumes listed above include a number of staged projects that will roll over into maintenance dredging as they come online over the next 10 years. They also include dredging the entrance channel of the Ross River, which is currently dredged every three years at approximately 140,000m^3. However, this schedule may change depending on requirements/priorities of the river, and potential reuse of this sand. Noting that in the three separate years that the Ross River is proposed to be dredged, there will be two different dredges in operation – by way of ~140,000m^3 from the Ross River generally dredged using a cutter suction dredge, whereas the majority of all other material will be dredged using a TSHD.

5.3.1 Contingencies

Due to its location in the tropics, the Port of Townsville also requires a contingency volume to enable reestablishment and safe operation of port infrastructure, after a cyclone or extreme weather event has passed through/near the region. Cyclones can have either a direct or indirect impact on sediment volumes within Cleveland Bay.

Cyclones that have a direct impact on the bay do so through storm surge, wind, increased wave energy and rain; as experienced by Tropical Cyclone Yasi in 2011. Tropical Cyclone Yasi crossed the Queensland coastline at Mission Beach as a severe Category 5 cyclone; despite the distance to the eye, Cleveland Bay was still heavily impacted by the cyclone - given the size of the storm. The wind and rain generated by this cyclone increased the sediment volume in the bay within days. Tropical Cyclone Yasi added 350,000m^3 back into port infrastructure, primarily the channels and around the Outer Harbour.

Cyclones that indirectly impact the bay are those that impact an area of the coastline south of Cleveland Bay generating an increase in the long-shore drift volumes. The extreme weather events in 2011 increased the sediment load of the long-shore drift, with increased volumes reaching the bay two years after. Tropical Cyclone Debbie hit the Burdekin/Whitsunday/Mackay coast in March 2017, the sediment input created by this cyclone has yet to reach the Port of Townsville, this long-shore drift is expected to bring upwards of 200,000m^3 into the bay in 2019/2020.

As the intensity and frequency of tropical cyclones are predicted to increase over the coming years, the Port is allowing for at least one Tropical Cyclone to directly impact port infrastructure over the coming 10 years. The predicted volumes as shown in Tables 6 and 7 do not account for cyclone contingencies, as these are unpredictable, and could occur on any year. Adding any contingency volumes to these numbers would only artificially inflate the volumes. Therefore, a 350,000m^3 cyclone contingency volume will sit outside of the stated maintenance dredging volumes, to only be used in the event of a cyclone impacting upon port infrastructure, in areas approved at the time, for unconfined sea placement.

5.3.2 Contingency Planning

Following an extreme weather event that has the potential to remobilise large volumes of sediment in Cleveland Bay, the Port undertakes bathymetric surveys to assess the depths of each area of port infrastructure. These surveys will determine the impact the event has had and the volume of material (if required) to be removed to reinstate declared depths back to be the pre-event declaration. Previous experience with sediment mobilised by strong winds and waves generated by extreme weather events (e.g.

cyclones), indicates that the most material infilling of maintenance dredge areas will occur in the Outer Harbour and the Platypus Channel; as well as the Ross River Channel if major flooding occurs.

On the basis of these surveys and in consultation with the Regional Harbour Master, the Port may be required to undertake emergency maintenance dredging to allow vessels access back into various areas of port infrastructure. The Port has included a contingency volume (350,000m^3) into this Plan, for the purposes of emergency dredging and sea placement activities, which may be required following an extreme weather event (cyclone or flood event). This volume is based on the approximate volume of material deposited in the Outer Harbour and navigational channels during previous cyclones (i.e. Tropical Cyclones Yasi and Althea).

To meet legal obligations under State legislation (*Transport Infrastructure Act 1994*), the Port requires certainty that it can rapidly resume effective operations of the Port after being impacted by an extreme weather event. To do this, the Port also needs to ensure sediment quality is suitable for sea placement. The potential for contaminants at concentrations exceeding the NAGD 2009 to accumulate in maintenance dredge areas, (that are currently approved for unconfined sea placement) during an extreme weather event is considered low, as:

- Potential contaminant sources (including current DES licensed discharges, DES listed contaminated lands) are minor for Cleveland Bay compared to the amount of material being remobilised during a major cyclonic/weather event.
- The risk of flood waters mobilising contaminants not included in the approved SAP, is low. This is based on the known input areas both in and around Cleveland Bay. The majority of Townsville's industrial area is within the Bohle River catchment which discharges into Halifax Bay (to the north-west of Cleveland Bay); agriculture consists mostly of cattle grazing, again which discharges to Halifax and Bowling Green Bays (north and south respectively of Cleveland Bay); leaving mostly urban inputs to the Ross River and Ross Creek systems.
- During major flood events, any potential contaminants in the catchment, generally mobilise during the 'first flush.' However, they would be substantially mixed and diluted by the large quantities of freshwater flowing out of the river and dispersing throughout and across the whole of the bay via the flood plume.

Consultation with both the Queensland Government, and the Cth Government would occur in the event emergency maintenance dredging and the contingency volume is needed.

5.4 Examination of Reuse, Recycle and Disposal Options

The *1996 Protocol to the London Convention* requires consideration of alternative methods of dealing with waste, (the convention's definition includes dredge material). The Port gives due consideration to alternatives to sea placement, to ensure that the placement of dredge material has environmentally sound outcomes. Alternative placement and beneficial reuse options have been investigated and assessed in a number of internal and external studies undertaken over the last 20 years. The most recent being an external investigation undertaken by SKM (2013), on behalf of the GBRMPA, although it has also been reviewed for the PEP EIS (compiled by AECOM in 2009) and again reviewed in 2015 /2016 for the Additional Environmental Impact Statement (AEIS).

Alternative options for maintenance dredge material are primarily dictated by the sediment characteristics and dredging methodologies. The choice of dredge methodology is dictated by the scale of the operation, nature of the materials to be dredged, and other constraints that may reduce accessibility - such as limited water depths and dredging in operational port channels. The economic feasibility of options can also impact on their viability.

Maintenance dredge material at the Port of Townsville is usually dominated by the silt fraction, and therefore, there are fewer options than the coarser material that is found during capital dredging works.

The Port has considered the following options:

- Beneficial reuse – placement on land / reclamation
- Beneficial reuse – offsite recycling
- Beneficial reuse – treatment of sediments
- Beneficial reuse – beach re-nourishment
- Beneficial reuse – habitat restoration
- Beneficial reuse – disposal / capping at landfills

5.4.1 Beneficial Reuse – Placement on Land / Reclamation

The main alternative strategy to the placement of the dredge material at sea is placement on land. Historically, (since inception in 1864), the Port has reclaimed large areas of land using dredge material, with the majority of the current Port being built on reclaimed land. In the late 1970s to early 1980s, this resulted in the establishment of the East Port Area (100ha), which has been available for dredge material placement since that time. Currently, the Port utilises two land-based DMPAs, namely the East Port Area which includes designated dredge ponds, and the TMP, both of which are located on Port land.

Existing land placement options are limited with no new suitable available port-owned land. The East Port area is nearing capacity, and preference for land placement of material potentially exceeding NAGD 2009 has been implemented for the last 15 years, as a good environmental practice measure by the Port. Currently, there is approximately 210,000m^3 capacity (allowing for space to dewater) if no additional action is taken. Given legislative changes, particularly the introduction of the *Sustainable Ports Development Act 2015*, capacity needs to be prioritised to ensure all capital dredge material is brought to land.

The CU Project (as part of the PEP) will bring to land all capital dredge materials. The reclamation area at the end of Stage 3 (of the PEP), will comprise of 152ha, filled by capital dredge material, exhausting all capacity for annual maintenance dredge material. It must be noted that both PEP and CU capital works are not part of this LTMDMP. PEP has been approved via the EIS process, and CU is seeking their own tidal works applications as part of that project. This LTMDMP does, however, consider and include the maintenance material generated after CU has come online, as this will be within the 10-year period of this plan.

On average, the Port places approx. 10% of its maintenance dredging volume on land each year (including material that does and does not meet the NAGD 2009). However, to meet legislative changes made in 2015 to capital dredge placement, this maintenance dredge volume is likely to decrease for land placement, as it is necessary to give priority to land placement of capital dredge material. Maintenance dredge material that is currently brought to land that meets the NAGD 2009, will now most likely be placed at sea due to the limitation of land availability.

A range of factors come into consideration for placement on land, including the availability of suitable land, the size of the available land, tailwater management, ASS/PASS, and the management techniques and options, including transport of material to site, dewatering, handling and then the transport of material offsite, or long-term management onsite.

The Port does not currently hold approvals for the establishment of a new land placement area, nor does it own suitable lands. Current land space is limited in close proximity to the Port, and any land that is close by is of insufficient capacity to cater for the annual volume of maintenance dredge material involved, other than the Townsville State Development Area, which is in a range of different ownerships. Any utilisation of this land may not be achievable within the scope of this 10-year plan.

Costs associated with handling this material on land are approximately 2-3 times higher than the cost of sea placement if an already established land placement area is used. These costs can rise by approximately 8 times if a new land placement area is to be developed. These costs include the purchase of the land, earthworks to construct settling ponds, the running of transport of material to site, and equipment needed to handle the material, once onsite. Then there are costs for tailwater management and potential water treatment, costs to dewater and store the material, costs for ASS/PASS treatment, and, costs for relocation of material offsite (once its been de-watered). Any of these additional costs would increase the cost of production and operations not only for the Port but for all companies operating out of the facility. These costs would be passed on to the consumer in order to maintain an effective port facility.

The report written by SKM in 2013, commissioned by the GBRMPA was part of a response to the World Heritage Committee's request to Australia to undertake a strategic assessment. With the primary aim of determining the likely impact of actions on MNES, as defined by the EPBC, the effectiveness of existing management arrangements, and the need for improved management strategies (SKM 2013).

SKM (2013) determined that for the Port of Townsville, reclamation is the primary option that could feasibly be considered for land-based placement of dredge material. Other land-based options are highly constrained due to a lack of available land and due to the nature of sediments to be dredged, which is unsuitable for beach re-nourishment or construction purposes.

5.4.2 Beneficial Reuse – Offsite Recycling

The Port aims to reuse dredge material wherever possible. However, the potential for reuse is primarily associated with coarser materials, i.e. sands are predominantly used for reclamation of land for infrastructure projects. The maintenance dredge material consists of muds, and silty sands to fine-grained sands, minor medium to coarse-grained sands and stiff clays. The beneficial reuse possibilities for maintenance material as offsite fill/construction material, or for use in soil products are limited primarily due to the material's low strength, high compressibility, salt content, and poor drainage characteristics when dredged and placed on land.

The characteristics of the maintenance material sediments (i.e. high fines content) make the material unsuitable for use as fill or other purposes. Most commercially available topsoils comprise of at least 70% to 80% sand by weight for adequate drainage requirements. The maintenance material the Port dredges from the majority of its maintenance areas would require blending with additional large quantities of sand, in order to be used as a soil product, e.g. topsoil. Consequently, for every 1.0m^3 of dredge material, around 3-4m^3 of clean sand would need to be blended with the dredge material, depending upon the density of the dredge material and sand. This would require between 2,400,000m^3 and 3,000,000m^3 of combined material to be relocated offsite annually, after a 600,000m^3 maintenance dredging campaign. The high salt water content of the dredge material also complicates its beneficial reuse possibilities; it requires dewatering operations and salt extraction treatment in the form of stockpiling for at least one wet season to reduce the salt levels; or would require a significant volume of freshwater. Using freshwater is a significant limitation to this process given the limited supply of water in Townsville. As the Port is located in the dry tropics, this option is unviable.

The costs associated for the treatment of this material would be significant, including the need for an extensive irrigation system to salt leach; as well as treating the significantly large volume of ASS/PASS.

Any beneficial reuse of maintenance dredge material needs to have the material dewatered first. Dewatering has its own problems. The availability of space to receive and dewater maintenance dredge material on/near port land is limited, making tailwater management difficult onsite. Historically land at the Port of Townsville has been used to dewater third party dredge material, before being removed by the third party, offsite. This process has now ceased given the limited land available.

TCC has raised concerns regarding the amount of potable water that would be required for extensive irrigation purposes in salt leaching, if this option was chosen, particularly given the history of water restrictions and limited rainfall in Townsville.

The Port has limited ability to treat, or cope with, the volumes of dredge material and dewatering issues involved with the reuse of dredge material for broad range applications (building purposes, bricks, etc.). The reused/recycled dredge material is generally of lower quality to existing onshore supplies for these materials, in comparison to other products already available in the Townsville area. The reuse/recycled dredge material is also economically unviable and would trigger amendments to the Port's existing EAs; it would also trigger royalty charges to legally move the treated material offsite, and resolution of commercial competition with the local quarries be undertaken. This all further adds to its economic disadvantage.

The movement of large volumes of dredge material for beneficial reuse, particularly at distant mine sites, would require extensive transport capabilities either by truck or rail on both ends of the system. For example: to move dredge material from a 600,000m^3 dredging campaign off port lands, would require approx. 40,000 'B-double' truck movements each way to meet road and safety legislation. This equates to approximately 109 trucks heading into and out of the Port each and every day, 365 days a year.

This would not only add considerably to the costs of dredging but would also increase the amount of greenhouse gas emissions from truck exhausts being released into the environment; it would cause an adverse economic impact on road infrastructure; increasing heavy trucking volumes and associated road safety impacts, and amenity impacts, which would all adversely impact on the health and safety of motorists travelling on the same routes; and increase noise pollution to surrounding business and residents with the increase in truck breaking/engine reeving as they enter and exit the Port.

Significant environmental considerations at the placement site would also need to be assessed and managed, to ensure there were no unforeseen environmental impacts by placing maintenance dredge material at the selected site.

5.4.3 Beneficial Reuse – Treatment of Sediment

As the amount of land available to receive dredge material becomes restricted, the Port has increasingly focused on bringing to land dredge material that is not suitable for ocean placement, for it to be appropriately managed. Methods to destroy, reduce or remove contaminants in maintenance dredge material is not necessarily an issue for the Port as contaminant concentrations are substantially below relevant guideline values for reuse on land, with the exception of ASS/PASS issues, and salinity.

The proportion of dredge material most useful for reuse is the sand fraction, which can be used in construction and beach re-nourishment projects. The proportion of sand in the soft, unconsolidated sediment proposed for maintenance dredging is small (estimated from bore logs to be less than 10% by weight). Therefore, this poses practical and economical challenges to physically separate fine and coarse-grained sediment. This would also result in a large quantity of fine-grained sediment with poor geotechnical capabilities and reduced self-buffering capacities for ASS considerations, which would remain onsite to be dealt with separately; meaning this increases the risk profile of material that remains on port lands.

5.4.4 Beneficial Reuse – Beach Re-nourishment

Beach re-nourishment is another possible beneficial reuse of dredge material. The high fines content of the maintenance dredge areas at the Port renders most of the proposed dredge material unsuitable for beach re-nourishment. The majority of the maintenance dredge material would not be stable under a moderate wave climate typical of the shallow waters of Cleveland Bay. In Townsville, TCC has State-imposed requirements on local beach re-nourishment approvals, as to the allowable grain size of material used for beach re-nourishment - to prevent erosion (particularly for the Strand and Rowes Bay Beaches). In the case of the Strand Beach, this is due to it being a completely man-made construction.

Currently, only a limited component of the maintenance dredge material meets the State's specific grain size requirements/criterion. The sand dredged from the mouth of the Ross River, which is considered to be of good quality, has been supplied to TCC following the 2019 flood event. However, on selling this material introduces complications due to interactions with other local markets (competition), it requires royalties to be paid on its removal from Port lands, and the locations in need of beach re-nourishment are currently being restored by the local council, who source their material from a commercial entity.

5.4.5 Beneficial Reuse – Habitat Restoration

Other possible beneficial reuse of dredge material includes habitat development/restoration and levee maintenance. A common form of habitat development using dredge material is the creation/restoration of tidal wetlands (SFBRWQCB 2000). However, no local habitat construction/rehabilitation projects or levee maintenance projects could be identified in which the dredge material would be beneficially reused. Additional State approvals including royalty payments would be required prior to this being a viable option, which further adds to its economic disadvantage compared to other material.

5.4.6 Beneficial Reuse – Disposal / Capping at Landfills

Rehabilitation and cover at existing landfills is also a possible beneficial reuse of dredge material. Contaminant concentrations in unconsolidated sediment residing in the maintenance dredge areas, are well below acceptable levels for disposal at a landfill and do not require treatment except to neutralise the acid generating capacity of PASS, and the salt content of the material in some cases. Minor amounts of dredge material are currently approved to be placed at a local landfill - Vantassel Street Waste Disposal Site operated by TCC, (State Approval No: ENAQ04313912). However, the Council has indicated that they are not in the position to accept large quantities of maintenance dredge material as it "has no beneficial reuse for landfill application in terms of interim or final capping requirements as a result of its pH and physical characteristics" (TCC 2014).

Key implications for each of the alternatives are shown in Table 8.

5.5 Selected Future Dredging and Placement Strategy

Given the uncertainty of the timing of capital dredging works (PEP), the Port cannot accurately provide predictions on future maintenance dredging requirements beyond the scope of this 10-year plan. The first stage of PEP, CU, will be completed within the life of this document, however, additional stages of PEP are dependent upon supply, demand and funding. As discussed in Section 1.4, the Port also intends to undertake reviews throughout the duration of the lifespan of this document, to ensure any changed circumstances, e.g. additional stages of PEP, are incorporated into revisions of this Plan.

What the Port can predict is the volumes required to maintain those areas of the CU, once they roll over into the maintenance dredging campaigns.

As part of the Section 19 Deed of Agreement, Research and Monitoring Plan with the DAWE, the Port has recently undertaken an investigation into alternative DMPA locations for future consideration. The outcomes of the study are currently being reviewed by the Port and DAWE. This LTMDMP will be updated following completion of the review and related discussions with regulators.

The Port continues to review land placement options and opportunities as new opportunities arise.

Table 8: Key Implications for Each Maintenance Dredging/Placement Alternative

Options		Key Implications: Human Health	Environment	Operational	Cost	Legislative
Not dredging		Increases risk to navigational safety and health of humans on vessels. Reduces cyclone resilience.	Increases greenhouse gases due to reliance on road, rail, and air transport for the movement of products, in order to continue the same level of support to the region.	Results in depth restrictions for vessels due to infilling of the channels, and ultimate cessation of commercial vessels to the Port.	Results in significant loss of revenue for the greater Townsville region, not just for the Port of Townsville. Adversely increases the cost of living in NQ as access to products and fuel decreases. Has significant direct and indirect impacts on employment (port employees, port users and customers, and companies that rely on imports/exports from the Port of Townsville).	Breach of Queensland's *Transport Infrastructure Act 1994.*
Installing sediment barrier devices (permanent hardstand structure), reducing dredge volumes.		Increased risk to navigational safety and health of humans on vessels as a permanent, hard structure, would pose a significant hazard, cutting the bay in half as it followed the Platypus and Sea Channels out to the end of Magnetic Island.	Significant environmental impacts during construction. Significant ongoing impacts by cutting the bay in half. Would significantly change the sedimentation characteristics of the bay. Would significantly impact upon sensitive receptors (permanent destruction). Would act as a barrier for marine fauna – preventing their movement between feeding/life cycle habitats. Would be reclamation by default and would reduce the marine area of the GBRWHA.	Would sit in some of the Anchorages beyond port limits, reducing their availability for vessels. Would need significant maintenance – removing sediment building up (otherwise the bay would become even more shallow), maintenance after severe weather events, maintenance on navigational lighting required the length of the barrier. May not actually prevent sediment build-up and would pose a risk during severe weather events being so close to the channels – the structure may fall into the channels and cause an obstruction to navigation and port operations.	Significant outlay of capital costs for quarry material, to build the wall. Operational costs for maintenance, especially after cyclones/severe weather events would be significant. Would require significant environmental offsets if it could actually be approved by State and Cth governments.	Works may fail to meet the EPBC. Other approvals needed would include those under: - The *Planning Act 2016* (which includes the *Coastal Protection and Management Act 1995, Fisheries Act 1994, Environmental Protection Act 1994).* - The *Environmental Offsets Act 2014.*
Land placement / reclamation (port land)		Increase safety risks due to a large area of waterlogged dredge ponds, and the ongoing management by port employees. Increases in land transport (truck/rail movements) due to the volume of maintenance material that would come to shore, and associated increases in road/rail accidents due to the increase in land transport. Potential dust, noise, and air emission nuisance issues for the neighbouring residents of South Townsville; and increased risk to navigational safety within the bay due to floating pipelines used to transfer maintenance dredge material to shore.	Creates PASS, tailwater management issues and greenhouse gas emissions from increases in plant & equipment. Potentially reduces the marine area of the GBRWHA for any further reclamation, as there is no available land. Does not decrease/change maintenance dredging impacts i.e. water quality, turbidity, disturbance to the seabed, transport and resuspension of contaminants, marine fauna strikes, and underwater noise remain as currently assessed.	Lack of availability of suitable nearby land to treat and store the material. Land is needed for placement of dredge material and to be available for long-term management of the area. Maintenance material on land reduces the available capacity for approved capital DMPAs. Maintenance material has poor engineering qualities, making it not suitability for beneficial reuse without further treatment and stabilisation.	Increases cost of dredging campaign by up to 8 times the current cost. Significant cost of purchasing suitable reclamation areas or new land near the Port, to place, treat and store the material. Significant cost of clearing/preparing that land to ensure it is suitable to take the proposed material. Significant cost of treating the maintenance material for PASS/ASS to ensure no further environmental impacts are created.	The Port would need approvals under: - The *Planning Act 2016* (which includes the *Coastal Protection and Management Act 1995, Fisheries Act 1994, Environmental Protection Act1994).* - The *Environmental Offsets Act 2014.* - Potential assessment under the EPBC depending on location. The Port would also need Land Owners Consent from DNRME.
Beneficial reuse (i.e. on or offsite recycling for construction, fill, products, etc.)	**With treatment**	Limited risk due to low contaminant concentrations. Increase in potential noise due to a mid-scale processing plant for onsite recycling. Risks for land placement include: - Navigation risk - long floating pipelines required to bring material to shore.	Creates PASS, salt content, tailwater management issues and greenhouse gas emissions from plant & equipment. Does not decrease/change the maintenance dredging impacts and remain as currently assessed.	Land is needed for placement of dredge material, for treatment to address poor engineering qualities of the material before it can be reused/recycled into a usable by-product. Contaminant treatment not required as concentrations below land-based acceptance levels. ASS/PASS and salinity treatment needed before beneficial reuse could be an option.	Increases cost for treatment, and treated material remains uneconomic compared to existing onshore supplies in the region. Onsite processing is cost prohibitive to start-up and can be cost prohibitive for ongoing operational/maintenance costs. Cost for royalties that may still be required to be paid on end-product (once maintenance dredge material has been processed and converted into a viable by-product).	The Port would need approvals under: - The *Planning Act 2016* (which includes the *Coastal Protection and Management Act 1995, Fisheries Act 1994, Environmental Protection Act 1994).* The Port would also need Land Owners Consent from DNRME.

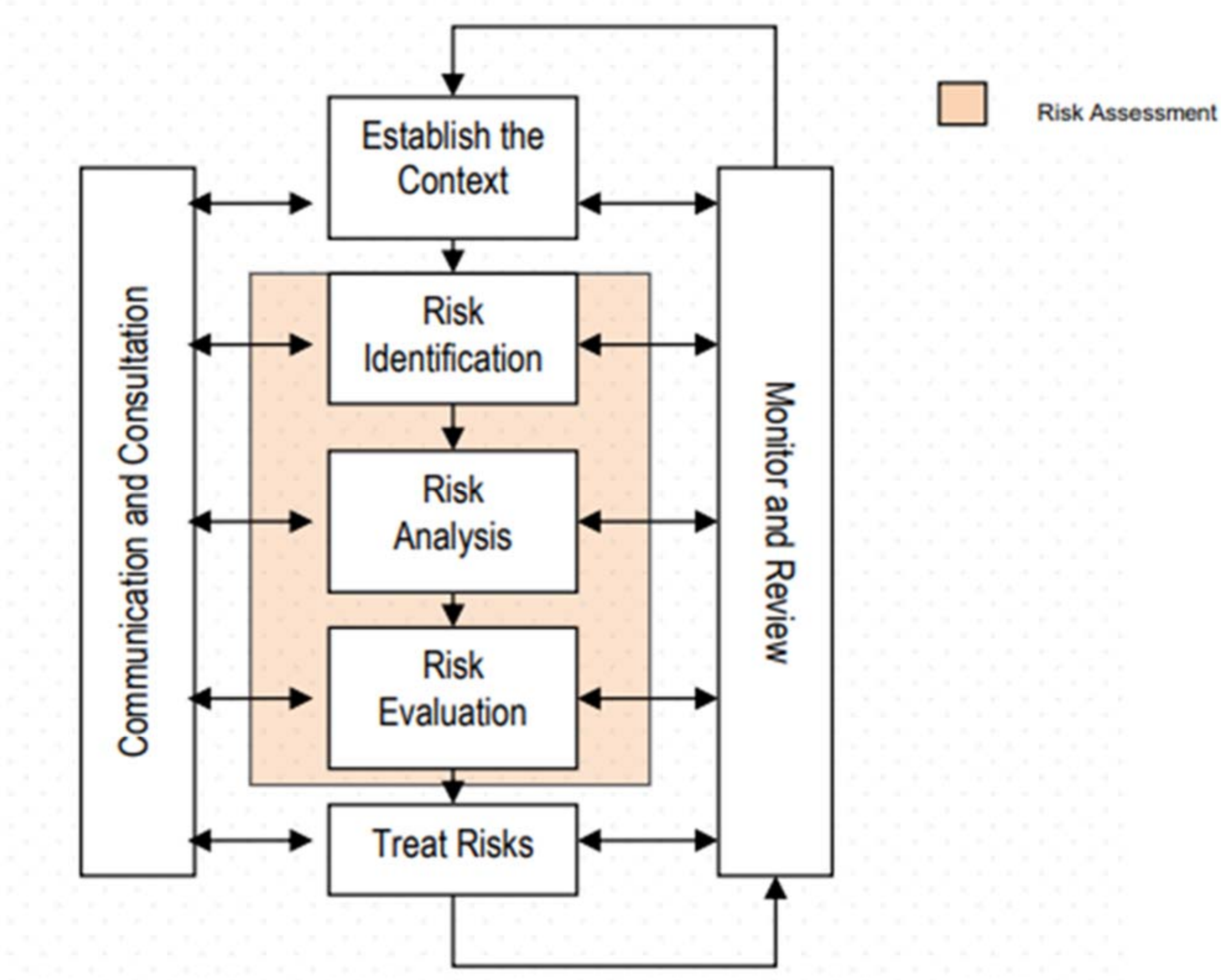
Options		Key Implications: Human Health	Environment	Operational	Cost	Legislative
		- Transport risks – increase in land transport, and increased accident risks. - Dust, noise and air emissions nuisances for the neighbouring residents.		New onsite processing requires new staff and ongoing maintenance of plant.		
	Without treatment			No local project could be identified to take maintenance dredge material, with its poor engineering qualities, ASS/PASS and salinity issues that all require treatment to prevent further impacts to the potential receiving environment/area.	Increase in costs for transportation out of the Townsville region (given no local project could be identified for reuse), cost to pay royalties in removing the material from Port lands. Maintenance dredge material generated at the Port of Townsville is uneconomic to reuse or recycle for construction, fill or any other product compared to existing onshore supplies.	
Beach re-nourishment		Limited risk due to low contaminant concentrations. If the material is barged to an appropriate area, this would create a hazard to navigation due to the volume of barge runs within the bay. Or if the material was bought to land, there would be an increase in land transport (truck/rail movements) to move the material to the designated location. This could then increase road/rail accidents due to the increase in land transport. Increases potential dust, noise, and air emission nuisance issues for neighbouring residents of any area identified for placement.	Creates PASS, salt content, tailwater management issues and greenhouse gas emissions from plant & equipment. Does not decrease/change maintenance dredging impacts, and they remain as currently assessed.	Majority of maintenance material is not suitable as it does not meet Queensland Government's conditions on beach re-nourishment approvals. The Port's maintenance material has poor engineering qualities that requires treatment before reuse and is not stable enough to remain onshore as beach re-nourishment.	Increase in costs for transportation to appropriate beaches, increase the cost to pay royalties in removing the material from Port lands; and it is uneconomic to use this material, given the quality and consistency of material available from other existing onshore supplies within the region. Increase cost or truck/barge movement to move material to the designated site.	Fails to meet requirements of Queensland's *Coastal Protection and Management Act 1995.* Other approvals needed would include those under: - The *Planning Act 2016* (which includes, *Fisheries Act 1994, Environmental Protection Act 1994); and* - Potentially the *Environmental Offsets Act 2014.*
Habitat restoration		Limited risk due to low contaminant concentrations. Increases in land transport (truck/rail movements) due to the volume of maintenance material that would come to shore. This then increases road/rail accidents due to the increase in land transport. Increases potential dust, noise, and air emission nuisance issues for the neighbouring residents of both South Townsville, and the area surrounding any habitat restoration.	Creates PASS, salt content, tailwater management issues and greenhouse gas emissions from plant & equipment. Does not decrease/change maintenance dredging impacts, and they remain as currently assessed.	No local project could be identified that would benefit from the maintenance material generated from Cleveland Bay. Poor engineering qualities of material require treatment before material could be utilised in habitat restoration projects. The material also requires dewatering prior to being moved to the designated site, along with treatment for ASS/PASS and salinity, depending on where habitat restoration may be required.	Increase in costs for transportation to appropriate areas of restoration; increase the cost to pay royalties in removing the material from Port lands; and it is uneconomic to use this material, given the quality and consistency of material available from other existing onshore supplies within the region. Increase in cost to dewater the material and increase cost for truck movements to move the material to the designated site.	The Port would need approvals under: - The *Planning Act 2016* (which includes the *Coastal Protection and Management Act 1995, Fisheries Act 1994, Environmental Protection Act 1994).* Land Owners Consent may also be required from DNRME.
Landfill		Limited risk due to low contaminant concentrations. Increases in land transport (truck/rail movements) due to the volume of maintenance material that would come to shore. This then increases road/rail accidents due to the increase in land transport.	Creates PASS, salt content, tailwater management issues and greenhouse gas emissions from plant & equipment. Does not decrease/change maintenance dredging impacts, and they remain as currently assessed.	Treatment required to address poor engineering qualities of the material. Treatment would also be required for ASS/PASS, salinity and dewatering prior to placement in landfill. Contaminant treatment not required as concentrations below land-based acceptance levels.	Council will not accept the volume of material generated, due to their site volume limitations. Landfill placement also increases cost for treatment, transportation and royalties.	The Port would need approvals under: - The *Planning Act 2016* (which includes the *Coastal Protection and Management Act 1995, Fisheries Act 1994, Environmental Protection Act 1994).*

Options	Key Implications				
	Human Health	Environment	Operational	Cost	Legislative
	Increases potential dust, noise, and air emission nuisance issues for the neighbouring residents.				Land Owners Consent from TCC (and any other local council) for placement at an operating landfill facility.
Sea placement	Limited risk due to low contaminant concentrations. Minor navigational impacts from a TSHD, however, these are considered to be low, as the vessel highly manoeuvrable and scheduling of the Inner Harbour allows for dredging around ships berthing.	Results in limited short and long-term impacts at sea DMPA to water quality, removal of existing habitats, burial and smothering of organisms on the seafloor. Potential dredging impacts remain, including dredge plumes are localised to the source point. Placement in the DMPA is away from sensitive receptors in the bay and >6km from Magnetic Island.	Does not require any additional plant & equipment other than the dredge vessel. The TSHD is a fast, mobile vessel, which limits impacts to normal shipping and port operations.	No costs for treatment and transport beyond the normal running costs. No ongoing management. Significant input into monitoring and testing the associated parameters as required under permit conditions.	The Port need approvals under: - The *Planning Act 2016* (which includes the *Coastal Protection and Management Act 1995, Fisheries Act 1994, Environmental Protection Act 1994);* - Cth's *Environment Protection (Sea Dumping) Act 1981; and* - Landowners consent from DNRME for placement areas.

6 RISK ASSESSMENT FRAMEWORK

The Port is committed to the effective management of risks arising for the environment in which it operates. The Port's Risk Management Policy and Risk Management guidelines are consistent with the International Risk Management Standards (AS/NZ ISO 31000:2009). Figure 17 shows the risk assessment process.

Figure 17: Risk Assessment Process



Under the *Transport Infrastructure Act 1994*, the Port is required to establish, manage and operate efficient port facilities and services. To comply with the *Transport Infrastructure Act 1994,* the Port must maintain navigable areas within the Port's jurisdiction to target operational design depths within the bounds of its approved maintenance areas (i.e. within the existing footprints). This, at the Port of Townsville, means regular maintenance dredging activities are required to remove natural accumulations of sediments within the existing port facilities. The Port undertakes maintenance dredging within:

- Sea Channel (every 1 to 2 years)
- Platypus Channel (annually)
- Outer Harbour (annually)
- Inner Harbour (annually)

- Berths 1, 2, 3, 4, 8, 9, 10, and 11 (annually)
- TMP (only when required, limited sedimentation occurs within the harbour)
- Ross River, including TMP Swing Basin (every 3 years)
- Ross Creek (rarely - only when deemed necessary)

Risks have been assessed initially on the basis of no management controls (inherent risk), then again following the introduction of management controls (residual risk).

Whilst all dredging equipment has been considered in this risk assessment, the risk scores are based on the most impacting dredge plant. For the Port of Townsville, this is the TSHD for plume generation, or a cutter suction dredge for land placement, as it can be assumed that environmental risks for other types of dredge equipment would be less given the location and scale of such activities. This assumption is supported by the finding of modelling of maintenance dredging at the Port of Townsville which has shown that the TSHD generates the most turbidity out of the dredging plant used at the Port of Townsville (in both dredging and sea placement).

Modelling has been undertaken for maintenance dredging at the Port of Townsville, that considered the generation of turbidity in the water column as a result of:

- Turbidity generated by the dredge while operating (hopper overflow and propeller wash) and resuspension of dredge material that has been disturbed by the dredging process;
- Deposition (e.g. sedimentation) of dredged sediment particularly on sensitive receptors; and
- Longer term resuspension of placed material within the DMPA modelled over a 12-month period, in:
    - A representative ‘El Nino’ year (Figures 18 and 19);
    - A representative ‘La Nina’ year (Figures 20 and 21); and
    - A representative ‘Transitional’ year (Figures 22 and 23).

The modelling investigation was undertaken for a 670,000m^3 maintenance dredge program that included dredging in the Sea Channel (closest proximity to the coral) and 12 months re-suspension. The volume of 670,000m^3 is considered to be a worst-case volume, which includes the Dredge returning to Townsville directly after a normal campaign to undertaken emergency works (cyclone sediments).

This modelling incorporated available water quality data from five locations around Cleveland Bay and indicated:

- Impacts from annual maintenance dredging under different periods are predicted to be negligible, with zones of impact restricted to the immediate dredging and placement areas only. The change in turbidity due to dredging at sensitive receptor locations is predicted to remain well within the range of variability in ambient water quality of Cleveland Bay.
- Sensitive ecological receptors in Cleveland Bay, such as seagrass and coral reef habitats along Magnetic Island, are within the ‘zone of influence’ of maintenance dredging (and associated dredge material placement at the approved DMPA), however, they are not predicted to be within any zones of low, moderate or high impact.

- The zones of impact for all climate scenarios indicate a similar small localised 'zone of low impact' within and directly adjacent to the Platypus Channel near the bend in the channel. There are no zones of moderate or high impact predicted anywhere in the model domain.

Table 9 describes the different zones of impact, which relate to Figures 18 to 23 (BMT WBM 2014).

Table 9: Description of Impact Assessment Threshold Values

Zone of Impact	Water quality (Turbidity)	Threshold Value
Zone of Influence	Extent of detectable plumes, with no predicted ecological impacts.	Dredging related turbidity exceeds 0.5 NTU above 50th percentile conditions and 2 NTU above 80th percentile conditions.
Zone of Low Impact	Excess turbidity may push total turbidity beyond natural variation, potentially resulting in sub-lethal impacts to ecological receptors with recovery time of approximately 6 months.	Excess turbidity greater than one standard deviation from the natural background mean for nearshore areas, and two standard deviations for offshore areas.
Zone of Moderate Impact	Excess turbidity likely to push total turbidity beyond natural variation, potentially resulting in sub-lethal impacts to ecological receptors and/or mortality with recovery time up to 24 months.	Excess turbidity greater than two standard deviations from the natural background mean for nearshore areas, and three standard deviations for offshore areas.
Zone of High Impact	Excess turbidity most likely to cause total turbidity to go beyond natural variation, (excluding extreme weather events) potentially resulting in mortality of ecological receptors with recovery greater than 24 months.	Excess turbidity greater than three standard deviations from the natural background mean for nearshore areas, and five standard deviations for offshore areas.

Noting: 20th percentile (low turbidity conditions – low wind and waves); 50th percentile (average conditions); and 80th percentile (high turbidity conditions – moderate to high wind and waves).

Figure 18: El Nino Year – Modelled Zones of Impact for a Typical Dredging Period

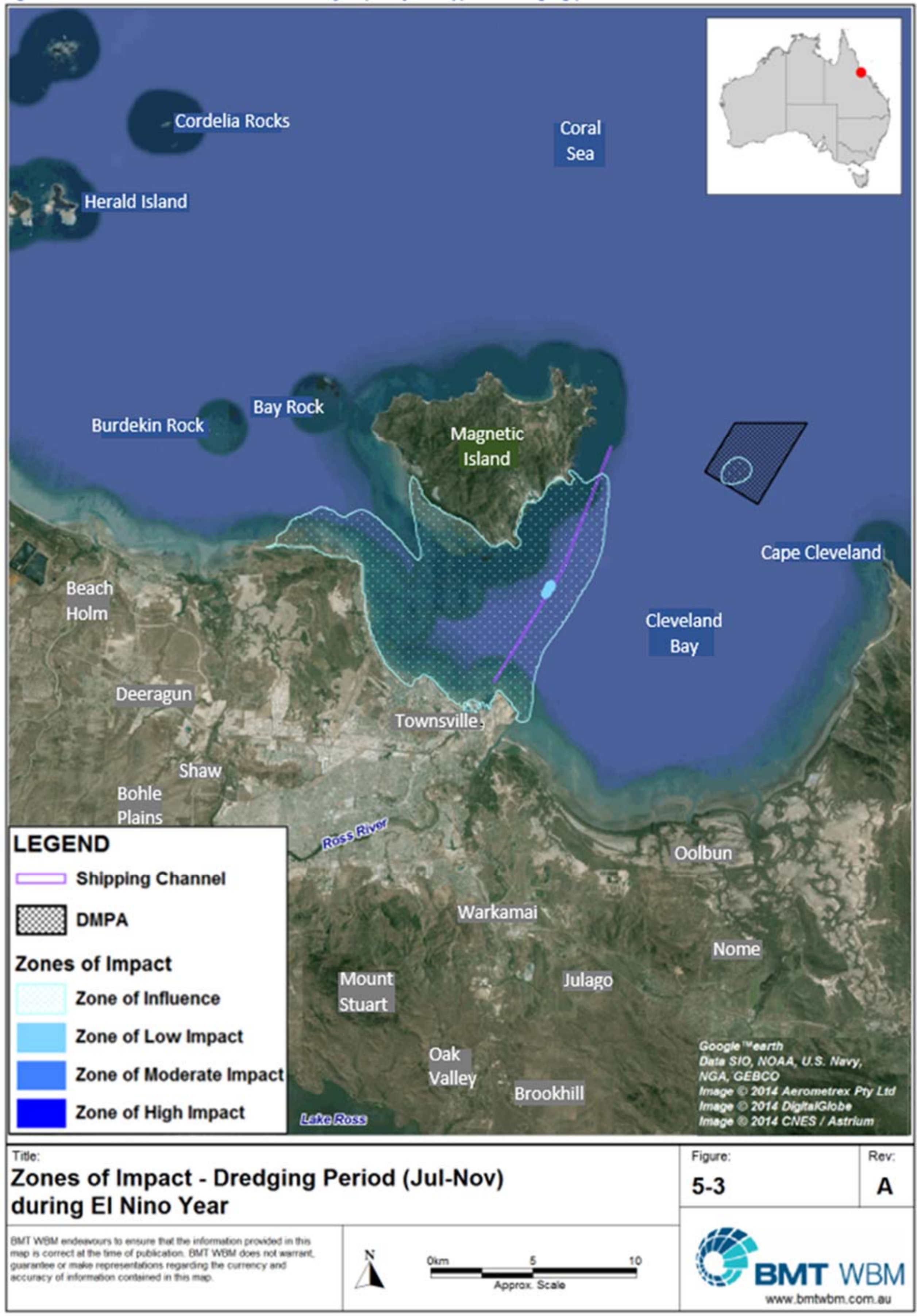


Figure 19: El Nino Year – Modelled Zones of Impact over a 12-month Period

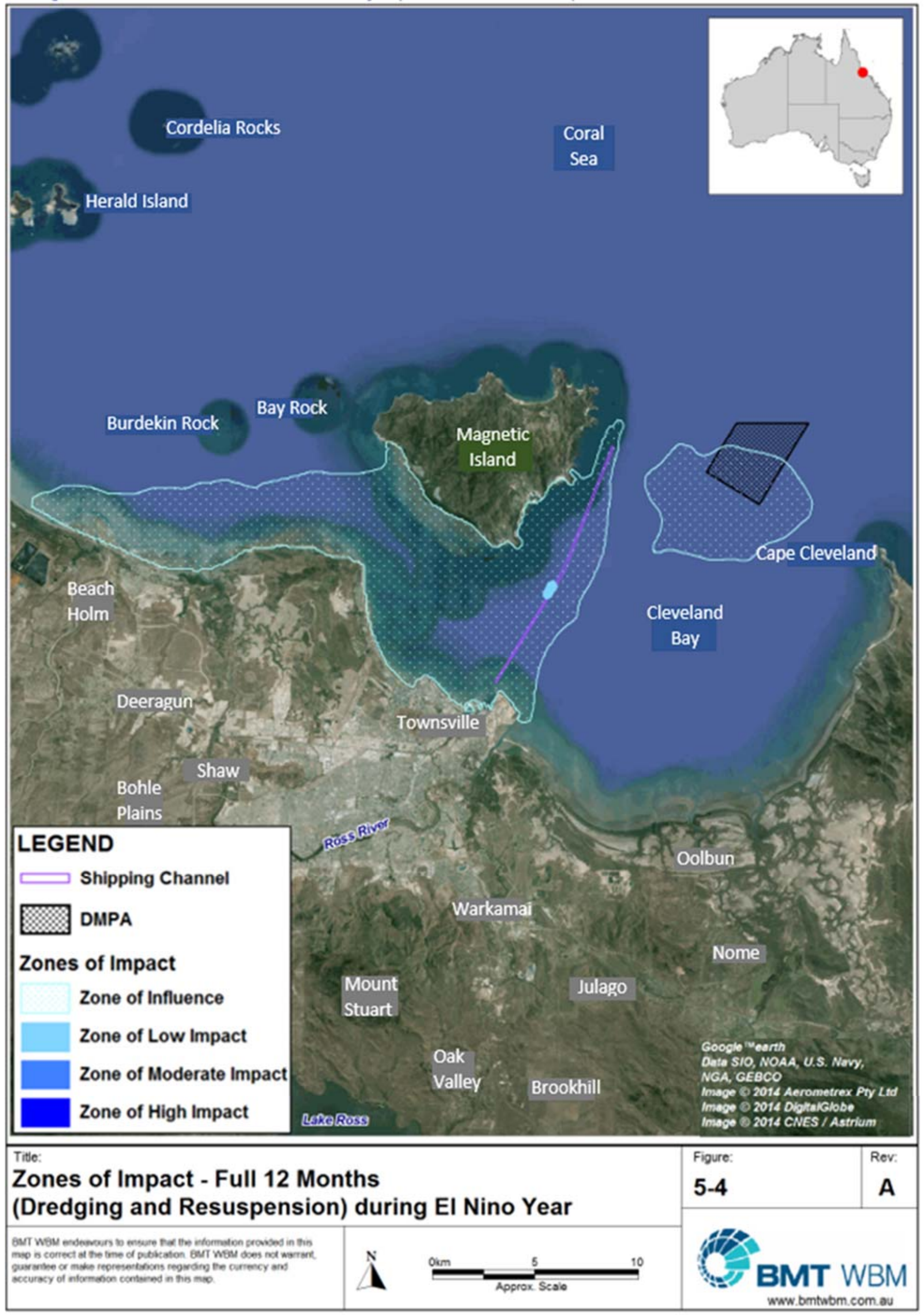


Figure 20: La Nina Year – Modelled Zones of Impact for a Typical Dredging Period

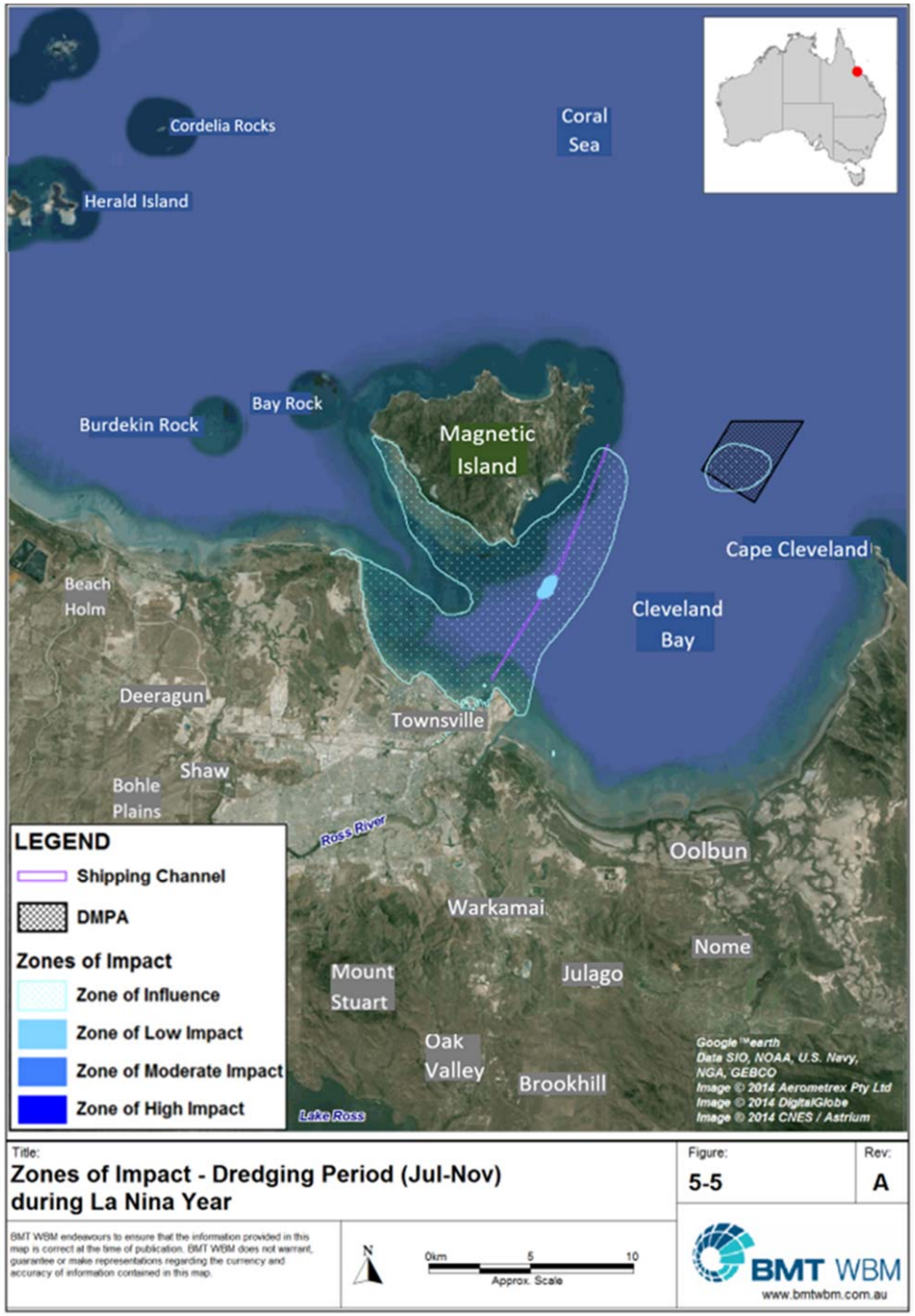


Figure 21: La Nina Year – Modelled Zones of Impact over a 12-month Period

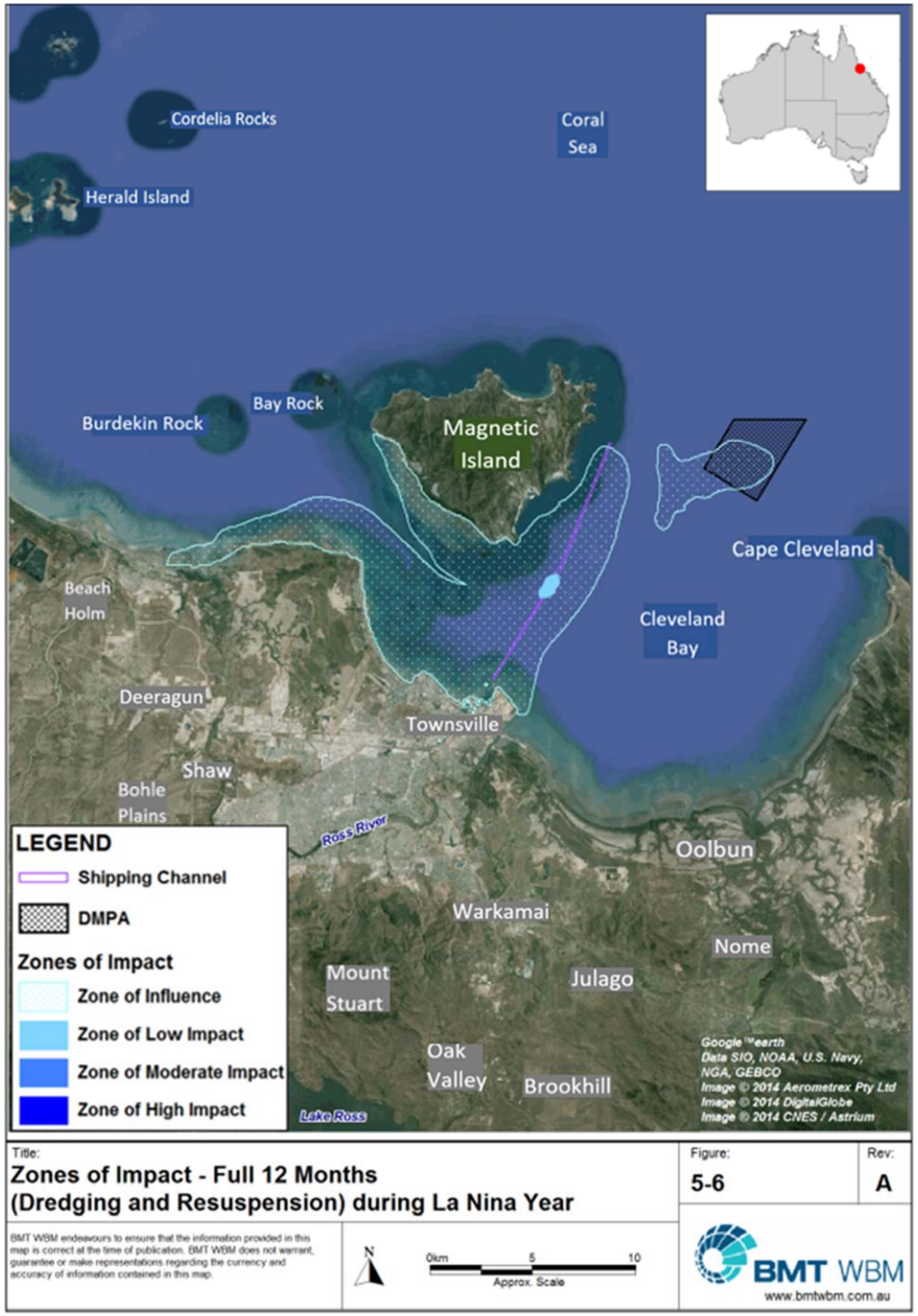


Figure 22: Transitional Year – Modelled Zones of Impact during a Typical Dredging Period

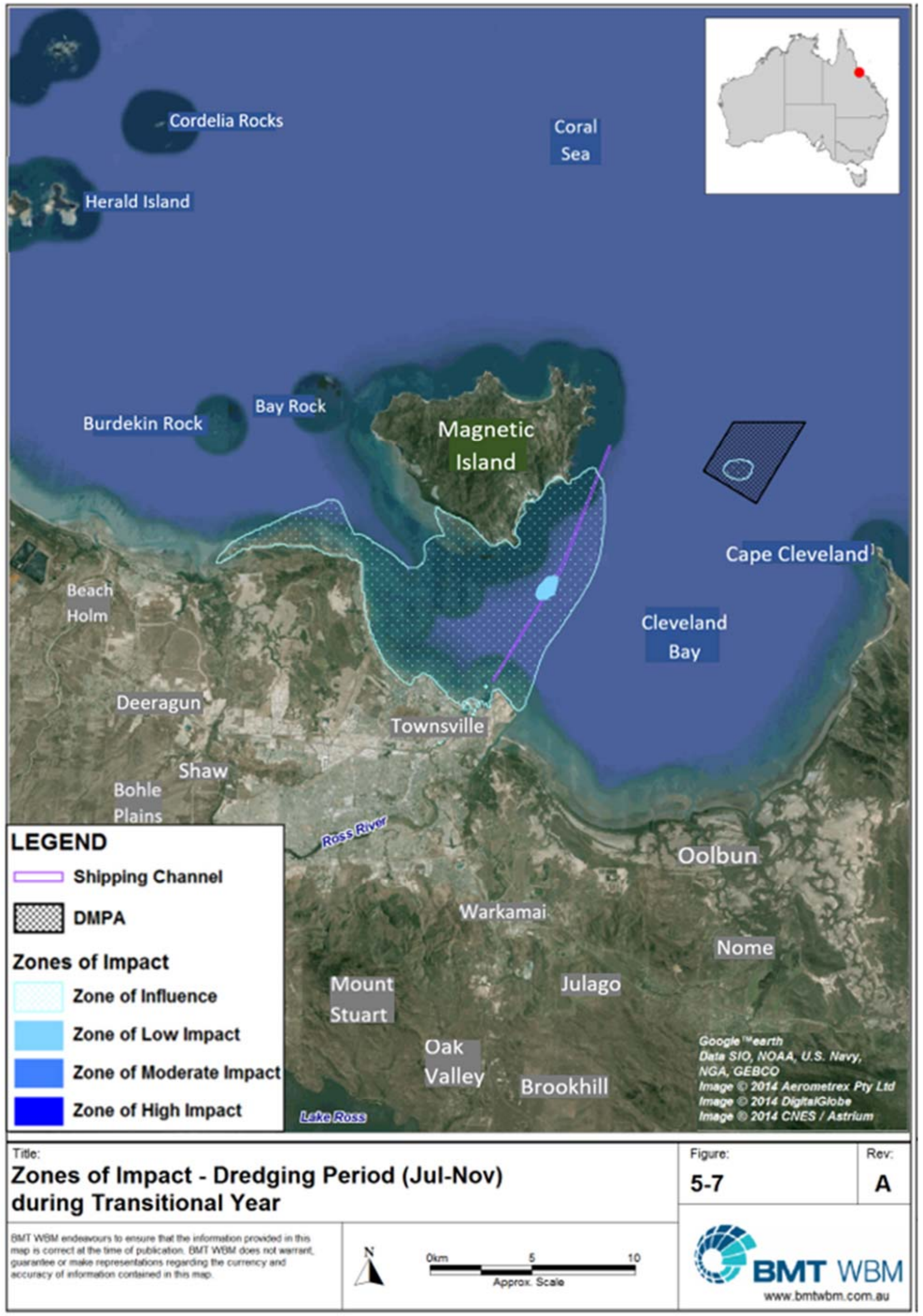
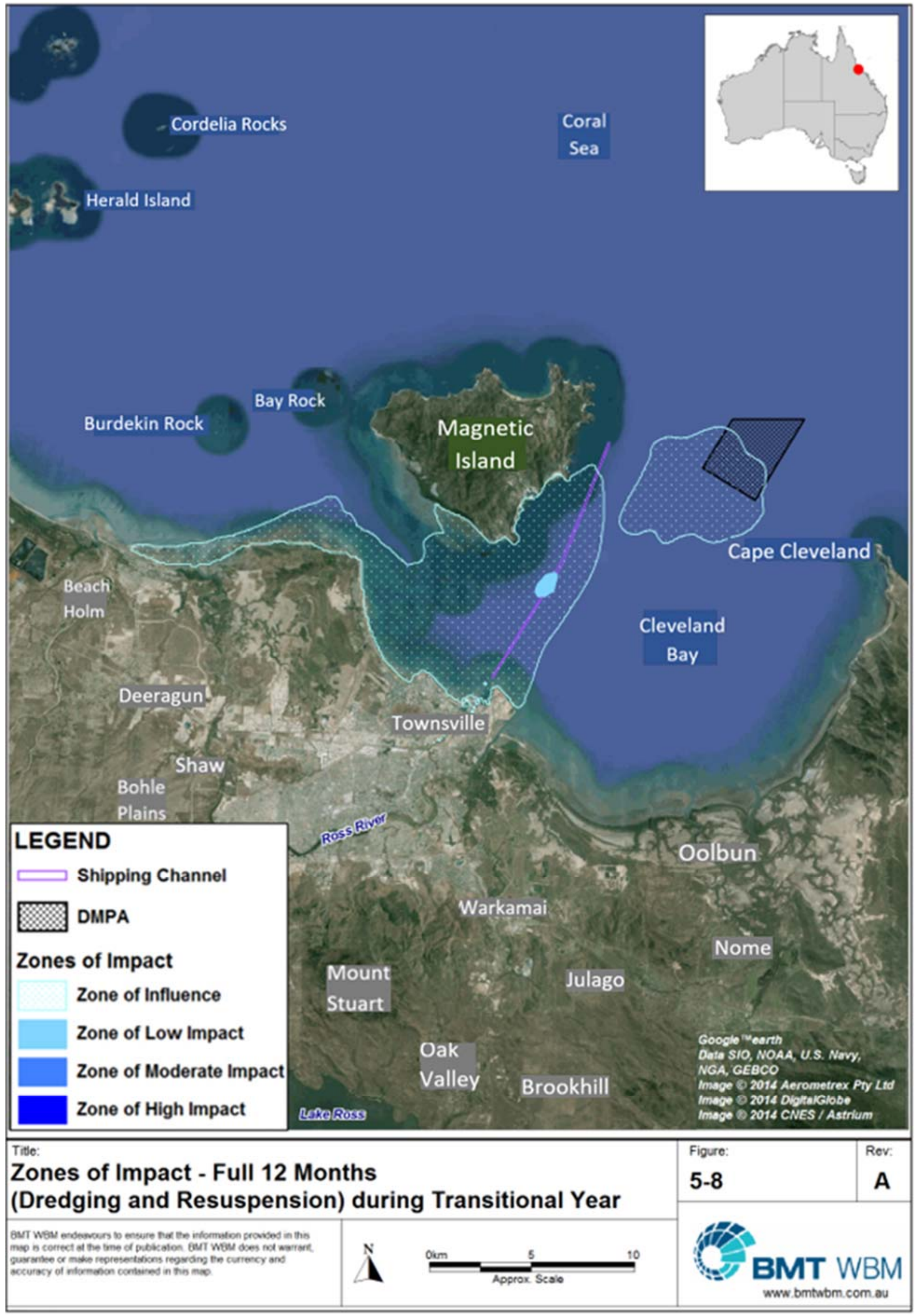


Figure 23: Transitional Year – Modelled Zones of Impact over a 12-month Period



A comprehensive risk assessment covering all environmental, technical and operational, economic, and social and cultural risk areas has been developed for the maintenance dredging activities at the Port of Townsville.

Table 10 is a high-level risk assessment, covering the key risk areas and areas of interest for Cleveland Bay. Once all comments have been received from consultation with local experts, any knowledge gaps, unidentified impacts, or changes to the residual risks will be included in the LTMDMP.

Table 10: Risk Assessment for the Port of Townsville, to / from Maintenance Dredging within Cleveland Bay

Issue	Risk Receptor	Potential Impact	Details	Likelihood / Consequence	Residual Risk
ENVIRONMENTAL					
Turbidity generated during dredging	Sensitive receptors: Coral, seagrass and benthic communities	Temporary smothering of sensitive receptors	Temporary turbidity plumes localised to source point, or within/directly adjacent to the channels.	Unlikely / Insignificant	Low
Turbidity generated during maintenance material placement in DMPA	Sensitive Receptors: Coral, seagrass and benthic communities	Temporary smothering of sensitive receptors	Negligible impact, placement area is 6km+ from sensitive receptors of the bay. Temporary impact at DMPA – with a limited change seafloor profile for benthic communities. The $12km^2$ DMPA, would register a change of 4cm for a full campaign.	Rare / Insignificant	Low
Underwater noise during dredging and placement	Megafauna	Masking megafauna communications; impacting on hunting behaviour	TSHD highly mobile vessel; noise production monitored for dredge plant; dredge vessel operates within noise modelling volumes.	Rare / Insignificant	Low
Dredge vessel strike	Dolphins, whales, dugongs	Death/injury of protected megafauna species	Dredge is mobile with high bridge tower for visual observations of animals within a 300m radius. Most megafauna can readily avoid the dredge.	Rare / Moderate	Low
Dredge draghead entrains a turtle	Turtles (including listed turtle species)	Death/injury to turtles	Dredge dragheads have turtle diversion devices installed. The suction of dragheads only permitted while the draghead is on the seafloor (i.e. not mid water column).	Possible / Insignificant	Low
Dredge draghead entrains other marine fauna	Fish, eels or sea snakes	Death/ injury to marine fauna	Dredge dragheads have diversion devices installed. The suction of dragheads only permitted while the draghead is on the seafloor (i.e. not mid water column).	Rare / Insignificant	Low

Issue	Risk Receptor	Potential Impact	Details	Likelihood / Consequence	Residual Risk
Introduced marine pests to Cleveland Bay from dredge vessel	Local and regional marine ecosystems	Introduction of pest species to Cleveland Bay	All vessels must comply with State and Cth Biosecurity Legislation (quarantine, ballast water management, inspections and declarations). The Port has marine biosecurity monitoring in harbour.	Rare / Insignificant	Low
OPERATIONAL AND TECHNICAL					
Dredging or placement activity impedes commercial traffic	Commercial fleet Local and regional community	Temporary commercial disruptions	Temporary delays only (<hour) in production and operation for commercial operators. TSHD highly manoeuvrable, allowing for movement around other vessels.	Unlikely / Minor	Low
Severe weather disrupts dredging resulting in a reduction of depth, restricting all shipping movements	Commercial fleet Local and regional community	Temporary disruption	Temporary, short-term delays (days), disrupting all operations in and out of the Port. TSHD can arrive in days, it has high production rates to clear infrastructure, reducing further downturn for port operations. RHM to re-declare depths.	Unlikely / Serious	Medium
Dredging or placement activity impedes recreational traffic	Recreational fleet Local community	Temporary disruption	Temporary delays (<hour) in and out of Ross Creek by TSHD, or Ross River by cutter suction. Both mobile dredgers, allowing movement around operations area.	Unlikely / Insignificant	Low
Legislative increase in land placement	Commercial fleet Local and regional community	Ongoing disruption; navigation hazards; delays in operations	Limited land available for placement. Delays in placement restricts dredging production and declared depths of infrastructure. Adequate volume forecasting in LTMDMP and permits to State and Cth Governments required.	Rare / Major	Low
ECONOMIC					
Legislation increases land placement, increasing the cost of maintenance dredging	Local community; Regional community and Queensland	Temporary loss of port for transport impacts network of supply chains due to increased cost for normal port operations	Medium term (months) negative impacts, including increased costs to consumers. Adequate volume forecasting required in LTMDMP and relevant approvals by State and Cth Governments.	Unlikely / Minor	Low
Dredging or placement activity impedes	Commercial fleet Local and regional community	Temporary commercial disruption	Temporary delays (<hour) in production and operation for commercial operators. TSHD highly manoeuvrable,	Unlikely / Minor	Low

Issue	Risk Receptor	Potential Impact	Details	Likelihood / Consequence	Residual Risk
commercial traffic			allowing movement around other vessels.		
Loss of infrastructure depth following a cyclone	Local community; Regional community and Queensland	Restricted access to port for transport, impacts network of supply chains	Temporary, short-term (weeks) negative impacts in production in and out of the Port. TSHD can arrive in days, it has high production rates to clear infrastructure, reducing further downturn for port operations. RHM to re-declare depths.	Unlikely / Serious	Medium
SOCIAL AND CULTURAL					
Community disturbance by dredge (light, noise, fumes)	Local community	Loss of amenity	Short term (hours) localised impacts to within the vicinity of the dredge vessel.	Unlikely / Insignificant	Low
Dredging or placement activity disrupts water traffic	Recreational and/or commercial vessels Local community	Temporary disruption	Temporary delays only (<hour) in production and operation for vessel operators. TSHD vessel highly mobile in Cleveland Bay; Cutter suction dredge leaves a clear path for vessels in Ross River.	Unlikely / Insignificant	Low
Visual impact from dredging or placement	Local community	Temporary disruption	Temporary turbidity plumes (hours) localised to the source point, or within/ directly adjacent to, the channels; and placement area is >6km from Magnetic Island.	Unlikely / Insignificant	Low
Cultural heritage (indigenous and non-indigenous) impacted by dredging	Local traditional owners Local community	Disturbance of cultural artefacts Impact on cultural important marine species	The Port has a Cultural Heritage Management Plan registered with the Queensland Government. The Port's site inductions include cultural heritage and direction to report any artifacts found. Impacts on culturally important marine species addressed in Environmental Risk Assessment above.	Unlikely / Minor	Low

This risk assessment is based on definitions of risk consequences, likelihood and hazard grade, adapted from:

- *Great Barrier Reef Region Strategic Assessment: Strategic assessment report, GBRMPA, Townsville* (GBRMPA, 2014) for the Environmental, and Social and Cultural Risk Assessments; and
- The Port's Risk Assessment Guidelines (POT 442) for the Economic, and Operations and Technical Risk Assessments

7 IDENTIFICATION AND TREATMENT OF KEY RISKS

As identified in the risk assessment, the sensitive receptors of the bay are the key environmental concerns for maintenance dredging at the Port of Townsville. These concerns include impacts to coral and their spawning periods, the location of seagrass meadows and impacts from turbidity, and impacts to marine fauna within the bay.

To mitigate these impacts, adaptive measures are implemented by way of the scheduling of the TSHD Brisbane, and a detailed Dredge Environmental Management Plan (DMP) approved by the Port prior to the dredge arriving in Townsville:

- The scheduling of the TSHD is undertaken based on a risk assessment completed by each Queensland port which includes environmental windows to avoid. The Port is committed to limiting any impact maintenance dredging and placement activities have upon Cleveland Bay – which includes avoiding dredging during the coral spawning periods (October/November each year).
- To ensure specific operational controls for maintenance dredging and placement activities are considered/controlled in campaign-specific DMPs as drafted by the Port of Brisbane Corporation as owner and operator of the TSHD Brisbane – see Section 8.
- Where possible, for perception reasons, the Port requests dredging is avoided in school holidays mid-year (peak tourism season).

On 30 July 2015, the Port entered into a Deed of Agreement with DAWE under Section 19 of the *Environment Protection (Sea Dumping) Act 1981*. This Deed of Agreement expired in July 2020 and Section 9 of this LTMDMP has been updated with the Port' current research and monitoring programs.

Table 11 shows the historic ambient and targeted monitoring that has occurred within Cleveland Bay, by the Port since 2009.

Table 11: The Last 19 Years of Long and Short-Term Research Programs at the Port of Townsville

Year	Benthic Fauna/ Introduced Marine Pests	Bioavailability / Toxicity / Elutriate Testing	Coral	Hydrocarbons	Hydrodynamics / Sediment Characteristics	Marine Mega Fauna	Nutrients / Pesticides / Herbicides	Photosynthetically Active Radiation (PAR)	Seagrass	TBT / Organic Carbon	Trace Metals	Turbidity (NTU)	Underwater Noise
2019	✓		✓		✓	✓	✓	✓	✓		✓	✓	
2018	✓	✓			✓		✓	✓	✓	✓	✓	✓	
2017	✓	✓						✓	✓	✓	✓	✓	
2016	✓					✓		✓	✓		✓	✓	
2015	✓			✓		✓	✓	✓	✓		✓	✓	
2014			✓				✓		✓		✓	✓	
2013	✓		✓		✓		✓		✓		✓		
2012		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓
2011	✓	✓			✓	✓			✓	✓	✓		✓
2010	✓	✓			✓	✓			✓	✓	✓		
2009		✓		✓	✓	✓			✓	✓	✓	✓	
2008	✓	✓		✓		✓	✓		✓	✓	✓	✓	
2007									✓		✓		
2006				✓			✓				✓	✓	
2005		✓			✓		✓			✓	✓		
2004		✓			✓		✓				✓		
2003		✓			✓					✓	✓		
2002		✓		✓	✓		✓			✓	✓		
2001	✓		✓		✓						✓		

✓ = *monitoring conducted.*

8 ENVIRONMENTAL MANAGEMENT

In order to manage the environmental risks associated with dredging and placement activities, the Port follows the recommended structure of the MDS (Figure 24), as well as Ports Australia's *Code of Practice for Dredging and Dredge Material Management* (Figure 25).

In following these structures, the Port reviews and approves the contracting dredge owner's DMP each year prior to the dredge vessel arriving in Townsville. This includes the TSHD Brisbane, owned by the Port of Brisbane Corporation, and cutter suction dredge, as contracted from time to time by the tender process, the past two campaigns were undertaken by Hall Contracting with the vessel Everglade, – see Section 8.2 for the description of dredge types used at the Port of Townsville.

The Port has a range of other small plant that are internally operated, primarily the mechanical dredge, however, there is also the potential for backhoe and suction dredges, though these are currently not utilised. The Port has a range of operational controls for the mechanical dredge, formalised via internal work practices however a full DMP will be drafted for this in 2019.

Figure 24: Dredge Management and Monitoring Elements (MDS 2016)

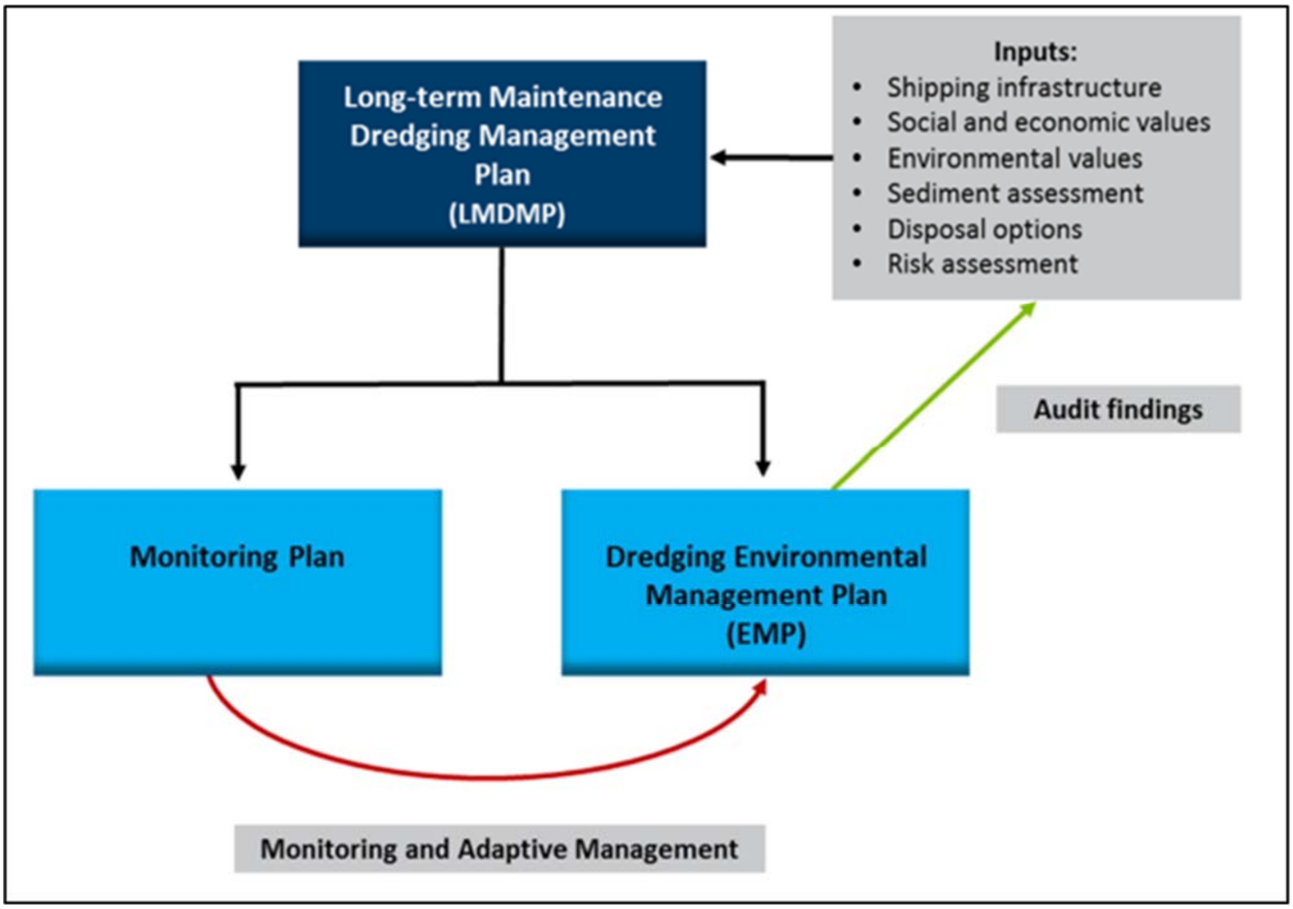
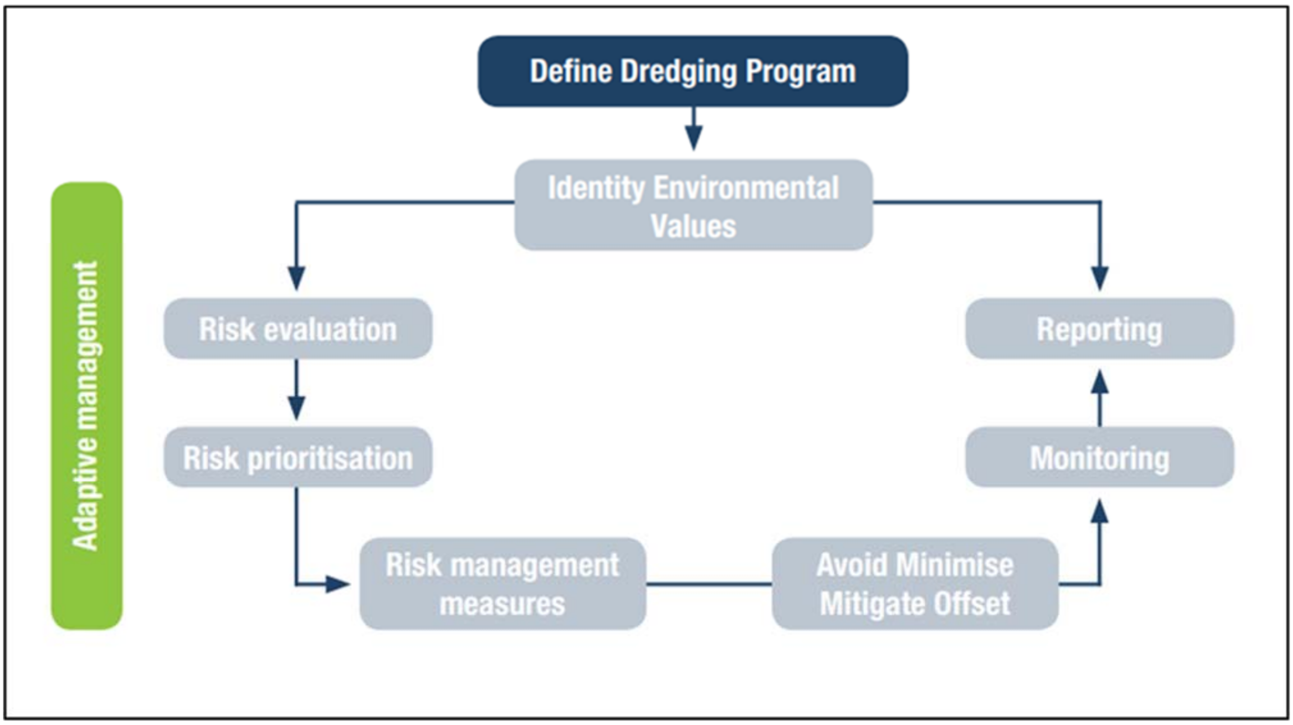


Figure 25: Application of Adaptive and Risk Assessment Management Process (Ports Australia 2016)



8.1 Example Dredge Environmental Management Plan

Whilst DMPs can vary per operator, structures usually are similar. The TSHD Brisbane's DMP has followed the following structure:

1. *Description of Port of Brisbane Corporation's use of TSHD Brisbane and requirement of the DMP as part of their EMS.*
2. *Description of the TSHD Brisbane*
3. *Location and description of the Port of Townsville*
4. *Description of the approved activity at the Port of Townsville*
5. *List of environmental legislation and approvals as applied to dredging at the Port of Townsville*
6. *Roles and responsibilities of key personnel associated with dredging at the Port of Townsville*
7. *The DMP (structure)*
8. *Management plans*
    - *Waste management*
    - *General and recycling wastes*
    - *Sewage treatment*
    - *Hazardous waste*
    - *Emissions*
    - *Turbidity control*
    - *Protected marine fauna*
    - *Cultural heritage*

- *Ballast water management*
- *Vessel washdown; and*
- *Bunkering of fuel*

9 *Incident reporting*

10 *Environmental monitoring*

- *Environmental complaints*
- *Dredge activity and observations*
- *Turbidity*
- *Cultural heritage*
- *Protected fauna*

11 *Emergency procedures*

12 *Emergency contact details*

The Port contracts maintenance dredging to the Port of Brisbane Corporation using the TSHD Brisbane. The main responsibility for following the DMP and the Port approval conditions lies with the TSHD Brisbane. The Port is however responsible for undertaking all pre, during and post hydrographic surveys, environmental monitoring (monitoring of marine fauna is the responsibility of the Dredge Master during dredging), auditing and reporting. The Port also has an oversight role for deviation from the DMP, and demonstration of all condition compliance, noting the Port of Brisbane Corporation is in charge of the plant.

8.2 Types of Equipment Used for Dredging at the Port of Townsville

The methods for maintenance dredging are determined based on the volume and area to be dredged, equipment availability, and the placement method. The majority of maintenance dredging at the Port of Townsville is undertaken using a TSHD. A cutter suction dredge is utilised in shallower waters and smaller scale dredging works (e.g. spot removal, minor berth pocket dredging and areas inaccessible for TSHDs) may be undertaken using a mechanical grab dredge with a split hopper barge. The Port also maintains declared depths and vessel safety between dredging campaigns, and some works are supported by bed levelling. Operation of any dredging method could be carried out by a number of dredgers dependent on their availability and will be in accordance with a DMP developed by the dredging contractor for the specific dredging campaign, taking into account the requirements of the Port's EMP guideline and any permits. Further details of maintenance dredging methods are provided below, with a comparison of production rates listed in Table 12 at the end of this section.

8.2.1 Trailer Suction Hopper Dredge

A TSHD is typically used for the Port's annual dredging campaign where significant volumes of material can be removed in relatively short periods in deeper waters with no or limited navigational impacts. Since 2001, the TSHD Brisbane has been used for the majority of dredging at the Port of Townsville (Figure 26). The TSHD Brisbane (84m long and ~3,500t displacement) is a relatively small TSHD, owned and operated by the Port of Brisbane Corporation. The TSHD Brisbane dredges at many Queensland ports, therefore maintenance dredging works at the Port of Townsville are scheduled dependent on the TSHD Brisbane's availability and may be influenced by dredging requirements at other Queensland ports.

Figure 26: Trailer Suction Hopper Dredge Brisbane

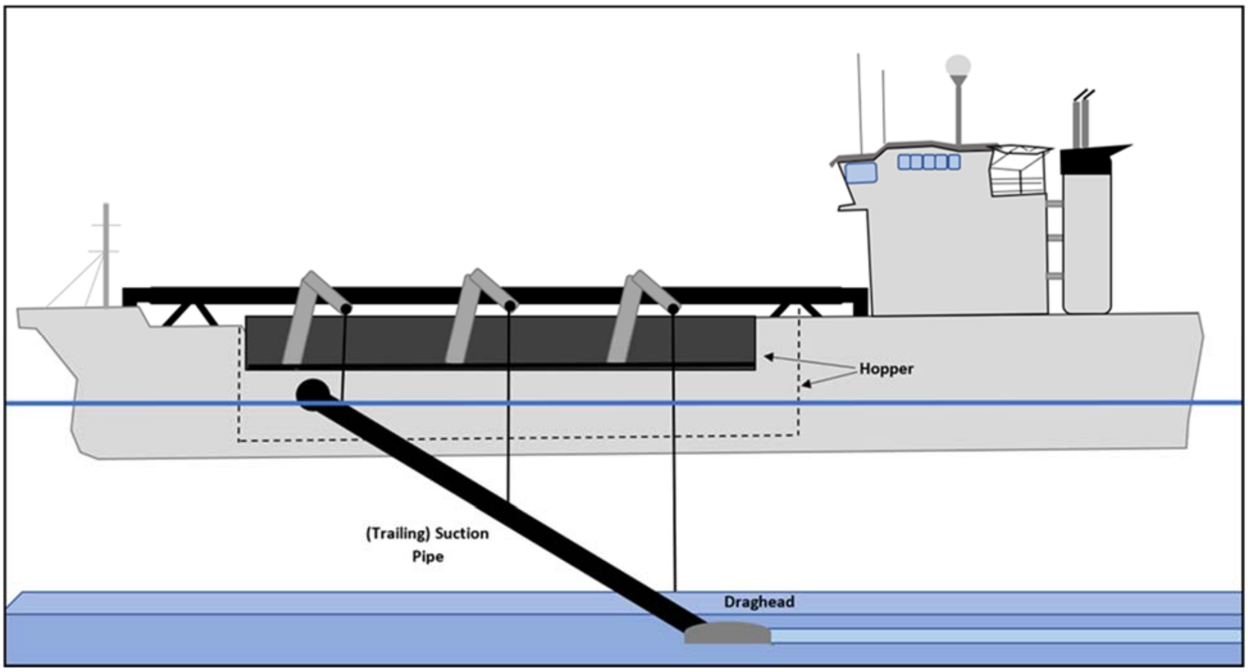
Hydrographic survey information is loaded onto the TSHD Brisbane's onboard computer system and the vessel can operate in either automatic mode, where onboard computers control vessel dredge systems, or manually. The onboard computers also assist in accurately positioning the vessel by displaying a differentially corrected GPS position of the vessel track against intended dredge areas.

The vessel dredges sediment by lowering two suction heads (one on either side of the vessel) to the seafloor whilst steaming slowly (1-3 knots) ahead. Large onboard pumps draw water through the heads entraining sediments from the seafloor and depositing a mixture of water and sediments into the vessel's central hopper (Figure 27). The total volume of the hopper is 2,900m^3, but the effective capacity of the hopper is dependent upon the type of material being dredged, ranging from approx. 1,700m^3 for sands to approx. 2,800m^3 for fine silts. Once the hopper has reached optimum capacity for the type of material being dredged, the vessel steams to the DMPA.

During placement at sea, the material is generally "bottom discharged" by opening large valves in the floor of the hopper.

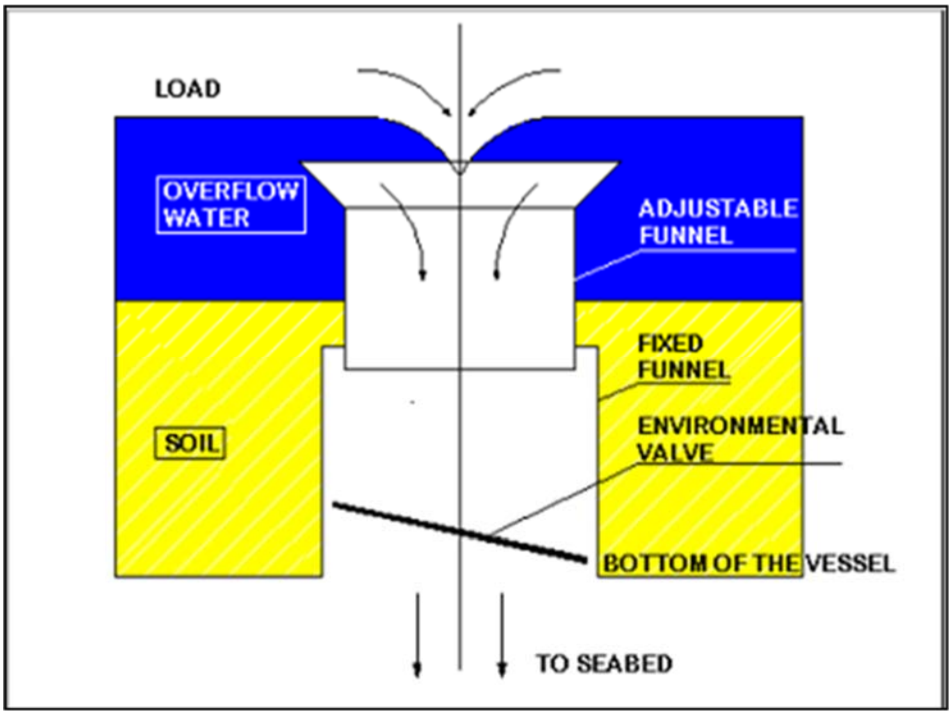
An environmental valve, or 'green valve' (Figure 28), is used in the dredging industry to reduce the surface turbidity during overflow of the hopper. While the green valve does not reduce the amount of sediment released from a dredge, it does reduce the extent of turbid dredge plumes in the water column and limits the mobility of dredge material.

Figure 27: Trailer Suction Hopper Dredge, Working View



The overflow from the TSHD consists of water, sediments and air. Without a green valve, the air in the overflow carries the sediment fines to the surface. As a consequence, the sediment fines are dispersed over a much larger area increasing turbidity in the water column. With a green valve, the overflow is choked such that a constant fluid level is maintained in the hopper and, as a result, no air is taken down with the overflow water. This results in more sediment taken to the seabed and less sediment suspended in the water column as turbid plumes. The material on the seabed is less likely to become mobilised into areas of sensitive ecological receptors compared to material suspended in the water column.

Figure 28: Diagram of an Environmental Valve or 'Green Valve'



8.2.2 Mechanical Grab Dredge and Split Hopper Barge

A mechanical grab dredge and split hopper barge (Figure 29) owned and operated by the Port is typically used for minor dredging work which generally only requires the removal of small volumes of material; in areas where larger dredging vessels are unable to access; and/or to remove material which does not meet NAGD 2009 requirements for sea placement and therefore, is required to be placed onshore. This method of dredging is slow and operation is often suspended due to commercial vessels requiring access to the Port's berths; once the berth is free operation can then again commence (which could be days or weeks depending on cargo). This material is then pumped to shore, rather than sea placement due to operational requirements.

Mechanical grab dredging is undertaken by vessels owned and operated by the Port, namely the Max Hooper and the Netterfield. The Max Hooper is a 30m deck barge, which supports a 60t crane that operates a 3m^3 clamshell bucket. The crane and bucket collects the sediment and places it directly into the Netterfield. The Netterfield is a split hopper barge, (36m long, 200m^3), capable of hinging open along its centre line and placing material directly into the sea; it has also been fitted with a slurry pump, so the material can be pumped out and placed directly onshore.

Mechanical grab dredging is a labour intensive and slow method of dredging small volumes, the Port can average anywhere up to approximately 20,000m^3 a year, depending on the areas requiring dredging and previous scheduling. This method of dredging occurs opportunistically throughout the year when areas of port infrastructure are free from commercial/cargo vessels.

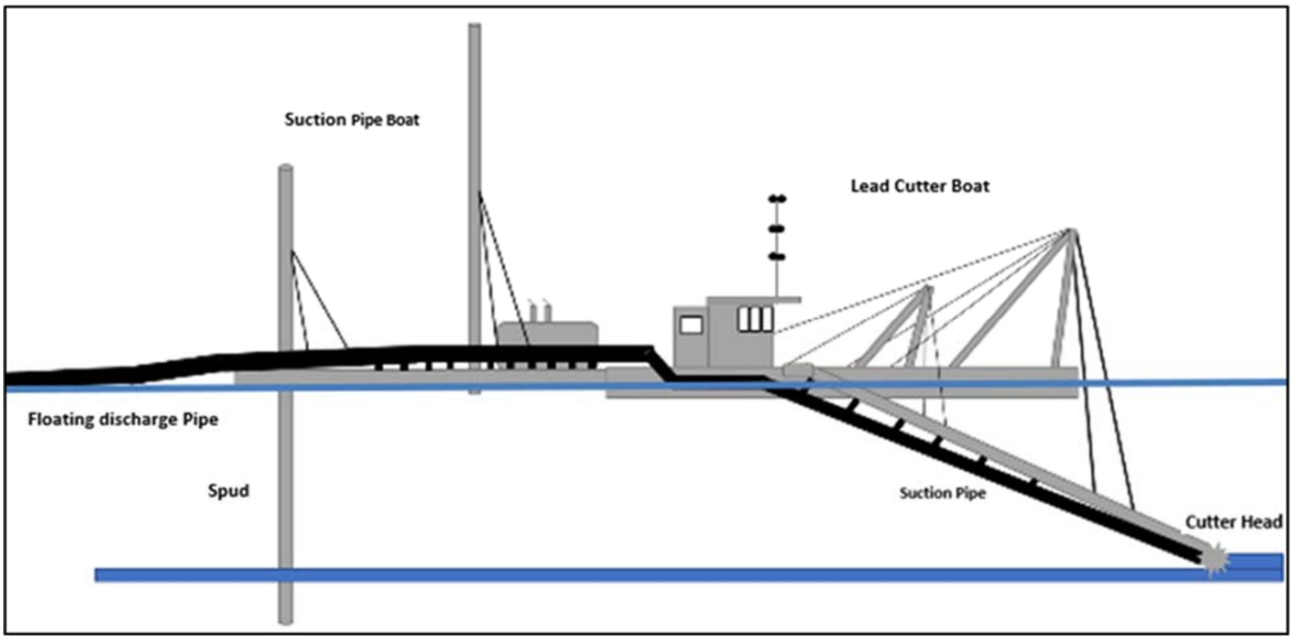
Management controls and mitigation actions designed to minimise environmental and operational impacts and to meet permit conditions, are documented via the Port's integrated management system. The Port also maintains management over tailwater although this is limited due to the slow scale of the mode of dredging.

Figure 29: Mechanical Grab Dredge and Netterfield Split Hopper Barge

8.2.3 Cutter Suction Dredge

A cutter suction dredge is generally made up of two parts: the lead cutter boat, and the suction pipe boat that locks into the lead boat. The dredge is equipped with a rotating cutter head, which is mounted to the head of the suction pipe (Figure 30). Maintenance material sediments are sucked up as they are cut, by the dredge pumps on board the tail boat and transported by floating pipeline, either to land or to a split hopper barge for sea placement. The suction pumps on, as an example, the Everglade can move sediments through a floating pipeline for a maximum length of 1000 metres. This type of dredge is a manually operated dredge that is fixed to the river bed via spud poles during cutting/suction works to stabilise and manoeuvre the dredge machinery.

Figure 30: Cutter Suction Dredge, Working View



For previous campaigns, the Port has contracted out the cutter suction dredge *Everglade*, along with her crew (Figure 31) to undertake dredging in the Ross River. Currently dredging of the Ross River occurs on a three years basis, with approximately 140,000m^3 removed each campaign (from Ross River entrance channel, and TMP swing basin); an average campaign is typically completed within two months.

A site based DMP which addresses standard operational procedures to minimise environmental impacts and address regulatory and permit conditions, is provided to the Port for approval prior to the vessel arriving in Townsville. Each cutter suction dredge vessel contracted by the Port also maintains management over tailwater, and floating pipe management.

Figure 31: Cutter Suction Dredge Everglade

8.2.4 Suction Dredging

For operational purposes, occasionally different plant and equipment, such as small suction heads and barges, may need to be utilised, usually for small volumes or in areas inaccessible by other dredging equipment. This method relies purely on the water velocity to mobilise the sediment with material going into a barge and either transported to the sea DMPA for sea placement or pumped ashore to the land DMPAs for land placement.

8.2.5 Backhoe Dredging

A backhoe dredger consists of a long reach excavating unit mounted on a pontoon or secured barge, which is positioned by spuds (legs). After positioning, the pontoon is slightly raised from the water by winches to create additional downward spud pressure and reduce wave effects. The hydraulic backhoe is mounted at the lowest point of the pontoon to facilitate maximum dredging depth. The buckets and booms can be replaced or changed to suit the depth of dredging and type of materials to be dredged and this method can move stiff material. A backhoe dredger allows for a very targeted campaign and can achieve depths of -15.5m LAT with material going into a barge and either transported to the sea DMPA for sea placement or pumped ashore to the land DMPAs for land placement.

8.2.6 Production Rates

The production rates of each dredging option dictate the areas in which they operate for maximum efficiency. Table 12 lists the production rates for the three main types of dredging that occur at the Port of Townsville.

Table 12: Comparison of Dredge Equipment Production Rates at the Port of Townsville

Dredge Equipment	Volume per day (m^3)
TSHD	~ 11,000 to 14,000
Cutter Suction Dredge	~ 2,500
Mechanical Grab Dredge	~ 330

8.3 Affiliated Works with Maintenance Dredging

8.3.1 Sounding

To ensure all maintenance dredging is undertaken only in approved areas, to approve depths, and within approved volumes, the Port undertakes hydrographic surveys (soundings) of the harbours, channels, berths, DMPA etc. These soundings are achieved by using both multibeam and single-beam echo sounder systems to produce accurate hydrographic data and sounding charts. The TSHD Brisbane uploads the pre-dredge soundings to align their onboard navigational positioning system. Soundings are undertaken after dredging has finished, to confirm depths, areas and volumes meet the approved limits (both State and Cth regulations).

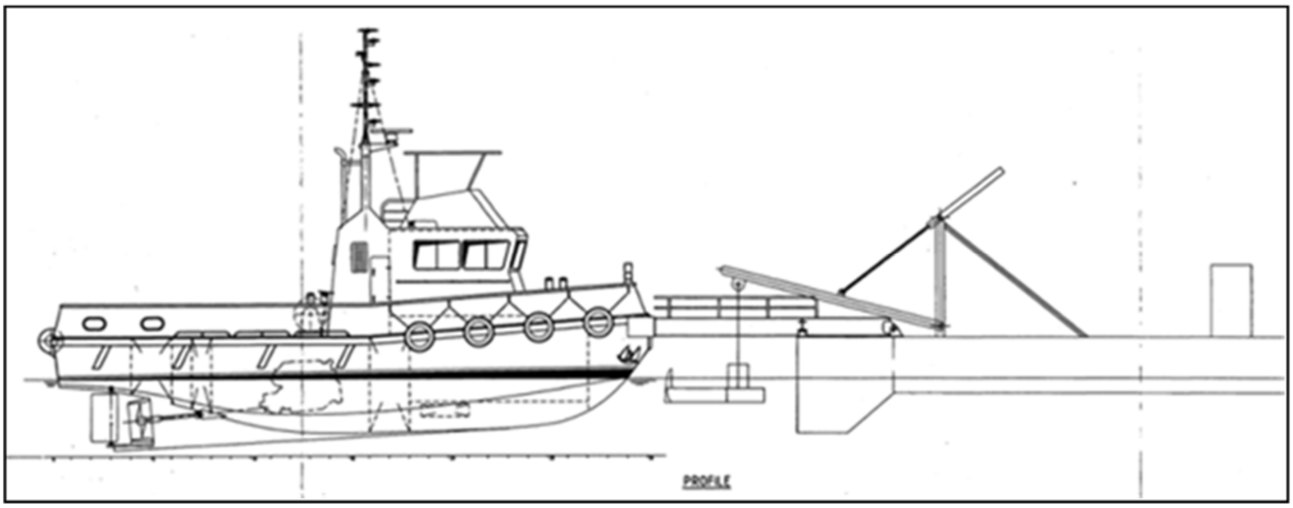
8.3.2 Bed Levelling

Bed levelling is a method used to support other forms of dredging, without the need to dredge. Bed levelling uses a beam to push peaks of sediment into lower areas and flattens out a berth or operational area.

The Port operates a bed leveller (a 16m work vessel pushing a 14.5 x 6m barge via a purpose-designed pushing frame) to assist in maintaining declared depths at berths and operational areas within the Port of Townsville (Figure 32). The barge machinery consists of a diesel powered hydraulic power pack, lifting derrick and winch gear, which supports and controls the depth of the beam. The barge is also fitted with a bow thruster to assist in turning the work vessel/barge in confined areas. All barge machinery may be remotely controlled via a radio on the work vessel.

The bed leveller maintains depth by relocating and flattening sediment displaced by vessel and tide movements. Sediment is moved by lowering a steel beam (of various sizes) to the declared height of the area being worked. The work vessel then steers a predetermined course using the GPS plotter as a reference. The beam acts as a grader blade and pushes material from high peaks to lower areas, which is essential in maintaining declared depths close to design depths. Unlike the dredging methods described above, the bed levelling method does not entrain sediment into the dredging equipment.

Figure 32: Bed Levelling Equipment



9 MONITORING FRAMEWORK

The Port undertakes a range of ambient, impact and real-time monitoring programs before, during and after maintenance dredging campaigns (Table 13). These are to ensure the health of Cleveland Bay remains high, whilst helping to identify, manage or reduce any detected impacts to sensitive receptors known within the bay, and around Magnetic Island. A number of these programs are conditioned by development approvals and not just for maintenance dredging.

Table 13: Monitoring Programs at the Port of Townsville

Monitoring Type	Description
Ambient monitoring **(PORT WIDE)**	The Port undertakes a number of ambient monitoring programs throughout the bay, and not just for maintenance dredging. These programs include marine water, marine sediment, air quality (and dust), biosecurity, light/PAR, seagrass, potable water, trade waste, groundwater and stormwater. These programs set out to understand and monitor not only the marine environment of Cleveland Bay but also how the Port may impact upon the surrounding environment.
Impact monitoring **(MAINTENANCE DREDGE CAMPAIGN-SPECIFIC)**	The Port has undertaken a number of impact monitoring programs, which required dredge plume monitoring, including plumes generated by placement activities. Impact monitoring is also undertaken by way of real-time water quality equipment positioned in the bay. The data captured by these buoys helps to identify direct and/or indirect impacts from maintenance dredging and placement activities on the sensitive receptors within the bay.
Real-time monitoring **(MAINTENANCE DREDGE CAMPAIGN-SPECIFIC)**	The Port has a number of real-time water quality buoys operating within Cleveland Bay. These buoys are utilised for both ambient monitoring as well as impact monitoring – collecting NTU and Conductivity in different sections of the bay. This data is used to monitor water quality during dredging and placement areas. A real-time water quality dashboard has been developed for these water quality buoys and a link has been placed on the Port website for public access.

The results of campaign-specific monitoring are reviewed after each campaign, with any impacts identified presented to the TACC, and then captured in the following year's campaign-specific DMP and environmental monitoring program. The Port is committed to undertaking a broader long-term review of all baseline environmental monitoring as part of the 5-year LTMDMP review.

In 2015, the Port entered into a Section 19 Deed of Agreement for a Research and Monitoring Plan with the Cth DAWE, which expired in July 2020. Table 14 lists the current research and monitoring programs which the Port will deliver over the next five years. During the 5 year formal review, this table will be reviewed to consider research and monitoring programs that may be required until the end of this LTMDMP i.e. 2029. This review will incorporate the results of ongoing research and monitoring by the Port and other organisations.

Table 14: Research and Monitoring Programs 2020-2025

	Research and Monitoring Area	Objective	Methodology	Timing (Year) 2020/2021	2021/2022	2022/2023	2023/2024	2024/2025
Monitoring								
1	Monitoring of Turbidity and PAR near Sensitive Receptors	Assess contribution of maintenance dredging and dredge placement activities on turbidity and PAR levels	Turbidity and PAR monitors with data loggers on underwater benthic frames serviced on a regular basis by contractor with water quality grab samples taken to assist with calibration/verification of results	1	2	3	4	5
2	Monitoring of Turbidity, Temperature and conductivity near Sensitive Receptors and in Cleveland Bay	Provide real-time data on turbidity, temperature and conductivity conditions to the public	Real time surface water quality sensors deployed on buoys/port infrastructure serviced on a regular basis with water quality grab samples taken to assist with calibration/verification of results	1	2	3	4	5
3	Monitoring of Various Water Parameters in Receiving Environment	Assess water quality conditions in receiving environment around the Port's receiving environment at different times and conditions	Periodic grab sampling of marine waters to assess physio-chemical, metallic and nutrient conditions	1	2	3	4	5
4	Monitoring of Metals in Marine Sediments in Receiving Environment	Assess marine sediment conditions in receiving environment around the Port's receiving environment at different times and conditions	Periodic van veen grab sampling of marine sediments to assess metallic nutrient conditions	1	2	3	4	5
5	Sediment Sampling and Analysis Plan (SAP)	Fulfil NAGD requirements	Marine sediment sampling by contractor in accordance with methodology specified in NAGD to assess suitability of maintenance dredge material for unconfined placement		2	3		5
6	Monitoring of Seagrass in Cleveland Bay	Assess any changes to seagrass distribution and diversity in Cleveland Bay	Surveys via helicopter, boat-based free-diving and boat-based CCTV camera-sled toes by contractor	1	2	3	4	5
7	Monitoring of Coral in Cleveland Bay	Assess any changes to coral distribution and diversity in Cleveland Bay	Surveys via boat-based free-diving and cameras by contractor		2	3	4	
8	Marine Megafauna Monitoring around Dredging Equipment	Identify marine megafauna interactions with dredging equipment	Surveys via boat-based observational and cameras by contractor		2	3	4	

	Research and Monitoring Area	Objective	Methodology	Timing (Year) 2020/ 2021	2021/ 2022	2022/ 2023	2023/ 2024	2024/ 2025
Research								
9	Comparison of Logger Equipment measuring Underwater Light	Compare different approaches to measuring underwater light to support integration of different data sets for interpretation of long term trends	Various brands of PAR monitors with data loggers on underwater benthic frames serviced on a regular basis by contractor	1				
10	Aerial Review of Turbidity in Cleveland Bay	Using satellite imagery to assess visible turbidity levels in Cleveland Bay and around DMPA	Assessment of current and historical modis satellite imagery and computer corrections by contractor					5
11	Monitoring of Benthic Fauna at DMPA in Cleveland Bay	Assess community composition and rate of recolonisation at the DMPA and in Cleveland Bay	Surveys via boat-based grab sampling and cameras by contractor	1	2			
12	Creation of a DNA Library	Assess community composition of benthic fauna in Cleveland Bay	DNA analysis and compilation of library by contractor			3		
13	Operational Approaches to Grab Maintenance Dredging	Optimise grab dredging methodologies to provide improved efficiency of land placement	Research studies – as based upon changing equipment and data collected from the field			3	4	
14	Hydrodynamic/ Bathymetric Conditions in Cleveland Bay	Assess contribution of maintenance dredging and dredge material placement activities on bathymetry at DMPA	Desktop study / comparison of current & historical bathymetric surveys					5
15	Program to be developed in partnership with local stakeholders	To improve understanding of indigenous and social values of water in Townsville region	Community attitudes re maintenance dredging and placement (light, noise, fumes, visual impact, cultural heritage (indigenous and non-indigenous) via survey etc.	As proposed by Dry Tropics Healthy Waters Partnership				
16	Research into underwater noise levels if using dredge equipment other than TSHD Brisbane	Assess noise profile of new dredge vessel compared to TSHD Brisbane on underwater noise levels	Underwater noise monitoring during dredging and placement	Triggered by proposed use of new equipment				

10 PERFORMANCE REVIEW

As described in Section 1.2, the Port's objectives for this LTMDMP are:

a) Maintaining safe navigation for the continued operation of both Ports;

b) Ensuring the OUV of the GBRWHA and sensitive receptors surrounding both the Port of Townsville and the Port of Lucinda are maintained;

c) Ensuring a robust, transparent long-term planning approach to the management of sediments within port infrastructure;

d) Continuing the long-term proactive and environmentally responsible management approach of maintenance dredging and material placement at the Port of Townsville;

e) Capturing and communicating operational controls for best management; and

f) Supporting local and regional communities, ensuring the health, wellbeing and connectivity to the global market is maintained.

Performance indicators used to determine whether these objectives are being met and/or to better inform future risk assessments are:

- Routine maintenance dredge volumes are within predicted volumes outlined in Table 6 of this document.
- Routine maintenance dredge volumes are within modelled parameters, and modelling is updated if changes are noted and incorporated into the risk assessment as required.
- The Port's requirements for timing of dredge, as identified by the risk assessment, are incorporated into annual scheduling discussions with Queensland ports and Port of Brisbane Corporation.
- No material is placed at sea that has not been assessed against NAGD 2009 and approved for placement (noting a new SAP is required every 5 years).
- Demonstrated evidence that all dredging undertaken is done so under a relevant EMP or DMP.
- The Port to undertake observation during dredge campaigns to provide oversight for compliance with EMP/DMP and/or approvals.
- Incorporate information from ambient and target monitoring and research projects into risk assessments to inform decisions and improve outcomes.
- Capture any performance measures that have not been achieved and detail corrective actions undertaken.
- Full compliance with State and Cth approvals and reporting requirements including notification processes and volume reporting.
- Undertake scheduled internal audits of the LTMDMP as part of the Port's Certified Integrated Management System.
- Annual reviews to be undertaken against the performance indicators, this review includes consolidation of the effectiveness and relevance of the performance indicators. This includes initiating an independent review of the LTMDMP if the annual reviews determine the performance indicators are not effective.

- Undertake a full review of the LTMDMP (informal at 12 months; formal at 5 years; and formal for the creation of new LTMDMP at 10 years).

SCHEDULE 2 – PORT OF LUCINDA

11 PORT LOCALITY, SETTING AND SHIPPING

11.1 Location and Environmental Setting

Port of Lucinda (18°31'S, 146°21'E) sits almost 100 kilometres north of Townsville, approximately 26km north-east of the township of Ingham. Lucinda is located within the Hinchinbrook Shire Council Region, and within the northern corner of Halifax Bay, east of the Herbert River mouth and Hinchinbrook Channel. The Port sits below Hinchinbrook Island (Figure 33).

The Port of Lucinda exports sugar grown and milled from the surrounding district (Victoria and Macknade Sugar Mills). It is equipped with onshore sugar handling and storage facilities, as well as a single trestle jetty and conveyor running out to an offshore berth and ship loader.

The jetty is one of the longest of its type in the world, extending 5.6 kilometres out to sea and dipping 1.2 metres over its length as it follows the curvature of the earth. Sugar takes 22 minutes to travel along the conveyor from the onshore storage sheds to the offshore ship loader.

The port terminal is operated by Lucinda Bulk Sugar Terminal, a subsidiary of Queensland Sugar Limited (Port website, 2020).

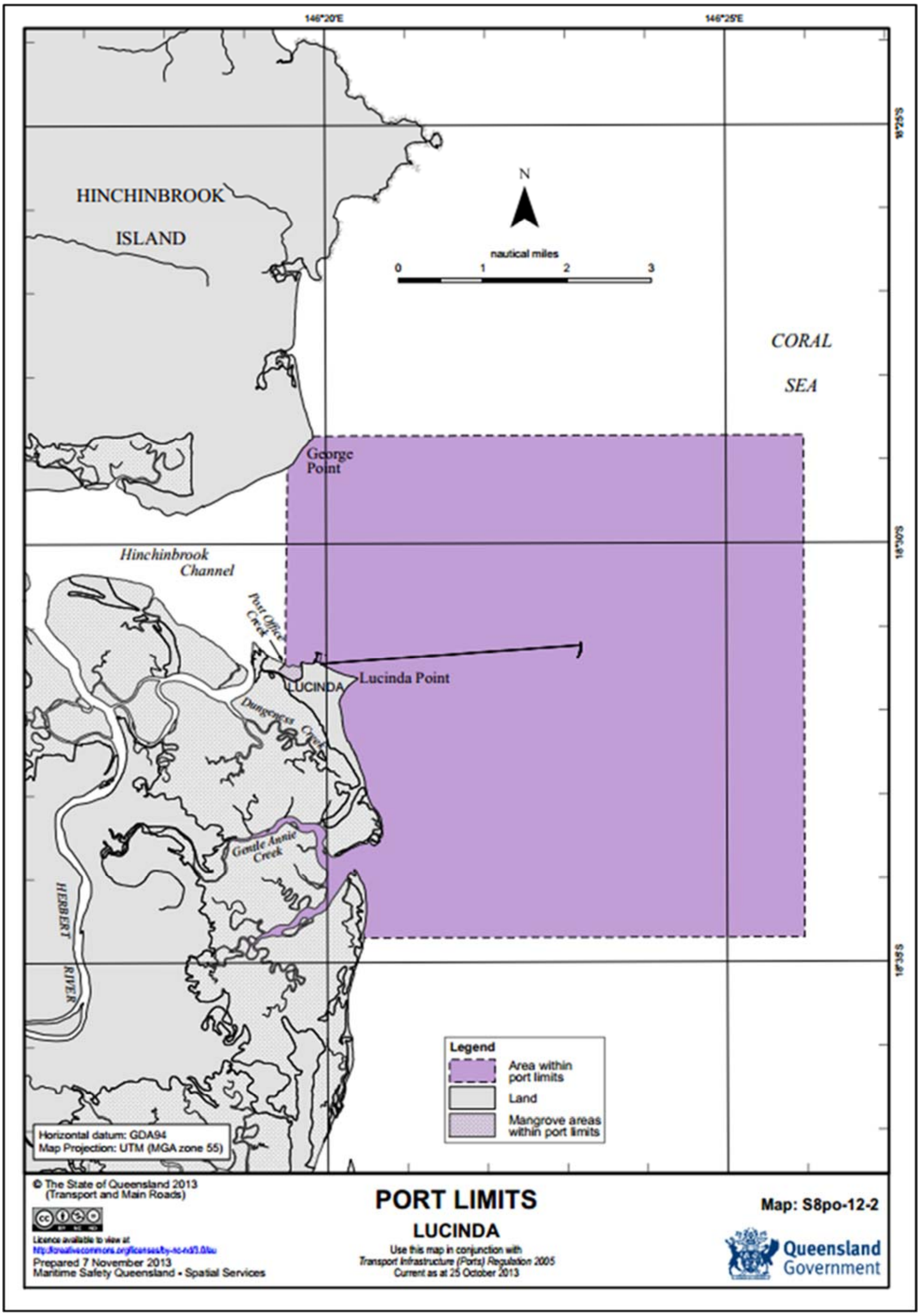
Figure 33: Port of Lucinda in Halifax Bay

11.2 Port of Lucinda Overview

The Port of Lucinda was gazetted in 1892, born out of the need for an all tide access facility for the growing sugar cane industry's exports. The bulk terminal at Lucinda was opened in 1958, with the construction of a new L shaped concrete wharf with wooden piles (PCQ 2004). Due to the shallowing of the Hinchinbrook Channel, this inner wharf was no longer a long-term solution; in 1975 the construction of the (current) offshore jetty began, finishing in 1979. This 5.6km long jetty houses a conveyor system to move sugar out to the offshore berth. The berthing depth was designed at 14m deep, and due to the self-scouring nature of this area of the bay, the berth does not require maintenance dredging.

The Port of Lucinda has State designated Port Limits (Figure 34), which differ from the exclusion zone from the Cth Marine Park – see Figures 36 and 37 in Section 12.1.3.

Figure 34: Port Limits at the Port of Lucinda



11.3 Current and Future Uses

In the 2018/2019 financial year, the Port of Lucinda totalled a throughput (export) of 647,685 tonnes of sugar, via 15 ships.

As the Port of Lucinda has not been deemed a Priority Port, master planning is not required. The Port is reliant on the production of sugar from the surrounding cane farms and two sugar mills. There is no expected change of usage of this facility, as the conveyor, trestles and jetty are arranged for exports only.

11.4 Navigational Infrastructure

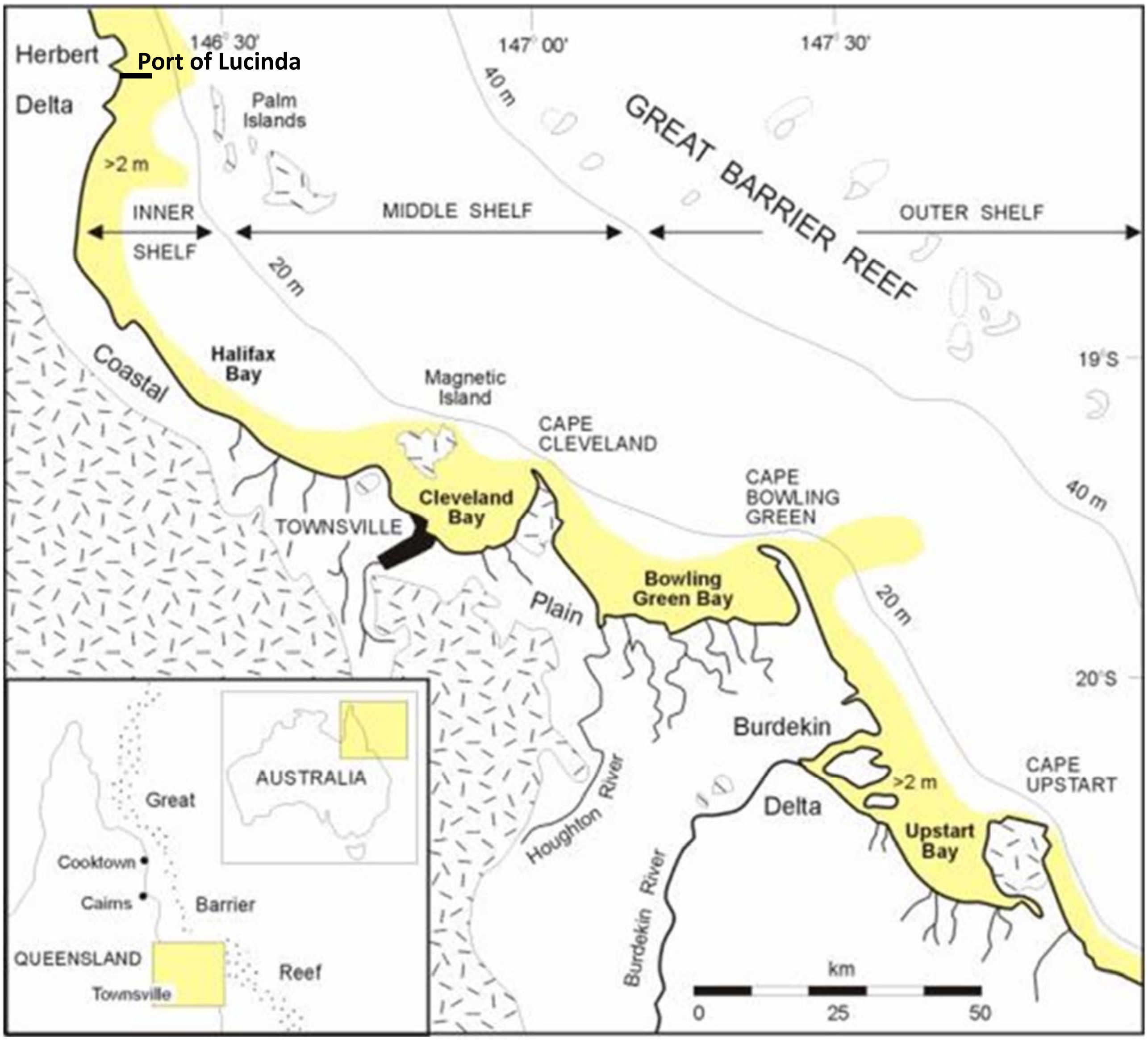
The Port of Lucinda operates via a 5.6km long jetty, with a 400m wharf located on its end. The jetty houses a conveyer belt that moves sugar from the three terminal sheds to ships berthed at the end. This jetty negates the need for any large vessel from entering the onshore facilities. Only the pilot vessels need to berth at the public (inner) wharf situated off the main port area.

12 PORT OF LUCINDA ENVIRONMENTAL VALUES

The Port of Lucinda is situated on the coastline east of the township of Ingham, in tropical North-East Queensland, approximately 1,473 kilometres north of Brisbane, Queensland's capital city. The Port is located in the north-east corner of Halifax Bay, near the mouth of the Herbert River and at the southern entrance to the Hinchinbrook Channel (Figure 35). The Palm Island Group sit at their closest point 16km from the main port lands. Pelorus Island is the Port's closest neighbouring island and the top most island in the Palm Island Group.

Halifax Bay is a naturally long, broad and turbid bay; it is bound to the south by Cape Pallarenda, and Hinchinbrook Island to the north, which are approximately 90km apart. The bay is mostly east facing, with limited shelter (except the Palm Islands in the north) making the bay on occasion a turbid water body, enhanced by the sediment load received from the multiple creek systems which dot the coastline of the bay (one river, two mangrove deltas, 10 named creeks, and multiple unnamed drainage lines).

Figure 35: Regional Location Map including Halifax Bay, North Queensland



Located within the wet tropical region of Northern Queensland, Lucinda is characterised by a tropical, seasonal wet and dry climate. High humidity and frequent storms and occasional cyclones typically occur during the wet season (November to April). The dry season (May to October) produces mild and moderate temperatures. The temperature ranges from a mean maximum of 30°C in January to a mean minimum of 18°C in July. Relative humidity is highest in the mornings and average annual rainfall in Lucinda is approximately 1,056.2mm, with the majority typically recorded during the wet season (January to March).

12.1 Environmental Values

12.1.1 Climate and Coastal Processes

Climate change projections indicate that the region's future climate is likely to be characterised by:

- Increased average annual temperature and increased number of days with maxima over 35°C;
- Decreased average annual rainfall, increased annual potential evaporation, and more drought-like conditions;
- Increased average wind speeds;
- Increased number of severe tropical cyclones; and
- Elevated sea level and increased frequency and height of storm surge.

Careful planning of the potential effects of natural events such as cyclones and floods including predicted climate change risks are a key consideration in port planning, design and operations.

Halifax Bay is a moderate wave energy environment as it is only sheltered from the predominant south-east waves by the Palm Island Group. The open expanse of the bay's outer edges makes the bay shallow only along the coastal beaches (1 to 5m below chart datum), deepening quickly out to 9m, and then out to 12 – 15m halfway between the coast and Palm Island. The coastline continues to be shaped by the prevailing waves at a slow rate, punctuated only by the energy from severe weather events that easily move across the bay onto the shoreline.

The Port of Lucinda and surrounding coastal areas remain relatively untouched. This is mainly due to the location of the main township, Ingham being located some 26km inland. Limited land available for residential areas also reduces coast modification – Taylors Beach to the south and Cardwell to the north are the two main coastal development areas of Halifax Bay. Long-shore drift that moves sediments north along the coastline, adds to the sediment loading at Lucinda Point. The 5.6km jetty ends offshore in deep water, meaning there is a limited need to manipulate the natural environment in order to operate a functioning port.

The Hinchinbrook Channel and Island are both protected areas, which also limits development along the coast.

12.1.2 Marine Ecosystem Values of Halifax Bay

Halifax Bay supports numerous rich and diverse coastal habitats with varying ecological sensitivities, typically abundant in north-east Australia's coastal wet tropics area, including:

- Corals;
- Soft bottom communities;
- Intertidal and subtidal seagrass beds are present in about 10% of the bay and provide food for the threatened dugong and turtles and are also a nursery for prawns;
- Extensive mangrove and saltmarsh communities, all of which:
  - provide a nursery and shelter for fish, mud crabs and prawns;
  - trap tide-borne sediments and help control coastal erosion; and
  - provide vital protection from strong winds, tidal surges and heavy rainfall associated with cyclones, which occasionally affect this part of Queensland's coastline; and
- Forested, brackish and freshwater swamps.

Reef Communities

Reef communities comprised of hard corals exist around all of the Palm Islands, as well as on the south-west side of Rattle Snake Island (known as Rattle Snake Island Reef), in the south of Halifax Bay. A large number of hard corals have been recorded in these communities, with 340 species recorded around the Orpheus Island dive sites. The distribution and abundance of coral species vary in the fringing reefs of the different islands and is related to the physical characteristics of the substrate and energy environments.

Coral cover, species diversity and aesthetic quality are generally considered higher in the fringing reefs on the north-western sides of each of the islands; which provided protected areas from the prevailing waves on the eastern sides. However, further out from Pelorus Island sits Bramble Reef (amongst other reefs) within the main GBR shelf.

Current coral conditions of the GBR shelf have been impacted by two consecutive years of coral bleaching. However, the GBRMPA released survey results from the Eye on the Reef program in September 2018 indicate there were minor levels of coral disease and coral damage throughout the marine park. Isolated cases of minor coral bleaching begin to appear from Port Douglas in the north to the Capricorn Brunker Group in the south, (gbrmpa.com.au, 2018).

Seagrass Communities

A number of studies have been undertaken both within Halifax Bay and around the Port of Lucinda on the seagrass communities. In 1993 Lee Long *et al.* indicated spatial and temporal variations in seagrass density and species composition for the Hinchinbrook Region, PCQ 2004 also described dense seagrass communities in the lower intertidal and shallow areas of the port region, including the nearby Hinchinbrook Channel; at the time, the closest seagrass meadows to the offshore berth were located on part of the larger sandbank near Lucinda Point.

Mangrove Communities

Mangrove communities represent diverse communities growing in the intertidal zone of tropical to temperate coastal rivers, estuaries and bays (Lovelock 2003). Sixteen species of mangroves have been identified in the port area, with the most dominant species being *Cerips tagal* (PCQ 2004). They are most extensive in the Hinchinbrook Channel, the mouth of the Herbert River, and in the Halifax Bay Wetlands National Park.

The occurrence of particular mangrove species is dependent on environmental factors such as salinity (Sam and Ridd 1998), nutrient availability (Walker and O'Donnell 1981), oxygen levels in the sediment and wave energy (Brinkman *et al.* 1997).

Saltmarsh Communities

Halifax Bay is also home to saltmarsh species. Saltmarshes are ecologically important habitats, as they link the marine environment to terrestrial, and provide habitat for both marine and terrestrial organisms (Goudkamp and Chin 2006).

Saltmarsh communities tend to occupy the areas of low energy, intermittent, tidal inundation, on sheltered soft substrates, and often occur behind mangrove communities (Creighton *et al.* 2015). Different saltmarsh community types produce different benefits to the ecosystem, including sediment trapping, nutrient cycling, dissipation of wave energy, fish and prawn nurseries, carbon sequestration, and feeding areas for birds (Creighton *et al*. 2015).

Distribution throughout the bay depends on the site microhabitat and seasonal influences from both land and sea direction. Saltmarshes play an important role in the ecosystem by providing organic matter, a rich supply of nutrients, and support a great diversity of both marine and terrestrial life (adapted from RIVER Group 2004).

Marine Megafauna

Being home to the Wet Tropics World Heritage Area, Hinchinbrook Island National Park, the GBRMP and two declared FHAs, Halifax Bay is home to a diverse range of aquatic fauna, including whales, dolphins, turtles, and dugongs. PQC 2004 lists the area is home to a number of listed species, including Irrawaddy River Dolphin, Estuarine Crocodiles, Green and Loggerhead Turtles, Indo-Pacific Humpback Dolphins, and Dugongs. A comprehensive study undertaken by Queensland Parks and Wildlife services in 2002 found populations of both the Green Turtle and Loggerhead Turtle within the port area.

Fish and Fisheries

The mangroves, seagrasses, reef and soft bottom benthic communities present in Halifax Bay provide habitat for a variety of fish species. Fishing for target species is a common practice in Halifax Bay, where legal fishing can occur, which includes the Hinchinbrook Channel, for traditional owners, commercial and recreational fishers. Target recreational fishing species include Barramundi, Threadfin Salmon, Queenfish, Grunter, Flathead and Mud Crabs.

FHAs have been established in Halifax Bay and Hinchinbrook Island for many years. The Halifax Declared FHA was originally declared in 1983, with two redeclarations occurring in 1989, and again in 2003 to re-establish the cadastral boundaries. The Hinchinbrook Declared FHA was declared in 1971, followed by two redeclarations in 1983, and again in 1999 both to clarify and link to cadastral boundaries.

Declared FHAs provide protection and breeding grounds for target indigenous, recreational, and commercially important species (including Barramundi, Blue Salmon, Estuary Cod, Flathead, Grey Mackerel, Grunter, Prawns etc.). While these species are highly mobile, it is recognised that the loss of important habitats such as for feeding, or breeding, including seagrasses, reef and benthic habitat, may affect long-term stock levels and abundance.

12.1.3 Protected Areas within Halifax Bay

The Port of Lucinda's sea jurisdiction is within the GBRWHA, which is also a national heritage place. The Port and its marine infrastructure are all within an exclusion zone from the Cth GBRMP and the State GBR Coast Marine Park (Figure 36). However, there are areas that lie outside the exclusion zone but still remain within port limits (Figure 37).

Some of the key conservation areas, as well as other features of the region, include:

- The GBRWHA, a world and national heritage place;
- The GBRMP and the State GBR Coast Marine Park (including a number of different zones of protection);
- A Declared FHA Management A area within the Hinchinbrook Channel;
- A Declared FHA Management B area within Halifax Bay;
- The neighbouring Hinchinbrook Island National Park; and
- The Palm Island Group National Parks.

12.2 Social Values

Lucinda is located on the traditional lands of the Warrgamay people. Halifax Bay is central to the social life of Lucinda and provides recreational activities such as boating and fishing and is a magnet for anglers, with the old inshore jetty and park at the Port servicing as an important tourist attraction. The catchments flowing into Halifax Bay are primarily used for farming sugar cane, supported by the Port of Lucinda which is the world's longest offshore sugar loading facility (Terrain, 2016).

Figure 36: Great Barrier Reef Marine Park Boundaries/Zones around the Port of Lucinda Exclusion Zone

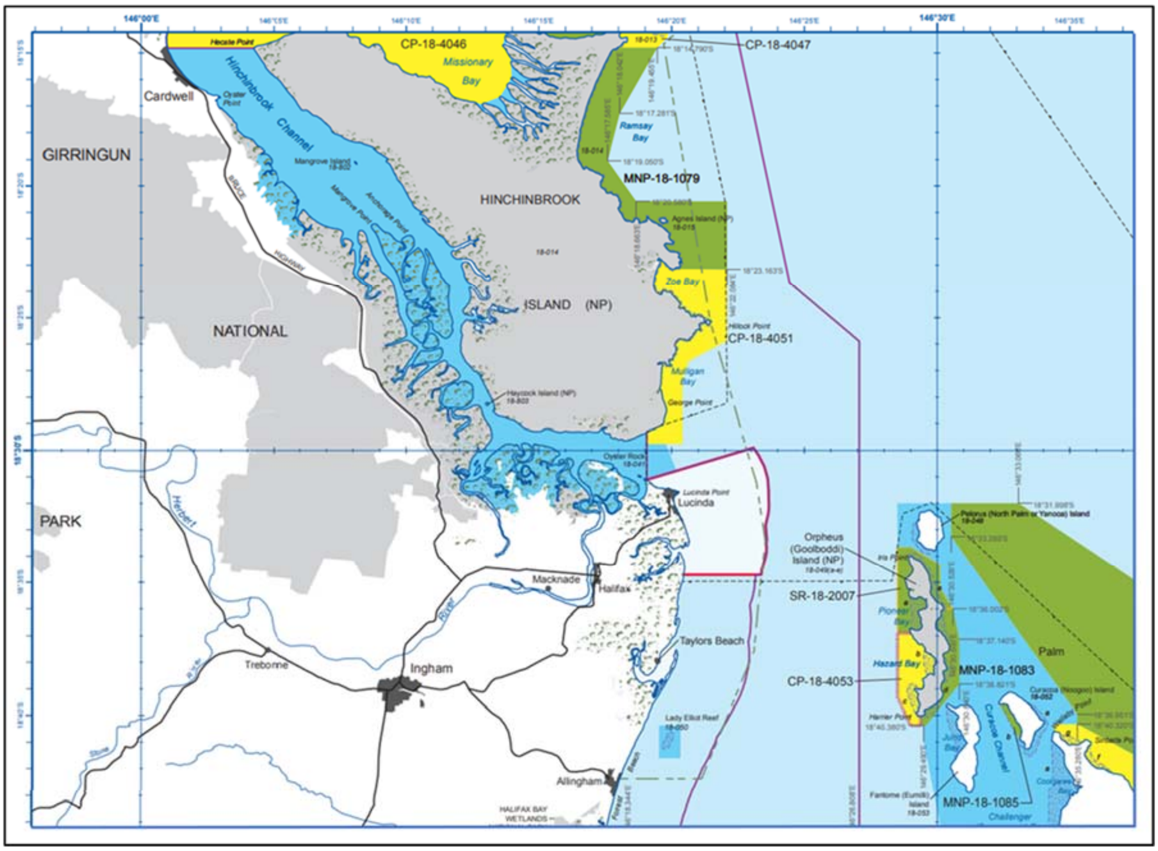
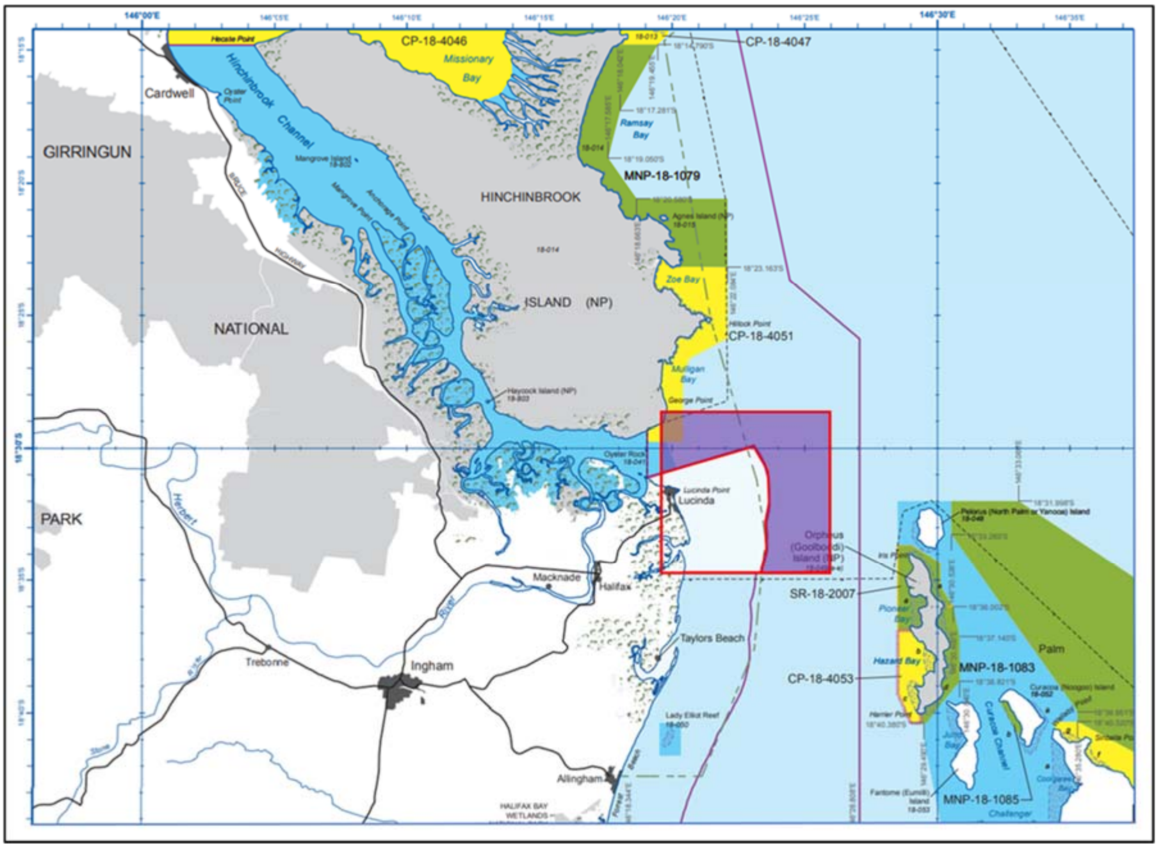


Figure 37: Port Limits and Port Exclusion Zone Overlay



13 CONSULTATION AND KEY ISSUES

During the public review period for this Plan, two submissions were received with comments regarding the Port of Lucinda. One recognised the inclusion, the second provided formatting and information inclusion comments. These edits have been included in January 2020 as per the Gap Analysis Action List on the Port of Townsville website.

The Port of Townsville website has a page dedicated to long term maintenance dredging in order to host all the associated documents that accompany the LTMDMP.

This page will remain operational for the duration of the Plan, being updated with relevant reviews; ensuring access and currency of reports and data.

14 PORT SEDIMENT CHARACTERISTICS

14.1 Port Sediment

A small number of targeted sediment characteristic studies have been undertaken within the lower half of Halifax Bay, over the past five decades. To date, studies around the northern section of the bay have not been identified (including around port infrastructure). As the Port does not require maintenance dredging, a SAP has not been necessary. Should any maintenance dredging be required, a full SAP will be undertaken, and relevant applications to both State and Cth Governments would be required. No approved placement areas (land or sea) exist for Lucinda.

14.2 Minimisation of Sediment Accumulation and Dredging Needs

The Port of Lucinda jetty and berth structure are currently self-cleaning systems. The structure was constructed in an area that allows vessels to berth at the wharf without the need for maintenance dredging, and therefore there is currently no further need to minimise sediment accumulation and there are no dredging needs.

14.3 Maintenance Dredging and Placement Requirements

The Port of Lucinda does not undertake any maintenance dredging and as such has no material placement requirements. There are no approved placement areas in Lucinda. If dredging was ever required significant investigation and applications to relevant government regulators would be required.

14.4 Examination of Reuse, Recycle and Disposal Options

Currently, the examination of the reuse of maintenance dredge material is not required as no maintenance dredging or placement activities are planned or approved for the Port of Lucinda. Should such works be required for approval, all reuse, recycle and disposal methods will be provided in a review of this LTMDMP prior to any applications to the State and Cth Governments.

14.5 Selected Future Dredging and Placement Strategy

This currently is not applicable to the Port of Lucinda as no dredging approval is considered necessary at this point in time. Should maintenance dredging ever be considered for the Port of Lucinda, this LTMDMP will be updated to accompany applications to both State and Cth governments.

There are no future dredging or placement strategies currently proposed for the Port of Lucinda.

15 RISK ASSESSMENT FRAMEWORK

As dredging is not required at the Port of Lucinda, a risk assessment for maintenance dredging and placement activities is currently not required. Should at any point maintenance dredging be required for the Port of Lucinda, a risk assessment will be created to accompany a development approval for such works, including placement activities.

16 IDENTIFICATION AND TREATMENT OF KEY RISKS

As dredging is not conducted at the Port of Lucinda, the identification and treatment of key risks for maintenance dredging and placement activities is currently not required. Should maintenance dredging be required for the Port of Lucinda, the identification and treatment of key risks will be updated in this LTMDMP to accompany applications to both State and Cth governments.

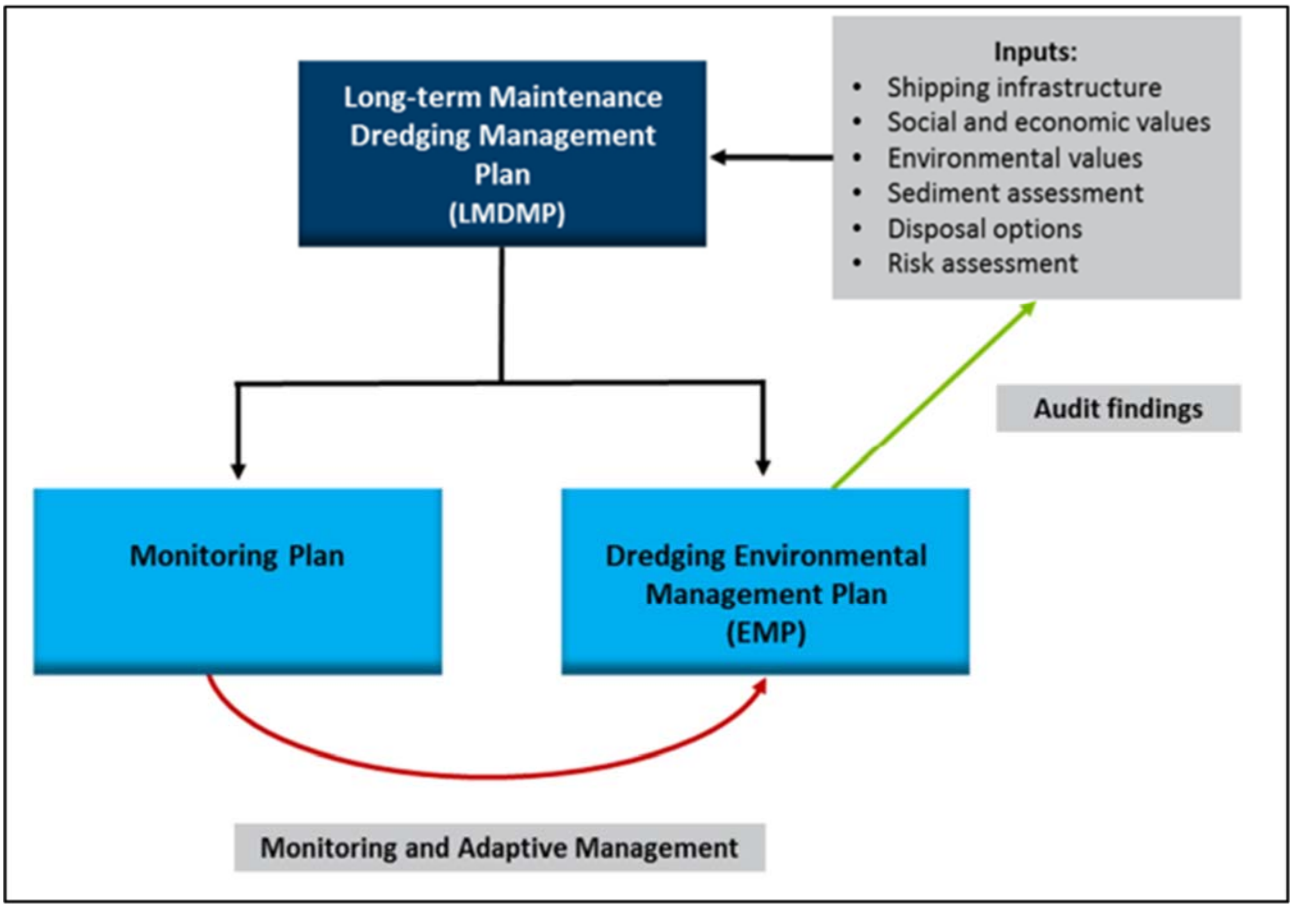
17 ENVIRONMENTAL MANAGEMENT

The Port follows the recommended structure of the MDS (Figure 38) to manage the environmental risks associated with dredging and placement activities at the Port of Lucinda. Should the requirement for maintenance dredging be needed at the Port of Lucinda, the following structure will be implemented in order to comply with any conditions attached to an approval from State and/or Cth Governments.

The Port of Lucinda falls under the Port's EMS. Twice-yearly formal environmental observations are undertaken at the Port of Lucinda and monitoring as part of routine management is undertaken.

If maintenance dredging is ever approved for the Port of Lucinda, this section will be updated.

Figure 38: Dredge Management and Monitoring Elements (MDS 2016)



18 MONITORING FRAMEWORK

Currently, the Port undertakes some monitoring at the Port of Lucinda (Table 15). As maintenance dredging and placement activities do not occur at the Port of Lucinda, a detailed monitoring program for maintenance dredging is not required.

As mentioned in previous sections of this document, should any maintenance dredging and placement activities be proposed for the Port of Lucinda, an updated LTMDMP and a detailed monitoring program will accompany any approval sought from the State and Cth Governments.

Table 15: Monitoring Programs at the Port of Lucinda

Monitoring Type	Description
Ambient monitoring **PORT WIDE**	The Port undertakes some monitoring at the Port of Lucinda. Due to the lack of maintenance dredging, there is a low-risk profile (average of 15 vessels per year). Monitoring has included biosecurity, potable water, groundwater and stormwater, and targeted programs when required.
Impact monitoring **MAINTENANCE DREDGE CAMPAIGN-SPECIFIC**	Maintenance dredging is not approved or undertaken for the Port of Lucinda. Impact monitoring is not currently required, however, should any maintenance dredging be approved by State and Cth governments, impact monitoring will be implemented.
Real-time monitoring **MAINTENANCE DREDGE CAMPAIGN-SPECIFIC**	Currently, no real-time monitoring is undertaken at the Port of Lucinda, as no maintenance dredging is approved or undertaken. As above, should any maintenance dredging be approved by State and Cth governments, real-time monitoring would be implemented if required.

19 PERFORMANCE REVIEW

As described in Section 1.2 the Port's objectives for this LTMDMP are:

a) Maintaining safe navigation for the continued operation of both Ports;

b) Ensuring the OUV of the GBRWHA and sensitive receptors surrounding both the Port of Townsville and the Port of Lucinda are maintained;

c) Ensuring a robust, transparent long-term planning approach to the management of sediments within port infrastructure;

d) Continuing the long-term proactive and environmentally responsible management approach of maintenance dredging and material placement at the Port of Townsville;

e) Capturing and communicating operational controls for best management; and

f) Supporting local and regional communities, ensuring the health, wellbeing and connectivity to the global market is maintained.

Performance indicators used to determine whether these objectives are being met and/or to better inform future risk assessments for the Port of Lucinda are:

- Annual hydrographic surveys to determine any changes in the self-scouring nature of the berth.
- Annual reviews to be undertaken against the performance indicators, this review includes consolidation of the effectiveness and relevance of the performance indicators. This includes initiating an independent review of the LTMDMP if the annual reviews determine the performance indicators are not effective.
- Undertake a full review of the LTMDMP (informal at 12 months; formal at 5 years; and formal for the creation of new LTMDMP at 10 years).

Should any maintenance dredging be approved for the Port of Lucinda, the Port will implement the indicators as used for the Port of Townsville, these are:

- Routine maintenance dredge volumes are within predicted volumes outlined in Table 6 of this document.
- Routine maintenance dredge volumes are within modelled parameters, and modelling is updated if changes are noted and incorporated into the risk assessment as required.
- The Port's requirements for timing of dredge, as identified by the risk assessment, are incorporated into annual scheduling discussions with Queensland ports and Port of Brisbane Corporation.
- No material is placed at sea that has not been assessed against NAGD 2009 and approved for placement (noting a new SAP is required every 5 years).
- Demonstrated evidence that all dredging undertaken is done so under a relevant EMP or DMP.
- The Port to undertake observation during dredge campaigns to provide oversight for compliance with EMP/DMP and/or approvals.
- Incorporate information from ambient and target monitoring and research projects into risk assessments to inform decisions and improve outcomes.

- Capture any performance measures that have not been achieved and detail corrective actions undertaken.
- Full compliance with State and Cth approvals and reporting requirements including notification processes and volume reporting.
- Undertake scheduled internal audits of the LTMDMP as part of the Port's Certified Integrated Management System.
- Annual reviews to be undertaken against the performance indicators, this review includes consolidation of the effectiveness and relevance of the performance indicators. This includes initiating an independent review of the LTMDMP if the annual reviews determine the performance indicators are not effective.
- Undertake a full review of the LTMDMP (informal at 12 months; formal at 5 years; and formal for the creation of new LTMDMP at 10 years).

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21 DEFINITIONS AND ACRONYMS

ADF	The Australian Defence Force
AIMS	Australian Institute of Marine Science
ASS/PASS	Acid Sulphate Soils / Potential Acid Sulphate Soils
CLG	Community Liaison Group
CoA	Commonwealth of Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth
CU	Channel Upgrade
DAWE	(Cth) Department of Agriculture, Water and the Environment
DMP	Dredge Environmental Management Plan
DMPA	Dredge Material Placement Area
DNRME	(QLD) Department of Natural Resources, Mines and Energy
DPA	Dugong Protection Area
DTMR	(Qld) Department of Transport and Main Roads
DUKC	Dynamic Under Keel Clearance
EA	Environmental Authority
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMS	Environmental Management System
EPBC	(Cth) *Environment Protection and Biodiversity Conservation Act 1999*
ERA	Environmentally Relevant Activity
FHA	Declared Fish Habitat Area
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area
GOC	Government Owned Corporation
IMO	International Maritime Organisation
JCU	James Cook University
LMAC	(Townsville) Local Marine Advisory Committee
LTMDMP	Long-Term Maintenance Dredging Management Plan
LTMMP	Long-Term Monitoring and Management Plan for Maintenance Dredging
MDS	Maintenance Dredging Strategy
MNES	Matters of National Environmental Significance
MSQ	Maritime Safety Queensland

NAGD	National Assessment Guidelines for Dredging 2009
NGO	Non-Governmental Organisation
NQCC	North Queensland Conservation Council
OUV	Outstanding Universal Value
PAB	Port Advisory Body
PEP	Port Expansion Project
PEWG	Planning and Environment Working Group
PIANC	Permanent International Association of Navigation Congresses
Port	Port of Townsville Limited
QPA	Queensland Ports Association
RHM	Regional Harbour Master
SAP	Sediment Sampling and Analysis Plan
TACC	Technical Advisory and Consultative Committee
TCC	Townsville City Council
TMP	Townsville Marine Precinct
TSHD	Trailer Suction Hopper Dredge

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