Long-term Maintenance Dredging Management Plan

North Queensland Bulk Ports Corporation

Port of Hay Point

Long-term Maintenance Dredging Management Plan

2018 – 2043

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ADAPTIVE STRATEGIES

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1. Introduction

The Port of Hay Point (the Port) is a major bulk commodities port managed by the North Queensland Bulk Ports Corporation Pty Ltd (NQBP). The Port was established in 1971 and is home to two coal terminals - Dalrymple Bay Coal Terminal (DBCT) and Hay Point Coal Terminal (HPCT). It is a coastal port with offshore trestle jetties extending approximately 4km seaward. The port has seven dedicated coal loading berths, with over 100 Million tonnes of coal currently exported each year. The majority of this coal (~85%) is metallurgical (coking) coal exported to Asian customers for the making of steel.

Hay Point is located approximately 40 km south of Mackay in Queensland on Australia's east coast. The maritime areas of the Port are within the Great Barrier Reef World Heritage Area (GBRWHA) and adjacent to the Great Barrier Reef Marine Park (GBRMP). The shipping departure path, which is approximately 9 km long, extends into the Marine Park.

The port's navigational areas include seven ship loading berths, an apron area, departure path, apron areas and tug harbour. An approved Dredged Material Placement Area (DMPA) is located approximately 6 km from the berth areas.

Left unmanaged, natural sediment fills up navigational infrastructure, impacting the depth necessary for safe loading, manoeuvring and transit of ships. A reduced ability to effectively load ships can have a substantial economic impact on the region that the port supports.

1.1. Purpose and Objectives

The purpose of this Long-term Maintenance Dredging Management Plan (LMDMP) is to document the strategy for managing natural sediment accumulation at the Port of Hay Point, in a way that ensures the safe and efficient operation of the Port and the ongoing protection of local environmental values and the Outstanding Universal Value (OUV) of the GBRWHA.

The objectives of the LMDMP are to:

1. Provide a framework for maintenance dredging of the Port over the next 25 years.
2. Establish a robust, transparent long-term planning approach to managing port sediment.
3. Outline operational, planning, consultation and monitoring arrangements.
4. Maintain local environmental values, including the Outstanding Universal Value of the GBRWHA.
5. Apply continual improvement practices in the management of sediment and dredging actions.

1.2. Changes to the LMDMP

This plan is intended to demonstrate commitment to the long-term management of maintenance dredging and disposal activities for the Port of Hay Point, from 2018 to 2043. The plan is supported by a 25-year technical analysis (*The Port of Hay Point Sustainable Sediment Management Assessment*).

This LMDMP will be reviewed and updated every 5 years or when one of the following occurs:

a) when permit conditions have been changed or amended or new permits issued
b) when monitoring results report substantially different impacts than were predicted, or
c) if an incident occurs that poses a significant risk to effective future management.

The current approved LMDMP will be maintained on the North Queensland Bulk Ports (NQBP) website – www.nqbp.com.au.

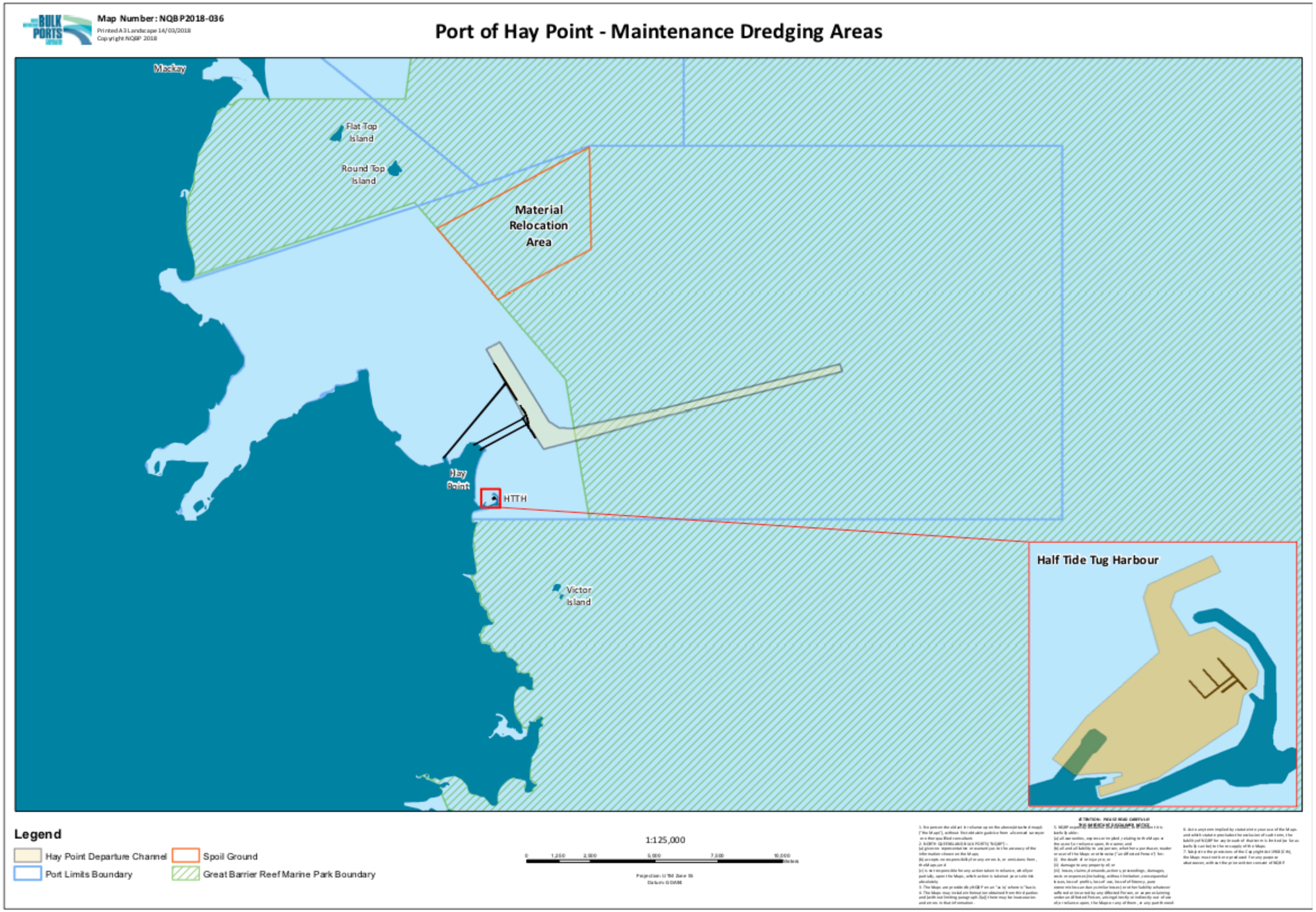


Figure 1: Port of Hay Point

1.3. Policy Content

The plan will also ensure that dredging activities align with the principles, elements and objectives described in:

- Reef 2050 Long term Sustainability Plan (CoA 2015)
- Environmental Code of Practice for Dredging and Dredged Material Management (Ports Australia 2016)
- GBRWHA Maintenance Dredging Strategy (SOQ 2016)
- National Assessment Guidelines for Dredging (NAGD) (CoA 2009).

Reef 2050 Long Term Sustainability Plan

The Reef 2050 Plan was released by the Australian and Queensland governments in March 2015 and is the overarching framework for protecting and managing the Reef until 2050. The Plan is a world-first document that outlines concrete management measures for the next 35 years to ensure the Outstanding Universal Value of the Reef is preserved now and for generations to come.

The Plan sets clear actions, targets, objectives and outcomes to drive and guide the short, medium and long-term management of the Reef. The Plan firmly responds to the pressures facing the Reef and will address cumulative impacts and increase the Reef's resilience to longer term threats such as climate change.

In relation to ports, the Reef 2050 Plan notes that:

> "As an island nation, Australia relies heavily on its maritime links. In 2012-13, ports in and adjacent to the World Heritage Area accounted for 20 per cent of the total throughput of all Australian ports combined, with a value of $40 billion.
>
> Ports have been operated along the Great Barrier Reef coast since well before its world heritage listing and are included within its boundaries. The footprint of port areas is small, covering less than 0.1 per cent of the World Heritage Area. The importance of ensuring port activities are ecologically sustainable, particularly dredge projects and the disposal of dredge material, is recognised by all levels of government and by the ports industry.
>
> Ports on the Great Barrier Reef coast are major hubs for the export of Australian products including coal, minerals, sugar and other agricultural products, and liquefied natural gas. The ports of Gladstone (18 berths), Townsville (9 berths), Hay Point (7 berths) and Abbot Point (2 berths) are tiny compared to the megaports of China, Singapore, Europe and the United States which each have 75 to 250 shipping berths and will remain tiny by comparison after current expansion plans are completed.
>
> The Outlook Report 2014 found the direct and flow-on effects of port activities, including dredging and the disposal of dredge material, generally occur in areas that are already under pressure from an accumulation of impacts. While port activities have a significant localised effect, these activities pose a relatively lower threat to the health of the broader World Heritage Area compared to, for example, the broadscale impacts from land-based run-off."

The Reef 2050 Plan includes a number of port related actions that make clear the need for port authorities to understand the sedimentation characteristics of their ports, avoid and reduce impacts where possible, and establish sustainable long-term management arrangements.

Ports Australia Dredging Code of Practice

The Ports Australia *Dredging Code of Practice for Dredging and Dredged Material Management* sets out a number of environmental principles that Australian ports meet when undertaking dredging and disposal of dredged material. The principles have been defined on the basis of ecologically sustainable development principles.

Queensland Maintenance Dredging Strategy

Queensland's *Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports* (SOQ 2016) provides a framework for sustainable, leading practice management of maintenance dredging at ports in the Great Barrier Reef World Heritage *(*GBRWHA). The framework builds on the current regulatory requirements to ensure the ongoing protection of the Reef's values and the continued operating efficiency of ports within the GBRWHA.

The Strategy sets up a framework for maintenance dredging management and requires ports within the GBRWHA to develop and implement long-term maintenance dredging management plans.

Figure 2: Framework for Long-term maintenance dredging management (SOQ 2016)

The development and implementation of this Plan is in line with applicable principles contained in the Maintenance Dredging Strategy, specifically:

- Developing the knowledge base, using the best science available
- Avoiding or minimising the need for maintenance dredging
- Application of the principles of ecologically sustainable development
- Maintaining and enhancing environmental values, including the OUV of the Great Barrier Reef World Heritage Area
- Going further than avoiding and mitigating impacts, to look for opportunities to deliver environmental protection, restoration or enhancement outcomes (working with nature principles)
- Application of comparative analysis to determine the most suitable solutions
- Application of adaptive management and continuous improvement processes
- Reporting evaluated performance and providing access to data and information from monitoring
- Favouring transparency, consultation with key stakeholders and values-based assessment.

This LMDMP fulfils the expectations of the Queensland's *Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports*, as outlined in Figure 3. As outlines the LMDMP comprises the main planning and management tool. The supporting Maintenance Dredging EMP and Monitoring Program are provided in separate documents.

- The Maintenance Dredging EMP is developed in conjunction with the dredge operator, it is specific an individual dredging campaign and contains the operational controls for the dredge.
- The Monitoring Program is developed by NQBP and outlines the ambient, impact and adaptive monitoring overseen by the Port Authority.

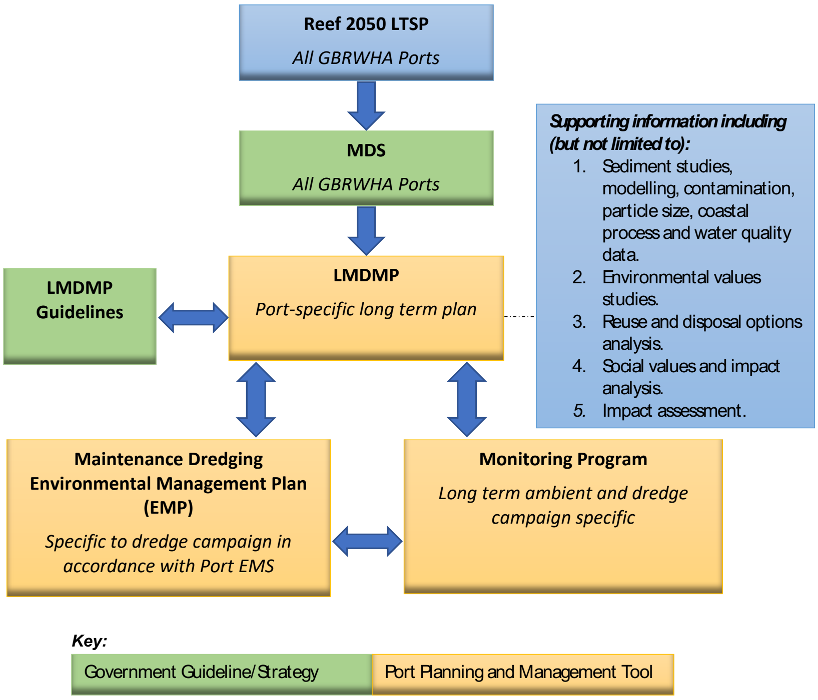


Figure 3: Planning and implementation mechanisms for maintenance dredging of ports Queensland wide (CoA 2009)

National Assessment Guidelines for Dredging (NAGD)

The NAGD established a scientific assessment framework to determine if dredge material is suitable for ocean disposal in line with the *Environment Protection (Sea Dumping) Act 1981* and the *1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972* (the London Protocol). The Guidelines include an assessment framework (Figure 4) that is applied to ensure the impacts of dredged material loading and disposal are adequately assessed.

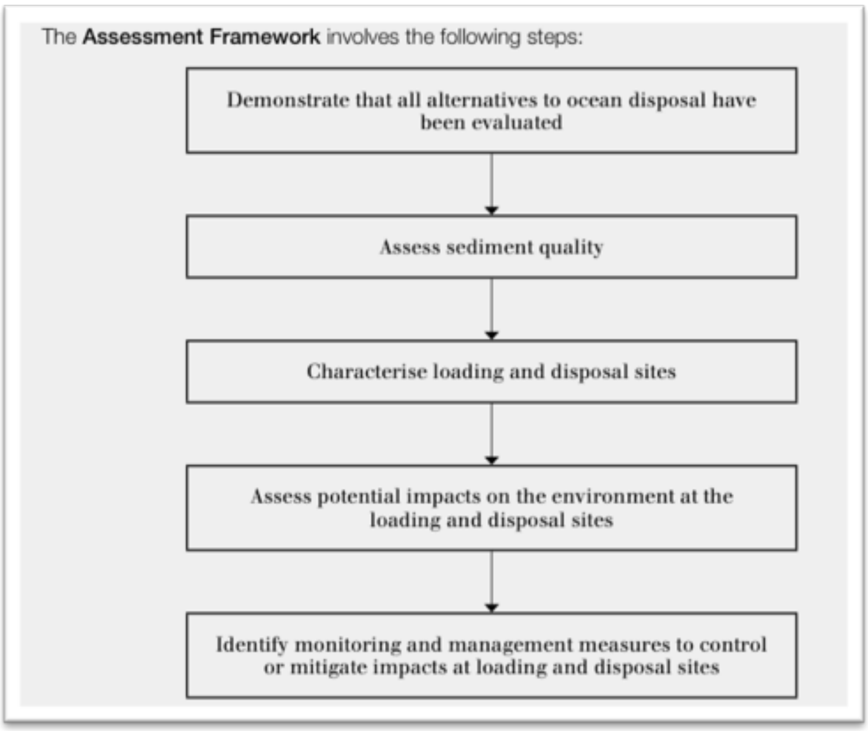


Figure 4: National assessment framework for dredge material disposal (CoA 2009)

1.4. Governance

LEGISLATION AND APPROVALS

Maintenance and capital dredging programs are subject to a number of Commonwealth and Queensland government laws and policies. This section describes the key environmental, cultural and planning legislation and policies that apply to dredging and dredge material placement projects undertaken at the Port of Hay Point. Specifics on which of these particular legislation and approvals processes apply to a proposed dredging project will need to be undertaken in the initial planning stage of any proposed dredging campaign, taking into account the specifics of each proposed dredging program.

COMMONWEALTH LEGISLATION AND POLICY

A number of key pieces of Commonwealth environmental and cultural protection legislation may apply to dredging projects undertaken within Australia:

- Environment Protection (Sea Dumping) Act 1981
- Environment Protection and Biodiversity Conservation Act 1999
- Great Barrier Reef Marine Park Act 1975.

Environment Protection (Sea Dumping) Act 1981

Dumping of waste and other material from any vessel, aircraft or platform in Australian waters is prohibited under the *Environment Protection (Sea Dumping) Act 1981*, unless a permit has been issued. Permits are most commonly issued for dredging operations and the creation of artificial reefs. The Act fulfils Australia's international obligations under the London Protocol (to prevent marine pollution by controlling dumping of wastes and other matter). The Act is administered by the Department of Environment and Energy (DEE); or by the Great Barrier Reef Marine Park Authority (GBRMPA) for activities inside the Great Barrier Reef Marine Park.

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central environmental legislation. The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities, wetlands and heritage places which are defined in the EPBC Act as matters of national environmental significance (MNES).

The EPBC Act is triggered when a development proposal has the potential to have a significant impact on MNES. Approval under this Act is not required is significant impact to MNES will not result.

Great Barrier Reef Marine Park Act 1975

The *Great Barrier Reef Marine Park Act 1975* is the primary Act relating to the Great Barrier Reef Marine Park. It establishes the Great Barrier Reef Marine Park and the Great Barrier Reef Marine Park Authority (GBRMPA), a Commonwealth authority responsible for the management of the Marine Park. The Act provides a framework for planning and management of the Marine Park, including through zoning plans, plans of management and a system of permissions. Dredging or placement of material inside the Marine Park requires a permit issued by GBRMPA.

STATE LEGISLATION AND POLICY

The Queensland Government also regulates maintenance dredging under a series of State laws. The legislation that applies is determined by the location of the dredging activity and the type and scale of dredging being undertaken.

The primary legislation that may apply includes:

- Queensland Marine Parks Act 2004
- Sustainable Ports Development Act 2015

Queensland Marine Parks Act 2004

The Great Barrier Reef Coast Marine Park (GBR Coast MP) is a state marine park that runs the full length of the GBR from just north of Baffle Creek (north of Bundaberg) to Cape York. It provides protection for Queensland tidal lands and tidal waters.

The Marine Parks Act 2004 supports the creation of a comprehensive and balanced zoning system within the GBR Coast MP, providing protection of the Great Barrier Reef's unique biodiversity, while continuing to provide opportunities for the use of and access to the marine park.

Sustainable Ports Development Act 2015

The *Sustainable Ports Development Act 2015* (Qld) (SPD Act) restricts new port development in and adjoining the GBRWHA to within current port limits and outside Commonwealth and state marine parks. It also prohibits major capital dredging for the development of new or expansion of existing port facilities in the GBRWHA outside the priority ports of Gladstone, Abbot Point, Townsville and Hay Point/Mackay, and prohibits the sea-based disposal of port-related capital dredge material within the GBRWHA.

In addition, the SPD Act mandates master planning for priority ports and their surrounding land and marine areas.

APPROVALS

There are a number of State and Federal approvals necessary for ongoing maintenance dredging and disposal at the Port of Hay Point. As at the commencement of 2018, State approvals are in place, and new Federal approvals are being sought.

Table 1: Dredging related permits

Permit	Activity
Environmental Authority (EA)	Undertake maintenance dredging of navigational infrastructure
Operational Works (Tidal Works)	Disposal of dredged material below high-water mark
Marine Park Permit	Maintenance Dredging and Disposal in Marine Park
Sea Dumping Permit	Maintenance Dredging and Disposal at sea.

NOTIFICATION AND OBLIGATIONS SCHEDULE

Prior to maintenance dredging commencing NQBP will develop a 'notifications and obligations schedule' that clearly outlines relevant reporting requirements and obligations arising from all current permits. The schedule will separately show notification requirements and condition obligations for the periods:

1. Pre-maintenance dredging commencing.
2. During active maintenance dredging and disposal.
3. Post-maintenance dredging reporting and closeout.

The most current notifications and obligations schedule will be provided to the Technical Advisory Consultative Committee (TACC).

1.5. Responsibilities

NQBP is a government owned corporation that reports to two Government Shareholding Minsters (Minister for Main Roads, Road Safety and Ports; and the Treasurer). The shareholding ministers are represented by a Board of Directors who oversee the governance and direction of the organisation.

NQBP as the Port Authority for the Port of Hay Point are responsible for the maintenance of:

- Departure Path and Apron Areas, and
- Half Tide Tug Harbour

NQBP also take on the responsibility of maintaining navigational infrastructure specific to Dalrymple Bay Coal Terminal (DBCT) and Hay Point Coal Terminal (HPCT), including:

- DBCT Berth Pockets x 4
- HPCT Berth Pockets x 3

As such, NQBP are the holder of all permits related to maintenance dredging at the Port of Hay Point.

A *Maintenance Dredging Steering Committee* oversees the day to day planning and operations of maintenance dredging at the Port of Hay Point. The committee is responsible for:

- financial review and approval
- dredging contract review and approval
- approval of the LMDMP, Monitoring Program and environmental management plans
- review and approval of external affairs and media correspondence.

The committee is chaired and attended by key executives of NQBP and includes senior representatives from both port terminals.

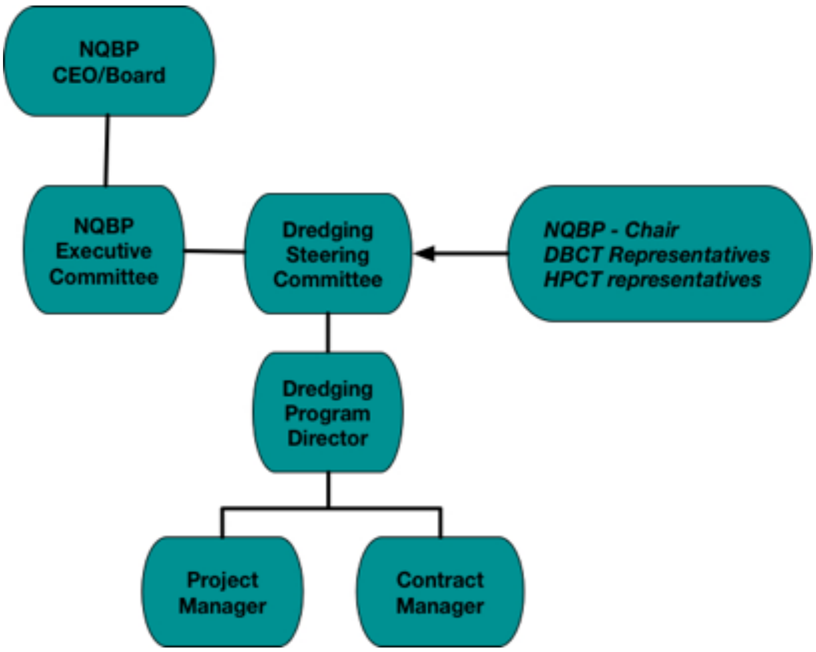


Figure 5: Structure of Maintenance Dredging Steering Committee

2. Port Locality, Setting and Shipping

Hay Point is located approximately 40 km south of Mackay in Queensland on Australia's east coast. It is situated close to the neighbouring communities of Louisa Creek, Salonika and Half Tide.

The Port of Hay Point is one of the largest coal exporting ports in the world, as of 2017 the combined export volumes from the two terminals (approx. 115 million tonnes per annum) equates to around 1,020 ship calls or 2,040 ship movements per year.

All of the vessels calling at the Port are bulk carriers, which are a highly efficient form of transport globally and are able to move large volumes of product effectively around the world. Bulk carriers vary in size, however, the four main industry standards of bulk carriers are:

- Handy: up to 40,000 dry weight tonnes (DWT).
- Handymax: up to around 50,000 DWT, and around 150 m to 200 m in length.
- Panamax: up to around 90,000 DWT, and averaging around 230 m in length, but limited in beam to 32 m to permit passage through current Panama Canal locks.
- Capesize: upwards of 90,000 DWT, but typically around 100 000 DWT to 250,000 DWT, with a length of around 280 m or more and wider in the beam than a Panamax ship.

In 2017, ships calling at the Port of Hay Point are primarily Panamax or Capesize with the average ship cargo parcel (volume) being 100,000 to 110,000 DWT.

To accommodate bulk carriers of this size the navigational areas within the Port have been deepened to enable the safe departure of loaded vessels.

Figure 6Figure 6 provides a cross-sectional representation of the various depths related to dredging and safe vessel movements.

Figure 6: Shipping channel terms and depths

The offshore infrastructure at the Port of Hay Point is described below and is shown in Figure 7.

The environmental setting of the Port of Hay Point is discussed in Section 4.

2.1. Channels and Apron

In October 2006 NQBP completed the development of a departure channel and apron area for shipping at the Port. These areas include:

- a ship manoeuvring apron area approximately 500 m wide adjacent to the existing berths
- a departure channel from the apron east to deeper water approximately 9,500m long. The first 500m of the channel is 500m wide, after which it tapers to a width of 300 m.

The departure path and apron area have a design depth of 14.9 m below Lowest Astronomical Tide (LAT).

2.2. DBCT

Dalrymple Bay Coal Terminal (DBCT) is the larger of the two terminals with a total capacity of 85mtpa. It is a multi-user facility that services a large number of coal mines in the Bowen Basin coalfield area. DBCT consists of four berths, each serviced by a shiploader.

2.3. HPCT

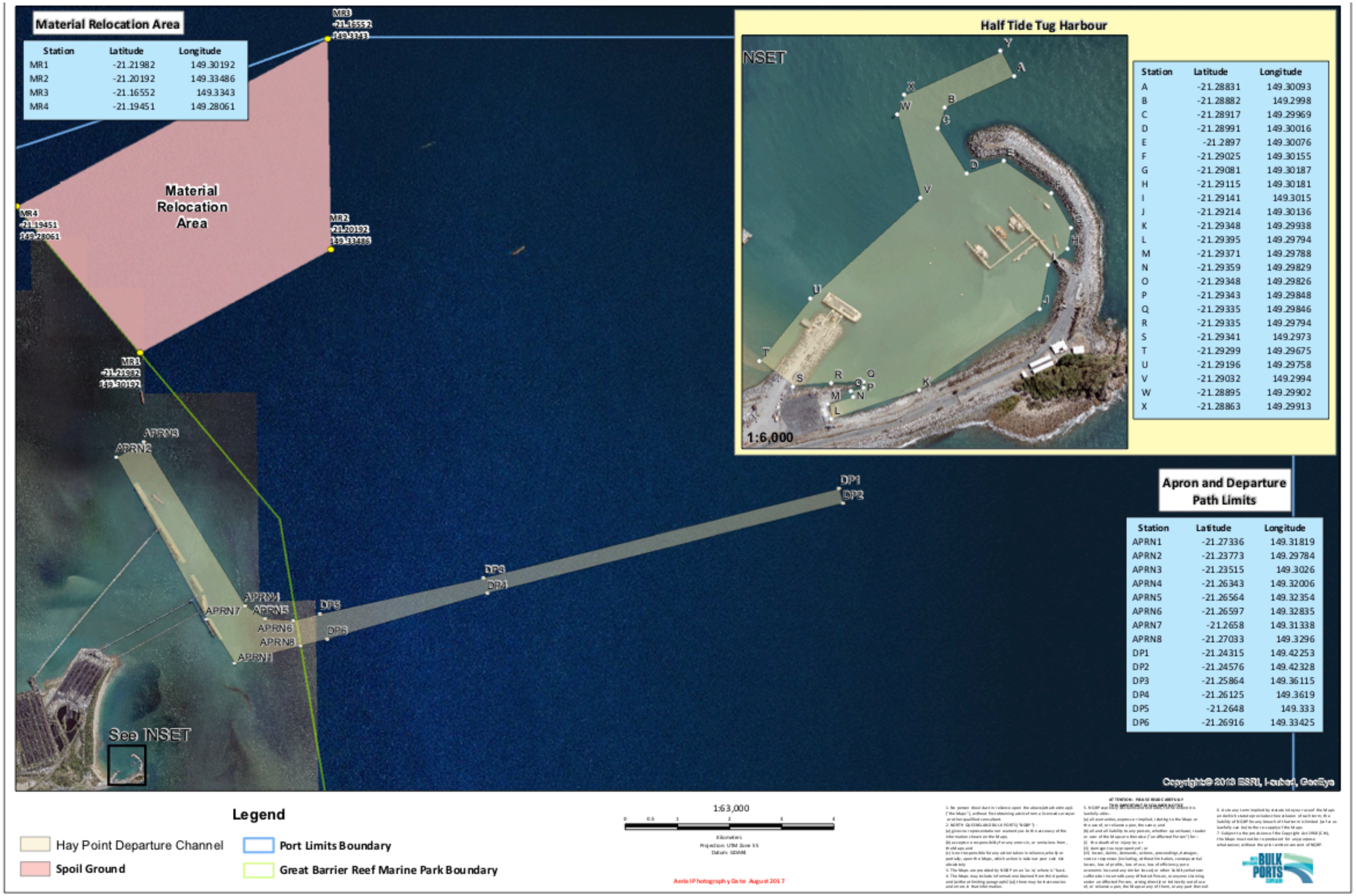
Hay Point Coal Terminal (HPCT) is operated by Hay Point Services Pty Ltd for BHP Billiton Mitsubishi Alliance (BMA). HPCT currently has a capacity of 55mtpa. The trestle wharf at HPCT is 2.2 km long and supplies coal to three berths.

2.4. Tug Harbour

The Half Tide Tug Harbour provides mooring for the tugs servicing both terminals. This includes 6 berths and a small swing basin and access channel.

Table 2: Dimensions of navigational areas at the Port of Hay Point

Location	Design Depth (m below LAT)	Length (m)	Width (m)
Departure Path	14.9	9,500	300-500
Apron	14.9	4,500	500
DBCT Berth 1	19.6	425	71
DBCT Berth 2	19.6	425	71
DBCT Berth 3	19.0	450	71
DBCT Berth 4	19.0	450	71
HPCT Berth 1	16.6	343	61
DBCT Berth 2	16.7	366	61
DBCT Berth 3	19.0	460	70
Tug Harbour	5.6 (approaches) 6.1 (berths) 1.0 (boat ramp)	120,000m^2	



Material Relocation Area

Station	Latitude	Longitude
MR1	-21.21982	149.30192
MR2	-21.20192	149.33486
MR3	-21.16552	149.3343
MR4	-21.19451	149.28061

Half Tide Tug Harbour

Station	Latitude	Longitude
A	-21.28831	149.30093
B	-21.28882	149.2998
C	-21.28917	149.29969
D	-21.28991	149.30016
E	-21.2897	149.30076
F	-21.29025	149.30155
G	-21.29081	149.30187
H	-21.29115	149.30181
I	-21.29141	149.3015
J	-21.29214	149.30136
K	-21.29348	149.29938
L	-21.29395	149.29794
M	-21.29371	149.29788
N	-21.29359	149.29829
O	-21.29348	149.29826
P	-21.29343	149.29848
Q	-21.29335	149.29846
R	-21.29335	149.29794
S	-21.29341	149.2973
T	-21.29299	149.29675
U	-21.29196	149.29758
V	-21.29032	149.2994
W	-21.28895	149.29902
X	-21.28863	149.29913

Apron and Departure Path Limits

Station	Latitude	Longitude
APRN1	-21.27336	149.31819
APRN2	-21.23773	149.29784
APRN3	-21.23515	149.3026
APRN4	-21.26343	149.32006
APRN5	-21.26564	149.32354
APRN6	-21.26597	149.32835
APRN7	-21.2658	149.31338
APRN8	-21.27033	149.3296
DP1	-21.24315	149.42253
DP2	-21.24576	149.42328
DP3	-21.25864	149.36115
DP4	-21.26125	149.3619
DP5	-21.2648	149.333
DP6	-21.26916	149.33425

Figure 7: Navigational infrastructure at the Port of Hay Point

3. Port Environmental Values

In managing sediment and dredging activities at the Port of Hay Point it is essential to understand the environmental, social and cultural values of the Port and the surrounding area. The commercial activities were discussed previously in Section 3.

The focus is on values that are considered important or notable at a national, regional or local level. The aim is to provide a useful level of detail and relevance to management planning. Values are described for the broader area incorporating the port limits and adjacent environs. More detailed information regarding these values can be found in the *Port of Hay Point Environmental Values Report* (Jacobs 2016).

The area from the south of the Port of Hay Point to north of the Port of Mackay has been highly modified. The area supports agricultural, urban, industrial, port and shipping, and commercial and recreational uses. The sub-catchments in this region are some of the most modified catchments along the Queensland coast, with over 50 per cent of catchment areas used for intensive agriculture such as sugar cane (Reef Catchments 2014).

The region also continues to support areas of international, national and state environmental significance. Historic land use practices have resulted in fragmented remnants of native vegetation throughout the landscape and along riparian corridors. These natural features provide important habitat corridors for a variety of native flora and fauna. The marine environment adjacent to the Port and coastline also contributes to the diversity of values in the region and importantly the Outstanding Universal Value (OUV) of the GBRWHA.

WHAT IS AN 'IMPORTANT VALUE'?

- For the purposes of this review, *important environmental* values are those that are:
- Matters of national environmental significance protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Matters of state environmental significance protected under Queensland environmental protection and management laws.
- Habitats or ecosystems that are considered 'important' or 'critical to the survival' of listed species or communities.
- Values that contribute significantly to the Outstanding Universal Value of the GBRWHA.

Important *social and cultural* values are those that are:

- Included in national or state registers.
- Identified by traditional owners or community members.
- Values that contribute to the appreciation culture and heritage in the region.
- Features that provide a connection to the landscape, history or previous or current use of the area.

3.1. OUV of the GBR World Heritage Area

The Port of Hay Point is partly within the GBRWHA (listed as a World Heritage Area in 1981). The GBRWHA is listed based on it meeting four World Heritage criteria for OUV:

- Natural beauty and natural phenomena (Criterion (vii)).
- Major stages of the Earth's evolutionary history (Criterion (viii)).
- Ecological and biological processes (Criterion (ix)).
- Habitats for conservation of biodiversity (Criterion (x)).

Of the important environmental values present in the region, three are considered to contribute significantly to the OUV of the GBRWHA (Jacobs 2016). These are:

- Internationally recognised **migratory shorebird roosting sites** at Sandringham Bay and Mackay Town Beach that support 23,000 shorebirds each year during their annual migration.
- A core **aggregation/calving area** for the east-coast population of humpback whales approximately 80 km east of Mackay.
- A high diversity of **mangrove species** within estuarine areas.

3.2. Regional Environmental Features

The key environmental values present within the region are summarised in Table 3.

Table 3: Regional environmental features

FEATURE	DESCRIPTION
World Heritage	The area lies adjacent to, and within the Great Barrier Reef World Heritage Area. Of the important key environmental features present within the region, three are considered to contribute significantly to the OUV of the GBRWHA. These include internationally recognised migratory shorebird roosting sites at Sandringham Bay and Mackay Town Beach; a core aggregation/calving area for humpback whales 80 km offshore of Mackay; and, a high diversity of mangrove species.
Remnant Vegetation	The Mackay region supports a wide range of remnant vegetation types in varying condition and patch size. Vegetation types mapped within the area include mangroves, dunal vegetation, vine forest, swamps and wetlands, open eucalypt forest and tussock grassland (Jacobs 2016). Of these vegetation types (or Regional Ecosystems) a number are listed as 'endangered' or 'of concern' under the Queensland *Vegetation Management Act 1999* (Jacobs 2016). Approximately 2,875 ha of 'endangered' REs are present and 1,285 ha of 'of concern' REs are present. These vegetation types occur as scattered patches along the coastline and estuaries.
Threatened Ecosystems	Two threatened ecological communities occur within the study area including the Commonwealth listed critically endangered Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (58 ha) and endangered Broad-leaved Tea Tree Woodlands in High Rainfall Coastal North Queensland (121 ha).
Threatened Terrestrial Fauna and Flora	The area supports a number of threatened fauna including birds and mammals, with locally important populations present. Four threatened flora species are known to occur in the area including black ironbox (*Eucalyptus raveretiana*), lesser swamp orchid (*Phaius australis*), holly-leaved graptophyllum (*Graptophyllum ilicifolium*) and *Omphalea celata*. There is also potential habitat for the byfield matchstick (*Comesperma oblongatum*) and *Neisosperma ilneri* within the study area.
Shorebirds	Significant shorebird roosting habitat is present within the area including internationally important habitat at Sandringham Bay and Mackay Town Beach. Nationally important shorebird roosting sites occur at the mouth and banks of the Pioneer River, Armstrong Beach and Sandfly Creek. The area supports over 23,000 shorebirds each year during annual migration. Sandringham Bay is internationally important for the eastern curlew, lesser sand plover and great knot, and nationally important for the terek sandpiper (*Xenus cinereus*), bar-tailed godwit and ruddy turnstone (*Arenaria interpres*). Mackay Town Beach is also an internationally important site for the eastern curlew, the great knot, and lesser sand plover. Mackay Town Beach has large areas of intertidal flats that are suitable for shorebird feeding. Over 4,000 roosting shorebirds have been recorded and it is estimated that the shorebird feeding area density is 25 birds/100 m^2. Other species known to feed at Town Beach include the bar-tailed godwit, whimbrel and grey-tailed tattler.
Mangroves	The Pioneer River and Sandringham Bay – Bakers Creek Aggregation support extensive mangrove communities. These areas contain a diversity of mangrove species that is found throughout the Mackay region. The area suffered significant mangrove dieback in 2002, particularly of the Grey Mangrove due to pesticide use on cane farms within catchment areas.
Rivers	The Pioneer River, which runs through the city of Mackay, and Bassett Basin lie south of the Port of Mackay. Basset Basin is an estuary of the Pioneer River and provides important nurseries. It was declared a Fish Habitat Area in 1993 and is assigned management category B (i.e., where existing or planned use requires a more flexible management approach). Prior to this

	it was a wetland reserve and managed to enhance existing and future fishing activities. Mangroves and related tree communities make up 4.2 km^2 of the 6.6 km^2 Fish Habitat Area.
Water	The area is influenced by the Alligator Creek, Sandy Creek, Bakers Creek and Sarina Beaches subcatchments of the Pioneer Basin. These catchments are some of the most modified catchments of the Great Barrier Reef coast, with over 50% of their catchment used for intensive agriculture production (Reef Catchments 2013). Water quality in the area is considered to be poor due to the high levels of nutrients and pesticides resulting from the surrounding land uses.
Soils	Soils in the region provide high-quality sugarcane and grazing land. They primarily consist of Quaternary alluvium and lacustrine deposits (sand, silt, mud and gravel). Soils in low-lying coastal areas (<5 m AHD) of Mackay and Hay Point contain Potential Acid Sulfate Soils.
Islands	A small number of islands lie offshore of the Mackay region. The nearest islands to the Port of Mackay and Port of Hay Point include Slade Islet, Round Top Island, Flat Top Island and Victor Islet. Keswick and St Bees Island occur further offshore, to the north-east of the Port of Mackay.
Seagrass	Seagrass in the region is naturally variable in distribution and species composition due to a number of seasonal factors. Deepwater seagrasses are particularly transient, and usually only occur between July and November. Two deepwater seagrass beds and one coastal seagrass bed (north-western shore of Round Top Island) have previously been observed in the waters offshore of the Port of Mackay. Deepwater seagrass meadows have also been recorded offshore of Hay Point. These meadows are particularly variable, and often occur as small patches during December and May. Surveys have also found three small patches of inshore seagrass adjacent to Dudgeon Point.
Coral	There are a number of reefs dominated by sediment-tolerant hard coral species within the waters offshore of Mackay and Hay Point. Hay Reef, Victor Islet, Round Top Island, Flat Top Island, Taroba Rocks, Dudgeon Point, Keswick Island and St Bees Island all support areas of coral. These areas have been shown to support low to medium densities of corals.
Benthic Habitats	The region supports macroalgae and benthic invertebrate communities of varying densities which also vary over time. Macroalgae species observed within the area include *Sargassum* sp., *Udotea* sp. and *Caulerpa* sp. (Rasheed et al 2004; Thomas et al 2010). Low density (<1 – 5%) macroalgae communities are present surrounding both the Port of Mackay and the Port of Hay Point. High macroalgae cover (>20%) occurs on the rocky reef areas surrounding islands within the area including Flat Top and Round Top islands, Slade Islet and Slade Point (Rasheed et. al. 2001). The seafloor offshore of the two ports supports large areas of medium density algae (5-20%), with patches of low and high density occurring in inshore and offshore areas. Most of the seafloor in the area is comprised of open sandy areas with sparse cover of invertebrates such as bivalves, ascidians, bryozoans, echinoids and corals.
Sediments	Marine sediments along the coastal strip of the area can be described as silts and silty sands. Further offshore sediments have been found to be dominated by medium and coarse sand, with small amounts of gravel and finer fractions of silts and clays. The finer fractions of sediments in the marine environment can act as sinks for contaminants. Analysis of sediment quality from the Port of Hay Point and Port of Mackay have found that contaminant substances have tested <u>below</u> the National Assessment Guidelines for Dredging (NAGD, DEWHA 2009).
Threatened Marine Fauna	The area supports locally important populations of a number of threatened and migratory marine species. Marine species known to occur in the area include: marine turtles (green, flatback, leatherback and hawksbill), dugongs, whales and dolphins. Low-density marine turtle nesting has been identified on beaches in the region. There is also an important aggregation area for humpback whales 80 km off the coast of the Port of Mackay. It is thought that whales aggregate for breeding and calving in these waters.

3.3. Marine Values

The key marine values present in the vicinity of the port area are summarised in Table 4 and shown in Figure 8.

Table 4: Marine values

MARINE	
Rocky and coral reefs	• Round Top Island, Flat Top Island, Slade Islet, Victor Islet, Dudgeon and Hay Reefs are known to support small rocky fringing reefs. Reefs in these areas are comprised of hard coral species common to turbid marine environments in the Great Barrier Reef (genera Montipora, Acropora, Pocillopora and Turbinaria) and a diverse range of soft corals, sponges, sea fans, ascidians and hydroids similar to fringing reefs in areas experiencing large tidal variations (Ayling et al 1998). • These rocky and coral reef habitat areas are locally important to fish and other marine species. They are not considered to be regionally significant areas of coral or rocky reef habitat.
Seagrass	• Seagrass beds within the assessment area are likely to be ephemeral (Rasheed et al 2001; Rasheed et al 2004). Historically, seagrass has been found within survey areas in low and medium densities. The most recent seagrass surveys located offshore *Halophila decipiens* beds within and adjacent to the existing dredge material placement area (McKenna et al 2016). • Seagrass beds have also historically occurred in inshore areas at Dudgeon Point, Flat Top and Round Top islands.
Macroalgae	• Cumulative algae cover in areas within and surrounding the existing dredge material placement area indicate the region supports large areas of medium density algae (5-20%), with patches of low (<1-5%) and high density (>20%) occurring in inshore and offshore waters. Algae species observed in the area have been found to generally include *Sargassum, Udotea* and *Caulerpa* (Rasheed et al 2004; Thomas et al 2010).
Benthic invertebrate communities	• Surveys of benthic invertebrate communities within the existing spoil ground indicated the area was predominately comprised of low density communities (1-10%) with a small patch of moderate density (>10%) communities (Thomas & Rasheed 2001). These regions had a mostly open seafloor (with small areas of rubble patches) with a moderate density of encrusting bryozoans and polychaete worms (Thomas & Rasheed 2001).
Threatened and migratory marine fauna	• There are no known important populations of threatened or migratory marine animals within the offshore assessment area. The assessment area does however support marine species foraging or resting in the area these include: – flatback, green, loggerhead, leatherback, olive ridley and hawksbill turtles forage in the algal, seagrass and rocky reef areas – dugong forage in the inshore and offshore seagrass areas – humpback whales use the nearby offshore waters for resting during their migration along the east coast – saltwater crocodile transit through the area (NQBP 2010; 2011, 2018). • There is also potential for the indo-pacific humpback dolphin, the Australian snubfin dolphin, and inshore and offshore forms of the bottlenose dolphin to occur within the offshore areas (NQBP 2011). • The intertidal wetlands of Sandringham Bay- Bakers Creek Aggregation provide seasonally important feeding habitats for waders and other migratory shorebirds, particularly between August and April (Harding & Milton 2003).

Marine water and sediment quality	• Water quality in the offshore waters of the Port of Hay Point is influenced by wind driven currents and large ranging tidal currents, causing naturally turbid waters as a result of constantly resuspended sediments. Water quality analysis in areas surrounding the existing port infrastructure indicate that offshore areas have a lower percentage of total nitrogen than inshore sites. The offshore areas also have higher salinities, DO (% saturation) and pH than inshore sites (Worley Parsons MDMP 2013). • Sediments within the existing dredge material placement area are dominated by medium and coarse sand (>85.5%) and gravel (6.4%), the finer fractions <63 μm (silt and clay) represent <4% of the sediments (Worley Parsons – Marine 2012). Sediments within the potential outer placement area are comprised of mostly sand (80.6%) with small fractions of silts (10.5%) and clays (8.6%) (Worley Parsons 2013).

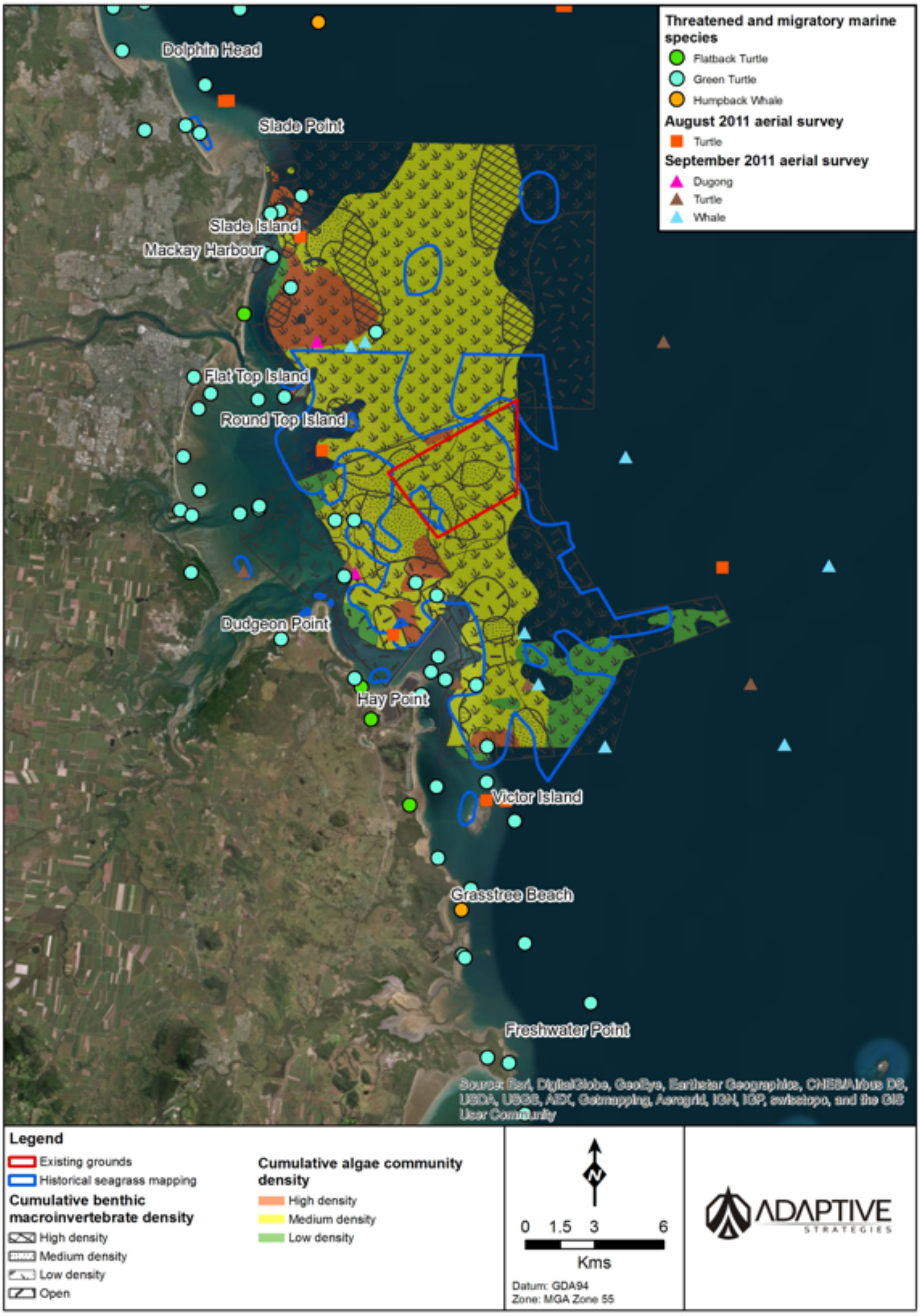


Figure 8: Marine values in vicinity of Port of Hay Point

3.4. SOCIAL VALUES

The closest significant population hubs to the Port of Hay Point are the towns of Sarina, 23 km to the south west of the port, and Mackay 40 km to the north, which is the administrative centre of the region. The coastal communities of Hay Point and Louse Creek are located adjacent to the Port.

The region's economy is based on the mining, livestock, agriculture (in particular sugar cane farming), manufacturing and tourism industries. The sugar industry in the region provides one-third of Queensland's production and Mackay is a mining services hub, with the resources sector exporting more than half of Queensland's coal exports through the region's coal ports. Port operations and construction at the Port of Hay Point provide local and regional employment and investment.

COMMUNITY NEEDS AND INTERESTS

The Mackay region has experienced significant growth in population since 2011 and expects to grow further over the next 20 years. During the recent mining boom, the region experienced pressures in relation to the provision of affordable housing and other infrastructure and service provision. The Mackay Regional Council notes that the region's population is estimated to grow to 180,000 by 2036 from the current 120,000. Plans are that 'the focus of that population will be in urban areas, particularly in Mackay, and also Sarina, Marian, Mirani and Walkerston'.

The region's urban growth has been fragmented, making infrastructure more expensive to deliver and requiring high levels of community subsidy. The development of this situation was due to the pressures of an unprecedented boom in mining and mining services. As well as noting the importance of minimising rate rises and containing the cost of funding new infrastructure, the council notes that a much greater choice of housing needs are required, as well as residential development that is well linked to and serviced by infrastructure and community facilities.

EMPLOYMENT AND HOUSING

The top 10 industry sectors in terms of regional exports, employment, value-added and local expenditure on goods and services in the Mackay Region are:

- Construction Services
- Heavy & Civil Engineering Construction
- Wholesale Trade
- Pre-School, Primary, Secondary & Special Education
- Professional, Scientific & Technical Services
- Sugar & Confectionery Manufacturing
- Health Care Services
- Retail Trade
- Coal Mining
- Agriculture, Forestry & Fishing Support Services

In general, unemployment in the Mackay region has increased due to the recent downturn in the mining industry and related construction activity after a period of significant growth. Mackay has yet to stabilise to a more usual business cycle and there continues to be unused capacity in labour markets and commercial activity. There are some indications that construction activity may be recovering and moving to meet residential property demand. It is likely that employment by industry may have shifted somewhat since the previous Census in 2011.

The activities of the port are reflected in the high proportion of employment in the transport sector. Any expansion of port activities at the Port of Hay Point will grow employment in this sector further but may also support an increase in the employment sectors of retail trade and accommodation and food services. Port development would support increased employment in the construction sector for the period of the development work.

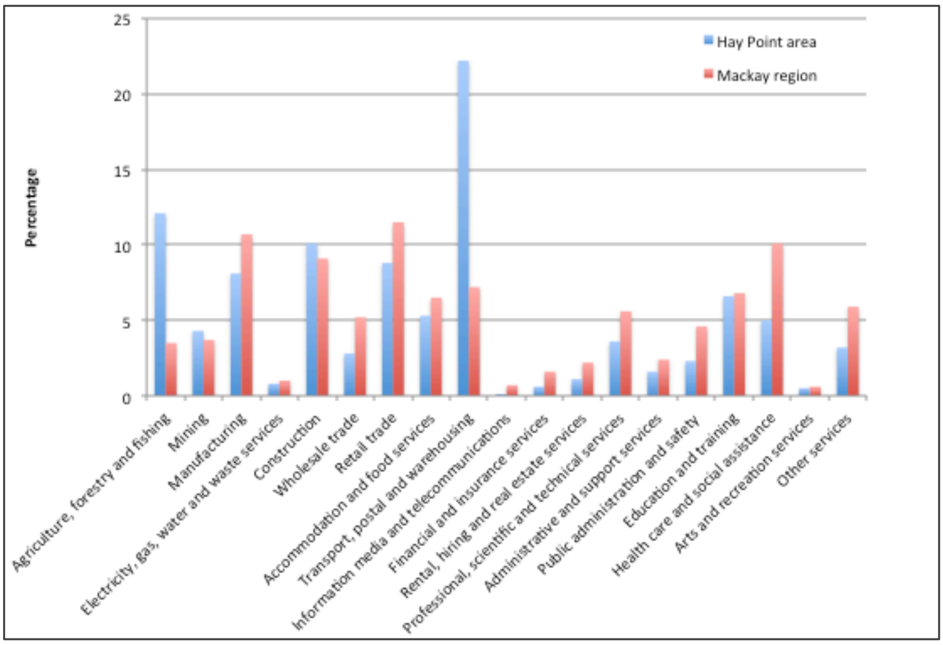


Figure 9: Employment by industry, Hay Point and Mackay region

SOCIAL INFRASTRUCTURE

Half Tide Tug Harbour is located at the Port of Hay Point and allows safe mooring of the tug boats providing towage to ships in the Port. The tug harbour includes a public boat ramp that provides amenity to the area. There are other public boat ramps available in the areas around the port and Sarina Beach. The administrative building at the Hay Point Coal Terminal operates a viewing platform where visitors can view the handling and export activity of the Port.

Sarina is the service hub for the southern parts of the Mackay region in the vicinity of the Port of Hay Point. Sarina serves as a commercial and community service centre, with capacity for residential expansion and some opportunity for extension to industrial activity. Other services are provided in Mackay.

Snapshots of the key social indicators present within the study area are provided in Table 5.

Table 5: Regional social features

FEATURE	DESCRIPTION
Population & demography	The Mackay region has an estimated population of 123,724 persons and has had an average annual growth rate of 1.7 per cent over five years. The area surrounding Hay Point has a current estimated resident population of 21 193. The area has experienced an average annual growth rate of 0.9 per cent over five years. In 2015 it is estimated that 20.7 per cent of residents were aged under 15 years, 67.2 per cent between 15 and 65 years and 12.1 per cent 65 years and over. This is very similar to that of the Mackay region, but slightly younger demographic than Queensland in general. In 2011, 4.1 per cent of people in the Hay Point area identified as Aboriginal or Torres Strait Islander and 7.3 per cent were born overseas - a significantly lower proportion than that of the Mackay region at 11.7 per cent and 20.5 per cent for Queensland.
Income & disadvantage	Median income for the area surrounding Hay Point is lower than the Mackay region in general but is higher than the average for Queensland. There were 594 low-income families (10.7 per cent of families in comparison 13.0 per cent overall in Queensland). The Index of Relative Socio-Economic Disadvantage value for Sarina indicates that this area is relatively disadvantaged in comparison to other parts of the Mackay region.
Workforce participation & employment	The Hay Point area’s labour force at end March 2015 was 11,260. The most recent estimated unemployment rate for Sarina was 8.6 per cent, much higher than Queensland’s rate of 6.2 per cent. The Walkerston-Eton unemployment rate was only 4.8 per cent, significantly lower than Queensland and the Mackay local government area’s unemployment rate (7.7 per cent). The Transport, Postal and Warehousing industry employs 22.2 per cent of workers in the area and 12.1 per cent were employed in the Agriculture, Forestry and Fishing sector. This contrasts with the 7.2 per cent and 3.5 per cent working in these industries respectively across the Mackay region. Other important areas of employment include Construction (10.1 per cent), Retail trade (8.8 per cent) and Manufacturing (8.1 per cent). People travel into the area from elsewhere to work in industries such as Transport, Postal and Warehousing (22.3 per cent), Agriculture, Forestry and Fishing (12.2 per cent), and to a lesser extent Education and Training (6.6 per cent). They travel out to work in Mining (4.3 per cent), Manufacturing (2.1 per cent) and Health Care and Social Assistance (2.1 per cent).
Housing cost & supply	A greater proportion of occupied private dwellings in the Hay Point area were fully owned in 2011 than in the region generally. Median mortgage repayments are lower in the area than for the Mackay region as a whole. Median rent is also lower than in the greater Mackay area.
Education & training	In 2011, the Mackay Region recorded 46.6 per cent of people with a highest level of schooling of year 11 or 12 (or equivalent). This is lower than for Queensland (55.3 per cent) as a whole. Of people aged 15 years and over, 51.5 per cent had a non-school qualification, in comparison to 54.2 per cent in Queensland. Where people specified the field of their non-school qualification, 30.5 per cent had a qualification in Engineering and Related Technologies and 11.1 per cent in Management and Commerce.
Recreational activities	The region supports a full range of recreational and sporting activities, particularly within Mackay where sporting fields, parks, and community centres provide a focus for community activities. Of relevance to the Port, key recreational activities include: boating, fishing, snorkelling and diving, surfing, beach based activities, walking and sightseeing. There is a public boat ramp at Half Tide Tug Harbour and a public access area on the north side of Mackay Harbour.

3.5. Cultural Heritage Values

BRIEF HISTORY OF HAY POINT

Despite significant sailing activity past Hay and Dudgeon Points in the late eighteenth century, the first Europeans only landed on the Presto at Sandy Creek, just north of Dudgeon Point in 1862.

The process of European settlement had a significant impact on the Aboriginal people of the region. An Aboriginal reserve was established in 1871 in the area with 14,080 acres set aside near the Cape Palmerston and Homebush pastoral runs. By 1879 government funding for the reserve was cut and the land reclaimed for settlement, forcing the Aboriginal residents to move elsewhere. Between 1898 and 1967 there were 72 documented removals of Aboriginal people from the Mackay district by the Queensland Government. Most were removed to the reserves and missions at Yarrabah, Barambah (now Cherbourg), Woorabinda and Palm Island.

Development began in the southwest of Dudgeon Point in 1896, when a tramway from Plane Creek Sugar Mill to the mouth of Louisa Creek was completed.

In the late 1960s the Utah Development Company (USA) and Mitsubishi (Japan) began coal mining on a large scale at Goonyella, about 150 km south-west of Mackay. The consortium built a separate rail track, running parallel with the Queensland rail route in parts and proceeding through the Sarina district to Hay Point, the site for a large purpose built coal-export terminal. The first coal was loaded from it in 1971. Since 1983 a government-owned facility, leased to the private sector, has operated nearby at Dalrymple Bay.

THE INDIGENOUS PEOPLE OF THE HAY POINT AREA

The Yuwibara (Yuibera) People are the registered claimants of an area that includes the Port of Hay Point (QC2013/007). The Yuwibara people therefore have priority as parties as a registered native title claimant for the area covering the port including coastal waters. These rights are considered registered as an entry has been made on the National Native Title Register. They must be consulted with regard to the Indigenous cultural heritage of the area and any assessment of its significance.

The Wiri (Widi), Barada Barna Kabalbara and Yetimarla, Yuibera (Yuwibara), Birri-Gubba and Kungalburra peoples all have strong associations with the Mackay area and therefore Hay Point. They also have interests in terms of the cultural heritage of the area but recognise that the Yuwibara people have the particular care of the area related to the Port of Hay Point and therefore specific knowledge about traditions, observances, customs or beliefs associated with the area.

The port authority has consulted with the representatives of the Yuwibara people and the other Indigenous people of the area about plans for dredging (including placement of dredged material) and other development. It has also undertaken consultation when developing environmental impact statements and other planning documents.

IDENTIFIED INDIGENOUS CULTURAL HERITAGE AT HAY POINT

Indigenous cultural heritage in Australia can be understood as cultural heritage relating to Aboriginal and Torres Strait Islander communities and may include traditional stories, knowledge and practices, and places with traditional stories and knowledge attached to them. An extensive legislative framework protects Indigenous cultural heritage.

It is also important to note that Indigenous people see the natural environment and the cultural landscape as integral parts of the Aboriginal heritage concept. Indigenous cultural values are viewed as being inextricably linked to the natural attributes of the landscape. The cultural significance of an area is not just due to the presence of tangible sites or objects; it is rooted in the ‘connection to country’ of its people (Bird 2009).

Few Indigenous cultural heritage surveys and studies have been conducted in and around the Port of Hay Point area. Of those that have many are unpublished or not available in full. However, it is considered unlikely that there are significant unknown heritage sites in the area that have not yet been investigated. It is, however, assessed as likely that the sand dune area in the Louisa Creek area parallel to the freshwater swamp and going along the beach towards Mount Hector may contain sub-surface archaeological material.

Cultural heritage assessment consistently identifies Dudgeon Point as an area of Indigenous cultural significance. For the Yuwibara people (and other Indigenous groups in the area) the importance of Dudgeon Point is linked to Mount Hector and the coastline.

In 2003 and 2004 some areas of Aboriginal cultural significance were identified primarily in the Dudgeon Point coastal zone. The majority of these sites were concentrated on the bar of sand that extends from Dudgeon Point to Mount Hector along the coast (approximately 3 km). This dune system separates the freshwater lagoon from the littoral zone and appears to have been a focal point for subsistence activity in the past. In general, the whole dune could be described as a Significant Aboriginal Area, but two main concentrations of artefacts have been located. Of these two scatters, the larger, southerly one includes material that suggests a number of activities were occurring in the area. Individual stone artefacts were also found in all of the sub-environments, from the coastal strip, to the cleared grazing land and into the remnant forest strip to the south.

From the perspective of Aboriginal people living a traditional lifestyle, the Dudgeon Point area offered a range of natural systems that feature access to fresh water and different types of food and raw materials. It was rich in resources, including food and medicine. It is reasonable to suggest that key places for resources would have been:

- Louisa Creek, where extensive shell middens are still visible.
- Sandringham Bay with its wide sandy estuarine conditions.
- Hay Point which contains the remnants of a traditional fish trap.
- The large lagoons along the coastline, such as at Dudgeon Point and west of Half Tide Beach near Hay Point.

OTHER CULTURAL HERITAGE

The National Heritage List, the Commonwealth Heritage List, the Queensland Heritage Register and the Mackay Regional Council Local Heritage Register do not include listings for any non-Indigenous cultural heritage sites within the Hay Point area.

Areas of local heritage interest, such as the sugar wharf at Louisa Creek given its role in the development of the region’s sugar industry, are recognised and are included in buffer areas relating to development and other port activities. In 2012, sites associated with early settlement, closer settlement pattern, pastoral and agricultural land management, small scale mining and the establishment of transport and communication networks were identified in the port area but were assessed as ‘at best of local significance’.

4. Consultation

4.1. Technical Advisory and Consultative Committee

Under the NAGD (CoA 2009), development of a Technical Advisory and Consultative Committee (TACC) is necessary to assist in the consultation process required for a Sea Dumping Permit application. The NAGD states that:

"The TACC is intended to assist ports and other proponents and Determining Authority to access local knowledge and reconcile various stakeholder interests."

The TACC is intended to:

- provide continuity of direction and effort in protecting the local environment
- support communication between stakeholders
- assist in the establishment of longer term management arrangements, including reviewing the development and implementation of management plans and monitoring programs
- review dredging and dumping activities in accordance forecast plans and programs
- make recommendations to the port authority and regulators as necessary or appropriate.

NQBP has an established TACC for the Port of Hay Point, which includes representatives from Commonwealth, Queensland and local governments, port users and community interest groups as detailed in Table 6.

Table 6: TACC Membership

Organisation	Member Category
North Queensland Bulk Ports	Port Authority
Hay Point Coal Terminal	Terminal Operator
Dalrymple Bay Coal Terminal	Terminal Operator
Great Barrier Reef Marine Park Authority	Commonwealth Government
Department of Environment and Energy	Commonwealth Government
Department of Environment and Heritage Protection	Queensland Government
Department of Agriculture and Fisheries	Queensland Government
Department of Transport and Main Roads	Queensland Government
Maritime Safety Queensland	Queensland Government
Mackay Regional Council	Local Government
North Queensland Land Council Representative	Traditional Owners
Reef Catchments Limited	Natural Resource Management Group
James Cook University	Technical
Queensland Seafood Industry Association	Industry
Whitsunday Charter Boat Industry Association	Industry

Explore Whitsundays	Industry
Mackay Tourism	Industry
Australian Marine Conservation Society	Community
Mackay Conservation Group	Community
Mackay Recreational Fishers Association	Community
Mackay Local Marine Advisory Committee	Community
Port of Hay Point Community Reference Group	Community

5. Sediment Assessment

5.1. PORT SEDIMENT CHARACTERISTICS

Port navigational areas, including shipping channels, aprons and berth pockets, are areas that have been deepened to allow the safe navigation, movement, loading and transit of ships trading at the Port. In these deeper areas of the Port, currents, wave energy and tidal regimes are responsible for mobilising and transporting sediments. This can be different to what is occurring in the adjacent natural seabed areas. The different depths and water movement can cause significant changes in the patterns of sediment scouring and accumulation.

The natural seabed depth at the Port of Hay Point ranges from around 12 m below lowest astronomical tide, (LAT) at the end of the trestles (extending some 3.8 km offshore) with a very gradual slope in natural bathymetry of only 2 to 3 m over a 9 km distance offshore to the end of the departure path. The departure path and apron area is constructed to a designed navigational depth of 14.9 m below LAT, whereas the design depth of the berth areas varies from 16.6 m to 19.6 m below LAT.

Accretion of seabed sediments results in 'high spots' or 'high areas' within the navigational areas, above which safe navigational depths are enforced by the Regional Harbour Master. The result is often reduced 'declared' depths, the effects of which may significantly affect the efficiency of the Port.

To identify the opportunities to identify if there is an ongoing need for maintenance dredging, and to answer key questions a number of studies were needed that focused on:

- Defining the nature and sources of marine sediments that accumulate in the navigational areas of the Port.
- Describing the forces that drive sediment dynamics at the local, regional and wider Great Barrier Reef lagoon scale.

Typical high silt/clay sediment sample from port of Hay Point Navigational Area

NATURE OF THE SEDIMENT

Based on laboratory analysis the nature of the sediment accumulating in the navigational infrastructure at the Port of Hay Point was found to be fine clay/silt material with an average of 60%, (with a highly variable range of between 9% in the departure path areas and 80% in the North Apron and DBCT berths), mixed with sand (36%) and small amounts of gravel material (4%) (Advisian, 2016).

It was noted that the further offshore the higher the sand and gravel content. Also given the mixed nature of the sediment and dominance by fine material, it is considered that it would be unrealistic to be able to separate sediment types during maintenance dredging. The type and mixture of the sediments is an important consideration when examining the ability to avoid, reduce, reuse or dispose of sediment.

As shown in Table 7, laboratory testing has consistently shown that the sediment is suitable for ocean disposal with very low levels of contamination and bioavailability as per the NAGD (CoA 2009).

Table 7: Summary result of recent sediment contamination testing at the Port of Hay Point

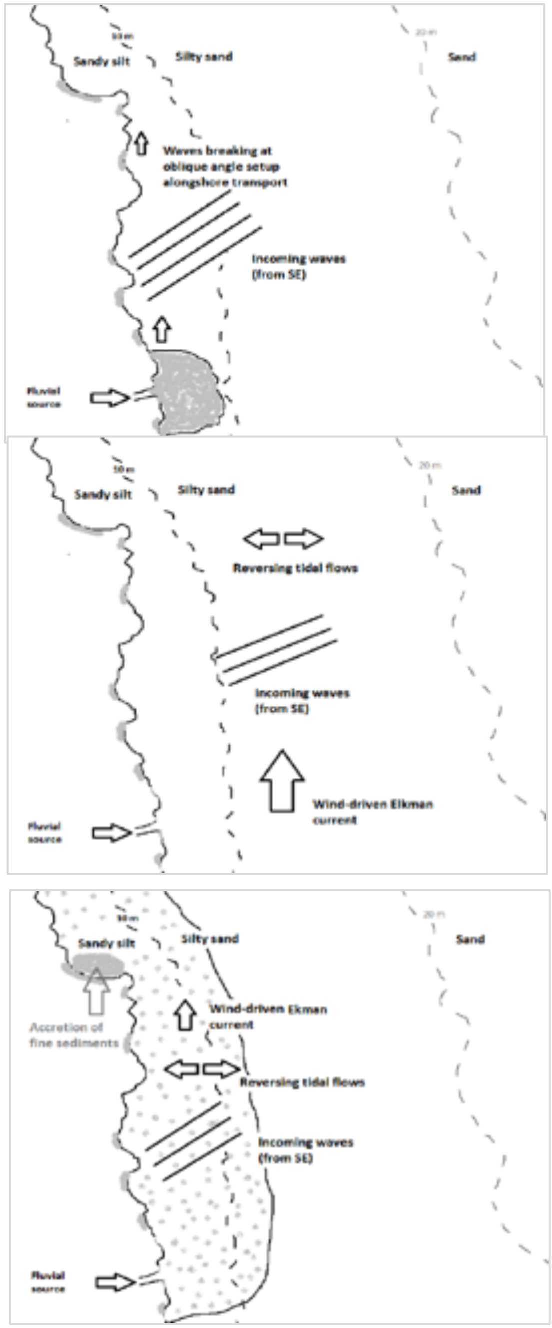
Port area	Dates	Volume	Summary of sampling results
Departure path	May – July 2013	110,000 m^3	TBT below the laboratory detection level Metals, Hydrocarbons, PAHs below screening levels Overall conclusion: suitable for unconfined ocean disposal
Aprons	May – July 2013	110,000 m^3	TBT below screening levels Metals Hydrocarbons, PAHs below screening levels Overall conclusion: suitable for unconfined ocean disposal
Tug harbour	May – July 2013	~37,854 m^3	TBT below screening levels Metals, Hydrocarbons, PAHs below laboratory detection level or screening levels Overall conclusion: suitable for unconfined ocean disposal
HPCT Berth 1	May – July 2012 Nov 2012	30,492 m^3	TBT above screening levels (95%UCL of 15.3 ugSn/kg+). Total sediment, dilute acid extraction, elutriate testing – all below screening levels Metals, hydrocarbons, PAHs below laboratory detection level or screening levels Overall conclusion: suitable for unconfined ocean disposal
HPCT Berth 2	May – July 2012 Nov 2012	32,765 m^3	TBT above screening levels (95%UCL of 30.47 ugSn/kg). Arsenic, copper, lead, zinc above 95%UCL screening values. Total sediment, dilute acid extraction, elutriate testing – all below screening levels Hydrocarbons, PAHs below laboratory detection level or screening levels Overall conclusion: suitable for unconfined ocean disposal
DBCT Berth 1	August 2014	38,500 m^3	TBT reported a 95% UCL of 6.9 ugSn/kg (< screening criteria). Five locations initially reported TBT concentrations above screening. Each sample (original plus the 3 replicates) were averaged and applied to the 95% UCL calculation. All metals remained below the screening criteria. Several individual PAHs were identified, leading to low level total PAHs. 95% UCL of 216 ug/kg and maximum of 1232 ug/kg, well below the NAGD screening criteria of 10,000 ug/kg. Overall conclusion: suitable for unconfined ocean disposal
DBCT Berth 2	July 2014	38,500 m^3	TBT reported a 95% UCL of 1.3 ugSn/kg (< screening criteria). All metals remained below the screening criteria. Several individual PAHs were identified, leading to low level total PAHs. Berth 2 reported a 95% UCL of 149 ug/kg and maximum of 636 ug/kg, well below the NAGD screening criteria of 10,000 ug/kg. Overall conclusion: suitable for unconfined ocean disposal
DBCT Berth 3 & 4	March 2016	58,504 m^3	All analytes below screening levels Overall conclusion: suitable for unconfined ocean disposal

SEDIMENT BUDGET

An in-depth examination of the sediment transport and dynamics in the central Great Barrier Reef (Gibbs *et al.,* 2016) identified and clarified the major sediment types and distributions in the region. This appears to be the first integrated or consolidate work of its type and has enabled the development of an integrated conceptual model of the sediment transport mechanisms and provides the first estimates of sediment transport rates and fluxes.

This work has shown that the dominant source of sediments accumulating in the navigational areas at the Port of Hay Point are large stores of available sediments on the inner continental shelf which are transported through coastal processes. Cyclones are also known to be a contributing cause of sediment movement and accumulation within the navigational areas of the Port.

Annual sediment transport volumes were estimated using the Mackay wind and wave data, published tidal heights and rates, available grain size data and the 'Sedtran05 1-d model'. The conceptual sediment budget for the Hay Point region was produced using 'ArcGIS' and the 'United States Army Corps of Engineers Coastal Inlets Research Program Sediment Budget Analysis System (SBAS)'. The sediment budget calculations indicate that sediment is generally moving northwards within three defined sediment transportation processes:



- ***Littoral drift*** - littoral transport along the surf zone is one of the major sediment transport pathways on exposed coastlines. The offshore reefs of the GBR act as efficient dissipaters of ocean swells and hence the energy contained in the wave environment by the time it reaches the coast is substantially reduced by comparison to coastal areas south of Fraser Island.
- Fluvial (river) or 'new' sources of fluvial sand inputs, while important, are of a tiny magnitude in comparison to the existing available seabed sources of coarse sediments available for littoral transport.
- ***Nearshore turbidity pathway*** - re-suspension which is not driven by breaking waves but rather the transient orbital flows beneath waves, along with tidal flows, act on the seafloor to create a bed shear stress large enough to mobilise fine sediments. Once mobilised, waves, wind and tidal movements transport the finer particles northwards along the coastline.
- ***Inner-shelf bed load transport*** - Larger waves (~ 1 m) and stronger tidal currents (> 0.25 m/s) are able to re-suspend larger sand particles. As in the turbidity pathway, once the bed shear stress is sufficient to mobilise sand particles, a near bottom current flow is required to generate the transport of material. The wind generated water movements established during prolonged wind events, the same winds that generated the waves, are able to mobilise the sands and transport these northwards.

FINDINGS

The model indicates that the volume of sediment deposition (storage) is relatively small compared to the overall volume of sediment moving within the system. In areas where there is high tidal activity or where fluvial currents are strong and dynamic, much higher gravel content is found in the sediment than in other areas where sand, carbonates, or muds are more prevalent.

As a result, the system is considered balanced, meaning almost the same volumes of sediments that are entering a location are leaving, other than in an area of sand accumulation well to the north of Mackay.

When investigating the contribution of catchment derived sediments in consideration of reducing sedimentation in the Port area, the model proposes that reducing fluvial sources of sediment through in-catchment sediment control measures will result in very little reduction in sediment accumulation.

The analysis shows that even if catchment management measures were successful in reducing river sediment discharge by 50%, the reduction in sediment to the navigational areas at the Port of Hay Point would only be in the order of 0.1% and 4% of total sediment inputs.

5.2. MAINTENANCE DREDGING AND DISPOSAL REQUIREMENTS

To better understand exactly where sediment accumulates and in what quantities with the Port's navigational areas, an examination was undertaken of the historic siltation in the channel, apron and berths at the Port of Hay Point (Symonds & Donald, 2016; Symonds & Loehr, 2016). The work was designed to:

1. Provide quantitative changes in bathymetry since the completion of the capital dredging work in October 2006.
2. Analyse the cause and reasons behind any changes.
3. Develop a predictive tool for use in future sediment management decision making.

Coastal processes were defined using a wide range of hydrodynamic, meteorological, water quality and sedimentation data. Some of the key findings around coastal processes are shown in Table 8.

Table 8: Coastal processes and site conditions at the Port of Hay Point

Process	Description
Tides	• The Port is located in an area of the Queensland coast that experiences very high tidal ranges, with semi-diurnal tides and a peak tidal range of 7.14 m (MSQ, 2015).
Wind Climate	• Local wind climate is governed by the east to south east trade winds, with lighter land breezes from the south-west sector during the winter months and lighter north-easterly afternoon sea breezes common during summer afternoons.
Wave Climate	• The Port is largely protected from swell waves as a result of the GBR and islands. • Large open fetch to the south east and predominant south easterly trade winds dominate the local wave direction.
Current Regime	• Water currents at Hay Point are predominantly driven by the large astronomical tides with tidal currents in excess of 0.5 m/s measured adjacent to the berths. • Measured data at the port suggests that the ebb tidal currents to the north-west are slightly stronger than the flood currents to the south-east, • Predominant south easterly trade winds act to reinforce the net northerly tidal current.
Rainfall / Fluvial Flows	• The major catchment areas discharging nearby to the port include the Pioneer River (approximately 17 km to the north-west) and Plane Creek (approximately 14 km to the south) with both playing a role in the delivery of sediments to the marine environment.
Cyclones	• Recent notable cyclones include TC Ului (March 2010), TC Dylan (January 2014) and TC Debbie (March 2017).
Water Quality	• Concentrations of suspended sediment in waters adjacent to the Port are predominantly driven by bed sediments being suspended through current and wave action. • During the summer months higher suspended sediment concentrations occur compared to the winter months (16.6 mg/l compared to 6.6 mg/l) as a result of stronger winds and the increased occurrence of higher energy waves from cyclones and storm events.
Deposition	• It is evident from data collected nearby to Hay Point (JCU, 2014-2015) that periods of elevated suspended sediment result in subsequent peaks in deposition. • Hay Point is not an accretional environment, with deposition typically only occurring following resuspension of existing bed sediment during specific events.
Sediment Properties	• Areas of the North Apron and DBCT berths exhibit the highest percentages of silt and clay with 80% of the sediment being made up of finer fractions (silts and clays).

Hydrographic survey data of the Port of Hay Point apron, departure channel and berths (MSQ 2003 to 2015) was used to inform the bathymetric changes in the navigational areas of the port.

Figure 10 shows the cumulative change in bathymetry since development of the apron and departure path in 2006.

The majority of the bathymetry is still below the design depth of 14.9 m below LAT, indicating that, generally, limited erosion (blue areas) has occurred over the apron and channel areas during this 10-year period.

The most extensive siltation (red areas) has occurred in the North Apron, with some localised accretion also occurring in the gap between the DBCT and HPCT berths.

The centreline deepening of the departure path is assumed to be a result of propeller wash from the larger vessels departing the port fully laden keeping this area free of accumulating sediment.

The largest accretion has occurred in the natural deep trench located in the Mid Outer Channel where accretion of up to 0.4 m has occurred.

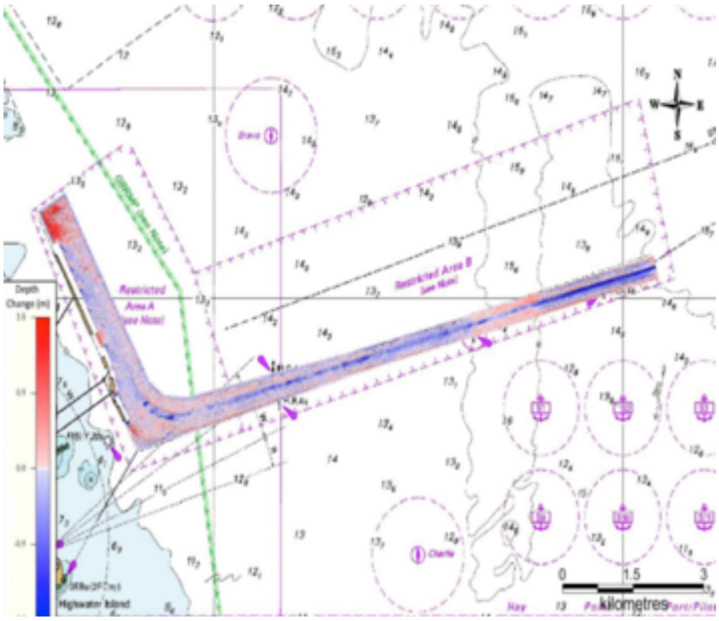


Figure 10:Difference in bathymetry (February 2007 to October 2015) red represents areas of accretion and blue areas of erosion

The only navigational areas in the Port of Hay Point that showed discrete patterns of sedimentation were the northern apron and berth pocket areas. Due to the high trapping efficiency of the berths, resulting from their depth relative to the adjacent bed elevations, these areas are able to trap more fine-grained silts and clays than the apron and departure channel.

Extreme events that result in strong winds and large waves, such as tropical cyclones, have the potential to result in relatively large changes to the seabed bathymetry. Three significant tropical cyclones (TC) have occurred in the Hay Point area since 2010. TC Ului did not appear to result in any significant change in the bed elevation, whereas TC Dylan resulted in erosion of between 300,000 and 725,000m^3 (the large range is due to possible bias with a survey) of the apron and departure channel, with average erosion depths of between 0.1 and 0.2 m across the navigational area. More recently TC Debbie in March 2017, caused significant sediment disruption and movement resulting in the deposition of approximately 350,000m^3 of sediment in the Port of Hay Point.

The variation from cyclone to cyclone highlights how difficult it is to predict potential impacts of an extreme event. The historical dredging volumes are provided in Table 9.

Table 9: Historical dredging volumes (2004 – 2017)

Year	Maintenance dredging volumes (m^3)	Capital dredging volumes (m^3)
2004	98,900	0
2005	0	400,000
2006	0	9,000,000
2007	0	0
2008	192,294	0
2009	0	0
2010	216,070	0
2011	0	275,000
2012	0	0
2013	0	0
2014	0	0
2015	0	0
2016	0	0
2017	0	0

FINDINGS

Total siltation volume above the design depth over the next 20 years was predicted to be between 885,000 m^3 and 1,129,000 m^3 depending on the occurrence of tropical cyclones.

Given the varying rates of accumulation across the Port it can be expected that dredging of critical areas will be needed approximately every 3 years if designed depths and port efficiency is to be maintained. Depending on cyclones, volumes may vary between 200,000 m^3 and 250,000 m^3 if no sedimentation reduction measures are adopted.

5.3. MINIMISATION OF SEDIMENT ACCUMULATION AND DREDGING NEEDS

SUSTAINABLE SEDIMENT MANAGEMENT

The following is a summary of the **Port of Hay Point Sustainable Sediment Management Assessment for Navigational Maintenance.** For further details and data associated with the comparative analysis please refer to the Port of Hay Point Sustainable Sediment Management Assessment for Navigational Maintenance Report (Adaptive Strategies 2017) and supporting technical reports.

All reports are available at https://nqbp.com.au/sustainability/research-and-reports/sustainable-sediment-management-research.

CONCEPT

From 2015 to 2017, NQBP undertook an extensive research project to investigate the most sustainable way to manage accumulated sediment in and around the Port of Hay Point.

The project: the *Port of Hay Point Sustainable Sediment Management Assessment for Navigational Maintenance* (SSM), was to understand how the day to day operations at the Port of Hay Point are affected by marine sedimentation and to determine, if necessary, the best way to manage operations and sediments.

This innovative sediment management approach has been widely acknowledged and a similar framework is now applied in the Department of Transport and Main Road's Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports. This is applicable to all ports operating in the GBRWHA.

The SSM project investigated where specifically the sediment at the Port of Hay Point comes from, what impact it has on Port operations, whether accumulation can be eliminated or reduced, and what alternatives are available to reuse or dispose of any sediment that might need to be dredged.

The project has determined what is the best short and long-term approach to managing sediments within the Port. This includes investigation and consideration of:

- the source and nature of the particular sediment at the Port
- the requirements for management of the sediment in the short and longer term
- whether sediment can be managed without dredging while maintaining port operations and meeting legal requirements
- the feasible alternatives for use or placement of material if dredging is required
- the best package of measures to provide for long-term (25-year) sustainable management of marine sediments at the Port.
- The project involved consultation with stakeholders including Commonwealth, State and Local Government; port operators; conservation groups; the local community including indigenous people, fishing groups and community bodies; researchers; and tourism operators.

The work has provided valuable context for long-term management at the port, including understanding the economic effects of sedimentation and development a long-term sediment management strategy.

SSM METHOD

A central component of the SSM Project is a structured decision-making process that has focused on what is important to all stakeholders, not just the port authority and port customers. Contained within this structured process is a detailed comparative analysis of the various alternatives that are available to manage sediment to determine the best long-term strategy.

The decision-making process for the SSM project is a complex task dealing with social, economic and environmental factors. The principles of Structured Decision Making (Gregory *et al*, 2012) were used to provide a robust method for the Project. The process involved the following five steps:

AVOIDANCE AND REDUCTION

The SSM project considered a range of possible alternatives to avoid or reduce the volumes or rates of sedimentation occurring within the navigational areas of the port, as this would be the first and potentially ideal way to manage sediments in the Port area.

The SSM investigation:

- Described the sediment and hydrodynamic environment at the Port of Hay Point in the context of possible solutions to ‘keep sediment out’ or ‘keep sediment moving’ from the offshore infrastructure areas.
- Identified both engineered and technological solutions to avoid or minimise future maintenance dredging and consider their feasibility based on the Hay Point environment, port layout and infrastructure design.
- Undertook a constraints analysis of the solutions for any feasible alternatives.
- Estimated the potential impact of any feasible solutions to existing and future maintenance dredging at the Port of Hay Point.

Three broad strategies that can be implemented to reduce siltation at ports and harbours are to keep sediment out, keep sediment moving and/or keep sediment navigable. The potential applicability of approaches to reduce sedimentation must be considered on a case-by-case basis as the suitability is dependent on the port configuration, sediment type, natural environment and processes.

The range of possible approaches is provided in Table 10.

Table 10: Outline of approaches to avoiding or reducing sedimentation

Strategy	Approach	Example
Keep Sediment Out	Control sediment sources	Reduce sediment inputs through better catchment management
	Divert sediment-laden flows	Divert river inputs away from port
	Trap sediments before entering port	Sediment traps and insurance trenches
	Blocking sediment entry	Pneumatic barriers, silt screens, barrier curtains
	Habitat creation	Seagrass, saltmarsh, mangroves to stabilise and promote accretion away from port areas
Keep Sediment Moving	Structural solutions to train natural flows	Training walls to divert flow and prevent local deposition of sediment.
	Devices to increase bed shear stresses	Hydraulic jets, mechanical agitators
	Methods to reduce sediment flocculation	Adopting designs that reduce turbulence and therefore flocculation (e.g. solid wharf walls instead of piling supported wharfs).
Keep sediment navigable	Adopt a 'nautical depth' navigation approach which includes fluid mud	Nautical depth is the distance from the water surface to a given wet density, typically in the range of 1,100 to 1,300 kg/m^3.

The SSM investigation showed that many of the alternatives were simply not achievable in an offshore coastal port such as the Port of Hay Point, many being more suited to ports located in rivers, estuaries or enclosed by breakwalls or similar structures.

The alternatives that were considered achievable at the Port of Hay Point included:

- traditional maintenance dredging
- constructed sediment traps
- installation of jet arrays
- using a drag bar or sea rake to mobilise the seabed sediments
- use of propeller wash agitation.

For each of these alternatives, as well as for traditional maintenance dredging, an estimate of the associated costs and greenhouse gas emissions (tonnes/$CO^2{}_{eq}$) was calculated. In addition, a constraints analysis for each of the alternatives has been developed to get an understanding of environment impacts, operational impacts, ongoing maintenance requirements, the confidence in achieving the desired outcomes and consideration of the regulatory pathways or approvals. A summary of findings by the SSM investigation is provided in Table 11.

Table 11: Constraints analysis for each of the reduction alternatives

Approach	Environment Impacts	Operational Impacts	Ongoing Maintenance	Confidence	Regulated Activity	Cost (M$)	GHG emissions (tonnes/CO^2_{eq})
Maintenance Dredging	Low	Low	No	High	Yes	4.9	6,369
Sediment Trap	Low	Low	Low	Medium	Yes	6.6	8,860
Jet Array	Low	Low	High	Low	Yes	70.9	242,214
Drag Barring	Medium	Medium	No	High	No	6.8	21,454
Propeller Wash Agitation	Low	Low	No	Medium	No	13.2	23,640

Of all the alternatives considered, only traditional maintenance dredging would be successful in the removal of the existing material accumulated in the Port of Hay Point navigational areas.

RESEARCH FINDINGS

The key findings of the SSM investigations were that:

- **Traditional maintenance dredging** provides the most cost effective and lowest GHG emission solution, and there are defined approval pathways.
- **Drag barring** or **sea raking** in the berths is a feasible solution to prevent ongoing high accretion rates. Application of this approach could extend the period between maintenance dredging activities from 3 to 5 years (approximately). It is not expected that drag barring would be as effective in other navigational areas of the Port.
- **Propeller wash agitation** by tugs is not a feasible solution for managing the siltation. It has been considered that operational changes to the manoeuvring of ships and tugs during berthing activities, could assist in mobilisation of seabed sediments in the north apron area and would have little to no cost or increased GHG emissions. Neither option offers a complete solution to sedimentation.
- Only the northern Apron area would benefit from a **sediment trap**, by deepening the northern apron area to act itself as a sediment trap. The solution could reduce the frequency of the required maintenance dredging in the northern apron from every four years to every 10 years. However, it would result in an increase in the dredge volumes of 160,000m^3 over a 20 year period due to the initial establishment dredging required.
- **Excluding the northern apron** from the declared navigational area could reduce maintenance dredging by 260,000m^3 over a 20 year period. Analysis of vessel tracking data to see what current usage of the northern apron area looks like, however, showed that most of the apron area is used in the manoeuvring and transit of ships at the Port of Hay Point, and as such the northern apron area could not easily be excluded.

The SSM project therefore recommended that continued operational measures be employed to reduce sedimentation and increase the period between maintenance dredging activities, from a predicted 3 year interval to potentially 5 yearly for a volume or around 200,000m^3. It noted that continuing to drag bar/sea rake the berth areas and the varied alignment of vessel movements within the departure path, offset from the centre line, would be most effective.

5.4. Examination of Reuse, Recycle and Placement Options

As the alternative analysis showed that eliminating the need to conduct maintenance dredging at the Port of Hay Point is not a feasible option if port operations and safety are to be maintained at efficient levels, the SSM project then moved to determine the most suitable use or placement location for any dredged material.

The SSM project undertook a comprehensive reuse assessment investigation of the most appropriate solutions for reuse of any maintenance dredging material. Factors considered were: sediment suitability, greenhouse gas emissions, opportunity or demand, conceptual cost, confidence in beneficial reuse process, duration from construction to use, environmental implications, socio-economic implications, environmental approvals, constraints, knowledge gaps and longevity of the beneficial reuse option.

One of the primary considerations for reuse is the physical and chemical properties of the sediment to be dredged. The analysis of the geotechnical properties of the material to be dredged showed that the sediment is:

- mostly fine clay/silt material (60%), mixed with sand (36%) and small amounts of gravel material (4%).
- free of contamination
- highly mixed and thus impractical to separate during dredging for alternate use or placement options
- likely to contain high plasticity clay
- likely to have very high moisture content, and therefore significant effort would be required to dry out the sediment
- likely to have very low to medium compressibility and have some potential to swell and shrink, making it unsuitable for heavy load bearing uses
- is likely to be potential acid sulfate soil (PASS); however, the sediment contains sufficient acid neutralising capacity to buffer inherent acidity to negligible concentrations and as such are unlikely to require ASS treatment.

The assessment then identified potential beneficial reuse options and analysed the opportunity, potential feasibility and achievability of the options in the context of the Port of Hay Point.

Two beneficial reuse options were selected for further consideration: ‘Habitat restoration’ (combining direct and indirect placement) and ‘Land reclamation’. These options were selected as they ranked highly on the primary consideration of sediment suitability and also were considered to have high or moderate demand /opportunity.

The two other highly ranked options of deep water habitat creation and shoreline protection were discounted as the opportunity and need for these are not clearly identified in the Hay Point-Mackay area.

From these two selected beneficial reuses, three alternatives were developed based on likely suitable locations where the opportunity is known to present, these are:

1. Land reclamation - Port of Hay Point.
2. Land reclamation - Mackay Harbour.
3. Habitat (mangrove) restoration - Sandringham Bay.

In addition to reuse analysis, a number of material placement alternatives and locations were identified following studies undertaken to identify potential locations for the placement of dredge material.

Investigations for land disposal at Hay Point and Dudgeon Point indicated that all terrestrial areas are highly constrained due mainly to a combination of existing or proposed uses, existing environmental values, steeply sloping terrain and/or potential impacts on nearby residential areas. No land at Hay Point has been identified as having potential suitability for dredge spoil disposal.

Review of potential onshore placement sites was undertaken considering:

- Location of the site to minimise potential impacts on ecologically sensitive areas, both for the placement location and the pipeline route from dredge area to placement site.
- Proximity of the site to a watercourse for returning waters.
- Location of a sufficiently large area and generally level, yet as close as possible to deep water to allow a dredge to access within 1,500 m of the site to facilitate pumping.

Of a number of offshore placement locations considered in the past, three were also selected for consideration:

- an existing placement area that has been used at the Port for a number of years with success, monitoring has shown very low levels of environmental impact
- a mid shelf option in deeper water less influenced by tides and currents and well away from known inshore sensitive environments
- an option beyond the eastern limits of the GBRWHA and Marine Park, well away from sensitive environments and internationally listed areas.

In total eight (8) alternatives for sediment reuse or placement were identified and included in the comparative analysis.

Table 12: Maintenance dredge material reuse and placement options

Approach	Alternative	Summary description
Reuse	Alternative 1	***Land reclamation - Port of Hay Point*** – a 20 hectare land reclamation at half-tide tug harbour – in the area identified for future reclamation in the Port's Land Use Plan.
	Alternative 2	***Land reclamation - Port of Mackay*** – a 20 hectare land reclamation adjacent to the northern breakwall – in the area identified for future reclamation in the Port's Land Use Plan.
	Alternative 3	***Habitat (Mangrove) Rehabilitation*** – a 60 hectare are adjacent to NQBP's Dudgeon point land holding – Sandringham Bay.
On shore	Alternative 4	***Onshore pond at Dudgeon Point*** – a 50 hectare onshore bunded area on NQBP's Dudgeon point land holding - seaward of the previously proposed development footprint for the site.
	Alternative 5	***Onshore pond at Port of Mackay*** – a 32 hectare onshore bunded area on NQBP's Port of Mackay land holding - located in 'Bedford Paddocks, west of Slade Point Road.
Off shore	Alternative 6	***Existing offshore dredge material placement area*** – an at-sea relocation area that has been used since 2006 Capital dredging at the port of Hay Point – approximately 7km travel distance from main dredging area.
	Alternative 7	***Mid-shelf offshore dredge material placement area*** – a deeper water at-sea relocation area further offshore – approximately 25km travel distance from main dredging area.
	Alternative 8	***Coral Sea offshore dredge material placement area*** – an at-sea relocation area outside the marine park – approximately 315km travel distance from main dredging area.

CONCLUSIONS

The SSM project's initial assessment of the eight alternatives showed that:

- Land reclamation at the Port of Mackay using the maintenance material was consistently the poorest performing alternative across the range of fourteen defined performance measures.
- The only alternatives that delivered an immediate solution (next 1-3 years) were the existing and mid-shelf at-sea solutions. All other alternatives had an estimated minimum implementation time of 4-5 years.
- The two onshore containment alternatives (Port of Mackay and Dudgeon Point) and the Half-tide Land Reclamation offer a solution for a 20 year period only, after which another solution would need to be found.
- Only one area has been identified for mangrove restoration, the extent of which may only be suitable for one 200,000m^3 maintenance dredge campaign.

Based on this initial assessment it was obvious that a number of long-term strategies would need to be considered, using either the at-sea alternatives or a mixture of alternatives.

Eleven long term strategies were developed, combining the various alternatives, over a 25-year timeframe.

Table 13: Long-term (25 year) strategies

#	Long-term strategy (25 years)				
	Campaign 1	Campaign 2	Campaign 3	Campaign 4	Campaign 5
Strategy 1	At-sea existing	Hay Point Reclamation	Hay Point Reclamation	Hay Point Reclamation	Hay Point Reclamation
Strategy 2	At-sea existing	Mangrove Habitat	At-sea existing	At-sea existing	At-sea existing
Strategy 3	At-sea existing	Mangrove Habitat	Hay Point Reclamation	Hay Point Reclamation	Hay Point Reclamation
Strategy 4	At-sea existing	Mangrove Habitat	Dudgeon Point Onshore	Dudgeon Point Onshore	Dudgeon Point Onshore
Strategy 5	At-sea existing	Dudgeon Point Onshore	Dudgeon Point Onshore	Dudgeon Point Onshore	Dudgeon Point Onshore
Strategy 6	At-sea existing	Mangrove Habitat	Mackay Onshore	Mackay Onshore	Mackay Onshore
Strategy 7	At-sea existing	Mackay Onshore	Mackay Onshore	Mackay Onshore	Mackay Onshore
Strategy 8	At-sea existing	At-sea existing	At-sea existing	At-sea existing	At-sea existing
Strategy 9	At-sea mid-shelf	At-sea mid-shelf	At-sea mid-shelf	At-sea mid-shelf	At-sea mid-shelf
Strategy 10	At-sea existing	At-sea Coral Sea	At-sea Coral Sea	At-sea Coral Sea	At-sea Coral Sea
Strategy 11	At sea mid shelf	Mangrove Habitat	At sea mid shelf	At sea mid shelf	At sea mid shelf

The structured decision making process showed how each of the eleven strategies compared equally. In addition, the structured decision-making process is able to show how the comparison would change if the outcomes were significantly weighted (75%) in favour of one particular theme.

Table 14: Long term strategies - comparative analysis results

Weighting	Long Term Strategy										
	At Sea Existing x 1 Reclamation Hay Point x 4	At Sea Existing x 1 Habitat Rehabilitation x 1 At Sea Existing x 3	At Sea Existing x 1 Habitat Rehabilitation x 1 Reclamation Hay Point x 3	At Sea Existing x 1 Habitat Rehabilitation x 1 Onshore Dudgeon Point x 3	At Sea Existing x 1 Onshore Dudgeon Point x 4	At Sea Existing x 1 Habitat Rehabilitation x 1 Onshore Mackay x 3	At Sea Existing x 1 Onshore Mackay x 4	At Sea Existing x 5	At Sea Mid-shelf x 5	At Sea Existing x 1 At Sea Coral Sea x 4	At Sea Mid-shelf x 1 Habitat Rehabilitation x 1 At Sea Mid-shelf x 3
Equal weights	41	70	45	54	52	47	44	71	68	56	68
Environment (75%)	39	69	44	63	60	61	57	65	72	46	75
Social (75%)	36	57	41	54	53	37	31	57	56	52	56
Economic (75%)	44	80	44	48	49	39	40	89	74	59	69
Cultural (75%)	74	92	78	73	68	71	65	92	91	88	91
WHA (75%)	42	68	50	64	60	62	57	65	55	68	60

Best score for an option under a particular weighting scenario

Second best score for an option under a particular weighting scenario

Worst score for an option under a particular weighting scenario

A sensitivity analysis was undertaken to ensure that no one measure was substantially biasing the results.

The outcomes of the comparative analysis presented some very clear results:

- All strategies that included reclamation performed poorly.
- Both strategies including onshore placement performed poorly, except when a 'world heritage' focus was applied to the weighting, where they then performed well due to locations being outside GBRWHA.
- The Coral Sea (Strategy 10) was consistently lower performing than the other two at-sea alternatives.
- Both the at-sea existing (Strategy 8) and at-sea mid-shelf (Strategy 9) were consistently the highest performing long-term approach. The mid-shelf strategy, with higher greenhouse gas emissions, higher cost and a longer period of disruption to the Port, only performed marginally better when potential changes to water quality where considered.
- Mangrove restoration, in combination with at-sea placement also performed very well and is the only alternative to provide a potentially positive environmental outcome.

5.5. Selected Dredging and Placement Strategy

Based on the extensive work of the SSM project, a clear preferred 25-year maintenance dredging strategy is now established that involves:

1. Use of operational measures to extend periods between maintenance dredging campaigns.
2. Use of traditional dredging in the short term (12 months) to restore navigational areas to safe design depths.
3. Use of traditional dredging to maintain navigational areas at safe design depths – every 3-5 years in a volume of between 200,000 and 250,000 cubic metres.
4. Placement of dredged material at sea – preferably at the existing dredge material placement area.
5. Commitment to a detailed investigation into mangrove restoration in Sandringham Bay with the intention of executing, if feasible, a restoration program in the next 10 years.

5.6. Future Dredging Requirements

The SSM Project concluded that:

- Traditional maintenance dredging is the only feasible means of removing the existing accumulated material.
- Operational measures may reduce the frequency of future maintenance dredging needs but it is expected that traditional maintenance dredging will be required to remove approximately 200,000m^3 every 5 years.

This LMDMP is proposed to maintain effective navigational depths at the Port over a 25 year period. In the first instance permit approvals will be sought for a 10-year period to enable dredging to occur periodically over this time. This is expected to involve up to three (3) dredging campaigns, depending on any cyclonic conditions that may require a more frequent scheduling of dredging activity.

The total volume expected to be dredged in the initial 10 year period is between 780,000 m^3 to 980,000m^3 (depending on cyclonic influences).

The initial campaign to remove historically accumulated sediment and sediment from the more recent TC Debbie is in the order of 340,000m^3. Subsequent campaigns will be in the order 220,000m^3, an additional contingency dredge volume of up to 200,000m^3 has been allowed for in the case of another cyclone event.

Siltation at the Port is a result of natural sediment transport processes (predominantly littoral drift) that is unable to be avoided. Some opportunities to reduce future rates of sedimentation where identified, although these would be most effective once design depths are re-established.

- Bathymetric modelling showed that siltation would continue to be prevalent in the northern apron area and berth pockets. Although some siltation may occur in the rest of the apron area and departure channel, it is expected to be minimal and may require periodic maintenance dredging (approximately 10,000m^3, once in every 10 years).
- A sediment budget demonstrates that even if catchment loads were reduced by 50% in the region, a maximum benefit of no greater than 4% would be seen in navigational areas at the port.
- Once design depths are re-established, the continued use drag barring of berths can extend the periods between dredging to a predicted frequency of maintenance dredging to approximately 200,000m^3 every 5 years.

Dredging will most likely be undertaken using a Trailer Suction Hopper Dredge (TSHD), the *Brisbane*, and each campaign is likely to last up to 3-6 weeks. Initially, dredge spoil will be disposed of in the existing disposal ground, located just outside the Port limits in the Great Barrier Reef Marine Park (GBRMP).

6. Risk Assessment Framework

Depending on the scale and frequency, dredging and dredge material placement activities have the potential to adversely impact on sensitive environmental receptors, social or cultural values associated with the Port.

Impacts can occur over a short or long term and can be direct or indirect. Dredging related impacts can result from:

- the direct removal of benthic habitat in the vicinity of the dredged area
- smothering of benthic organisms in offshore dredge placement locations
- changes to marine water quality from increased turbidity and sedimentation
- mobilisation of contaminants released from dredged sediments
- collisions and disturbance from vessel movements
- increased noise and lighting from dredge vessel operations.

Prior to each dredging campaign a risk assessment of potential impacts to environmental, social or cultural values should be undertaken. The assessment will help to determine the level of potential harm that environmental, social or cultural values are at from the proposed dredging program. The assessment will assist in refining where management measures to avoid, reduce or mitigate impacts are needed. Identified measures can then be incorporated into revisions of the Maintenance Dredging EMP. This process is outlined in 11.

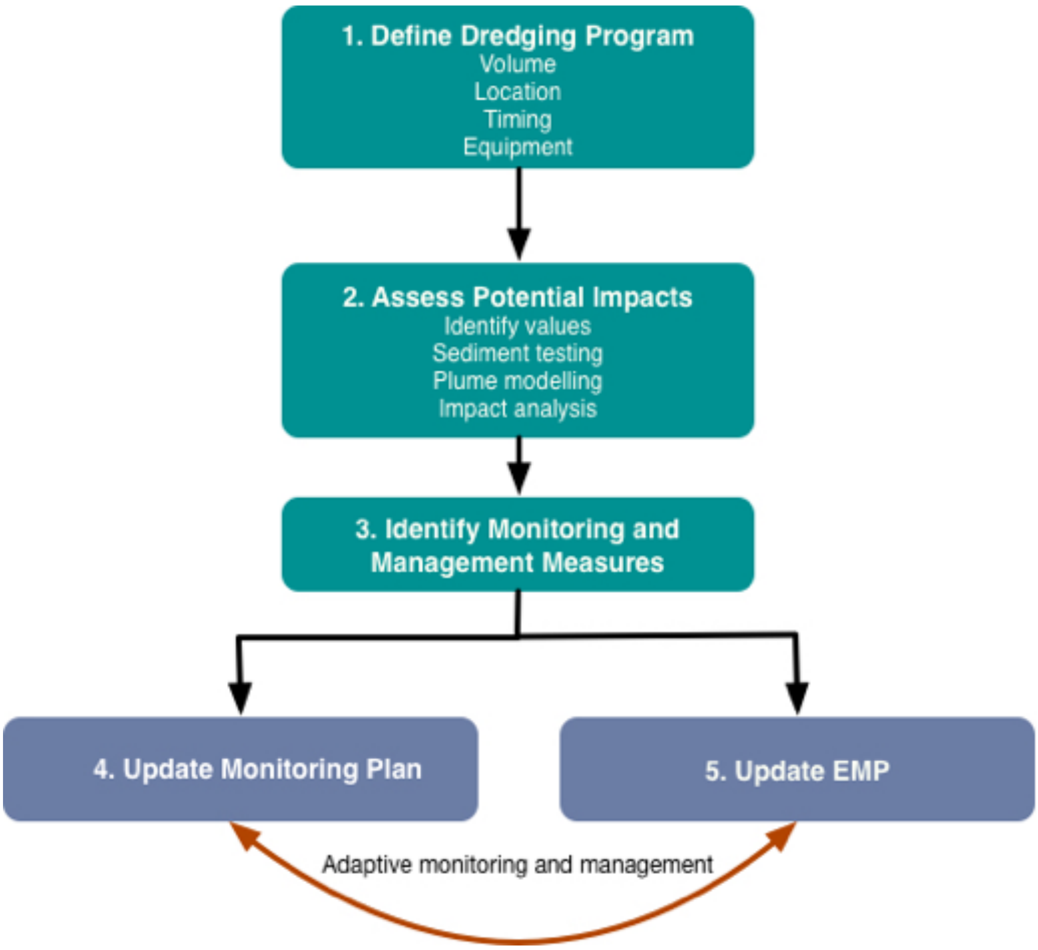


Figure 11: Process for identification of potential impacts and management measures

Information needed to inform the risk assessment should include:

- Up to date environmental values information, including data from baseline surveys of coral, seagrass and water quality.
- Dredging program design including: dredge type, volumes, locations, duration, seasonal timing.
- Sediment characteristics: particle sizes, contamination results
- Sediment plume modelling
- An environmental impact assessment, including an EPBC Act self-assessment against significant impact criteria.

INITIAL ASSESSMENT

To inform the development of this LMDMP an environmental risk assessment has been undertaken of potential dredging scenarios and volumes (ELA 2018). Supporting this risk assessment were:

- a detailed plume modelling study (112 simulations) looking at potential water quality changes across various dredging volumes (Royal HaskoningDHV 2018)
- an environmental thresholds study (Royal HaskoningDHV 2018)
- an environmental values report (Jacobs 2016).

As outlined in Section 4, there are a number of environmental values that occur in the vicinity of the Port of Hay Point. Whilst there is potential for some of the values to be impacted by maintenance dredging, the plume modelling and risk assessment undertaken has indicated that any impacts are highly unlikely to be residual or significant from maintenance dredging.

Generally, the proposed maintenance campaigns will consist of 3-5 yearly dredging of volumes in the order of 200,000 to 350,000 cubic metres. Campaigns will be short-lived in duration (3-6 weeks) and will include a range of impact avoidance and reduction measures that will further reduce impact risks. Any dredging campaign that is substantially different to the parameters modelled and assessed should be subject to a new specific detailed assessment.

All potential impacts were assessed against known environmental values and data to determine the risks posed by maintenance dredging at the Port of Hay Point. The key findings of this risk assessment are:

- Resuspension of sediments from maintenance dredging is comparable to natural suspended sediment concentrations (SSC) during calm conditions
- Water quality monitoring results and numerical modelling of sediment transport demonstrates that natural SSC levels are much higher than those generated by maintenance dredging
- Analysis against intensity and duration thresholds indicated that dredging would not result in in impacts to sensitive environmental values if the dredging volume is under 800,000 m3
- Risks to sensitive habitats such as seagrass and coral communities are likely to be negligible to low. Seagrass communities are naturally low density and ephemeral and have been shown to recover post-dredging. Coral communities lie outside of area predicted to be impacted by turbidity and sedimentation, and ecologically relevant turbidity thresholds will be used during dredging to further prevent impacts
- Protected species are also unlikely to be significantly impacted by maintenance dredging. The Port of Hay Point does not provide critical habitat resources for any marine species and disturbance to habitats will be low. Indirect disturbances can be effectively managed via best practise dredging operations. The short timeframe of each campaign will also reduce risks
- Risks to protected areas including the GBRWHA and GBR Marine Park will also be low to negligible. Other users may experience short-term disruptions to their activities

The activities associated with maintenance dredging are well tested and understood. It is considered that there would be limited ongoing management and monitoring requirements once the placement of dredged material has been completed, however NQBP will continue their ongoing ambient water quality program.

A summary of risks is provided in Table 15. This risk assessment is based on the application of standard mitigation measures.

Table 15: Summary of environmental risk findings

Risk activity (cause)	Potential environmental receptors	Potential Impact	Consequence	Likelihood	Risk rating
Smothering from dredge material placement	Transient seagrass beds and seagrass habitat Benthic macroinvertebrate communities	Temporary loss of benthic habitat	Minor Temporary, short-term negative impact	Possible	**Moderate**
Dredging and placement generated sediment plume	Coral and rocky reef habitats at Round and Flat Top islands, and Slade Islet Seagrass	Changes to water quality leading to mortality or changes in coral and seagrass cover/diversity	Negligible Within the natural variation and tolerance of the system	Rare for volumes below 800,000m^3	**Low**
Dredging and placement generated sediment plume	Coral and rocky reef habitats at Round and Flat Top islands, and Slade Islet	Sediment deposition resulting in coral loss	Negligible Within the natural variation and tolerance of the system	Rare for volumes below 800,000m^3	**Low**
Movement of dredge vessel from the Port to the dredge material placement area	Transitory threatened and migratory marine animals	Potential for marine fauna vessel strike	Negligible No impact at the population or sub-population level	Unlikely	**Low**
Release of contaminants and nutrients	Marine biota	Potential for lethal and sub-lethal effects on marine biota	Negligible Material is consistently suitable for at sea disposal	Rare	**Low**
Dredging suction	Foraging marine turtles	Potential for marine fauna to be caught	Negligible No impact at the population or sub-population level	Unlikely	**Low**

Overall, the conclusion is that environmental risks from maintenance dredging at the Port of Hay Point will be negligible to low. Maintenance dredging is short in duration and impacts to water quality are within the range of natural variability of the region. This in turn limits the likelihood of flow on impacts to species and their habitats, as well as protected areas and other users.

The comprehensive Maintenance Dredging EMP (as outlined in Section 10) will ensure each maintenance dredging campaign is undertaken in line with best practice, and that impacts are avoided and reduced as far as possible. A key element of this is the application of ecologically relevant environmental triggers, which will be applied in real time during dredging. This is coupled with a comprehensive impact and ambient monitoring program that has been designed to detect and respond to changes in the marine environment at the Port.

7. Treatment of Key Risks

NQBP is committed to minimising and managing potential impacts from dredging and dredge material relocation as far as practicable.

Based on the results of the initial risk assessment, targeted and ambient monitoring and established best practice; a set of key management strategies and actions to minimise the impact from dredging and dredge material relocation operations will be identified and incorporated into the Maintenance Dredging EMP.

These measures should, if necessary, be supplemented and enhanced with the ongoing real time inputs from the adaptive monitoring program.

7.1. Environmental Management Plan

An EMP provides the operational practices required for dredging activities to meet environmental standards. The EMP forms the operational control document to ensure all site specific environmental issues are adequately addressed. The EMP covers all aspects of the dredging operations specific to Hay Point and will contain:

1. Location and description of the activities
2. Timing of the dredging operations
3. Measures to meet permit conditions
4. Standard management measures relating to:
   - Waste management
   - Ballast water management
   - Bunkering of fuel
   - Vessel washdown
5. Adaptive management measures relating to:
   - Water quality
   - Marine fauna
   - Climate conditions
6. Operation and incident reporting
7. Emergency procedures and contacts

7.2. Adaptive Management Measures

Adaptive management provides for continuous monitoring, evaluation and adjustment of management response measures based on real-time monitoring and environmental conditions (Figure 12).

Based on an understanding of acceptable environmental conditions and thresholds for impact a series of response levels (triggers) can be established and then monitored to ensure that conditions that may produce environmental harm are avoided or ceased before impacts occur.

Figure 12: Adaptive management cycle (CEDA, 2015)

The dredging monitoring framework is outlined in Section 9 with details provided in the supporting *Port of Hay Point Marine Environmental Monitoring Program (NQBP 2018)*.

Adaptive monitoring will be implemented for each maintenance dredging campaign. The program is focused on real time collection and analysis of data to detect impending environmental harm and undertake corrective action where necessary. This is a key step in impact avoidance and management.

As detailed in the *Port of Hay Point Marine Environmental Monitoring Program* and based on a risk assessment conducted in 2018 (Eco Logical Australia 2018), the adaptive monitoring and management program will focus on water quality, weather conditions and marine fauna (mammals and turtles). Responses to monitoring results will be required if trigger events occur. The nature of the response is scaled according to the level of environmental risk.

8. Environmental Management Framework

The following framework is designed to provide a repeatable structure for planning and executing maintenance dredging activities at the Port of Hay Point.

The framework provides NQBP and its stakeholders with a clear and structured process for identifying, planning and implementing maintenance dredging. This process provides certainty for NQBP staff, TACC members and regulators around how NQBP will plan and manage dredging activities. The framework will also be key to supporting long-term permit applications.

The framework is illustrated in Figure 13. It is comprised of a staged planning and design process. Three key elements feed into the framework including consultation, monitoring and supporting studies. The framework provides NQBP with:

1. A technically informed process for the identification of Port maintenance dredging and dredge material management needs.
2. A process for identification, risk assessment and management of potential impacts to environmental values from proposed activities.
3. Adaptive management and operational controls to avoid and minimise potential impacts during dredging activities.
4. Ongoing monitoring and management of Port needs and values.

Most importantly, the framework provides a process that will be undertaken in collaboration with key Port stakeholders. Stakeholder consultation will occur throughout the application of the framework including during any dredging program design, execution and ongoing monitoring and management.

The framework draws on and incorporates aspects of processes outlined in relevant key policy documents. These include the:

- The National Assessment Guidelines for Dredging (NAGD) assessment framework for ocean disposal (CoA 2009).
- Queensland Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports (SOQ 2016)
- Long Term Monitoring and Management Plan Requirements for 10 year Permits to Dump Dredge Material at Sea (CoA 2012).

Details of each of the steps in the framework are described in the following sections including:

- Identification of Port navigation needs, risks and sediment management approaches
- Dredging program design
- Dredging execution and control
- Monitoring and management

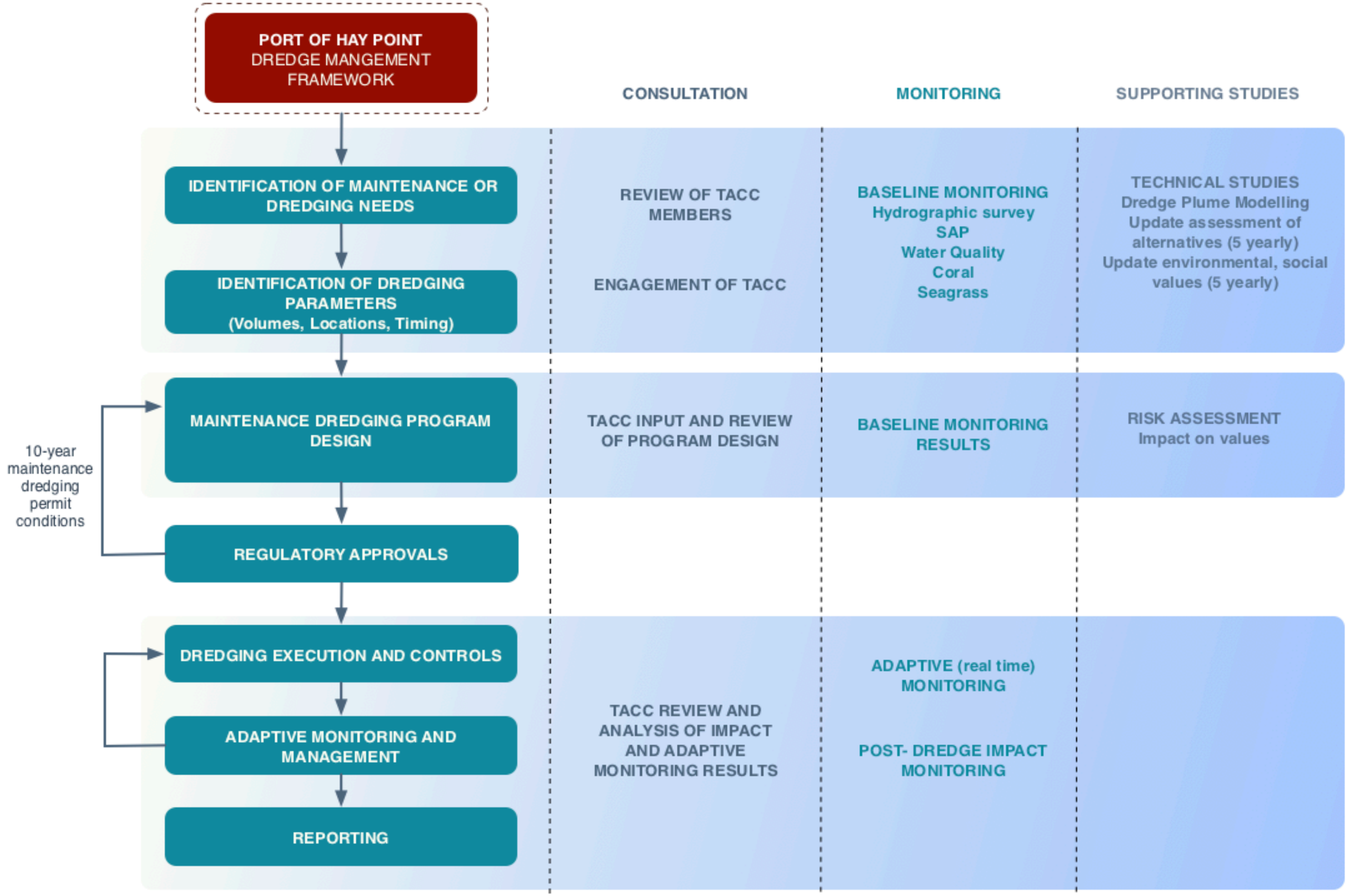


Figure 13: Dredge Management Framework

8.1. Identification of Maintenance Dredging Needs

Identification of navigational risks in the offshore environment of a Port is one of the first steps of the framework process and is key to identifying whether maintenance dredging is likely to be required. Regular baseline monitoring (bathymetric surveys) of the offshore infrastructure of the Port including berths, swing basins and channels, is required. This monitoring will map sediment distribution within key offshore operational areas of each Port. Data from the monitoring will also be able to identify changes in sediment dynamics over time.

Where sediment accumulation may create a potential or future navigational hindrance, a risk assessment should then be undertaken. The aim of the assessment is to determine the level of risk posed to the ongoing safe operation of the Port. The level of risk can then be used to trigger the timing of the further phases of the dredge management framework.

Broad categories of risk are outlined in Table 16. An aim of the framework is to maintain all Port areas in the low or medium risk rating at all times.

Table 16: Navigational risk categories

Risk	Description	Response
Extreme	Port vessel access and safety is compromised. Declared depths are above Port operational requirements. The full loading of vessels is constrained by berth depths. Loaded vessels cannot depart Port or can only depart on high tide.	Sediment management measures are required immediately. Expedite framework planning and actions.
High	Safety and/or access to the Port could be compromised at any time in the near future or access is already significantly tidally constrained. Loaded vessels can only depart on high tide.	Sediment management measures are required immediately. Expedite framework planning and actions.
Medium	Port depths and sedimentation trends indicate that access and/or safety could be compromised within the next 12-18 months (especially in the case of cyclonic activity)	Commence planning for appropriate sediment management action(s).
Low	Sedimentation rates are low, indications are that Port access will not be compromised or affected within the next 2 years 9depedning on cyclonic influences).	Continue to monitor.

8.2. Identification of Dredging Parameters

Should an immediate or future navigational risk at the Port being identified, it is necessary to determine the appropriate response in terms of the type of sediment management activity required.

Baseline monitoring data will be required to inform this phase. Up to date information regarding sediment volumes, quality and contamination may be needed. The specific data required includes:

1. Sediment Sampling and Analysis Plan (SAP) results. The process for undertaking sampling and analysis of sediments is described the NAGD (CoA 2009).
2. Bathymetric survey data.

SEDIMENT MANAGEMENT OPTIONS

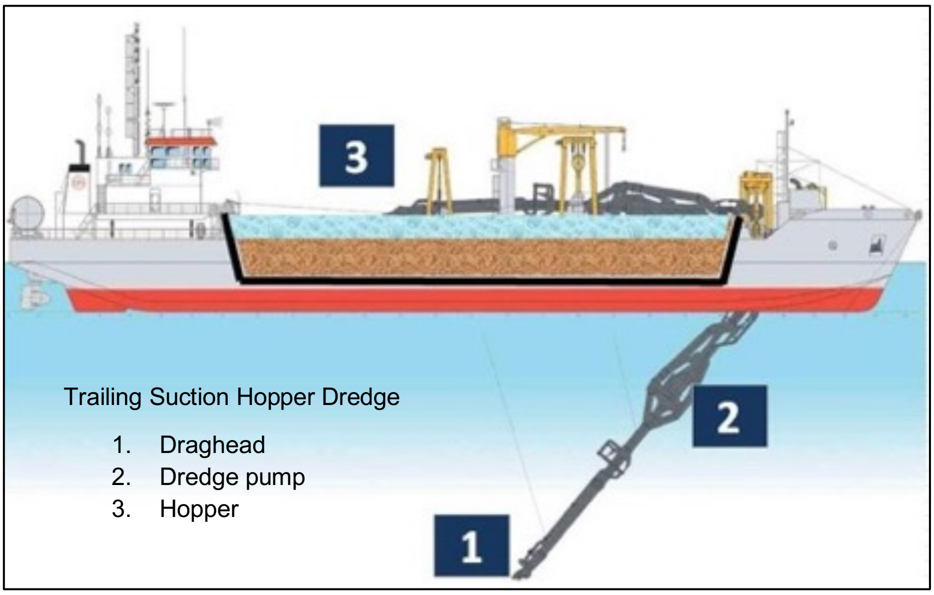
Depending on the scale of sedimentation and level of navigational risk posed a range of management options could be applied. These need not necessarily be stand-alone actions and could be deployed sequentially to reduce and then remove the risk. Measures include:

A. **Bed levelling:** using a drag bar, high spots of sediment accumulation can be removed and reduced by shifting them into lower lying depressions in channels and berths. This can help to maintain a suitable declared depth. Rarely is this a long-term solution but it can be used to alleviate immediate risks or to prolong the period between major dredging activities.

B. **Propeller wash agitation** from operating vessels within the Port area may be of some assistance in reducing the accumulation of sediment in certain areas. This may be partially effective in berth areas and in the shallower channel areas. Minor variation of the vessel path along the channel may assist in widening the area free of accumulated sediment.

C. **Hopper dredging:** often considered the more traditional dredging method, use of a trailing suction hopper dredge (vessel) where sediment is collected in the hopper of the vessel and placed at a designated location. This method is necessary for removing larger volumes and areas. Figure 14 provides a cross section of a typical hopper dredge.

Figure 14: Cross section of a Trailing Suction Hopper Dredge (Source: Ports Australia 2016)



8.3. Dredging Program Design

Should it be determined that hopper dredging is required then the next stages from the sediment management framework is the design of the dredging program and obtaining of relevant approvals.

Where the need for maintenance dredging and dredge material disposal has been identified, planning for all aspects of the program needs to be undertaken. This includes:

- Timing and duration of the dredge program
- Location of dredging areas and volumes
- Equipment needs and standard procedures (TSHD Brisbane or other suitable dredge)
- Identification and assessment of potential impacts to values at dredging and disposal sites
- Mitigation and management measures (including adaptive management) to address potential impacts to values
- Operational controls.
- Monitoring requirements.

All three input elements of the framework, including consultation, monitoring and supporting studies, will aid in the design of individual dredging programs. Additionally, standard dredging procedures and guidelines will need to be incorporated into the design.

TYPE OF DREDGE

Depending on the ongoing viability and availability the *TSHD Brisbane* will be used for periodic dredging over at least the next 10-years.

Subsequent to this or if the *TSHD Brisbane* is not available a simular and suitable trailer suction hopper dredge would be commissioned and used.

For the purposes of this management plan, the specifications and operations of the *TSHD Brisbane* will form a baseline for dredge specification and operational environmental management. A brief description of the *TSHD Brisbane* operations is provided below.

Material to be dredged is removed through two suction heads, which are lowered into position on either side of the vessel. As the vessel steams slowly at around 1 – 3 knots, large pumps draw water through the heads, which entrain the sediment and transport the water/sediment mixture aboard into a central collection hopper. The capacity of the hopper is dependent on the sediment type – with volumes (including both sediment and water) approximating 2,800 m3 for fine silts and 1,700 m3 for sands (of a maximum hopper capacity of 2,900m3). Each extraction run takes approximately 1 hour to complete. Whilst the suction heads are fitted with high-pressure water jets, which can be used to agitate consolidated sediment, they are rarely required for maintenance dredging.

The sediment/water ratio of material delivered to the central hopper of the *TSHD Brisbane* is typically quite low. Whilst it varies depending on the type of sediment being dredged, the sediment concentration is generally in the order of 10 – 30 % solids. To maximise dredge material capacity, these large volumes of water are managed using a central column weir, which is incorporated into the hopper. This arrangement allows excess water to decant from the sediment and overflow to discharge. Overflow occurs only toward the very end of the dredging run as the hopper nears capacity (typically the last ten minutes of a one hour dredging run).

Once the dredge has filled its hopper, the vessel will then relocate the material to the designated dredge material relocation ground. Dredged material is discharged below keel level to minimise turbidity generation. Each dredged material placement is manually logged using both satellite navigation and standard bridge equipment, and is electronically fixed using a differentially corrected global positioning system (GPS). The time taken to place material over the dredge material relocation ground is typically about 15 minutes.

Mitigation of potential turbidity and suspended solids impacts from dredging and dredge material relocation is partly achieved through the use of suitable and specifically designed modern vessels. The following are considered the minimum standard of specification for TSHDs that will be selected to undertake maintenance dredging works in the Port of Hay Point:

- The dredger will operate under a Maintenance Dredging EMP. The EMP will be revised by NQBP in conjunction with the dredging contractor, and implemented for each maintenance dredging campaign. The permit conditions, dredge dumping procedures, any associated adaptive monitoring arrangements and corrective actions are incorporated into the EMP. Implementation of the EMP is audited by NQBP environmental staff.
- During the dredging works, electronic logs of each dredge material relocation event will be maintained.
- TSHDs undertaking dredging works at the Port of Hay Point will include the following specifications:
    - Central weir discharge system
    - Below keel discharge point
    - Low wash hull design
    - Electronic positioning system (GPS)
    - Turtle exclusion devices on intake heads.

Introduced marine pests

Introduced marine species are species translocated to regions outside their natural range, typically by the passage of vessels nationally and internationally. Where these species present a threat to human health or environmental and economic values, they are termed a ‘pest’. Outbreaks of marine pests are an obvious possible risk at Ports trading with international clients. Translocation of marine pests may occur via:

- Ballast water - used to control the trim and draft of a vessel;
- Fouling - encrusting organisms via fouling of vessels (*e.g.* hulls, propellers, intake grates etc.).

Any TSHD dredger contracted to undertake dredging works will be required to comply with marine pest protocols, including National and Queensland bio-Security requirements in relation to ballast water and marine pest management, this includes the National System for the Prevention and Management of Marine Pest Incursions, in particular the National Biofouling Management Guidance for Non-Trading Vessels.

The TSHD Brisbane operates in Australian water only and complies with National standards.

TACC CONSULTATION

Consultation with the TACC should occur during the design phase of larger dredging activities, particularly those involving a hopper dredge, sea or land disposal. The TACC should be consulted on:

- Proposed program specifics such as the location of dredging and disposal sites and the timing and duration of dredging and associated activities
- Results of the risk assessment of potential impacts to values and proposed mitigation and management controls
- Scope of program monitoring and reporting requirements.
- Further details on TACC membership and role is provided in Section 5.

9. Monitoring Framework

Dredging related monitoring is detailed in the *Port of Hay Point Marine Environmental Monitoring Program (NQBP 2018)*.

NQBP will oversee the implementation of the monitoring plan, with each component being undertaken by appropriately qualified marine scientists.

Overall, the monitoring plan is made up of a combination of regular ambient monitoring (long-term monitoring) and individual dredging event related monitoring (impact and real time monitoring). The environmental monitoring plan aims to:

- Assess the long-term ambient environmental health of the Port and nearby sensitive receptors.
- Detect any impacts from maintenance dredging, both immediately after dredging campaigns and over time.
- Respond to real time environmental conditions during maintenance dredging to prevent serious environmental harm
- Collect data that will be used to drive continual improvement

These aims will be met through the implementation of a three-tiered approach to monitoring (Figure 15). The three-tiers will include ambient, impact and adaptive monitoring. Results from each tier of the monitoring program will be used to inform the relevant stages of the dredging management framework.

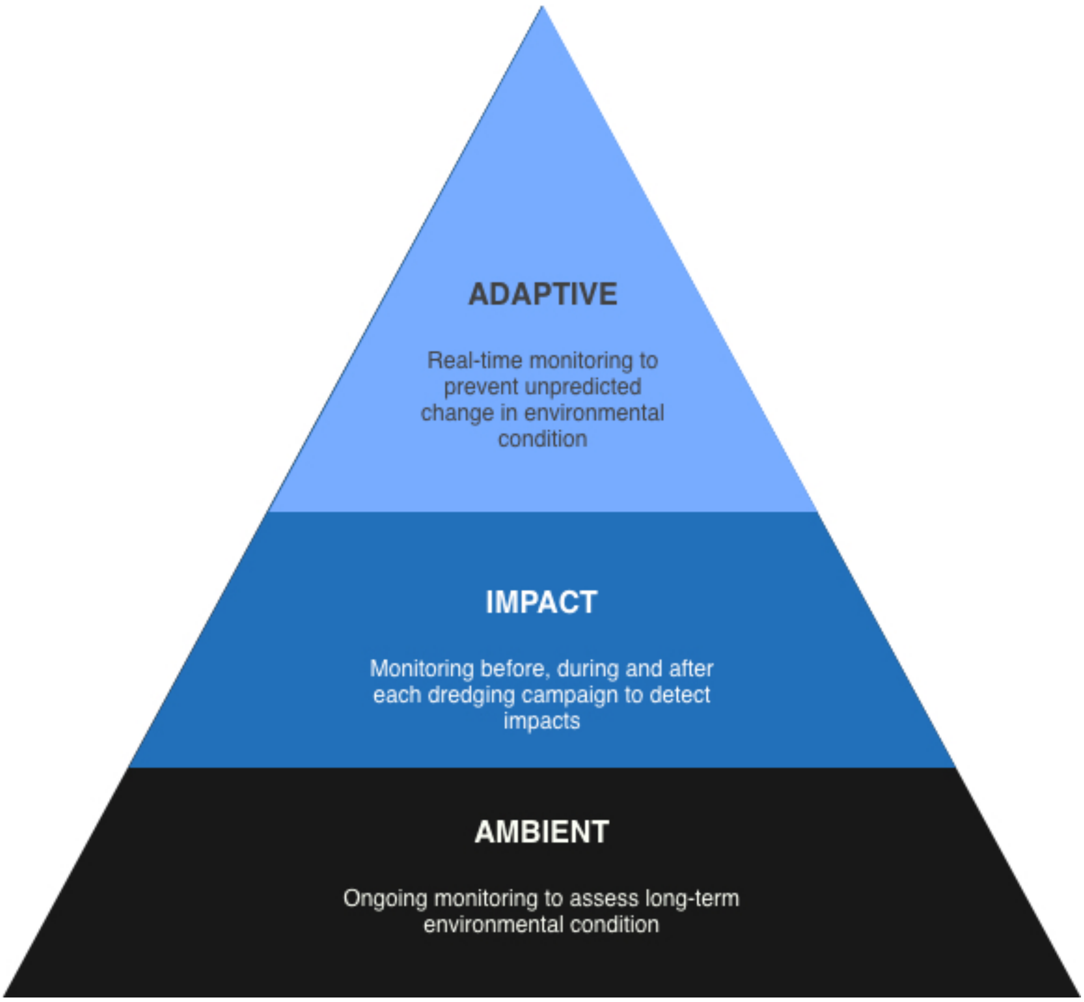


Figure 15: Tiered approach to monitoring

AMBIENT

The aim of this monitoring is to provide a long-term environmental health assessment of the Port and nearby sensitive receptors. The ambient monitoring program focuses on water quality, coral, seagrass and invasive marine pests.

IMPACT

Impact monitoring will be implemented for each maintenance dredging campaign, with the aim of detecting any adverse impacts due to dredging. If the results of the impact monitoring detect changes in the condition of sensitive receptors, the data can be used in conjunction with data from baseline and adaptive monitoring programs to understand likely cause of impact (i.e. was it dredging).

The impact monitoring program focuses on water quality and coral, as the two receptors most likely to be adversely impacted by dredging. The ephemeral nature of seagrass means that as a sensitive receptor is less suited to short term impact assessment monitoring and detection of dredging related changes. A long term seagrass data set is being established which may enable future analysis and correlation of seagrass health with other factors.

ADAPTIVE

Adaptive monitoring and management will be implemented for each maintenance dredging campaign. The program is focused on real time collection and analysis of data to detect potential environmental harm and undertake corrective actions where necessary. This is a key step in impact avoidance and management.

Monitoring of water quality, weather conditions and certain marine fauna will be undertaken, as detailed in the *Port of Hay Point Marine Environmental Monitoring Plan*. Responses to monitoring results will be required if trigger values occur. The nature of the response will be scaled according to the environmental risk. Triggers and the required adaptive management actions are provided in the dredge program management section (Section 9).

Monitoring review and updates

The *Port of Hay Point Marine Environmental Monitoring Plan* will be reviewed after each dredging campaign and the Plan updated prior to any future dredging.

The review will examine the;

- Effectiveness of monitoring methods
- Response times and outcomes of adaptive monitoring actions
- Monitoring results and data
- Environmental changes and any incidents causing harm

The review will be undertaken in consultation with the TACC and their feedback incorporated into any future Plan revisions.

10. Performance Review

The *Environmental Code of Practice for Dredging And Dredging Material Relocation* (Ports Australia 2016) identifies that 'transparent and open information sharing is important to improve knowledge and to understand community values, client needs and government expectations. Communication and reporting is an important component of this, to demonstrate performance and provide for community accountability'.

In fulfilment of this principle, reporting under this Plan will involve:

- regular updates to the TACC on any planned or conducted dredging activities
- publication (on the NQPB website) of an annual report detailing:
  - dredging activity in the past 12 months
  - results of any environmental monitoring associated with dredging actions
  - indications of any possible upcoming dredging activities.

For any operations covered by a Commonwealth Sea Dumping Permit, an annual report meeting the International Maritime Organisation's reporting requirements will be submitted to the Australian Government each year. The report will summarise the dredging and disposal monitoring activates undertaken during the year, including:

- permit number
- permit start and expiry dates
- locations and type of material dredged
- volume dredged at each location
- disposal locations used
- disposal method used.

RECORD KEEPING

During dredging activities, NQBP (or their contractors) will keep records which detail:

- the times and dates of when each material disposal run is commenced and finished
- the position (by GPS) of the vessel at the beginning and end of each dumping run with the inclusion of the path of each dredge material relocation run
- the volume of dredge material (in cubic metres) dumped for the specific operational period. These records will be retained for audit purposes
- detail of any spill of oil, fuel or other potential contaminant, details of remedial action and monitoring instigated as result.
- details of any marine mega fauna observations during dredging activities
- time and duration of any alterations to the program, including stop work actions, as a result of any environmental mitigation measure.

Post the dredging program, NQBP will

- undertake a bathymetric survey of the dredged area and dredge material placement site
- within one month of the completion of the bathymetric survey provide a digital copy of the final survey results to the RAN Hydrographer, copied to relevant regulatory agencies
- continue monitoring as per the Port of Hay Point Dredging Monitoring Plan.

INCIDENTS AND CONTINGENCY ARRANGEMENTS

All NQBP Hay Point staff, and any contractors involved, have the responsibility to report any significant incidents and emergencies.

- In the first instance, reporting should be to the operational works supervisor, but generally, the Environment Manager will have the responsibility to initiate corrective action for environmental incidents.
- All incidents should be reported to the Manager responsible for the Project, as specified by NQBP.
- In the case of an environmental emergency, after first notifying the Environment Manager, the operational works supervisor may make contact with NQBP's nominated consultants, who would help co-ordinate and

manage a response. Depending on the nature and magnitude of the incident, the Environment Manager may be required to notify government regulators.

Significant environmental incidents should be logged in writing, with all relevant details recorded, after corrective action has been completed.

Should an environmental incident occur during the course of dredging or placement of material, NQBP will take measures to mitigate the risk or impact. NQBP would report the following information to DEHP/GBRMPA, within 24 hours:

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

AUDITING AND IMPROVEMENTS

NQBP will undertake an internal audit after the completion of each dredging campaign, as per the 'Notifications and Obligations Schedule'. Audit findings will be provided to the TACC and will be used to inform improvements and revisions to the Maintenance Dredging EMP and Marine Environment Monitoring Program.

11. Supporting Information

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